



Year End Self-Evaluation

Brookhaven National Laboratory

Science and Technology
Fiscal Year 2003

October 8, 2003



BROOKHAVEN SCIENCE ASSOCIATES
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PREFACE

This is the Annual Self Evaluation Report for Science and Technology for Fiscal Year 2003 for Brookhaven National Laboratory. It reflects Brookhaven Science Associates' (BSA) assessment of how the Laboratory performed in the area of Science and Technology (S&T). The criteria for performance in this area are identified in Appendix B of the Prime Contract between BSA and the DOE for operating Brookhaven National Laboratory.

The report is composed of two sections; Section 1, called *Critical Outcome 1* is a narrative highlighting the Laboratory's accomplishments within the four S&T performance objective categories. Section 2, called *Attachment 1*, is a more quantitative section that provides detailed facts and figures pertaining to the Laboratory's S&T performance within relevant reporting topics.

This report was prepared by the individual Science and Technology Directorates and Departments and was compiled by the Office of Management Services.

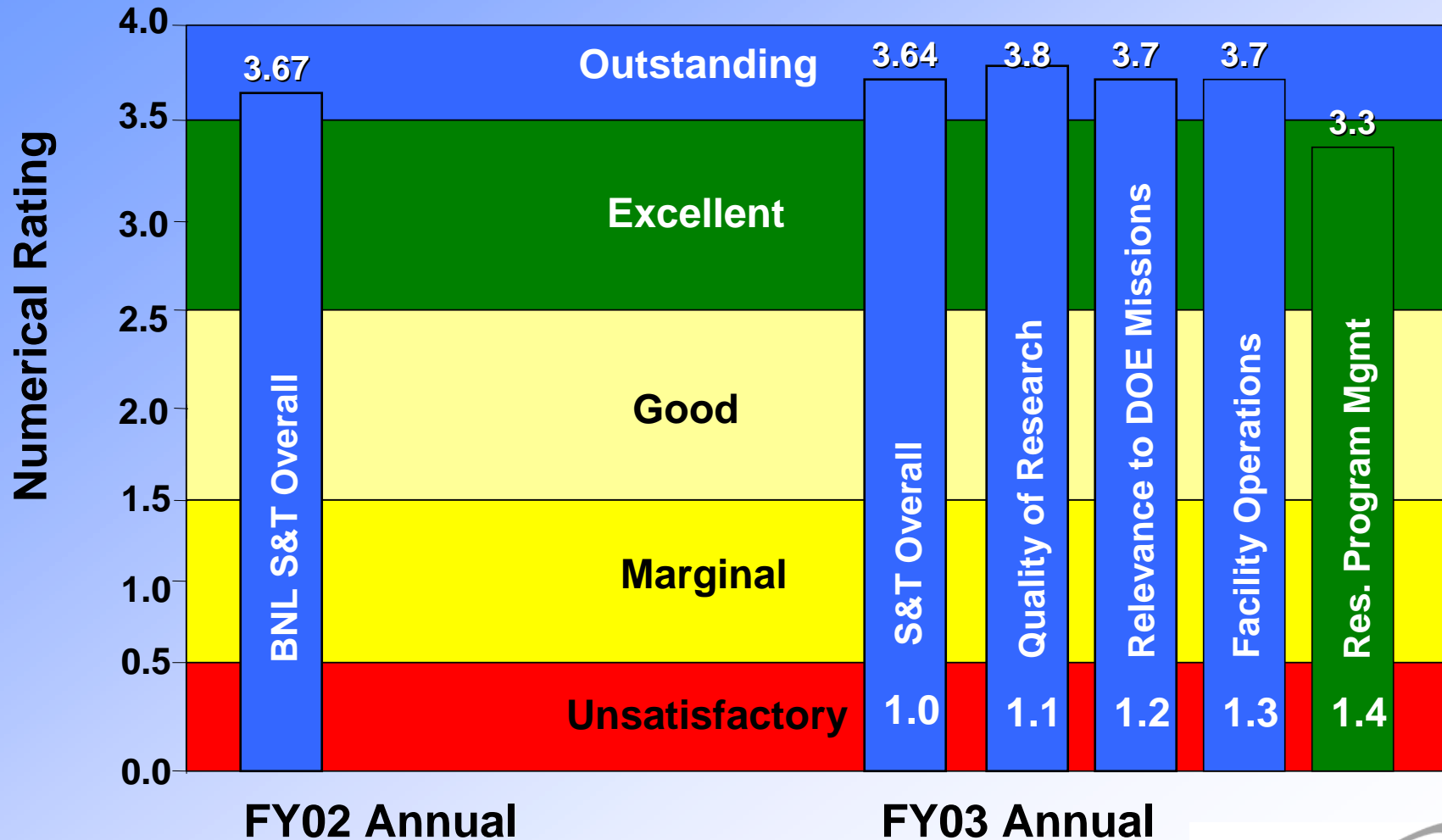
INTRODUCTION

With the implementation of the Performance Based Contract between Brookhaven Science Associates (BSA) and the Department of Energy (DOE) for operating Brookhaven National Laboratory (BNL), BSA is required to execute a Performance Based Management System (PBMS). The PBMS is designed to include clear, reasonable, and objective performance measures as a standard to assess BSA's overall performance on its scientific, technical, operational and managerial obligations.

For FY2003, the performance measures contained in the Prime Contract have been divided into three Critical Outcomes; Excellence in Science and Technology, Environmental Restoration, and Laboratory Management and Operations.

The results of BSA's self evaluation for Excellence in Science and Technology are presented in this report. This report is being submitted early to support the DOE's Office of Science review of the Laboratory scheduled for September. A more comprehensive report, containing the self evaluations of all three Critical Outcomes will be issued, as in previous years.

Critical Outcome 1: Science & Technology



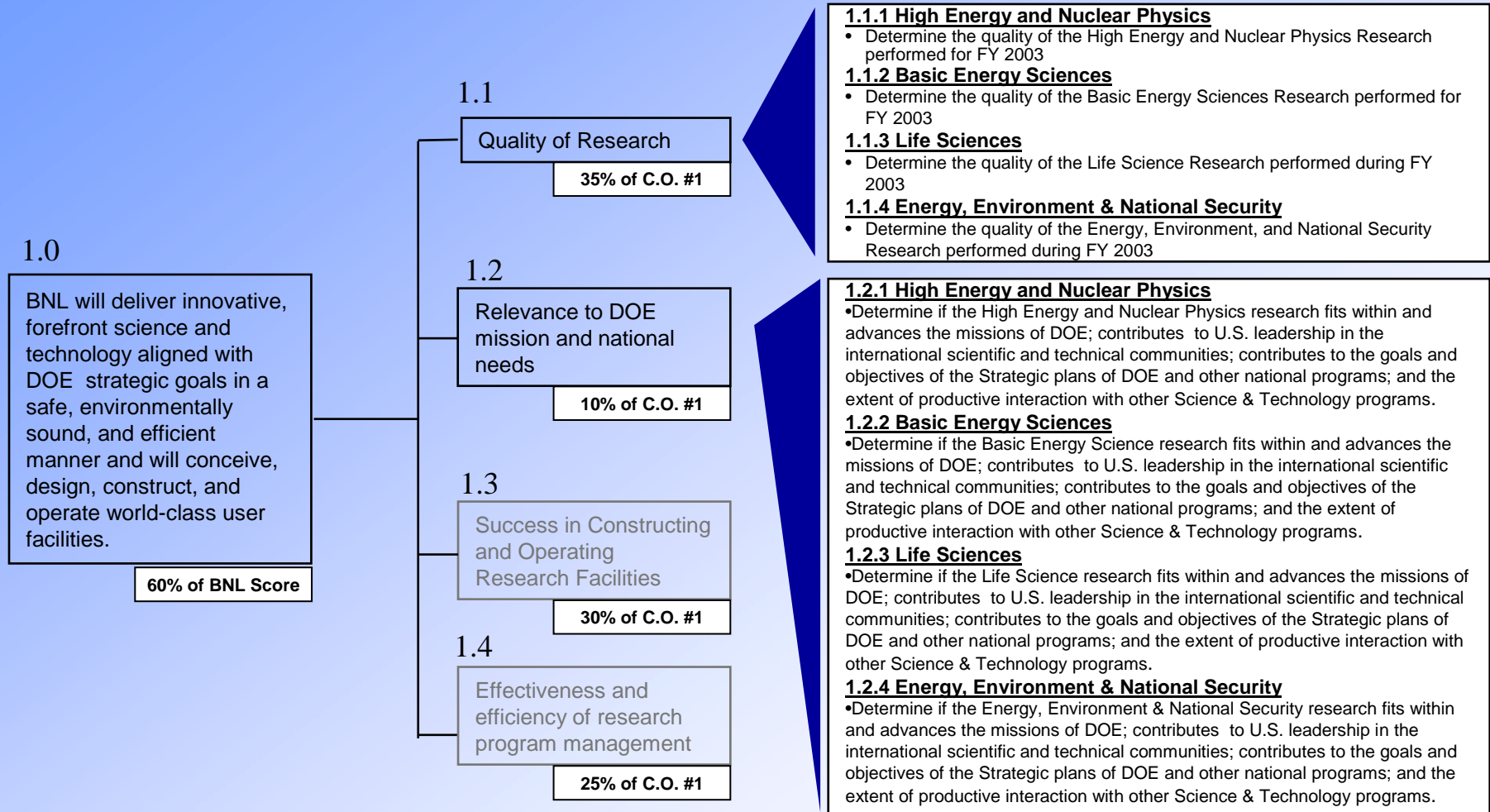
1.0 Basic Science & Technology

FY 2003

Critical Outcome

Objectives

Performance Measures



1.0 Basic Science & Technology

FY 2003

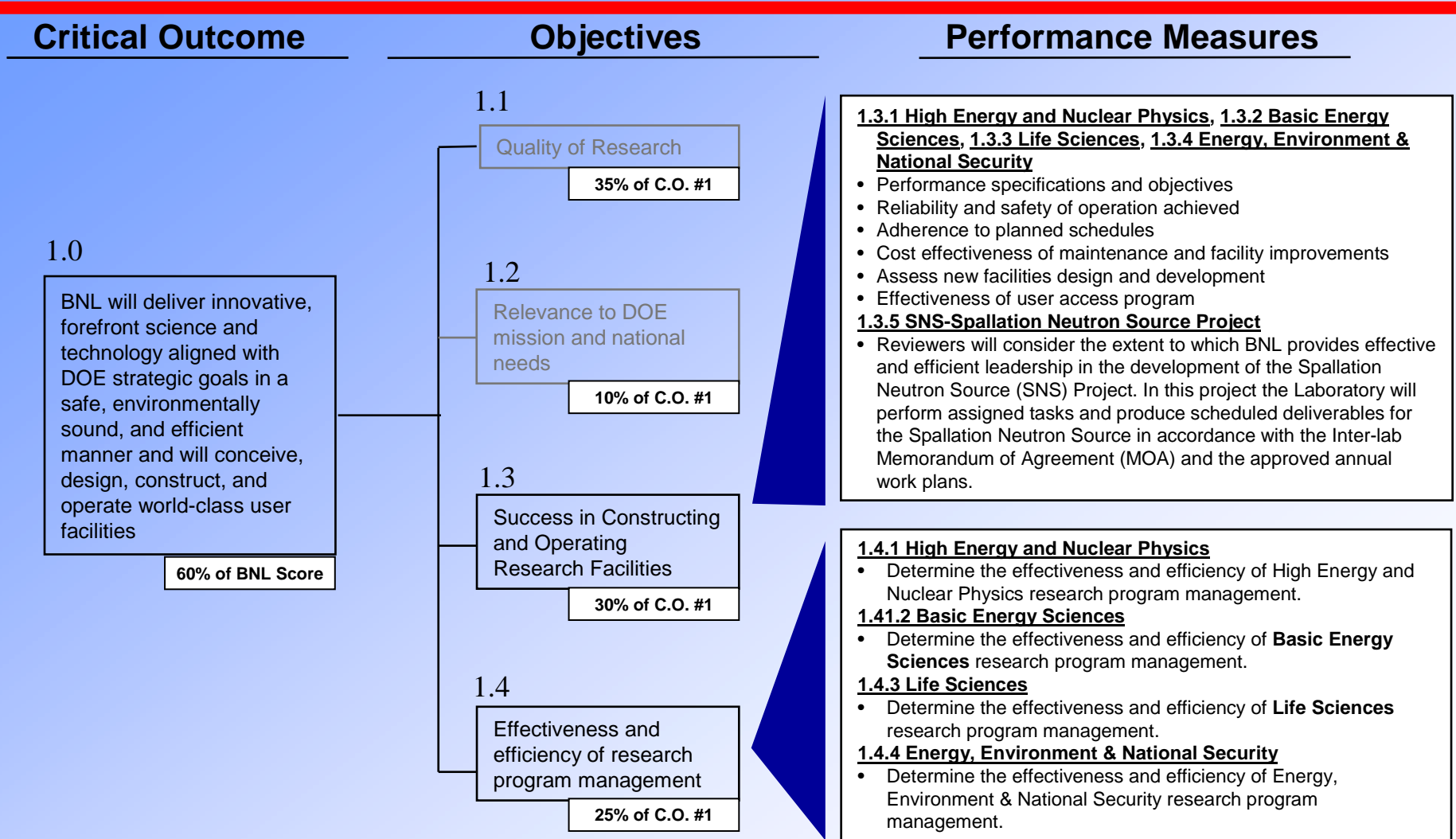


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1.0 EXCELLENCE IN SCIENCE & TECHNOLOGY

1.1 INTRODUCTION

Brookhaven Science Associates (BSA) rated its overall Science and Technology (S&T) performance for Fiscal Year (FY) 2003 performance as **Outstanding** with a corresponding score of 3.64. The Laboratory achieved noteworthy accomplishments under each of the four Office of Science S&T Objectives and demonstrated progress in addressing comments raised by the Department of Energy (DOE) in previews, reviews and evaluations.

Individual scores for the Office of Science Objectives are shown in the Table below.

Objective	Weight	Rating	Score
Quality of Research	35%	Outstanding	3.8
Relevance to DOE Mission and National Needs	10%	Outstanding	3.7
Success in Constructing and Operating Research Facilities	30%	Outstanding	3.7
Effectiveness and Efficiency in Research Program Management	25%	Excellent	3.3
Overall	100%	Outstanding	3.64

These scores were assigned by the Deputy Director for Science and Technology based on input from the Associate Laboratory Directors (ALDs) of the four BNL Science Directorates. In determining the evaluation scores, the Deputy Director considered many factors including benchmarks from past experience and DOE evaluations; major successes; peer review input and research program deficiencies; success in addressing issues to improve research program management both within science and technology organizations, as well as those initiatives taken at the institutional level.

In the following sections, highlights of performance are discussed. Detailed supporting information provided by Science Division and Department Chairs is included in Attachment 1 of this report.



New Laboratory Director, Dr. Praveen Chaudhari, addressing Laboratory Staff

1.2 INSTITUTIONAL LEVEL PERFORMANCE

In FY 03 BSA completed its first contractual cycle and operated under a one-year extension. BSA focused, for this period, on improving upon and/or sustaining its outstanding reputation in science and technology as well as maintaining its initial focus

from the first contract cycle; to sustain and/or improve in the areas of Environmental, Safety and Health (ES&H) and Community Relations. We believe we have accomplished this goal and more. There has been a continuous and sustained improvement in the areas of Environmental Safety and Health (ES&H) and Community Relations during this period. However, it is very important to remember that Brookhaven National Laboratory is here to perform science and technology research. Therefore, we are proud of achieving an ***Outstanding*** rating in Science and Technology as well as being in alignment with DOE's missions and goals, and building strong collaborations with other national laboratories and universities.

The Laboratory's Science and Technology managers continue to focus on addressing the core areas and major initiatives, in prioritized manner, to achieve and sustain outstanding performance. As reported in previous years many of the management changes are still maturing, additional management changes have occurred in FY 03, and assessments have been initiated of the "Management System" by which the Laboratory operates in support of the improvement cycle. Initiatives adopted to attract and retain key scientific staff, improve strategic planning, and improve LDRD management continue to mature and we continue to see benefits in committing our resources in this area. We continue to expand upon and improve the integration of BNL capabilities and collaborations to maximize benefits of National Laboratory based research.

1.2.1 Initiatives

1.2.1.1 Scientific Staff

In FY 03 significant scientific staff hires and organizational changes have taken place at the Laboratory. The most significant hire occurred on April 1st when Dr. Praveen Chaudhari began his tenure as the new Laboratory Director. Dr. Chaudhari joins BNL after 36 years of distinguish service at IBM as a materials scientist and senior manager of research, including 10 years as Director, and then Vice-President of Science. With this appointment Dr. Peter Paul, who served as Interim Laboratory Director, returned to his position as Deputy Director for Science & Technology.

At the Associated Laboratory Director level there have been two changes. Dr. Steven Dierker was appointed Associated Laboratory Director for the new Light Source Directorate. Dr. Helena Benveniste was appointed Interim Associate Laboratory Director for the Life Science Directorate. Dr. Benveniste fills the position held previously by Dr. Nora Volkow who was appointed the new Director of National Institute of Health's National Institute on Drug Abuse (NIDA.)

Within the Basic Energy Science Directorate there have been three new senior management appointments; Dr J. Misewich as Department Chairman for Materials Science, Dr. A. Harris as Department chairman for Chemistry and Dr. R. Hwang as Director of the new Center for Functional Nanomaterials.

BSA continues its effort to retain and recruit top-level scientific staff at all levels to maintain its core scientific strength. Maintaining an aggressive and focused hiring effort, the S&T sector was able to attract many new scientists and technical staff. Examples of some of these hires are:

- ◆ Dr. P.Petreczky, a Goldhaber Fellow, in the Nuclear Theory Group
- ◆ Dr. J. Dunlop as the STAR Analysis coordinator
- ◆ Dr. H. Yu, a Goldhaber Fellow, in Chemistry
- ◆ Dr. L. Cooley, Materials Science Superconductivity Group
- ◆ O.Gang, a Goldhaber Fellow, Drs. C. Petrovi and J. Gardner, all in the Condensed Matter Physics
- ◆ K. Mayer, a Goldhaber Fellow, Drs. D. Roy, M. Naidu, and H. Li , all in Biology
- ◆ Drs. C. Du and P. Guida, in Medical

Taking advantage of the Laboratory's postdoctoral Research Associate subsidies program, the distinguished Goldhaber Fellowship Program established by BSA and other opportunities, the science and technology sector of the Laboratory has achieved a population of 121 young scientists (data as of 6/1/03 – source Human Resources); this number represents more than 23% of the total scientific staff. BNL's target is to reach 150. However the problem still remains regarding the salaries of postdoctoral Research Associates at BNL. Despite measures taken to boost salaries, they remain significantly below the DOE Laboratory average.

Significant hires supporting Laboratory operations include Mr. J. Tarpinian appointed new Assistant Laboratory Director for Environmental, Safety, Health and Quality Directorate (ESH&Q) and Ms. S. Kendall as Diversity Manager.

1.2.1.2 Planning (Long and Short Term)

The Laboratory engages in several aspects of planning, i.e., Facilities Initiatives Planning, program planning and integration, staff planning, and planning to meet user needs. The Laboratory continues to improve and integrate the planning process, although some aspects are still being tuned. The 3BPB process for prioritizing short-term infrastructure/ESH projects, major facility and site master planning, and high level Laboratory Initiatives planning conducted by the Director and ALD's, continue to be performed in an outstanding manner. Plans for staff and program realignment and integration are being executed and should be rated as *Excellent*. Bottoms-up planning and integration is improving and should be rated *Good* to *Excellent*. Some organizations do an outstanding job of short- and long-range planning, while others need to improve, especially for long range planning. Overall organizational planning should be rated *Good*; integration across organizations is improving. Integration of the major directions for programs and initiatives, as determined by senior management, is *Excellent*. Below are examples of institutional planning and execution of that plan.

- Science and Technology planning by senior management provided a roadmap for new facilities and Science and Technology initiatives, and a vision of how the Laboratory will continue to serve the nation and DOE, and our international users

and partners. The Laboratory Initiatives presented in our Institutional Plan flow from these efforts. With the DOE, the Laboratory is pursuing plans to bring its top priority science facilities to fruition.

- BNL's highest priority, the upgrade of the NSLS (NSLS-II), will provide the synchrotron user community with cutting edge capabilities well into the future. In February 2003, BNL received DOE approval to begin planning for a 3rd generation storage ring at the NSLS. It is crucial for characterizing the new nanoscale structures fabricated in the BNL Center for Functional Nanomaterials (CFN) that recently passed CD-1.
- The results of Laboratory planning, in partnership with core universities, established RSVP as a construction project in the NSF FY-04 budget. This project and the NASA Space Radiation Facility, completed in June 2003, will make use of cutting edge capabilities of the AGS, and provide these unique capabilities to other sponsoring agencies.
- Planning for the next twenty years of research at RHIC entails a luminosity upgrade of RHIC and its detectors (RHIC-II) and adding an energetic electron beam (eRHIC) for collisions with RHIC ion beams. A recent NSAC evaluation of proposed facilities gave its highest rating to the science of eRHIC. These plans will continue to provide cutting edge capabilities in Nuclear Physics well into the future at a cost well below that of a new facility.
- BNL put forward a practical plan, the "Very Long Baseline Super Neutrino Beam" for achieving the critical geographical baseline and beam energy conditions to determine the complete set of parameters that describe the neutrino mass and oscillation system. This BNL-developed concept requiring a modest upgrade to the AGS was judged by a HEPAP facility panel as "central to the future of the field."
- Program realignment and response to DOE needs is a major goal of the Laboratory. A key element of our planning included establishing the CFN as a separate department. Two BNL senior scientists (from Condensed Matter Physics and the Materials Science Department) already brought their programs to the CFN. Together with the CFN Director, they comprise the core scientific leadership.
- Site Master Planning continues to focus on providing space appropriate for science in the 21st Century. The Laboratory is actively pursuing Third Party Financing as one measure for implementing its plans. Working with the DOE (SLI), BNL continues to provide sound short and long range plans to maintain and improve the site, including those for our new facilities, the Research Support Facility to be built in FY 04, the Energy Sciences Building whose construction we hope can start in FY 04 either as an SLI or third-party project, and the User Research Center that was submitted in the FY 04 budget.

- Five years ago the Laboratory planned and implemented steps to rejuvenate, expand, and strengthen its research capabilities. Since 1998, the number of post-doctoral Research Associates has doubled. The Goldhaber Fellowship now funds 10 top young scientists. We continue to invest in strategic hires to reinforce and enhance programs.
- One of our primary goals is to increase the research funding that BNL receives from other federal agencies. A Work for Others Task Force, composed of senior staff, will assist the Office of Intellectual Property formulate a Strategic Plan to accomplish this goal.
- Small program planning needs to extend to longer time frames and organizations need to continue to look for opportunities to collaborate and integrate their capabilities to meet sponsors' current and future needs. We recognize the importance of communication for S&T program success, and to this end, we have integrated communication strategies into S&T planning.

Summary

Overall we rate the short and long-term planning as medium to high *Excellent*. Long-range initiatives and large programmatic plans, staff plans and user need plans are high *Excellent to Outstanding*. Improvements need to be made in organizational planning and integration (bottom to top) and in long-range integration of programmatic and support planning.

1.2.1.3 Overall Integration and Collaborations

Integration and collaboration activities include those internal to BNL based on its interdisciplinary character and external with other institutions, in the U.S. and abroad. The laboratory has a strong history of collaboration in High Energy and Nuclear Physics and that strength continues. The NSLS continues to expand its role as a major focal point for laboratory, industrial and university collaborations, and will be an integrating element in our Center for Functional Nanomaterials (CFN). BNL leads the FACE program and has a principal role in the ARM program. Internal collaborations (within the organization and across organizations) continue to grow.

- HE and NP participate in numerous international collaborations under formal Government-Government agreements. Among them are:
 - 1) BNL-IHEP (the Institute for High Energy Physics, Beijing) Accelerator Collaboration;
 - 2) BNL-JPARC Superconducting Magnet Collaboration;
 - 3) BNL-Riken Collaboration in the Spin Physics Program at RHIC;
 - 4) BNL-GSI Superconducting Magnet Collaboration;
 - 5) US-CERN LHC accelerator Collaboration and ATLAS Detector Collaboration

- In the area of experimental research programs, there are
 - 1) E949, E962, and; KOPIO Collaborations at AGS;
 - 2) BRAHMS, PHOBOS, PHENIX, and STAR Collaborations at RHIC;
 - 3) RIKEN BNL Research Center at BNL
 - 4) LENS Research Collaboration at NSLS;
 - 5) SNO Collaboration at Sudbury; and
 - 6) The D0 Detector Collaboration at the Tevatron.

- In addition, BNL is planning to establish a Physics Analysis Center at the Laboratory to strengthen and coordinate the contributions of U.S. collaborators to the scientific productivity of the worldwide ATLAS research program.

- The BES and EENS directorates are also involved in extensive collaborations. Among them are:
 - 1) US-Japan Collaboration on Neutron Scattering;
 - 2) ISIS Postdoctoral fellow program with Rutherford Appleton Laboratory;
 - 3) Scientific Collaboration on Neutron Scattering;
 - 4) US-PRC Collaborative Program with IHEP, Beijing;
 - 5) Complex Materials Consortium;
 - 6) Global Climate Change and Carbon Management;
 - 7) International Nuclear Safety Program; and
 - 8) Initiatives for Proliferation Prevention.

- The NSLS is heavily used and vital for the large research community in the Eastern US. Due to its success in meeting user needs, building a strong scientific program, and fostering collaboration and integration for effective operations, we received DOE's approval in February 2003 to begin planning for a 3rd generation storage ring, NSLS-II .

- The CFN is the result of both internal and external collaborations and the integration of several BNL internal department staff and external university staff. Recently, it passed CD-1; it will be a focal point for collaboration with nearby universities, NSF nanocenters and industry.

- In HE and NP, BNL and others collaborate to recommend to DOE the long-range directions for programs and facilities. In response to these long-range plans, BNL, with several universities and other DOE and foreign laboratories, is moving to a new concept for RHIC, RHIC II and eRHIC, and will continue to participate in the long range neutrino program plans.

- In several cases, new staff and post-docs were hired to support the capabilities of programs and to help integrate aspects of one discipline into another. For example, our new intralaboratory collaborations in Materials Synthesis will bring together researchers in Condensed Matter Physics, Materials Science, and the CFN to enhance and extend ongoing research.

- Some other indicators include our approaches to computation, imaging and neutron science. We are applying computational methods to experimental problems such as nanoscience, protein structure and function, and climate modeling. Our imaging programs are collaborative with research hospitals and clinics, our biomedical engineering laboratory involves five BNL departments/divisions, LBNL, and university participation. Further, BNL is leading the instrument team at the SNS to build HYSPEC, a novel neutron instrument.

Summary

Overall, we rate Program Integration and Collaboration medium *Outstanding*. Our major efforts in HE/NP, BES, and EENS are high *Outstanding*. Our small program integration and collaboration efforts, as summarized in the FY 2004-2008 Institutional Plan, are moving to high *Excellent*.

1.2.1.4 Proposal Process

We break the proposal process into three main categories: the standard FWP process, new proposals for DOE, and proposals for Work for Other.

- In general DOE sets the FWP process. Since the FWP is primarily a budget vehicle, it is not rated here. However, we note that over the last few years, the Laboratory has attempted to meet DOE program needs by providing early drafts for use in the DOE budget process. As an indicator, we evaluate that responsiveness as *Excellent* and intend to be as timely as possible in meeting this need.
- Our proposal response to new initiatives in DOE depends on the program and the DOE program expectations. We believe our process is high *Good to Excellent*. We expect that the process will evolve in the upcoming year to significantly improve the quality of our proposals and their success. For every proposal our goal is to answer the call, to assure that we have the capabilities to meet the stated goals of the request for proposal and to assemble an interdisciplinary team to implement the program.
- In our Work for Others proposals, we have been quite successful with several agencies, most notably the NIH. Detailed summaries of our current WFO programs can be found in the Institutional Plan. Based on the success rate, we rate this as *Excellent*.

1.2.1.5 Laboratory Directed Research and Development

In FY 2003, the LDRD Program continued under the leadership of the Program Director. He continues with the full responsibility for all aspects of the program and it continues to function efficiently and effectively. Implementation of the results of the formal Baldrige type self-assessment performed in FY 2002 continues to have a positive impact on the administration of the program. Again in FY 2003, the Program Director and a committee, consisting of the Deputy Director for Science and Technology, the four Associate

laboratory Directors, and four senior scientific staff, reviewed all proposals, obtained additional information deemed necessary, selected the projects to be funded and the amount of each award. This year we indicated that funding would be made for two years with essentially no likelihood of a third year. This will permit the funding of more projects in subsequent years. The LDRD Director performed a mid-year review of all projects. This review was a factor in determining whether a project would continue into the next fiscal year. In addition, the Program Director continued the monthly meetings with the DOE Brookhaven Area Office to update the progress of the program and verify that the BNL LDRD Program is meeting the overall LDRD requirements. The significant new requirements that were imposed on the LDRD Program in FY 2002 as a result of congressional inquiry continued to effect the DOE LDRD Program. BNL continues in its support of these new requirements by:

- Participating in the DOE SC LDRD working group to develop new guidelines
- Participating in the development of the new CFO LDRD database
- Ensuring that all projects support the DOE security missions and missions of other federal agencies
- Identifying potential use/benefits to the DOE security missions for all projects
- Submitting data sheets for all projects to the DOE Operations/Site Office for concurrence
- Including the DOE-BAO LDRD Program Manager in all LDRD selection meetings

In FY 2003, BSA increased its expenditure level from \$7.0 Million to \$8.5 Million, which is beginning to approximate 2 percent of BNL operating funds, which is still far less than the maximum of 6 percent permitted by DOE. There were several success stories in the LDRD Program with projects receiving direct funding from DOE, NIH, and CRADA agreements. In addition, several projects also submitted patents. We are planning to increase the LDRD budget in FY 2004 to \$9.5 Million which continues us on the road to be more in line with the budget of the other DOE Science laboratories.

1.2.2 Scientific Recognition

Awards and Accomplishments: Throughout its history, Brookhaven National Laboratory has received numerous recognitions for its contributions to the Technical and Scientific Community. These are the awards and accomplishments received during fiscal 2003 (October 2002 through September 2003).



Raymond Davis

Raymond Davis Jr., a retired chemist, has won the Nobel Prize in Physics for detecting solar neutrinos, ghostlike particles produced in the nuclear reactions that power the sun. In awarding the prize to Davis, the Royal Swedish Academy of Sciences cited him “for pioneering contributions to astrophysics, in particular for the detection of cosmic neutrinos.” Davis shares the award with two other scientists.

Peter Daum, an R&D Manager in the Environmental Sciences Department, was named recipient of Southampton College's first annual environmental leadership awards. Daum was recognized in various categories for his contributions and individual achievements in regionally important environmental programs.



Peter Daum

Gerry Bunce, senior physicist, John Hill, physicist, Alexei Tsvetik, senior physicist, and Craig L. Woody, senior physicist, were elected as Fellows of the American Physical Society (APS).



Stephen Schwartz

Stephen Schwartz, a senior chemist, has been elected a Fellow of the American Association for the Advancement of Science. Schwartz is among 291 members elected as Fellows in 2002 by their peers. These individuals have been elevated to this rank because of their efforts to advance science or foster applications that are deemed scientifically or socially distinguished.

Pavel Rehak, a physicist, has been named a Fellow of the Institute of Electrical and Electronics Engineers (IEEE). His extraordinary record of accomplishments are stated on the IEEE web site. Rehak, who was one of 260 members of IEEE chosen as Fellows for 2003, was cited for "contributions to the theory and development of particle and photon detectors."



Pavel Rehak

Praveen Chaudhari, Brookhaven's Director, and Joanna Fowler, a senior chemist, have been elected as members of the National Academy of Sciences. They were among 72 new members and 18 foreign associates from 11 countries who were elected by the Academy for their distinguished and continuing achievements in original research.



Diane Cabelli

Diane Cabelli, a chemist, was among eleven women honored for their accomplishments and contributions to Brookhaven Town at the Town-sponsored Women's Recognition Night on March 20. Cabelli was honored for her contributions to science.

William Willis, a senior physicist, has won the American Physical Society's 2003 W.K.H. Panofsky Prize in Experimental Particle Physics. The award citation credits Willis "For his leading role in the development and exploitation of innovative techniques now widely adopted in particle physics, including liquid argon calorimetry, electron identification by detection of transition radiation, and hyperon beams."



William Willis

Three scientists associated with BNL— Martin Blume, senior physicist, Doon Gibbs, Acting Associate Laboratory Director, and Denis McWhan, retired Associate Laboratory Director — along with Kazumichi Namikawa of Gakugei University in Tokyo, Japan, have won the 2003 Advanced Photon Source Arthur H. Compton Award. The award recognizes important technical or scientific accomplishments that are beneficial to the Advanced Photon Source, a synchrotron light source at DOE's Argonne National Laboratory where researchers use high-brilliance x-ray beams to probe materials.



Toshifumi Sugama

Toshifumi Sugama, a chemist, and Keith Gawlik of DOE's National Renewable Energy Laboratory have jointly won a 2003 Federal Laboratory Consortium Award for Excellence in Technology Transfer. This year, the team will be among 22 recipients of the annual award, which recognizes employees who have accomplished outstanding work in the process of transferring a technology developed by a federal laboratory to a commercial marketplace. In addition Sugama, along with industrial partners Bob Curran & Sons and Ticon Corporation, has won a 2002 R&D 100 Award for developing a smart high-performance polyphenylene sulfide coating, particularly suited for use in carbon-steel heat exchanger tubes in geothermal power plants.

Robert A. Bari, a senior physicist, has been awarded the 2003 American Nuclear Society "Tommy" Thompson Award. The Nuclear Installation Safety Division of ANS sponsors the award. The award credits Bari "for his outstanding contributions to the field of nuclear installation safety and his outstanding wisdom and direction to key elements of the world of nuclear safety activities."



Robert Bari



Paul Kalb

Paul Kalb, a research engineer, was one of seven Long Islanders honored as "Innovator of the Year" by Long Island Business News. He won the honor for inventing a technology, sulfur polymer stabilization/solidification that makes the disposal of mercury more practical and safe, compared to existing methods.

1.3 DEPARTMENT OF ENERGY RESEARCH PROGRAMS

1.3.1 *Nuclear Physics (NP)*

1.3.1.1 **Quality of Research**

- **RHIC Program:** In the first run of RHIC with asymmetric beams, d-Au, results do not show the high-pt suppression that was observed in Au-Au collisions, i.e. the signal of hot dense matter is absent in d-Au collisions. The “smoking gun” for dense partonic matter appears to be the effect called jet quenching. The d-Au collisions show the clear jet signature, i.e. no quenching. In Au-Au collisions, the jet signature is present in peripheral collisions, but suppressed in central collisions. This strong suppression is best explained as due to strong partonic energy loss in dense quark-gluon matter. The discovery of this new form of matter was announced by all four RHIC experiments at a colloquium on June 18. During this year, RHIC for the first time accelerated protons with 25% longitudinal polarization to energies of 100 GeV in each ring. No other accelerator in the world can do that. PHENIX and STAR detectors made meaningful measurements of the analyzing power $A(LL)$, which will give information on gluon polarization in the proton. Despite these early successes, the low luminosity of proton-proton collisions and low proton polarization are concerns. Both the polarization and beam intensity need to be improved. Upgrade plans for the two large RHIC detectors were developed by RHIC users in collaboration with the Laboratory, and were evaluated by an external review committee.
- **Nuclear Physics Theory:** BNL developed the concept of the Color Glass Condensate to the level of real predictions on the nuclear modification factor, i.e. the change of the nuclear medium from an assembly of uncorrelated nucleons. The existence of this new predicted gluonic condensate could have an effect on the observed jet quenching in Au-Au collisions. In parallel BNL’s theorists have probed the phenomenology of the quark-gluon plasma and are comparing it with data from RHIC. Simulations efforts on finite-temperature QCD were strengthened by the addition of Peter Petreczky. In an outstanding development, the QCDOC first chip element was successfully tested with a lattice gauge calculation. A concern is the further delay of funding for the full 10 teraflop (sustained) machine for the National Lattice Gauge Consortium.
- **LEGS:** BNL satisfied its goal of deuteron polarization in a production cryostat. The polarized H-D molecule is transferred with a transfer cryostat to the in-beam cryostat, where high-energy photons interact with the polarized H-D target. BNL successfully built, tested and commissioned the in-beam cryostat for polarized H-D. Construction of the transfer cryostat was begun in collaboration with Juelich. The first data runs are expected in fall 2003. A concern is that the experiment, with a superconducting magnet and novel TPC (using the same technology as planned for RHIC upgrades), is very ambitious, and data taking may not be completed by FY-05 as planned.

- SNO: BNL researchers participated in the successful data runs that demonstrated that the disappearance of solar neutrinos is due to neutrino oscillations. BNL is maintaining the all-important radio-cleanliness of the huge SNO volume and is a partner in developing the LENS detector that will measure the low-energy neutrinos from the dominating P-P reaction.

1.3.1.2 Relevance to DOE Mission

- RHIC is the main facility of the DOE program in high-energy nuclear physics, and will be unique worldwide until the LHC turns on in 2007. With its rapid start up and rapid publication of results, RHIC is performing its mission to find and explore the novel quark-gluon matter that existed in the early universe. It now serves the research of over 1000 national and international users from universities and laboratories. BNL nuclear theory provides the theoretical framework for the exploration of Quantum Chromodynamics and all aspects of hot and cold quark-gluon matter
- BNL supports the mission of the DOE to operate the large non-accelerator based water-Cerenkov detectors for solar neutrinos, which require ultra pure water.

1.3.1.3 Success in Constructing and Operating Research Facilities

- RHIC successfully concluded its third annual running campaign, meeting its maximum design luminosity goals for Au-Au collisions. The goal of delivering beams for physics at 80% of planned operating time was nearly achieved. PHENIX has completed its full baseline detector configuration. STAR will install its final part of the EM calorimeter next year. BNL achieved successful acceleration of polarized protons through the AGS-RHIC complex and successful operation of Siberian snakes and spin rotators in RHIC. We completed the repair of the Siemens motor-generator set that allowed rapid ramp-up of the AGS, which is crucial for preservation of polarization through the acceleration process. We successfully implemented automated check-in procedures for users in compliance with DOE access regulations, and a web based training system.

1.3.1.4 Effectiveness and Efficiency of Research Program Management

- All DOE nuclear physics reviews have been completed successfully. The RHIC program generated an action item for a stronger and more detailed planning process for the next five years including RHIC and detector evolution. This plan is being developed at the present time. We attracted two outstanding young scientists, one a Goldhaber Fellow in nuclear theory, the other an Associate Physicist from Yale. Two BNL postdocs were placed as Assistant Professors at Vanderbilt University and MIT, respectively. We attracted a world-renowned electron accelerator expert from Duke University to provide expertise for RHIC electron cooling and the concept development of eRHIC.

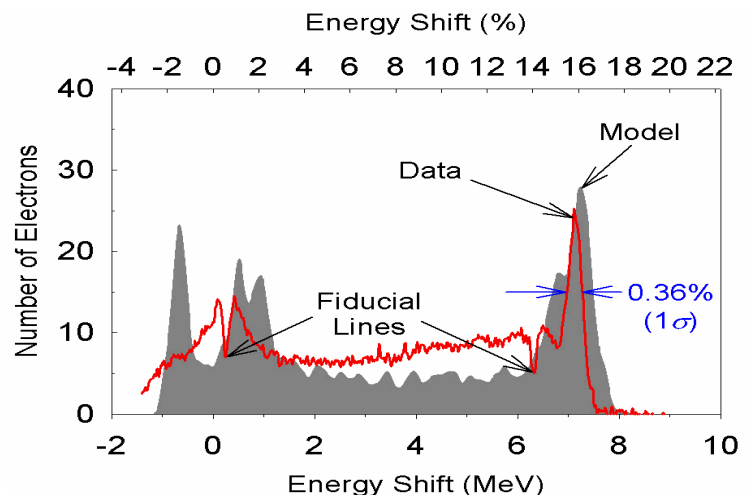
1.3.1.5 Strategic Planning

- The concept of RHIC-II, the 40-fold luminosity upgrade of RHIC using electron cooling of RHIC beams at full energy, was further developed. We began R&D on a high-current energy recovering electron linac and magnetic solenoid guide field for the e-Au cooling region. BNL further developed the concept of eRHIC, an electron ion collider of cm energy $\sqrt{s} = 60$ to 100, and high luminosity. BNL assembled a steering committee for eRHIC; this intensifies our collaboration with Bates Laboratory at MIT for joint planning of eRHIC.

1.3.2 High-Energy Physics (HEP):

1.3.2.1 Quality of Research

- ATLAS program: A BNL scientist now leads the applications software effort for the entire LHC grid computing effort. BNL is also building up its ATLAS Physics Analysis Center and has begun to hire young scientists for this effort. BNL is host to the Tier-I Computing Center for U.S. ATLAS and has executed successfully its first mock data challenge.
- Ongoing stationary target experiments: The analysis of the crucial negative muon data of the G-2 experiment, which have statistics equal to the positive muon data, is proceeding and close to completion. Later this year the final results on all data will be presented. The last run on the E-949 Experiment shows that the intended technical improvements in sensitivity and data rate capability of the experimental set-up have in fact been achieved. The analysis of available data will double the existing statistics on the branching ratio of $K^+ \rightarrow \pi^+ \nu \bar{\nu}$. At Fermilab BNL is involved in the MINOS experiment as leader of the $\nu_\mu \rightarrow \nu_e$ analysis group. BNL has prepared a proposal to MINOS to upgrade the NuMI neutrino beam for the ν_e appearance experiment.
- High-energy theory: W. Kilgore published a landmark paper on the next-to-next-to-(sic) leading order calculation of the production cross-section of the Higgs particle. This is a very important result for the Higgs search at the LHC. F. Paige developed analysis techniques for Supersymmetry signatures for the first data run of ATLAS at the LHC.
- Accelerator Test Facility: The transition to the Physics Department was completed; the facility served outside users on 14 active accelerator physics experiments. Plasma



wake acceleration and plasma focusing were demonstrated. Most interestingly the acceleration of electron beams in two-phase coupled lasers has been refined to produce high-resolution acceleration, a requirement for use of lasers as accelerator mediums. The STELLA experiment uses two inverse free electron lasers (IFEL) as the laser acceleration mechanism. The first IFEL (IFEL1) is the buncher, the second IFEL (IFEL2) is the accelerator. This IFEL traps and accelerates the microbunches, separated by 10.6 μm with individual bunch lengths of $\approx 1 \mu\text{m}$ (equivalent to $\approx 3 \text{ fs}$). The resulting accelerated beam shows high energy resolution (see figure at left).

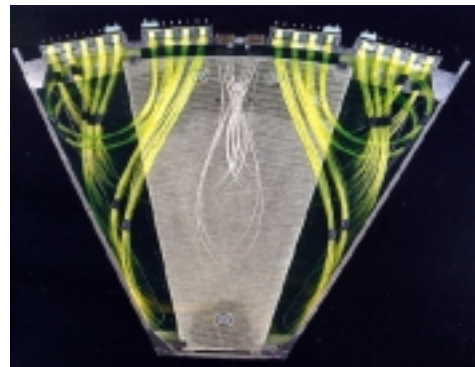
- Advanced Accelerator Group – It continued work on the technology of muon storage rings for neutrino factories and colliders. An interesting new concept, that of a fixed field alternating gradient (FFAG) device was introduced to serve for the required rapid acceleration over a wide energy range with large acceptance. This device offers size and/or cost benefits over a conventional linac and could be useful for high-intensity proton sources (like injecting into the AGS) or for muon acceleration for a muon storage ring.

1.3.2.2 Relevance to DOE Mission

- The U.S. LHC effort is the top priority of the DOE HEP mission element. BNL has key roles in U.S. ATLAS, the LHC Grid computing effort, and the LHC accelerator construction.
- BNL has important roles in the Fermilab program, including participation in D0 and MINOS.
- BNL is now a partner in the national effort developing the Linear Collider design concept.

1.3.2.3 Success in Constructing and Operating Research Facilities

- ATLAS: The Detector construction project, computing project and accelerator project all are on schedule. Brookhaven's work on the liquid argon cryostat, the cryostat feed throughs and system crate are completed or progressing on schedule. BNL also delivered the first completed LHC quadrupole magnet, the first production magnet of any type delivered for installation into the LHC accelerator.
- D0 Collider detector: J. Kotcher is the lead person on the D0-run IIb upgrade for the entire D0 detector. The D0 detector is performing smoothly for the current extensive IIa data run. In particular, the forward pre-shower detector build by BNL was successfully commissioned and is in operation. A module of this detector (as shown in the figure) was selected by the Museum of Modern Art for inclusion in an exhibition called "Signatures of the Invisible."



1.3.2.4 Effectiveness and Efficiency of Research Program Management

- The HEP base program received strong support at the 2003 HEP Program Review.
- RSVP: A construction start for this very highly rated program searching for rare symmetry-violating events is now slated in the NSF budget in 2006 or sooner. Memoranda of understanding between BNL, NSF, and the experimental university collaborations are being developed.
- HEP Theory: BNL began a search for a world-recognized lattice gauge theorist to lead a Lattice Gauge Theory Center at BNL, to be formed to exploit the capabilities of the planned QCDOC computing facility. BNL's W. Marciano and Z. Parsa organized the 2003 Intersection Conference in NYC with about 450 participants. This major conference discusses physics topics and results that are common to high energy and nuclear physics, particle astrophysics and cosmology.
- Collider-Accelerator: The NASA Space Radiation Laboratory at BNL was commissioned on time and on budget and put into operation at the AGS Booster. BNL's contribution to the Spallation Neutron Source facility is nearing completion and is equally on time and on budget. In both cases the outside lab or agency has been very satisfied. . Agreement was reached with China on BNL's participation in the upgrade of the BEPC e^+e^- accelerator at IHEP-Beijing.

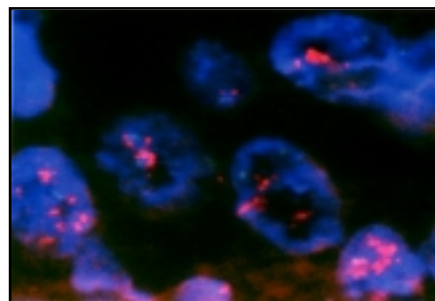
1.3.2.5 Strategic Planning

- Long Baseline Neutrino Oscillation: M. Diwan led a study group that developed the physics case, sensitivity, detector and neutrino beam requirements. BNL produced a White Paper on this topic that includes an AGS upgrade to 1MW beam power and a new neutrino production line. A HEPAP subpanel advising the DOE Office of Science Concept judged the concept as "absolutely central to the field". Discussions are underway on possible collaboration with the UNO experiment as the potential underground detector for the long baseline oscillation initiative.
- Astrophysics and Cosmology: BNL began working on creating experimental and theoretical efforts in astrophysics and cosmology; we initiated an association with the collaboration proposing the Large Synoptic Survey Telescope (LSST), working with SLAC and other DOE labs to seek DOE funding for this project. We began work with Columbia University (Physics and Astronomy Departments) to explore the dark energy potential of some aspects of LSST data.
- Linear Collider: BNL became a partner in the conceptual development of the Next Linear Collider, both in the accelerator design and the detector. For the accelerator, the Superconducting Magnet Division at BNL produced the first viable design of the final focus region, based on BNL's superior technology for small-diameter superconducting coils.

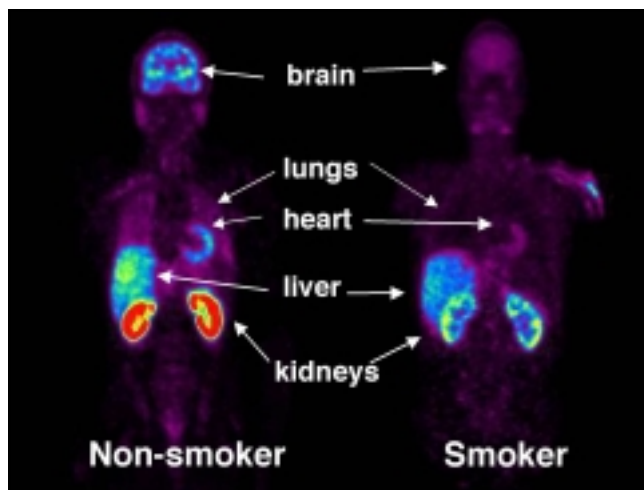
1.3.3 Biological and Environmental Research

1.3.3.1 Quality of Research

- In the Genomes to Life program, Genomic Signature Tags (GSTs) were developed as a new system for profiling genomic DNA and were used to profile the CpG methylation status of human DNA. The application of modified GST methodology for analyzing the composition and function of complex microbial communities was also developed.
- A gene was identified that is amplified in 12-18% of primary human breast cancers, and its relationship to posttranslational modifications of the p53 tumor suppressor gene was characterized. This gene may be a target for drug development.
- In the Plant Sciences program, it was proven that *Arabidopsis* trichomes can be used as a model system for cotton fiber development. This will help to determine what genes are responsible for cotton fiber strength, length and abundance. Methods are continuing to be developed for rational engineering of plant desaturase.
- Research in the area of emerging pathogens has grown and includes work with bioterrorism agents such as botulinum toxins and ricin toxin as well as SARS virus. Progress has been made in understanding the translocation mechanism of botulinum molecules through the vesicle membrane.
- In the area of Optical Imaging, the effect of drugs of abuse on calcium transients are being studied. Optical instrumentation was acquired and the first physiological data on a live rat (brain) before and during ischemia was collected.
- Using PET technology to study the smoker's brain it was discovered that smokers have a 35-45% reduction in monoamine oxidase-B (MAO B) in brain, heart, lungs, kidneys and spleen. MAO B is involved in the breakdown of dopamine, a neurotransmitter implicated in reinforcing and motivating behaviors as well as movement. In addition, though most of the emphasis on tobacco smoke toxicity is on the lungs and the upper airways, this finding highlights the fact that multiple organs in the body are also exposed to pharmacologically significant quantities of chemical compounds in tobacco smoke.



Breast tumor specimen showing gene amplification (red signals)



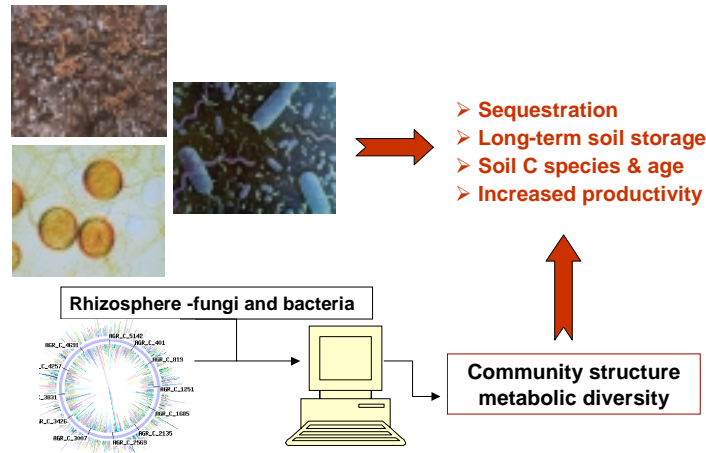
Monoamine Oxidase B and Tobacco Smoke

Pet Images Of Monoamine Oxidase B (Mao B) In A Non-Smoker And A Smoker Using [11c]L-Deprenyl As A Radiotracer. Smokers Have A 35-45% Reduction In Mao B In Brain, Heart, Lungs, Kidneys And Spleen.

- In the PET program, an integrated plant metabolism chamber was developed to be used as a scientific tool to investigate plant synthetic capacities as a function of environmental stressors. This unique system exploits short-lived positron emitting isotopes externally detected using a combination of PET and Direct Positron Imaging.
- Radiotracer technology is advancing. Four new positron labeled molecules for imaging cannabinoid receptors in the brain were synthesized and evaluated. Experiments with ^{11}C -ethanol for studies on alcohol abuse in humans were initiated, and peptide nucleic acids were labeled in steps toward imaging gene expression.
- Produced and patented, biologically active synthetic analogs of two growth factors, including basic fibroblast growth factor for use in wound healing and radiation protection, as well as other applications.
- Cancer diagnostics and therapy research is advancing. It was shown experimentally, after 3 hours of irradiation, that microbeams cause significant vascular damage only in tumor tissue, without any vascular effect on the normal brain. Pre-clinical BNCT therapeutic efficacy studies using the thermal neutron beam at the MIT research reactor facility were completed.

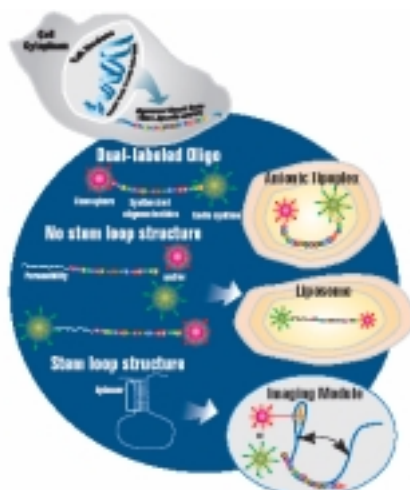
1.3.3.2 Relevance to DOE Missions and National Needs

- The Genomes to Life initiative is strengthening with the development of high-throughput molecular methods to elucidate microbial community structure and functioning. Genomic Signature Tags (GSTs) were developed as a new system for profiling genomic DNA. A modified GST methodology for analysis of the composition and function of complex microbial communities was also developed.



Genomes to Life: High throughput methods to elucidate complex Microbial Communities

- At DOE's request, a white paper was submitted which proposed to sequence the genomes of five different genera of the order Thermatogales, a hydrogen producing microbe. This information is key to eventually obtaining the most efficient production of hydrogen by Thermatogales under different physiological conditions, and will provide a firm foundation for ultimately maximizing hydrogen production.
- To enhance the multi-agency funded imaging program, a new NIH intramural program for PET imaging in drug abuse research has been established by NIH at BNL to support research at Brookhaven by NIDA and NIAAA investigators. This funding is to continue to develop and apply imaging technologies to understand brain reward mechanisms and the brain circuits that are disrupted during addiction.
- Sixteen new proposals were submitted to DOE by Life Sciences in the areas of Genomes to Life, Radiotracer Technology and Low-Dose Radiation Effects.
- A major proposal was submitted to NIH to use our PET and MRI imaging capabilities to determine the effects of substance abuse on the developing human brain. The initial work will focus on defining the fetal targets for drugs of abuse at various times during ontogeny in order to determine sites of drug-cell or drug-organ interactions (pharmacokinetics).
- Funding was provided by DOE/OBER for a collaborative project with AMEs Lab and Lawrence Berkeley (Nuclear Imaging of Gene Expression consortium) to develop gene-specific imaging agents that will be used in conjunction with fluorescence microscopy, PET, and SPECT imaging modalities.

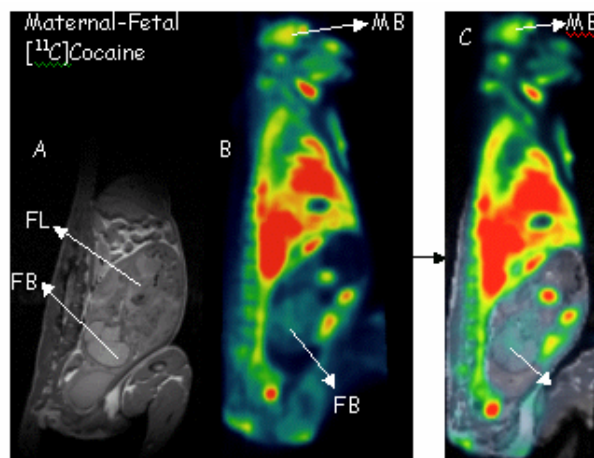


Stage I of Nuclear Imaging of Gene Expression, which includes development of novel probes, delivery vehicles and signal amplification.

- We continue to develop in the areas of detection and intervention of emerging pathogens. The GST technique developed to support DOE's Genomes to Life Program may be used for the rapid detection and identification of pathogens.

1.3.3.3 Success in Constructing and Operating Research Facilities

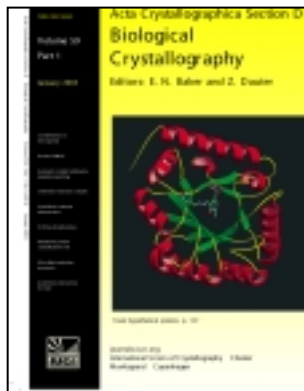
- BNL has unique facilities and imaging instruments including the Brookhaven Linac Isotope Production Facility, NASA Space Radiation Laboratory, the National Synchrotron Light Source, and the PET and MR facilities. New initiatives in the Life Sciences will introduce state-of-the-art instrumentation for translational genomics and phenotyping and new infrastructure for high throughput structural microbiology.
- By taking advantage of two imaging modalities (above) -- Positron Emission Tomography (PET) and high field Magnetic Resonance Imaging (MRI) technologies are being developed to non-invasively track maternal and fetal pharmacokinetics of two major classes of drugs of abuse - nicotine and, in this case, cocaine - during ontogeny in the living pregnant non-human primate. This will be used as a model for future studies of the acute and chronic effects of maternal drug exposure on fetal brain development.



