

Science and Technology
Year End Self-Evaluation
Brookhaven National
Laboratory

Fiscal Year 2002
DRAFT

August 28, 2002

BROOKHAVEN SCIENCE ASSOCIATES
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Brookhaven National Laboratory

PREFACE

This is the draft Annual Self Evaluation Report for Science and Technology for Fiscal Year 2002 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 by Laboratory S&T Department 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.

The Final BSA Annual Self Evaluation Report will include an attachment that dispositions or references the disposition of the issues raised in the DOE Fiscal Year 2001 Performance Evaluation of Brookhaven Science Associates.

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

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INTRODUCTION