Proton density MR image (A) and corresponding ^{11}C -Cocaine PET image (B) with the resultant warped combination (C). Time activity curves of ^{11}C in maternal and fetal organs are also shown (D and E). FL=Fetal Liver; FB=Fetal Brain; MB=Maternal Brain.

- The genetically modified mouse is a major new scientific tool in the neurosciences. A program in multi-modality imaging for genetically engineered animals has been initiated which combines high field (9.4 Tesla) microMRI, Optical imaging and microPET. General Plant Project Funding was used to renovate the facility to house the 9.4 T MRI machine. Installation of the machine will be completed in FY 03.
- In the PET instrumentation area, there was development of "RatCAP", a miniature head-mounted PET tomograph for imaging the brain of the awake rat. Also, a novel high-resolution PET detector (monolithic crystal) and a wrist monitor for non-invasive PET input function measurement was developed.
- MRI studies have also been advanced in the effort to image the Awake Animal Brain. This research will advance our ability to relate biochemistry and behavior in transgenic animals, and is promising applications beyond animal imaging, such as compensation for motion and correction in human MRI studies.
- The NASA Space Radiation Laboratory (NSRL) was fully commissioned along with long-term satellite lab space in the Medical Department. The facility saw its first user population in July 2003. A grant was submitted to NASA for the establishment of a "Center for Space Radiation Neurobiology" to take advantage of BNL's strengths in neuroscience and the new NASA Space Radiation Laboratory.
- The Macromolecular Crystallography Facilities successfully underwent a combined NIH/DOE external review (which is a very rare occurrence at BNL). The \$6M/yr grant represents a 5 year renewal of NIH and DOE funding for operation of macromolecular crystallography beamlines at the NSLS with a substantial increase in funding to build and operate X25 and X29 as high brightness undulator beamlines and to install crystal changing robotics for rapid, efficient operation.

- The Macromolecular Crystallography Facilities successfully developed, and now operates, a Rapid Access Crystallography program to facilitate data collection of short-lived crystals. They also developed and operated a Mail-In Crystallography program that was featured in the journal Nature; article 423: 799-800, June 19, 2003



- Two cover articles were reported from users to the NSLS Macromolecular Crystallography Facilities. A group from Rockefeller University published the first picture of a voltage-dependent potassium ion channel. The second, a representation of the fold of yeast hypothetical protein with PLP and protein ligand Lys49 bound to PLP, was published in Acta Crystallographica (1/03) by BNL researchers as part of a project for the high-throughput structural and functional studies of proteins.
- Two cryoElectron Microscopes, purchased by OBER, have been installed. The smaller, screening scope is operational and the larger scope arrived 7/03 and is being installed. This will augment the STEM facility by facilitating the analysis of protein complexes such as heavy metal transporters, and other molecular machines of relevance to DOE. In addition, the STEM facility had a successful renewal of its Research Resource grant funding for 5 years that is worth \$850K/yr.
- The Brookhaven Linac Isotope Producer (BLIP) had a 97% on-time delivery rate and met specifications 99% of the time. The Facility successfully developed a solid cyclotron target for simultaneous production of Co-57 and Cd-109 and designed, built and installed a target transfer cave.
- Technologies related to the Genomes to Life Effort are advancing rapidly as evidenced by the development of auto-induction media and protocols for convenient, high-level expression of proteins from cloned coding sequences in the T7 expression system. A provisional patent application was filed and the first commercial use was introduced by Novagen in June 2003.

1.3.3.4 Effectiveness and Efficiency of Research Program Management

- In our continued efforts to align ourselves with DOE priorities, we maintain close communications with our DOE program managers. Two OBER Division Directors came to BNL in Jan 2003 to discuss new initiatives and meet with the scientific staff. Life Sciences also hosted the head of the Center for Cancer Research along with 16 of his NCI colleagues to facilitate collaborations between BNL and NCI.
- Several scientists in key areas were successfully recruited into Life Sciences; a cryoElectron Microscopist, a scientist with expertise in optical imaging and microMR, and a senior scientist who will bring a DOE funded research program to

work on PET radioligands. Several assistant scientists were also hired to support the NASA Space Radiation Laboratory and research program.

- A grant was submitted to NASA for the establishment of a “Center for Space Radiation Neurobiology” to take advantage of the institution's strengths in neuroscience and the new NASA Space Radiation Laboratory which is located at Brookhaven. Collaborators have also been recruited from several other institutions.
- BNL and Battelle entered a collaborative research agreement to study novel anti-microbial drugs. We will use recently developed crystallographic techniques as a first step in this goal of discovering new drugs. We hold a CRADA with Cotton Incorporated for cotton gene engineering, with Bioset for synthetic growth factor technology, and with PSIMEI for development of cancer therapy agents.
- The Life Sciences Directorate had over 200 published papers, the majority of which are co-authored. The Directorate sponsors about 400 researchers annually through its user facilities which include Macromolecular Crystallography, NASA Space Radiation Biology, and STEM, as well as the research support facilities such as the Clinical Research Center and the Animal Facility.
- The Clinical Research Center completed its corrective action plan from a shutdown of operations in 2000. There were numerous improvements to operations including a restructuring of the program. The clinical program has undergone several audits in FY 03 all of which have had favorable results. A new CRC manager has been recruited and will start in 8/03.
- The BLAF had favorable reviews from AALAC (a triennial accreditation), USDA, NYSDH and internally by the IACUC. The Association for the Assessment and Accreditation of Laboratory Animal Care International (AAALAC) Audit was a major audit. This association provides peer review evaluation for laboratory animal programs.
- Two major editorial accomplishments were reported. One was a guest editorial for a special edition journal “Drug Development Research”, Gatley, S. J. and Carroll, F. I., on PET and SPECT in Medication Development. The second, was a published book “Molecular Nuclear Medicine: The Challenge of Genomic and Proteomic to Clinical Practice” L. Feinendegen, W. Shreeve.
- Two scientists were granted tenure in Life Sciences. Gene-Jack Wang in the Medical Department who conducts a PET research program on obesity and addiction and S. Swaminathan of the Biology Department who conducts structural studies on toxins and is part of the proteome project.
- The Directorate had several successes in the area of education and mentoring. We ran a Macromolecular Crystallography Data Collection Course and a National Center for Biotechnology Information (NCBI) Training Workshop. The Medical

Department hired five post-docs on an NIH Training Grant and hosted an intensive six week American Chemical Society funded Nuclear Chemistry Summer School.

1.3.3.5 Strategic Planning

- Genomes to Life Research advances have led to four recently submitted proposals to DOE. Participation on the GTL Computational Biology Facility Workgroup and other GTL workshops should also aid in the growth of the program.
- To enhance the imaging program, a new NIH intramural program for PET imaging in drug abuse research has been established by NIH at BNL to support research at Brookhaven. This funding is to continue to develop and apply imaging technologies to understand brain reward mechanisms and the brain circuits that are disrupted during addiction. It further solidifies BNL's leadership role in addiction research.
- A grant was submitted to NASA for the establishment of a "Center for Space Radiation Neurobiology" to take advantage of BNL's strengths in neuroscience and the new NASA Space Radiation Laboratory. Collaborators have also been recruited from several other institutions.
- We continue to support the DOE/NE initiative for a new source of radiopharmaceuticals: the Cyclotron Isotope Research Center (CIRC). This Center is needed to produce present and future radioisotopes for the biomedical, scientific, and industrial communities, and conduct research into the development of the next-generation radiopharmaceuticals for imaging and therapy.
- The Directorate is continuing to foster Industrial collaborations with pharmaceutical companies (Long Island Life Sciences Initiative). In this area two CRADAs have been established with Bioset for synthetic growth factor technology and with PSIMEI for the development of cancer therapy agents
- A white paper was submitted to DOE to sequence the genomes of five different genera of the order Thermotogales, a hydrogen producing microbe. This information is key to eventually obtaining the most efficient production of hydrogen by Thermotogales under different physiological conditions, and will provide a firm foundation for ultimately maximizing hydrogen production by Thermotogales.

1.3.3.6 Response to DOE FY02 Evaluation

- "DOE acknowledges BNL submitted numerous proposals to BER but had limited success in obtaining new funding. ...BNL has...not done a very good job overall in submitting Life Sciences proposals that are highly responsive to BER needs". In response to this Life Sciences management has initiated regular communications with BER to discuss alignment with their programs. The staff has also participated in numerous program development workshops including a new GTL workgroup on computational biology facilities. This year we have submitted 16 new DOE

proposals in the areas of Genomes to Life, Radiotracer Technology and Low-Dose Radiation Effects.

- "Life Sciences research at BNL...has consistently not been very relevant to DOE programmatic needs and directives. DOE acknowledges that current research is generally of high scientific quality." Life Sciences is taking steps to rectify this issue including, as stated above, increased communication with program managers and participation in the program development workshops.
- "Only two projects, excluding structural biology. DOE acknowledged limited funding available from BER for Life Sciences; however, BNL has also not done a very good job overall in submitting Life Sciences proposals that are highly responsive to BER needs." There are, in fact, 10 funded FWP's in Life Sciences, none of which are new. They include cellular biology (Sutherland, Anderson), genome sequencing (Dunn), radiopharmacology (Volkow), medical imaging (Ernst), clinical feasibility (Ernst, Volkow), BNCT (Miura), and molecular nuclear medicine (Gatley, Gifford). Life Sciences is committed to communicating better with DOE to increase the number of funded projects.
- "...a peer review in 2002 indicated that the genomic sequencing project was doing a poor job of meeting the needs of the DOE Joint Genome Institute, a principal intent of the project." This comment stems from a recompetition in the Genome Sequencing Program. BNL proposed to sequence the more difficult regions of the DNA, using a BNL developed technology, in order to provide closure to those gaps. However, the goal of the project was to close all the gaps in one year. Since BNL was not a high-throughput facility they felt we could not meet their schedule and gave the money to close the gaps to a large-scale facility.
- "The fact that BNL has only two Life Sciences research projects (excluding structural biology) doesn't speak very highly of BNL's ability to respond successfully to BER calls... DOE acknowledged limited funding, but stated BNL has not done a very good job in submitting LS proposals." In response to this Life Sciences management has initiated regular communications with BER to discuss alignment with their programs. The staff has also participated in numerous program development workshops including a new GTL workgroup on computational biology facilities. This year we have submitted 16 new DOE proposals, all pending review.
- "Absence of bright young staff. DOE concerned that retirement of senior staff may negatively impact future scientific health of program." Life Sciences has been actively recruiting bright young staff. Over the past two years there have been nine scientific staff new hires in key areas such as membrane crystallography, cryoEM, environmental ecology, imaging, radioligand research and radiobiology. One of the new hires, Helene Benveniste, is currently acting as the ALD for Life Sciences and is commissioning an animal MRI facility.

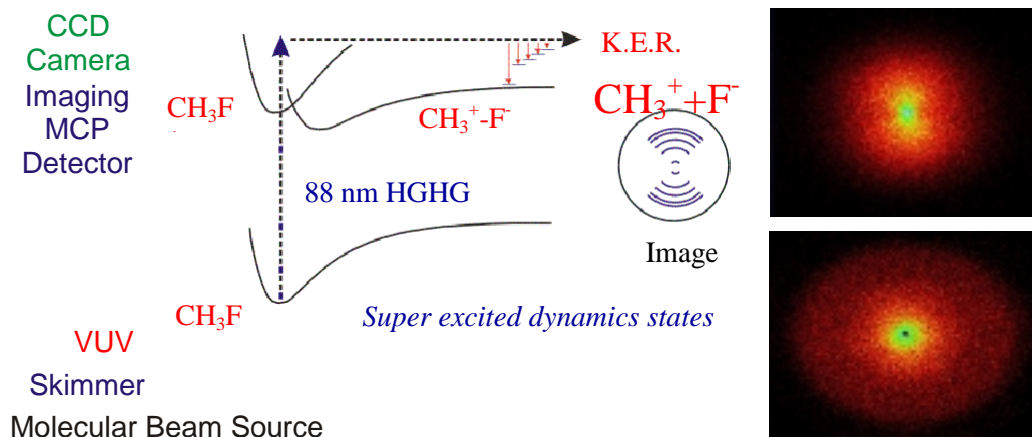
1.3.3.7 Accomplishments towards OS FY 03 Performance Plans

- There are no specific items that are directly linked to our scientific performance missions. The strategic goals and mission of the Life Sciences Directorate are aligned with DOE programs. For the OS target addressing Safety, Health, and Security we are in line with BNL's approach to integrating Environment, Safety, and Health (ES&H) and security requirements into the processes for planning and conducting work at the Laboratory.

1.3.4 Basic Energy Sciences (BES)

1.3.4.1 Quality of Research

- A recently completed chemical dynamics experiment utilized coherent radiation produced by High Gain Harmonic Generation at the Deep Ultra-Violet Free Electron Laser at the National Synchrotron Light Source. The technique of Ion Pair Imaging Spectroscopy is being used to determine the internal energy of the products and dynamics of a methyl fluoride, FEL generated, dissociation process.

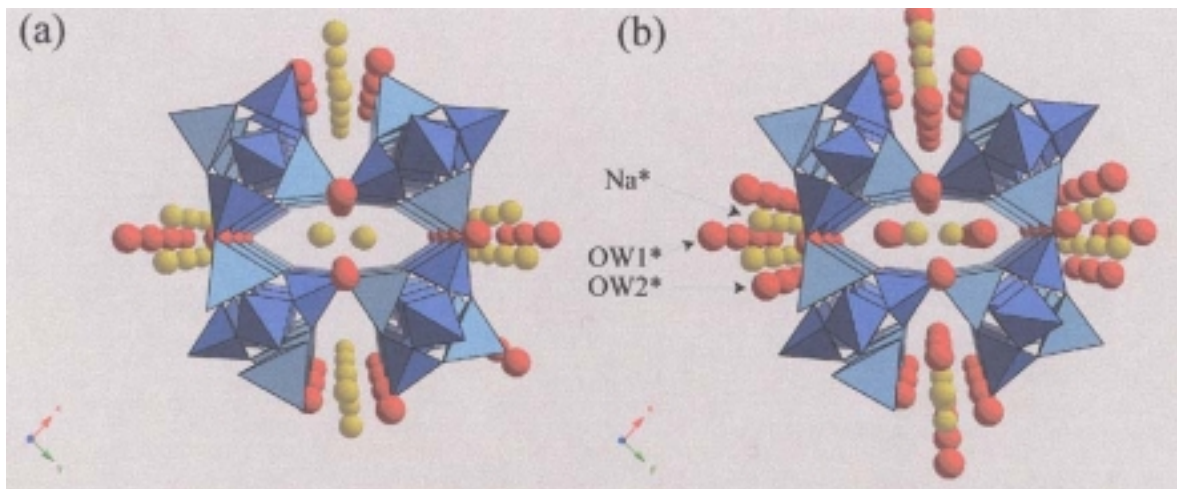


Ion Pair Imaging Spectroscopy Experiment at the DUV-FEL

Excitation of CH_3F molecules with the high intensity 88 nm HGHG light produced by the DUV-FEL accesses ion-pair states that dissociate. When one of the products is structureless (such as F^-) the kinetic energy release directly reflects the internal energy in the other product and the dynamics of the process.

- Electrical signals during corrosion have been used to monitor the presence and intensity of the corrosion process. These signals have been analyzed in terms of electrical noise and each stage of corrosion, and each type of material, has its own signature. Unlike stainless steel, aluminum is far more “talkative” with a greater vocabulary identifying various stages including oxide film breakdown, the staccato of pit growth, and the silence of passivity. Corrosion damage presently costs the U. S. economy 4 % of the annual Gross National Product, and is a major deterrent to the performance limits safety, and economy of both fossil and nuclear energy technologies.

- The magnetic induction distribution of Ni nanoparticle arrays has been determined using newly developed phase-retrieval techniques. This is a fast and robust method using electron beams for nanometer scale imaging of the distribution of magnetic moments and magnetic flux in ferromagnets.
- The experimental confirmation of reversible and irreversible pressure-induced hydration in zeolites with natrolite topology demonstrates how hydrostatic pressure can be used to control the water content and assemble unique nanowater structures that can be used as models of transient and disordered biological “water wires.”



Hydrated Zeolite Natrolite and Its Superhydrated Structure Above 1.5GPa
The hydrated zeolite is shown in figure (a) while the superhydrated structure is shown in (b).

- Nanoparticles of gold deposited on a support of titania can absorb and dissociate sulfur dioxide more efficiently than either pure gold or bare titania surfaces. Catalytic removal of sulfur dioxide is a key process in air pollution control. This enhanced reactivity was uncovered in synchrotron photoemission experiments.
- High temperature superconductors such as $\text{YBa}_2\text{Cu}_3\text{O}_7$ (YBCO) are able to carry very large electric currents without electrical resistance losses as in ordinary copper wires, thus offering significant improvements in energy efficiency. But growing sufficiently thick films of YBCO has not been feasible due to its complex growth mechanism. A new epitaxial liquid-assisted growth method has been successfully developed, which involves reactions of precursor films to form the desired compounds in several sequential steps. The new method is a necessary step toward the economic mass-production of superconducting wires of YBCO.
- New compounds have been developed that can improve lithium battery performance. Several new organic boron compounds with fluorinated groups have been developed and are used as additives for lithium battery electrolytes. The result is improvement in electrolyte conductivity and cathode stability at high temperatures.

- X-ray techniques have been developed for studying nano-sized liquids on patterned template surfaces with atomic scale precision. These studies show how the structure and wetting behavior of the nanometer thin liquid film, compared to an ideally flat substrate, are modified by the nano-patterned surfaces.
- A novel x-ray detector system has been developed that is designed to meet the challenging demands of synchrotron radiation experiments. This system is based on silicon sensing elements and a special integrated circuit designed to analyze the energy of each photon with high resolution and to accumulate the events in on-chip counters.
- A new technique has been developed to directly determine atomic positions in thin films. The technique involves an analysis of the coherent interference of synchrotron x-rays diffracted from both the host substrate and the epitaxial film. The technique was applied to a gadolinium arsenic substrate with a thin gadolinium oxide film, which acts as an insulating layer.
- A soluble catalyst that precipitates for reuse has recently been discovered. It is a tungsten-based catalyst that dissolves into a liquid reactant mixture, completely transforms the reactants into a new liquid product, and precipitates as a reusable catalyst once its work is done. This novel material eliminates the generation of hazardous waste and has been demonstrated for the production of alkoxysilanes.
- New theoretical models indicate that there are certain configurations of magnetic structure in two dimensions that would allow the existence of separate particles, some with only spin (spinons) and others with only charge (holons), in three dimensions. The theory results support experimental work where excited holons have been characterized. These combined results of experimentation and theory suggest that “spin-charge” separation does indeed occur in real crystal systems, and may lead to a better understanding of high temperature superconducting materials.
- New insights have been gained into electrical conductivity. By shooting a beam of high-energy photons at a solid and measuring the energy and lifetimes of emitted electrons, it has been shown that good conductivity in the direction normal to the metallic planes requires the presence of well-defined electrons within the plane. At higher temperatures when well-defined electrons no longer exist in the planes, the direction perpendicular to the planes is insulating.
- The molecular details of cell membrane fusion have been revealed using x-ray diffraction techniques. Cellular membrane fusion is one of the most common ways for molecules to enter or exit a cell, in processes such as fertilization or viral infection. The existence of a temporary intermediate structure, previously postulated but never observed, during cell membrane fusion has been identified.
- A fundamental breakthrough in understanding the origin of one of the dominant factors limiting the performance and utilization of commercial superconducting

magnets and cables has been achieved. A strong correlation was discovered between the magnitude of a stress degradation effect (the limiting factor) and the degree of phonon anharmonicity, or softness, of the crystal lattice of the superconductor. A model was developed which explains this correlation and several phenomena, including the stress insensitivity of entire classes of superconducting materials and the effects of alloying additions on the stress effect.

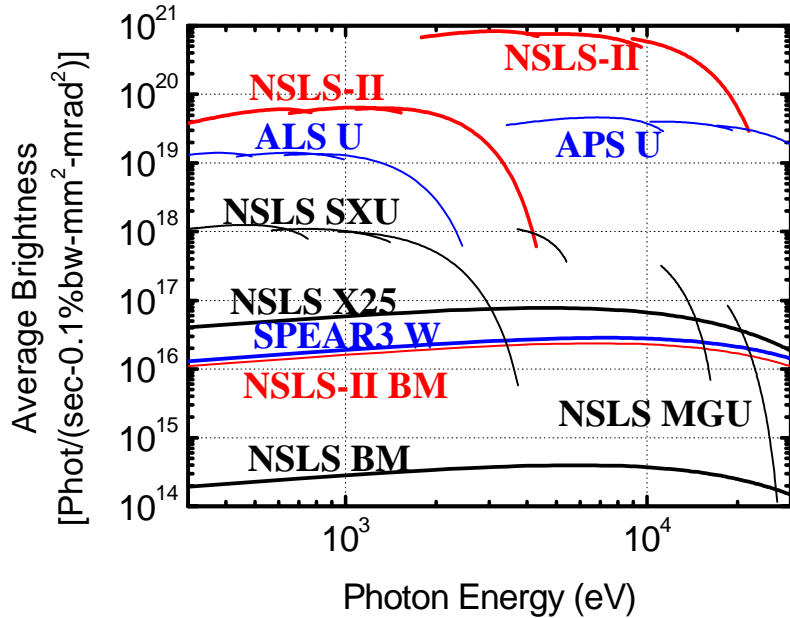
1.3.4.2 Relevance to DOE Missions and National Needs

- The Center for Functional Nanomaterials project and Jumpstart program support the DOE Nanoscale Engineering and Technology initiative and the DOE/BES broad challenge of “realizing the nanoscale revolution.”
- The NSLS continues to be one of the most heavily used of the DOE synchrotron light sources. The number of users continues to expand as does their disciplines.
- A proposal was submitted in support of the Catalysis initiative that was ultimately unsuccessful. However, as a result of planning for this initiative, new programs in catalysis science are being developed.
- The Center for Neutron Science is leading the design effort in the construction of a novel neutron instrument at the Spallation Neutron Source.
- Through the Center for Functional Nanomaterials, the Laboratory is a partner in the TEAM (Transmission Electron Aberration-corrected Microscope) project, which involves research and development in a collaboration among five BES-sponsored electron beam microcharacterization centers.
- During FY 2003, proposals have been submitted on the following mission-critical subjects: catalysis, neutron instrumentation, soft matter, and nanoscience theory.

1.3.4.3 Success in Constructing and Operating Research Facilities

- To enhance the capability of the NSLS to meet the increasing and changing user demands, the following major upgrades were completed recently or are in progress. Two new RF cavities are being installed in the x-ray ring. A new digital orbit feedback system, which significantly improved orbit stability on the VUV ring, is being implemented on the x-ray ring. A new National Institutes of Health-funded beamline, X6A, for structural biology was completed by the NSLS, and is ready for user operation. A major initiative is underway to upgrade all the insertion device

beamlines on the x-ray ring to meet the demand of new scientific programs.



Brightness of Undulators and Bends in the NSLS-II Storage Ring

This assumes a 3 GeV ring with a stored current of 500 ma. Undulators and wigglers at ALS, APS, and SSRL (SPEAR3) are shown in blue for comparison. New NSLS-II curves are shown in red. Current NSLS curves are shown in black.

- The NSLS has undertaken an aggressive program of enhanced support of beamline operations and science consistent with DOE policy direction regarding user access at its facilities. It has also realized significant achievements in source R&D with the first laser seeded and High Gain-Harmonic Generation lasing of an FEL in the ultra-violet. These strengths in accelerator and user science are being brought to bear in a proposal for a new state of the art 3rd generation storage ring to provide world-class capabilities to our large and outstandingly productive user community.
- The Center for Functional Nanomaterials (CFN) took several important steps this year: Robert Hwang was hired as Director, the conceptual design was completed, and an Architectural-Engineering firm was selected with the engineering phase scheduled to begin in the summer of 2003. CFN users will be able to conduct nanoscience research at BNL, beginning in late FY 2003, using currently available equipment under the auspices of the “Jumpstart” user program.



Artist's Rendering of the CFN Building

The CFN is to the right of the NSLS.

- NSLS is working closely with the BNL Center for Functional Nanomaterials to structure the general user program and to meet the demand for synchrotron techniques by Nanoscience Users. New synchrotron tools will also be developed specifically for Nanoscience programs.
- Powder Diffraction Center: A center for x-ray powder diffraction is being organized at the NSLS. Depending on funding, four dedicated instruments will be included: a high resolution instrument, a high throughput instrument, an instrument optimized for high pressure and pair-distribution function, and an instrument with combined powder diffraction and x-ray spectroscopy capability.
- The DUV-FEL has conducted a series of experiments including Self Amplified Spontaneous Emission (SASE) lasing at 400 nm, direct laser seeding of the electron beam at 266 nm, and HGHG from 800nm laser seed light to 266 nm FEL light. This unique resource allows BNL to probe the limits of sources well ahead of what is in routine use today, paving the way for the next generations of synchrotron radiation based research well into the future.
- At the TEM facility, electron microscopy tools have been advanced with the development of quantitative methods to study the magnetic induction distribution using phase retrieval methods, which has enabled the study of magnetic nanoparticle arrays. BNL is also participating in the TEAM proposal to build a new generation in electron microscopy with aberration correction.
- Using the LEAF facility, we have studied the thermodynamics of electron attachment and electron mobility in supercritical fluids, made the first measurements

of the spectrum and reactivity of the solvated electron in ionic liquids, and investigated rapid electron tunneling in organic molecules.

- The Center for Neutron Science (CNS) is leading the design effort in the construction of a novel neutron instrument (called HYSPEC) at the Spallation Neutron Source that is designed for studies of small single crystals of new materials of interest to the condensed matter physics community. DOE has approved this instrument concept and a conceptual design will be developed. The installation of the US-Japan spectrometer at HFIR is proceeding on schedule for FY 2005 operation.

1.3.4.4 Effectiveness and Efficiency of Research Program Management

- New Chairs have been appointed in the Materials Sciences Department, the Chemistry Department, and the Nanoscience department.
- BNL's nanoscience program continues to move forward. The program theme is controlling the physical and chemical response of nanoscale functional materials. The two chemistry Nanoscale Science Engineering and Technology (NSET) programs, "Catalytic Nanomaterials" and "Charge Transfer at the Nanoscale," continued into a second year with exciting progress. Furthermore, a new NSET proposal was awarded: "Nanotemplate Directed Assembly of Soft Matter and Biomaterials."
- A vibrant in-house materials synthesis capability continues to be developed via a joint program in the Physics and Materials Science Departments, including PLD thin film and single crystal oxide growth, as well as synthesis of large inorganic molecules. The newly formed Materials Science department brings additional synthesis capabilities through hires with expertise in PLD studies of thin films, carbon nanotubes, and superconducting materials. In addition, a new group has recently been formed concerned with the synthesis and characterization of intermetallics, powdered oxides and Silar-grown thin films.
- The revitalization of materials science at BNL has continued. Several steps have been taken to more closely integrate the programs in materials physics, metallurgy, and materials chemistry with those in condensed matter physics and several areas of chemistry. The goal is to strengthen traditional core programs and compete more effectively with interdisciplinary responses to the DOE's initiatives. James Misewich was hired as Department Chair of the new Materials Science Department (MSD), which was formed within the Basic Energy Sciences Directorate, and other important strategic hires are being made. Lance Cooley was hired to add significant strength to an area of long-time importance, the synthesis and properties of superconducting materials, while another recent strategic hire, Stan Wong (joint with Stony Brook), has established a strong new program in the synthesis of novel nanomaterials
- The Laboratory is a partner in the TEAM (Transmission Electron Aberration-corrected Microscope) project, which involves research and development in a

collaboration among five BES-sponsored electron beam microcharacterization centers. The BNL emphasis is detector and monochromator development, and development of techniques such as position sensitive coherent electron detection. The TEAM project is highly collaborative and the BNL program interfaces with the partner laboratories through quarterly meetings of the directors and a program allowing extended exchange visits among researchers at the institutions.

- The Center for Neutron Science (CNS) continues to develop and maintain the world-class neutron science capabilities at BNL and continues to support the major investment in neutron facilities and research at other DOE facilities. Currently the focus of research activities are at the NIST and HFIR reactors and ISIS spallation source.
- BNL is pursuing a plan to strengthen and expand its Catalysis Program in accord with the new DOE interest in centers of excellence in catalysis science. The BNL chemistry group together with academic collaborators from Columbia and Rutgers Universities recently submitted (March 2003) a proposal “Understanding and Manipulating the Active Sites in Catalytic Reactions” in response to a DOE call. BNL has held two workshops on catalytic science and synchrotron probes at BNL in the last two years, and has several new and existing programs in catalysis science that will contribute to and benefit from this initiative.
- The award of a successful NSET proposal for funding in the area of nanotemplate directed assembly of soft matter and biomaterials has enabled formation of a joint program among researchers in the new Soft Matter Group of the Physics Department and in the NSLS. The initial focus is x-ray scattering studies of thin fatty acid films on liquid mercury, an ideal smooth substrate, and has revealed new phases and phase transitions.

1.3.4.5 Strategic Planning

- A series of retreats were held among the BES Chairs and the NSLS Director to map out the relationship of the existing core science programs to the Center for Functional Nanomaterials. Some of the key areas being examined are catalysis, bulk synthesis, soft matter, and the interactions between the CFN and the NSLS.
- The NSLS staff has been planning for the future needs of synchrotron users. As a result of an extensive planning process, it has been determined that a new high brightness light source will provide the opportunity for ground-breaking research for U.S. science. This project is in the pre-conceptual design phase and its design will include the capability to add an energy recovery linac.
- The NSLS has undertaken an aggressive program of enhanced support of beamline operations and science consistent with DOE policy direction regarding user access at its facilities. It has also realized significant achievements in source R&D with the first laser seeded and High Gain-Harmonic Generation lasing of an FEL in the ultra-

violet. These strengths in accelerator and user science are being brought to bear in a proposal for a new state of the art 3rd generation storage ring to provide world-class capabilities to our large and outstandingly productive user community.

- At the TEM facility, electron microscopy tools have been advanced with the development of quantitative methods to study the magnetic induction distribution using phase retrieval methods, which has enabled the study of magnetic nanoparticle arrays. The Laboratory is a partner in the TEAM (Transmission Electron Aberration-corrected Microscope) project, which involves research and development in a collaboration among five BES-sponsored electron beam microcharacterization centers. The BNL emphasis is detector and monochromator development, and development of techniques such as position sensitive coherent electron detection. BNL will be integrating all of its TEM capability through the CFN.
- The Center for Neutron Science (CNS) is leading the design effort in the construction of a novel neutron instrument at the Spallation Neutron Source that is designed for studies of small single crystals of new materials of interest to the condensed matter physics community. DOE has approved the mission need for this instrument design and CD-0 has been awarded.
- A vibrant in-house materials synthesis capability continues to be developed via a joint program in the Physics and Materials Science Departments, including PLD thin film and single crystal oxide growth, as well as synthesis of large inorganic molecules. The newly formed Materials Science department brings additional synthesis capabilities through hires with expertise in PLD studies of thin films, carbon nanotubes, and superconducting materials. In addition, a new group has recently been formed that is concerned with the synthesis and characterization of intermetallics, powdered oxides and Silar-grown thin films. Plans need to be developed between the bulk synthesis groups and the CFN.
- BNL is pursuing a plan to strengthen and expand its Catalysis Program in accord with the new DOE interest in centers of excellence in catalysis science. The BNL chemistry group together with academic collaborators from Columbia and Rutgers Universities recently submitted (March 2003) an unsuccessful proposal “Understanding and Manipulating the Active Sites in Catalytic Reactions” in response to a DOE call. BNL has held two workshops on catalytic science and synchrotron probes at BNL in the last two years, and has several new and existing programs in catalysis science that will contribute to and benefit from this initiative. The next step is currently being planned.

1.3.4.6 Response to FY02 DOE Evaluation

- The DOE evaluation states “Basic Energy Sciences were found to be Outstanding in quality, relevance and facility operations but concerns were noted in recruitment and hiring of critical staff.” Significant advancement in this area has been made during the past year with the hiring of James Misewich as Chair of the Materials Sciences

Department, Alex Harris as Chair of the Chemistry Department and Robert Hwang as Director of the Center for Functional Nanomaterials. Of course, Praveen Chaudhari is the new laboratory director and Doon Gibbs is serving as the Interim Associate Laboratory Director for Basic Energy Sciences. The only key staffing issue that remains in regards to BES Management is to fill the position of ALD for BES.

- The DOE report stated “Under previous management, the Materials and Engineering Physics program has been a low priority for BNL. If the current assessment of BNL management is that this program is a high priority, then continuity of leadership is a critical issue. There is concern regarding the future leadership of the Superconducting Materials program. This program has a long history of leadership in its field.” The revitalization of materials science at BNL has continued. Several steps have been taken to more closely integrate the programs in materials physics, metallurgy, and materials chemistry with those in condensed matter physics and several areas of chemistry. The goal is to strengthen traditional core programs and compete more effectively with interdisciplinary responses to the DOE’s initiatives. James Misewich was hired as Department Chair of the new Materials Science Department (MSD), which was formed within the Basic Energy Sciences Directorate, and other important strategic hires are being made. Lance Cooley was hired to add significant strength to an area of long-time importance, the synthesis and properties of superconducting materials, while another recent strategic hire, Stan Wong (joint with Stony Brook), has established a strong new program in the synthesis of novel nanomaterials.
- The DOE report states that “The catalysis and surface electrochemistry projects can be integrated better.” The researchers of these two programs have a good interaction and discussions of the topics of common interests. Further collaboration is determined by the possibilities of gaining some benefits from the complementary techniques and information that can be obtained for the systems in quite different environments (UHV and aqueous electrolyte solutions). Such situations do occur and, for instance, one joint experiment on the Pt/Ru system is planned for September 2003. This type of naturally arising collaboration determined by the research problem appears quite adequate for collaboration between catalysis and surface electrochemistry groups.
- The DOE report states that “The Nanoscale Structure and Structural Defects in Advanced Materials program received accolades, and its leader was recognized as a world-class scientist. BNL should take the opportunity for continued investment in or around this program. Also important is the close coordination of the staff of this program with the BNL Center for Functional Nanomaterials.” BNL has invested its own funds in infrastructure development of three new laboratories to house additional microscopes acquired for this program. BNL has also invested funds and considerable time and effort to acquire microscopes from New York State and from Lucent Technologies. Furthermore, this program is being transferred to BNL’s

Nanoscience Department to enhance coordination between the CFN and the TEM programs.

1.3.4.7 Accomplishments towards OS FY 03 Performance Plans

- This general performance measure (PM) states that the DOE Office of Science (OS) will ensure the safety and health of the workforce and the public, and will protect the environment. I assume that this will be answered at the Lab level by site ESH organizations.
- (SC4-1) This PM states that DOE BES will competitively select and peer review at least 80% of all new research projects and evaluate approximately 30% of ongoing projects. In the period FY 2001 TO FY 2002, BNL submitted 6 NSET (nanoscale science, engineering and technology) proposals that were peer reviewed. In FY 2003 BNL submitted proposals that have been peer-reviewed on the following subjects: catalysis, neutron instrumentation, soft matter, and nanoscience theory. During the period FY 2001 to FY2002 the following scientific programs/facilities were peer-reviewed: NSLS, Condensed Matter Physics & Materials Chemistry, Metal/Ceramics and Engineering Sciences, and the Photochemical and Radiation Sciences. There were no DOE BES program reviews at BNL during FY 2003.
- (SC4-1) This PM states that BESAC/BES sponsored workshops will be used to direct activities towards the following emerging technologies: photovoltaics, radiation effects, materials synthesis and processing, and catalysis. BNL scientific staff participated in a catalysis workshop that was held in May 2002 that resulted in the catalysis initiative and a call for proposals. BNL staff will be participating in a materials synthesis and processing workshop to be held in summer 2003.
- (SC4-2) BNL held a national Nanoscale Science Research Center workshop in March 2002. Input from the user community that was provided at this workshop and other smaller workshops were used to establish instrument suites and fabrication capabilities at the BNL CFN.
- (SC4-3) BNL has just submitted in June 2003 a proposal for development of advanced detectors at the NSLS.
- (SC4-3) This PM states that collaborative, national R&D programs should be established to meet common needs at the BES synchrotron light sources, e.g., for detectors and other components. The NSLS is participating in 3 collaborative, national programs with the other synchrotron laboratories: 1) a proposal for x-ray detector development was submitted as part of a call by DOE/BES, 2) for superconducting undulator R&D, 3) and with ongoing accelerator R&D activities.
- (SC7-4A) Maintain and operate the BES scientific user facilities so that the unscheduled downtime on average is less than 10% of the total scheduled operating time. For FY 2002, the NSLS number was 2% for the VUV and 4% for the X- ray; to

date, for FY 2003 the average unscheduled downtime is less than 10%, i.e., 1% for the VUV and 14% for the X-ray.

- (SC7-4A) Maintain the cost and schedule milestones within 10% for upgrades and construction of scientific user facilities. For FY 2003 this PM is not applicable to BES facilities, i.e., the NSLS and the CFN.

1.3.5 Advanced Scientific Computing Research (ASCR)

1.3.5.1 Quality of Research

25 x Longer Simulation Time for Protein Dynamics

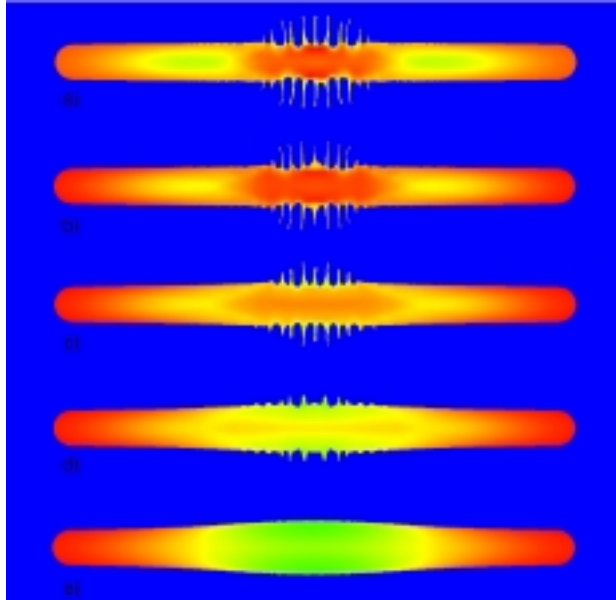
- Developed detailed performance model for classical molecular dynamics (MD) of proteins with 100,000 atoms on QCDOC, a massively parallel computer of radically new architecture. These studies show that this machine is capable of 1 microsecond simulated time on such proteins using 2 weeks of run time, opening up new regimes for computational biology. Similar timings are predicted for the magnetic and geometrical structure of nanoclusters.

Mitigation of Cavitation Induced Damage in SNS Targets

- Studies of cavitation in mercury and the influence of bubbles in liquid mercury targets on cavitation are underway to further understand damage in mercury target vessels of relevance to spallation neutron sources.

Muon Collider and SNS Target Simulations

- Performed detailed simulations of the hydrodynamics of mercury following the deposition of energy from an intense proton beam. Temporal evolution and spatial distribution of the resultant “splash” are in excellent agreement with recent experiments.



Stabilizing effect of the magnetic field on the Richtmyer-Meshkov instability in the mercury jet under the proton energy deposition. a) $B = 0$, b) $B = 2$ Tesla, c) $B = 4$ Tesla, d) $B = 6$ Tesla, e) $B = 10$ Tesla

SciDAC (TSST, Accelerators)

- The Scientific Discovery through Advanced Computing (SciDAC) project “Terascale Simulation Tools and Technologies Center (TSTT)” has successfully simulated the growth of droplets from Diesel fuel injectors for comparison with experiments at the Advanced Photon Source at Argonne National Laboratory.
- Developed new simulation techniques for wake fields in accelerators as part of Scientific Discovery through Advanced Computing (SciDAC) project “Advanced Computing for 21st Century Accelerator Science and Technology”.

Nanoscale Simulation

- Developing code to perform first principles density functional calculations on nanoscale particles of up to 5000 atoms (~ 5 nanometer diameter). This code will be a resource for the Theory and Computation Facility in the Brookhaven Center for Functional Nanomaterials. Completed study of magnetic properties of nanoscale cobalt wires on platinum surfaces and compared with synchrotron x-ray experiments.

Visual Statistical Analyzer (ViStA)

- Developed VisTa, the visual statistical analyzer to provide rapid analysis of complex data sets such as those from positron emission tomography (PET), magnetic resonance imaging, and mass spectrum analyses of aerosol particles and of blood serum (for cancer detection).

1.3.5.2 Relevance to DOE Mission

- Work in magnetohydrodynamics related to advanced target design for future colliders and neutron sources is critical to the mission of The Office of Science.
- Work in computational biology contributes to the Genome to Life programs in BER.
- Work in computational nanoscience contributes to the goals of the BES Centers for Nanoscience.

1.3.5.3 Effectiveness and Efficiency of Research Program Management

- Prepared three proposals for DOE funded research.

1.3.5.4 Strategic Planning

- Joint BNL-IBM Workshop on Computational Biology held at BNL, July 31-August 1, 2003.

1.3.6 Energy, Environment, and National Security

1.3.6.1 Energy Resource Mission (EE/FE/NE)

- Scientist Toshifumi Sugama received an R&D 100 Award and an FLC Award for Excellence in Technology Transfer, in recognition of the development and commercialization of a patented high-performance coating system for use in carbon-steel heat exchanger tubes in geothermal power plants.
- Pilot plant operations have been successful in recovery of high-quality silica from geothermal brines which supports the technical and economic feasibility of this technology.
- NNDC supported the significantly increased demand to disseminate nuclear data.
- Provided technical support for the NIST safety analysis update and the HIFR accident analysis.
- Completed the SNS collimator design and issued fabrication specifications to ORNL.
- Demonstrated that the molecular imprinting process for gas purification was effective for selective separation of hydrocarbons from butane gases.
- “Terascale Simulation Tools and Technologies Center” project has successfully simulated the growth of droplets from diesel fuel injectors for comparison with experiments at Argonne’s APS.

- Performed detailed simulations of the hydrodynamics of mercury following the deposition of energy from an intense proton beam. Temporal evolution and spatial distribution of the resultant “splash” are in excellent agreement with recent experiments.

1.3.6.2 Environmental Research

- Environmental Sciences, the NSLS and the Earth Sciences Department at State University of New York at Stony Brook, created a new Environmental Molecular Sciences Institute. This NSF/DOE Institute provides end station upgrades to NSLS environmental beam lines, research and development of new environmental applications and training for students.
- Completed New England Air Quality pilot study in collaboration with PNNL and NOAA. BNL provided chemical species measurements made aboard the G1 aircraft.
- Researchers continued developing and reporting new algorithms for the retrieval of aerosol properties from moments of the particle size distribution.
- Steven Schwartz elected Fellow of the American Association for the Advancement of Science.
- Paul Kalb named “Innovator of the Year” by LI Business News for inventing a technology called Sulfur Polymer Stabilization/Solidification (SPSS)
- Developed detailed performance model for classical molecular dynamics (MD) of proteins with 100,000 atoms on QCDOC, a massively parallel computer of radically new architecture. These studies show that this machine is capable of 1 microsecond simulated time on such proteins opening up new regimes for computational biology.

1.3.6.3 National Security (NNSA/EM)

- TEMASU, a 5 year research project to develop a underground imaging system completed a field demonstration that will now lead to commercialization of the system through a license agreement.
- Critical Infrastructure Vulnerability Assessments, A major study in support of the DOE, DHS and New York State was completed. This resulted in a better understanding of the variation of risks to acts of terrorism of 18 specific infrastructures that are critical to the well being of the state.
- BNL continues to play a major role in the Nuclear Materials Consolidation and Conversion (MCC) project. A BNL staff person was appointed project lead. A goal of the project is to reduce the number of sites and buildings that contain weapons-usable nuclear material and reduce the attractiveness of existing highly enriched uranium by downblending it to low enriched uranium.

- BNL made substantial contributions under the MPC&A Regulatory Project in assisting Russia's MINATOM and Gosatomnadzor in the development of a regulatory framework for implementing the improved and more comprehensive nuclear materials safeguards.
- Conducted surveys of International Atomic Energy Agency (IAEA) personnel in Vienna, Austria, analyzed IAEA inspector training, and developed model certification program for IAEA safeguards inspectors.
- Organized and Managed Federal/State study on "Security of Radioactive Materials at Non-Reactor Sites in NYS" and on "Security of Chemical Weapon Components in NYS."
- Helped secure Department of Homeland Security designation as a Homeland Security National Laboratory.
- The BNL portable compressed-xenon spectrometer was upgraded with a new high-voltage power supply, preamplifiers and data acquisition electronics, reducing size and weight.
- The thermal neutron imaging system was upgraded with a new camera enclosure, high-precision coded-aperture masks, and custom-designed digital position-encoding electronics. Software was written to process thermal neutron images by fast Fourier transforms.
- Study completed that demonstrates and quantifies the affects of surface roughness on CZT device performance as it relates to the ability of standard Br2/methanol etchants to remove surface damage resulting from mechanical polish.

1.3.6.4 Success in Constructing and Operating Research Facilities

- Four of the Free-Air CO₂ Enrichment (FACE) facilities, Eastern Pine Forest, Mojave Desert, Northern Hardwood Forest, Eastern Hardwood Forest, became a single official DOE Distributed User Facility. A BNL scientist was named the FACE Facility Coordinator. The Coordinator, DOE, and users are preparing a management plan for the Facility. The Facility is open to all qualified investigators and includes opportunities for field research and modeling activities that use data produced by the Facility.
- EENS designed, constructed, and is currently operating the Radiation Detector Testing and Evaluation Center (RADTEC). RADTEC is being used to operate and test commercial and government "off-the-shelf" technologies targeted for various homeland security applications. RADTEC will provide baseline data for evaluation and comparison of detector technologies. Successful construction and operation of RADTEC will result in a multi-year "test-bed" program.

1.3.6.5 Effectiveness and Efficiency of Research Program Management

- Completed implementation of Peoplesoft for integrated financial planning, management, and reporting. Comprehensive training program was conducted, and system is being effectively utilized to identify funding shortfalls and associated staffing impacts.
- Created a Systems Administration Group to address cybersecurity issues and to assure compliance with Laboratory and DOE cybersecurity requirements.
- Established a virtual Laboratory Homeland Security Office to coordinate BNL's interactions with DOE-NNSA and DHS on issues and new programs which respond to Homeland Security research and development needs. This office has been pivotal to Laboratory efforts in working with federal, state, and local governmental agencies, as well as university and industry collaborators, on Homeland Security Initiatives.
- Continued to actively pursue opportunities to upgrade research facilities. Obtained funding to upgrade environmental research laboratory, and participated in planning to construct a new, privately-funded, Energy Sciences Building.
- Utilized comprehensive planning process to identify and secure funding for key strategic hires in energy, environment, and national security programs. It is expected that these strategic investments in scientific personnel will enable the Laboratory to expand current research programs and generate new funding support.

1.3.6.6 Strategic Planning

- BNL's Advanced Sensors Initiative has resulted in a number of proposals having been submitted to DOE/NNSA, DARPA, DTRA, and various other agencies. Research on pressurized xenon-ray detectors which was supported by LDRD has led to a new DOE-funded program for further detector development. BNL's new Radiation Detector Testing and Evaluation Facility (RADTEC) will foster government and industry collaborations for BNL's continued research and development of advanced sensor technologies.
- BNL's expertise in advanced sensors and atmospheric chemistry is being utilized for the creation of the Urban Atmospheric Observatory (UAO). BNL is working with the Environmental Measurements Laboratory to deploy sensors in New York City for urban meteorological measurements which would provide information on the transport of dangerous airborne agents in NYC. Understanding of transport models will assist in emergency management and planning.
- BNL has created a new Environmental Molecular Science Institute at the NSLS in collaboration with University of Stony Brook. This NSF/DOE Institute provides end

station upgrades for the environmental beam lines at the NSLS which will support research by the environmental science, environmental clean-up, and geosciences communities.

- BNL's Advanced Fuels Initiative has made progress through our continued collaborations with industry partners. There is an active CRADA program with Texaco to utilize molecular engineering for gas purification. We are also working with a local small company on a multiyear STTR program to develop a commercial low NOx burner technology. BNL has also committed resources to renovate a laboratory which will be dedicated to methane hydrates research.
- BNL's Homeland Security Initiative has been advanced in several areas. BNL has been recognized as a Homeland Security National Laboratory, and has designated a BNL Director for Homeland Security. We have organized and managed federal/New York State studies on "Security of Radioactive Materials at Non-Reactor sites in NYS" and on "Security of Chemical Weapons Components in NYS". In addition a major study has been completed to assess critical infrastructure vulnerability in NYS. BNL is actively working with DOE and DHS to assist in program planning and has submitted numerous proposals for programs in advanced sensors, risk assessment, infrastructure protection, and port security.

1.3.6.7 Response to DOE FY02 Evaluation

- DOE recognized BNL's contribution to the FACE program but asked about how the Laboratory was going to improve its position in this program. In FY 03, four of the FACE facilities became a single official DOE Distributed User Facility and a BNL scientist was named as the FACE Facility Coordinator. The Coordinator, DOE, and users are preparing a management plan for the Facility which will provide investigators an opportunity for field research and modeling activities.
- DOE has been extremely complimentary of BNL's Atmospheric Science Programs, but was critical of performance by the Tracer Technology Center in a Salt Lake City atmospheric study. Environmental Sciences has recently reorganized the Tracer Technology Center, added two senior engineers to the Center's staff, and reassigned supervisory responsibility for the Center. This reorganization will improve both the technical and management capabilities of the Tracer Technology Center.

1.4 WORK FOR OTHERS AND TECHNOLOGY TRANSFER

The Laboratory's Work for Others Program has two components, work for other federal agencies and work for non-federal sponsors. The Laboratory is consolidating the Work for Others Program in the Office of Intellectual Property and Sponsored Research (OIP). The Work for Others Program permits the Laboratory to conduct research that is of scientific interest, compliments its DOE mission work, and contributes to sustaining its

core research capabilities. BNL's Technology Transfer Program compliments our DOE research mission through projects that enhance our research capabilities while permitting BNL to be a resource to US industry. Key components of the Technology Transfer Program are CRADAs and intellectual property protection and licensing.

1.4.1 WFO - Other Federal Agencies

1.4.1.1 National Institutes of Health (NIH)

- The Imaging and Neuroscience Center, the STEM, and the NSLS's Structural Biology Program operate through partnerships between DOE and NIH and receive funding from both agencies.
- There are nine experimental stations at the NSLS for macromolecular crystallography. The stations are used by more than 800 biologists from BNL, other national laboratories, universities and pharmaceutical companies. Four of these beamlines are part of a cooperative effort funded by DOE and NIH.
- At one of the structural biology beamlines, administered by LANL and funded under the DOE NIH cooperative effort, new standardized methods, equipment, and software are being developed for macromolecular crystallography. Also funded by this effort will be a new beamline being developed by Albert Einstein College of Medicine based upon a small gap in vacuum undulator.
- Under funding from NIH to Structural Genomics, Inc. to BNL, the Laboratory is piloting procedures for cost effective large scale protein crystallography.
- NIH funds significant clinical research relating to addiction at Brookhaven's PET and MR facilities. These projects include studying brain functions in alcoholics, monitoring methamphetamine abuse treatment, monitoring brain dopamine in cocaine abusers and MR studies of brain function in HIV infected individuals abusing drugs.
- NIH funds research in the Medical Department relating to evaluation of microbeam radiation therapy at the NSLS for the treatment of head and neck cancers.
- NIH funds significant research in the Biology Department related to adenovirus regulation and anti-viral development, DNA damage and repair in mammalian cells and genetic variation in human DNA repair genes.

1.4.1.2 National Aeronautics and Space Administration (NASA)

- Construction and commissioning of the NASA funded NASA Space Radiation Laboratory (NSRL) was completed and the first NASA run at the NSRL for BNL researchers and users took place in July, 2003. This facility enables radiobiological

and materials research related to NASA's Mars mission. NSRL has laboratories for in vitro, in vivo, and physics experiments.

- BNL scientists are involved in two aspects of NASA's Space Radiation Health Program. The first is the Space Biomedical Research Program that focuses on understanding the biological consequences of long term space flight. The second is as a part of the National Space Biomedical Research Institute (NSBRI) which focuses on preventing or solving health problems related to prolonged space travel.

1.4.1.3 Environmental Protection Agency (EPA)

- BNL scientists are working with the EPA and US Army Corps of Engineers to produce economical, environmentally effective treatment technologies for the sediments and soils being dredged from New York Harbor.
- BNL scientists are working with EPA's Office of International Activities in designing and overseeing the construction of a waste processing facility in Murmansk, Russia and the development of environmentally sound sustainable growth opportunities in Kazakstan.
- The MARKAL MACRO Program developed at BNL is still used widely abroad in energy planning and the EPA funds Brookhaven to work with representatives from the Caribbean and Central America to utilize this program.

1.4.2 WFO - Non-Federal Sponsors

1.4.2.1 Private Firms

- The Atmospheric Chemistry Division of the Environmental Sciences Department is working with Aerodyne Research, Inc. on the development of a versatile aerosol mass spectrometer.
- The Energy Sciences and Technology Department is working with Airborne Containment Systems on the development of a device for removal of biological and radiological hazards injected into commercial air handling systems.
- The Energy Sciences and Technology Department is working with Enconet Consulting on the development of risk informed applications for nuclear power plants.
- The Energy Sciences and Technology Department is working with Insight Technologies, Inc. on the development of a two stage oil burner with load tracking control.

- The Atmospheric Chemistry Division of the Environmental Sciences Department is working with ITT Industries on the development of sensors using raman lidar spectroscopy.
- The Energy Sciences and Technology Department is working with KeySpan on several projects relating to the development of new materials for liner and dike repairs.

1.4.2.2 Non-Profit Organisations/Institutions

- The Energy Sciences and Technology Department is working with the Electric Power Research Institute (EPRI) on several projects relating to guidance for the operation of nuclear power plant control rooms.
- The MR Group in the Medical/Chemistry Departments is working with the New England Medical Center on studies relating to cerebral injury in HIV infection.
- The PET Group in the Chemistry Department is working with NYU Medical Center on brain imaging in Alzheimer's subjects.
- The Energy Sciences and Technology Department is working with the Oil Heat Research Alliance in developing methods to maximize fuel performance in residential heating systems.
- The Environmental Sciences Department is working with Woodshole Oceanographic Institute on a number of oceanography related projects around the world.

1.4.2.3 Universities

- The Medical Department is working with Emory University on the development of a monkey model for use in MR studies of AIDS and opiates.
- The Atmospheric Chemistry Division of the Energy Sciences Department is working with Penn State University on the development of cloud property retrieval algorithms.
- The Biology Department is working with Stony Brook University in the development of a new approach for assessing mutagenic risk of contaminants in the Long Island Sound.
- The Environmental Sciences Department is working with Stony Brook University on an oceanographic study of the outer bank.
- The Environmental Sciences Department is working with the Scripps Institute of Oceanography on collecting and evaluating current profile data.

- The Physics Department is working with the University of California at Irvine on the conceptual design of the MECO Vacuum Window for the RSVP Project at the AGS.
- The Medical Department is working with the University of Connecticut in developing PET and SPECT radiotracers.
- The Chemistry Department is working with the University of Florida in determining the catalytic mechanism of human superoxide dismutase activity.
- The Physics Department is working with the University of Rochester on the barrel cryostat design for the US ATLAS Project.
- The Collider Accelerator Department is working with Yale University on the research and development that will support the KOPIO Project under the RSVP program at the AGS.

1.4.2.4 State Agencies

- The Environmental Sciences Department is working with the Texas Natural Resource Conservation Department on the analysis of air quality in the Houston area.
- The Energy Sciences and Technology Department is working with the New York State Energy Research and Development Authority (NYSERDA) on projects involving high efficiency condensing heating appliances.

1.4.2.5 Foreign Sponsors

- The Energy Sciences and Research Division is working with the Swedish Nuclear Power Incorporate on the development of procedures for the Swedish Nuclear Power Inspectorate.

1.4.3 Technology Transfer

1.4.3.1 Intellectual Property Program

- The Laboratory's Intellectual Property Program continues to be effective. Through unsolicited invention disclosures from researcher's, manuscript review by OIP, and OIP interaction with research departments OIP is able to identify those inventions made at the Laboratory that have commercial potential or DOE mission relevance. BSA reports inventions to DOE and makes title decisions in a timely fashion.
- For inventions to which BSA takes title, OIP files US Patent applications in a timely fashion and has over 95% of the US Patent applications filed issued as US Patents.

- The T7 gene expression system technology developed in the Biology Department is the subject of a number of patents and continues to be of commercial interest to industry. There are over 336 licenses issued to industry covering this technology.
- There are 164 BNL invented technologies in the BSA Patent Portfolio. Sixty-five of these come from BNL's life sciences research. Forty-eight percent of the BSA owned technologies have been licensed to industry and 9% of the BSA owned technologies have already been commercialized. The majority of commercialized technologies are in the life sciences and environmental remediation fields.
- The gross and net patent licensing revenue received by BSA has grown each of the last three years and should grow again in FY 03. The share of this revenue which is reinvested in Laboratory research programs has also grown from \$795K in FY 00 to \$1,307K in FY 02.
- The patent licensing program continues to be very cost effective, with the cost of patent prosecution, patent maintenance and licensing being 29% of the gross revenue in FY 00, 27% in FY 01, and 23% in FY 02.
- Among the projects funded at the Laboratory in FY 02 from patent licensing income are an MRI magnet upgrade project in the Chemistry Department, a small animal MRI machine purchase in the Medical Department and a high current superconducting linac cavity project related to eRHIC in the Collider Accelerator Department.

1.4.3.2 CRADA Program

- CRADA projects are a valuable component of the Laboratory's research portfolio, enhancing BNL's research capabilities and providing researchers access to industrial expertise.
- The Laboratory has 34 active CRADA projects. Seventeen were started in FY 02 and nine were started in FY 03.
- The Laboratory has received meaningful funding from industry under funds-in-CRADAs (over \$4M in FY 01 and over \$2.4M in FY 02). The pharmaceutical industry, represented by companies such as Johnson and Johnson and Glaxo SmithKline, have shown particular interest in the research capabilities of the PET group.
- BNL is participating in 15 IPP-NIS CRADAs under which DOE supports the research by BNL and the NIS Institute while our industrial partner supports its own work through the CRADA. Projects being conducted under the IPP CRADAs involve detector development, radioisotope development for nuclear medicine and fuel development for nuclear power plants.

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1.0 Excellence In Science & Technology

1.1 Quality of Research

Supporting information for BSA Quality of Research performance for Fiscal Year 2003 has been organized into the following data categories.

- Significant Accomplishments
- Significant Awards
- Publications
- Number of Patents, Disclosures, Licenses and Royalties
- Significant New Hires
- Proposals
- LDRD Initiatives
- Editorial Activity and Major Book Articles
- Technical Committees

Each Department within each BSA Scientific Directorate has provided supporting performance information within the above format. The following is a compilation of that performance data.

1.1.1 High Energy and Nuclear Physics

1.1.1.1 Collider Accelerator Department

Significant Accomplishments

- This last running cycle, RHIC operated for the first time with unequal mass ion species. This is a first for high energy colliders. The ion run of deuterons upon gold was operated at 100 GeV / nucleon and above design luminosity. This operation mode provided the data for the 4 experiments to confirm that a new hot and dense form of matter is produced in gold upon gold collisions
- Polarized proton collision operations had its full complement of Siberian Snakes and spin rotators installed and operational. Despite the failure of 1 magnet in a snake chain of 4 magnets, polarization was routinely delivered at 30% polarization and above design luminosity
- The AGS Siemens motor generator set was repaired and brought back into operation. The AGS therefore was able to deliver proton polarizations of 50% for RHIC operations
- The Booster Applications Facility Project (BAF) was completed on schedule, below cost and met beam specifications
- The NASA Space Radiation Laboratory (NSRL) started research operations upon the completion of BAF
- The BNL part of the SNS Project at ORNL continued to meet all construction milestones at or below estimated costs. FY2003 is the peak of the BNL activity for this project

Significant Awards

- D. Phillips - Environmental Stewardship Award

- A.J. McNerney - IEEE Region 1 Award for Electrical Engineering Management

Publications

No. of Peer Reviewed Pubs:	6	No. of Refereed Pubs:	9
No. of Internal Reports:	20	No. of Invited Papers:	12
No. of Books:	0	No. of Conf Proceedings:	158
No. of Other Pubs:	1		

Number of Patents, Disclosures, Licenses and Royalties

- Disclosure: Binocular Stereoscopic Viewing System for X-Ray and Gamma-Ray Luggage and Cargo Inspection Stations, P. Thieberger, 11/02
- Disclosure: Zener-diode Voltage Divider for Low-Energy, High-Intensity Electrostatic Accelerators, P. Thieberger, 10/02
- Disclosure: Regulation of Low Energy Particle Accelerators by Using Resonances in Nuclear Reactions, P. Thieberger, 10/02
- Patent No. 6,575,041, Capacitive Strain Gage and Method, M. Kesselman, 6/03
- Patent No. 6,528,949, Plasma Valve, A. Hershcovitch, 3/03
- Patent No. 6,515,487 B1, Low Voltage Low Current Bubble Detection Circuit, W.C. Dawson, 2/03

Significant New Hires

- Twelve new hires and transfers into C-A from other BNL Departments
 - One Senior Scientist
 - One Associate Scientist
 - Two temporary PhD students
 - Two Research Associates
 - Six replacements for staff lost through attrition
- C-A is also supporting four graduate students in Accelerator Physics

Proposals

- RHIC - Collider-Accelerator Operation
- RHIC Experiment Operations (partial)
- Accelerator and Experimental Facility Operations for HEP
- Accelerator and Experimental Facility Operation for Medium Energy Physics
- Spallation Neutron Source Project
- NASA - NASA Space Radiation Laboratory (NSRL)
- NASA - Genetic and Epigenetic Effects - E966
- Proton Radiography - E963

Editorial Activity and Major Book Articles

- Editor, Beam-Beam'03 Workshop Proceedings, W. Fischer
- Editors, 2002 Beam Instrumentation Workshop Proceedings, G.A. Smith and T. Russo
- Editors, Spin 2002 - 15th International Spin Physics Symposium Proceedings, Y. Makdisi, W. MacKay, A. Luccio
- Editor, Workshop on Polarized Electron Sources and Polarimeters Proceedings, Y. Makdisi

- Editor, BNL Report 71228, AGS Super Neutrino Beam Facility Accelerator and Target System Design (Neutrino Working Group Report II), D. Raparia
- Editor, Member, Physical Review ST-AB, I. Ben-Zvi
- Editor, Increasing the AGS Polarization Workshop Proceedings, T. Roser
- Book Article, Chapter on Photoinjectors, “Femtosecond Beam Science”, I. Ben-Zvi

Technical Committees

Review of BNL:

- RHIC Polarized Jet Review, November 18-19, 2002, BNL - T. Roser, Y. Makdisi
- DOE/NASA BAF Review, October 24, 2002, BNL - D. Lowenstein, P. Pile, A. McNerney, J. Becker
- EBCO Cyclotron Accelerator Readiness Review Team, February 10-14, 2003, BNL - E. Lessard, Chair
- DOE High-Energy Physics Review, April 22-23, 2003 - D. Lowenstein, T. Roser, P. Pile, I. Ben-Zvi, A. McNerney, J. Hauser
- DOE/NASA BAF/NSRL Review, June 19, 2003, BNL - D. Lowenstein, P. Pile, A. McNerney, J. Becker
- DOE RHIC Program Review, July 9-11, 2003, BNL - D. Lowenstein, P. Pile, T. Roser, J. Hauser
- BSA Review of BNL HENP Program, July 21-22, 2003, BNL - D. Lowenstein, T. Satogata

Service Activity for DOE Program and/or Nat'l./Regional Level

- USPAS Governing Board - D. Lowenstein
- US/Russia Joint Coordinating Committee on Fundamental Properties of Matter - D. Lowenstein
- Member, APS, DPB Executive Committee, F. Pilat
- Organizing Committee for the 2002 Beam Instrumentation Workshop - G. Smith, T. Russo
- Organizing Committee for the 2004 Beam Instrumentation Workshop - T. Russo
- Spallation Neutron Source Accelerator Readiness Review Team, Review of the Front End and Klystron Gallery, October 14-17, 2002, ORNL - E. Lessard, Chair
- Fermilab Run II Luminosity Performance Review, October 28-31, 2002, Fermilab - T. Roser, D. Lowenstein
- SNS DOE Review, November 13-15, 2002, ORNL - J. Wei, T. Roser
- SBIR Phase I Grant Application Review, February 2003, W. Fischer
- FNAL Accelerator Advisory Committee, Fermilab, February 4-6, 2003 - T. Roser
- Peer Review Panel for Muon Ionization Cooling Experiment (MICE) Proposal, Rutherford Appleton Laboratory, February 15-18, 2003 - D. Lowenstein
- J-PARC Accelerator Technical Advisory Committee, Japan, March 7-8, 2003 - T. Roser
- DOE Review of Fermi National Accelerator Laboratory High Energy Physics Program, Fermilab, March 18-20, 2003 - D. Lowenstein
- Ions at LHC Review, CERN, March 26-28, 2003 - T. Roser
- DOE Review of SLAC High-Energy Physics Program, April 9-11, 2003 - I. Ben-Zvi
- SBIR Proposal Review, April 2003, A. Kponou
- Peer Review Panel for Muon Ionization Cooling Experiment (MICE) Proposal, Rutherford Appleton Laboratory, April 30-May 3, 2003 - D. Lowenstein

- SNS DOE Review, May 6-8, 2003, ORNL - J. Wei, T. Roser
- NSCL Operations Review, Michigan State University, May 7-9, 2003 - D. Lowenstein
- Technical, Cost and Schedule Review of the HRIBF High Power Target Lab at ORNL, ORNL, May 19-21, 2003 - A.J. McNerney
- JLab DOE Program Review, June 25-27, 2003, Jlab - T. Roser
- Fermilab Run II Luminosity Performance Review, July 21-23, 2003, Fermilab - T. Roser
- Spallation Neutron Source (SNS) Accelerator Readiness Review Team, Review of Linac Tank 1, August 12-14, 2003, ORNL - E. Lessard, Chair
- SNS ASAC Review, September 22-24, 2003 - J. Wei

BNL Committees

- C-A Department Committee Listing is on file in the Department Office
- OPSEC - D. Lowenstein, P. Pile
- SBMS Steering Committee - D. Lowenstein
- PAAA Working Group - D. Lowenstein
- Senior Neutrino Planning Committee - D. Lowenstein
- Training & Qualifications Steering Committee - D. Lowenstein
- BNL Integrated Security Group - D. Lowenstein
- ALD for ESH&Q Selection Committee - D. Lowenstein
- Employment Benefit Committee - D. Lowenstein
- BNL Envoy Committee - J. Scott
- C-AD/Physics Accelerator Experiments Approval Committee (AEAC) - J. Wei, W. Fischer, S. Peggs, F. Pilat, P. Yamin, T. Kirk, D. Lowenstein, P. Pile, T. Roser
- BNL Lecture Committee - F. Pilat
- Contract Administration Committee - J. Hauser
- Credit Card Committee - J. Hauser
- Search Committee for a Deputy Purchasing Manager - J. Hauser
- PG&A Review Committee - J. Hauser
- Laboratory Environmental Safety and Health Committee - E. Lessard, Chair
- BNL Radioactive Drug Research Committee - E. Lessard
- BNL Radiological Control Working Group - E. Lessard
- BNL Safety Improvement Team - E. Lessard
- BNL Institutional Review Board - E. Lessard (alternate member)
- BNL Labor Negotiations Committee - A. McNerney, G. McIntyre
- BNL Consolidation Team - A. McNerney
- Laboratory Communication Focus Group - A. Hershcovitch
- Continuity of Operations Committee - D. Phillips
- WOSH (Worker Occupational Safety and Health) Committee - C.J. Liaw, D. Weiss, etc.

1.1.1.2 Physics Department

Significant Accomplishments

NUCLEAR PHYSICS

PHENIX Group

Significant Accomplishments at RHIC

- PHENIX Experiment took data in the full baseline configuration with complete central spectrometer and complete North and South muon spectrometers
- PHENIX Experiment published a complete set of identified π^0 measurements in Au-Au, p-p and d-Au collisions at $\sqrt{s_{NN}}=200$ GeV which confirmed the suppression of π^0 's discovered in 2001 in Au-Au collisions at $\sqrt{s_{NN}}=130$ GeV and indicates by the absence of suppression in d-Au collisions that the suppression in Au-Au collisions is a final state effect due to the interaction with the hot dense medium.

Significant Instrumentation Developments

- Data Acquisition Rate in PHENIX was doubled to 120MB/s. Online Calibration and real-time data filtering were implemented.
- The PHENIX upgrade test stand was implemented, with a data acquisition (DAQ) system to read out, in addition to other hardware already supported, the new SIS 3300 Flash analog-to-digital converter (ADC), which is needed for the time projection chamber (TPC) prototype.
- Critical TPC and hadron-blind detector (HBD) components were studied and developed using gas electron multiplier (GEM) readout for the PHENIX detector upgrade. The PHENIX group completed construction of a TPC drift cell, demonstrated functionality of a multistage GEM in pure CF_4 , measured VUV transmission of potential radiator gases, fabricated CsI photocathodes and measured absolute quantum efficiencies.
- Members of the PHENIX group developed a working prototype for a portable PET tomograph to be used for imaging live awake animals, produced the first images of phantoms and demonstrated the position resolution capabilities of the final detector.

Significant computer/software developments

- The PHENIX group produced the new 3D Magnet field map for PHENIX and prepared for mapping the central magnet with the new inner coil.
- A Java-based web browse-enabled PHENIX event display was developed.
- The PHENIX group developed a distributed file catalog for PHENIX data. Irina Sourikova described the technology in a presentation at the CHEP'03 international conference.
- The PHENIX group integrated a Kalman filter for the determination of central arm track momenta into the standard PHENIX reconstruction code.

STAR Group

Significant Accomplishments at RHIC

- STAR applied 4- and 6-particle correlation into flow analysis, studied elliptic flow as a function of transverse momentum, pseudorapidity and centrality, as well as flow fluctuations. (Tang)
- STAR's directed flow study with a 3-particle correlation method, yielded the first observation of directed flow at RHIC. (Tang)

Significant Instrumentation Developments

- STAR DAQ upgraded by a factor of 2 in speed (Ljubicic)
- Integrated new detectors into STAR DAQ: PMD, TOFr, EEMC, SSD (Ljubicic)
- New data compression mode for the TPC integrated and running ("DAQ 100") (Ljubicic)
- Develop capability for triggering on rare probes (Ljubicic)
- ATLAS Trigger/DAQ – completed ROB emulator FPGA implementation (LeVine)
- Developed data acquisition system for the PP2PP experiment at RHIC (Ljubicic)

Significant computer/software developments

- The STAR group developed code to improve "space charge distortion" corrections for the TPC data (Van Buren)
- The V0 decay reconstruction code was ported to C++ for inclusion of SVT tracks (Van Buren)
- The monitoring system for the STAR Trigger & DAQ was developed (Ljubicic)
- An efficient Cluster Finding algorithm was developed (LeVine)
- An electronic Shift Log and Scheduler were developed for STAR (Carcassi)

Heavy Ion Research Group (HIRG)

Significant Accomplishments at RHIC

- BRAHMS operated successfully for RHIC run 3
- Data was obtained for both the d Au and pp running

Significant Instrumentation Developments

- New BRAHMS Cherenkov, time-of-flight, and inelastic p-p detectors were commissioned.
- New trigger electronics for both BRAHMS spectrometers were developed

RHIC Spin Group and Riken/BNL Research Center (RBRC) Experimental Group

Significant Accomplishments at RHIC and AGS

- The cross section for π^0 at $\sqrt{s} = 200$ GeV was measured at mid-rapidity versus transverse momentum, to $p_T = 14$ GeV/c, covering 8 orders of magnitude, by the PHENIX experiment. Perturbative QCD describes the cross section very well. Reported to the QuarkMatter2002 and Spin2002 conferences.
- Large asymmetry was discovered for forward π^0 production at $\sqrt{s} = 200$ GeV, by the STAR experiment, reported to Spin2002 Conference.

- Large asymmetry was discovered for very forward neutrons at $\sqrt{s} = 200$ GeV, by the PHENIX spin group, reported to Spin2002 Conference.
- RHIC polarimeter measurements in the 2001/2 spin run successfully made every two hours during stored beam, with <5% systematic error in polarization; presented to the Spin2002 conference.
- First measurements of slope parameter and spin asymmetry for elastic scattering at $\sqrt{s} = 200$ GeV, were performed by the pp2pp experiment, reported to Spin2002.
- The neutron local polarimeter for PHENIX, and the spin rotators for longitudinal polarization at PHENIX were commissioned. The first (ever) data for collisions of longitudinally polarized protons were collected, with integrated luminosity 0.35 pb^{-1} , with sensitivity to gluon polarization. Presented to PAC2003 conference.
- The beam-beam counter local polarimeter for STAR, and the spin rotators for longitudinal polarization at STAR were commissioned. The first (ever) data for collisions of longitudinally polarized protons were collected, with integrated luminosity 0.5 pb^{-1} , with sensitivity to gluon polarization.
- Collected data on transverse spin asymmetry for forward π^0 production at STAR, increasing transverse momentum coverage from the previous run.
- Collected data on slope and asymmetry parameters for elastic scattering at pp2 pp with improved systematic errors and expected improvement in statistical errors of factor of 5 relative to the previous run.
- Experiment 930 (Germanium Ball) completed Λ - ^{16}O , Λ - ^{15}N and Λ - ^{10}B data taking in 2002. Data are being prepared for publication. PRL quality results on the tensor force from the Λ - ^{16}O are expected.
- The Spin group performed the first (ever) measurement of polarization during 0.5 s AGS acceleration with measurements every 1 ms, showing the expected polarization reversals every 10 ms from imperfection spin resonances. Unexpected structure also observed. Presented to the PAC2003 and CIPANP03 conferences.
- First (ever) measurement of polarization during the 2 minute RHIC acceleration for single RHIC ramps was also carried out.
- Measurements of the momentum transfer dependence of asymmetry in coulomb-nuclear interference region for proton-carbon scattering for proton energies from 6-100 GeV were carried out and presented to CINANP03 conference.

Significant Instrumentation Developments

- The Spin group carried out the design, construction, and successful use of a proton-carbon coulomb-nuclear interference polarimeter in the AGS for the 2003 spin run.
- A waveform digitizer upgrade was carried out to collect polarimeter data with individual event information, for AGS and RHIC polarimeters (from Yale).
- π^0 forward calorimeters for STAR were designed, constructed and successfully used.
- Four Roman Pot stations and silicon and scintillator detectors were constructed, installed and used in the pp2pp experiment for the 2003 spin run.

Significant computer/software developments

- New data acquisition for the polarimeters was developed to store individual events at 1 MHz rate. This is required for polarization measurements during AGS and RHIC acceleration.

LEGS Group

Significant Instrumentation Developments

- Nuclear Magnetic Resonance (NMR) polarization monitoring system for HD targets was completed; milestones were demonstrated.
- The vibration-isolation system for increasing deuteron polarization by reducing the temperature of the dilution refrigerator is operational.
- New In-Beam and Transfer Cryostats are under construction
- The helium liquefier system is operational.
- A 1st iteration ASIC for the TPC readout was fabricated and tested.
- A large-bore 1.8T super-conducting magnet was delivered and testing was started.

Significant computer/software developments

- Low noise NMR data collection under program control
- Prototype TPC data collection tested and working

Nuclear Theory Group

Significant research accomplishments (by group member)

Baltz

- Showed that (negative) Coulomb corrections to e^+e^- pair production increase with the charge of colliding heavy ions and arise from the spatial cutoff of the transverse Coulomb potential.

Jalilian-Marian

- Showed neutrino-nucleon cross-sections can be enhanced compared to PQCD leading twist results.
- Showed the limiting fragmentation phenomena can be understood in the framework of high gluon density effects.
- Clarified/showed the existence of the Cronin effect in the color glass condensate formation.

Kahana

- Present work on hadron effects at RHIC energies indicates most or all of high transverse momentum suppression (“Jet suppression”) can be attributed to co-mover re-scattering in final phases of a Au-Au event, leaving d-Au virtually unaffected.

Kharzeev

- Developed, in a series of papers with collaborators, a theoretical approach to the Cronin effect and high pT suppression based on the Color Glass Condensate.
- Continued working on the theory of quarkonium production.

Kretzer

- Software for data analysis based on the results documented in the publications.

McLerran

- Understanding of small x valence quark distribution.
- Proposals for understanding jet quenching effect in terms of color glass condensate.
- Continued to build and strengthen nuclear theory efforts at BNL.

Millener

- BNL E930 observed γ -ray transitions in ^{16}O , $^{15}_{\Lambda}\text{Be}$, and $^7_{\Lambda}\text{Li}$ using ^{16}O and ^{10}B targets. KEK E518 observed 7 γ -ray transitions in $^{11}_{\Lambda}\text{B}$. The data shows some surprising differences from the predictions for the proposal. Work has begun to try to understand the γ -ray decay scheme. Japanese doctoral students are analyzing the data from the above experiments.
- A paper on the decay of $^4_{\Lambda\Lambda}\text{H}$ and an interpretation of pion spectra from BNL E906 has been accepted for publication (with S. H. Kahana and D. E. Kahana).
- A reprogramming of 1hw shell-model code for light nuclei is almost complete. Extensions to 2hw and higher excitations are also underway.

Petreczky

- The lattice calculation of the meson spectral function in the free theory limit was completed. A calculation of static quark-antiquark free energies and screening in SU(2) gauge theory was completed. Substantial progress was made in study of quarkonium properties at $T > O$.

Petrov

- Finishing hardware test of QCDOC on simulator.
- Design and implementation of qcsh/QCDOC code development for adjoint Z(3) symmetric model.
- Determination of the singlet octet potential for Asqtad Action

Teaney

- Finished a first study on the effects of viscosity on the observables in heavy ion collisions: "The effect of shear viscosity on spectra elliptic flow and HBT radii", D. Teaney, nucl-th/0301099. Accepted for publication in Phys. Rev. C.
- Began to research small-x physics at HERA and at RHIC. Work with Henry Kowalski resulted in a model of small-x physics at HERA: "An impact parameter dipole saturation model", H. Kowalski and D. Teaney, hep-ph/0304189, submitted to Phys. Rev. D. With this work, many of the saturation models at RHIC can be significantly more constrained. Work with J. J. Marian continues this direction.
- Started to investigate in collaboration with K. Itakura, Y. Kovchegov, and L. McLerran, how saturation influences the evolution of baryon number at RHIC. This resulted in: "Baryon stopping and the valence quark distribution at small x", K. Itakura, Y. Kovchegov, L. McLerran, D. Teaney, hep-ph/0305332, submitted to Nucl. Phys. A.

Venugopalan

- Helped develop theoretical understanding of the initial stage of heavy-ion collisions.
- Developing ideas to understand thermalization and transport phenomena in heavy ion collisions.
- Close involvement with RHIC experimentalists from all four experiments—for example, was invited to attend PHOBOS physics discussion group on regular basis. Was also on STAR Advisory Committee to evaluate the forward pion detector idea at RHIC.
- Continued involvement with the eRHIC project. Delivered invited talks on eRHIC physics and writing a review of eRHIC physics for Annual Reviews of Nuclear Science with A. Deshpande, R. Milner & W. Vogelsang.
- Lectured on High Energy Nuclear Physics at National Nuclear Physics Summer School.

RHIC Computing Facility

Hardware Upgrades

- RCF mass storage system was upgraded from 9940a to 9940b tape drives, a factor of 3 better performing technology, resulting in a system data volume capacity of 4.5 PBytes and theoretical data throughput capacity of 1000 MBytes/sec.
- RCF processor farm capacity was increased from 480 to 900 SPECint2000.
- RCF online (disk) storage system increased from 66 to 110 Tbytes.
- RCF aggregate raw data recording capacity increased to a reliably obtainable rate of 200 MBytes/sec

RHIC Production Computing Support

- Operated in support of reconstruction and analysis of RHIC Run 2 data
- Operated in support of data taking for RHIC Run 3
- Operated in support of initial reconstruction and analysis of RHIC Run 3 data
- Deployed appropriate versions of Grid middleware to support STAR's transfer of RHIC data to NERSC from RCF storage systems

Riken Theory Group

Significant accomplishments

- Lattice Gauge theory calculations: nuclear structure functions; g-2 initiated; domain wall fermions with full QCD initiated.
- Theory studies for RHIC spin.
- Theory studies for RHIC heavy ions reactions.

Significant Instrumentation Developments

- Completed chip design of 10-teraflop QCDOC computer and successfully took delivery of first prototype chips on daughterboards.

HIGH ENERGY PHYSICS

Omega Group

Significant accomplishments (by experiment)

g-2:

- Finished the 2000 g-2 data analysis and reported the result of 0.7 ppm.
- Made significant progress in the 2001 g-2 data analysis.

EDM:

- Submission of the muon electric dipole moment (EDM) Letter of Intent to J-PARC and presentation of the LOI to J-PARC. Y. Semertzidis is the co-spokesperson of the muon and deuteron EDM collaboration.
- Development of a deuteron EDM concept using the AGS ring.

D0:

- S. Protopopescu is leading the D0 simulation group and the data tier group.

- BNL had a leading role in the development of the tau identification algorithms and measurement of $Z \rightarrow \tau\tau$ cross-section in D0 Run 2 data.
- S. Protopopescu is a member of the top D0 editorial board.
- J. Kotcher is the D0 RUN IIb upgrade project manager.

Radio Detection of Ultra High Energy Cosmic rays

- H. Takai received LDRD project funds.
- Installation of a radio detection station in BNL.
- Installation of GPS system for muon detection system and radio station.
- Installation of a Data Acquisition system for the radio detection system.

Radiation Studies of power devices

- Study of SEB cross section of power MOSFET with heavy ions
- Modeling of SEB for LHC environment

ATLAS

- H. Takai is the convener of the ATLAS heavy ion study group.
- BNL took the lead in simulation studies of the ATLAS detector performance for heavy ion physics.
- Letter of Intent (LOI) for the LHCC will be ready by fall 2003.

Significant Instrumentation Developments

- Development of an Inclinometer capable to do better than 1 nanoradian relative accuracy in collaboration with S. Rescia of the Instrumentation Division.
- Tilt meter developed with an accuracy of $\sim 10^{-9}$ radian.
- Completed the installation of the Warm cables base planes and pedestals on the ATLAS Barrel Electromagnetic calorimeter and the first ATLAS End Cap calorimeter.
- The Liquid Argon test set up at BNL has gone in to operation and the certifications of the final liquid argon readout electronics has started.
- About 50% of the ATLAS Muon chambers have been constructed during the last year. The readout electronics has been finalized and is going in to production.

Significant computer/software developments

- S. Rajagopalan has been selected as the coordinator of the U.S. ATLAS software, established the US organization and a resource loaded WBS for U.S. core software activities.
- Coordination of the Liquid Argon Software, prototype development of the Calorimeter Reconstruction Software, successfully deployed in ATLAS Data Challenge I.
- Coordination of the ATLAS Event Data Model Effort – first prototype implementation of the Raw Event Model, deployment of the architecture for the ATLAS Event Data Model, successfully used in ATLAS Data Challenge I.
- First design document drafted for the overall Atlas Reconstruction Software

Electronic Detector Group

Significant accomplishments

- Analysis of E787 data from 1997 improves the upper limit on $B(K^+ \rightarrow \pi^+ \nu \bar{\nu})$ in the soft p_π region by a factor 2.

- Analysis of E949 data shows that major detector upgrades worked as designed.

Significant Instrumentation Developments

- KOPIO shashlyk calorimeter modules achieved record resolution.

Significant computer/software developments

- First GEANT simulation of KOPIO experiment with all systems included.

Advanced Accelerator Group

Significant Instrumentation Developments

- Developed greater understanding of the design principles of FFAG accelerators, including performance and cost optimizations
- Made significant progress in three families of ring coolers for neutrino factories, particularly for the RFOFO ring design.
- Designed pulsed 15 T solenoid for the targetry experiment AGS E951.
- Completed measurements of the effects of irradiation on the coefficient of expansion of super-Invar, a candidate target material made calculations of horn-focused neutrino fluxes and detector simulations for the BNL neutrino superbeam study.

Physics Analysis Software (PAS) Group

Significant computer/software developments

- Operated ATLAS simulation and reconstruction production on BNL facilities for ATLAS Data Challenge 1 (DC1), making BNL the largest non-CERN contributor to DC1.
- Deployed the Magda distributed data management system we developed as the data management system for ATLAS DC1, managing terabytes of data worldwide.
- Deployed the ATLAS baseline event storage system, AthenaROOT, developed by BNL.
- Led the integration of the POOL physics data storage system into ATLAS software.
- Led the development and production deployment of the ATLAS simulation software.
- Provided ATLAS Software Librarian and user support services to the US ATLAS community and International ATLAS, including the ATLAS automated software build system.
- Led the 80-person Applications Area of the LHC Computing Grid Project developing physics applications software for the LHC experiments.

Accelerator Test Facility (ATF)

Significant Accomplishments

- ATF is operational at full energy; all experiments collecting data and publishing

Significant Instrumentation Developments

- Upgraded HE beam line of ATF, leading to superior performance

ATLAS Computing Facility

Hardware Upgrade

- ACF online (disk) storage system increase from 2 TBytes to 12 Tbytes.

Significant computer/software developments

- Operated in support of ATLAS DC1 Phase 1, event generation and simulation of detector response.
- Operated in support of ATLAS DC 1 Phase 2, simulation of event pileup and reconstruction.
- Deployed latest US versions of Grid middleware for bulk of US ATLAS systems at BNL Tier 1; integrated and interoperated with US ATLAS Tier 2's and other elements of US ATLAS Grid Test bed.
- Deployed initial version of the LHC Computing Grid (LCG-0) for limited subset of local systems and demonstrate their ability to interact appropriately with components at CERN.
- Developed and deployed initial version of Grid software to download Virtual Organization membership data and generate local accounts.

Significant Awards

NUCLEAR PHYSICS

- C.L. Woody, APS Fellowship
- Thomas Schaefer, RHIC Fellow and Stony Brook Faculty Member (presently RHIC Fellow and North Carolina State Faculty Member): DOE Division of Nuclear Physics 2002 Outstanding Junior Investigator Award
- G. Bunce – APS Fellowship

HIGH ENERGY PHYSICS

- M. Creutz, Adjunct Professor, SUNY, Stony Brook
- S. Dawson, Adjunct Professor, SUNY, Stony Brook
- S. Dawson, DPF Chair Elect
- W. Marciano, Humboldt Senior Researcher @ Univ. Karlsruhe (2002-Open)

Publications

No. of Peer Reviewed Pubs:	119	No. of Refereed Pubs:	102
No. of Internal Reports:	70	No. of Invited Papers:	54
No. of Books:	2	No. of Conf Proceedings:	181
No. of Other Pubs:	4		

Significant New Hires

- A Goldhaber Fellow, P. Petreczky, was hired in the Nuclear Theory Group to enhance the group's strength in finite temperature lattice QCD.

- An associate physicist, J. Dunlop, was hired in the STAR Group to bring the STAR Analysis Coordinator to BNL.

Proposals

NUCLEAR PHYSICS

Proposals ($\geq 250K$)

Funded:

- Continuing NSF ITR grant #0219210: "Computing Grid for Analysis of Data from PHENIX at RHIC", computer science/HENP, 6 people from BNL (Morrison, Mioduszewski) and SUNYSB, (\$388k total).

Submitted:

- C. L. Woody (Co-P.I.), "Development of a Proton CT Prototype System ", proposal to the National Institute of Biomedical Imaging and Bioengineering (NIBIB) Division of the National Institutes of Health, R.Schulte (P.I), (Co-P.I.), (\$1764K total)
- C. L. Woody, "Non-Invasive Blood Radioactivity Monitor ", proposal to the National Institute of Biomedical Imaging and Bioengineering (NIBIB) Division of the National Institutes of Health, D. Schlyer (P.I.), (\$470K total)
- C. L. Woody, "An Anger Approach for 1 mm Resolution Small Animal PET", proposal to the National Institute of Biomedical Imaging and Bioengineering (NIBIB) Division of the National Institutes of Health, P. Vaska (P.I.), (\$535K total)
- Ljubicic "STAR DAQ Upgrade Proposal" R&D submitted to Physics Department for DOE funding, Dec. 02 - \$1.8M over 3 years (DOE)
- T. Hallman, "RHIC STAR Detector Upgrades" R&D submitted to Physics Department for DOE funding, Dec. 02 - \$4.1M over 3 years (DOE).
- T. Hallman, "TOF Proposal" being considered - \$5M (DOE & NNSFC).
- L. Bland, Proposal for a forward π_0 detector at STAR, approved Aug. 2002

HIGH ENERGY PHYSICS

- Proposal to Operate the Brookhaven AGS to Complete E949 - A Measurement of the $B(K^+ \rightarrow \pi^+ \nu \bar{\nu})$, S. Kettell, M. Marx \$25.5M, pending
- RSVP Major Research Equipment proposal to the National Science Foundation, L. Littenberg and others \$144.91M approved 2001
- M. Creutz, DOE SciDAC lattice gauge software project - started in 2001, \$152K for 2003 plus \$498K carryover, expect renewal at about \$300K/year
- M. Creutz, Lattice gauge supercomputer pending with DOE HEP; possibly some support starting in 2003, hope for substantial funds in 2004
- S. Dawson, EpsCor Proposal with Univ. of Oklahoma, \$150K/year for three years (funds 2 postdocs at Univ. of Oklahoma)
- Particle Physics Data Grid, T. Wenaus, \$648k over 3 years (2002-2004), DOE SciDAC funded, with probable extension to 5 years at similar funding level.

- "Development of Superconducting High Current RF Cavities at 700 MHz", Ilan Ben-Zvi, Joint Technology Office, and Funding: \$350K FY03, \$400K FY04.

LDRD Initiatives

NUCLEAR PHYSICS

- C. L. Woody, Completed 2nd year of LDRD on "Fine Grain Gas and Silicon Detectors for Future Experiments in Nuclear Physics at High Energies", in collaboration with STAR (\$100K)
- P. Petreczky, LDRD proposal "Lattice QCD relevant for RHIC and AGS."
- T. Ludlam, Fine Grain Gas and Silicon Detectors for Future Experiments in Nuclear Physics at High Energies."
- T. Ludlam, T. Hallman and S. Aronson, Joint STAR and PHENIX Detector R&D.
- Les Bland, Spin structure studies of the proton using the STAR detector.

HIGH ENERGY PHYSICS

- H. Takai and F. Lanni, Radio Detection of Ultra High Energy Cosmic Rays.
- FFAG magnet development.
- Material studies of high power targetry.
- Development of High Brightness, High Current Electron Beams.

Editorial Activity and Major Book Articles

NUCLEAR PHYSICS

- Johnson, B.M., Associate Editor, Physical Review Letters
- Johnson, B.M., Associate Editor, Physical Review E
- Johnson, B.M., Associate Editor, Physical Review Special Topics: Accelerators and Beams
- Quark Matter 2001 Proceedings, Edited by T.J. Hallman, D.E. Kharzeev, J.T. Mitchell, and T. Ullrich, Nucl. Phys. A 698 (2002).
- Baltz, Convener of the CERN Yellow Report in preparation, "The Physics of Ultra Peripheral Collisions at the LHC".
- D. Kharzeev, Managing Editor, International Journal of Modern Physics.
- D. Kharzeev, Editor, Annals of Physics.
- L. McLerran, Senior Editor for Nuclear Physics A.
- J. Millener, Physical Review C, Associate Editor for Theoretical Nuclear Structure.
- R. Venugopalan, Contributed Chapter of Book "QGP3" to be published by World Scientific.
- T. Hallman, Associate Editor, Nuclear Physics A, Elsevier.
- T. Ludlam, Guest Editor, Nucl. Instr. & Methods A: special volume on RHIC and its Detectors.
- J.L. Nagle and T.S. Ullrich: Experimentalists are from Mars, Theorists are from Venus; complete chapter (48 pages) for "QCD Perspectives on Hot and Dense Matter", Kluwer Academics Publisher, ISBN 1-4020-1035-2

- Co-editor of Proceedings for the 7th International Conference on Strangeness in Quark Matter (March 2003 in Atlantic Beach, NC), Journal of Physics G.

HIGH ENERGY PHYSICS

- M. Creutz, Editorial boards for Computing in Science and Engineering, International Journal of Modern Physics C.
- S. Dawson, Associate Editor (Physical Review D).
- W. Marciano, JHEP, Co-Editor of “Electromagnetic Probes of Fundamental Physics with S. White, Editing QED Book.
- F. Paige, Associate Editor, Physical Review D.
- R. Pisarski, Associate Editor, Physics Review D.
- Soni, Co-editor of book entitled, “Linear Collider Physics in the New Millenium.”
- Ben-Zvi completed book section on photoinjectors, book title “Femtosecond Beam Science”, edited by M. Uesaka, Imperial College Press/World Scientific, February 2003.

Technical Committees

NUCLEAR PHYSICS

PHENIX

Leadership Positions:

- PHENIX Detector Council (E. O’Brien, Chair, A. Franz, TEC, Magnet; D.P. Morrison, computing)
- PHENIX Executive Council (O’Brien, Morrison/Tannenbaum)
- Convener for the PHENIX Global/Hadron PWG (A. Franz, J. T. Mitchell, J. Velkovska)
- Convener for the PHENIX Hard/Photon PWG (S. Mioduszewski, M. J. Tannenbaum)

Collaboration Committees:

- PHENIX Run2 Data Production Manager (Mar. 2002 - Nov. 2002). T. Chujo
- Experiment Operations Group member for PHENIX Time-of-Flight Detector (June 2002 - July 2003). (T. Chujo)
- Johnson, B.M., Run Organization Task Force, PHENIX, 2002.
- Paper Preparation Group (PPG) Member for PPG015 (Run2 proton scaling paper). (T. Chujo, S Mioduszewski, D. P. Morrison, J. Velkovska)
- PPG Chair for PPG026 (Run2 Identified charged hadron paper). (T. Chujo)
- Internal Review Committee (IRC) Member for PPG014/024 (Run2 Au-Au/p-p π^0 paper). (T. Chujo)
- PPG Member PPG014 (S. Mioduszewski)
- IRC Chair for PPG028 (Run3 d-Au charged and π^0 paper). (T. Chujo)
- PPG027, chair J.T. Mitchell, member M. J. Tannenbaum
- PPG020, Member J.T. Mitchell
- IRC for PPG009 130 GeV Au-Au Identified charged hadrons (S. Mioduszewski)

- IRC for PPG022, Elliptic flow of identified hadrons in Au-Au collisions at 200 GeV (C. Pinkenburg)
- PPG023, High pT hadron production Au-Au 200 GeV (M. J. Tannenbaum)

BNL and Physics Department Committees:

- Johnson, B.M., Brookhaven Lecture Committee, BNL, 2002-2008.
- Johnson, B.M., Elected Member of RHIC & AGS Users Executive Committee (RAUEC), BNL, 2002-2005.
- Johnson, B.M., Chair, RAUEC Annual Meeting Subcommittee, BNL, 2003.
- Johnson, B.M., Co-Organizer, Annual RHIC & AGS Users Meeting, BNL, May 2003.
- Johnson, B.M., Member, RAUEC Computing Subcommittee, BNL, 2002-...
- Johnson, B.M., Member, RAUEC Quality of Life Subcommittee, BNL, 2002-...
- J. T. Mitchell, RHIC and AGS User's Executive Committee
- J. T. Mitchell, Brookhaven National Laboratory Quality of Life Committee
- J. T. Mitchell, BNL Association of Students and Postdocs Advisory Board
- D. P. Morrison, Chair of the Physics Department Nuclear Physics Planning Committee.
- D. P. Morrison, Physics Department Colloquium Committee
- T.K. Shea, Committee for final review of SBMS Subject area on Confined Spaces.
- M. L. Purschke, BNL Cyber Security Advisory Council (CSAC)
- M. J. Tannenbaum, BNL Council 2002-2005

External Advisory Committees:

- M.J. Tannenbaum, Conseil Scientifique, Labo Leprince-Ringuet, Ecole Polytechnique, Palaiseau, France. 2002—
- C.L. Woody, Member of the Radiation Instrumentation Steering Committee of the IEEE Nuclear and Plasma Sciences Society (Chairman-elect, term starting Jan. 2004)

Conference organizing committees:

- International Advisory Committee TRD2003, Bari, Italy (E. O'Brien)
- Spin 2002 Conference, BNL, Local Organizing committee.(M. J. Tannenbaum)
- 7th QCD Workshop, Villefranche-sur-mer, France, Jan 2003, session organizer. (M. J. Tannenbaum)
- 8th Conference on the Intersections of Particle and Nuclear Physics, New York, NY, May 19-23, 2003. Local Organizing committee. (M. J. Tannenbaum)
- Organizing and Program Committee of the 2003 IEEE Nuclear Science Symposium Program (to be held in Portland, Oregon, Oct 19-25, 2003) (C. L. Woody)
- Co-Organizer (with F. Sauli) of the "Workshop on Micropattern Detectors for Time Projection Chambers" at the 2003 Nuclear Science Symposium (C. L. Woody)
- Reviewer of abstract submissions for IEEE-Nuclear Science Symposium 2003 (E. O'Brien)

DOE Review Committees:

- DOE/NSF Review of US-ATLAS/CMS Maintenance and Operations Program (FNAL) April 2003 (E. O'Brien)
- DOE/NSF USLHC Evaluation M&O Group (E. O'Brien)
- Reviewer of DOE SBIR proposals (E. O'Brien, A. Franz)

STAR

Detector Operations:

- Maintained and operated the STAR experiment for Run III and associated shutdown activities.
- Lead the STAR collaboration as Spokesperson – analyzed d + Au data in record time leading to jet quenching discovery announcement and special colloquium
- Coordinated all aspects of STAR Detector Operations (W. Christie)
- Served as Liaison between STAR, C-AD, and other RHIC Experiments (W. Christie)

STAR Committee Memberships:

- STAR Advisory Board (W. Christie, T. Hallman, T. Ljubicic)
- STAR Physics Analysis Coordinator (J. Dunlop)
- STAR Physics Working Group Leaders (S. Panitikin, T. Ullrich, Z. Xu)
- STAR Trigger Board (W. Christie, T. Ljubicic)
- STAR Management Board (W. Christie)
- STAR Council (W. Christie, T. Hallman)
- STAR Upgrade Steering Committee (T. Ullrich)
- STAR Integrated Tracker Review Committee (T. Ullrich)

BNL Committees:

- Member of the C-AD Experimental Safety Review Committee (W. Christie)
- Member of the Physics Department award committee for FY02 (W. Christie)
- BNL representative to the STAR Executive Committee (W. Christie)
- Chairman, Nuclear Physics Seminar Committee (T. Ullrich)
- RHIC Experimental Safety Review Committee (RESC), (W. Christie)
- VIP Advisory Committee (G. VanBuren)
- BNL Site Master Plan Committee (T. Ludlam)
- RHIC Polarized Jet Target Review, November 2002 (D. Lynn)

Service Activity for DOE Program and/or Nat'l/Regional level:

- NSAC Subpanel on Education, May 2002 (T. Hallman)
- Chairman, PAC, of the Joint Institute for Nuclear Research (T. Hallman)
- International Advisory Committee, Quark Matter 2002 (Nantes, France) (T. Ludlam)
- Vice Chair, Gordon Conference in Nuclear Physics, 2003 (T. Ludlam) (T. Ullrich)
- Co-Organizer of the 7th International Conference on Strangeness in Quark Matter, March 2003 (T. Ullrich)
- Co-Organizer, Heavy Ion Session - Intersections (T. Hallman)

LEGS

- JLab PAC23, Jan'03: A.M. Sandorfi
- JLab 12 GeV Upgrade Review, Jan'03: A.M. Sandorfi
- JLab PAC24, June'03: A.M. Sandorfi

Nuclear Theory Group

- RBRC Theory Advisory Committee (A. Baltz)
- Co-organizer of RBRC Workshop “Large-Scale Computations in Nuclear Physics using the QCDOC”, September 26-28, 2002. (A. Baltz)
- (BNL) Lab committee on tenure May-June 2002 and 2003 (S. Kahana)
- Member of NSAC, RBRC Theory Advisory Committee, Department Tenure and Continuing Appointment Committees. (L. McLerran)
- Working group on hard probes in heavy ions collisions at LHC, CERN Yellow Report. (P. Petreczky)
- Department Tenure & Continuing Appointments Committees. (R. Venugopalan)
- Organizing Committee for SPIN 2002 at BNL (Sept. 2002) Organizing Committee for "Current and future directions at RHIC", RBRC Workshop, Aug 5-23, 2002 (Werner Vogelsang)

RHIC Computing Facility

International Conference Organization:

- Member, International Program Advisory Committee, CHEP 2003, San Diego, CA, March 24-28 (B. Gibbard)

BNL Committees:

- CSAC members (B. Gibbard, T. Throwe)
- ITD Leadership Council member (B. Gibbard)

Service Activity for DOE Program:

- Review of DOE SBIR Grant Applications (B. Gibbard, R. Baker)

HIGH ENERGY PHYSICS

Service Activity for DOE Program and/or Nat'l/Regional level:

- International Advisory Committee member of the Lepton Moments Symposium held in Cape Cod, June 8-11, 2003. (Y. Semertzidis)
- Lehman Review of NuMI, 28-30 May 2003 (S. Kettell)
- Lehman Review of NuMI, 9-11 Dec 2002 (S. Kettell)
- DOE review of the SLAC High-Energy Physics Program, April 9-11, 2003
- Review of DOE SBIR Grant Applications (B. Gibbard, R. Baker)
- SciDAC executive committee (M. Creutz)
- Organizer of extended lattice gauge workshop at the Santa Barbara Institute of Theoretical Physics for the winter of 2005 (M. Creutz), Co-organizers: H. Neuberger, J. Kogut and T. Wettig.
- Advisory committee for RIKEN Brookhaven Research Center (M. Creutz)
- US Linear Collider Steering Committee (S. Dawson)
- HEPAP subcommittee on Outreach and Education (S. Dawson)

- DPF Executive Committee (S. Dawson)
- Organizing Committee, Linear Collider Workshop, Cornell, July 13-16, 2003 (S. Dawson)
- Organizing Committee, Linear Collider Workshop, Arlington, TX, Jan. 9-11, 2003 (S. Dawson)
- Fermilab URA Review member, March 14-15, 2003 (S. Dawson)
- Chair, Linear Collider working group on Radiative Corrections (S. Dawson)
- Program Chair, DPF 2003 meeting, Philadelphia 4-8, 2003 (S. Dawson)
- Program Chair, LOOPFEST2, BNL, May 14-16, 2003 (S. Dawson)
- International Advisory Committee, Les Houches Workshop on TeV Physics, May 26-June 6, 2003 (S. Dawson)
- International Advisory Committee, Aspen Winter Conference (S. Dawson)
- Executive Committee of New York State Section of the APS Particle Physics Seminar Committee (W. Kilgore)
- Member, P5 (DOE and NSF Advisory Committee) (W. Marciano)
- Member, Orbach Futures Committee (W. Marciano)
- Member, NUSEL Steering Committee (W. Marciano)
- Member, BNL Neutrino Planning Committee (W. Marciano)
- Member, UNO Theory Advisory Committee (W. Marciano)
- Chair, CIPANP 2003, May 19-23, 2003 (W. Marciano)
- Member, LEPTON-PHOTON 2003 Int. Advisory Committee, Aug. 11-16, 2003 (W. Marciano)
- Member, NSF Funding Committee (W. Marciano)
- Co-Convener, ATLAS SUSY Working group (F. Paige)
- Member, ATLAS Physics Coordination Working group (F. Paige)
- Member, ATLAS jet/etmiss/tau working group (F. Paige)
- Member, NLC LHC/LC and SUSY working groups (F. Paige)
- Member, Advisory Committee for RIKEN/BNL Research Center (R. Pisarski)
- Co-coordinator for the Working Group on Unitarity Angles at the Workshop on the CKM Unitarity Triangle, Durham, UK (April 5-9,2003) (A. Soni)
- Member, SPIN 2002 Organizing Committee (L. Trueman)
- Member, Organizing committee for 4th Circum-Pan-Pacific Symposium on High Energy SPIN Physics (L. Trueman)
- Physics in Collision International Advisory Committee (Zeuthen, Germany) (L. Littenberg)
- CIPANP 2003, Tests of Fundamental Symmetries co-organizer (G. Redlinger)
- Member, International Program Advisory Committee, CHEP 2003, San Diego, CA, March 24-28 (B Gibbard)

BNL Committees:

- Member of Sambamurti Awards Committee (S. Protopopescu)
- Member of a Tenure Case Committee (S. Protopopescu)
- Member of a Tenure Case Committee, Continuing Appointments Committee and Chair of Senior Scientist Appointments Committee (D. Lissauer)
- Review of STAR EEMC, May 2003 (L. Littenberg)
- RHIC/AGS Users Executive Committee (S. Kettell, C. Scarlett and M. Sivertz)

- Physics Colloquium Committee (I. Ben-Zvi)
- Members, CSAC (B. Gibbard, T. Throwe)
- Member, ITD Leadership Council (B. Gibbard)
- Member, Muon Collaboration Technical Board (H. Kirk)
- Muon Collaboration Simulation Board (R. Fernow, H. Kirk, J. S. Berg)
- Members, Muon Collaboration Executive Board (R. Palmer, J. Gallardo (secretary))
- Muon Collaboration FFAG Workshop, Oct. 28 – Nov. 8, 2002 (J. S. Berg)

Conferences organized:

- Organizers, Summer Institute, Shelter Island, May 26 – June 4, 2003 (R. Palmer, K. Tuohy and P. Tuttle)
- Computing in High Energy Physics (CHEP2003) International Program Advisory Committee, La Jolla CA, March 2003
- US CMS Software and Computing Advisory Panel, Fermilab, October 2002

Additional Comments

Community Service and Community Lectures (BNL):

- Presentation about Particle detectors for BNL Undergraduate Summer Students (A. Franz)
- Presentation about Particle detectors for BNL High School Summer Students (A. Franz)
- Brookhaven Semester Program 2003 (M. Harvey)
- Relativistic Heavy Ion Physics Research at the Relativistic Heavy Ion Collider (RHIC), Science Undergraduate Laboratory Internship (SULI), BNL, June 27, 2003. (B. M. Johnson)
- Modern Physics: Understanding the Very Small and the Very Fast, Community Summer Science Program (CSSP), BNL, July 9, 2003. (B. M. Johnson)
- President, Brookhaven Organization of Scientists (BOS), 1999-present.
- Invited plenary talk at New York State Annual CSTEP Conference, New York, NY (March 2003) (G. Van Buren)
- Science lectures at Hauppauge High School (May 2003) and Merrick Middle School (October 2002) (G. Van Buren)

Grants (<250K)

Ongoing:

- Principal Investigator, Nuclear Physics Teaching and Learning Science (\$40K total) 1998-... (B. M. Johnson)
- US Member of Civilian Research and Development Foundation (CRDF) project on Generation of multiply charged ions in vacuum arc plasmas, \$88K yearly. (B. M. Johnson) P.I. Oks, E. (Tomsk, Russia), U.S. Co-P.I. Herscovich, A. (BNL).
- Very Large, High Gain APDs for Particle Physics, SBIR DE-FG02-03ER83763 (Phase 1)

In progress:

- S. Kretzer, RIKEN-BNL workshop on “Theory Studies for polarized pp scattering” to be held at BNL Aug/Sept. 2003
- L. McLerran, Joint proposal with Ukrainian physicists to CRDF for funding visitors to BNL.
- L. McLerran, Joint U.S.-Israel Science Foundation grant with Tel Aviv physicists.
- SBIR proposal to DOE with Tech-X Corporation on developing MAD9 accelerator code

Outreach Programs

- BNL QuarkNet program Mentor with 15 teachers from local schools (H. Takai)
- Mentor for High School Students (H. Takai)

1.1.1.3 Instrumentation Division

Significant Accomplishments

Silicon Detectors

- Processing and development of the novel Si stripixel detectors (single-sided processing, 2D position sensitivities) for various experiments;
- Second prototype batch of stripixel detectors with 1-5 micron position resolution in both X and Y coordinates has been completed. Laser and electron beam tests on these detectors have shown 2D position sensitivity;
- First prototype batch of large (3x6 cm²) stripixel detectors for PHENIX upgrade has produced first stripixel detectors for a real experiment application. Electron source test at RIKEN and electron beam test at KEK have shown 2D position sensitivities with X and Y position resolutions of about 25 microns, which is the digital resolution of the 80 micron pitch detector;
- Developed and processed a number of novel Si strip/pixel detectors for various experiments;
- Fabricated 16 planes of novel segmented, multi-pitch Si strip detectors with double metal technology for the CERN NA60 experiment with successful beam run in 2003 at CERN;
- Made pixel array pad detectors for NSLS with extremely good testing results;
- Made the second batch prototype Active Matrix Si detectors for protein crystallography;
- Made the second batch prototype submicron resolution Si stripixel detector for NASA human tissue ion radiation studies;
- Development and processing of radiation hard/tolerant Si detectors for high energy physics experiments: novel Semi-3d detector structures for much improved (up to 4- times higher) radiation hardness; oxygenated Si detectors for up to three times radiation hardness to charged particles; high resistivity CZ Si detectors for up to 5 times higher radiation hardness to charged particles.

Gas Detectors

- Upgraded existing 20cmx20cm and 50cmx50cm neutron detectors for ANL and SNS;
- Completed the mechanical design of the LEGS TPC and started the construction phase;
- Study and characterization of gas electron multipliers from CERN and 3M;
- Design and construction of 10cmx30cm X-ray detector for Princeton University Tokamak studies.

Microelectronics

- Used new PDD ASIC to demonstrate self-triggering, precision peak detection, timing and risetime detection, derandomization, and analog multiplexing of signals from 32 CZT X-ray detectors into one output;
- Beam test of 576 channels of ASIC-based readout for ATLAS cathode strip chambers demonstrated all-optical control and readout;
- Designed fast gated integrator for SPLAT2 aerosol particle spectrometer;
- Developed software for optimized low-noise design of MOSFET charge-sensitive amplifiers;
- Designed microelectronics for “RatCAP” PET project.

Monolithic Circuits

- Development of Si Sensor and ASIC for EXAFS spectroscopy at NSLS;
 - Full characterization of Si Sensor with 10 μ m, 50 μ m and variable gap size
 - Investigation of Si Sensor with mini-drift based approach, later designed by Dr. Pavel Rehak and fabricated on site
 - Full characterization of ASIC version 1
 - Metallization spacing problem due to masking error from the MOSIS was detected through measurements and visual inspection, and has been addressed
 - Re-design, optimization, improvement, layout and submission for fabrication of ASIC version 2
- Cooperation with Symbol Technologies for linear optical sensor with integrated front-end electronics;
 - Assisted Symbol at the characterization of the ASIC, positive results
- Characterization of 0.18 μ m CMOS devices;
 - Development and optimization of a system for the measurement of low-frequency noise
 - Assisted at development of system for characterization at cryogenic temperature
- Cooperation with eV Products (II-VI Inc.) at development of a Peak Detector and Derandomizing ASIC;
 - Full characterization of ASIC version 1
 - Metallization spacing problem due to masking error from the MOSIS was detected through measurements and visual inspection, and has been addressed and a free fabrication from MOSIS Service with the problem fixed was obtained
- Cooperation with the LEGS Group (BNL) at the development of an ASIC for a TPC;
 - Design, layout and submission for fabrication of ASIC version 1
 - It implements a novel circuit solution for the continuous reset of the preamplifier
 - It implements a new version of the patented two-phase peak detector
 - A test board was designed (laid out and fabricated on site)
- Development of ASIC for “RatCAP” PET (Mobile animal);
- Development of ASIC for CdZnTe based Coplanar Grid sensor for Los Alamos National Laboratory;
 - Design and optimization of CMOS front-end preamplifier for large capacitance
 - Design of ASIC channel is in progress

- Cooperation with Cadence Design System at optimization of PSPICE and Schematics simulation tools;
- Development of a new circuit solution for preamplifier continuous reset in low-voltage technologies, with Invention Disclosure to be submitted.

Micro/Nano Fabrication

- Initial operational capability achieved for new JEOL 6500 SEM to be used for nanoscale imaging and e-beam lithography;
- Beginning of Jumpstart Research Program sponsored by CFN in Nanotechnology using existing division facilities in Micro/Nanofabrication.

Laser and Optics

- Superconducting RF injector, a collaborative project between IO, CAD and a small LI company AES has been designed, built and is being tested;
- Ultra high vacuum system for photocathode development of RHIC II (electron cooling) has been designed, procured, assembled and tested;
- Laser beam profile and bandwidth required to generate high harmonic, VUV and XUV radiation has been achieved as a part of the LDRD project;
- Using high-intensity femtosecond light pulses, >100 nm spectral broadening via self-phase modulation is observed from Xeon pressurized in a hollow capillary tube;
- The transient Columb field of a relativistic picosecond electron bunch is measured to <40 picosecond on a streak camera using the electro optical technique.

Optical Metrology

- Completed and installed a customized Long Trace Profiler (LTP) optical head at BESSY II in Berlin for use on an ultra-precision optical measuring machine;
- Assisted Ocean Optics in conversion of non-standard LTP at Crystal Scientific, UK, into the current version;
- Installed a new LTP IV at the Canadian Light Source in Saskatoon, Saskatchewan;
- Use of new phase plate beamsplitter results in superior LTP stability.

Significant Awards

- Science and Technology Award, B. Yu, 2002
- BNL Engineering Award, J. Fried, 2002
- IEEE Fellow, 2003

Publications

No. of Peer Reviewed Pubs:	24	No. of Refereed Pubs:	3
No. of Internal Reports:	0	No. of Invited Papers:	4
No. of Books:	0	No. of Conf Proceedings:	20
No. of Other Pubs:	0		

Number of Patents, Disclosures, Licenses and Royalties

- Patent on tw-phase peak detector was issued, G. DeGeronimo, #US 6,512,399
- “Method of Fabricating a High Aspect Ratio Microstructure”, J. Warren, issued May 6, 2003

- US Patent: “Photo Generator” T. Srinivasan-Rao, October 1, 2002, #US 6,459,766 B1. International patents also for this invention
- US Patent: “Method of surface preparation of niobium”, T. Srinivasan-Rao, et al. Feb 25, 2003, Patent # US 6,524,170 B2
- Record of invention: “ Resonant repetition rate up/down converter for commercial lasers”, T. Srinivasan-Rao, Pct. 29, 2002
- Royalties received from LTP patent licensed to Ocean Optics, Inc., P. Takacs.

Proposals

- “Advanced 3He Neutron Detector Prototype with Pad-Readout for the SNS”, PI G. Smith, C. Britton, DOE BES, \$2.9M
- “Advanced X-Ray Detectors for Synchrotron Radiation”, PI D. Siddons, V. Radeka, P. O’Connor, G. De Geronimo, P. Rehak, DOE BES, \$960K
- Development of high duty factor, high brightness, all niobium, superconducting RF gun Ongoing CRADA, PI: T. Srinivasan,-Rao, \$250 k

LDRD Initiatives

- Advanced 3He Detectors for the Spallation Neutron Source, Submitted, PI: G. Smith.
- Micro- and Nano-machining of materials using ultrashort light pulses, submitted, PI: T. Tsang
- Technique towards attosecond optical pulse measurements – surface-like third-harmonic-generation in the XUV, submitted, PI: T. Tsang
- Applications of supercontinuum light source and data visualization to biological problems, submitted, PI: Sebastian White
- Generation of Coherent, femtosecond, high Brightness VUV and x ray beams Using High Order Harmonic Conversion LDRD, T. Srinivasan-Rao, \$130 k.

Technical Committees

Radeka, V.

- Member, SNS Detector R&D Executive Committee;
- Journal Reviewer, IEEE Transactions on Nuclear Science, Nuclear Instruments and Methods, Review of Scientific Instruments.

O’Connor, Paul

- Journal reviewer, IEEE Transactions on Nuclear Science;
- Technical reviewer, ATLAS TRT ASDBLR chip;
- “ , ATLAS MDT ASD8 chip;
- “ , ATLAS LArg calorimeter Front End board;
- “ , ATLAS LArg calorimeter Deep Submicron digital chip set;
- Secretary, BNL Council;
- Member, BNL WFO Strategic Planning Task Force;
- Organizer, 5th International Meeting on Front End Electronics for High Energy, Nuclear, Medical, and Space applications, Snowmass CO.

DeGeronimo, G.

- Reviewer for IEEE and DOE.

Li, Zheng

- Reviewed papers for IEEE, NIM, and proposals for DOE's SBIR and ADP.

Srinivasan-Rao, T.

- Laser SBMS Committee, T. Srinivasan-Rao.

Tsang, T.

- Journal reviewer for Optics Letters, Physical Review Letters, and for DOE SBIR.

Warren, J.

- Serves as Co-leader of the Nanopatterning Cluster, Center for Functional Nanomaterials.

Takacs, P.

- Reviewer for Applied Optics, Optical Engineering, and Reviews of Scientific Instruments;
- Optical Fabrication and Metrology Program Review committee at the Advanced Photon Source, Argonne National Lab.

Additional Comments

O'Connor, Paul

- Short course presenter, IEEE Nuclear Sciences Symposium, Nov. 2002;
- Mentor, co-op summer student Emerson Vernon.

DeGeronimo, G

- PI for new CRADA with eV Products (II-VI Inc.) for "Development of Peak Detector/De-randomizer ASIC for Multi-Sensor Signal Processing"

Srinivasan-Rao, T.

- Photocathode research for electron cooling of RHIC beam Program Development, Program Development, T. Srinivasan-Rao, \$160 k;
- Affirmative Action Advisory Committee, T. Srinivasan-Rao.

Takacs, Peter

PI for CRADA with Ocean Optics, Inc. of Dunedin, Florida for new LTP developments.

1.1.1.4 Superconducting Magnet Division

Significant Accomplishments

LHC Program

- Delivered four of five D1 dipole magnets. The fifth one has completed testing and is awaiting CERN approval prior to shipping.
- Completed assembly of all nine D2 dipole magnets. Testing has been completed for five of these, and preparation for shipping is underway.

- Completed assembly of all six cold mass assemblies needed for three D3 dipole magnets. Commenced cryostat assembly.
- Commenced assembly of all three D4 dipole cold mass units.
- Tested 406 samples of superconducting cable.

SNS Program

- Completed magnetic measurements for six first article magnets (26Q40 quadrupole, 30Q58 quadrupole, 24D68 dipole, 21S26 sextupole, 26S26 sextupole, 36CDM30 multipole corrector, 27CD30 corrector).
- Completed magnetic measurements for 115 production magnets (41CDM30 corrector (2), 26Q40 quadrupole (3), 21S26 sextupole (1), 21Q40 quadrupole (29), 27CDM30 corrector (30), 21CO26 octupole (9), 21CS26 sextupole (9), and 17D 120 dipole (32).

RHIC Helical Dipole Spares Program

- Completed assembly of two of three spare helical dipole storage units and commenced assembly of the third. Completed testing of one.

AGS Snake Program

- Completed detail design for AGS Snake coils; commenced assembly.

GSI Program

- Completed assembly of fast ramping R&D magnet, featuring cored Rutherford cable. Commenced testing.

High Field Magnet R&D

- Completing detail design for 12 T Nb₃Sn common coil magnet using “React & Wind” technology.
- Successfully built and tested a slotted coil using flexible pre-reacted Nb₃Sn cable.
- Successfully produced coils from HTS cables with no significant degradation in conductor performance.
- Successfully produced small diameter test coil for a final focus magnet for the Next Linear Collider.

Publications

No. of Peer Reviewed Pubs:	15	No. of Refereed Pubs:	1
No. of Internal Reports:	3	No. of Invited Papers:	N/A
No. of Books:	N/A	No. of Conf Proceedings:	N/A
No. of Other Pubs:	N/A		

LDRD Initiatives

- High field NMR
- NLC – final focus magnet R&D
- Niobium Tin superconductor R&D

Technical Committees

- U.S. LHC Accelerator Steering Committee, M. Harrison

- U.S. ATLAS Project Advisory Panel, M. Harrison
- LHC Machine Advisory Committee, M. Harrison
- LHC Cost and Schedule Committee, M. Harrison
- Muon Collider Technical Advisory Committee, M. Harrison
- DPF Wilson Prize Committee, M. Harrison
- SNS Accelerator Systems Advisory Committee, M. Harrison
- FNAL Run II Director's Review, M. Harrison
- DOE ITER Review, M. Harrison
- DESY Machine Advisory Committee, M. Harrison
- U.S. Linear Collider Task Force, M. Harrison
- Accelerator Test Facility External Committee, M. Harrison
- 2003 Particle Accelerator Conference Program Committee, P. Wanderer
- 2003 Magnet Technology Conference Scientific Program Committee, P. Wanderer
- FNAL Review Committee for Internal Review of Superconducting Magnet R&D, P. Wanderer
- DOE HEP Review Committee for LBL, P. Wanderer, A. Ghosh
- International Organizing Committee, 13th Annual Magnet Measurement Workshop, P. Wanderer, A. Jain
- BNL Center for Functional Nanomaterials (CFN) Project Oversight Team, M. Harrison
- BNL Environmental Management Project Oversight Team, M. Harrison
- BNL Cryogenic Safety Committee, R. Thomas, J.F. Muratore, M.L. Rehak, K.C. Wu
- BNL Lectureship Committee, P. Wanderer
- BNL Technology Transfer Coordinating Committee, E. Willen

Additional Comments

- Lectures on "Magnetic Field Measuring and Mapping Techniques", CERN Academic Training Program, A. Jain
- Lectures on Superconducting Accelerator Magnets, U.S. Particle Accelerator School, R. Gupta, A. Jain

1.1.2 Basic Energy Sciences

1.1.2.1 Chemistry Department

Significant Accomplishments

Thermal, Photo and Radiation Chemistry

- The first mechanistic investigation of a spin-forbidden proton-transfer reaction has shown that spin restrictions create an energy barrier that slows the proton transfer by 5 orders of magnitude. Spin-forbidden processes are fundamentally important in chemical dynamics, but this is the first such investigation for a proton-transfer reaction. The reactions studied relate to the chemistry of nitric oxide, a free radical of vast biological and environmental significance.
- LEAF provided the first spectra and reactive dynamics of solvated electrons in ionic liquids, a new class of environmentally friendly solvent. Ionic liquids promise to reduce solvent use in chemical manufacturing and to improve processing of nuclear fuel and radioactive wastes, but their chemistry is not well studied. Surprises being explored include a lifetime of a

reactive mobile form of the electron (“dry electron”) thousands of times that in normal solvents.

- A LEAF study of the transport of charges on long conjugated molecules (“molecular wires”) in solution showed that positive charge (“holes”) captured on 15 nm long conjugated molecules transported to traps at either end within ~10 ns. The work showed efficient charge transport in a class of molecules which may ultimately be useful in solar energy conversion.
- A novel experimental technique at LEAF demonstrated the collection of fast (ps-ns) kinetic chemical reaction data in a single accelerator shot. The development will open up faster kinetic studies of charge transfer dynamics in novel synthesized molecules which are available only in small quantities and are crucial for planned scientific studies.
- Theoretical chemists developed a self-consistent model to treat electron transfer energetics in cases where thermal fluctuations modulate tunneling energy barriers (e.g. of the superexchange type) This addresses a major theoretical challenge to formulate a compact framework for treating the dynamics of electronic transport in complex condensed-phase molecular assemblies entailing multiple charge transfer steps and involving intermediate states of widely variable lifetimes. The electron-phonon coupling coefficients needed to implement this new model may be obtained from detailed molecular-level calculations.
- Combined experiment and theory demonstrated that reactivities of metal radicals vs. ligand radicals in formation of a metal-metal bonded species and a metal-carbon dioxide adduct differ by 8 orders of magnitude. Formation of a ligand radical is thus undesirable in photochemical carbon dioxide reduction, in contrast to the general view in artificial photosynthesis that a ligand radical is helpful for a long-lived excited state. New photocatalyst designs are needed for solar energy conversion involving carbon dioxide.
- Conceptual work outlined the principles of a molecular switch based upon current flow through a Donor-Bridge-Acceptor (D-B-A) system inserted between two metal electrodes. By utilizing D/A couples with small reorganization energies, switching can be achieved at modest applied potentials. This system depends on an electron hopping mechanism which can exploit the nuclear factors, along with the field resulting from the applied voltage, to control the current.

Molecular Dynamics

- A recently completed chemical dynamics experiment utilized coherent radiation produced by the High Gain Harmonic Generation – Free Electron Laser at the National Synchrotron Light Source. The technique of Ion Pair Imaging Spectroscopy determined the dissociation dynamics and product internal energy distribution of methyl fluoride in an FEL generated dissociation process.
- Crossed molecular beams combined with velocity map imaging of reaction products to provide new information on chemical dynamics of combustion and atmospheric chemistry reactions. Studies of oxygen atoms reacting with alkanes showed dramatically contrasting results for ground and excited state oxygen reactants and showed that the products were highly excited - more so than previously believed.
- Chemists applied a novel numerical method, the two-layer Lanczos algorithm, to speed up calculations of rotational and vibrational states of molecules up to six atoms. The method reduced calculation time by a factor of 10, and enabled studies of molecules of 5 or 6 atoms

using a rigorous theory. This is important for thermodynamic and spectroscopic studies of combustion and greenhouse gases.

- Chemical dynamics provided a quantitative tool for resolving problems in molecular spectroscopy of methylene, an important intermediate in combustion. Photofragment Doppler line shapes and thermalization kinetics provided distinctive markers to support or refute otherwise ambiguous assignments of the irregular electronic line spectra of methylene.
- Spectroscopic experiments acquired new benchmark-quality measurements of photofragment polarization and correlated state distributions of CN from jet-cooled NCCN, which challenge dynamical and statistical theories of radical-radical reactions.
- There is little or no persistent methanol product in the reaction of methyl and hydroxyl radicals at pressures less than six torr using time-of-flight mass spectrometry, and chemists are pursuing confirmation of this puzzling result with infrared spectroscopy. This work builds on the successful completion of an apparatus for radical-radical real time reaction measurements.
- *Ab initio* electronic structure calculations determined geometries and vibrational frequencies of stationary points on the methanol ground-state potential energy surface. These enabled classical dynamics studies of the O(1D) + CH₄ and CH₃ + OH reactions and elucidated important oxygen + alkane combustion reactions.
- Extensive *ab initio* electronic structure calculations addressed the structure of Ti₈C₁₂, a recently observed “magic number” nanocluster. Extensive tests showed that simplifications good enough for smaller molecules can lead to incorrect predictions of the structure. Converged predictions of the structure required surprisingly high level of theory and can lead to better approximations for future structural calculations.

Molecular Processes - Catalysis

- A soluble catalyst that precipitates for reuse has recently been discovered. It is a tungsten-based catalyst that dissolves into a liquid reactant mixture, completely transforms the reactants into a new liquid product, and precipitates as a reusable catalyst once its work is done. This novel material eliminates the generation of hazardous waste and has been demonstrated for the production of alkoxysilanes.
- Nanoparticles of gold deposited on a support of Titania can absorb and dissociate sulfur dioxide more efficiently than either pure gold or bare Titania surfaces. Catalytic removal of sulfur dioxide is a key process in air pollution control and this enhanced reactivity was uncovered in synchrotron photoemission experiments (JACS 124, 5242 (2002)).
- STM and XPS studies provided mechanistic details of the oxidation of Mo nanoclusters supported on gold, the formation of MoO₃ and the spreading of oxide. Mo oxide formed ramified two-dimensional islands covering a substantially larger fraction of the Au surface than the metallic Mo (JACS 125, 8059 (2003)).
- We have studied theoretically metal nanoparticles on the Au(111) interface and show that the metal particles energetically prefer to be embedded into the surface or form Au/metal particles/Au(111) sandwich like structures. This explains the previously observed deactivation of the Mo/Au interface to CO, O₂, and S₂ adsorption, now understood to result from the passivation of Mo as a result of the intermixing between Mo and Au. (PRB 67, 155416 (2003)).

- Using in situ time-resolved X-ray diffraction, X-absorption and first-principles density functional calculation, we have demonstrated the importance of kinetic effects for formation of well-defined suboxides during a reduction process and the activation of copper oxides catalysts. (JACS, in press).
- A magnetron sputtering source has been used in conjunction with mass spectrometry to generate ion beams of *size-selected* clusters and nanocrystallites of a number of early transition metal (Mo, Nb, Zr, Ti) carbides and sulfides. These nanostructured materials are expected to exhibit unique catalytic properties that can be “tuned” through variations in size, structure and deposition support.

Radiotracer Chemistry and Biological/Neuroimaging

- Building on PET imaging evidence that smokers have reduced brain monoamine oxidase (MAO), a new PET study shows that smokers have reduced MAO in peripheral organs - the kidneys, heart, lungs and spleen. This demonstrates that effects of tobacco smoke extend far beyond the lung and upper respiratory tract. MAO B is a crucial enzyme that breaks down neurotransmitters, and too much or too little can adversely affect health and behavior.
- PET imaging scientists carried out the first successful imaging of the norepinephrine transporter (NET) in the primate brain and studies are underway to translate this tracer to humans. The brain NET is recognized to be involved in depression and other CNS disorders and is an important molecular target in the drug development for depression and ADHD. Brain imaging of NET has previously been hampered by the lack of suitable radiotracers.
- Investigations of brain function during microdialysis using microPET imaging have shown significant decreases in brain function as a result of probe placement. Microdialysis is a neurology technique used to directly measure neurotransmitter levels in the brains of rodents and other animals, with an implanted sampling probe in a specific brain region. The new results indicate that probe placement must be considered in analyzing microdialysis results.
- This year we licensed the patent for the use of gamma vinyl GABA (GVG) in addiction treatment, and treatment trials are underway in cocaine addicts. The patent is based on our strategy for addiction treatment using GVG, an epilepsy drug which inhibits signaling from dopamine, the brain’s major reward chemical. We discovered that GVG stops addictive behaviors in animals for drugs including cocaine, nicotine, heroin and methamphetamine.
- The FDA approved our proposal to begin imaging in smokers and control subjects with a new radiotracer we have developed which binds selectively to nicotine binding sites in the brain. Nicotine is the major addictive component of cigarette smoke. The binding sites for nicotine in the human brain are involved in the addictive properties of nicotine and also appear to be involved in degenerative disorders.
- We have simultaneously combined MicroPET and microdialysis in the same animal to better understand the quantitative relationships between changes in radiotracer binding and corresponding changes in neurotransmitter levels. This cross validation of two important neuroscience tools is fundamental to all further microPET radiotracer studies and solidifies microPET/microdialysis in animals as a combined neuroscience tool for drug studies.
- Research has overcome a major hurdle in PET imaging of awake animals by miniaturizing and integrating the detector and electronics of a PET camera which fits onto the head of an awake rat, and a prototype is nearing completion. The miniature camera will maintain a fixed position on the animal’s head and thereby avoid blurring. This will allow imaging without the use of anesthesia which reduces brain function.

- We have imaged plant metabolism using short-lived positron emitters, carbon-11 (half life: 20.4 min), nitrogen-13 (half-life: 10 min) and oxygen-15 (half life: 2 min), and are beginning systematic imaging studies of the effects of environmental stressors on plant metabolism. This work is enabled by a unique capability for longitudinal studies through nondestructive imaging in a new environmentally controlled plant metabolism chamber where plants are exposed to labeled substrates, then imaged using phosphor plate imaging or the PET camera.

Magnetic Resonance Imaging

- Scientists introduced the NMR "Shutter-Speed" concept as an important new quantitative tool for analysis of "diffusion-weighted" MRI. The shutter speed, or the inverse of the NMR time-scale for water interchange between tissue compartments in biological samples being imaged, can change dramatically during an MRI experiment due to different diffusion coefficients, e.g. for extracellular and intracellular water. Diffusion-weighted MRI is clinically used for early detection of stroke, for the tracing of tissue fiber tracts, and for the detection of brain function; the shutter speed concept will improve the quantitative analysis in these applications with the potential to improve clinical diagnosis, and generally impact *in vivo* MRI.
- The shutter speed concept improved pharmacokinetic parameters obtained from dynamic-contrast-enhanced MRI, in which a contrast reagent is followed as it passes through a tissue region of interest. Such studies are used in the detection and diagnosis of cancer, in the assessment of myocardial infarction, and in the detection of multiple sclerosis lesions in the brain, among many indications. Parameters obtained without proper treatment for the changes in effective diffusion coefficient were found to be underestimated, in some cases by factors of two to three, and substantial improvement is foreseen by use of the shutter speed analysis.
- We have developed magnetic resonance techniques to measure blood-brain barrier permeability of water and applied these methods to study human brain. This is important development because it provides a fundamental physiological measure that could be very sensitive to disease pathology and can readily be used to obtain serial measurements (Proc. Int. Soc. Magn. Reson. Med. 11 2188 (2003))
- We have developed efficient magnetic resonance acquisition and post-processing techniques that allow quantitation of brain water as well as morphological properties. We have applied these methods to determine the effects of sex, aging, and disease on human brain properties. Our findings include:
 - Women have increased brain water content compared to men. Furthermore, we observed that brain water content was positively associated with plasma estradiol levels which are modulated during normal menstrual cycles. (Proc. Int. Soc. Magn. Reson. Med. 11 123 (2003))
 - Brain water content increased with age for men, with marked increases in water content after the sixth decade. This change is thought to reflect increased gliosis with normal aging. Cortical gray matter loss was evident for men with a linear dependence through the fifth decade, after which white matter losses were more dominant. Women were much more immutable with age than men. (Proc. Int. Soc. Magn. Reson. Med. 11 1087 (2003)).

- Our techniques allow quantitation of subtle water content increases in multiple sclerosis normal appearing white matter, thought to reflect microscopic disease, as well as macroscopic disease measures (i.e. white matter loss due and atrophy). Both macroscopic and microscopic disease measures were found to be associated with clinical performance deficits. This emphasizes the importance of being able to objectively measure total disease burden in multiple sclerosis, and is likely to be useful in evaluating new therapies. (Neurology, 55 P04.088 (2003))

Neutrino Physics

- SNO's publications in 2002 in Physical Review Letters, in which the Solar Neutrino Problem was "solved" by the first-time measurement of the solar neutrino Neutral Current flux, were rated as comprising the number two Scientific News Story of 2002 by the American Physical Society, and by Science Magazine.
- Continued active participation in the Sudbury Neutrino Observatory:
 - Nearing completion of the two-year "Salt Phase" of SNO operations, with the goal to amplify the signal from the neutrino Neutral Current Interaction. An article on this work will be submitted for publication later this year.
 - Involved in preparations for the insertion into the SNO detector of the proportional counters that will detect neutrons and serve as the "Neutral Current Detectors".
 - Preparation of an article on the observation of atmospheric muons and atmospheric neutrinos is nearing completion.
- Research on indium-loaded organic liquid scintillators for the LENS project (Low-Energy Neutrino Spectrometer): Developed procedures for the synthesis and characterization of organic complexes of indium methylvalerate in 1,2,4-trimethylbenzene, and evaluation of their properties as liquid scintillators for neutrino detection.

Nuclear Physics (PHOBOS)

- Performed a deuteron-gold control measurement that confirmed that the "jet quenching" seen in gold-gold is due to a hot, dense, strongly interacting medium. Along with those of other RHIC experiments, this result will be on the cover of an upcoming Physical Review Letters.
- Published, with a BNL staff member as lead author, the result that "limiting fragmentation" is seen in gold-gold collisions over the full range of RHIC energies. This will also appear in Physical Review Letters.
- Submitted, with a BNL staff member as lead author, the result that the multiplicity per participating nucleon pair in gold-gold collisions scales in a universal way when compared with proton-proton and electron-positron collisions.

Significant Awards

- 2002 NOBEL PRIZE IN PHYSICS to *Raymond Davis Jr.* "for pioneering contributions to astrophysics, in particular for the detection of cosmic neutrinos." Davis shared the prize with Masatoshi Koshiba of Japan, and Riccardo Giacconi of the U.S.
- 2003 ELECTION TO THE NATIONAL ACADEMY OF SCIENCES for Joanna Fowler as a "world leader in the synthesis of compounds labeled with short-lived positron emitters for positron emission tomography [and] applications of these compounds to human brain biochemistry..."

- Awarded three scientists (Mark Baker, Jean Logan and Dave Schlyer) tenure.
- 2002 SCIENCE AND TECHNOLOGY AWARD to Yu-Shin Ding “for five pioneering contributions that have moved the field of radiotracer chemistry and BNL’s PET imaging program forward.”
- 2003 BROOKHAVEN TOWN WOMEN’S RECOGNITION AWARD IN SCIENCE to Diane Cabelli
- 2003 BNL Spotlight awards to *Stephen Howell* and *Jean Petterson*

Publications

No. of Peer Reviewed Pubs:	106	No. of Refereed Pubs:	0
No. of Internal Reports:	N/A	No. of Invited Papers:	48
No. of Books:	N/A	No. of Conf Proceedings:	10
No. of Other Pubs:	N/A	No of Formal Report:	1

Number of Patents, Disclosures, Licenses and Royalties

Patents, Disclosures, Licenses and Royalties:

3 Patents:

- “Treatment of Addiction and Addiction-Related Behavior”
- “Application of Chiral Critical Clusters to Asymmetric Synthesis”
- “Novel treatment for Obsessive-Compulsive Disorders (OCD) and OCD-related disorders using GVG”

4 Disclosures:

- “The Use of Vitamin B6 Supplementation to Mitigate the Visual Field Deficits Produced by the Administration of Gamma-vinyl GABA (Vigabatrin) in Humans.”
- “The use of ¹¹C-Toluene and other Radiolabeled Volatile Organic Compounds to Study Inhalant Abuse.”
- “Imaging and Quantifying Carbon Utilization in Plants Using ¹¹CO₂.”
- “The use of anti-glaucoma agents to mitigate the ophthalmological toxicity produced by the administration of gamma-vinyl GABA”

Significant New Hires

- The recruitment of our new Department Chair brings to BNL a prominent and experienced scientist and technical manager. His scientific interests in surface science, ultrafast laser studies and a wide range of optical probes of materials make a natural fit with several expanding research efforts in the Chemistry Department.
- Goldhaber Fellow hired to carry out fundamental research concerning basic mechanisms of chemical dynamics and reactivity in complex molecular assemblies.

Proposals

- "PET Investigations of Abused Inhalants," Madina R. Gerasimov, NIH NIDA Funding: \$345K per year (7/01/02-6/30/05).
- “Optimizing Intensity and Duration of GVG Pharmacotherapy,” Stephen Dewey, NIH Funding: \$242K per year (9/30/02-8/31/05).
- Nanocatalysis \$550K yearly. P.I. Michael White, Jan Hrbek, James Muckerman
- Nanocharge Transfer \$650K yearly. P.I. Carol Creutz

LDRD Initiatives

- “New Development of Norepinephrine Transporter Radioligands for PET Studies of Substance Abuse, Depression and ADHD, \$112K.
- “Hydrogen Atom Transfer from Carbon to Metal – Relevance of a Novel Reaction to Catalyzed Hydrocarbon Conversions”, \$80K.
- “Radioprotection in *D. Radiodurans*, a Radiation Resistant Bacterium”, \$75K.
- “Experiments in the Short-Wavelength Regime Pertinent to the DUV_FEL Concept”, \$132K.
- “Imaging Tandem Mass Spectrometry for High-Throughput “Fingerprint” Detection of Complex Molecules in Mixtures, \$113K.
- “Condition: Green Chemistry Radiolytic Studies of Ionic Liquids in Service of Security and the Environment”, \$80K.

Editorial Activity and Major Book Articles

6 Book Chapters

BNL Committees

Administrative Council, S. McAlary

BNL Council, R. M. Bullock, J. Miller

BNL Institutional Review Board, D. Schlyer, R. Ferrieri

BNL Radioactive Drug Research Committee, D. Schlyer

BNL-USB Relations Committee, C. Springer, J. Muckerman, R. Holroyd

Brookhaven Lecture Committee, G. Hall, J. Wishart

BNL Cultural Outreach: Concert Committee, J. Muckerman

Central Shops Users Group, C. Koehler, Jr.

Computer Security Representative, M. Kahanda

Cyber Security Advisory Council, J. Muckerman

Institutional Animal Care and Use Committee, D. Cabelli

Laser Safety Advisory Committee, G. Hall

Lectureship Committee, C. S. Springer

OPSEC Working Group, R. Hahn

Research Library Advisory Committee, J. Hrbek

Technology Transfer Coordinating Committee, M. Bullock

1.1.2.2 National Synchrotron Light Source

Significant Accomplishments

- *A new powder and single crystal diffraction beamline was completed.*
The new bending magnet beamline, X6B, utilizes a Si(111) monochromator, tunable from 5 keV to 20 keV, and a double focusing mirror. The beamline was constructed to meet the increasing demand of nanoscience users for powder and single crystal x-ray diffraction.
- *A new protein crystallography beamline was completed and user operation started.*
The beamline was funded by the National Institutes of General Medical Sciences to meet the increasing demand in protein crystallography. The beamline consists of a Si(111) monochromator, tunable from 7 keV to 20 keV, and a double focusing mirror.
- *The X17 Superconducting wiggler beamline was upgraded.*

This beamline is the only high-energy x-ray insertion device at the NSLS and serves a large and very productive earth science and high-pressure users community. Two new experimental hutches were constructed which can be operated simultaneously, thus significantly increasing the amount of beam time available to each user community.

- *Low-energy x-ray beamline was upgraded.*
The X19A beamline is the best low-energy beamline at the NSLS. A new monochromator was designed and installed in FY03 to improve the cooling of the monochromator crystals. The new design improves energy and intensity stability and serves the catalysis, environmental science, magnetism and bio-materials user communities.
- *A high-speed position sensitive detector for powder diffraction was developed.*
The high-speed position sensitive detector for powder diffraction permits the study of reaction mechanisms, phase transformations, chemical kinetics and materials under applied loads, voltage, chemical potential and other influences in situ and in real time. That device took existing technology and adopted a highly-parallel readout strategy, combined with digital signal processing for position interpolation, to generate a high-resolution, high-speed device.
- *The DUV-FEL conducted an important series of experiments.*
The experiments included Self Amplified Spontaneous Emission (SASE) lasing at 400 nm, direct laser seeding of the electron beam at 266 nm, and HGHG from 800nm laser seed light to 266 nm FEL light. Initial chemical science user experiments probing new scientific opportunities enabled by this unique source were initiated.
- *A digital orbit feed-back system was implemented for the NSLS X-Ray Ring.*
This system permits greater control of electron orbits within the ring and increases overall stability of the synchrotron light for research.

Significant Awards

- *D. Lynch and G. Rakowsky:* Brookhaven Lab Engineering Award 2003
- *Lisa Miller:* Summer, 2002: Department of Energy Outstanding Mentor Award

Publications

Publications	<u>Users/Staff</u>		<u>Users/Staff</u>
No. of Peer Reviewed Pubs:	269/75	No. of Refereed Pubs:	269/80
No. of Internal Reports:	N/A/2	No. of Invited Papers:	N/A/2
No. of Books:	5/4	No. of Conf Proceedings:	18/33
No. of Other Pubs:	4/7		

Number of Patents, Disclosures, Licenses and Royalties

Total: One (1)

- L.D. Chapman, M. O. Hasnah, O. Oltulu, Z. Zhong, J. Mollenhauer, C. Muehleman, K. Kuettner, M. Aurich, E.D. Pisano, R. E. Johnston, W. C. Thomlinson and D. Sayers, "Diffraction Enhanced X-ray Imaging of Articular Cartilage", US patent #657,7708, awarded on June 10, 2003.

Significant New Hires

- A condensed matter physics experimentalist with research interest in strongly correlated electrons and biophysics was hired. Recently, he has developed a new soft x-ray resonant

scattering technique to directly probe the spatial distribution of carriers in high T_c superconductors.

- A biophysics experimentalist with research interest in membrane physics, as well as anti-microbial peptides and membrane proteins, was hired. Recently, he used x-ray scattering to provide the first direct test for different models of membrane fusion.
- A condensed matter physics experimentalist with research interest in nanoscience was hired. He is developing a new microprobe and microdiffraction beamline optimized for nanoscience experiments.
- A promising young condensed matter physics experimentalist with interest in magnetism and transition metal oxides was hired. She will help the NSLS expand the user communities into these areas.
- A physicist with outstanding expertise in high brightness photoinjectors and free electron lasers was hired. This person provides an important asset for our programs at the DUV-FEL.

Proposals

- "Laser Seeded Free Electron Lasers & High Gain Harmonic Generation Experiments at the Source Development Laboratory of the NSLS", funded by Office of Naval Research, FY03, \$200K.
- "X-ray Micro-diffraction Instrument at the NSLS X13B Mini-Gap Undulator Beamline", funded by DOE-BES, FY03, \$814K
- "Metal Ions and Protein Structure in Protein-Folding Diseases" funded by NIH, FY03, \$205.6K/year for four years.
- "NanoScience Patterning of Soft and Biological Materials", funded by DOE-BES, FY03, \$450K/year to the NSLS for three years.
- "BNL Environmental Molecular Science Institute", funded by DOE-BES, FY03, \$310K.
- "Diffraction Enhanced Imaging of Articular Cartilage", funded by NIH, FY03, \$500k/year for 3 years.
- "Diffraction Enhanced Imaging of Micro-fracture in bones", funded by DOD, \$100k/year for 3 years.

LDRD Initiatives

- Development of CZT Array Detector Technology for Synchrotron Radiation Applications
- New Applications of Circular Polarized VUV-Ligh
- Prototype Approaches for Infrared Nanospectroscopy
- Pressure-Induced Protein folding monitored by Small Angle X-ray Scattering and Fourier Transform Infrared Microspectroscopy
- Soft CondensedMatter Probed byLow-Energy Resonant Scattering
- Femto-Second Transmission ElectronMicroscope Based on Photocathode RF gun
- X-Ray Photon Correlation Spectroscopy Studies for Nanostructured Block Copolymers
- Ultrafast X-ray Science
- Femto-Second Synchronization for Ultra-Short Pulse DUV-FEL Radiation
- Rapid Wavelength Tunability for the DUV-FEL
- High-Gain Harmonic Generation at the DUV-FEL
- Exploring the use of Powder Diffraction for Proteins
- Element-Resolved Dynamics of Nanoscale Ferromagnets

- Membrane Biophysics Using Single-Layered Lipid Membrane

Editorial Activity and Major Book Articles

Editorial Activity

- Referee for papers submitted to NIM vol. A, S. Kramer
- Co-Editor of Journal of Synchrotron Radiation, L. E. Berman
- Editorial Board Member of "Liquid Crystals", 1996-present, R. Pindak

Major Book Articles

- S. Krinsky, "Fundamentals of Hard X-Ray Synchrotron Radiation Sources." In Third-Generation Hard X-Ray Synchrotron Radiation Sources, Ed. Dennis Mills, John Wiley & Sons, Inc, 2002.

Technical Committees

BNL Committees

- Brookhaven Council, S. Hulbert, Chair 2002-2003; L. Berman, P. Siddons, Members 2003-2004
- Brookhaven Lecture Committee – S. Ehrlich - Member
- Brookhaven Safety Improvement Committee, R. Casey – Member
- CD-1 Presentation Team for the Center for Functional Nanomaterials, 2003, R. Pindak - Member
- Center for Functional Nanomaterials User Administration Committee, 2002-3, R. Pindak - Member
- Committee to select the architectural/engineering firm for the Center for Functional Nanomaterials, 2002, R. Pindak - Member.
- Cryogenic Safety Committee, P. Mortazavi - Member
- Research Library Advisory Committee, L. Berman - Member
- Search Committee for the Director of the Center for Functional Nanomaterials, 2002, R. Pindak - Member.
- Technology Transfer Committee, Z. Zhong - Member

Conference Organization

- 2003 National Synchrotron Light Source Annual Users' Meeting, 2002-3, R. Pindak – Program Chair
- 2003 National Synchrotron Light Source Annual Users' Meeting, 2002-3, L. Miller – Member, Organizing Committee
- 2003 NSLS User's Meeting Workshop on Spectroscopies in High Magnetic Fields, L. Carr Co-organizer.
- Accelerator Section Special Session, Health Physics Society Annual Conference, July, 2003, R. Casey – Program Chair
- BIO-MATTERS: from IR to X-rays, NSLS User meeting, May, 2003, V. Stojanoff - Member
- Crystallization, May 19th, 2003, V. Stojanoff – Member
- International Conf. on Low Energy Excitations in Solids (LEES '02), L. Carr - Co-organizer.

- International Organizing Committee: “Workshop on Infrared Microscopy and Spectroscopy”, Lake Tahoe, CA, July 8-11, 2003, L. M. Miller.
- Workshop on “Mechanical Engineering Design of Synchrotron Radiation Equipment & Instrumentation” Program Committee, September, 2002, E. Haas, P. Mortazavi - Members

External Technical Advisory Committee Memberships

- Advisory Board and Technical Advisory Committee (Chair of Technical Advisory Committee), L. Berman – Member
- National Institute of General Medical Sciences and National Cancer Institute Synchrotron, L. Berman – Member
- Scientific Advisory Committee for the Alberta Synchrotron Institute, L. Carr – Member
- US National Committee for Crystallography, L. Berman - Member
- X-Ray Spectroscopy Proposal Review Panel, Advanced Photon Source, Argonne National Lab., 2003-2005 L. M. Miller - Member

Professional Societies

- American Society of Mechanical Engineers – Particle Accelerator & Applications Committee – E. Haas – Chair
- Accelerator Section, Health Physics Society, R. Casey - President

Reviews of Other Facilities

- DOE Review of the High Intensity Gamma Source, Duke University, September 2002, S. Krinsky - Member
- Review of APS: Review of APS Radiation Safety Program at ANL, March, 2003, R. Casey – Chair
- Review of LBNL: Internal Review of the LUX machine, Lawrence Berkeley National Laboratory, April 2003, S. Krinsky –Member
- Review of LBNL: Internal Review of Ultrafast X-ray Science Facility, Lawrence Berkeley National Laboratory, March 2003, S. Krinsky – Member

1.1.2.3 Material Science Department

Significant Accomplishments

- Kinetics of Bi monolayer phase transitions on Au(111) have been measured on a millisecond time scale by X-ray intensity transients measurements using a low resistance drop cell. Fast coarsening of randomly adsorbed adatoms was found in the formation of the (2 × 2) Bi monolayer, demonstrating the role of surface diffusion in phase transition kinetics.
- A possibility of using Pt monolayer level deposits as active electrocatalysts for O₂ reduction was demonstrated by placing a Pt monolayer on carbon-supported metal nanoparticles and on Au(111) single crystal surfaces. The mass-specific activity of such catalyst is 2.5 times higher than that of standard Pt electrocatalysts.
- Synthesis of a new family of borinate anion complexing agents: Prior to this we have synthesized anion complexing agents based on electron deficient boron sites that are coordinated with various fluorinated aryl or alkyl electron withdrawing groups. The compounds were borane, borate or boronate compounds. The boranes are the best

compounds but are difficult to synthesize. Borates are easy to synthesize but are chemically and electrochemically unstable. Boronates are easy to synthesize and are stable. However, they have high molecular weight and they increase electrolyte viscosity. The new borinates offer the best compromise because they are easy to synthesize, are stable, and have a lower molecular weight. Furthermore, they are excellent anion complexing agents that result in the dissolution of LiF, which is normally insoluble in conventional non-aqueous solvents.

- Demonstrated the ability of anion complexing agents to stabilize anions, such as PF₆⁻, in non-aqueous electrolytes: All conventional non-aqueous electrolyte solvents, including poly(ethylene oxide), are Lewis bases that interact strongly with cations. These solvents differ from water in that there is no mechanism, like hydrogen bonding, which permits interaction with anions. The anions in non-aqueous solvents are not coordinated by a solvent, so they can easily undergo chemical and electrochemical attack. This is particularly true for anions such as PF₆⁻ or BF₄⁻. We have shown that addition of our borane anion complexing agent stabilizes PF₆⁻. More recently, a group at Uppsala University have confirmed a similar effect for BF₄⁻.
- A visualization technique developed in the Materials Science department revealed that previous processes elucidated in the initiation of pitting in stainless steel cannot be blindly applied to the study of aluminum corrosion. Noise observed in the case of stainless steel is associated with passivity breakdown and repair while in aluminum somewhat similar noise arose from the growth of pits.
- Rational functionalization of single wall carbon nanotubes including the development of solution phase ozonolysis techniques, organic derivitization of carbon nanotubes, the functionalization of carbon nanotubes with inorganic coordination complexes containing catalytic metal atoms, and the synthesis of nanotube-nanocrystal heterostructures. These efforts have significantly enhanced the purification, exfoliation, and solubilization of carbon nanotubes.
- A low-temperature hydrothermal reaction has been utilized to generate crystalline barium titanate and strontium titanate nanotubes, which have been characterized by means of X-ray diffraction and transmission electron microscopy, coupled with energy dispersive X-ray analysis.
- High precision data obtained on the microcrystallography of porphyrins using synchrotron radiation at 20K unambiguously established molecular structures, mapped the electronic and stereochemical consequences of electron transfer (free radicals), and provided the needed basis for theoretical calculations that predict or rationalize electronic properties. Comparison with density functional theory emphasized the importance of combining structural and theoretical studies.
- The work on conformationally designed porphyrins (i.e. with different shapes) has been extended to water soluble chromophores which exhibit excited state behavior in water comparable to the novel properties observed for nonplanar porphyrins in nonaqueous media. These results establish that the potential use of such photosensitizers can now be extended to environmentally benign aqueous media.
- The theory on ac losses in thin films in perpendicular magnetic fields, [D. V. Shantsev, et al., Phys. Rev. B 61, 9699 (2000)], was tested for the first time using a thin YBCO film at 77 K up to applied magnetic fields of ~ 0.15 T. This experimental work demonstrated that the theory works well.

- Studies of an epitaxial liquid assisted growth process developed at Brookhaven National Lab for the production of thick films of high temperature superconducting YBCO has increased our understanding of the complex and unconventional growth process. This work has led to the successful growth of thick films which is a necessary step toward the mass-production of superconducting wires.
- Theoretical work in the superconductivity group clarified the similarities and differences between the strain effects on the physical properties of 123-phase cuprate superconductors arising from external stress and from “chemical pressure” due to doping.
- Thin films of interspersed ferromagnetic/antiferromagnetic nanocrystallites Ni/NiO and Co/(Mn,Co)O are found to exhibit non-intuitive effects such as depressed ferromagnetic TC and moment compensation behavior. For example, in the Co/(Mn,Co)O films the noted exchange bias shift becomes larger with larger ferromagnetic phase saturation and the film remanance undergoes an as-yet unexplained increase with increasing temperature.
- A high resolution magneto-optic imaging system was built which allows study of magnetic interactions in great detail and it’s propagation in real time. Using this apparatus, magnetic flux jumps in superconductors were directly captured and studied as well as the correlation between flux pinning and structural defects in superconductors.
- Working in collaboration with Profs. Hermann, Sampath, and Gambino at Stony Brook, we have fabricated superconducting coatings of magnesium diboride on flexible metal foils. The coatings attained 39 K critical temperature, as found in bulk MgB₂, in the as-deposited condition. Work is now underway to improve the density of the deposit and control the deposition process.
- Electron holography experiments were carried out on Ca-doped and undoped YBCO bicrystals to measure the grain boundary space-charge distribution at nanoscale. A new understanding of the physics controlling the interfacial superconductivity has been gained through the experiments and data analysis based on band-structure modeling.
- Progress in electron microscopy for magnetic imaging includes the derivation of the magnetic transport-of-intensity equation that establishes the fundamental relation between the magnetic-phase contrast and the micromagnetic parameters of materials such as nano-scale supercurrents in superconductors and nanomagnetization in magnetic materials.
- Quantitative electron diffraction method (PARODI) developed at BNL was further improved by combined use of electron holography to measure the mean inner potentials and to study valence electron distribution in Si and MgB₂.
- 0.14nm resolution has been achieved on our STEM instrument for Z-contrast. Nano-probe EELS has been used to study a wide range samples, especially the newly discovered MgB₂ superconductors on the hole-state symmetry near the Fermi level, and the results were compared with DFT calculations.
- A deconvolution method based on the Richardson-Lucy maximum likely-hood algorithm has been developed to eliminate the intrinsic distortion of the CCD camera and to significantly improve the energy resolution of EELS experiments.

Significant Awards

- Y. Zhu, Distinguished Science and Technology Award, BNL, Jan. 2003
- R. Klie, John H.L. Watson Memorial Scholarship, International Congress of Electron Microscopy, Durban, South Africa, Sept. 2002.
- S. Wong, 3M Nontenured Faculty Award

- L. Lewis, DOE Office of Science Undergraduate Research Programs Outstanding Mentor Award, Feb. 2002.

Publications

No. of Peer Reviewed Pubs:	97	No. of Refereed Pubs:	
No. of Internal Reports:		No. of Invited Papers:	1
No. of Books:		No. of Conf Proceedings:	28
No. of Other Pubs:			

Number of Patents, Disclosures, Licenses and Royalties

- H. Isaacs: Visual surface analysis
- L. Lewis: Double magnetocaloric effect
- L. Lewis: Novel hysteresis mechanism in hybrid permanent magnets
- L. Lewis: Simple magnetic field amplification of functional magnetic materials

Significant New Hires

- J. Misewich: Chairman, Materials Science Department. Misewich brings fresh leadership to the MSD and enhances the nanoscience activities at BNL.
- L. Cooley: Associate Scientist, Superconductivity Group. Cooley has an excellent record in superconductivity with a special interest in the recently discovered superconductor magnesium diboride. His research will enhance the development of synthesis at BNL.

Proposals

- Y. Zhu, J. Wall, and P. Rehak: "Understanding aperiodic structure and non-spherical charge density, electron orbital, and spin of functional materials", \$200K.
- L. Cooley: "Understanding Flux-Pinning Limits, React-and-Wind Strand Optimization, and Critical Current Measurements of High-Energy Physics Superconductors", DOE-HEP, \$37.5K FY2003, \$150K October 2003.
- J. Misewich, "Studies of Individual Nanotubes", \$120K.
- J. McBreen, "Low Platinum loading catalysts", \$50K.
- M. Renner, "Synchrotron based structural studies of hydrophyrin sensitizers for photodynamic therapy", DOE funded CRADA, \$262K.

LDRD Initiatives

- L. Wu et al., "Nanostructured transition metal oxides" \$40K.
- M. Renner, "Chemical sensors: immobilization of organometallic complexes into sol-gel matrices", \$86K.
- M. Balasubramanian, "In situ soft x-ray absorption spectroscopy studies of cathode materials for thin film lithium-ion batteries", \$80K.
- L. Lewis, "Functional bulk Mn-based nanocomposites", \$28K.
- L. Cooley, "New synthesis techniques to control atomic defects in advanced intermetallic compounds", \$88K/yr
- Q. Li, "High resolution magneto-optic studies of magnetic materials", \$26K
- S. Wong, "Size dependence of catalytic activity of iron oxide nanocrystals", \$104K

Editorial Activity and Major Book Articles

- Y. Zhu, Editorial Board, Micron, the International Research & Review Journal for Microscopy
- Y. Zhu, co-editor, MRS Symposium Proceedings Vol.727, Nanostructured Interfaces, with J.M. Plitzko, G. Duscher, and H. Ichinose, Sept. 2002.
- Y. Zhu, co-guest-editor, special issue for Ultramicroscopy, 2003, in press.
- Y. Zhu, Q. Li, L. Wu, V.Volkov, G. Gu, and A.R. Moodenbaugh, “Microstructure of superconducting MgB₂”, in: Studies of High Temperature Superconductors: Advances in Research and Applications, V.38, pp. 423-442, A.V. Narlikar, Ed., Nova Science Publishers, Huntington, NY, 2002
- R.F. Klie, K. Sun, M.M. Disko, J.Y. Liu and N.D. Browning, “Atomic Scale Studies of Heterogeneous Catalysts”, Encyclopedia of Nanoscience and Nanotechnology (in print)
- J. Fajer, Editorial Board of Spectrochimica Acta.
- H. Isaacs, Editorial board of Corrosion Engineering Science and Technology
- R. Adzic, Editorial Board J. Serb. Chem. Soc.
- R.R. Adzic, “Electrocatalysis on surfaces modified by metal monolayers deposited at underpotentials”, in “Encyclopedia of Electrochemistry”, Vol 1, A. Bard, M. Stratmann, eds., Wiley-VCH, New York (2002).
- R.R. Adzic, J.X. Wang, B.M. Ocko, J. McBreen, “Surface X-ray scattering and X-ray absorption spectroscopy techniques”, in “Handbook of Fuel Cell Technology”, vol. 2, V. Vielstich, T. Lamm, H. Geistaiger Eds. J. Wiley and Sons. 279, 2002.
- D.O. Welch, “Fundamentals of Superconductivity:Characteristic properties: Normal State vs. Superconductor”, Chapter A2.1, Handbook of Superconducting Materials, David Cardwell and David Ginley, editors, Institute of Physics Publishing Limited (Bristol, 2003).
- L. Cooley, Technical editor, 2002 Applied Superconductivity Conference (Aug 2002)
- L. Cooley, Editorial advisory board, Superconductor Science and Technology

Technical Committees

- Y. Zhu, Member of International Relation Committee, MRS (2003 - 2006);
- Y. Zhu, Coordinator, Transmission Electron Aberration-free Microscopy (TEAM) project, DOE (2002--)
- Y. Zhu, National Review Panel, Instrumentation for Major Research and Materials Research Instrumentation, NSF (2002)
- J. McBreen, Financial Policy Committee, The Electrochemical Society, Inc.
- H. Isaacs, Chair: Uhlig Award Committee, The Electrochemical Society
- H. Isaacs, Whitney Award Committee, NACE International
- R. Adzic, 4th International Electrocatalysis Conference, Como, Italy Sept., 2002.
- L. Lewis, Executive Committee, American Physical Society Topical Group on Magnetism (GMAG); term ends 2006.
- L. Lewis, Program Chair, INTERMAG03, Boston, MA, March 31 – April 3 (2003).
- L. Lewis, Program Committees: National Advisory Committee, 17th International Workshop on Rare Earth Magnets and Their Applications (2002)
- D. Welch, Superconducting and Magnetic Materials Committee (Chairman, 2002), Electrical, Magnetic, and Optical Materials Division, The Minerals, Metals, and Materials Society (TMS).

- L. Cooley, Board member, International Cryogenic Materials Commission. 2003 International Cryogenic Materials Conference is September 21-26, Anchorage. I am on the program, awards, and other committees.
- L. Cooley, Technical committee 90 – “Superconductivity” – US National Committee to the International Electrotechnical Commission
- L. Cooley, DOE-HEP wire development oversight committee

1.1.2.4 Condensed Matter Physics

Significant Accomplishments

Neutron Scattering

Research accomplishments

- Experiments provide important new insights into relaxor ferroelectrics
- Measurements of high-energy, zone-boundary spin waves in stripe-ordered $\text{La}_{1.69}\text{Sr}_{0.31}\text{NiO}_4$ reveal a very modest renormalization and surprisingly weak anisotropy in the dispersion compared to the undoped parent
- Optical conductivity measured on stripe-ordered $\text{La}_2\text{NiO}_{4.133}$ has, for the first time, been interpreted in terms of mid-gap states associated with charge stripes
- The change from short-range to long-range charge order in going from layered to cubic manganite and cobaltate compounds is explained in terms of quenched disorder and a dimensional crossover

Instrumentation Developments

- Proposal to build a *hybrid spectrometer* (HYSPEC) for the Spallation Neutron Source has passed Critical Decision 0 (CD0)

X-ray Scattering

Research accomplishments

- Commenced program in soft-matter at nanotemplated surfaces, making 3 new hires, including a Goldhaber Fellow
- Commenced program in soft x-ray resonant scattering, making 1 new hire - First results in April 2003
- Observation of holon-antiholon continuum in quasi one-dimensional Mott insulator SrCuO_2
- Systematic study of molecular orbital excitations and their Cu-O bond length dependence in various cuprates
- Investigated structure of alkane thiols on liquid mercury and discovered dimerization between neighboring sulfurs.
- Began the studies on kinetic processes in thin organic films in controllable environments using time resolving GISAX/Interferometry system
- Completed study of fatty acid cation binding and polymer concentration series
- Published significant results running contrary to 15-year established thought on stereochemical recognition and templating

- Discovery of a second solute state of large inorganic ions

Instrumentation Developments

- Commissioning of new CCD and APD detectors at beamline X22B
- GISAX setup combined with spectroscopic interferometer for in-situ study of structure of thin films under different environments

Condensed Matter Theory

Research accomplishments

- The correlation functions of the staggered magnetization were calculated exactly for a representative case of four chains.
- The theory for inelastic Neutron Scattering in transverse-field Heisenberg chains was developed.
- The existence of magnetic excitations with fractional spin (spinons) was proven for a Heisenberg model of a frustrated magnet in $D > 1$
- The correlation profile of the Internet was calculated
- The Transfer Matrix and Random Matrix Theory ideas were applied to study the diffusion on the Internet network and allowed us to detect its modular structure.
- The role of gene duplication in the evolution of protein interaction and regulatory networks was analyzed.
- Hierarchical and anti-hierarchical networks were constructed and studied.

Electron Spectroscopy

Research accomplishments

- Photoemission studies of the low-energy excitations in different low-dimensional systems, including strongly correlated materials.
- Infrared studies on high-temperature superconductors revealed different energy scales of the superconductivity associated with the metallic or non-metallic normal state.
- Grew and studied various oxide films on metal surfaces that could be used as gate dielectric in tailored FET devices.

Instrumentation Developments

- New analyzer with sub meV resolution placed at the U13UB beamline at the NSLS and used for the highest resolution photoemission studies.
- New optical system with strong-focussing optics for a high-pressure diamond anvil cell has been built and placed at the U10A beamline at the NSLS for studies in vibrational spectroscopy.

Materials Synthesis and Characterization

Research accomplishments

- Discovery of irreversible pressure-induced hydration in a zeolite
- Development of nanocrystallography by applying pair-distribution functions

- First single crystal growths using flux method (CeCoIn₅, CrSb₂, FeSb₂)

Instrumentation Developments

- New focusing optics on X7A using Si111 to provide 200 micron beam without contamination from $\lambda/2$
- Establishment of new synthesis & growth capabilities including sol-gel and ‘soft synthesis’
- Commissioning of a hydrothermal diamond anvil cell to perform simultaneous measurements at high pressure and high temperatures at beam line X7A/NSLS

Significant Awards

- Doon Gibbs – 2003 Advanced Photon Source Arthur H. Compton Award
- John Hill – APS Fellowship
- Oleg Gang – Goldhaber Fellow
- M. Tsvetlik – APS Fellowship
- Award of Tenure, May 31, 2003 (Christopher Homes)
- Yongjae Lee : Sidhu Award (Pittsburg Diffraction Society) & Van Valkenburg Award (Gordon Conference on High Pressure Physics and Chemistry)

Publications

No. of Peer Reviewed Pubs:	68	No. of Refereed Pubs:	85
No. of Internal Reports:	3	No. of Invited Papers:	12
No. of Books:	9	No. of Conf Proceedings:	19
No. of Other Pubs:	1		

Number of Patents, Disclosures, Licenses and Royalties

Tianbo Liu

- Polyoxomolybdates and Polyoxomolybdates-related Derivatives as a Novel Class of MRI Contrast agent”, passed phase-1 BNL evaluation (scientific importance and originality check by outside lawyers), under phase-2 evaluation (economic potential).

Tom Vogt

- Invention disclosure of a new family of luminescent materials

Significant New Hires

- A new Assistant Physicist (C. Petrovic) was hired to initiate our program in Materials Synthesis
- A new Assistant Physicist (J. Gardner) was hired as part of the BNL-NIST alliance
- O. Gang was appointed a Goldhaber Fellow to initiate studies in Soft Condensed Matter

Proposals

- "HYSPEC: A Crystal-Time-of-Flight Hybrid Spectrometer for the Spallation Neutron Source", CD0 approval in June 2003, DOE, budget of at least \$9M to be determined in detail

- DOE NSET Proposal “Nanotemplate Directed Assembly of Soft and Biomaterials”, funded for \$750,000/year DOE 2002 (Ocko(PI), E. DiMasi, T. Liu, L. Yang(CoPI’s))
- NSF NIRT Proposal “Wetting of Surfaces with Nano-Scale Structures”, Funded for \$1,000,000, for 4 years, Ocko and Gang (Co PI’s)
- Nanocenter Proposal (involved in 3 or 6 thrust areas) funded for \$85,000,000 (B. Ocko, and Doon Gibbs, section leaders, E. DiMasi, T. Liu and J. Hill, contributors.)
- Proposal for a new MGU-based micro-diffraction instrument at NSLS beamline X13B, submitted under DOE BES LAB03-03, Fully funded at \$815K, approved June 2003.
- Proposal for a new SAXS/GISAXS at X9, submitted under DOE BES LAB03-03, Expected funding in 2004.
- Theory Institute for Strongly Correlated and Complex Systems, S. Maslov and A. M. Tsvelik, DOE funding in the first year: \$300K.
- Systemic analysis of molecular networks, I. Mazo, S. Maslov, N. Daraselia, S. Egorov – NIH/NSF Funding: \$170K/year for 4 years.

LDRD Initiatives

- Polyoxometalate giant molecules: novel synthetic methods, characterizations and potential applications, \$ 100K (Tianbo Liu)
- Biomineralization – A route to advanced materials, LDRD 02-67 funded at \$100K, \$105K/annum FY02-03, Elaine DiMasi P.I., support PI salary
- High pressure in strongly correlated materials (Christopher Homes)
- Completed LDRD from FY02 Self organized nanoparticles (Myron Strongin)
- “Exploratory Sol-Gel Synthesis Routes” LDRD 03-127

Editorial Activity and Major Book Articles

- J. Tranquada, Divisional Associate Editor for Physical Review Letters
- Editorial Board, Journal of Physics: Condensed Matter (John Hill)
- T. Liu completed book chapter “Light Scattering by Protein” for *Encyclopedia of Surface and Colloid Science*, pp. 3023-3044, A. Hubbard Ed., Marcel Dekker, Inc., 2002
- Adzic, R.R., Wang, J.X., Ocko, B.M., and Mcbreen, J. EXAFS, XANES, SXS. In: *Handbook of Fuel Cells-Fundamentals, Technology and Applications*, W. Vielstich, A. Lamm, and H.A. Gasteiger (Eds.), Vol. 2, pt. 3, pp. 279-301, John Wiley & Sons, Ltd., Chichester, 2003
- Nelson, C.S., Hill, J.P., and Gibbs, D. Resonant X-ray Scattering as a Probe of Orbital and Charge Ordering. In: *Nanoscale Phase Separation and Colossal Magnetoresistance*, Chapter 9, pp. 179-183, Elbio Dagotto (Editor), Springer-Verlag, Publisher, 2002
- Gibbs, D., Hill, J.P. and Vettier, C. New Directions in X-ray Magnetic Scattering. In: *Third Generation Hard X-ray Synchrotron Radiation Sources: Source Properties, Optics and Experimental Techniques*, pp. 267-310, D. Mills, Editor, J. Wiley & Sons, Inc., Publisher, 2002
- Hill, J.P. Magnetic X-ray Scattering. In: *Characterization of Materials*, p. 752, John Wiley & Sons, 2002
- A. M. Tsvelik completed the second edition of his book “Quantum Field Theory for Condensed Matter Physicists” for Cambridge University Press

- S. Maslov wrote an invited book chapter in the “Handbook of Graphs and Networks”, published by Wiley-VCH
- F.H.L. Essler finished a book entitled "Hubbard Model" accepted for publication by Cambridge University Press
- Griffiths, P.R. and Homes, C. Instrumentation for far-infrared spectroscopy. In: Handbook of Vibrational Spectroscopy, Vol. 1 (Theory and Instrumentation), John Chalmers and Peter Griffiths, Editors, John Wiley & Sons, New York, Publisher

Technical Committees

Service Activity for DOE Program and/or Nat'l/Regional level

- Lehman Review Committee for SNS, November 2002+May 2003, J. Tranquada
- LANSCE and IPNS Review, October 2002, J. Tranquada
- SNS-HFIR User Group Executive Committee, 2002-2003, J. Tranquada
- NCNR Program Advisory Committee, September 2002+May 2003, J. Tranquada
- HFIR Proposal Review Committee, December 2002, J. Tranquada
- Executive Director, IXS-CAT (John Hill)
- Review Committee, Physical Review Letters (Doon Gibbs)
- Selection Committee, Adler Award (Doon Gibbs)
- Proposal Review Panel, Advanced Photon Source (John Hill)
- Member, Scientific Advisory Group for the Center for Soft Condensed Matter, University of Oslo and University of Trondheim, Norway (Doon Gibbs)
- Chair, Search Committee Associate Division Director, Advanced Photon Source (John Hill)
- Chair, Search CMC Search Committee, Advanced Photon Source (Ben Ocko)
- Proposal Review Panel, XMAS, European Synchrotron Radiation Source (John Hill)
- User Program Advisory Committee, XFEL project, MIT/Bates (John Hill)
- Chairman, Beamline Review Committee, ALS, Berkeley (Peter D. Johnson)
- Member, Cross-cutting Review of Magnetism Committee, ALS, Berkeley (Peter D. Johnson)

NSLS beamline development

- X6B – powder diffraction consortium
- X13B – microbeam diffraction consortium
- X9 – SAXS, GISAXS, GID beam line consortium

Conferences Organized

- 2003 X-ray Physics Gordon Conference, July 2003 (Doon Gibbs)
- Novel Insertion Devices, Advanced Photon Source, December 2002 (John Hill)
- Soft-Matter and NSLS II, Septemeber 2003 (Ben Ocko)
- Strongly Correlated Electron Systems and NSLS II, August 2003 (John Hill)
- Session Chair, Gordon Research Conference on Biomineralization, August 2002 (Elaine DiMasi)
- Session Organizer on Electrodeposition, Materials Research Society, November 2002 (Ben Ocko)
- NSLS workshop on synchrotron microbeams in nanoscience, May 2003 (Elaine DiMasi)
- Co-chairman International Workshop on Low Energy Electrodynamics in Solids, Montauk, October 2002 (Peter D. Johnson)

- Co-chairman 9th International Workshop on Low Energy Electrodynamics in Solids, Uppsala University, July 2003
- International Advisory Board VUV Radiation Conference (Peter D. Johnson), 1998-2007
- Program Committee, International Workshop on Low Energy Electrodynamics in Solids, Montauk, 2002 (Christopher Homes)

BNL Committees

- BNL Council, S. Shapiro
- Director's Safety Committee, S. Shapiro
- NSLS proposal review committee, summer 2002, X-ray scattering (Tianbo Liu)
- BNL Physics Colloquium Committee (Elaine DiMasi)
- NSLS Beamtime Allocation Committee (Elaine DiMasi)
- Nanocenter Thrust Leaders (Ben Ocko and Peter D. Johnson)
- Condensed Matter Physics Seminar Committee (Young-June Kim)
- NSLS beamline allocation panel (Elaine DiMasi)
- Senior scientists Committee (Alexei M. Tsvelik)
- Seminar Committee (Fabian H.L. Essler)
- Computer Security Liaison (Fabian H.L. Essler)
- Colloquium Committee (Sergei Maslov)
- Affirmative Action Committee (Myron Strongin)
- Physics Department Colloquia Committee (Christopher Homes, Chairperson)
- Condensed Matter Physics Seminar Committee (Tony Valla)
- Condensed Matter Physics Seminar Committee (Christopher Homes, Chairperson)
- CFN Management Team to obtain CD-1 (Tom Vogt)
- CMP Future Committee Chairman (Tom Vogt)
- VUV SPIG Rep NSLS Users Executive Committee (Peter D. Johnson)
- Technical Coordinator in Project Team for Construction of CFN (Tom Vogt)

1.1.3 Life Sciences

1.1.3.1 Biology Department

Significant Accomplishments

Genomes to Life and related technologies

- To support the DOE Genomes to Life effort we are developing high-throughput molecular methods to elucidate microbial community structure and functioning. This has led to the development of four new proposals that were recently submitted to DOE
- Members of DOE Genomes to Life Experimental Facility Workgroup in Computational Biology
- Developed Genomic Signature Tags (GSTs) as a new system for profiling genomic DNA. (J.Dunn)
- Used GSTs to profile CpG methylation status in human DNA. (J.Dunn)
- Developed the application of modified GST methodology for high throughput analysis of the composition and function of complex microbial communities. (J.Dunn, van der Lelie)

- Developed method to optimize protein folding during overexpression in bacteria. Incorporation of this method into high-throughput protein expression systems used by GTL facility. (P.Freimuth)

Genomics, Proteomics and Crystallography

- Cover Article: A representation of the fold of yeast hypothetical protein with PLP and protein ligand Lys49 which is bound to PLP. *Acta Crystallographica Section D: Biological Crystallography*, Vol. 59, Part 1 (January, 2003). (p.127)
- Development of auto-induction media and protocols for convenient, high-level expression of proteins from cloned coding sequences in the T7 expression system. Filed provisional patent application. First commercial introduction by Novagen in June 2003. (F.W.Studier)
- Two new crystal structures were solved in the Structural Genomics Project. (S. Eswaramoorthy)
- Maria Bewley, BNL Biology and Battelle-Columbus joined together on March 20, 2003 in a Cooperative Research and Development Agreement to determine the structures of microbial proteins, research that may lead to the design of novel anti-microbial drugs. (M.Bewley)
- Identified a gene that is amplified in 12-18% of primary human breast cancers and characterized its relationship to posttranslational modifications of the p53 tumor suppressor gene. (C. Anderson)

Emerging Pathogens

- Using crystallographic methods, significant progress has been made in understanding the translocation mechanism of botulinum molecules through the vesicle membrane has been made. (S.Swaminathan)
- Showed that actin is a cofactor for the adenovirus proteinase. (W.Mangel)
- Crystallized the adenovirus proteinase in the absence of any cofactors and obtained high quality X-ray diffraction data. (W.Mangel)
- Discovered that some viruses can use the most abundant protein in the cells they are infecting to destroy the cells and allow new viruses to escape to infect others. The findings, described in the November 29, 2002, issue of the *Journal of Biological Chemistry* 277: 46298-46303, build upon earlier Brookhaven research on how virus particles become infectious and may lead to the design of more effective antiviral remedies. (W.Mangel)

Plant Sciences

- Proof of the use of *Arabidopsis* trichomes as a model system for cotton fiber development. (B.Burr)
- Developed methods for rational engineering of plant desaturase in order to change their specificity with respect to the placement of the double bond in the fatty acid, the length of the fatty acid that serves the substrate, and the chemical outcome of the reaction. (J. Shanklin)
- Initiated structural studies of the alkane hydroxylase as a model for the lipid modification enzymes. (Shanklin)

Nanoscience

- The Science article (Vol. 299(5614): 1877-1881) issued on March 21, 2003 is a major advance in nanobiotechnology and biosensors. It for the first time couples an enzyme reaction with >10 times the efficiency to an electrode for current generation. (J.Hainfeld)

Facilities/Instrumentation Developments

CryoElectron Microscopy Facility

- Installed and commissioned a cryoEM as a tool for screening purposes
- Renovated biochemistry labs, offices, and room to house large CryoEM scope
- Installed second cryoEM in renovated space

Scanning Transmission Electron Microscopy Facility

- Renewal of STEM NIH Grant for 5 years
- New version of Mass Analysis software and documentation distributed to users
- New simulation software for the entire EM protocol: specimen description, imaging, detection, and analysis
- Development of a new STEM Detector for improved imaging of nanostructures

Macromolecular Crystallography Facilities

- Development and operation of Rapid Access Crystallography program
- Development and operation of the Mail-In Crystallography program at the Biology PX beamlines at the NSLS as featured in the journal article Nature 423: 799-800, June 19, 2003
- Optimized the performance of the X12C beamline and diffractometer for data collection. This beamline produces almost the same number of publications as the much more intense beamline X25
- Implemented comprehensive upgrades of NSLS beam line X12B (D.Schneider)
- Direct fabrication of cryogenic crystal changing robot for use in rapid screening and machine assisted data collection

NASA Space Radiation Laboratory Tissue Culture Support Facility

- Fully commissioned facility in collaboration with C-A and Medical Depts.
- Recruited and hired two assistant scientists to manage NSRL tissue culture facility and user program
- A grant was submitted to NASA for the establishment of a “Center for Space Radiation Neurobiology” to take advantage of the institution's strengths in neuroscience and the new NASA Space Radiation Laboratory which is located at Brookhaven. Collaborators have also been recruited from several other institutions

Educational

- Two graduate students from Stony Brook obtained Ph.Ds after doing thesis work in the Biology Department
- Organized annual RapiData 2003 (Rapid Data Collection and Structure Solving at the NSLS: A Practical Course in Macromolecular X-Ray Diffraction Measurement) Course and the Cold Spring Harbor Course in Protein Crystallography

- Organized a National Center for Biotechnology Information (NCBI) Training, May 22, 2003 in BNL Biology Department

Significant Awards

- S. Swaminathan awarded Tenure, June 1, 2003 for his significant contributions to the structure of complex protein toxins and creative contributions to structural biology methodology
- John Dunn awarded BNL Science and Technology Award in January 2003
- Daniel van der Lelie awarded Office of Educational Programs Outstanding Mentor Award on June 25, 2003

Publications

No. of Peer Reviewed Pubs:	51	No. of Refereed Pubs:	51
No. of Internal Reports:	2	No. of Invited Papers:	7
No. of Books:	2	No. of Conf Proceedings:	4
No. of Other Pubs:	4		

Number of Patents, Disclosures, Licenses and Royalties

- Gross Licensing Revenue for FY02 was \$1,872,000

Patents:

- Sensing Mode Atomic Force Microscope, Hough, Paul V. C. Wang, Chengpu, 2/11/2003, 6,518,570, 98-08

Disclosures:

- Media and Procedures for Stable Growth and Maintenance of Expression Strains, and for Auto-Induction of Protein Production in the T7 Expression System in Escherichia coli, Studier, William F. 08-16-2002
- ADS Genes for Reducing Saturated Fatty Acid Levels in Seed Oils, Shanklin, John, Heilmann, Ingo H., 05-12-2003

Licenses:

- Total: 30

Significant New Hires

- Debasish Roy and Mamta Naidu, Assistant Biologists
- Dr. Huilin Li, Associate Biophysicist, will establish a new, independent research program for biological structures using frozen-hydrated electron microscopy (EM) under the LDRD project entitled, "Develop the CryoEM Research Capability at BNL for Biology Applications."
- Kimberly Mayer, Goldhaber Fellow, supported through the Goldhaber Fellowship Program, will be involved in work related to improving the quality of plant fatty acids and storage oils under the Oilseed Engineering Alliance CRADA. (Supervisor: John Shanklin)

Proposals

Recently submitted:

- Genomic Characterization of Pfiesteria spp. Complex, Dunn, EPA \$50k (pending)
- Rapid Detection and Identification of Zoonotic Pathogens, Dunn, NIH, \$1.05k (Funded, expected start 8/03)

- Studies of Proteins that Regulate Polyamine Homeostasis, Flanagan, NIH \$456K (pending)
- High Resolution Gold Labels for EM, Hainfeld, NIH, \$465K (pending)
- SPORE in Skin Cancer, Setlow, NIH, \$64k (pending)
- Structural Studies of Intact Clostridium Botulinum and Neurotoxins Complexed with Inhibitors Leading to Drug Design , Swaminathan, DOD, \$252K (pending)
- Structural Studies on Toxins and Virulence Factors of Yersinia pestis, Swaminathan, DOD, \$391K (pending)
- System for Discovering Bioengineered Threats by Knowledge Base Driven Mining of Toxin Data, Swaminathan, DOD, \$453K (pending)
- Preliminary studies on C. botulinum progenitor toxin B, Swaminathan, NIH, \$92k (pending)
- Compounds Binding to and Neutralizing Botulinum Toxins, Swaminathan, NIH, \$68K (pending)
- Genetic Variation in Human NHEJ DNA Repair Genes, Anderson, NIH, \$320K (pending)
- Adenovirus-Receptor Interaction: Structure, Function and Retargeting, Mangel, NIH, \$296K (pending)
- The Structural Basis of Selective Permeability in Aquaporins, Fu, NIH \$277K (pending)
- Effects of Deep Space Radiation on Human Hematopoietic Stem Cells / Effects of Long-Duration Space Flight upon Stem/Progenitor Cell Biology and Function, Sutherland, B, NSBRI, \$123K (pending)
- STEM Mass Mapping & Heavy Atom Labeling of Biomolecules, Wall, NIH, \$681K (pending)
- Develop a Hybrid Electron Cryo-tomography Scheme for High Throughput Protein Mapping in Whole Bacteria, Li and Hainfeld, DOE \$1700K (pending)
- High-Throughput Biophysical Analyses of Purified Proteins, John M. Flanagan, F. William Studier, John C. Sutherland, Lisa M. Miller, Lin Yang - \$2900K (pending)
- TomoSTEM: A New Instrument for Visualizing Fluorescent Labels at Nonometer Resolution, Wall , DOE, \$3000K (pending)
- New Genomic Strategies and Technologies for High Throughput Analysis of the Composition and Function of Complex Microbial Communities, van der Lelie and Dunn, DOE, \$2,544k (pending)
- “Center for Space Radiation Neurobiology”, Anderson co-PI, NASA-Washington, \$10.2M

LDRD Initiatives

- Understanding the Pathways of Ubiquitin Dependent Proteolysis, Bewley B.
- Structural Characterization of DNA-PK, A Human DNA Double-Strand, Flanagan J.M.
- New Protein Expression Tools for Proteomics, Freimuth P.L.
- High-throughput Structure Determination of the Human Proteome Project, Studier F.W.
- Cryo-EM for Solving Membrane Proteins, Hainfeld J.F.
- Human DNA Damage Responses: DNA-PK and p53, Anderson C.W.
- Molecular Mechanisms Underlying Structural Changes in the Adult Brain: A Genetic Analyses, Dunn J. J.
- Biological Templates for NanoStructures, Flanagan J.M.
- DNA-Nano Wires that AutoConnect in 3 Dimensions (NANO III), Hainfeld J. F.
- Crystallization and X-ray Analysis of Membrane Proteins, Fu D.

- In Vitro Investigation of the DNA Double Strand Break Repair Mechanism by Non-Homologous End-Joining in the context of Chromatin, Lyman E.
- Genomic Selex to study Protein DNA/RNA Interactions in *Ralstonia metallidurans* CH34 Regulating Heavy Metal Homeostasis and Resistance, van der Lelie D.
- Lead Resistance in *Ralstonia metallidurans* CH34, van der Lelie D.
- Design of a *Ralstonia metallidurans* Two-Hybrid Protein System for Studying Signaling Pathways Regulating Heavy Metal Homeostasis and Resistance, Taghavi S.
- Defining New Pathways for Disarming Anthrax Toxin, Freimuth P.L.
- Structural Studies on the Integral Membrane Protein AlkB, Shanklin J.
- Develop the CryoEM Research Capability at BNL for Biology Applications Anderson C.W.

Editorial Activity and Major Book Articles

Major Book Articles:

- J. Howitt, C.W. Anderson, and P. Freimuth. Adenovirus interaction with its cellular receptor CAR. In: *Adenoviruses: Model and Vectors in Virus-Host Interactions. Virion Structure--Viral Replication and Host-Cell Interactions*, W. Doerfler and P. Bohm, Editors, Vol 272: Current Topics in Microbiology and Immunology, Chapter 11, pp. 331-364, Springer-Verlag, Heidelberg, Germany (April, 2003)
- S. Swaminathan and S. Eswaramoorthy. Crystal Structure of *Clostridium botulinum* Neurotoxin Serotype B. In *Scientific and Therapeutic Aspects of Botulinum Toxin*, M.F. Brin, M. Hallett, and J. Jankovic, Editors, Chapter 3, pp. 29-39, Lippincott Williams & Wilkins, Philadelphia, PA (2002).

Editorial Activity (this a representative list of the types of editorial activities conducted by the staff):

- Executive Editor, Protein Expression and Purification (J.Dunn)
- Editorial Board for Virology (J.Dunn)
- Editorial Board of the Journal of Histochemistry and Cytochemistry. (J.Hainfeld)
- Reviewer for Biochemistry, Journal of Biological Chemistry, and BioTechniques. (W. Mangel)
- Jane Setlow, Editor, Genetic Engineering: Principles and Methods, Vol. 24, 267p. Kluwer Academic/Plenum Publishers, New York, NY (2003)
- Editor/Reviewer for PNAS (R. Setlow)
- Reviewer for: Photochemistry Photobiology, Cancer Research, Carcinogenesis, Internal Journal Cancer Research, Cancer Epidemiology, Biomarkers and Prevention, and Ageing Research. (R.Setlow)
- Editorial Board: Advances in Plant Biochemistry and Molecular Biology (2002-Present). (J.Shanklin)
- D. van der Lelie, Guest Editor, Plant and Soil (International Journal on Plant - Soil Relationships), Vol. 249, No. 1, February 1, 2003, 236p. This special issue of Plant and Soil is based upon papers presented at two very successful Special Symposia of the 6th International Conference on the Biogeochemistry of Trace Elements (ICOBTE), 1-2 August 2001, held at the University of Guelph, Canada. The first was entitled, "Phytoremediation" and was organized by F.J. Zhao and A.J.M. Baker, and the second, "Phyto-, Microbial and Chemical Remediation Tools for Metal-contaminated Soils and Groundwater", organized and moderated by A.J.M. Baker, D. van der Lelie and J. Vangronsveld.

Journal Reviews (while not all-inclusive, this list represents the types of reviews the staff conducts):

- C.Anderson, Reviewer for FEBS Letter, Molecular Cell Biology, Biochemistry, Nucleic Acids Research, EMBO Journal, Journal of Biological Chemistry, PNAS, Oncogene
- M.Bewley, Reviewer for Acta Crystallographica, Structure, Journal of Molecular Biology
- B.Burr, Reviewer for Crop Science, Genetics, Plant Cell
- J.Dunn, Reviewer for Journal of Molecular Biology and BioTechniques
- J.Flanagan, Reviewer for Cell, Molecular Cell, Nature Structure Biology, Structure, Nature
- P.Freimuth, Reviewer for Journal of Biological Chemistry, Journal of Virology

Technical Committees

BNL Committees

- Members of Brookhaven Council (P.Freimuth) and (W.Mangel)
- Members of Brookhaven Lecture Committee (B.Sutherland, Chair) and (D.Schneider)
- Members of BNL BSA Concert Committee (G.Hind, Chair) and (J.Trunk)
- Member of BNL Cyber Security Advisory Council (D.Schneider)
- Member of BNL Information Technology Leadership Council (J.Wall)
- Member of BNL Integrated Security Group (C.Anderson)
- Member of BNL Institutional Animal Care and Use Committee (N.Manning)
- Members of BNL Institutional Biosafety Committee (P.Freimuth, Chairperson), (B.Burr), (A.Emrick, Coordinator), (S.Lacks), (B.Lade), (J.Setlow)
- Member of BNL Lectureship Committee (G.Hind, Chair)
- Member of BNL Management Council (C.Anderson)
- Member of BNL OPSEC Working Committee (J.Dunn)
- Member of BNL Pollution Prevention Council (A.Emrick)
- Member of BNL Research Library Advisory Committee (B.Burr)
- Member of BNL Science Council (C.Anderson)
- Members of BNL Scientific Advisory Committee for Radiobiology (R.Setlow), (B.Sutherland, Chairperson), (C.Anderson)
- Member of BNL Technology Transfer Coordinating Committee (P.Freimuth)
- Member of BNL Training and Qualifications Management Steering Committee (B.Sutherland)
- BNL Director's Committee (of NAS members) to suggest/recommend BNL staff members for National/Other Awards (R.Setlow)
- Member of the BNL Group to Assist in Establishing and External Advisory Committee for a Proposed "BNL Center for Space Radiation Neurobiology". (R.Setlow)
- BNL Radiation Research Committee (Reviews NASA supported proposals for the use of the AGS or NSRL) (R.Setlow)
- Special Interest Group Representative for Biological Scattering and Diffraction to the NSLS Users' Executive Committee until May of 2003. (M.Becker)
- C.Anderson, Member of the Brookhaven National Laboratory's Center for Data Intensive Computing

Service Activity for DOE Program

- Served on numerous DOE workshops to formulate Genomes to Life program and subsequent calls for proposals
- BES Energy Biosciences Council. The Council on Energy Biosciences is a self-directed, informal forum for the analysis and assessment of research areas that offer new scientific opportunities. The Council organizes workshops and provides background information on new research opportunities relevant to the mission of the program. (Shanklin)
- Served on a special working group in early January 2003 to write on Energy Biosciences Research as part of a factual document on Renewable and Solar Energy that will be included as an Appendix in the future report "Basic Research Needs to Assure a Secure Energy Future." from the Basic Energy Sciences Advisory Committee. (Shanklin)
- On January 19, 2003 participated in a workshop BES will hold in Riverside, California on Systems Plant Biology. The report appeared in the June 2003 issue of Plant Physiology. (J.Shanklin)

Service activity for WFO

- C. Anderson-Post-Translational Protein Modification: Novel Technologies and Implications for Cancer Prevention (8/02).
- C.Anderson, Member of Board of Directors, National Space Biomedical Research Institute, 1999-
- C.Anderson, Member of Battelle Technology Council, 1999-2002
- C.Anderson, Member, Executive Committee, NCI Training Grant, Department of Microbiology, State University of New York at Stony Brook, 2001-
- Member of Genome Study Section, Center for Scientific Review, NIH (J.Dunn)
- Member of Committee to organize Computing for Biology: IBM-BNL Blue-Gene Science Workshop 2003 (P.Freimuth)
- National Research Council, Space Science Board (Task Group on Research on the International Space Station) (R.Setlow)
- Radiation Effects Research Foundation (Visiting Director) (R.Setlow)
- Universities Space Research Association; Division of Space Life Sciences (R.Setlow)
- NASA Committee to review proposals for support to use the NSRL facility at BNL (R.Setlow, B. Sutherland)
- Scientific Advisory Committee for a SUNY/BNL proposal to NASA "Induction of Leukemia by HZE Particles". (R.Setlow)
- Member of NIH Panel to Review a Structural Genomics Program (F.W.Studier)
- Served as a member of the NIH Botulinum Toxin Expert Panel Meeting on November 20, 2002 (S.Swaminathan)
- NIH P-41 Principal Investigators (J.Wall)

Other Technical Committees

- C.Anderson, Conference Organizer, Methods in Protein Structure Analysis 2002 (MPSA2002), Valencia, Spain, September 8-12, 2002
- C.Anderson, Member of the Genetics Training Program, State University of New York at Stony Brook, 1984-

- C.Anderson, Member of the Steering Committee of the M.D./Ph.D. Program, School of Medicine, State University of New York at Stony Brook, 1987-
- C.Anderson, Secretary and Member of the Board of Directors of the International Association for Protein Structure Analysis and Proteomics, 1999-
- Member of Scientific Advisory Committee for the International Conference Series on Methods in Protein Structure Analysis, 1995-
- Members of Advisory Board: Genetic Engineering: Principles and Methods (book published annually by Plenum Press) (C.Anderson and J.Shanklin)
- Carl Anderson, Workshop Organizer, Computing for Biology: IBM-BNL Blue-Gene Science Workshop 2003 to be held July 31 - August 1, 2003 at BNL
- Coordinator, International Rice Genome Sequencing Project (1997-Present). (B.Burr)
- Member of Program Advisory Committee, NIST Center for Neutron Research (D.Schneider)
- Member of a Columbia University Advisory Committee for a Program Project Grant in Radiation Biology (R.Setlow)
- BNL steering committee to launch a new Non-profit BNL education foundation to further science and scientific education in our neighboring communities. (J.Shanklin)
- University at Stony Brook (USB)/BNL 2002 Seed Grant Initiative Evaluation Team (J.Shanklin)
- Chair (elected) of Scientific Program Committee for the National Plant Lipid Cooperative Meeting, Chair of Desaturase session, held in June 2003 at Fallen Leaf Lake, CA. (J.Shanklin)
- Member: International Society for Plant Molecular Biology (J.Shanklin)
- Member: American Society of Plant Physiology (J.Shanklin)
- Member International Committee on Proteolysis (past) Faculty of 1000 (2001-Present) (J.Shanklin)
- Scientific Advisory Board for Institute for Molecular Biotechnology, Jena, Germany (F.W.Studier)
- Member of the Institutional Biosafety Committee, State University of New York at Stony Brook (P.Freimuth)
- Member of the Genetics Training Program, State University of New York at Stony Brook (P.Freimuth)
- Member of the Executive Committee for the Genetics Training Program, State University of New York at Stony Brook (P.Freimuth)

1.1.3.2 Medical Department

Significant Accomplishments

Imaging Program

- The animal MRI installation is on schedule. The space was fully renovated and the instrument is being installed
- In the PET instrumentation area, there was development of RatCAP miniature head-mounted PET tomograph for imaging brain of awake rat; development of novel high-resolution PET detector (monolithic crystal); development of wrist monitor for non-invasive PET input function measurement

- On the pregnant macaques project: set up anesthesia, imaging and co-registration of PET and MRI images; first paper finalized and accepted for publication in Journal of Nuclear Medicine; database under development
- Optical Imaging - effect of drugs of abuse on calcium transients: Optical instrumentation acquired and first physiological data acquired on alive rat (brain) before and during ischemia
- C57BL6 Mouse brain atlas by MR microscopy
 - MRM atlas created using AIR algorithms (abstract submitted to Society of Neuroscience)
 - Segmentation of brain regions initiated in collaboration with Drs. Hof (Mount Sinai) and Ma (Post-doc, Mount Sinai)
 - Effect of selective destruction of granule cell layer on MRM images (Paper submitted to Neuroscience)
- Developed physiological protocol for baboon PET studies which was tested, and retest data are now reproducible and stable
- Synthesized and evaluated four new positron labeled molecules for imaging cannabinoid receptors in the brain
- Undertook experiments with ¹¹C-ethanol for studies on alcohol abuse in humans
- Labeled peptide nucleic acids for imaging gene expression
- Successful recruitment of senior staff scientist, Anat Biegon, to work on PET radioligands
- Recruitment of staff scientist, Congwu Du who has expertise in Optical Imaging and microMRI
- A 'fellow-ship' rotation at BNL imaging program during 3rd year for Anesthesiologist Residents was established
- Established NIH/NIAAA Intramural Program which can lead to other agencies establishing similar programs that utilize our facilities and resources (NCI)
- Clinical Research on the 4 Tesla MRI program is being supported by > 10 NIH funded studies, and the MR group published over 10 papers and presented over 30 posters or oral presentations in 2003
- Served as editors for a special edition journal "Drug Development Research", Gatley, S. J. and Carroll, F. I.) on PET and SPECT in Medication Development
- Published book "Molecular Nuclear Medicine: The Challenge of Genomic and Proteomic to Clinical Practice" L. Feinendegen, W. Shreeve

NASA Space Radiation Research

- The NASA Space Radiation Laboratory (NSRL) was fully commissioned and satellite lab space in Medical was allotted and set up. The facility saw it's first user population in July, 2003
- A grant was submitted to NASA for the establishment of a "Center for Space Radiation Neurobiology" to take advantage of the institution's strengths in neuroscience and the new NASA Space Radiation Laboratory which is located at Brookhaven. Collaborators have also been recruited from several other institutions

Radioisotopes Program

- Organized and ran a Nuclear Chemistry Summer School which is a five week program for undergraduates sponsored by the American Chemical Society

- Brookhaven LINAC Isotope Production Facility successfully developed a solid cyclotron target for simultaneous production of Co-57 and Cd-109
- Successful synthesis with both aqueous and non-aqueous conditions, and characterization (x-ray crystal structure, nmr, etc) of a new 1:1 tin –117m stannic DTPA chelate
- Prepared DOE/NE FWP and material for politicians in an effort to move forward with the proposed Cyclotron Isotope Research Center (CIRC)

Cancer Diagnostics and Therapies

- Showed experimentally that microbeams cause significant vascular damage in tumor tissue only, after 3 hours of irradiation, without any vascular effect on the normal brain. This should have implications in clinical radiotherapy
- Successfully completed pre-clinical BNCT therapeutic efficacy studies involving the boronated porphyrin, code named PP200 using the thermal neutron beam at the MIT research reactor facility
- Research has demonstrated that a halogenated porphyrin, currently under development, acted as a potent radiosensitizer when administered in combination with conventional x-rays. A reformulated version of the porphyrins has demonstrated impressive therapeutic efficacy at much lower doses than those used in the initial pilot study
- Initiated a project to study Stem cell trafficking
- Produced and patented, biologically active synthetic analogs of two growth factors, including basic fibroblast growth factor for use in wound healing and radiation protection, as well as other applications

Significant Awards

- Tenure Award-Gene-Jack Wang
- DOE Mentor Awards: Louis Peña, Onarae Rice, Peter Thanos
- Paul Aebersold Award, Society of Nuclear Medicine, 2003 (Volkow)
- Mid-career Investigator Award in Patient Oriented Research, NIDA/NIH, Chang
- Independent Scientist Development Award from NIDA/NIH, Thomas Ernst
- “Imaging-Science Track Award for Research Transition (I/START)”, Tomasi, Dardo, National Institutes of Health

Publications

No. of Peer Reviewed Pubs:	122	No. of Refereed Pubs:	122
No. of Internal Reports:	0	No. of Invited Papers:	47
No. of Books:	8	No. of Conf Proceedings:	11
No. of Other Pubs:	47		

Number of Patents, Disclosures, Licenses and Royalties

Total: 9

Medical’s Gross Licensing Revenues for FY02 were \$497,000

Disclosures:

- Synthesis of Multicarboranylporphyrins for Radiotherapy and Imaging, Wu, Haitao, 12-2-2002

- Synthesis and Medical Uses of Carborane-Containing Metalloporphyrins, Wu, Haitao, Miura, Michiko, 3-25-2003
- Millennium Pharmaceuticals, Inc. Conjugates for therapy, SPECT and PET imaging, 7/29/2002
- Biosurface Engineering Technologies, Inc., Synthetic Cytokine Analog, 10/08/2002
- Macrocyclics, Inc., Macrocyclic Polyaminocarboxylate Technology, 01/01/2001

Patents:

- Therapeutic Tin-117m Compositions, Srivastava, Suresh C, .Mausner, Leonard F.Meinken, George E., Atkins, Harold L., 99-07, 6,517,810
- Radiopharmaceutical Compositions, Srivastava, Suresh C.Meinken, George E. 00-36, 1/7/2003, 6,503,477
- Metalloporphyrins and their Uses as Imageable Tumor-Targeting Agents for Radiation Therapy, Miura, Michiko, Slatkin, Daniel N. 01-10, 5/20/2003, 6,566,517
- Process for the Manufacture of 117Sn Diethylenetriaminepentaacetic Acids, Srivastava, Suresh C., Li, Zizhong, Meinken, George E. 01-13, 4/1/2003, 6,541,514

Significant New Hires

- C. Du, Assistant Medical Scientist
- P. Guida, Assistant Medical Scientist, was a Research Associate

Proposals

- “National Programs of Excellence in Biomedical Computing (NPEBC)”, Benveniste, Helene, National Institutes of Health, \$742K
- “Developing and Improving Institutional Animal Resources”, Benveniste, Helene, National Institutes of Health, \$694K
- “Maternal-Fetal In Vivo Imaging”, Benveniste, Helene, NI Drug Abuse, \$1.5M
- “GCRC Supplement to the SUNY Stony Brook GCRC Site”, Chang, Linda, National Institutes of Health, \$6.5M
- “Effects of HIV in the Aging Brain: fMRI and 1H MRS”, Chang, Linda, NI Mental Health, \$2.25M
- “X-Ray Microbeams to Enhance Brain Tumor Chemotherapy”, Dilmanian, F. Avraham, Brain Tumor Society \$200K
- “Remyelination Quality Following Minimal - Tissue - Damage Demyelination With Micro Beams”, Dilmanian, F. Avraham, Christopher Reeve Paralysis Foundation, \$150K
- “Effects and Techniques in Microbeam Radiation Therapy”, Dilmanian, F. Avraham, National Institutes of Health \$1.44M
- “Effects and Techniques in Microbeam Radiation Therapy” Dilmanian, F. Avraham, National Institutes of Health, \$2.7M
- “Testing Our Concepts of Remyelination”, Dilmanian, F. Avraham, National Institutes of Health \$620K.
- “Microbeam Radiation Therapy for Gliomas”, Dilmanian, F. Avraham, NI Neurological Disorders + Stroke, \$408K
- “Comparing X-Ray Microbeams and Broad Beams at Optimal Configurations ...”, Dilmanian, F. Avraham, US Department of Defense \$554K

- “BCRP Idea Award: Comparing X-Ray Microbeams and Broad Beams at Optimal Configurations in a Model of Metastatic Breast Cancer”, Dilmanian, F. Avraham, US Department of Defense, \$554K.
- “Bystander Effects and Adaptive Responses Elicited in Low Doses of Low LET Radiation From a High Intensity X-ray Microbeam”, Dilmanian, F. Avraham, US Department of Energy \$1.4M.
- “Cell Responses to Site Specific Low-Dose Low-LET Microbeam X-ray Irradiation”, Dilmanian, F. Avraham, US Department of Energy \$1.2M.
- “X-Ray Microbeams as a New Tool to Study Migration and Repopulation of Oligodendrocyte Progenitors Imaged With MicroPET”, Dilmanian, F. Avraham, US Department of Energy \$1.2M.
- “MicroPET Studies of Brain Damage by Heavy Ion Particles”, Gatley, Samuel John, NASA-Washington, \$1.4M.
- “Center for Space Radiation Neurobiology”, Gatley, Samuel John, NASA-Washington, \$10.2M
- “Human Brain Pharmacokinetics of (-)-Delta-9 THC”, Gatley, Samuel John, National Institutes of Health \$376K.
- “Feto-Maternal Pharmacokinetics of Abused Inhalants”, Gatley, Samuel John, National Institutes of Health, \$526K.
- “PET Studies of Alcohol Distribution and Metabolism”, Gatley, Samuel John, NI Alcohol Abuse and Alcoholism, \$530K
- “An invivo Rat Model for Central Nervous System Damage from HZE Particles” Gifford, Andrew N., NASA-Washington, \$881K
- “Modulation of Neurotransmitter Release by Cannabinoids”, Gifford, Andrew N., National Institutes of Health, \$1.12M.
- “Monoamine Oxidase Inhibition and Nicotine Reward”, Gifford, Andrew N., National Institutes of Health, \$367K.
- “Animal Model for Inhalant Abuse”, Gifford, Andrew N., NI Drug Abuse, \$380K.
- “Imaging Gene Expression with Radiolabeled Peptide Nucleic Acids”, Gifford, Andrew N., US Department of Education, \$1.19M.
- “Behavioral Correlates of fMRI Response in Cocaine Users (K23)”, Goldstein, Rita Z., NI Drug Abuse, \$791K.
- “HZE Radiation Effects on Oligodendrocytes and Progenitors In Vivo”, Pena, Louis, NASA-Washington, \$1.3M
- “New Investigator: Modulation of Specific Radiation Tolerance by FGF-like Peptides.” Pena, Louis, National Institutes of Health, \$1.59M
- “UV and X-ray Microbeams for Cell Stress Signaling Studies”, Pena, Louis, National Institutes of Health, \$958K
- “Sub-Contract on ONR Proposal at SUNYSB - Weiliam Chen SUNY PI: Sustained Delivery of Cytokine Analogs for Burn Wound Healing”, Pena, Louis, ONR - Office of Naval Research, \$457K.
- “Synthetic Cytokine Analog Radiation Protectors”, Pena, Louis, US Army Medical Rsch + Materl Cmmd, \$1.9M.
- “A Novel Plate-Fiber Device for PET/SPECT Imaging”, Srivastava, Suresh, National Institutes of Health, \$2.22M.

- “microPET Imaging and Rodent Models of Drug Abuse”, Thanos, P., National Institutes of Health, \$1,1M
- “Development of non-invasive imaging methods using microPET technology to study the function of stem cells and genes in vivo.”, Thanos, P., NYSTAR, \$200K
- “Acoustic Interference on Attention in HIV Patients”, Tomasi, Dardo, National Institutes of Health, \$264K
- “Brain Dopamine Function in Adults with ADHD”, Volkow, Nora, National Institutes of Health, \$2.6M
- “Brain Dopamine Pathology in Obese Individuals”, Wang, Gene-Jack, National Institutes of Health, \$748K
- “Synthetic FGF Analog for Medical Device Applications”, Zamora, Paul O., National Institutes of Health, \$100K

LDRD Initiatives

- Efficacy of Unidirectional Microbeam Radiation Therapy in Treating Malignant Tumors: Preclinical Studies in Rats and Mice, Dilmanian A.
- Microvascular Endothelial Cells as Targets for Ionizing Radiation: In Vitro and In Vivo Models, Pena L.
- Combination of Magnetic Fields and 20 keV Synchrotron X-rays to produce Microbeams for Cell Culture Experiments, Pena L.
- Gene Expression Profiling of Methamphetamine-induced Toxicity in Neurons in Culture using DNA Microarrays, Vazquez M.
- "Functional Spectral Signature" (FSS) Method for Signal to Noise-Enhancement of Brain Patterns in PET Images, Felder C.
- Creating a MicroMRI Facility for Research and Development, Benveniste H.
- Targeting Tin-117m to Estrogen Receptors for Breast Cancer Therapy, Kolsky K.
- MRI Imaging Program, Chang L.
- Roles of Dopamine Receptor Agonists in Brain Metastasis of Breast Cancer, Lin
- The Micro PET Study of Gene Expression in Rodents, Thanos P.
- Investigation of the Early Response in Functional MRI, Ernst T.
- PET Imaging of Violent Behavior, Wang G.J.
- PET Studies of Acetaldehyde Distribution & Metabolism to Better Understand Alcohol Related Diseases, Li Z.
- Relationship between Dopamine Function and Working Memory, Chang L.

Editorial Activity and Major Book Articles

Journal:

- Gatley, S. J. and Carroll, F. I. “Drug Development Research”, Wiley-Liss Pub (2003).

Book:

- L. Feinendegen, W. Shreeve, et al, Molecular Nuclear Medicine: The Challenge of Genomic and Proteomic to Clinical Practice, Springer Verlag Pub.(2003)

Book Chapters:

- L.F. Mausner, S. Mirzadeh, Reactor Production of Radionuclides, in: Handbook of Radiopharmaceuticals: Radiochemistry and Applications, M.J. Welch and C.Redvanly eds. John Wiley & Sons Ltd., NY (2003)
- S. Mirzadeh, L.F. Mausner, Reactor Production of Medical Radioisotopes, in: Handbook of Nuclear Chemistry, A. Vertes, S. Nagy and Z. Klencsar eds. Kluwer Academic Publishers BV, Dordrecht, The Netherlands (submitted May 2003)
- Gatley, SJ, Volkow ND, Fowler JS, Ding Y-S, Logan J, Wang G-J, Felder C, Telang FW, Gifford AN. Imaging the brain dopamine transporter using PET and SPECT. In Contemporary Neuroscience: Neurotranmitter Transporters: Structure, Function and Regulation, 2nd Edition Reith, M.E.A. (Ed.). Humana Press Inc., Totowa NY, 2002, 433-465.
- Swanson, J.M., Volkow, N.D., Newcorn, J., Casey, B.J., Moyzis, R., Grandy, D., Posner, M. Attention Deficit Hyperactivity Disorder. In Encyclopedia of Cognitive Science. Nadel, L. (Ed.). Nature Publishing Group, London, 2003, pp 226-231
- Srivastava, S.C., Bone Seeking Therapeutic Radiometals. In: Technetium, Rhenium, and Other Radiometals in Chemistry and Nuclear Medicine. M. Nicolini and U. Mazzi, Eds., S.G. Editoriali, Padova, Italy, 2002, pp 305-315
- Srivastava, S.C. Twenty Years of the Technetium Symposium. In: Technetium, Rhenium, and Other Radiometals in Chemistry and Nuclear Medicine. M. Nicolini and U. Mazzi, Eds., S.G. Editoriali, Padova, Italy, 2002, XXVII-XXXVII

Editorial Activity (reviewer, editor) This list is not all-inclusive but is a good representation of the types of editorial activities conducted by Medical Department staff:

- Reviewer, Annual Society of Behavioral Medicine meeting
- Reviewer, "Brain function in substance dependent abused women", Minority Biomed. Research Support program, Meharry Med. College, Nashville, TN., Goldstein
- Reviewer, Psychiatry Research: Neuroimaging; Journal of Psychopharmacology;
- NeuroImage
- Reviewer, Archives of General Psychiatry; American Journal of Psychiatry;
- Neuropsychologia
- Member American Psychological Association; Society for Neuroscience; Cognitive Neuroscience Society; International Society of Magnetic Resonance in Imaging
- Reviewer of Applied Organometallic Chemistry
- Reviewer for Neurology
- Assistant Editor for Neurobase
- Reviewer for Psychopharmacology
- Reviewer for Archives of Neurology
- Reviewer for Journal of Neurology, Neurosurgery and Psychiatry
- Reviewer for Psychiatry Research: Neuroimaging
- Reviewer for Journal of Magnetic Resonance Imaging
- Reviewer for Biological Psychiatry
- Reviewer for American Journal of Psychiatry
- Reviewer for Neuroscience & Biobehavioral Reviews
- Reviewer for Drug and Alcohol Dependence

- Reviewer for Neuron
- Reviewer for The Canadian Journal of Neurological Sciences
- Reviewer for NeuroImage
- Reviewer for Annals of Neurology (2002- present)
- Reviewer for Life Science
- Member, Editorial Board, Bioconjugate Chemistry
- Member, Editorial Board, ALASBMN Journal
- Member, Editorial Board, World Journal of Nuclear Medicine
- Assistant to the Editor, "Salud Mental" Journal of the Mexican Institute of Psychiatry
- Associate Editor, Clinical Positron Imaging
- Editorial Board, Journal of Neuroscience Research
- Publication Committee, ISMRM

Technical Committees

This list, while not all-inclusive, represents technical activities conducted by the Medical Department staff:

BNL Committee

- BNL IACUC (Institutional Animal Care and User Committee) member, Vaska
- BNL Medical Dept CRC Credentialing Committee, Benveniste (Chair), Wang
- BNL Medical Dept. CRC QA Committee, Benveniste (Chair), Chang, Wang
- BNL Policy Council, Benveniste, Chang, Gatley
- BNL Science Council, Benveniste, Chang, Gatley
- BNL Lecture Committee, Dilmanian, Srivastava
- Technology Transfer Coordination Committee, Srivastava
- Research Professor of Radiology, SUNY Stony Brook, Srivastava
- Member, Clinical Research Advisory Committee, BNL; Wang
- BNL Director of Operations for the National Space Biomedical Research Institute (Vazquez)

Service Activity for WFO

- NIH Study Section (NIDA-K Committee) – Bethesda, MD, July, 2002, Chang
- NIH Study Section (NIDA Neuroimaging I/START) - July, 2002, Chang
- NIH Study Section “Hepatitis C Diagnosis, Treatment and Interaction with HIV/AIDS” , Chang
- NIDA Special Emphasis Panel ZDA1 RXL-E(07) – Arlington, VA, August 1st, 2002, Chang
- NIH Study Section “NINDS Special Emphasis Panel ZNS1 SRB-A(02) – Wash., DC, August 26th, 2002, Chang
- NIH Study Section (NIDA-K Committee) – Arlington, VA, November 12-14, 2002, Chang
- NIH Study Section (NIDA-K Committee) – Bethesda, MD, March 12-14, 2003, Chang
- Reviewer for NCCR Special Emphasis Panel, Ernst
- NIH Reviewer, "Neuroimaging technology development to assess brain and behavior in pediatric populations" initiative, Ernst

- NSBRI Associate Team Leader, Radiation Effects Team, National Space Biomedical Research Institute (Vazquez)
- NASA Vice-Chair Scientific Commission F, Life Sciences as Related to Space, COSPAR (Vazquez)

Service Activity DOE

- DOE grant reviewer in 2003-imaging instrumentation

Educational Activities

- Member Electronic Education Committee, ISMRM, Chang
- Dilmanian, Member, Graduate Admissions committee of the Department of Biomedical Engineering, SUNY Stony Brook
- Dilmanian, Member, Ph.D. Qualifying Exam Committee of the Department of Biomedical Engineering, SUNY Stony Brook
- Dilmanian, Member, Curriculum Committee, Medical Physics Program, SUNY SB.
- Research Associate Professor of Radiology, SUNY-Stony Brook , Wang
- Lecturer, Neuropsychological Assessment Graduate course (PSY 563), Department of Psychology, SUNY Stony Brook. Goldstein
- Ph.D. Thesis Committee, SUNY-Stony Brook, NY, Ernst (Chair), Chang
- Supervisor, Internship program worksite, SUNY Potsdam. Goldstein
- Chair, Ph.D. Thesis Examination Committee, University of Oslo, Oslo, Norway,
- Member, Program Committee, American College of Neuropsychopharmacology (ACNP), Volkow
- Member, Nominating Committee, American College of Neuropsychopharmacology (ACNP), Volkow

Society Memberships

- American Psychiatric Association.
- Society of Nuclear Medicine.
- Society for Neuroscience.
- American College of Neuropsychopharmacology.
- Institute of Medicine of the National Academy of Sciences
- Member American Academy of Neurology (elected to be Fellow since June, 2003) Chang
- Member American Neurological Association (elected to be Active Member, since April, 2003) Chang
- International Society of Magnetic Resonance in Medicine (Board of Trustee, 2001 – present) Chang
- American Chemical Society (ACS) Srivastava
- American Association for Cancer Research, Srivastava
- Division of Nuclear Chemistry and Technology, ACS, Srivastava
- Society of Nuclear Medicine (SNM), Srivastava
- Radiopharmaceutical Science Council, SNM, Srivastava
- Therapy Council, SNM, Srivastava
- Clinical Trials Council, SNM, Srivastava
- American Association for the Advancement of Science 1985-2000, Srivastava

- Indo-American Society of Nuclear Medicine, Srivastava
- International Isotope Society, Srivastava
- International Association of Radiopharmacology, Srivastava
- International Society of Radiolabeled Blood Elements, Srivastava
- Federation of Latin American Societies of Nucl. Medicine and Biology – Honorary Lifetime Member, Srivastava
- International Society of Radiopharmaceutical Chemistry and Biology, Srivastava

Committee Membership

- Executive Committee American Chemical Society, Division of Nuclear Chemistry and Technology (DNCT).
- Chair, Seaborg Award Fund-Raising Committee, American Chemical Society
- Member, Society of Nuclear Medicine Pharmacopeia Committee 2000-2003
- Permanent Member, International Steering Committee, Tc, Re, and other Radiometals in Chemistry and Nuclear Medicine
- 6th International Symposium on Tc in Chemistry and Nuclear Medicine, Bressanone, Italy, September 4-7, 2002, International Steering Committee.
- International Scientific Advisory Committee, World Federation of Nuclear Medicine and Biology, 1998-2002

Other

- SNM Representative on the World Radiotherapy Council, Srivastava
- Chair 2003, American Chemical Society Division of Nuclear Chemistry and Technology, Srivastava
- 223rd National ACS Meeting, Orlando, FL, April 7-11, 2002, Chairman and Organizer, Seaborg Award Symposium, Srivastava
- Board of Directors, SNM Therapy Council, 2000-2003, Srivastava
- Board of Directors, International Society of Radiolabeled Blood Elements, 2001-2003
- Member, SNM Radiopharmaceutical Commission, 2001-2003, Srivastava
- IAEA International Expert on Cooperative Research Program and Clinical Trials on Radiosynovectomy, 2001-2005, Srivastava
- Co-organizer, First International Symposium on Advances in Nuclear Medicine and Radiopharmaceuticals (ANMR), Cabo Frio, Brazil, September 25-28, 2002, Srivastava
- International Scientific Program Committee, and Session Chairman, 8th Congress of the World Federation of Nuclear Medicine and Biology, Santiago, Chile, Sept.29–Oct. 4, 2002. Srivastava
- International Task Force and Founding Member, World Radiopharmaceutical Therapy Council, Srivastava

1.1.4 Energy, Environment and National Security

1.1.4.1 Environmental Sciences

Significant Accomplishments

- Continued operations of North Carolina FACE facility and the ARM External Data Center.
- Environmental Sciences, the NSLS and the Earth Sciences Department at State University of New York at Stony Brook, created a new Environmental Molecular Sciences Institute. This NSF/DOE Institute provides end station upgrades to NSLS environmental beam lines, research and development of new environmental applications and training for students.
- Completed New England Air Quality pilot study in collaboration with PNNL and NOAA. BNL provided chemical species measurements made aboard the G1 aircraft.
- Researchers continued developing and reporting new algorithms for the retrieval of aerosol properties from moments of the particle size distribution.

Significant Awards

- Stephen Schwartz, elected Fellow of the American Association for the Advancement of Science
- Paul Kalb named “Innovator of the Year” by LI Business News for inventing a technology called Sulfur Polymer Stabilization/Solidification (SPSS)
- Russell Dietz selected 2002 winner of the OPD Excellent Presentation Award by the American Nuclear Society.
- A. J. Francis invited to serve as advisor to research group in the Japan Atomic Energy Research Institute
- Peter Daum was awarded an Environmental Leadership Award by Southampton College of Long Island University, for contributions and individual achievements in regionally important environmental programs.

Publications

No. of Peer Reviewed Pubs:	41	No. of Refereed Pubs:	
No. of Internal Reports:	4	No. of Invited Papers:	11
No. of Books: (Chapters)	8	No. of Conf Proceedings:	20
No. of Other Pubs:			

Number of Patents, Disclosures, Licenses and Royalties

Patents: 1

- U.S. Patent: *Apparatus for Rapid Measurement of Aerosol Bulk Chemical Composition*, Yin-Nan Lee and Rodney Weber, January 14, 2003, Patent No. 6,506,345.

Disclosures: 5

- Reactive Spikes for Extraction of Mercury from Soil, Sediment, or Sludge, M. Fuhrmann, J. Heiser, P. Kalb, (August 2002).
- Reactive Blanket for Extraction of Mercury from Soil, Sediment, or Sludge, J. Heiser, M. Fuhrmann, P. Kalb, (August 2002).

- Multi-Purpose Multi-Station Container Inspection System, L. Wielopolski (December 2002).
- Nuclear Control Room (CR) Charcoal-Filtered Air System Effectiveness and CR Unfiltered Air In-Leakage Quantified Directly by Atmospheric Tracer Depletion (ATD), R. Dietz (January 2003).
- ChemiLuminescence *Analysis of Atmospheric Radicals (CLAAR)*, S. R. Springston (April 2003).

Royalties

- Development of In Situ Treatment of Mercury – Phase II (P. Kalb) \$50K

Significant New Hires

- A junior hire was made to lead the development of environmental molecular science research in the Environmental Sciences Department and assist in the Center for Environmental Molecular Science (CEMS).
- A senior hire was made to lead the development of aerosol radiative processes research.

Proposals

30 Field Work Proposals (FWP) submitted to DOE, and in addition, 30 Proposals submitted in response to various calls; 5 funded, 24 are pending, and 1 rejected:

Funded:

- Natl. Cooley's Anemia Foundation
 - A Novel Method to Measure Iron in vivo in the Liver and Heart of Thalassemia Patients, L. Wielopolski, \$45K
- DOE
 - Envirosuite Capital Equipment Support, M. Fuhrmann, \$400K
- Houston Advanced Research Center
 - Quantification of Fugitive Reactive Alkene Emissions from Petrochemical Plants with Perfluorocarbon Tracers, R. Dietz, \$75K
- DOE
 - Microbial Transformations of TRU and Mixed Wastes: Actinide Speciation and Waste Volume Reduction, A. J. Francis, \$290K, \$273K, and \$257K.
- NETL
 - In Field, Continuous, Non-invasive Soil Carbon Scanning System, Wielopolski, \$118K, \$166K, and \$174K.

LDRD Initiatives

LDRD's Funded

- 03-039 - Integrated Analysis of Carbon and Nitrogen Metabolism in Plants
- 03-025 - Real-Time Detection and Multi-Dimensional Characterization of Single Airborne Microorganism
- 03-026 - Developing New, Unified Systems Theory on Size Distributions of Atmospheric Particles

- 03-027 - Measurement of HO₂ Radicals by ChemiLuminescence Analysis of Atmos. Radicals
- 03-030 - Chemistry of the Rhizosphere
- 03-077 - Real-Time Consequence Assessment System for Atmospheric Terrorist Events in NE Urban Corridor

Program Development

- PD03-036 – Development of a Heated Face Apparatus

Editorial Activity and Major Book Articles

Book Chapters/Sections completed and published:

- Y. Liu, P. Daum, S. Chai, F. Liu, “Cloud parameterizations, cloud physics, and their connections: an overview,” in *Recent Res. Devel. Geophysics*, Vol. 4.
- K. Jones and H. Feng, “Microanalysis of materials using synchrotron radiation,” in *Chemical Applications of Synchrotron Radiation*, Vol. 12B.
- C. Benkovitz, J. Heintzenber, F. Raes, S. E. Schwartz, “Tropospheric aerosols,” in *Atmospheric Chemistry in a Changing World*.
- M. P. Neu, C. Ruggiero, A. J. Francis, “Bioinorganic chemistry of plutonium and interactions of plutonium with microorganisms and plants,” in *Advances in Plutonium Chemistry 1967-2000*.
- S. E. Schwartz, “Cloud chemistry,” in *Handbook of Weather, Climate, and Water*.
- J. Heintzenberg, F. Raes, S. E. Schwartz, “Tropospheric aerosols,” in *Atmospheric Chemistry in a Changing World – An Integration and Synthesis of a Decade of Tropospheric Chemistry Research*.
- Y-N. Lee, “Addendum I: Henry’s Law constants of OH and HO₂,” in *Chemicals in the Atmosphere—Solubility, Sources and Reactivity*.
- S. E. Schwartz. “Presentation of solubility data: Units and applications,” in *Chemicals in the Atmosphere—Solubility, Sources and Reactivity*.

Editorial Activity:

- Stephen Schwartz served on the editorial advisory board of *Tellus B*.
- Lucian Wielopolski served as Associate Editor for *Medical Physics*.

Manuscripts Reviewed:

- C. N. Flagg served as reviewer for *Journal of Geophysical Research, Ocean and Deep Sea Research*; and as proposal reviewer for the National Science Foundation.
- R. McGraw served as reviewer for *Journal of Aerosol Science*, *Journal of Physical Chemistry*, *Journal of Chemical Physics* and *Proc. of the National Academy of Science*.
- Lawrence Kleinman reviewed articles for *Atmospheric Environment*, *Environmental Science and Technology*, and *Journal of Air and Waste Management*.
- Y. Liu reviewed papers for *Applied Optics*, *Optics Letters*, *Geophysical Research Letters*, and *Journal of Atmospheric Science*.
- A. Sedlacek reviewed manuscripts for *Applied Optics*.

- Mark Miller reviewed articles for Journal of Geophysical Research, Journal of Atmospheric and Oceanic Technology, Geophysical Research Letters, and Journal of Applied Meteorology.
- Keith Jones reviewed papers for Geological Society (London), and X-Ray Spectrometry.
- Lucian Wielopolski reviewed scientific manuscripts for Journal of Applied Physiology, Physics in Medicine and Biology, and Medical Physics.
- Alistair Rogers reviewed scientific manuscripts for Plant, Cell & Environment, and Photosynthesis Research.
- G. Hendrey reviewed manuscripts for *Global Change Biology*.

Technical Committees

BNL Committees

- Aviation & Marine Safety Committee, W. Behrens, P. Daum, C. Flagg
- Brookhaven Lecture Committee, L. Kleinman, S. Schwartz
- OPSEC Working Group, P. Daum
- Research Library Advisory Committee, M. R. Reynolds
- Technology Transfer Coordinating Committee, P. Kalb
- Laser Safety Committee, A. Sedlacek
- Plant Engineering Zero-Based Budget Committee, C. Wirick
- Distinguished Lecture Committee, C. Wirick
- SBMS Steering Committee, C. Wirick
- Training & Qualifications Management Steering Committee, C. Wirick
- Science Council, C. Wirick
- Management Council, C. Wirick
- Cyber Security Advisory Council, W. Behrens
- BNL Council, G. Hendrey

1.1.4.2 Energy Sciences and Technology

Significant Accomplishments

- SNS collimator design completed, specs for fabrication issued, job well done! Project nearing completion and turn-over to ORNL
- Initiated vulnerability analyses of nuclear power plants under NATO (joint with Ukraine); near field earthquake effects (IAEA-sponsored research)
- Supported GEN-IV GRF passive safety options
- Completed construction and initiated operation of RADTEC Program
- Support NIST safety analysis update; HIFR accident analyses
- Developed and presented a nuclear safety workshop in Moscow attended by 30 GAN staff members
- Recovery of silica and mineral from geothermal brines
 - The Pilot plant operated continuously at 5 gallons per minute and at 190°F produced pure and high quality silica. Reactions were fast and the process is simple and environmentally acceptable

- Current data indicate that production of high quality silica from geothermal brines is technically and economically feasible. The total benefit of silica production is equivalent to \$0.011 per kwh
- Molecular Engineering: Next Generation of Gas Purification Technology (Chevron Texaco, Virginia Commonwealth U, and BNL)
 - Up to the present, we have shown the molecular imprinting process worked well for selective separation hydrocarbons e.g. heptanes, hexanes and pentanes from butane gases. Currently the project is in progress to separate smaller gases in natural gas(ML)
- California Governor’s Office of Emergency Services praised Nuclear Wallet Cards issued by the NNDC as essential source of radiological information, April 3, 2003
- Nuclear data dissemination continues to grow rapidly, projected growth is 21% in FY03

Significant Awards

- R&D 100 Award “Smart PPS Coating System”, 2002. (Sugama)
- Federal Laboratory Consortium for Technology Transfer (FLC) Award in 2003(Sugama)
- Distinguished Inventor Award of Battelle, 2003. (Sugama)
- Michael Todosow: Fellow, American Nuclear Society

Publications

No. of Peer Reviewed Pubs:	78	No. of Refereed Pubs:	10
No. of Internal Reports:	46	No. of Invited Papers:	
No. of Books:		No. of Conf Proceedings:	12
No. of Other Pubs:	1		

Number of Patents, Disclosures, Licenses and Royalties

- US Patent 6,537,796 on 3/25/2003, “Conversion of Geothermal Waste to Commercial Products Including Silica”.
- Carl Czajkowski: Anthrax Vacuum
- Jae Jo: Co-Inventor of the patent pending, “Method and Device for Electro-Extraction of Heavy Metals from Technological Solutions and Wastewater” (Docket No. 085332-0101)

Significant New Hires

- Scientist hired to lead nuclear reaction data evaluation activities and development of the US evaluated nuclear reaction data file ENDF/B-VII.

Proposals

- Recovery of Lithium, cesium and rubidium from geothermal brines proposed for \$750K from FY2003-FY2006, Mow Lin
- Geochemical stabilization of sedimentary organic matter: formation of heterocyclic structures containing sulfur and nitrogen, submitted to DOE Office of Basic Energy Sciences, 3 years, 670K
- Low NOx Commercial Burner, STTR Phase II proposal submitted to DOE in cooperation with Heat Wise, Inc. Awarded. \$770K, 2 years
- Next-Generation Database Computer System”, P. Oblozinsky, R. Arcilla, C. Dunford and D. Winchell, DOE-SC DNP capital equipment funding \$150,000 awarded in March 2003

- “Fission Product Data for Burn-up Credit”, C. Dunford and P. Oblozinsky, 3-year project for \$275,000, DOE-NNSA funding \$74,000 awarded in May 2003 for FY03.

Michael Todosow:

- Proposal to DARPA to evaluation signatures from various amounts and configurations of special nuclear materials
- W-BNFL/ULBA for processing of concentrates containing erbia; W for boron enrichment facility at Tomsk and thermal-hydraulic test facility at Kurchatov

Kenneth Perkins:

- Development of a Safety Analysis Review Capability for the Armenian Nuclear Regulatory Authority, NRC Office of International Programs, FY-03, \$300k
- Strengthening Kazakhstan Regulatory Authority, NRC Office of International Programs, FY-03, \$50k
- Support to the Russian Federal Nuclear and Radiation Safety Authority, NRC Office of International Programs, \$600k
- Support for Orders and Rules, DOE Office of Nuclear and Facility Safety Policy, FY-03, \$125k.

Mohammad-Ali Azarm:

- Benchmarking and Revision of NRC SDP Process: FY02 to FY04 continuing at \$1000k per year

John Carew:

- “Boiling Water Reactor Fluence,” NRC Office of Nuclear Regulatory Research, \$614K, April 2, 2001-February 28, 2003
- “BNL Technical Assistance in Support of Division of Systems Safety and Analysis, Reactor Systems Branch Issues,” NRC Office of Nuclear Reactor Regulation, \$350K, October 1, 2000- September 30, 2003
- Advanced Candu Reactor 700 Review, NRC NRR: \$400k April 2002 to April 2003

LDRD Initiatives

- Dynamics of Wind Turbine-Tower-Foundation Systems (AJP & MB)
- Methane Hydrates (BNL Project/Start 2002 -) (DM)
- Michael Todosow, et al., “Investigation of Neutron & Gamma Probes to Detect Explosives in Sealed Container”
- Mohammed-Ali Azarm and Robert Bari, “Electrical Reliability”

Editorial Activity and Major Book Articles

- Several reviewers for Nuclear Technology
- George Greene: Editor, International Journal of Heat Transfer

Technical Committees

- ASHRAE TC6.3 (Vice Chair and Research Subcommittee Chair –Note: will take over Committee Chair in summer 2004. (John Andrews)
- ASHRAE SPC 152P –Method of Test for Determining the Design and Seasonal Efficiencies of Residential Forced-Air Heating and Cooling Systems, Voting Member (John Andrews)

- ARTI 21-CR Building and Facility Integration Subcommittee, Voting Member (John Andrews)
- ACCA Manual J8 Review Committee, Member (John Andrews)
- NACE Committee 182X, Corrosion in Geothermal Systems, Vice Chair (Marita Berndt)
- Methane Hydrate Advisory Committee, Member (Devinder Mahajan)
- BNL Energy Sciences & Technology Department Planning Committee, Member (Devinder Mahajan)
- UNC-CH National Science Foundation-Science Technology Center (NSF-STC) Review, Chapel Hill, NC, June 2-6, 2003 ‘NSF Panelist’; 10th International Conference on Composites and Nano Engineering (ICCE-10), New Orleans, LA, June 20-26, 2003, ‘Session Chair’ (Devinder Mahajan)
- Symposium on Synthetic Clean Fuels from Natural Gas and Coal-bed Methane: 30 Years Since First Oil Crisis, co-sponsored by the ACS Fuel and Petroleum Chemistry Divisions, ‘ACS Symposium Organizer 2003; National Labs Methane Hydrate Working Group, (2001-Present), ‘Chair’ (Devinder Mahajan)
- National Oilheat Research Alliance – ‘Member’ of Board of Directors (Roger McDonald)
- ASHRAE Technical Committee 6.10 on Fuels and Combustion -- ‘Chairman’ (Tom Butcher)
- ASHRAE Special Project Committee 103 – Efficiency of Central Heating Boilers and Furnaces –Vice Chairman (Tom Butcher)
- Steering Committee for planning International Forum: Fuel Oil for Heating, Cooling, and Power –Board Member (Tom Butcher)
- CSEWG Executive Committee, P. Oblozinsky, chair
- US Nuclear Data Program Coordinating Committee, P. Oblozinsky, chair
- International Nuclear Data Committee, P. Oblozinsky, vice-chair
- John Carew: Chair, Nuclear Safety Committee; BNL Criticality Officer; 2 ANS Committees; 1 ASTM Committee
- Michael Todosow: Member, ANS Reactor Physics Division Program Committee

1.1.4.3 Nonproliferation and National Security

Significant Accomplishments

BNL has maintained a key technical role in transferring technologies and methods for upgrading materials protection, control and accounting (MPC&A) of weapons-usable nuclear materials at Russian facilities:

- BNL continues to play a major role in the Nuclear Materials Consolidation and Conversion (MCC) project. A BNL staff person was appointed project lead. A goal of the project is to reduce the number of sites and buildings that contain weapons-usable nuclear material and reduce the attractiveness of existing highly enriched uranium by downblending it to low enriched uranium.
- A BNL staff member leads the MPC&A Education and Awareness project. Under this project, the team works with Russian sites to promote awareness and encourages management to allocate resources to MCPC&A for long-term sustainability.

- A BNL staff member leads the MPC&A Operations Monitoring Project. Under this activity a system was designed, constructed and installed at MEPhI to monitor the MPC&A system to ensure that they continue to detect, delay, and respond to attempts to divert nuclear material.
- BNL continues to be responsible for managing all of the contracting activities associated with the MPC&A upgrades at the Siberian Chemical Combine (Tomsk-7), and supports work at the Mining and Chemical Combine (K-26), and the All Russian Institute of Technical Physics (C-70).
- BNL made substantial contributions under the MPC&A Regulatory Project in assisting Russia's MINATOM and Gosatomnadzor in the development of a regulatory framework for implementing the improved and more comprehensive nuclear materials safeguards.
- BNL staff has developed the framework for a site-specific sustainability effort on optimizing physical inventory taking (PITs). This effort will result in a guidance-level directive which will help standardize threat analysis, statistical sampling, measurement accuracy, and other related techniques employed during the planning and conducting of PITs.
- A BNL staff member is the MPC&A lead for the project team for the Institute of Physics and Power Engineering.
- A team led by a BNL staff member conducts reviews of 30 MPC&A Program Projects, analyzing the information obtained in these reviews and providing the Program's Administrator with both summary and comprehensive reports on each project and support for program guidelines.
- Submitted to IAEA "Final Report to the International Atomic Energy Agency On the Feasibility of A Certification Programme For Safeguards Inspectors" for final revisions.
- Prepared preliminary project plan for Additional Protocol Workshop to be presented at IAEA/BNL in FY 2004.
- Completed draft report on an evaluation of Gas Centrifuge Enrichment Plant IAEA safeguards and possible improvements to safeguards.
- Provided U.S. Department of State and DOE/NNSA with an evaluation of present IAEA safeguards at Light Water Reactors with an emphasis on Russian VVER-1000 plants.
- A BNL staff member is one of 100 U.S. transparency monitors who routinely visit Russian sites that process HEU metal from dismantled weapons into low enriched uranium for U.S. power reactor fuel.
- A BNL staff member developed a concise algorithm for sampling to detect defects for both systematic and random errors.
- Organized and Managed Federal/State study on "Security of Radioactive Materials at Non-Reactor Sites in NYS."
- Completed design and started installation of radiation monitoring system of Spent Nuclear Fuel Storage Pad at the RTP Atomflot Site in Murmansk, Russia.
- Organized and Managed a Federal/State Study on "Security of Chemical Weapon Components in NYS."
- BNL secured a substantial technical role in the NNSA NA-22 Radiation Dispersal Device Program and a BNL Scientist is the principal author of the Strategic Plan and Action Plan.
- The BNL portable compressed-xenon spectrometer was upgraded with a new high-voltage power supply, preamplifiers and data acquisition electronics, reducing size and weight. It has been funded by DOE NA-42 for field testing.

- The thermal neutron imaging system was upgraded with a new camera enclosure, high-precision coded-aperture masks, and custom-designed digital position-encoding electronics and software was written to process thermal neutron images by fast Fourier transforms.
- BNL participated in a multi-lab joint experimental campaign to acquire radiation signatures from items containing special nuclear materials at the Atomic Weapons Establishment, Aldermaston, UK.
- Obtained access and achieved operational capability of Class 100 clean room facility located in NSLS.
- Obtained access and achieved operational capability of semiconductor device characterization facility in NSLS Controls Group.
- Established ability to fabricate planar, pixellated, and co-planar grid CZT nuclear radiation detection devices.
- Planar CZT device pressure contact (no wire soldering needed to attach signal processing electronics to the device) evaluation facilities have been established in NSLS Controls Group and Low Background Counting Room in Bldg. 703.
- Study completed that demonstrates and quantifies the affects of surface roughness on CZT device performance as it relates to the ability of standard Br₂/methanol etchants to remove surface damage resulting from mechanical polish.
- The Radiation Detector Test and Evaluation Center (RADTEC) for testing vehicle radiation portal detectors was established and placed into operation under DOE and DHS funding.
- Established internship program for recent graduates to work at the International Atomic Energy Agency
- TEMASU, a 5 year research project to develop a underground imaging system completed a field demonstration that will now lead to commercialization of the system through a license agreement
- Tera-Hertz sensor, the first set of material absorption experiments were completed on the NSLS. Results support the use of T rays to monitor aircraft wiring systems for defects
- Critical Infrastructure Vulnerability Assessments in support of the DOE, DHS and New York State was completed. This resulted in a better understanding of the variation of risks to acts of terrorism of 18 specific critical infrastructure elements in New York State.

Significant Awards

- Kara De Castro - Certificate of Appreciation from NNSA/DOE, Office of International Material Protection and Cooperation
- P.D. Moskowitz – Letter of Commendation from Mr. John Scanlon, Director, NYS Office of Public Security
- Joseph Indusi – Named a Fellow of the Institute of Nuclear Materials Management

Publications

No. of Peer Reviewed Pubs:	8	No. of Refereed Pubs:	4
No. of Internal Reports:	20	No. of Invited Papers:	1
No. of Books:		No. of Conf Proceedings:	9
No. of Other Pubs:	41		

Significant New Hires

- A scientist with international reputation in the development of compressed xenon gamma spectrometers was hired to continue his work on xenon and lead a new effort in cadmium zinc telluride device design and fabrication
- An Associate Scientist was hired to support CZT device fabrication technology development and CZT materials research development

Proposals

U.S. Support Program to IAEA

- Additional Protocol Workshop \$252K, P.I. B. Boyer, J. Lemley
- Nuclear Noncompliance Verification \$910K FY2003 supplemental. P.I. B. Boyer, D. Gordon
- DARPA: Stand-off Gamma and Neutron Spectra from Uranium- and Plutonium-Based Nuclear Weapons, P.I. J. Lemley. Pending
- "Hand-held gamma ray search detector for rapid survey," NNSA Office of Emergency Response, \$300K yearly, P.I. P.E. Vanier. Pending

Proliferation Detection: Enabling Technology

- "Growth and Quantification of the Scintillation Properties of LaBr₃:Ce³⁺ Crystal," – NA-22 \$300K per year, P.I. G. Wright. Pending

Proliferation Detection: Integrated Systems

- "Increasing performance of commercial CZT detectors for monitoring Special Nuclear Material," FY 04 \$183K, FY 05 \$130K, P.I. A. Bolotnikov, G. Wright. Pending
- "Understanding factors limiting energy resolution in long drift CZT detectors used for monitoring Special Nuclear Material," FY 04 \$155K, P.I. A. Bolotnikov, G. Wright. Pending
- Study on Alternative Methods for detecting SNM, DTRA, \$50K, P.I. J. Indusi.

Eighteen proposals were submitted to the Office of International Material Protection and Cooperation, NA-25, NNSA, DOE during FY03. These proposals ranged in size from a few hundred thousand to several million dollars. The current funding level for the division is at \$56m.

LDRD Initiatives

One LDRD proposal was submitted in FY03, two presently funded:

- Advanced xenon gamma spectrometer development
- Application of Compton-Suppression Gamma Spectrometry to Problems in Anti-Terrorism

Program Development:

International Safeguards

- Successfully received funding for proposals submitted to the U.S. Support Program to IAEA Safeguards (USSP) responding to IAEA requests
- Feasibility Study of Inspector Certification
- Additional Protocol Workshop
- Safeguards for Chernobyl 4 Shelter

Room-Temperature CdZnTe Radiation Detectors

- Device Fabrication Technology Development
- Exploration of Thermal Diffusion Processes in CZT for Improved Nuclear Radiation Detectors

Editorial Activity and Major Book Articles

- Journal of Environmental Systems Associate Editor, Ed Kaplan
- Peter Vanier is a member of SPIE program committee for coded aperture imaging session of annual meeting.
- James Lemley is Associate Technical Editor for Journal of Nuclear Materials Management
- James Lemley is the Book Review Editor Journal of Nuclear Materials Management

Technical Committees

Professional Society

- Long Island American Nuclear Society, Vice President/President-Elect – (2002-03), President (2003-2004), B. Boyer
- Institute of Nuclear Materials Management: Elected to Executive Committee as Member at Large; Chair, Standing Committee for Government-Industry Liaison; Technical Program Committee, J. Lemley

Service Activity for DOE Program and/or National/Regional level

- Department of Homeland Security's Homeland Security Senior Technical Manager, P.D. Moskowitz
- Joint Steering Committee and Joint Coordinating Committee for the Weapons Safety and Security Exchange Agreement between the US and the Russian Federation, P. Vanier

BNL Committees

- Participated in Safeguards and Security Management System Evaluation, J. Lemley
- Security Exercise Committee, J. Lemley
- Scientific Career Advisor for the Nonproliferation and National Security Department, B. Boyer.
- BNL Emergency Crisis Manager, Classification Board, J. Indusi.

Additional Comments

- BNL has strengthened its radiation detector Research, Development, Testing and Evaluation capability and is conducting research on advanced detector concepts.

1.2 Relevance to DOE Missions and National Needs

The Department/Division Chairs were given the following tables to review for accuracy of content. All changes received were made and are shown in the following tables.

DOE Office of Fossil Energy - Program Title: Coal	
Approximate Dollar Value: \$308.8K	
Sub Program (\$K)	Mission Alignment
AA20-25 (\$308.8K) Advanced Research and Environmental Technology	Energy Infrastructure, Energy Sources and President's Energy Plan: BNL continues to participate in the Natural Gas and Oil Technologies Partnership, which includes DOE, its National Laboratories, and the domestic petroleum industry. The partnership seeks to develop and apply new technologies, which meet the evolving industry needs.

DOE Office of Fossil Energy – Program Title: Gas	
Approximate Dollar Value: \$250.0K	
Sub Program (\$K)	Mission Alignment
AB05-45 (\$250.0K) Infrastructure	Energy Infrastructure, Energy Sources and President's Energy Plan: BNL, in partnership with industry and ANL, is conducting research on methane hydrate production.

DOE Office of Fossil Energy - Program Title: Petroleum	
Approximate Dollar Value: \$304.0K	
Sub Program (\$K)	Mission Alignment
AC10-05 (\$129.1K) Exploration & Production Support Research	Energy Infrastructure, Energy Sources and President's Energy Plan: BNL continues to participate in the Natural Gas and Oil Technologies Partnership, which includes DOE, its National Laboratories, and the domestic petroleum industry. The partnership seeks to develop and apply new technologies, which meet the evolving industry needs.
AC10-15 (\$174.9K) Effective Environmental Protection	Energy Infrastructure, Energy Sources and President's Energy Plan: BNL continues to participate in the Natural Gas and Oil Technologies Partnership, which includes DOE, its National Laboratories, and the domestic petroleum industry. The partnership seeks to develop and apply new technologies, which meet the evolving industry needs.

DOE Office of Nuclear Energy Science & Technology – Program Title: Nuclear Energy Research & Development	
Approximate Dollar Value: \$844.5K	
Sub Program (\$K)	Mission Alignment
AF45 (\$636.3K) Nuclear Energy Plant Optimization	Energy Infrastructure, Energy Sources and President’s Energy Plan: BNL is developing in partnership with US industry advanced control designs for nuclear power plants
AF57 (\$208.2K) Advanced Accelerator Applications (AAA)	Energy Infrastructure, Energy Sources and President’s Energy Plan: BNL is working on new fuel cycles in support of the Advanced Fuel Cycle Program

DOE Office of Chief Information Officer - Program Title: Cyber Security Program	
Approximate Dollar Value: \$5.1K	
Sub Program (\$K)	Mission Alignment
CS (\$5.1K) Cyber Security Program	Homeland Defense: BNL is working to protect its sensitive computer infrastructure from cyber threats.

Administrator for National Nuclear Security – Program Title: Weapons Activities	
Approximate Dollar Value: \$582.0K	
Sub Program (\$K)	Mission Alignment
DP09-01 (\$12.1K) Operation of Facilities	Protecting our Infrastructure: BNL continues to assist NNSA NA-53 in the preparation of guides and manuals related to the implementation of Integrated Safety Management.
DP09-09 (\$569.9K) Weapons Incidents Response	Protecting our Infrastructure: Technical support for emergency management, consequence assessment and protective actions.

DOE Office of Energy Efficiency & Renewable Energy - Program Title: Solar & Renewable Resource Technology	
Approximate Dollar Value: \$1,727.9K	
Sub Program (\$K)	Mission Alignment
EB21 (\$442.4K) Photovoltaic Energy System	Energy Infrastructure, Energy Sources and President’s Energy Plan: BNL is conducting our assessment of the health and environmental efforts of photovoltaic (PV) energy, which will plan an important role in planning for increased utilization of PV as an energy source.
EB27 (\$13.6K) International Solar Energy Program	Energy Sources and President’s Energy Plan: BNL assisted the Bolivian government staff in identifying and developing a Bolivian MARKAL database.

EB40 (\$651.4K) Geothermal	Energy Infrastructure and President's Energy Plan: BNL continues research on corrosion resistant materials and cements for reducing costs associated with the use of geothermal energy. Researchers are focusing on corrosion testing of NiCrMo alloys, evaluation of coatings and mortars for resistance to sulfur oxidizing bacteria, numerical modeling of remediated wells, and field testing.
EB50 (\$509.6K) Electric Energy Systems and Storage	Energy Sources: BNL continues work on the development of practical conductor for Electric Power Systems.

DOE Office of Energy Efficiency & Renewable Energy – Program Title: Building Tech, State & Community System	
Approximate Dollar Value: \$818.6K	
Sub Program (\$K)	Mission Alignment
EC09-02 (\$0.2K) Residential Buildings Integration	President's Energy Plan and Energy Infrastructure: BNL develops more efficient and nonpolluting heating systems as well as improvements to the distribution and use of energy in buildings. Researchers are developing advanced low Nox oil burner technologies for use in homes and commercial buildings.
EC09-04 (\$818.4K) Equipment, Materials and Tools	President's Energy Plan and Energy Infrastructure: BNL develops more efficient and nonpolluting heating systems as well as improvements to the distribution and use of energy in buildings. Researchers are developing advanced low Nox oil burner technologies for use in homes and commercial buildings.

DOE Office of Energy Efficiency & Renewable Energy - Program Title: Transportation Sector	
Approximate Dollar Value: \$5,317.6K	
Sub Program (\$K)	Mission Alignment
EE05 (\$1,260.4K) Vehicle Technologies R&D	Energy Infrastructure, Energy Sources and President's Energy Plan: BNL's programs on Natural Gas Storage Systems work with US industry to demonstrate systems that will lead to significantly reduced costs for production and storage of liquefied natural gas. This includes assessing the production of Liquid Natural Gas from landfills, developing state-of-the-art storage tanks and refueling facilities, designing novel cryogenic fuel delivery systems, and developing strategies for market end-use. BNL also works on the structure and characterization of new battery materials

EE06 (\$4,057.1K) Fuels Utilization R&D	Energy Infrastructure, Energy Sources and President's Energy Plan: BNL's programs on Natural Gas Storage Systems work with US industry to demonstrate systems that will lead to significantly reduced costs for production and storage of liquefied natural gas. This includes assessing the production of Liquid Natural Gas from landfills, developing state-of-the-art storage tanks and refueling facilities, designing novel cryogenic fuel delivery systems, and developing strategies for market end-use. BNL also works on the structure and characterization of new battery materials
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DOE Office of Energy Efficiency & Renewable Energy – Program Title: Policy and Management	
Approximate Dollar Value: \$44.9K	
Sub Program (\$K)	Mission Alignment
EH (\$44.9K) Policy and Management	Energy Infrastructure: BNL provides assistance to DOE in area of policy and management of energy.

DOE Office of Energy Efficiency & Renewable Energy - Program Title: Federal Energy Management Program	
Approximate Dollar Value: \$24.9K	
Sub Program (\$K)	Mission Alignment
EL17 (\$24.9K) Federal Energy Management Program	Energy Infrastructure: Reduce electrical energy costs to the laboratory.

DOE Office of Energy Efficiency & Renewable Energy – Program Title: Power Technologies	
Approximate Dollar Value: \$1,067.9K	
Sub Program (\$K)	Mission Alignment
EO01 (\$1,067.9K) Distributed Energy Resources	Energy Infrastructure, Energy Sources and President's Energy Plan: BNL performs research on building combined heat and power applications, with an emphasis on liquid fuels.

DOE Office of Energy Assurance - Program Title: Energy Security and Assurance	
Approximate Dollar Value: \$388.9K	
Sub Program (\$K)	Mission Alignment
ES01 (\$388.9K) Energy Security	Homeland Defense, Nonproliferation: Conduct a comprehensive study of radioactive materials located at Non-Reactor Sites within New York State.

Environmental Management – Program Title: Env. Res & Waste Mgmt – Defense	
Approximate Dollar Value: \$678.2K	
Sub Program (\$K)	Mission Alignment
EW02 (\$154.7K) Post 2006 Completion	Environmental Clean-up: Remediate contamination from past practices. Provides for program management and remediation and decontamination/decommissioning activities
EW40 (\$523.5K) Science and Technology	Environmental Cleanup: BNL continues to use its expertise to develop new or improved technologies for environmental clean up including is using an innovative tracer technology and 3D-visualization techniques to accelerate the characterization of structures and elucidation of contaminate transport.

DOE Office of Science - Program Title: Env. Res & Waste Mgmt - Non-Defense	
Approximate Dollar Value: \$39,871.9K	
Sub Program (\$K)	Mission Alignment
EX04 (\$38,661.5K) Site/Project Completion	Environmental Cleanup: Remediate Superfund contamination from past practices in accordance with CERCLA and the Interagency Agreement. Provides for program management, remediation and decontamination/decommissioning activities.
EX08 (\$1,210.4K) Excess Facilities	Environmental Cleanup: Conduct Surveillance and Maintenance activities of HFBR. These activities will continue until funding and direction is received from DOE to initiate decontamination / decommissioning activities.

DOE Office of Environmental Safety & Health – Program Title: Environmental, Safety & Health (Defense)	
Approximate Dollar Value: \$332.2K	
Sub Program (\$K)	Mission Alignment
HD (\$332.2K) Environmental, Safety & Health (Defense)	National Trust Science: BNL continues to participate in the Health Surveillance System in order to provide timely monitoring of the health of contractor employees on a continuing basis.

DOE Office of Intelligence - Program Title: Intelligence	
Approximate Dollar Value: \$10.3K	
Sub Program (\$K)	Mission Alignment
IN (\$10.3K) Intelligence	Homeland Defense: BNL monitors the ATP in the DOE Office of Intelligenece, participates in its annual review and provides expertise, advice and program support as requested.

DOE Office of Science – Program Title: High Energy Physics	
Approximate Dollar Value: \$31,144.5K	
Sub Program (\$K)	Mission Alignment
KA11 (\$18,433.5K) Proton Accelerator-Based Physics	National Trust Science – about 25% of the funds are for operation of the AGS accelerator to carry out very specialized experiments and the remainder of the funds is support for construction of the Large Hadron Collider (LHC) accelerator at CERN in Switzerland and part of one LHC experiment, ATLAS. BNL's roles are as the lead U.S. lab for the ATLAS experiment, computing and construction of accelerator magnets
KA14 (\$3,148.0K) Theoretical Physics	National Trust Science – High energy particle physics which includes experimental and theoretical research into the fundamental nature of matter as well as development of new accelerator techniques including superconducting magnet R&D
KA15 (\$9,563.0K) Advanced Technology Research & Development	National Trust Science – High energy particle physics which includes experimental and theoretical research into the fundamental nature of matter as well as development of new accelerator techniques including superconducting magnet R&D

DOE Office of Science - Program Title: Nuclear Physics	
Approximate Dollar Value: \$160,429.6K	
Sub Program (\$K)	Mission Alignment
KB01 (\$3,806.8K) Medium Energy Physics	National Trust Science: Exploration of the atomic nucleus as a laboratory to determine the origin of nuclear spin and to create new kinds of nuclei where a nucleus has one or more "strange" quarks.
KB02 (\$150,234.4K) Heavy Ion Physics	National Trust Science: Supports the operation of the Relativistic Heavy Ion Collider (RHIC) complex, including 4 accelerators, 4 large experiments and halls and the experimental research that is carried out. The focus is on creation of new states of matter. Also provides support for the waste management operations at the site.
KB03 (\$5,297.6K) Nuclear Theory	National Trust Science: this area provides the nuclear theory basis and support for all of the nuclear physics programs and also the support for the National Nuclear Data Center that DOE maintains
KB04 (\$1,090.8K) Low Energy Physics	National Trust Science: Investigation of the neutrino, an elusive particle that is emitted from the sun in its process of energy generation. Its study leads not only to an understanding of the sun but also of the neutrino itself

DOE Office of Science – Program Title: Basic Energy Science	
Approximate Dollar Value: \$74,509.2K	
Sub Program (\$K)	Mission Alignment
KC0201-01/02/03 (\$5,334K) Structure and Physical Properties of Materials	New Energy Sources, Presidential Energy Plan, and National Trust Science: Studies of nanoscale structural defects with TEM and other instruments, metal-environment interactions and superconducting materials leads to advancing understanding of structural and physical properties of materials.
KC020201 (\$4,358K) Neutron & X-Ray Scattering	New Energy Sources, Presidential Energy Plan, and National Trust Science: The Center for Neutron Science, the Physics & Chemistry Departments plan neutron instrumentation at SNS and provide operational & technical support in their research at other facilities. X-ray scattering studies help reveal underlying physics contributing to properties of materials.
KC0202-021/03 (\$3,652K) Condensed Matter Physics: Theory & Experimental	New Energy Sources, Presidential Energy Plan, and National Trust Science: Programs involve combination of experimental probes coupled with theory support to understand properties of highly correlated electron systems; and materials synthesis, including PLD thin film and crystal oxide growth.
KC020301 (\$1,399K) Materials Chemistry	New Energy Sources, Presidential Energy Plan, and National Trust Science: Program develops an understanding of electroresponsive conducting polymers and uses this information in the synthesis of improved materials.
KC0204011 (\$36,737K) National Synchrotron Light Source	New Energy Sources, Presidential Energy Plan, Climate Change Initiative, and National Trust Science: Program is for operation and development of the NSLS, which is part of DOE's theme of "extraordinary tools for extraordinary science" and is a national asset for multidisciplinary research.
39 KC02 (\$998K) Nanocenter	New Energy Sources, Presidential Energy Plan, and National Trust Science: Line item project funds for design and construction of the Center for Functional Nanomaterials.
KC03010 (\$4236K) Photochemical and Radiation Sciences	New Energy Sources, Climate Change Initiative, and Environmental Cleanup: Program explores the temporal properties of electron-transfer processes associated with chemical, solar and electrochemical energy conversion. The Laser Electron Accelerator Facility is used for this work. Porphyrin materials studies are included in this program.
KC030102 (\$3268K) Chemical Physics	New Energy Sources and Presidential Energy Plan: Gas phase molecular dynamics, imaging and characterization studies, dynamic properties of catalytic materials

KC030201 (\$2255K) Chemical Energy	New Energy Sources and Presidential Energy Plan: Catalysis studies of the reactivity and structure of surfaces and the growth of overlayers.
KC030202 (\$333K) Separations and Analysis	Presidential Energy Plan, Climate Change Initiative, and Homeland Defense: Program supports the development of experimental tools for investigating the rates of gas phase chemical reactions and growth of aerosol particles, which have environmental impacts, related to fossil fuel combustion.
KC030204 (\$848K) Chemical Engineering Sciences	New Energy Sources and Presidential Energy Plan Program: explores the structure and function of materials and interfaces of importance related to batteries and fuel cells, as well as in electrochemical corrosion of metals and alloys.
KC030301 (\$41K) Geosciences	New Energy Sources and Presidential Energy Plan: Program explores understanding of rock characterization, energy exploration and recovery.
KC0304 (\$886K) Energy Biosciences	New Energy Sources, Presidential Energy Plan, and Climate Change Initiative: Program includes studies of mechanistic and molecular based photosynthesis, lipid metabolism and genetic systems leading to engineering synthesis of alternative fuels and petroleum-replacing chemicals.
KC04 (\$168.9K) Engineering and Geoscience	New Energy Sources and Presidential Energy Plan: Program explores understanding of rock characterization, energy exploration and recovery.
KC06 (\$201.8K) Energy Bioscience	New Energy Sources, Presidential Energy Plan, and Climate Change Initiative: Program includes studies of mechanistic and molecular based photosynthesis, lipid metabolism and genetic systems leading to engineering synthesis of alternative fuels and petroleum-replacing chemicals.

DOE Office of Science - Program Title: Computational and Technology Research	
Approximate Dollar Value: \$1,522.3K	
Sub Program (\$K)	Mission Alignment
KJ01 (\$967.6K) Mathematical, Information and Computational Sciences	National Trust Science: Support the emerging high-priority scientific programs with advanced computing modalities, such as accelerator science, medical imaging, material science, and aerosol transport. Funds also support the particle physics data grid.
KJ02 (\$554.7K) CRADA	National Trust Science and Environmental Cleanup: BNL's program supports high-risk, multidisciplinary research partnerships to investigate challenging scientific problems whose solutions have promising commercial potential.

DOE Office of Science – Program Title: Biological and Environmental Research	
Approximate Dollar Value: \$23,561.6K	
Sub Program (\$K)	Mission Alignment
KP11 (\$7,103.6K) Life Sciences	National Trust Science: Support the research and development programs conducted by the Medical and Life Sciences Divisions of OBER in the Office of Science to utilize current advances in science and technology to develop innovative diagnostic and treatment solutions to critical problems in human health. The PET and MRI facilities at BNL provide unique resources for achieving these advances.
KP12 (\$5,333.5K) Environmental Processes	National Trust Science and Climate Change Initiative: BNL's Atmospheric Science program acquires data to understand the atmospheric processes that control the transport, transformation, and fate of energy-related chemicals and particulate matter. The emphasis is on processes and models related to new air quality standards for tropospheric ozone and particulate matter, and the relationships between air quality and climate change. Research, is being conducted, to understand and identify the sources, destinations, and impacts of carbon dioxide in our global environment.
KP13 (\$891.6K) Environmental Remediation	National Trust Science and Climate Change Initiative: BNL's fundamental understanding of complex phenomena to reduce or prevent pollution in order to protect human health and the environment. Knowledge gained through this research provides the fundamental scientific understanding needed to make bioremediation a viable option for dealing with DOE's most challenging clean-up problems.
KP14 (\$10,232.8K) Medical Applications & Measurement Science	National Trust Science: BNL's Center for Imaging and Neuroscience takes advantage of the unique facilities and expertise at the Laboratory for research in medical and imaging science. Researchers use nuclear technology and radiopharmaceuticals to develop new scientific and diagnostic tools, new treatments and to study human physiology and the mechanisms of disease in the areas of neuroscience and oncology.

DOE Office of Science - Program Title: Science Education	
Approximate Dollar Value: \$731.9K	
Sub Program (\$K)	Mission Alignment
KL (\$731.9K) Science Education	National Trust Science: Provide research internships to undergraduate students and teachers in order to help prepare the nations scientific and technical workforce.

National Nuclear Security Admin – Program Title: Nonproliferation & National Security Program Directives	
Approximate Dollar Value: \$102,928.3K	
Sub Program (\$K)	Mission Alignment
NN20 (\$616.5K) Nonproliferation and Verification R&D	Nuclear Nonproliferation; Homeland Security: BNL perform analyses, conducts research and development, provides technical support to US programs and policymakers, and builds prototype instruments and systems (hardware and software). These activities further US interests in nuclear materials safeguards and security, verification and transparency, nonproliferation of weapons of mass destruction and nuclear security-related infrastructure protection. A BNL technical staff member serves as a “transparency monitor” under the US/Russian Federation Highly-Enriched Uranium Purchase Agreement.
NN30 (\$148.7K) International Nuclear/Safety and Cooperation	Nuclear Nonproliferation and Homeland Security: BNL perform analyses, conducts research and development, provides technical support to US programs and policymakers, and builds prototype instruments and systems (hardware and software). These activities further US interests in nuclear materials safeguards and security, verification and transparency, nonproliferation of weapons of mass destruction and nuclear security-related infrastructure protection. A BNL technical staff member serves as a “transparency monitor” under the US/Russian Federation Highly-Enriched Uranium Purchase Agreement.
NN31 (\$31.5K) HEU Transparency Implementation	Nuclear Nonproliferation and Homeland Security: BNL perform analyses, conducts research and development, provides technical support to US programs and policymakers, and builds prototype instruments and systems (hardware and software). These activities further US interests in nuclear materials safeguards and security, verification and transparency, nonproliferation of weapons of mass destruction and nuclear security-related infrastructure protection. A BNL technical staff member serves as a “transparency monitor” under the US/Russian Federation Highly-Enriched Uranium Purchase Agreement.
NN40 (\$2,067.7K) Arms Control and Nonproliferation	Nuclear Nonproliferation and Homeland Security: BNL’s program incorporates environmentally oriented components into nuclear, chemical, and biological safeguards, nonproliferation and weapons dismantlement programs. We also work to ensure that the knowledge and skills possessed by former Russian weapons scientists are refocused on civilian activities with non-defense environmental orientation.

<p>NN41 (\$10,649.1K) Russian Transition Initiatives</p>	<p>Nuclear Nonproliferation: Cooperative efforts between the US and Russia to safeguard nuclear facilities and materials in the former Soviet Union.</p>
<p>NN50 (\$89,414.9K) International Nuclear Materials Protection and Cooperation</p>	<p>Nuclear Non-Proliferation and Homeland Security: BNL is playing a lead or supporting role in the following areas of the MPC&A Program:</p> <p>Introduction of technologies for very precise measurements of bulk nuclear materials. Development and implementation of comprehensive physical inventory statistical sampling plans, measurement requirements and performance procedures Downblending of HEU to LEU.</p> <p>Support the development of regulatory documents pertaining to nuclear materials protection, control and accounting in Russian facilities.</p>

<p>DOE Office of Nuclear Energy, Science & Technology - Program Title: Isotope Production and Distribution Program</p>	
<p>Approximate Dollar Value: \$3,151.7K</p>	
<p>Sub Program (\$K)</p>	<p>Mission Alignment</p>
<p>ST (\$3,151.7K) Isotope Production and Distribution Program</p>	<p>National Trust Science: The work at BNL supports the DOE's Medical Isotope Program which provides radioactive and stable isotope products to a wide and varied domestic and international market. Ultimate applications of isotope products include medical research and health care, industrial research and manufacturing, education, and national defense. The Medical Isotope program is related to DOE's theme of "Protecting our Living Planet".</p>

<p>DOE Energy Information Administration – Program Title: National Energy Information System</p>	
<p>Approximate Dollar Value: \$1,157.0K</p>	
<p>Sub Program (\$K)</p>	<p>Mission Alignment</p>
<p>TA (\$1,157.0K) National Energy Information System</p>	<p>President's Energy Plan and Climate Change Initiative: MARKAL-MACRO is a technology specific, data-rich optimization model that provides least-cost energy system solutions under specified constraints to support policy and planning decisions. BNL is utilizing MARKAL-MACRO and its associated databases and methods to evaluate energy source uses on both environmental and micro/macro economic scales.</p>

Work For Others – Non DOE	
Approximate Dollar Value: \$47,282.0K	
Sub Program (\$K)	Mission Alignment
DHHS(NIH) (\$20,550.0K) Macromolecular Crystallography, Adenovirus Receptor Interaction, Adenovirus Protease Regulation, Stem Mass Mapping, Neuroimaging Center	New Energy Sources, Climate Change, and National Trust Science: Several NIH projects are directly supportive of the upgrade and further development of the beamlines at the NSLS which are used in a broad range of research in the general area of structural biology, and is supportive of DOE's research theme of "extraordinary tools for extraordinary science". These enhancements relate to beam stability and advancing molecular crystallography capabilities. Several NIH funded projects are related to DOE's "Protecting our Living Planet" research theme by supporting basic and applied research in the Imaging Sciences at BNL. This includes studies of diseases of addiction, vaccine intervention for Lyme disease, and studies of HIV progression as it relates to brain function. Radiotracer development for nuclear medicine applications is also funded through these projects
DOS (\$3,209.0K) International Safeguards	Nuclear Proliferation and Homeland Defense: BNL's International Safeguards Project Office provides technical and administrative management support to the International Atomic Energy Agency (IAEA) in transferring U.S. technology for the increased effectiveness and efficiency in the implementation of IAEA safeguards.
EPA (\$1,743.0K) NJ/NY Harbor Cleanup	Environmental Cleanup: BNL is working with the EPA and DOE to stimulate development and commercialization of environmental treatment technologies for dredged material from the Port of New York/New Jersey that are environmentally effective and economically affordable.
NASA (\$8,880.0K) Booster Applications Facility	National Trust Science: The design and construction of the Booster Applications Facility is part of DOE's theme of "extraordinary tools for extraordinary science" and is a national asset for multidisciplinary research.
NRC (\$8,584.0K)	Energy Infrastructure, Homeland Defense and President's Energy Plan: BNL continues to provide technical support to a wide range of programmatic needs pertaining to the domestic and international nuclear power industry, including: aging, analysis, component and structural life extension, seismic engineering, human factors, and safety analysis.

<p>DOD (\$1,768.0K) Imaging Drug Abuse, Structural Studies</p>	<p>National Trust Science: A) Characterize the molecular changes underlying drug addiction and alcoholism and their relationship to function and treatment, and assess the neurobiological characteristics associated with predisposition for drug addiction. (B) Investigate molecular changes underlying normal aging and their relationship to vulnerability to neurodegenerative disease and treatment. (C) Investigate the actions of therapeutic drugs in the human body to optimize their beneficial effects, minimize toxicity and expedite their introduction into the practice of health care.</p>
<p>Misc. Federal Agencies (\$617.0K) Reflectometry System for Testing, others</p>	<p>National Trust Science, Energy Infrastructure and Homeland Defense: BNL undertakes specific tasks for other federal agencies such as DOC where BNL is completing neutronic and thermal-hydraulic calculations in order to demonstrate that the NIST Research Reactor meets safety requirements for normal operations and review of airport infrastructure for FAA and clean coal technologies.</p>
<p>CRADA (\$1,459.0K) Industry</p>	<p>National Trust Science, New Energy Sources, Nuclear Non - Proliferation, Presidential Energy Plan: These projects range from materials development for battery technology and superconducting materials, development of radiotracer technologies, development of a non-proliferative fuel, to engineering plants as a renewable energy source. Industries involved include DuPont, Dow, Chevron, GRI and Con Edison.</p>

<p>Non-Federal Agencies - Program Title: Work for Others</p>	
<p>Approximate Dollar Value: \$6,715.0K</p>	
<p>Sub Program (\$K)</p>	<p>Mission Alignment</p>
<p>Chemistry Dept. (\$487.0K) MS Legion Dev., Dose Response Studies</p>	<p>National Trust Science, New Energy Sources, and Presidential Energy Plan, Energy Infrastructure, Homeland Defense; Environmental Cleanup; and Climate Change: Projects in diverse areas that rely on the core capabilities of the Laboratory and/or the unique facilities available at BNL. Several projects are related to our capabilities in advanced instrumentation, imaging of well and diseased brains, genetic engineering of plants, development of new battery materials, recycled waste based cement composites, risk informed applications for nuclear power and spectroscopic imaging of multiple sclerosis.</p>

<p>Energy Sciences & Technology Dept. (\$1,280.0K) FAA Wire Study, Fuel Performance, Digital Control Rm Tech</p>	<p>National Trust Science, New Energy Sources, and Presidential Energy Plan, Energy Infrastructure, Homeland Defense; Environmental Cleanup; and Climate Change: Projects in diverse areas that rely on the core capabilities of the Laboratory and/or the unique facilities available at BNL. Several projects are related to our capabilities in advanced instrumentation, imaging of well and diseased brains, genetic engineering of plants, development of new battery materials, recycled waste based cement composites, risk informed applications for nuclear power and spectroscopic imaging of multiple sclerosis.</p>
<p>Environmental Sciences Dept. (\$1,110.0K) Raman Optical Physics, Hydrographic Observ.MV Oleander, others</p>	<p>National Trust Science, New Energy Sources, and Presidential Energy Plan, Energy Infrastructure, Homeland Defense; Environmental Cleanup; and Climate Change: Projects in diverse areas that rely on the core capabilities of the Laboratory and/or the unique facilities available at BNL. Several projects are related to our capabilities in advanced instrumentation, imaging of well and diseased brains, genetic engineering of plants, development of new battery materials, recycled waste based cement composites, risk informed applications for nuclear power and spectroscopic imaging of multiple sclerosis.</p>
<p>Medical Dept. (\$984.0K) CNS Damage</p>	<p>National Trust Science: The purpose of the NASA/DOE facility at Brookhaven National Lab is to study the genetic consequences of heavy ions in a hierarchy of biological systems. The biological models used range from a simple system in which damage is studied in isolated DNA, to complex endpoints.</p>
<p>Physics Dept. (\$1,100.0K) US Atlas, Detector R&D</p>	<p>National Trust Science, New Energy Sources, and Presidential Energy Plan, Energy Infrastructure, Homeland Defense; Environmental Cleanup; and Climate Change: Projects in diverse areas that rely on the core capabilities of the Laboratory and/or the unique facilities available at BNL. Several projects are related to our capabilities in advanced instrumentation, imaging of well and diseased brains, genetic engineering of plants, development of new battery materials, recycled waste based cement composites, risk informed applications for nuclear power and spectroscopic imaging of multiple sclerosis.</p>

Instrumentation Div. (\$192.0K) Heavy Ion Microbeam & Micron Resolution Detector	National Trust Science, New Energy Sources, and Presidential Energy Plan, Energy Infrastructure, Homeland Defense; Environmental Cleanup; and Climate Change: Projects in diverse areas that rely on the core capabilities of the Laboratory and/or the unique facilities available at BNL. Several projects are related to our capabilities in advanced instrumentation, imaging of well and diseased brains, genetic engineering of plants, development of new battery materials, recycled waste based cement composites, risk informed applications for nuclear power and spectroscopic imaging of multiple sclerosis.
Biology Dept. (\$1,412.0K) Center for Structural Genomics	National Trust Science: The aim, ultimately, is to build a body of structural information that will facilitate prediction of a reasonable structure and potential function for almost any protein from knowledge of its coding sequence. Such information will be essential for understanding the functioning of the human proteome, the ensemble of tens of thousands of proteins specified by the human genome.
Director's Office (\$150.0K) Grant Sharing	National Trust Science, New Energy Sources, and Presidential Energy Plan, Energy Infrastructure, Homeland Defense; Environmental Cleanup; and Climate Change: Projects in diverse areas that rely on the core capabilities of the Laboratory and/or the unique facilities available at BNL. Several projects are related to our capabilities in advanced instrumentation, imaging of well and diseased brains, genetic engineering of plants, development of new battery materials, recycled waste based cement composites, risk informed applications for nuclear power and spectroscopic imaging of multiple sclerosis.

Work For Others – Other DOE Labs/Field Offices – Program Title:	
Approximate Dollar Value: \$34,459.0K	
Sub Program (\$K)	Mission Alignment
PNNL (\$1,990.0K) Intern. Nuclear Safety, ARM Program, Gen IV Nuclear Detectors	Nuclear Proliferation, Energy Infrastructure, Climate Change and National Trust Science: BNL is conducting research for the development and optimization of proliferation resistant reactor designs and provide collection of MC&A information. BNL also continues to participate in a program, which addresses various safety issues related to the operation of Russian nuclear power stations. BNL continues to provide scientific support for the DOE - ARM infrastructure, including ARM Web Server, planning for ARM aircraft measurements, ocean environmental engineering, instrument development/deployment, and data interpretation. In addition to assisting in the planning of a Ecosystem Research Facility
ORNL (\$28,100.0K) Spallation Neutron Source, NSLS	National Trust Science: To aid other DOE laboratories in achieving their missions by providing unique expertise for construction of an accelerator to be moved to ORNL as an integral part of the Spallation Neutron Source.
LANL (\$1,686.0K) Planning/Design Superconductivity Quad.	National Science Trust: To aid other DOE laboratories in achieving their missions by providing unique expertise in the areas of construction, planning, managing and testing.
Fermi (\$225.0K) D-Zero Run 2b Upgrade	National Science Trust: To aid other DOE laboratories in achieving their missions by providing unique expertise in the areas of construction, planning, managing and testing.
Albuquerque (\$1,070.0K) Proton Radiography	National Science Trust: To aid other DOE laboratories in achieving their missions by providing unique expertise in the areas of construction, planning, managing and testing.
Other (\$1,388.0K) Atmospheric Radiation, Testing Grout Formulation, other	National Science Trust: To aid other DOE laboratories in achieving their missions by providing unique expertise in the areas of construction, planning, managing and testing.

DOE - Miscellaneous: Laboratory Support Programs and Programs in Support of DOE - Program Title:	
Approximate Dollar Value: \$22,882.1K	
Sub Program (\$K)	Mission Alignment
KG (\$11,183.9K) Facilities and Infrastructure	Landlord Infrastructure: Maintain infrastructure of the Laboratory
FS (\$9,764.9K) Office of Security and Emergency Operations	Homeland Defense: Provide site safeguards and security
CN (\$1,129.1K) Counter Intelligence	Homeland Defense: Supports the CI activities at the site.
HC (\$172.4K) Environmental, Safety & Health (Non Defense)	Energy Infrastructure and President's Energy Plan: BNL assists the DOE in evaluating the technical background needed for the development of policy and standards applicable to the design, construction, operation, maintenance and decommissioning of nuclear facilities.
WB (\$631.8K) In-House Energy Management	Energy Infrastructure: DOE provides funds to the site to implement projects for the more efficient use of energy at the site.

1.3 Success in Constructing and Operating Research Facilities

Supporting information for BSA Constructing and Operating Research Facilities performance for Fiscal Year 2003 has been organized into the following data categories.

- Budget and Schedule Performance
- Facility Performance Assessment
- Facility Availability
- User Survey Results

Each Department within each BSA Scientific Directorate has provided supporting performance information within the above format. The following is a compilation of that performance data.

1.3.1 High Energy and Nuclear Physics

1.3.1.1 Collider Accelerator Department

Budget and Schedule Performance

C-A performance was outstanding.

Financial performance was outstanding; all budgets were controlled and adhered to. Cost plans were on target.

Facility Performance Assessment

C-A performance was outstanding.

RHIC technical goals for FY 2003 were all either achieved or exceeded.

Performance:

- RHIC asymmetric operation, deuteron-gold, became operational
- RHIC operational with deuteron-gold and polarized proton beams at experiment requested collision energy, all five experiments collecting data and publishing
- Fifth experiment, PP2PP, brought into operation and collecting p-p data
- Peak luminosity approx. $5 \times 10^{26} \text{cm}^{-2} \text{sec}^{-1}$ (Au-Au), $6 \times 10^{30} \text{cm}^{-2} \text{sec}^{-1}$ (p-p), $6 \times 10^{28} \text{cm}^{-2} \text{sec}^{-1}$ (d-Au).
- Average store luminosity approx. $1.5 \times 10^{26} \text{cm}^{-2} \text{sec}^{-1}$ (Au-Au), $\sim 3 \times 10^{30} \text{cm}^{-2} \text{sec}^{-1}$ (p-p), $2 \times 10^{28} \text{cm}^{-2} \text{sec}^{-1}$ (d-Au).
- AGS provided polarized protons with 50% polarization
- Acceleration of polarized protons to 100 GeV with average 30% polarization
- RHIC Spin Rotators commissioned, providing first longitudinally polarized p-p collisions.
- Storage times up to 12 hours, depending on species (intrabeam scattering limited)
- Refill time of 45 minutes between stores
- NASA Space Radiation Laboratory construction completed and four beams commissioned. (C, Fe, Ti, H)

Facility Availability

- HEP (AGS) = Not funded in FY2003
- NP (RHIC) = 77.95%

1.3.1.2 Physics Department

The Accelerator Test Facility (ATF) was an existing facility when acquired by the Physics Department in 2003. It was operated by NSLS prior to its move to the Physics Department.

ATF has continued to operate excellently in Physics and has been integrated into the Physics Department ES&H systems. Extremely innovative work in high brightness beams, novel acceleration mechanisms and fundamental physics is performed at the ATF. Many students have received advanced degrees in accelerator physics at the ATF since its inception. Technical advances made at the ATF will play a big role in the upgrade of the RHIC complex and at other accelerator facilities around the world.

The systems for maintaining and improving the facility, for approving proposals and for installing and operating experiments are all working very well.

Budget and Schedule Performance

- ATF Operations and Development - Outstanding
- Physics of Beams at the Accelerator Test Facility - Outstanding

Facility Performance Assessment

- Proposed approx. 1100 hours users time per year, Provided same, Excellent.
- Beam performance in terms of brightness and stability keeps improving. Outstanding.
- Number of user experiments proposed about 10, actual 14, Outstanding.

Facility Availability

- The facility continues to be available at its usual level of 1100 hour per year on average. This is an outstanding level considering the level of ATF staffing.

User Survey Results

- No survey was made. However, users express a high level of satisfaction estimated at outstanding.

Additional Comments

- The ATF provides a unique service to the community in providing a hand-holding, fully instrumented, peak performing facility, enabling users to carry out quality research with state-of-the-art beams.
- The ATF provides graduate student education opportunities in accelerator physics, serving a large number of universities.

1.3.1.4 Superconducting Magnet Division

Budget and Schedule Performance

- LHC Program – budget status: budgeted cost = \$4.1 M, actual cost = \$3.95 M (9 months).
Schedule status: ahead of CERN installation schedule.

- RHIC Helical Dipole Spares Program – budget status: budgeted cost = \$743 K, actual cost = \$788 K (10 months). Schedule status: two of three magnets completed on schedule; third shifted to FY04 due to material shortage.
- AGS Snake – budget status: budgeted cost = \$430 K, actual cost = \$364 K (10 months). Schedule status: three month delay due to extended insulation scheme development.

Facility Performance Assessment

- Performance specifications and objectives for magnet programs have been met or exceeded.

1.3.2 BasicEnergy Sciences

1.3.2.1 Chemistry Department

Budget and Schedule Performance

- Completed installation of new cyclotron on time and within budget. 1.9 Million dollar budget, 50K still remaining after completed installation.

Facility Availability

- The status and prospects for LEAF have been evaluated by LEAF staff together with the chemistry department chair and the BES ALD. Exciting scientific investigations are underway, and near term goals for scientific investigations using LEAF have been set. A three-year capital improvement plan has been established and communicated to the DOE BES office. A new user plan has also been proposed and will be initiated in FY2004 to encourage the broadest collaborative use of LEAF and to initiate user access to this unique facility in conjunction with LEAF's role as a part of the ultrafast cluster of the Center for Functional Nanomaterials.

1.3.2.2 National Synchrotron Light Source

Budget and Schedule Performance

Each fiscal year, the NSLS updates and revises its Department Strategic Plan, its Annual Operating Plan and Individual Staff Objectives to meet Department goals. During FY2003, the NSLS requested individual plans for all routine operations and proposals for any non-routine work. All plans and proposals were prioritized and Operating, Capital and AIP funds were allocated to meet the goals. Progress was reviewed monthly and reallocations were made throughout the year as appropriate. This process ensures allocation of department resources in accordance with established priorities, and provides management with ongoing information regarding process and budget. We rate this process as outstanding.

Facility Performance Assessment

The storage rings continue to operate with high performance. The photon brightness and flux, key performance measures, are essentially at their theoretical limit for the existing accelerator lattice. The third of four RF cavities was replaced this year, with the fourth scheduled to be replaced in December 2003. The new cavities have increased reliability as well as enabling new insertion device beamlines from the two RF straight sections they occupy. In one of these RF

straights, a new mini-gap undulator was fabricated and installed this year to provide high brightness x-rays to a new structural biology beamline (X29) which is being constructed this year and will become operational next year. A digital orbit feedback system, previously implemented on the VUV ring, was implemented on the x-ray ring as well this year and has resulted in greatly improved photon beam position stability. Overall, we rate the facility performance as outstanding.

Facility Availability

The NSLS internal target is 95% *reliability*, i.e., we intend to provide a high quality on-specification photon beam to our users at least 95% of all scheduled operations. It also should be noted that DOE's performance objective for user facility reliability is 90%. In addition, some time is often available to users in addition to the scheduled hours (*availability*).

Nine months into fiscal 2003 (of which 8 months had scheduled operations), the VUV has achieved 98.6% reliability delivering 4211 scheduled hours. Availability is running at 107.9% of scheduled hours. Reliability/availability for the VUV ring is judged outstanding.

For the X-ray ring, reliability exceeded 95% for five months in FY 2003. However, two major equipment problems significantly curtailed planned operations in three operational months. Overall reliability for X-ray is to date 87.6%, delivering 3148 of 3594 scheduled operations hours. Availability for the year thus far is 109.1%. Given the deficiency in scheduled operations hours, reliability/availability for the X-ray ring is rated as good.

Since the NSLS has been in continuous operation for more than 20 years, some aspects of the machine are becoming prone to age and exposure related failures. Capital and AIP projects related to the accelerator complex have been selected to emphasize continuing high reliability and availability on systems for which impending problems can be anticipated. As noted above, some unanticipated failures occurred on the x-ray ring this year. However, the lost time was kept to a minimum largely through the experience and dedication of the staff.

User Survey Results

The NSLS asks for feedback from user groups at the conclusion of their visit to our facility. In the last fiscal year, 319 responses were received. A database is maintained with the detailed responses to each answer.

The following is a summary of key questions associated with user satisfaction (O=outstanding, E=excellent, VS=very satisfied, S=satisfied, DS=dissatisfied, VDS=very dissatisfied):

- The efficiency, effectiveness and general support provided by Beamline support personnel (i.e., Local Contact, Beamline Scientists, Technicians, etc.) was: O=127 / E=146 / S=30
- The overall success of your experiment was: : O=65 / E=155 / S=79
- How satisfied were you with the schedule or service (i.e., was the time or service delivered on schedule and was downtime kept to a minimum)? VS=147 / S=149 / DS=4 / VDS=3
- How satisfied were you with the performance (i.e., was beam or service maintained close to specifications)? VS=143 / S=154 / DS=5 / VDS=1

- How satisfied were you with the fraction of the year that the facility operates? VS=67 / S=213 / DS=2 / VDS=0
- How satisfied were you with the support for users provided by the NSLS staff? VS=67 / S=132 / DS=0 / VDS=3
- How satisfied were you with the support for users provided by the PRT staff? VS=151 / S=119 / DS=1 / VDS=0
- Based on your experience during this visit, please rate your overall satisfaction: O=54 / E=175 / S=76

1.3.3 Life Sciences

1.3.3.1 Biology Department

Budget and Schedule Performance

All facilities are operating on schedule and on budget. The NASA Space Radiation Laboratory, a joint project between C-A, Medical, and Biology was completed on schedule and saw its first user population in July, 2003.

Facility Performance Assessment

All Biology Facilities have had outstanding performance based as evidenced by the following and by the fact that they have been operating on schedule and within budget, even during periods of major reconstruction.

Macromolecular Crystallography Facilities at NSLS:

- 99 publications by users were reported for last year.
- Over the past year the beamlines saw approximately 134 investigators working about 82 different projects.
- Development and operation of Rapid Access Crystallography program.
- Development and operation of the Mail-In Crystallography as featured in the journal article Nature 423: 799-800, June 19, 2003.
- Optimized the performance of the X12C beamline and diffractometer for PX data collection. This beamline produces almost the same number of publications as the much more intense beamline X25.
- Implemented comprehensive upgrades of NSLS beam line X12B as part of the suite of facilities.
- Organized and ran a practical crystallography in our RapiData 2003 (Rapid Data Collection and Structure Solving at the NSLS: A Practical Course in Macromolecular X-Ray Diffraction Measurement) Course and assisted in the annual Cold Spring Harbor Course in Protein Crystallography.
- Initiated a semi-annual upgrade and maintenance programs on the beam lines.
- Direct fabrication of cryogenic crystal changing robot for use in rapid screening and machine assisted data collection.
- Designed and fabricated key components of crystal changer, including: frost-free containment of mobile crystal reservoir, micro motor control of commercial goniometer head, low-cost fast rotating goniometer axis, and retracting mechanisms for cold stream and counters.

- On X25, a new powerful, twin-monitor, dual processor computer for various uses was installed.
- The X25 user station was reconfigured to provide an off-to-the-side station for computing away from the turmoil of data collection.
- Cluster computing is now a standard industry practice, no longer a research project, so we'll consider the core computing facility as just a part of our whole computing infrastructure.

Scanning Transmission Electron Microscopy (STEM) Facility

- Renewal of STEM NIH Grant for 5 years. (J.Wall)
- New version of Mass Analysis software and documentation distributed to users. (J.Wall)
- New simulation software for the entire EM protocol: specimen description, imaging, detection, and analysis. (J.Wall)
- Use of above to justify several research proposals submitted (GTL & LDRD). (J.Wall)
- Development of a new STEM Detector for improved imaging of nanostructures. (J.Wall)
- Support of 40 active user/collaborator projects at STEM Resource. (J.Wall)

NASA Space Radiation Laboratory (NSRL)

- The NSRL had its first run this July, 2003. It had about 60 investigators working on 15 different experiments.

Facility Availability

- Scanning Transmission Electron Microscopy Facility continues to operate 40 hrs/week as it has for the last 25 years.
- The Biology Department operates five beamlines at the NSLS for Macromolecular Crystallography. Operations are limited to NSLS availability. Operations are about 215 days/year. Beamline maintenance and upgrades are scheduled during NSLS shutdowns to avoid any additional down-time.
- The NASA Space Radiation Laboratory (NSRL) had its first run this July, 2003. It had about 60 investigators working on 15 different experiments.

User Survey Results

- Comments from Advisory Groups and End of Run forms have been favorable. Advisory committee feedback is used to develop a path forward for the facilities.

1.3.3.2 Medical Department

Budget and Schedule Performance

Brookhaven LINAC Isotope Production Facility

- In the Isotope Production Facility, the production expenses are on budget and distribution schedules were maintained. The midyear production expenses are on-track and bills are delivered, as required, by 4 days of shipment.

Clinical Research Center

- The BNL Clinical Research Center has been operating below budget as they have had an interim Manager for much of the Fiscal Year. The new Manager has been recruited and will start in early August.

Brookhaven Laboratory Animal Facility (BLAF):

- The BLAF has been operating on budget. The BLAF has taken additional responsibilities for the maintenance of a short-term animal staging area at the new NASA Space Radiation Laboratory (NSRL) building.

9.4 Tesla microMRI Facility:

- This space for the new facility has been renovated and the instrumentation is currently being installed. It is on schedule and on budget.

NASA Space Radiation Laboratory (NSRL):

- Was completed on-time and budget. It saw its first user population in July 2003. It is anticipated there will be about 3 runs per year and will have about 150 users/yr.

Facility Performance Assessment

The facilities managed by the Medical Department have performed outstanding. We base this rating on the following data:

Brookhaven LINAC Isotope Production Facility

- In addition to maintaining its performance, the Isotope Production Facility had one process improvement project to design, build and install a target transfer cave. It was completed on schedule and budget.
- A Pollution Prevention Project was funded and completed as well.

Clinical Research Center

- The Clinical Research Center completed its corrective action plan from a shutdown of operations last year. They have made many improvements to their operations including a restructuring of the program.
- They have undergone several audits in FY03 all of which have had favorable results.
- A new CRC manager has been recruited and will start in 8/03.

Brookhaven Laboratory Animal Facility (BLAF)

- 15 BNL PIs use the BLAF along with 12 NASA Investigators and 1 NIH investigator. They work on 57 active protocols.
- Between 7/1/03 and 6/30/03 the BLAF has housed approximately 3500 mice, 2000 rats, 8 rabbits, 10 baboons and 17 macaques.
- The BLAF had favorable reviews from AALAC, USDA, NYSDH and internally by the IACUC.

NASA Space Radiation Laboratory (NSRL)

- The NSRL had its first run this July, 2003. It had about 60 investigators working on 15 different experiments.

Facility Availability

Brookhaven LINAC Isotope Production Facility

- Due programmatic changes in DOE High Energy and Nuclear Physics there was a drop in available beam for BLIP operations. The FY03 integrated beam current was 243,995 microamphours in 3120 total hours compared to FY02 of 344,752 microamphours in 3959 total hours. LINAC reliability also was poor. The number and quantity of isotopes produced and customers serviced declined as a consequence.

Clinical Research Center (CRC)

- The CRC had approximately 835 human subject visits from the period of 7/1/02-6/30/03 participating on 43 active Institutional Review Board protocols. Nine internal Principal Investigators and two external PIs conduct human subjects research at BNL.

Brookhaven Laboratory Animal Facility (BLAF)

- 15 BNL PIs use the BLAF along with 12 NASA Investigators and 1 NIH investigator. They work on 57 active protocols. Between 7/1/03 and 6/30/03 the BLAF has housed approximately 3500 mice, 2000 rats, 8 rabbits, 10 baboons and 17 macaques.

Radiation Therapy Facility

- The SUNY SB operated RTF for cancer treatment had approximately 6100 patient visits this year.

User Survey Results

Brookhaven LINAC Isotope Production Facility

A compliment and complaint log is kept. Any complaints are rectified (this year only 1 has been logged and was closed). Logs are sent to DOE Program Office. They had a 97% on-time delivery rate and meet specification 99% of the time. They report no defective targets or batches and have exceeded initial projection of production schedules. In addition, DOE Office of Isotopes for Medicine and Science performed a quality assurance audit. This Office (OIMS) manages radioisotope production for the DOE. As per their QA Program Plan, they assessed the Training and Nonconformance Reporting elements of the BNL Medical Department Radionuclide Research and Production Group. There were eight Findings, three Observations and three Recommendations, all of which have been addressed.

Clinical Research Center

In April 2003, a team from the University of Rochester performed an independent evaluation of the implementation of the human subjects research program at BNL including the Clinical Research Center operations. This review consisted of an in-depth assessment of the researcher's records and files as well as an evaluation of the policies and procedures that had been put in place as part of the May 2000 Corrective Action Plan. The report, dated 5/6/03, concluded that BNL's medical research program involving human subjects is currently operating in a satisfactory state of compliance and that the audit results demonstrate significant improvements across all areas relative to the previous University of Rochester audit, conducted in January 2000. Several minor recommendations for improvement were provided. These will be evaluated and implemented shortly. The primary recommendation was that "BNL continue its efforts to maintain its current standard of operations."

Brookhaven Laboratory Animal Facility (BLAF)

The BLAF had favorable reviews from AALAC (a triennial accreditation), USDA, NYSDH and internally by the IACUC. The Association for the Assessment and Accreditation of Laboratory Animal Care International (AAALAC) Audit was a major audit. This international association provides peer review and evaluation for laboratory animal programs. Certification of a program by AAALAC is accepted by the United States Dept. of Agriculture (USDA), Public Health Services (PHS), Dept. of Health and Human Services (DHH), and the National Institute of Health (NIH) as assurance that an institution meets current federal policies related to appropriate laboratory animal care and use. Accreditation is achieved in two ways: Site visits by peer group professionals every three years, and through annual reporting. BNL's had its triennial AALAC accreditation audit on 6/12/02. There were a 10 minor findings noted all of which have been addressed and closed.

1.3.4 Energy, Environment and National Security

1.3.4.1 Environmental Sciences

Facility Availability

- In FY 2003, four of the Free-Air CO₂ Enrichment (FACE) facilities, Eastern Pine Forest, Mojave Desert, Northern Hardwood Forest, Eastern Hardwood Forest, became a single official DOE Distributed User Facility. A BNL scientist was named the FACE Facility Coordinator. The Coordinator, DOE, and users are preparing a management plan for the Facility. The Facility is open to all qualified investigators and includes opportunities for field research and modeling activities that use data produced by the Facility.

1.3.5 SNS - Spallation Neutron Source Project

Progress on SNS

C-A performance was outstanding.

- All critical milestones have been met
- Long-lead procurements have been placed
- Staffing is up ~100 FTE's as planned
- Preparations are under way to fully obligate the ~\$27 M in FY 2003 funding

In summary, the milestones identified in the work packages that cover FY 2003 work have been fulfilled.

1.4 Effectiveness and Efficiency of Research Program Management

Supporting information for BSA Research Program Management performance for Fiscal Year 2004 has been organized into the following data categories:

- Management Goals and Processes for Fiscal Year 2004
- New Associate Scientists (or Above) Hired
- New Research Associates Hired
- Significant Improvements in Infrastructure and Management Systems that Support Research
- Safety Enhancements
- Steps Toward Development of Next Generation Facilities and Research Tools
- Discussion of Make up of the Facility User Community
- Steps Toward Improvement of Proposal Quality and Opportunities
- List the Number of International Collaborations
- List of Projects/Programs Involving Collaboration with Others
- Number of Users by Facility
- List of WFO Projects and Sponsors
- Staff Profile
- Funding Profile for the Last Seven Years
- Other Awards
- Other Publications, Citations, Press Releases for this Fiscal Year
- Number of Co-Authored Papers, CRADAS, etc.

Each Department within each BSA Scientific Directorate has provided supporting performance information within the above format. The following is a compilation of that performance data.

1.4.1 High Energy and Nuclear Physics

1.4.1.1 Collider Accelerator Department (C-A)

Management Goals and Processes for Fiscal Year 2004

- Accelerator systems will continue to be improved to enhance research quality.
- Accelerator operations will continue to be aligned with DOE mission.
- Facility operations enhancements reviewed and approved by the DOE Division of Nuclear Physics
- WFO planning to continue with NASA (AGS & NSRL) and with non-federal entities for a RCMS.
- WFO planning to continue with SNS Project

New Associate Scientists (or Above) Hired

- One Senior Scientist and one Associate Scientist

New Research Associates Hired

- Two Research Associates (junior scientists)

Significant Improvements in Infrastructure and Management Systems that Support Research

- RHIC: cryogenic system, facility infrastructure, power supplies etc. have been repaired and implemented. Approx. 2 years at present funding left to go.
- AGS: Siemens MG Set installation completed after failure caused by General Electric Corporation faulty QA program.
- Booster: slow extraction system operational. BAF/NSRL completed on schedule and below budget, successfully commissioned and operational
- LINAC: Polarized proton ion source is operational at record polarization
- BAF/NSRL: successfully operated for FY 2003 running cycle
- Proposal for EBIS/LINAC based preinjector for RHIC prepared.
- Tandem: Upgraded to allow delivery of deuteron beams to RHIC

Safety Enhancements

- Implemented the International Labor Organization Guidelines for Occupational Safety and Health Managements Systems, ILO-OSH-2001. These guidelines enhance ISM principles with additional principles that are similar to the ISO 14001, which is used for the Environmental Management System. These additional principles promote worker participation and continual improvement, which in turn increases worker protection.
- Continued consolidation of the Safety Assessment Documents for the Collider Accelerator complex. The single unified document is about 60% complete.
- Updated four Accelerator Safety Envelopes (ASEs) currently in use at the complex. The new ASEs meet DOE and SBMS requirements and specify the minimum necessary components and monitoring devices to allow operation. The major changes were to modernize the AGS ASE and to include specific actions in all ASEs whenever minimums are not met.
- Obtained approval for routine operations of the Tandem to Booster Line with low mass ions. In addition, confirmed the approval for operation of RHIC with deuterons and other ions. The staff developed and implemented the required administrative controls and engineered safeguards to operate in these modes safely. The approval process was conducted in compliance with the provisions of DOE Order 420.2, Safety of Accelerator Facilities and the BNL Accelerator Safety Subject Area.
- Obtained approval for routine operations of the NASA Space Radiation Laboratory (NSRL). The staff developed and implemented the required administrative controls and engineered safeguards for commissioning the beam line, for commissioning the experimental program and for routine operation of NSRL. The approval process was conducted in compliance with the provisions of DOE Order 420.2, Safety of Accelerator Facilities and the BNL Accelerator Safety Subject Area.
- Maintained ISO 14001 certification.

Steps Toward Development of Next Generation Facilities and Research Tools

- RHIC II: Electron cooling R&D vigorously underway with DOE support, including JLab, TJNAF and BINP
- ERHIC: Conceptual design commenced in collaboration with Bates Lab and BINP, with ZDR completion in FY 2004
- Neutrino Source: Conceptual design commenced

- RCMS: Conceptual design was completed.
- RSVP: Canadian funding approved and awaiting funding. NSF funding set for FY 2006 (possibly sooner)
- EBIS: R&D successfully completed. Funding requested.

List the Number of International Collaborations

There are six International Collaborations:

- CERN (Switzerland): Collider Beam Dynamics
- KEK (Japan): High Intensity Proton Synchrotron Systems
- TRIUMF (Canada), KEK (Japan) INR (Moscow-Russia): Polarized Proton H-minus Source
- ITEP: Polarized Jet
- BINP (Novosibirsk-Russia): EBIS Ion Source Electron Gun
- BINP (Novosibirsk-Russia), AES, JINR (Dubna-Russia), TJNAF: RHIC Electron Cooling (RHIC II)

List of Projects/Programs Involving Collaborations with Others

Non-DOE Funded Programs That Connect To DOE:

- NASA radiobiology at AGS and NSRL
- RCMS (Pennsylvania), Loma Linda University, etc. Medical Synchrotron
- NSF High-Energy Physics RSVP experiments (R&D funding, construction begins in FY 2006) TRIUMF etc.

Collaborations with Other Laboratories or Universities

- SNS Project (ORNL)
- KEK (Japan) High Intensity Proton Synchrotron Systems
- TRIUMF (Canada), KEK (Japan) INR (Moscow-Russia) Polarized Proton H-minus Source
- ITEP Polarized Jet
- BINP (Novosibirsk-Russia) EBIS Ion Source Electron Gun
- BINP (Novosibirsk-Russia) AES, JINR (Dubna-Russia), TJNAF, RHIC Electron Cooling (RHIC II)
- University of Pennsylvania, Stony Brook RCMS (Rapid Cycling Medical Synchrotron)
- ORNL, ANL, LANL, LBNL, TJNAF on SNS Project
- CERN (Switzerland) Collider Beam Dynamics
- Bates (MIT) eRHIC R&D

Number of Users by Facility

The numbers of users that are administered through the RHIC & AGS User’s Center are as follows:

AGS	422
ATF	34
RHIC	1084
Tandem	143
Total	1683

List of WFO Projects and Sponsors

- Booster Application Facility: NASA (completed FY2003)
- NASA Space Radiation Laboratory: NASA (operations begun FY 2003)
- Genetics and Epigenetic Effects: NASA
- Proton Radiography: NASA (LANL)

Staff Profile

Tenured:	8	Professional:	106
Continuing:	25	Technical:	224
Term:	9	Administrative:	25
Research Associates :	4	Management:	16
Scientific Total:	46	Information Tech:	43
		Total:	460

*Note: Riken Fellows, Goldhaber Fellows, and Visiting Scientists included with Research Associates.

Funding Profile for the Last Seven (7) Years

2003	\$132.7M
2002	\$133.1M
2001	\$127.8M
2000	\$116.5M
1999	N/A
1998	N/A
1997	N/A

Number of Co-Authored Papers, CRADA's, etc.

- CRADA # BNL-C-01-03, Non-Vacuum Electron Beam Welding with Accelaron Inc.
- CRADA # BNL-C-02-07, Accelerator design of a proton therapy facility with Accel Instruments, GMBH
- CRADA # BNL-C-03-09, Highly Stripped Ion Sources for MeV Ion Implanters

Co-Authored Papers:

The majority of C-A publications have co-authors. C-A has a total of 206 publications that include peer reviewed and refereed publications, internal reports, invited papers, conference proceedings and other publications. The list of published documents is available from the C-A Department Chairman's Office.

1.4.1.2 Physics Department

Management Goals and Processes for Fiscal Year 2004

- Initiate or strengthen efforts/groups in:
 - US-ATLAS Physics Analysis Center
 - Astrophysics/cosmology
 - Lattice Gauge Theory

- Very Long Baseline Neutrino Oscillations
- eRHIC experimental research
- Manage RHIC Detector R&D program
- Update departmental Experimental Safety Review processes

New Associate Scientists (or Above) Hired

- 1 Associate Scientist

New Research Associates Hired

- 12 Research Associates
- 1 Riken Fellow
- 1 Goldhaber Fellow

Significant Improvements in Infrastructure and Management Systems that Support Research

- New leadership and staff in Department Administrative group

Steps Toward Development of Next Generation Facilities and Research Tools

- RHIC Detector Upgrade R&D program managed in the Physics Department

Discussion of Make up of the Facility User Community

- ATF (Accelerator Test Facility) is the department's only major facility. There are currently about 15 active /approved experiments with collaborations within the US and international accelerator physics communities. Foreign collaborations at the ATF involve scientists from Russia, Japan, Taiwan and Israel.

Steps toward Improvement of Proposal Quality and Opportunities

- Closer involvement of the Administrative Group with proponents during the proposal writing stage.
- Review of LDRD proposals as input to the ALD-HENP prior to decision meetings

List the Number of International Collaborations

- Almost every collaboration involving the Physics Department's HENP staff has an international component

List of Projects/Programs Involving Collaboration with Others

- ALL experiments carried out by Physics Department HENP groups are collaborative with Others:
 - STAR, PHENIX, BRAHMS and pp2pp experiments at RHIC
 - KOPIO, MECO, E949, E930 and E821 experiments at the AGS
 - ATLAS experiment at the CERN LHC
 - D-Zero and MINOS experiments at Fermilab
 - Etc.

Number of Users by Facility

- ATF – about 100

List of WFO Projects and Sponsors

- University of Rochester (NF-99-08) U.S. ATLAS Barrel Cryostat Design and Procurement

- Burle Industries, Inc. (C-99-13) Project to Develop a Red Side Window Photomultiplier Tube and a Mesh Dynode Proximity Focusing Photomultiplier Tube
- Yale University, (NF-02-07) KPOIO Project

Staff Profile

Tenured:	34	Professional:	25
Continuing:	37	Technical:	29
Term:	31	Administrative:	25
Research Associates :	39	Management:	4
Scientific Total:	141	Information Tech:	35
		Total:	259

*Note: Riken Fellows, Goldhaber Fellows, and Visiting Scientists included with Research Associates.

Funding Profile for the Last Seven (7) Years

Total	(Operating)			(Capital)		
	NP	HE	Total	NP	HE	Total
2003	\$28.1M	\$17.0M	\$45.1M	\$5.7M	\$3.7M	\$9.4M
2002	\$26.9M	\$16.4M	\$43.3M	\$6.4M	\$6.3M	\$12.7M
2001	\$26.3M	\$18.9 M	\$45.2M	\$4.3M	\$4.7M	\$9.0M
2000	\$21.2M	\$14.8M	\$36.0M	\$2.7M	\$9.2M	\$11.9M
1999	\$14.7M	\$12.1M	\$26.8M	\$0.4M	\$2.7M	\$3.1M
1998	\$10.4M	\$13.6M	\$24.0M	\$1.1M	\$4.6M	\$5.7M
1997	\$11.5M	\$14.2M	\$25.7M	\$0.8M	\$1.6M	\$2.4M

Number of Co-Authored Papers, CRADA's, etc.

CRADAs: Burle Industries, Inc (C-99-13) Project to Develop a Red Side Window Photomultiplier Tube and a Mesh Dynode Proximity Focusing Photomultiplier Tube

1.4.1.3 Instrumentation Division

Management Goals and Processes for Fiscal Year 2004

In support of vital BNL programs:

- RHIC Detector Upgrades (silicon and TPC);
- e-cooler; e-RHIC
- High Current Photocathodes;
- Si-detectors for Polarimeters;
- Si-detectors & microelectronics;
- New small animal PETs, MRI;
- Neutron detectors for SNS;
- Neutron detectors;

- Detectors and Microelectronics for Homeland Security Program.

State of the art core technology:

- Fine-grained Si and gas detectors;
- Low noise microelectronics from submicron to nanoscale;
- Femtosecond, photon and particle beam generation & diagnostics;
- Nano-fabrication: pattern generation; deposition/ablation; characterization.

Safety Enhancements

- Maintain and update a Division Environmental Management System website to keep staff informed of environmental and safety issues;
- ES&H Coordinator and Division Head attended “Working Safely” meetings held by new lab director and communicated outcome to staff.

Steps Toward Development of Next Generation Facilities and Research Tools

- CMOS as direct conversion detectors
- Megapixel matrix on kohm cm Si
- Neutrino (“bubble”) detector
- Femtosecond ~100 eV source

List the Number of International Collaborations

10

List of Projects/Programs Involving Collaborations with Others

Core Competencies and Program Areas Served

- Semiconductor, Gas, Liquid Detectors:
- X-ray, gamma-ray Detectors (1D, 2D);
- High Resolution Neutron Detectors;
- Silicon (strip-,pad-, drift-) Detectors;
- Fast Noble Liquid Calorimetry;
- Gas Detectors for High Particle Rates and Multiplicities (Cathodes Pad/Strip Chambers)
- Micro-electronics:
- Monolithic and Hybrid Low Noise Amplifiers;
- Data Acquisition Electronics;
- Fast Noble Liquid Calorimetry Readout.
- Laser, Optics & Microfabrication:
- Optics Metrology;
- Laser and Optics in New Accelerator Concepts Photocathodes, Picosecond Switching;
- Electro-optics and Ultrashort Laser-pulse Techniques;
- Micro/nano Fabrication.
- HEP Activities
- Projects/Experiments
- LHC, with Physics Dept:
- ATLAS liquid argon calorimeter; signal integrity, coherent noise; ATLAS CSCs and low noise electronics for muon detectors;
- AGS:

- KOPIO, Si-drift photo diode for calorimeter;
- MECO, calorimeter readout & electronics, tracker electronics.

List of WFO Projects and Sponsors

- NSBRI
- LANL SPDs
- ANL Neutron Detector
- SNS/ORNL Neutron Detectors

Staff Profile

Tenured:	5	Professional:	10
Continuing:	9	Technical:	17
Term:	2	Administrative:	4
Research Associates :	4	Management:	0
Scientific Total:	16	Information Tech:	0
		Total:	47

*Note: Riken Fellows, Goldhaber Fellows, and Visiting Scientists included with Research Associates.

Visiting Scientist Profile

- Dr. A.T. Hrisoho, Linear Accelerator Laboratory, Orsay, France. Work associated with low noise semiconductor components for signal processing in particle detectors.
- Dr. E.C. Gatti, Polytechnic Institute of Milan, Italy. Research and development on semiconductor drift chambers.
- Dr. E.M. Verbitskaya, Ioffe Physico, Technical Institute of Russian Academy of Sciences, Russia. Research scientist doing detector characterization.

Funding Profile for the Last Seven (7) Years

2003	\$5.6M
2002	\$5.5M
2001	\$5.6M
2000	\$5.5M
1999	\$5.5M
1998	\$5.5M
1997	\$5.0M

Number of Co-Authored Papers, CRADA's, etc.

Co-Authored Papers: 27

CRADAS: 2

1.4.1.4 Superconducting Magnet Division

Management Goals and Processes for Fiscal Year 2004

- Continue to work within the U.S. HENP community to develop future facilities and technologies.
- Continue to collaborate with other science institutions world wide to both provide and develop superconducting technologies.
- Support the ongoing BNL research program with emphasis on the RHIC complex.

Significant Improvements in Infrastructure and Management Systems that Support Research

- Upgraded magnet test measuring system, for both vertical and horizontal testing, by replacing VAX computer systems with PCs and rewriting software.
- Expanded process control capability of cryogenic system by adding 32 analog input channels and nine analog output channels.
- Installed pipes, valves, and instrumentation to monitor and recover boil-off helium from Building 939.
- Constructed a feed can and an end can for testing LHC magnets using either forced cooling or liquid helium in MAGCOOL.
- Implemented “Design Team” approach to engineering design.

Safety Enhancements

- Performed ergonomic engineering evaluations of design room workstations.
- Assigned industrial hygienist to evaluate and characterize industrial processes.
- Performed thermal imaging of electrical distribution panels.

Steps Toward Development of Next Generation Facilities and Research Tools

- RHIC e-Cooling – solenoid magnet R&D
- GSI – rapid cycling magnet R&D
- NLC – final focus magnet R&D
- High field magnet R&D
- eRHIC
- Neutrino factory storage ring design and magnet R&D

List the Number of International Collaborations

- CERN – LHC superconducting magnets and superconductor testing
- IHEP – BEPC-II magnets
- GSI – rapid cycling magnet R&D

List of Projects/Programs Involving Collaborations with Others

- ORNL – SNS magnet testing
- FNAL – LHC superconducting magnet production and superconductor testing
- LBL – LHC superconductor testing
- eRHIC
- Neutrino factory and muon collider
- NLC – final focus magnet R&D

Staff Profile

Tenured:	1	Professional:	20
Continuing:	7	Technical:	54
Term:	0	Administrative:	3
Research Associates :	1	Management:	1
Scientific Total:	9	Information Tech:	2
		Total:	89

*Note: Riken Fellows, Goldhaber Fellows, and Visiting Scientists included with Research Associates.

Funding Profile for the Last Seven (7) Years

2003	\$12.7M
2002	\$15.4M
2001	\$13.4M
2000	\$17.0M
1999	N/A
1998	N/A
1997	N/A

Other Awards

- BNL Engineering Award

1.4.2 Basic Energy Sciences

1.4.2.1 Chemistry Department

New Associate Scientists (or Above) Hired

1

New Research Associates Hired

13

Safety Enhancements

- Replaced lighting ballasts throughout the building to increase energy conservation and reduction of PCB's.
- Disposal program initiated and nearing completion for legacy radioactive materials.

Steps Toward Development of Next Generation Facilities and Research Tools

- A three-year capital improvement plan has been established and communicated to the DOE BES office for improvements for the LEAF Facility.

Discussion of Make up of the Facility User Community

- LEAF - A new user plan has also been proposed and will be initiated in FY2004 to encourage the broadest collaborative use of LEAF and to initiate user access to this unique facility in conjunction with LEAF's role as a part of the ultrafast cluster of the Center for Functional Nanomaterials.

- PHOBOS Research – Roughly 50 users from 7 institutions from 3 countries comprise the experiments.
- MRI users are predominantly from other programs at BNL.

List the Number of International Collaborations

17

List of Projects/Programs Involving Collaborators with department appointments

- Thermal Photo-and Radiation-Induced Reactions in Condensed Media – 45
- Catalysis: Reactivity and Structure – 10
- Gas-Phase Molecular Dynamics – 24
- Photoinduced Molecular Dynamics in the Gas and Condensed Phases – 14
- Phobos Research – 6
- Solar Neutrino Research - 3

Number of Users by Facility

- LEAF - 32 Users
- MRI – 6 Users
- Phobos – 50 Users

List of WFO Projects and Sponsors

- Studies in Cocaine Abuse, NIH
- PET Investigations of Abused Inhalants, NIH
- Nondiamagnetic Agents in In Vivo ^{23}Na and $^1\text{H}_2\text{O}$ MR, NIH
- PET Studies of Brain Dopamine in Stimulant Abusers, NIH
- 4 Tesla MRI Bolus CR Studies of Human BBB Permeability, NIH
- Optimizing Intensity and Duration of GVG Pharmacotherapy, NIH
- Quantitation of Blood-Brain Barrier Permeability in MS Lesion Development, NMSS
- Radiotracer R&D in Nuclear Medicine and Neurosciences, NIH
- Clinical Correlates of Longitudinal PET Changes in Alzheimer's Disease, NYU (NIH Funding)
- Catalytic Mechanism of Human MN Superoxide Dismatuse, Univ. of Florida (NIH Funding)

Staff Profile

Tenured:	18	Professional:	7
Continuing:	7	Technical:	6
Term:	11	Administrative:	5
Research Associates :	29	Management:	3
Scientific Total:	65	Information Tech:	1
		Total:	87

*Note: Riken Fellows, Goldhaber Fellows, and Visiting Scientists included with Research Associates.

Funding Profile for the Last Seven (7) Years

2003	\$17.5M
2002	\$16.9M
2001	\$17.3M
2000	\$15.2M
1999	\$15.2M
1998	\$14.6M
1997	\$13.6M

1.4.2.2 National Synchrotron Light Source

Management Goals and Processes for Fiscal Year 2004

- Obtaining DOE approval for the start of the NSLS II project.
- Continuing improvement in beam line management and capability.
- Maintaining high reliability in the injector systems and storage rings performance.
- Securing a stable funding base for the DUV-FEL.
- Ensuring operational excellence in ESH and waste management programs.
- Maintaining interest and awareness by our stakeholders of NSLS accomplishments in accelerator and beam line research.

New Associate Scientists (or Above) Hired

- Two (2) Associate Scientists

New Research Associates Hired

- Three (3) Research Associates

Significant Improvements in Infrastructure and Management Systems that Support Research

- A new access policy for NSLS users has been drafted and is in the final review stage. This policy establishes a new mechanism for beam line involvement by research teams as a “Contributing User” and provides for greater responsibility for the operation and management of beam lines by the facility. This new program will greatly strengthen the management and support of the NSLS beam lines.
- A new system for submitting general user proposals and scheduling beamtime has been developed and is in the final review stage. This system integrates proposal submission,

safety review, and scheduling, and will provide better coordination and information exchange between users and facility and beamline management. The system will also be fully electronic (paperless) and enable more efficient scheduling with greater accountability as well as enabling rapid access to beamtime.

Safety Enhancements

- Following a series of incidents on the experimental floor, the ESH program was augmented to provide:
 - Improved definition of roles and responsibilities of PRTs and general users for safety
 - Improved training for permanent beam line staff to ensure understanding of safety requirements
 - Improved work planning to ensure identification and control of hazards
- The identification of safety related items essential in beam line configuration has been significantly enhanced to ensure that radiation fields associated with the beam line operation are controlled.
- Shielding of beam stops and beam profile monitors at the DUV-FEL have been improved and have reduced scattered radiation levels in occupied areas of the building.

Steps Toward Development of Next Generation Facilities and Research Tools

Significant progress has been made during FY 03 in developing the concepts for a new storage ring (NSLS-II) and in securing DOE support for the proposal. The following steps were taken:

- In Feb. 2003, the NSLS plans for a 3rd generation storage ring were presented to a sub-committee of the Basic Energy Science Advisory Committee. Strong support for a new storage ring at BNL was obtained.
- Initial machine parameters include:
 - 3 GeV, 500 mA, with top-off operation
 - 24 cell triple bend achromat
 - 21 straight sections and 24 bending magnet lines
 - Ultra-Low Emittance (1.5 nm horiz) and very high brightness $\sim 10^{21}$ (p/s/0.1%bw/mm²/mrad²)

Work is ongoing to further optimize the design as well as to conduct basic R&D in the underlying machine technology. An example of the latter is the development of superconducting undulators.

- Preparation of the science case is in progress. Several science workshops are scheduled in Summer/Fall 2003 to explore the full potential of the machine and to gather additional input from the user community.
- A major workshop is planned in early November 2003 to discuss the machine concept and the scientific opportunities it will enable.
- We are seeking to receive CD-0 approval for this project from DOE in early 2004. We plan to submit a full proposal in the fall of 2003 demonstrating the science case and outlining the machine concept.

Discussion of Make up of the Facility User Community

Users:

- Materials sciences (includes cond. matter physics & materials chemistry) 619
- Physics (excludes condensed matter physics) 76
- Chemistry (excludes materials chemistry) 190
- Biological and life sciences (excludes medical applications) 937
- Earth sciences 104
- Environmental sciences 102
- Engineering 114
- Instrumentation or technique development related to user facilities 80
- Other 191
- **TOTAL 2413**

Users by Institution:

- U.S. Govt Labs (non-BNL), 12
- U.S. Govt Other, 19
- UNIVERSITY (U.S.), 162
- INDUSTRY (U.S.), 63
- INTERNATIONAL,
- Foreign University, 93
- Foreign Corporation, 6
- Foreign Labs, 16
- OTHER,
- U.S. Other, 18
- U.S. Laboratory (non-Federal), 10
- Foreign Other, 16
- **TOTAL, 416**

Steps toward Improvement of Proposal Quality and Opportunities

An outreach program continued this year to increase awareness and understanding of research opportunities and capabilities within the NSLS. This program involves visits to universities for seminars, as well as a number of workshops to train users on specific experimental techniques. The purpose of this program is to identify new opportunities for work at the NSLS and to encourage new collaborations.

List the Number of International Collaborations

- There is an on-going collaboration (4 persons) with BESSY to advance the development of High Gain FELs. BESSY is a premier synchrotron radiation facility in Germany.

List of Projects/Programs Involving Collaborations with Others

- “NanoScience Patterning of Soft and Bio. Materials” --\$1,290K to the NSLS (other funds to BNL Physics) -- Collaborators from: Case Western Reserve University, Harvard, NJ Nanotechnology Consortium and UMass-Amherst. This collaboration will investigate the interactions of nanoscale patterned substrates on liquid crystal and bio molecules with the intent of directing their self assembly.

- “X-ray Micro-diffraction Instrument at the NSLS X13B Mini-Gap Undulator Beamline” -- \$814K -- Collaborators from: Bell Labs, Rutgers, IBM, University of Washington
- “BNL EMSI” -- \$310K - Collaborators from: BNL, Stony Brook University, Temple University, Pennsylvania State University. The collaboration will use a new microprobe endstation to study the chemical state and local environment of environmental important elements with micron spatial resolution.
- "Strain mapping end station development" Collaboration between NSLS and Rutgers University - \$35k funded by NSLS, \$400k funded to Rutgers University by Navy This collaboration will develop of a special sample-positioning end station for mapping strain in ‘real materials’.
- "Diffraction enhanced imaging of articular cartilage" Collaboration between RUSH Medical College (Chicago), Illinois Institute of Technology, and NSLS. \$500k/year from NIH for 3 years. Study of clinical applicability of Diffraction Enhanced Imaging for early diagnosis and treatment of osteoarthritis.
- "Diffraction Enhanced Imaging of Micro-fracture in bones" Collaboration between North Carolina State University, RUSH Medical College (Chicago) and NSLS - \$100k/year from DOD for 3 years - Study of clinical applicability of Diffraction Enhanced Imaging for early diagnosis of bone fracture.

Number of Users by Facility

- NSLS: 2413

List of WFO Projects and Sponsors

NIH

- X6A Protein Crystallography Beamline
- Metals and Protein Structure in Protein-Folding Diseases

Staff Profile

Tenured:	11.1	Professional:	28
Continuing:	4.2	Technical:	72
Term:	14.3	Administrative:	20
Research Associates :	7	Management:	6.4
Scientific Total:	36.6	Information Tech:	13
		Total:	176

*Note: Riken Fellows, Goldhaber Fellows, and Visiting Scientists included with Research Associates

Funding Profile for the Last Seven (7) Years

2003	\$36.2M
2002	\$34.6M
2001	\$34.7M
2000	\$32.1M
1999	\$32.2M
1998	\$31.0M
1997	\$27.7M

Other Publications, Citations, Press Releases for this Fiscal Year

- Panel Member, Press Roundtable “A Journalist Briefing on Nanoscience”, New York Academy of Science, New York City, NY , October 2002, R. Pindak
- Press Release: “Scientists Devise Tiny Liquid Crystal Devices for Telecommunications”, December 2002, R. Pindak
- Press Release: ”New Technique Reveals Structure of Films with High Resolution”, October 2002, R. Pindak
- Press Release: BNL 03-35, “Scientists Image Soft Tissues With New X-Ray Technique”, www.bnl.gov/bnlweb/pubaf/pr/2003/bnlpr051.303.htm. Z. Zhong
- Medical Imaging News, Vol 12, No. 19, May 16, 2003, p3. “Brookhaven Scientists Image Soft Tissues with DEI X-ray Technique”. Healthtech Publishing Company, Inc. Z. Zhong
- X. J. Wang, B. Faatz, Z. Huang, J.B. Murphy, L.H. Yu and M. Zolotarev, “ Seeded X-ray FEL Workshop at the NSLS”, SRN 16, 14 (2003).
- Meeting report, LEES '02, Synchrotron Radiation News, L. Carr (January, 2003).

Number of Co-Authored Papers, CRADA's, etc.

- Ninety Five (95) Co-Authored Papers
- Three (3) CRADs

1.4.2.3 Materials Sciences Department

Management Goals and Processes for Fiscal Year 2004

- The materials science department will take steps to plan for revitalization of the scientific portfolio of the department in response to new challenges and opportunities at Brookhaven, such as the CFN.
- The processes and operating procedures for the newly established materials science department are largely in place. Fine tuning and implementation of plans and processes to ensure smooth operation of the department is a goal for 2004.
- There are several mature scientific programs in the materials science department. We will take steps toward planning for evolution of programs and for succession in cases where leaders wish to retire.
- The materials science department will invest in improving department infrastructure.

New Associate Scientists (or Above) Hired

- J. Misewich, Chairman, Materials Science Department
- L. Cooley, Associate Scientist, Superconductivity Group

New Research Associates Hired

- Jan Bording (PD)
- W.-S. Yoon (PD)
- Stein (PD)
- M. Vukmirovic (PD)
- K. Kang. (PD)

Significant Improvements in Infrastructure and Management Systems that Support Research

- The materials science department, which is a new department, established a self-assessment plan.

Safety Enhancements

- Significant progress continues to be made in the disposal of legacy waste. This was supplemented this year with a plan to inspect all labs for legacy material.
- The materials science department has taken steps to improve housekeeping including random chairman visits to laboratories.

Steps Toward Development of Next Generation Facilities and Research Tools

- Aberration corrected transmission electron microscopy: The electron microscopy group is participating in a cross laboratory collaboration to develop a new generation of electron microscopy tools that utilize aberration correcting electron optics.
- Phase sensitive electron microscopy is a subject of increasing activity in our department. The development of phase sensitivity allows for better investigation of magnetic microscopy and biological sample imaging.

Steps toward Improvement of Proposal Quality and Opportunities

- The MSD has established a strategic planning committee to consider new initiatives.

List the Number of International Collaborations

- TEM, Prof. J. Taftø, University of Oslo, Norway, quantitative diffraction
- TEM, Prof. R. Egerton, University of Alberta, Canada, electron energy-loss spectroscopy
- TEM, Prof. H. Zandbergen, Delft Tech. U., Netherlands, complex structure determination
- Porphyrins, Drs. A. Giraudeau and J. P. Gisselbrecht: Université Louis Pasteur, Strasbourg, France. Electrochemistry and electrosynthesis of new porphyrin arrays.
- Porphyrins, Dr. Daniel Mansuy: Université Paris V, France. Biomimetic catalysis and self-assembled supramolecular arrays.
- Porphyrins, Prof. Klaus Möbius and Dr. Christopher W. M. Kay: Free University of Berlin, Germany. Advanced high-field magnetic resonance techniques and applications of theoretical calculation to radicals and triplet states.
- Porphyrins, Dr. Avigdor Scherz: Weizmann Institute of Science, Israel. Modified metallo bacteriochlorophyll photosensitizers for artificial photosynthesis.
- Electrochemistry, Saga University, Japan – M. Yoshio, Structure of Electrode Materials
- Electrochemistry, University of Sao Paulo, Sao Carlos, Brazil – E. A. Ticianelli, Electroactive Polymers
- Corrosion, Patrik Schmuki, University of Erlangen-Nuremberg
- Corrosion, Sannakaisa Virtanen, Swiss Federal Institute of Technology, ETH-Hoenggerberg
- Corrosion, Dominique Thierry, Swedish Corrosion Institute
- Corrosion, Aaron K. Neufeld, CSIRO, Australia
- Electrochemistry, H. Inoue, Osaka Prefecture University, Osaka, Japan
- Electrochemistry, A. Kowal, Institute of Catalysis and Surface Chemistry, Krakow, Poland

List of Projects/Programs Involving Collaborations with Others

- TEM, Prof. H. Herman, SUNY-Stony Brook, Thermal Spray

- TEM, Prof. M. Rafailovich, SUNY-Stony Brook, Polymers
- TEM, Prof. R. Gambino, SUNY-Stony Brook, magneto-optical films
- TEM, Prof. P. Gouma, SUNY-Stony Brook, TiAl-based structural alloys
- TEM, Prof. G. Neumark, Columbia University, ZnSe based photo-luminescence semiconductors
- TEM, Prof. R. Cava, Princeton University, novel transition-metal oxides
- TEM, Prof. M. DeGraef, Carnegie Mellon University, phase retrieval
- TEM, Prof. J.M. Zuo, U.of Illinois-UC, convergent beam diffraction
- TEM, Prof. L. Marks, Northwestern University, direct method
- TEM, Dr. Y. Wang, IBM-Hopewell Junction, semiconductor devices
- TEM, Dr. L. Ginnet, IBM-Yorktown Heights, p-n junctions
- TEM, Dr. J. Miao, Stanford U. Direct methods from oversampled electron diff.
- TEM, Prof. K.F. Canter, Brandeis University, Positron microscopy
- TEM, Prof. N. Browing, UC Davis, EELS
- Porphyrins, Prof. Charles M. Drain: Hunter College of the City University of New York. Self-assembly of macromolecular arrays and nanoscale materials.
- Porphyrins, Prof. Dewey Holten: Washington University. Picosecond dynamics of porphyrin excited states.
- Porphyrins, Prof. Jonathan S. Lindsey: North Carolina State University. New chlorins for radical structural studies.
- Porphyrins, Dr. Daniel J. Nurco: University of California at Davis. Synthesis and structures of conformationally designed chromophores, donor-acceptor arrays.
- Porphyrins, Prof. Kevin M. Smith: Louisiana State University. Synthesis of new porphyrin and chlorin photosensitizers and biomimetic models.
- Electrochemistry, SUNY Stony Brook - C. Grey, B. Hsaio, B. Chu, Polymers and Solid State NMR Studies
- Electrochemistry, Rutgers University – J. J. Xu, Amorphous Oxides
- Electrochemistry, NIST - D. Fischer, Soft X-ray XAS
- Electrochemistry, Pacific Northwest National Laboratory - T. L. Hubler, Redox Polymers, one person, \$75
- Electrocatalysis, Structure and function in electrochemistry and electrocatalysis University of Illinois.
- Electrocatalysis, Fuel Cell Research, Los Alamos National Laboratory
- Superconductivity, “Controlled Defect Structures in Rare-Earth-Ba-Cu-O Cuprate Superconductors” (D.O. Welch, Project Coordinator), a project of the DOE Center of Excellence for the Synthesis and Processing of Advanced Materials, Basic Energy Sciences, Division of Materials Sciences and Engineering.
- Superconductivity, Collaboration with H Hermann, S Sampath, and R Gambino, SUNY-Stony Brook to research MgB₂ deposition by thermal plasma spray. No current funds; SUNY seed grant in review.
- Superconductivity, Collaboration with R Suplinskas, Specialty Materials Inc., to investigate MgB₂ fibers and tapes by CVD. No current funds; subject of Superconducting Magnet Division LDRD proposal (A Ghosh lead investigator).
- Superconductivity, Collaboration with L DeLong, U Kentucky, to understand flux-pinning mechanisms in thin films with artificial nanodot arrays. Q Li will be participating.

List of WFO Projects and Sponsors

- H. Isaacs, “Noninvasive techniques to study passivity breakdown”, Applicable Electronics, \$131.5K.

Staff Profile

Tenured:	6	Professional:	5
Continuing:	6	Technical:	2
Term:	5	Administrative:	2
Research Associates :	8	Management:	1
Scientific Total:	25	Information Tech:	0
		Total:	35

*Note: Riken Fellows, Goldhaber Fellows, and Visiting Scientists included with Research Associates.

Funding Profile for the Last Seven (7) Years

2003	\$7.7M
2002	\$7.0M
2001	N/A
2000	N/A
1999	N/A
1998	N/A
1997	N/A

1.4.2.4 Condensed Matter Physics

Management Goals and Processes for Fiscal Year 2004

- Provide leadership in maintaining a world class program in Condensed matter Physics research
- Develop a coordinated synthesis capability for bulk single crystal growth in the Physics Dept.
- Explore ways of establishing new capabilities in Nanoscience research in Condensed Matter

New Associate Scientists (or Above) Hired

- Two Assistant Physicists

New Research Associates Hired

- Five Research Associates and one Goldhaber Fellow

Significant Improvements in Infrastructure and Management Systems that Support Research

- Working to establish strong collaborations between different research groups in Condensed Matter Physics on focused problems such as the electron dynamics of the one-dimensional complex oxide, SrCuO₂.
- Also working to establish stronger collaborations with other Departments within the BES Directorate, particularly the Materials Science Department.

Safety Enhancements

- In line with the rest of the Physics Department, Condensed Matter Physics is attempting to move towards a zero accident rate

Steps Toward Development of Next Generation Facilities and Research Tools

- Participated in discussions relating to the development of a proposal for the next generation Light Source, NSLS II
- Participated in the development of plans for the a lab wide Materials Synthesis capability
- Participated in the development of a coordinated strategy for Nanoscience research at BNL

Discussion of Make up of the Facility User Community

- The Condensed Matter Physics program maintains a number of facilities at the NSLS. As such a number of outside users are hosted by members of the Dept.

Steps toward Improvement of Proposal Quality and Opportunities

- The different research groups are strongly encouraged to write research proposals as new calls for funding initiatives are announced by the DOE. Other avenues including joint proposals with local universities are also explored.

List the Number of International Collaborations

Neutron Scattering:

- US-Japan Collaboration on Neutron Scattering, >20 people/year. Longstanding collaboration for neutron scattering experiments on condensed-matter-physics problems. BNL, ISSP/Univ. of Tokyo
- Neutron Scattering at the ISIS Spallation Neutron Source, 10 people. A DOE-funded post-doc is stationed at the ISIS facility. BNL, Rutherford-Appleton Lab, Oxford Univ.
- Scientific Collaboration on Neutron Scattering, 10 people. An informal collaboration established in 2000 to provide access to certain instruments at the Institute Laue Langevin neutron source. BNL, CEA/Grenoble

X-ray Scattering

- Electronic Excitations in Strongly Correlated Systems. Inelastic x-ray scattering studies of low-dimensional cuprates with four people: R.J. Birgeneau (Univ. of Toronto); Y. Ando (CRIEPI, Tokyo, Japan); S. Uchida (Univ. of Tokyo, Japan)

Charge and Orbital Ordering in Transition Metal Oxides

- Resonant x-ray scattering studies of charge and orbital order in 3rd and 4th transition metal oxides, with 5 people: Y. Fujii & H. Nakao (Univ. of Tokyo, Japan); Y. Murakami, K.

Hirota & Y. Endoh (Tohoku Univ., Japan); B. Keimer (MPI-Stuttgart, Germany); G. Sawatzky (Univ. of British Columbia, Canada)

Polyoxometalate Giant Molecules

- Novel properties of nano-scale polyoxomolybdate molecules with 1 person: Prof. A. Mueller (Univ. of Bielefeld, Germany)

Biophysics

- Structural studies of chlorophyll binding complex II proteins and lipids by liquid scattering, 4 researchers, from BNL and from the Hungarian Academy of Sciences

Thin films

- In-situ GISAXS studies of self-assembled surfactant templated silica thin films. With A. Gibaud (Université du Maine, Le Mans, France). 5 people

Surface Freezing

- Study of surface freezing phenomena in melts of chain molecules. With Moshe Deutsch (Bar-Ilan University, Israel) 4 people

Thin Silane Films

- Structural Studies of monolayer and multilayer thin organic films. With Jacob Sagiv (Weizmann Inst, ISRAEL) 3 people

Thin Films on Liquid Mercury

- Studies of organic monolayers on liquid mercury subphases. With Moshe Deutsch (Bar Ilan University, Israel) and 3 students.

Electron Spectroscopy:

- P. Pervan and M. Milun, Physics Institute Zagreb (Quantum Well Systems, Thin Films)
- D.P. Woodruff, University of Warwick (Quantum Well Systems, Thin Films)
- M. Mikami, Y. Mori, Osaka University (Strongly Correlated Systems)
- M. Yoshimura & T. Sasaki, D.A. Bonn & W.N. Hardy University of British Columbia, Vancouver, B.C. Canada (IR)
- E. Choi, University of Seoul [IR-Hexaboride (crystal growth)]
- Y. Imry, Weizmann Institute, Israel (Nanoscience)
- F. Liu, Institute of High Energy Physics, Beijing (ARPES)
- R. Lobo, Ecole Supérieure de Physique et Chimie Industrielles, Paris [Electron doped high-temperature superconductors]
- T.W. Noh, Seoul National University (Correlated Electron Systems)
- Z. Ovadyahu, Hebrew University, Israel (Nanoscience)
- L. Taillefer, Université de Sherbrooke, Quebec, Canada (IR)
- S. Tajima, ISTE, Shinonome 1-10-13, Tokyo 135, Japan (IR)
- T. Timusk & J.E. Greedan McMaster University, Hamilton, Ontario, Canada (IR)
- S. Uchida, The University of Tokyo, Yayoi 2-11-16, Bunkyo-ku, Tokyo 113, Japan (IR)

Materials Synthesis and Characterization:

- Brendan Kennedy University of Sydney: Systematic Studies of metal oxides under pressure and temperature with particular focus on perovskites by using synchrotron x-ray and neutron powder diffraction
- Brett Hunter Australian Nuclear Science and Technology Organization Sydney Australia: Neutron powder diffraction instrumentation and optics, data analysis
- Joe Hriljac (University Of Birmingham UK) High pressure crystallography in zeolites and microporous materials BNL is partially supporting a student (Marek Colligan) for this work

List of Projects/Programs Involving Collaborations with Others

Neutron Scattering:

- BNL-NIST Alliance for Neutron Scattering Research, 12 people. A BNL staff member stationed at NIST Center for Neutron Research supports BNL experimenters. BNL, NIST

X-ray Scattering:

- L. Gower, U. of Florida, crystal growth in the presence of polymer templates.
- C.-J. Zhong, SUNY at Binghamton, growth of well-defined gold nanoparticle aggregates via organic ligands
- C. Ahn, Yale University, Nanoscale manganite thin films
- FC. Chan, Massachusetts Institute of Technology, Single crystal cuprates
- M.V. Veenendaal, Northern Illinois University, Theoretical interpretation of resonant spectra
- Peter Pershan, Harvard, Studies of liquid metals and alloy surfaces and fluctuations on liquid water.
- Polymer-induced calcium carbonate mineralization. BNL and University of Florida, Gainesville
- Titanium implant materials surface structure and electrochemistry, BNL and Lawrence Livermore Nat'l Lab
- Chuck Black (IBM), Wetting phenomena. Study of wetting phenomena and thin liquid film structure on topologically nano-patterned surfaces.
- Tom Russell (University of Massachusetts in Amherst), Polymers. Studies of self-assembling behavior of diblocks copolymers on surfaces and its applications for nano-templating.
- Molecular Electronics. Study of structure of films of organic molecules with promising electrical properties, in situ study of crystallization from solutions. With Howard Katz and Theo Siegrist (Lucent)
- Studies of self-assembled monolayers from AOT solutions. With Dan Schwartz, University of Colorado.
- Surface fabrication. Development methods for controllable growth of nanowires with specific electronic properties using polymers nanotemplates. With Venkatesh Narayanamurti (Harvard University) and Tom Russell (University of Massachusetts in Amherst), 3 people.
- Nanoparticles. Study of self-assembling and manipulation of nanoparticles on the surfaces. Kinetics of surface adsorption. With Todd Emrick (University of Massachusetts in Amherst), Janet Petroski and Nicholas Camillone (Chemistry, BNL), 5 people

- Nano-fabrication. Developing methods of nano-fabrication on large areas. With John Warren and Aaron Stein (Instrumentation and Material Science, BNL) and Molecular Imprinting Inc. (Austin, Texas). 4 people
- Liquid crystals. Study of surface structure of liquid crystals and how it is affected by adsorption of ultrathin immiscible compounds. Fluctuations at the liquid interfaces. With Peter Persan and Masa Fukuto (Harvard University). 3 people

Electron Spectroscopy

- D. N. Basov, University of California at San Diego (IR)
- M. Greven, Stanford (Hg-based high-temperature superconductors) [IR]
- D. Smith, University of Vermont (Glasses) [IR]
- H. Ding, University of Boston (Correlated Electron Systems-ARPES)
- R. Cava Princeton University (Correlated Electron Systems-ARPES)
- K. Smith Boston University (Correlated Electron Systems-ARPES)
- B. Wells University of Connecticut (Correlated Electron Systems-ARPES)

Materials Synthesis and Characterization

- Valeri Petkov (University of Western Michigan) : Nanocrystallography using x-ray pair-distribution functions
- Pat Woodward (Ohio State University) : Pressure-induced hydration in metal oxide frameworks, charge, spin and orbital ordering in doped metal oxides
- Doug Buttrey (University of Delaware) Systematic studies of doped nickelates, high resolution electron microscopy on various metal oxide systems, oxidation catalysts
- John Parise (SUNYSB) High pressure crystallography
- Allen Burton (Chevron Texaco) Structure solution of novel zeolites, X7A PRT member, recently solved the most complex zeolite from powder diffraction data taken at X7A.

Number of Users by Facility

- CMP maintained facilities at the NSLS (approximately 140 users)

Staff Profile

Tenured:	10	Professional:	2
Continuing:	1	Technical:	6
Term:	13	Administrative:	2
Research Associates :	26	Management:	0
Scientific Total:	50	Information Tech:	0
		Total:	60

*Note: Riken Fellows, Goldhaber Fellows, and Visiting Scientists included with Research Associates.

Funding Profile for the Last Seven (7) Years

2003	\$9.4M
2002	\$8.5M
2001	\$6.8M
2000	\$7.7M
1999	\$7.5M

1998	\$7.5M
1997	\$5.5M

Other Awards

- Doon Gibbs – 2003 Advanced Photon Source Arthur H. Compton Award
- John Hill – APS Fellowship
- Oleg Gang – Goldhaber Fellow
- M. Tsvetik – APS Fellowship
- Award of Tenure, May 31, 2003 (Christopher Homes)
- Yongjae Lee : Sidhu Award (Pittsburg Diffraction Society) & Van Valkenburg Award (Gordon Conference on High Pressure Physics and Chemistry)

1.4.3 Life Sciences

1.4.3.1 Biology Department

Management Goals and Processes for Fiscal Year 2004

Obtain funding and develop the following areas to expand the DOE Genomes to Life initiative:

- New Genomic Strategies and Technologies for High Throughput Analysis of the Composition and Function of Complex Microbial Communities
- Computational Analysis of Genomic Signature Tags:
 - The aim is to develop algorithms that, based on sequence information of small tags, will provide clues as to the species from which the tags were derived.
- High Throughput Biophysical Analysis of Purified Proteins:
 - We plan to purify and analyze several hundred proteins from the bacterium *Ralstonia metallidurans*, including membrane proteins.
- Hybrid Electron Cryo-tomography Scheme for High Throughput Protein Mapping in Whole Bacteria: The goal is to develop, using *Ralstonia metallidurans* as a model, the ability to obtain, simultaneously, three-dimensional structural visualization and protein mapping.
- TomoSTEM: A New Instrument for Visualizing Fluorescent Labels at Nanometer Resolution: We propose to 3-D image bacteria in a frozen hydrated state using a unique electron probe system.
- Genomes to Life Tools for Protein Production and Characterization
- Participate on DOE GTL computational biology facility work group.

Continue to Develop in the areas of Detection and Intervention of Emerging Pathogens

- Structure/Function Attributes of Toxins and Virulence Factors
- Rapid Detection and Identification of Pathogens
- Screening Antiviral Agents against SARS Coronavirus

Continue to develop in the area of Membrane and Complex Structure Determination

Develop a Plant Systems Biology Program:

- Aim is to provide a context for generally improving corn and cotton crops by understanding their genome structure and mapping the quantitative trait loci for agronomic and model traits.

Develop a method for Whole Genome Analysis of Hydrogen Producing Bacteria

- We propose to draft sequence the genomes of members of five different genera of the order Thermotogales to three-fold coverage.

Continue to maintain and grow the Space Radiation Biology Program

- Continue to develop the space radiation biology program and provide support to the NASA Space Radiation Laboratory.

Continue to maintain state-of-the-art Macromolecular Crystallography Facilities:

- The focus will be to upgrade our flagship beamline X25, to join with Albert Einstein College of Medicine's Resource to bring the new undulator beamline X29 into operation, and to improve our methods and software for remote, conventional, and automated operations.
- Work with the BNL Center for Functional Nanomaterials to develop a biological component.
- Continue to work with Radiological Controls Division, Waste Management and other support Divisions in an effort to ensure efficient, cost-effective programs.

New Associate Scientists (or Above) Hired

3 Assistant Scientists:

New Research Associates Hired

6 Research Associates including one Goldhaber Fellow:

Significant Improvements in Infrastructure and Management Systems that Support Research

- The Biology Department obtained GPP funding to renovate a new facility for cryoElectron Microscopy (the equipment was DOE funded). The GPP funding covered the renovation to the rooms where the equipment is housed and also the peripheral wet biochemistry labs and offices.

Safety Enhancements

- The Biology Department, as the main user of biological etiologic agents on-site, worked with the Safety and Health Service Division to develop a Biosafety in Research Subject Area and associated links to the Institutional Biosafety Committee
- The Biology Department continues to get the staff involved in work planning activities, mainly through Experimental Safety Reviews. We also have had all-hands meetings which focus on safety issues such as injury prevention, radiation protection and environmental protection.

Steps Toward Development of Next Generation Facilities and Research Tools

Macromolecular Crystallography Facilities:

- Upgrades to all beam lines continue. This past year on X25 the new ADSC Q315 system has performed well through the year. The work-horse diffractometer- and beamline-control systems, MARMAD and OptiX, have been rewritten (cbass and GrEpx) to operate the new ADSC diffractometer and the VME/EPICS beamline-control mechanisms. A new powerful, twin-monitor, dual processor computer for various uses was installed. The user station was reconfigured to provide an off-to-the-side station for computing. Cluster computing is now a standard industry practice.

Scanning Transmission Electron Microscopy

- Renewal of STEM NIH Grant for 5 years.
- New version of Mass Analysis software and documentation distributed to users.
- New simulation software for the entire EM protocol: specimen description, imaging, detection, and analysis.
- Development of a new STEM Detector for improved imaging of nanostructures.

CryoElectron Microscopy

- Two cryoElectron Microscopes, supported by OBER, have been installed. The facility will facilitate the analysis of protein complexes such as heavy metal transporters, and other molecular machines of relevance to DOE.

Discussion of Make up of the Facility User Community

- NASA Radiobiology Program host's users who are NASA funded are mostly from US Universities and other national laboratories. There are also some users who are from Italy as part of an agreement NASA has with the Italian Space Agency.
- Macromolecular Crystallography: approximately 134 investigators working on 82 different research projects used these facilities over the past year. Most users come from US institutions. Over the past year there were also users from Germany, Singapore, Israel, and Canada.
- Scanning Transmission Electron Microscopy Facility: STEM has approximately 30 active projects involving collaborations with about 50 scientists from US institutions and internationally from Canada, England, and Hungary.

Steps toward Improvement of Proposal Quality and Opportunities

- Biology Department staff participates in workshops to formulate the call for proposals in key areas that we are interested in, such as Genomes to Life. Recently became members of the DOE GTL Computational Biology Workgroup.
- The Chair and ALD have meet with DOE funding managers frequently.
- The Biology Chair was successful in organizing a visit by our major DOE program managers. They came to the Biology Department and spoke with the researchers both as a whole and individually.
- Biology Chair was successful in getting the Director of the NIH Cancer Institute (C. Barrett) and 12 of his associates to visit BNL in order to foster collaborations and stimulate more funding opportunities.
- For our larger proposals we have included graphic designers, project managers, and printing services.
- In the fall we plan on holding a grant-writing workshop for new investigators.

List the Number of International Collaborations

- The Genomes to Life effort involves work on *Ralstonia metallidurans* with a group in Belgium.
- A NASA Space Radiation Biology project using Medaka fish as a model, with Japan.
- Many of the users to our facilities are from international institutions including a STEM project with a collaborator in Hungary to look at photosynthetic complexes.

List of Projects/Programs Involving Collaborations with Others

- Prediction of quantitative trait loci for cotton fiber quality. With Jean-Marc Lacape and Marc Giband, CIRAD, Montpellier, France. Supported in part by a grant from Cotton Incorporated (\$80K). (B.Burr)
- John J. Dunn P.I. on a NIH project with co P.I. Benjamin Luft at SUNY-SB entitled "Vaccine Intervention for Lyme Borreliosis" The major goal of this project development of recombinant forms of the outer surface proteins of the Lyme disease spirochete, *B. burgdorferi*, for vaccine development. Other collaborators include Richard Smith (PNNL) and Weigang Qiu (Hunter College of the City University of New York).
- NIH project "Genetic Variation in Human NHEJ DNA Repair Genes". This project is directed by Carl W. Anderson (BNL). (J.Dunn)
- "Rapid Detection and Identification of Zoonotic Pathogens" is a new effort that is to be funded by the NIH. This work will be a collaborative effort with Benjamin Luft's group at SUNY-SB and Roger Breeze USDA. (J.Dunn)
- "GST Methods for Site-Specific Human Genome Profiling" is a new project that is being carried out with Gail Mandel, SUNY-SB and Richard Goodman, Vollum Institute, Oregon Health Sciences University, Portland OR. (J.Dunn)
- "Induction of Leukemia by HZE Particles" is being done in collaboration with K. Rithidech, SUNY-SB. (J.Dunn)
- "Transcriptome Profiling of Human Platelets" is an ongoing project with Wadie Bahou and Dmitri Gnatenko (SUNY-SB). (J.Dunn)

- "Closure and Annotation of the *Ralstonia metallidurans* CH34 Genome" is a project that involves several researchers at DOE's Joint Genome Institute, Max Mergeay, Belgium Nuclear Research Center, Belgium and Daniel van der Lelie (BNL) (J.Dunn)
- "Biom mineralization of Silica in a Diatom" is a project involving M. Hildebrand (U. Calif. San Diego) and Geoffrey Hind (BNL) (J.Dunn)
- Paul Freimuth, Co-P.I., DOE project "Non-Homologous End-Joining DNA Repair: Characterization of Protein Structures and Complexes". Our contribution was to express truncated fragments of DNA-PKcs for structure-function analysis.
- Collaborator on project directed by Mike Welsh at University of Iowa College of Medicine, to study the role of the CAR receptor in release of adenovirus particles from infected cells. (P.Freimuth)
- X-ray reflectivity analysis of thylakoid lipids and light-harvesting complexes. Collabs.: E. DiMasi (BNL NSLS), G. Garab (Hungarian Academy of Sciences) (G.Hind)
- STEM analysis of lamellar aggregates of photosynthetic light-harvesting complexes. Collabs.: J.S. Wall (BNL Bio), G. Garab (Hungarian Academy of Sciences). (G.Hind)
- The structure of membrane crystals of the light-harvesting chlorophyll a/b protein complex. Collabs.: H. Li, J.S. Wall (BNL Bio), G. Garab (Hungarian Academy of Sciences) (G.Hind)
- Biom mineralization of silica in a diatom. Collabs.: M. Hildebrand (U. Calif. San Diego), A. Martin, J. Lonien, J. Dunn (BNL Bio) (G.Hind)
- Bacterial outer membrane protein PapC complex and its role in pili assembly. David Thanassi, SUNY-SB, Microbiology Department. (H.Li)
- VSV virus and its RNA-capsid protein complex. Min Luo, University of Alabama. (H.Li)
- Structural role of T-pilus in DNA transport. Clarence Kado, University of California at Davis. (H.Li)
- Characterization and structural investigation of the gephyrin and glycine receptor complex. Hermann Schindelin, SUNY-SB, Biochemistry Department. (H.Li)
- Collaboration with Mark Chance at Albert Einstein College of Medicine on mapping the binding sites for the interactions between the adenovirus proteinase and DNA and between the adenovirus proteinase and actin. (W.Mangel)
- Anand Saxena with Bill Studier. Solubilization, refolding, and purification of two membrane proteins, P10 and P11, that are expressed as inclusion bodies for eventual crystallographic work. Methods have been developed for large-scale purification and folding of the proteins. A paper describing the methodologies that have been developed is in preparation.
- Anand Saxena with Patrick Van Roey, Wadsworth Institute. Expression, refolding and purification of mitochondrial VDC channel, expressed in *E. coli* as inclusion bodies.
- Dieter Schneider with T Earnest (Berkeley Center for Structural Biology) and RM Sweet (BNL Bio). Perfect the Advanced Light Source basic design of a crystal changing robot and adapt it for use on our NSLS synchrotron beam lines.
- Dieter Schneider with George DeTitta (Hauptman-Woodward Medical Research Institute), RM Sweet, H Robinson, A Heroux and J Jiang (BNL Bio). Develop the crystal changing component and the remote data collection tools to complement the Hauptman-Woodward program in automatic crystal growth.
- Dieter Schneider with T Ellenberger (Harvard Medical School) and H Robinson (BNL Bio). Collaborate in the development of fundamental tools for the cryogenic crystal mounting, automated handling, and visualization.

- A funded proposal to EPA from SUNY (BNL is a subcontractor), A. McElroy, PI (R. Setlow is a Co-PI) "New Approaches for Assessing Mutagenic Risk of Contaminants in the Long Island Sound Environment" (~\$100,000/yr; BNL portion ~\$22,000/yr). This is a collaboration among Marine Sciences at SUNY (~3 investigators), BNL (2 investigators) and the Univ. Georgia (1 investigator). Sediments from the LI Sound region will be obtained by the EPA. If found, at SUNY, to be mutagenic in a bacterial assay, they will be used at BNL where embryos of transgenic fish (Medaka, designed at the Univ. of Georgia) will be placed on the sediments. Just before hatching, the embryos will be sent to Georgia where the embryos will be hatched, grown to a suitable size and various tissues separated. DNA will be analyzed for mutations in the transgene. Mutant DNA will be sent to BNL for sequencing.
- p53 Posttranslational Modifications: Dr. Ettore Appella, Laboratory of Cell Biology, NCI, NIH; Dr. Albert Fornace, Jr., Basic Research Laboratory, NCI, NIH - The objective is to determine the role of posttranslational modifications in regulating the function(s) of the p53 tumor suppressor gene in response to genotoxic and non-genotoxic cellular stress. These collaborations are relevant to DOE BER programs in low dose radiation. (C.Anderson)
- In vitro Chromatin-Based Transcription and DNA Repair: Dr. Michael Resnick, Chromosome Stability Section, NIEHS - The objectives are to develop methods for characterizing the role of p53 posttranslational modifications in regulating gene expression and chromosome stability through the development of yeast and in vitro chromatin-based transcription systems. (C.Anderson)
- A funded Proposal to the USB/BNL Seed Grant Program, A. McElroy, PI (R. Setlow, Co-PI). "Development of a Transgenic Fish Model for Use in Assessing Genotoxins in the Environment". The aim is to determine dose-response relations for several known mutagens/carcinogens.
- Dow/Dow Agrosiences Oilseed Engineering Alliance CRADA. \$500,000 per year, four FTEs at BNL. (J.Shanklin)
- Vincent Vilker, NIST. Determining changes in desaturase reduction potential during the catalytic cycle. No joint funding. One postdoc in Dr. Vilkers group. (J.Shanklin)
- Ylva Lindqvist, Karolinska Institute, Stockholm, Sweden. X-ray crystallography of fatty acid desaturases. No joint funding. One Student in Stockholm. (J.Shanklin)
- Participant in New York Structural Genomics Research Consortium, involving scientists from Albert Einstein College of Medicine, BNL, Columbia University, Structural Genomics, Inc., The Rockefeller University, University of California at San Francisco, and Weill Medical College of Cornell University. High-throughput determination of 3D structures of proteins that are representative of the types of protein structures found in nature. (F.W.Studier and S.Swaminathan)
- Collaborative project with Center for Microbiology Research, Porton Down, UK
- A NIH project has been submitted with J. Chaddock to study the enzymatic activity of neurotoxins. (S.Swaminathan)
- Collaborative project with B. Anderson of University of Madison to study the binding property of neurotoxins. A NIH project has been submitted. (S.Swaminathan)
- Collaborative project with Jim Bliska of Center for Infectious Diseases, SUNY-Stony Brook to study crystal structures of yersinia pestis outer surface proteins. Project has been funded by the Department of Defense. (S.Swaminathan)

- Collaborative project with SUNY-Stony Brook and Arizona State University on “A system for discovering bioengineered threats by knowledge base driven mining of toxin data”. Funded by Department of Defense. Collaborators: I.V. Ramakrishnan, M. Kifer and H. Davalcu (S.Swaminathan)

2003 STEM Collaborations:

- Dwight Anderson, Shelley Grimes, University of Minnesota. Packaging structures in bacteriophage phi29.
- Blair Bowers, Kirsten Remmert, NHLBI/NIH. Structure of CARMIL oligomers.
- John Briggs, Steven Fuller, Oxford, UK (with Vogt, Johnson, Cornell U.) In vitro RSV and HIV capsid structures.
- Esther Bullitt, Stephen Savarino, Boston University, Naval Military Research Center. Structure of enterotoxigenic pili.
- Lisa Craig, Mark Yeager, Scripps Institute. Structure of pili fibers.
- Edward Egelman, Sean Yu, University of Virginia. Oligomeric states of RecA and KaiC.
- John Flanagan, Vito Graziano, BNL Biology. Structure of DNA-PK and complexes.
- Paul Freimuth, Yian-Biao Zhang, BNL Biology. Solubilization of receptor (membrane) proteins.
- Gyozo Garab, Geoffrey Hind, Institute of Plant Biology, Hungary and BNL Biology. Structure of *S. oneidensis* outer membrane.
- Robert Gilbert, David Stuart, Wellcome Trust Centre, University of Oxford, UK. Structure of the surface antigen of hepatitis B virus.
- Ed Gogol, University of Missouri, Kansas City. Structure of GroEL-Luciferase complexes.
- Michael Himmel, Shi-you Ding, National Renewable Energy Laboratory. Structure of cellulosomes.
- Michael Himmel, Shi-you Ding. National Renewable Energy Laboratory. Structure of Quantum Dots.
- Dean Kedes, Christine O'Connor, Thaler Center for AIDS Research, University of Virginia. Structure of KSHV Capsids.
- Hilal Lashuel, Peter Lansbury, Harvard Medical School. Synuclein structure in early onset Parkinson's disease. Alzheimer's A-beta fibrils.
- Huilin Li, BNL Biology. Structures of pili and cd-complexes.
- Troy Messick, Cold Spring Harbor Laboratory. Structure of the Gal4/Gal80 activation domain.
- Royce Murray, University of North Carolina. Gold labels.
- Eva Nogales, Dylan Taatjes, University of California, Berkeley. Structure and Mass of a Transcription Complex.
- Richard Perhams, Samantha Holland, Cambridge University, UK. Mass/length of RP4 pili.
- Alan Rein, Siddhartha Datta, NCI, Frederick, MD. Structure of immature murine leukemia virus particles.
- Suzanne Scarlata, Marjorie BonHomme, SUNY at Stony Brook. Structure of empty HIV-1 capsid cores.
- Yuri Sergeev, Paul Wingfield, NEI/NIH. UV damage of eye lens proteins.
- John Shanklin, BNL Biology. Oligomeric states of a lipid modifying enzyme.

- Alasdair Steven, Ulrich Baxa, Reed Wickner, NIAMS/NIDDK/NIH. Structure of derivatized prions.
- Volker Vogt, Marc Johnson, Cornell University. In vitro Gag particles, from RSV and HIV.
- Kuan Wang, NIAMS/NIH. Structure of titin and nebulin.
- Itamar Willner, Fernando Patolsky, Hebrew University, Jerusalem. Structure of a Glucose Oxidase\Nanoparticle conjugate.
- Christopher Woodcock, Robert Simpson, University of Massachusetts Amherst and Penn State University. Mass and structure of the Tup1/Ssn6 yeast co-repressor complex.
- Yimei Zhu, Marek Malac, BNL and University of Alberta. Properties of Carbon-60 films.

Number of Users by Facility

- STEM had approximately 50 users over this past year working on about 30 projects.
- NSLS Macromolecular Crystallography Facilities had approximately 134 investigators working on about 82 different projects.
- NSLS Ultraviolet Biophysics program had about 5 investigators.
- The NASA Space Radiation Program had about 80 users.

List of WFO Projects and Sponsors

NASA

- Germ Cell Mutagenesis in Medaka Fish Following Exposure to Heavy, High Energy Cosmic Ray Nuclei, Setlow R.
- NASA Space Radiation Laboratory Operations Support, Sutherland B

NIH

- Adenovirus Protease Regulation, Mangel
- DNA Damage Clusters: Repair in Mammalian Cells, Sutherland B
- Genetic Variation in Human NHEJ DNA Repair Genes, Anderson
- The Structural Basis of Selective Permeability in Aquaporins, Fu
- DNA Damage Quantitation by Single Molecule Laser Sizing, Sutherland J
- Vaccine Intervention for Lyme Borreliosis, Dunn
- Adenovirus-Receptor Interaction: Structure, Function and Retargeting, Freimuth
- Macromolecular Crystallography at the NSLS, Sweet
- Clp: An Archetypal ATP-Dependent Protease, Flanagan
- STEM Mass Measurement & Heavy Atom Labeling of Biomolecules, Wall

NSBRI

- Effects of Deep Space Radiation on Human Hematopoietic Stem Cells / Effects of Long-Duration Space Flight upon Stem/Progenitor Cell Biology and Function, Sutherland B

DOD

- Differential Expression of DNA Double-Strand Break Repair Proteins in Breast Cells, Anderson
- Structural Studies of Intact Clostridium Botulinum and Neurotoxins Complexed with Inhibitors Leading to Drug Design, Swaminathan

Staff Profile

Tenured:	14	Professional:	23
Continuing:	4	Technical:	7
Term:	12	Administrative:	12+

Research Associates :	14*	Management:	2
Scientific Total:	44	Information Tech:	6
		Total:	94

*Note: Riken Fellows, Goldhaber Fellows, and Visiting Scientists included with Research Associates.

+ The administrative staff consists of typical administrative support, safety and building managers, some of whom are shared with Biology, as well as scientific support such as agricultural support services and laboratory specialists.

Funding Profile for the Last Seven (7) Years

2003	\$18.1M
2002	\$17.9M
2001	\$15.2M
2000	\$15.8M
1999	\$16.0M
1998	\$16.5M
1997	\$16.5M

Other Awards

- BNL Spotlight Awards - June 2003 - Frank Kito, Denise Kranz, and Rich Sautkulis
- CY 2002 Perfect Attendance Award - Phyllis Tinsley-Smith - March 2003

Other Publications, Citations, Press Releases for this Fiscal Year

- Press Release “Low Dose Radiation Research Grants Awarded”, B. Sutherland, 10/3/02
- Press Release “Scientists Reveal a New Way Viruses Cause Cells to Self-Destruct”, W. Mangel, 11/19/02
- Press Release “Gold “Nanoplugs” Wire up Enzymes”, J. Hainfeld, 3/20/03
- Press Release “Brookhaven Lab and Battelle Collaborate on Biological Research that may lead to novel antimicrobial drugs”, M. Bewley, 5/27/03

Number of Co-Authored Papers, CRADA’s, etc.

- 71 co-authored papers
- 9 CRADA and other collaborative agreements

1.4.3.2 Medical Department

Management Goals and Processes for Fiscal Year 2004

- Complete installation and commissioning of high-field 9.4 Tesla animal magnetic resonance instrument for functional and spectroscopic studies in animals and develop associated user program.
- Continue to expand biomedical engineering initiative to image the awake animal.

- Continue to seek funding for the Cyclotron Isotope Research Center, a facility to serve as a year round source of medical isotopes for nuclear medicine, for R&D, and for training and education.
- Continue to strengthen the Space Radiation Biology and neuroscience Program and also to better utilize the NASA Space Radiation Laboratory.
- Continue to mentor young scientists so that they can obtain funding from DOE, NIH and other agencies.
- Foster Industrial collaborations with pharmaceutical companies (Long Island Life Sciences Initiative)
- Setup research program for newly recruited sr. staff scientist who will be working on PET radioligand research.

New Associate Scientists (or Above) Hired

2 Assistant Medical Scientists

New Research Associates Hired

5 Research Associates

Significant Improvements in Infrastructure and Management Systems that Support Research

- General Plant Project Funding was used to renovate the facilities, which will house the animal MRI machine. The machine is being installed and will be operational by the end of the fiscal year.
- General Plant Project Funding to upgrade network capabilities for communicating imaging data within the Laboratory.

Safety Enhancements

- We are continuing to work with the Radiological Controls Division to improve the Department's Radiation Protection Program. The program has been assessed by Office of Independent Oversight and the QA office due to several radiation occurrences. We are working with the researchers to develop procedures to better enable the researchers to work efficiently and still maintain a compliant program. We have also discussed this with new ESHQ management and will work with DOE to address their concerns about the Medical Department Radiation Protection Program.
- The researchers are continually seeking opportunities to reduce hazardous and radioactive wastes and requirements by developing non-radioactive techniques to conduct their experiments and by seeking pollution prevention funding where applicable. This year, using Pollution Prevention Funds, a vial crusher to compact radioactive scintillation vials was purchased and a digital imaging system for x-ray processing in the Radiation Therapy facility.
- We have been actively engaging the researchers in the work planning processes in order to better communicate the regulations to the researchers and the need for flexibility to the support divisions.
- We are continuing to work with the subject matter experts in the development of new subject areas and work control processes.

Steps Toward Development of Next Generation Facilities and Research Tools

9.4T MicroMRI and Optical Imaging for Translational Genomics and Phenotypic Imaging:

- The genetically modified mouse is a major new scientific tool in the neurosciences and its development has generated new needs in terms of its anatomical, functional, biochemical and behavioral characterization. We have launched a new research program in multi-modality imaging for genetically engineered animals combining high field (9.4 Tesla) microMRI, Optical imaging and microPET (which is already a major effort at Brookhaven). A major priority is the development of a high resolution MRI mouse brain atlas and neuroimaging database, which will advance phenotypic imaging in normal and transgenic animals.

Biomedical Engineering Laboratory:

- A new project to develop specialized PET and MRI instruments to image the Awake Animal Brain is well underway and holds the promise to revolutionize animal imaging by designing and fabricating instruments which can image the brain of the awake animal (rat or mouse) in real-time and under natural physiological conditions. This research will advance our ability to relate biochemistry and behavior in transgenic animals, and is promising applications beyond animal imaging, such as compensation for motion and correction in human PET and MRI studies.

Cyclotron Isotope Research Center (70 MeV Cyclotron at BNL):

- The nation's requirements for a stable, domestic source of medical isotopes and for isotope R&D for diagnosis and therapy are currently unmet. The proposed Center would fulfill the following national needs: Produce present and future radioisotopes for the biomedical, scientific, and industrial communities; Conduct research into radionuclide production; Conduct research into the development and evaluation of next-generation radiopharmaceuticals for imaging and therapy; Provide education and training in nuclear and radiochemical techniques; Serve as a resource of very intense streams of positrons for both positron physics and material science research; Provide simultaneous multi-user capability for research, production, and (in the future) for commercial users.

NASA Space Radiation Laboratory

- The new facility had its commissioning run July 2003. It is anticipated that there will be 3 runs with a total of about 150 investigators per year.

Discussion of Make up of the Facility User Community

Brookhaven Laboratory Animal Facility (BLAF)

- Houses animals for researchers. The users include not only the BNL researchers in Medical, Biology, and Chemistry who do animal research but the external NASA Users as well.

NASA Space Radiation Laboratory-Long Term Laboratory Support Facility:

- NASA funded researchers from US Universities and other National Laboratories come to BNL to use the NSRL facility to investigate the radiation biology of a wide range of particle types and energies.

The Clinical Research Center:

- This facility processes all human subjects who participate in BNL clinical research program. The majority of the users are investigators from the Medical and Chemistry Departments

although there are several non-BNL users including scientists from major research hospitals in the New York metropolitan area.

Steps toward Improvement of Proposal Quality and Opportunities

- Improve Grant Writing: The Department is planning a grant-writing workshop for the fall, 2003. This will be the second such workshop that the Department has funded and encouraged staff to attend.
- Review Process: For junior scientists and those scientists who have a historically poor success rate at funding attempts, we have the Chairman, or designee, review proposals before they are submitted to the funding agency.
- Workshops to keep up to date on current standards.
- Actively encourage staff to participate in funding agency workshops to formulate future calls for proposals and to participate on review panels.
- Diversify in types and kinds of funding (i.e traditional NIH, NIH Training grants, Career Development, NASA, NASA-NSBRI)

List the Number of International Collaborations

Many of the researchers have international collaborations. The NASA program has investigators from the Italian space agency. Researchers involved in cancer diagnostics and therapies have collaborations with the European Synchrotron Radiation Facility.

List of Projects/Programs Involving Collaborations with Others

Most of the research programs in Life Sciences are conducted with collaborators from other institutions.

The clinical research programs conducted in our PET and MR facilities are performed in collaboration with major research hospitals in the New York metropolitan area. For example, we collaborate with NYU and Pilgrim State on schizophrenia studies, with Columbia on cocaine abuse studies, and with North Shore/LIJ on endocrine tumor studies. In addition, much of the clinical work we do relating to HIV and drug abuse is done in collaboration with clinics on Long Island.

A collaboration exists with the University of Connecticut on the development of radiotracers.

Number of Users by Facility

Clinical Research Center

- The CRC had approximately 835 human subject visits from the period of 7/1/02-6/30/03 participating on 43 active Institutional Review Board protocols. 9 internal Principal Investigators and 2 external PIs conduct human subjects research at BNL.

Brookhaven Laboratory Animal Facility (BLAF)

- 15 BNL PIs use the BLAF along with 12 NASA Investigators and 1 NIH investigator. They work on 57 active protocols. Between 7/1/03 and 6/30/03 the BLAF has housed approximately 3500 mice, 2000 rats, 8 rabbits, 10 baboons and 17 macaques.

Radiation Therapy Facility

- The RTF had approximately 6100 patient visits this year.

NASA Space Radiation Laboratory (NSRL)

- The NSRL had its commissioning run this July 2003. It had about 60 investigators working on 15 different experiments.

List of WFO Projects and Sponsors

DOD

- MRI Microscopy & Molecular Mode, Benveniste

NASA

- NASA Space Radiation Laboratory Operations, Vazquez
- Beamline Support, Vazquez
- MicroPet Study of Brain Damage, Gatley

NIH

- Neuroimaging & Mentoring-Drug Abuse, Chang
- “Project 5: Proton Magnetic Resonance Spectroscopy in Schizophrenia”, Chang
- Neuro-Bio Mech-Drug Abuse, Volkow
- NIAA-Intramural Research Program, Volkow
- Behavioral Correlation MRI Response to Cocaine, Goldstein
- Brain Activation Study HIV, Ernst
- Brain Imaging & Drug Abuse, Gatley
- Feto-Maternal Pharmacokinetics Abuse In Monkeys, Gatley
- Human Brain Pharmacokinetics (1)D9, Gatley
- Methamphetamine Abuse, Chang
- Microbeam Radiation Therapy-Glioma, Dilmanian
- MR Spect Monitor Heart HIV, Chang
- Neurotrans Rel, Gifford
- Pharmacokinetics, Volkow / Wang
- “Imaging-Science Track Award for Research Transition (I/START)”, Tomasi
- Studies in Cocaine Abuse, Volkow / Wang
- Summer Students NIDA, Volkow
- PET Studies Brain Dopamine Stimulant Abuse, Volkow / Wang

University of Connecticut, Gatley

Emory University, Chang

New England Medical Center, Ernst

NSBRI

- NASA Space Biology Research Institute, Vazquez

Scripps Research Institute, Chang

St Lukes-Roosevelt Hospital

- Body Composition, Wielopolski

University of Southern California, Ernst

American Chemical Society

- Nuclear Chemistry Summer School, Kolsky
- NARSAD Young Investigator, Goldstein

Staff Profile

Tenured:	3	Professional:	21
Continuing:	6	Technical:	3
Term:	11	Administrative:	18+
Research Associates :	6*	Management:	0
Scientific Total:	26	Information Tech:	0
		Total:	68

*Note: Riken Fellows, Goldhaber Fellows, and Visiting Scientists included with Research Associates. + The administrative staff consists of typical administrative support, safety and building managers, some of whom are shared with Biology, as well as scientific support such as veterinary services technicians and laboratory specialists.

Funding Profile for the Last Seven (7) Years

2003	\$12.8M
2002	\$11.5M
2001	\$9.2M
2000	\$10.0M
1999	\$7.8M
1998	\$10.0M
1997	\$9.5M

Other Awards

- Clubhouse Award-Mental Illness Awareness, Clubhouse of Suffolk, G. Wang
- Recognition Award, Suffolk Coalition to Prevent Alcohol and Drug Dependencies, Inc., 2002 (Volkow)

Other Publications, Citations, Press Releases for this Fiscal Year

- News Article: BrainWork, the Neuroscience Newsletter of the Dana Foundation, Goldstein
- News Article: "Brain Matter", The North Shore Sun by A. Clancy, Goldstein
- Press Release: Brookhaven National Laboratory ("Addicts' Brains Work Harder to Control Behavior", Goldstein
- Press Release: "BioSurface Engineering Technologies, Inc. Licenses Brookhaven Lab's Novel Synthetic Growth Factor Technology", Pena
- Press Release: "More Clues about Obesity Revealed by Brain-Imaging Study, Wang.

Number of Co-Authored Papers, CRADA's, etc.

The Medical Department had approximately 120 co-authored papers and the following CRADAs and other collaborative agreements:

- CRADA-Bioset, Inc., Pena
- CRADA-PSIMEI Pharmaceuticals Pl, Miura
- Scripps Research Institute, Chang
- St. Luke's-Roosevelt Hospital, Wielopolski
- University of Southern California, Ernst
- Glaxo SmithKline, Volkow

- Eli Lilly & Company, Volkow

Additional Comments

- The Medical Department runs an annual Nuclear Chemistry Summer School, which is funded by the American Chemical Society. Sixteen undergraduate students participate in the five-week course that consists of lectures and labs. This year our radioisotopes program hosted an Honor's physics group from Yeshiva University. Students participated in lectures and labs.
- The Radiation Therapy Facility is a cancer treatment facility in the Medical Department. It is run by SUNY SB Medical Center. All staff hold appointments with the Medical Department.
- This year an NIH Intramural Program was setup in the Medical Department. As a result five staff scientists and one post-doc will become NIH employees and will hold BNL Guest Appointments.

1.4.4 Energy, Environment & National Security

1.4.4.1 Environmental Sciences

Management Goals and Processes for Fiscal Year 2004

- Increase research for DOE BER's Atmospheric Science, ARM, FACE and Environmental Remediation Division's programs.
- Create the Urban Atmospheric Observatory (UAO) in New York. The UAO is a WHO partnership involving BNL, NOAA, EPA and DHS's Environmental Measurements Laboratory.

New Associate Scientists (or Above) Hired

- One scientist

New Research Associates Hired

- 4

Significant Improvements in Infrastructure and Management Systems that Support Research

- A more formal Systems Administrators Group was created to address cyber security issues.
- EENS developed a monthly tracking system to identify funding shortfalls and their impact on staff.

Steps Toward Development of Next Generation Facilities and Research Tools

- Four of the Free-Air CO₂ Enrichment (FACE) facilities, Eastern Pine Forest, Mojave Desert, Northern Hardwood Forest, Eastern Hardwood Forest, became a single official DOE Distributed User Facility. A BNL scientist was named the FACE Facility Coordinator. The Coordinator, DOE, and users are preparing a management plan for the Facility. The Facility is open to all qualified investigators and includes opportunities for field research and modeling activities that use data produced by the Facility.

Discussion of Make up of the Facility User Community

The FACE Facility user community is composed of scientists conducting research on the terrestrial carbon cycle

List the Number of International Collaborations

- Federal Agricultural Lab (FAL), Germany, FACE System.
- Swiss Federal Technical University, Switzerland, FACE System

List of Projects/Programs Involving Collaborations with Others

ANL

- ARM Program
- CSPHOT Instrument Mentor
- MMCR Instrument Mentor
- External Data Center
- External Data Algorithms

Battelle Memorial Institute

- Common Household Activities and Exposures to Disinfection

Battelle Pacific Northwest Laboratory

- Battelle-PNNL ARM Program
- External Data Algorithms
- Aircraft Coordination
- Data Quality Reporter
- PIF Data Management
- Web Application
- SGP SDS Development
- Surface Characterization
- Satellite Data Coordination
- External Data Center
- Integrated Data Base
- Classified Satellite Data Products
- Instrument Mentoring
- NSA – Log
- TWP – Log
- Reprocessing Data
- Tracer Preparation and Analysis for Fall 2000 VTMX-CBNP Experiments

Lockheed Martin Energy Research Corp.

- Assembly of a Control System for One 24-Valve Face Ring

National Energy Technology Laboratory

- CATS Analyses – NETL

Oak Ridge National Laboratory

- EE ORAU Travel

Penn State

- Development of Cloud Property Retrieval Algorithms at ARM Boundary Facilities

Sandia National Laboratory

- WIPP
- UAV

Savannah River

- Subcon Focus Area Lead Laboratory

SUNY Stony Brook

- Study of the Outer Shelf, Shelfbreak Front, and Slope from Long-Term ADCP and Hydrographic Observations from the MV Oleander

University of California/Scripps Inst. of Oceanography

- Collection of Shipboard Acoustic Doppler Current Profiler Data During the Shelf-Basin Interaction Program

University of Miami

- Technical Support for Fabrication Testing and Calibration for Two New PRP Instruments
- Fabrication of a Portable Radiation Package for Atmospheric Optical Measurement

West Valley Nuclear Services Company

- Grout Testing

List of WFO Projects and Sponsors

Aerodyne Research Inc.

- Aerosol Sampling
- Develop a Versatile Aerosol Mass Spectrometer for Organic Aerosol Analysis

ARCO [BP Amoco]

- CATS Tracer Project

Babcock Services, Inc.

- Babcock Services

Center for Energy and Environment

- CATS Analysis
- Center for Energy and Environment

CMHC Canada Mortgage and Housing Corp.

- Northern Ventilation and IAQ Pilot

Con Ed

- Equipment for Rapid Cable-Leak Locating and Detecting Capabilities

Constellation Nuclear

- Tracer Gas Study

Cooley's Anemia Foundation, Inc.

- Two Novel Methods to Measure Iron in Vivo in the Liver and Heart of Thalassemia Patients

Department of Defense (DOD)

- A Field Program to Identify TRI Chemicals and Determine Emission Factors from DOD Munitions Activities

Dominion Virginia Power

- CATS Analysis

Enermodel Engineering Ltd

- CATS/PFT Testing

Environmental Protection Agency (EPA)

- New York/New Jersey Harbor Contaminated Sediment Processing and Decontamination Technologies Full Scale Production Demonstration – Phase 2

- Developing a Decision Support Technology Matrix and Reference Guide
- CATS

Guangzhou Institute of Geochemistry

- Develop Particle-into-Liquid System

Hikawa Shoji Kaisha Ltd.

- Portable Radiation Package
- Portable Radiation System Upgrade

Houston Advanced Research Center

- Quantification of Fugitive Reactive Alkene Emissions from Petrochemical Plants with Perfluorocarbon Tracers

ITT Industries

- ITT-Dugway
- Ultraviolet Raman Spectral Signature Acquisition and Short Range Raman Lidar Optical Physics

JAMSTEC

- Shipboard Ocean and Atmospheric Radiation

Kewaunee Nuclear Power Plant

- CATS Analysis

KeySpan

- PFT Leak Detection Services

KeySpan/Consolidated Edison of NY

- Gas Pipeline Leak Detection and Pinpointing Technology

Kinectrics Inc.

- CATS Analysis

Maine Yankee Atomic Power Co.

- Analysis of Soil Samples
- PAB Test Pit Groundwater

NAHB Research Center

- PFT Testing

National Academies

- IAEA Training

National Aeronautics and Space Administration (NASA)

- Validation of the Sea WIFS Atmospheric Correction Scheme Using Measurements of Aerosol Optical Properties
- Tracer Study of Long-Range Transport in Support of the Big Bend National Park Regional Aerosol and Visibility Observational (BRAVO) Study
- Representation of Aerosol Microphysics in Regional to Global Scale Models

National Center for Atmospheric Research

- On-Site Technical Support for the FAA's Terminal Ceiling and Visibility Field Study

National Oceanic and Atmospheric Administration (NOAA)

- G-1 Measurements for the Summer 2002 AIRMAP Intensive

Newmont Metallurgical Services

- Mercury Stabilization
- Newmont Metallurgical Services

Point Beach Nuclear Plant

- CATS Analysis
Radiological Services, Inc.
- Radiological Services
Research Triangle Institute
- CATS
Royalty
- Feasibility Studies for Technologies Used to Treat Mercury Contaminated Materials
RTI
- PFT Tracers
Texas National Resources Conservation Commission
- Analysis of G-1 Aircraft Data Collected During TexAQS 2000
Port Authority of New York and New Jersey
- Newark Port Authority of New York and New Jersey
TNO Environment, Energy and Process Innovation
- TNO Environment
Tracer Detection Technology Corp.
- Tracer Detection Tech.
Usi
- Tracer Technology
- Usi – PFT Technology
Woods Hole Oceanographic Institute
- GLOBEC-01: The Physical Oceanography of Georges Bank and its Impact on Biology
- GLOBEC: Shipboard ADCP Data Collection and Retrospective Analysis

Staff Profile

Tenured:	7	Professional:	17
Continuing:	15	Technical:	4
Term:	7	Administrative:	7
Research Associates :	5	Management:	1
Scientific Total:	34	Information Tech:	5
		Total:	68

*Note: Riken Fellows, Goldhaber Fellows, and Visiting Scientists included with Research Associates.

Funding Profile for the Last Seven (7) Years

2003	\$19.7M
2002	\$20.8M
2001	\$19.5M
2000	N/A
1999	N/A
1998	N/A
1997	N/A

Other Publications, Citations, Press Releases for this Fiscal Year

Press Releases:

- July 2002 – Air Quality Study Focuses on New England
- September 2002 – P. Kalb, “Innovator of the Year” by LI Business News
- October 2002 – P. Daum Receives Environmental Leadership Award from Southampton College.
- January 2003 – LI Weather of 2002 by V. Cassella.
- February 2003 – Stephen Schwartz elected Fellow of the American Association for the Advancement of Science.
- March 2003 – Brookhaven Laboratory and Stony Brook U. open new Environmental Center.

1.4.4.2 Energy Sciences and Technology

Management Goals and Processes for Fiscal Year 2004

- Increase use of PeopleSoft for integrated planning and reporting.
- Review of self-assessment process
- Decrease costs on G&A side by 10%

New Associate Scientists (or Above) Hired

1

New Research Associates Hired

2

Significant Improvements in Infrastructure and Management Systems that Support Research

- Due to the continuing resolution, we were unable to make significant investments in this area during this fiscal year.

Safety Enhancements

- Revised Tier 1 process to address working condition improvement
- Participate in lab wide safety improvement process

List the Number of International Collaborations

6

List of Projects/Programs Involving Collaborations with Others

- Battelle Pacific Northwest Laboratory, SDRS BOA from PNNL
- Cornell University, CADD-Based Expert System for Passive Snow Control
- Oak Ridge National Laboratory, ORAU TRVL - NE - Czajkowski and US DOE Lab Technology Research Program Review - Rohatgi; Travel Expenses for NERI Review
- Oakland Operations Office (NERI), A Proliferation Resistant Hexagonal Tight Lattice BWR Fuel Core Design for Increase Burnup and Reduced Fuel Storage Requirement
- Oakland Operations Office (NERI), Optimization of Heterogeneous Utilization of Thorium in PWRs to Enhance Proliferation - FY 2001
- Oakland Operations Office (NERI), NERI 01-022 Particle Bed Gas-Cooled Fast Reactor (PB-GCFR) Design
- Oakland Operations Office (NERI), Development of GEN IV Advanced Gas-Cooled Reactors With Hardened/Fast Neutron Spectrum
- Richandl Operations Office, Development of GEN IV Advanced Gas Cooled Reactors With Hardened Fast Neutron Spectrum
- Sandia National Laboratory, Documentation for NUREG

List of WFO Projects and Sponsors

Airborne Contaminant Systems, Inc.

- Testing of Filtration Efficiency on Device for Removal of Biological/Radiological Hazards Injected Into Commercial Air Handling

Chevron

- Catalytic Coprocessing of CO and CO₂ into Methanol Via the BNL Low Temperature Methanol (BNL-LTM) Process

Concurrent Technologies Corp.

- Advanced Zinc Phosphate Conversion Coatings for Electrogalvanized Steel

Department of Commerce

- NIST Research Reactor Control Room Upgrade Plan

Department of Defense-U.S. Army

- Enhance Burner Design (Continuation of Project ID 05591 and 05586)

Department of State – ISPO

- Kursk Ultrasonic Test Equipment-23.8

Electric Power Research Institute

- Human Factors Technical Support for Digital I&C Modernization
- Development of Design Process Guidance for Digital Control Room Technologies

Emission Control 2000 LLC

- Evaluation of EC 2000 Devices for Oil-Fired Residential Heating Systems

Enconet Consulting

- PSA Applications for Regulatory Use

Energy Research Center

- New York State Premium Low Sulfur Fuel Marketplace Demonstration

Environmental Protection Agency

- 0.043055556
- MARKAL/MACRO Model Development in Central America: A Cooperative Program for GHG Emission Reduction and Project Identification

- MARKAL Model for Energy Conservation in Puerto Rico
- Develop MARKAL-MACRO Model for the State of New Jersey
Gas Technology Institute
- Development of a Device to Breakup Concrete Pavement
Glaztec, Incorporated
- Use of Chitosan as a Water-Based Anti-Corrosive Coating Material
Heat Wise, Inc.
- Low NOx Commercial Burner
Insight Technologies, Inc.
- Two-Stage Oil Burner with Load Tracking Control
KeySpan
- Polymer Grouts and Polymer Composite Liners for Retaining Excavated Wall Foundations
- Alt. Repair Mtls for Polymer Concrete Dike Overlay
Massachusetts Institute of Technology
- Joint Work With MIT on CRADA BNL C-01-07
National Aeronautics and Space Administration
- Reaction Pathways and Thermodynamic Studies of Atmospheric Reactions
National Combustion Company Inc. (NATCO)
- NATCO Testing and Analysis
National Institute of Standards and Technology
- Reactor Analysis in Support of the NIST Research Reactor (CI Status - Activities)
National Oilheat Research Alliance
- Maximizing Fuel Performance in Residential Heating Systems
NOCO Energy Corporation
- Low Cost Bioheating Oil Application
North Atlantic Treaty Organization – NATO
- The Structure and Risk Assessments of Nuclear Power Plants' (NPPs) Safety in Relation to Aircraft Crash
NYSERDA
- Variable Firing Rate Oil Burner Using Pulsed Fuel Flow Control
- Improved Electric Power Efficiency in Heating Equipment - Phase II
- High Efficiency, Condensing Heating Appliance Firing Low Sulfur Oil
- The Use of Biodiesel Blends in Space Heating Equipment
NYSERDA With NOCO Energy Corporation
- Low Cost Bioheating Oil Application
Quantum Group Inc.
- Quantum Group Inc.
Radkowsky Thorium Power Corporation
- Thorium Fuel Project
Raytheon Technical Services Company
- Technical Support to Raytheon Technical Services Company for the FAA Aircraft Wire Degradation Study (Phases III and IIII)
Swedish Nuclear Power Inspectorate
- Assistance to the Swedish Nuclear Power Inspectorate (SKI)
Thorium Power, Inc.

- Radkowsky Thorium Fuel Project
- U.S. Nuclear Regulatory Commission*
- Technical Assistance in Support of DSSA Reactor Systems Issues
- Japanese Collaboration on Seismic Issues
- Nuclear Safety Research Information Meeting
- North Anna Fire Protection Inspection
- Technical Support in Risk Assessment
- Seismic Response of Degraded Structures & Components
- MELCOR Benchmarking, Verification & Applications - Korean Funds
- Technical Assistance for Review of the Prairie Island Waterhammer and Two-Phase Flow Analysis (13388)
- Dry Cask PRA
- Support in Development of Consensus PRA Standards
- Low Power and Shutdown Risk Study
- Credit for Operator Action
- Risk - Infrmng Part 50
- TA License Renewal LRA
- Technical Assistance in Support of DSSA Regulatory Licensing Improvements
- Specialist Support for NPP Inspections
- EQ/Aging Power Cables and Electrical Penetrations
- TA for Risk Assessment of Nuclear Materials and Waste
- TA in Support of the Div. Of Engineering Review of Inservice Inspection Relief Request Licensing Actions
- Reactor Core Analysis
- Support for Inspection and Assessment Program Development and Oversight
- Boiling Water Reactor Fluence
- Dry Cask PRA
- TA in Support of the Division of Engineering Regulatory Licensing Improvement Activities
- Collaborative Research on Wire System Aging
- Strengthening Kazak Regulatory Authority
- Support to State Nuclear Regulatory Committee of Ukraine
- Technical Support and Training
- Support to State Nuclear Regulatory Committee of Ukraine - U-9550
- Improved Methods for Performing Importance Analysis
- SPAR Model Development Level 2/LERF
- Technical Assistance in Support of Technical Evaluation of Non-Power Reactors - University of Maryland License Renewal
- Reactor Analysis for High-Burnup Fuel
- Risk Informed Initiatives for Nuclear Materials
- Risk Associated With Cable Aging
- Advanced Reactor Regulatory Framework Development
- Digital Systems PRA
- Technical Assistance in Support of the Division of Engineering Review of Design Certification Applications

- Support to Russian Federal Nuclear and Radiation Safety Authority
- Armenian Nuclear Regulatory Authority - Development of a Safety Analysis Review Capability
- Strengthening Kazak Regulatory Authority
- Support to State Nuclear Regulatory Committee of Ukraine
- Estimate for Construction of PPS Drop Test Facility
- Soil-Structure Interaction for Buried Structures
- Role of Human Performance in Advanced Reactors
- Radiological Emergency On-Shift and Augmentation Staffing Levels for Nuclear Power Plants
- Support for Review of ESBWR Advanced BWR Design
- Support for Review of ACR-700 Design
- Effects of Switchgear Aging on Energetic Faults
- Technical Evaluation of Non-Power Reactors
- Coop - Switz - PRA Supports Y-6332
- Taiwan - PRA Supports Y-6332
- IAEA Coordinated Research Project on Seismic Ground Motion

Staff Profile

Tenured:	2	Professional:	22
Continuing:	40	Technical:	2
Term:	5	Administrative:	10
Research Associates :	2	Management:	1
Scientific Total:	49	Information Tech:	5
		Total:	91

*Note: Riken Fellows, Goldhaber Fellows, and Visiting Scientists included with Research Associates.

Funding Profile for the Last Seven (7) Years

2003	
2002	\$20.8 M
2001	\$19.5M
2000	N/A
1999	N/A
1998	N/A
1997	N/A

Other Awards

- Brookhaven EENS Directorate Leadership Award

Other Publications, Citations, Press Releases for this Fiscal Year

- Three Press Releases

1.4.4.3 Nonproliferation and National Security

Management Goals and Processes for Fiscal Year 2004

- Continue to strengthen scientific capability in advanced radiation detector systems.

New Associate Scientists (or Above) Hired

- Three Associate Scientists or above hired

Significant Improvements in Infrastructure and Management Systems that Support Research

- Streamlined IPP management for better response to DOE and to BNL scientists.
- BNL initiated an audit of ISPO Financial Controls by Craig, Fitzsimmons & Michaels, completed May 2003.
- Technical Survey Team (TST, for DOE MPC&A program) review and report process - team management improvement - assignment of report leads, summary leads, etc in advance of reviews
- Database (project, recommendation, guidance tracking)
- TST process changes
- Briefings for DOE/NNSA - Issue Digest: Testing MPC&A Systems; White Paper: Metrics for Prioritizing MPC&A Projects; Documentation Review: MC&A Survey, Proposed Protection Baseline Assessment, Operations Criteria, and Exit Strategy.

Safety Enhancements

- A comprehensive clean-up was carried out to eliminate legacy wastes and to encapsulate shielding materials, including lead and cadmium, stored in the East Counting Room and the basement of Building 703.

Steps Toward Development of Next Generation Facilities and Research Tools

- Helped secure funding for Radiation Detector Test and Evaluation Center (RADTEC) and working to arrange an enduring role for this facility.
- Technology Roadmapping for IAEA Equipment Needs, began August 2002.

Discussion of Make up of the Facility User Community

- DHS/NNSA Labs, Port Authority of New York/New Jersey, Customs and other first protectors for the RADTEC facility.

Steps toward Improvement of Proposal Quality and Opportunities

- Identify opportunities for BNL scientists in collaborative research under IPP program.
- Developed review procedure for technical, business and dual use for the proposal.

List the Number of International Collaborations

- Norwegian Defence Research Establishment, Norway
- IBRAE-RAN, Moscow; ICC Nuklid, St. Petersburg
- RTP Atomflot, Murmansk
- UK Atomic Weapons Establishment (Aldermaston, Berkshire). Measurement of radiation signatures and demonstration of BNL's Controlled Intrusiveness Verification Technology (CIVET). Two people from BNL, eight from other US labs, and six or more from AWE.

- UK Defense Science and Technology Laboratory (Sevenoaks, Kent). Detection of explosives by thermal neutron backscatter, using a Dstl Fort Halstead neutron generator and BNL's thermal neutron imaging system. Three people from BNL, a group of about five from Dstl Fort Halstead.
- All-Russian Research Institute of Automatics (VNIIA, Moscow). Construction of a Russian version of BNL's CIVET system. Two BNL people and a large group of VNIIA technical staff.
- ALL the Initiatives for Proliferation Prevention (IPP) programs have Russian and Kazakhstan Collaborators and US Partners and these include:
 - DuPont Chemicals
 - Kurchatov Institute
 - EXCOM
 - VNIIEF-Sarov
 - EXCOM
 - Institute of Applied Physics, Nizny-Novogorod
 - FLOWSERVE
 - Kurchatov Institute and Keldysh Research Centre
 - Aquilla
 - General Physics Institute, Russia

All of the work performed by the MPC&A Cooperative Programs Division involves collaboration with Russian Nuclear facilities. It is estimated that the division collaborates with roughly 75 Russian scientists and engineers at the following 15 nuclear sites:

- RIAR, Luch, Kurchatov Institute, IPPE, Sevmash, MEFhI, Lytkarino, Electrostal, JINR, Karpov, Krylov, TPU, C-70, K-26, and Tomsk.
- The FY03 budget for the division is \$56m and most of this funding is provided to the above 15 Russian facilities to upgrade their MPC&A systems in order to ensure that nuclear material stored at the facilities is not stolen or diverted.
- All MPC&A Projects reviewed involve international collaborations with Russian scientists and managers at nuclear facilities all over the country (see section on Significant Accomplishments) and with the Russian Ministry of Atomic Energy (MinAtom), the Civilian Nuclear Regulatory Body (Gosatomnadzor), and the Russian Ministry of Defense/Russian Navy).

List of Projects/Programs Involving Collaborations with Others

- Picasso at RTP Atomflot
- Pb-Bi Liquid metal Reactor Safety Study
- RF Naval SNF Terrorism
- "Security of Radioactive Materials at Non-Reactor sites in NYS"
- "Security of Chemical Weapon Components in NYS"
- Department of State (USSP), Feasibility Study of Inspector Certification (Sonalysts – 2 staff members)
- Department of State (USSP), Additional Protocol Workshop, (SAIC – 4 staff members) to BNL and to SAIC for Phase 1 of task

All of the work of the MPC&A Cooperative Programs Division involves collaboration with staff from other national laboratories and with Russian scientists and engineers at 15 nuclear sites in Russia. This collaboration encompasses numerous projects. There are additional collaborators or subcontractors with both US and foreign organizations:

- Collaboration with the technology laboratory of Virginia Polytechnic Institute and State University.
- Collaboration with the Center for International Trade and Security, University of Georgia.
- Collaboration with United Technologies in the area of fuel cell research.
- Collaboration with ORNL in performing a safety evaluation of the HIFR.
- Course entitled “International Organizations” being taught by a staff member at the State University of New York at Stony Brook.
- A staff member is assisting Lorex Industries with the development and demonstration of a laminar flow meter for UF6 measurements at the blend-point under the auspices of the U.S.-Russian Uranium Purchase Program.

List of WFO Projects and Sponsors

DOD

- Picasso at RTP Atomflot
- Picasso at FGUP Polyaminski SRZ

DOJ

- “Security of Chemical Weapon Components in NYS”

Department of State (USSP)

- Feasibility Study of Inspector Certification
- Additional Protocol Workshop
- Safeguards for Chernobyl 4 Shelter

Department of State

- Technical Assistance on Safeguards Issues

DARPA

- Stand-off Gamma and Neutron Spectra from Uranium – and Plutonium-Based
Senior Science Advisor for State Department Science and Technology Center Program

POTAS, Department of State

New York Gas Group

- TEMASU project

USDOT/FAA

- Tera Hz sensor development
- Safety Management system development

US DHS

- Critical infrastructure protection vulnerability assessments

Battelle Memorial Institute

Defense Threat Reduction Agency (4 accounts)

Environmental Protection Agency

Sub Terra Sensors

- LLC – TEMASU

General Electric Company

- Technical Monitoring, IPP

Staff Profile

Tenured:	0	Professional:	12
Continuing:	12	Technical:	0
Term:	3	Administrative:	13
Research Associates :	0	Management:	1
Scientific Total:	15	Information Tech:	0
		Total:	41

*Note: Riken Fellows, Goldhaber Fellows, and Visiting Scientists included with Research Associates.

Funding Profile for the Last Seven (7) Years

2003	\$42.1M
2002	\$20.8M
2001	\$19.5M
2000	N/A
1999	N/A
1998	N/A
1997	N/A

Other Awards

Other Publications, Citations, Press Releases for this Fiscal Year

- “Long Island Students Recruited for Internships”, BNL Laboratory Link, July/August 2002.
- A report was presented at the MPC&A Operations Monitoring Workshop held at the Joint Institute of Nuclear Research (JINR), Dubna, Russia, May 21-22, 2003.
- “A Simple Model for Predicting The Release of a Liquid-Vapor Mixture from a Large Break in a Pressurized Container,” (V.M. Fthenakis, U.S. Rohatgi and B.D. Chung), Journal of Loss Prevention in the Process Industry, pp. 61-72, July, 2002.
- “Impact of Nuclear Option on Environment and Economy,” (U.S. Rohatgi, J. Jo, J. Lee, R. Bari) Journal of Nuclear Technology, pp. 252-264, March, 2002.
- “RELAP5/MOD3.2.2 System Code Coupling with CONTAIN 2.0 Containment Analysis Code using Dynamic Link Library" B.D. Chung, U.S. Rohatgi, Jae Jo. NTHAS3: Third Korea-Japan Symposium on Nuclear Thermal Hydraulics and Safety, Kyeongju, Korea, October 13-16, 2002
- “Construction of Complex Images by an Adaptive Neuron-Like Research System,” CONIP'02- SEAL'02-FSKD'02 Conference, Singapore, 18 - 22 November 2002.
- “Neutronics Design and Fuel Cycle Analysis of a High Conversion BWR with Pu-Th Fuel,” Yunlin Xu , T.J. Downar, H. Takahashi and U.S. Rohatgi, ICAPP, ANS Meeting, Florida, June, 2002.
- “Steam Line Break and Station Blackout Transients for Proliferation Resistant Hexagonal Tight Lattice BWR,” U.S. Rohatgi, J. Jo, B. D. Chung, H. Takahashi and T. J. Downar, ICAPP, ANS Meeting, Florida, June, 2002.

Number of Co-Authored Papers, CRADA's, etc.

- 9 co-authored papers
- 5 CRADAs

Additional Comments

- Customer satisfaction, measured by continued funding and positive interactions with sponsors in the non-R&D projects, is a metric not captured in the list above.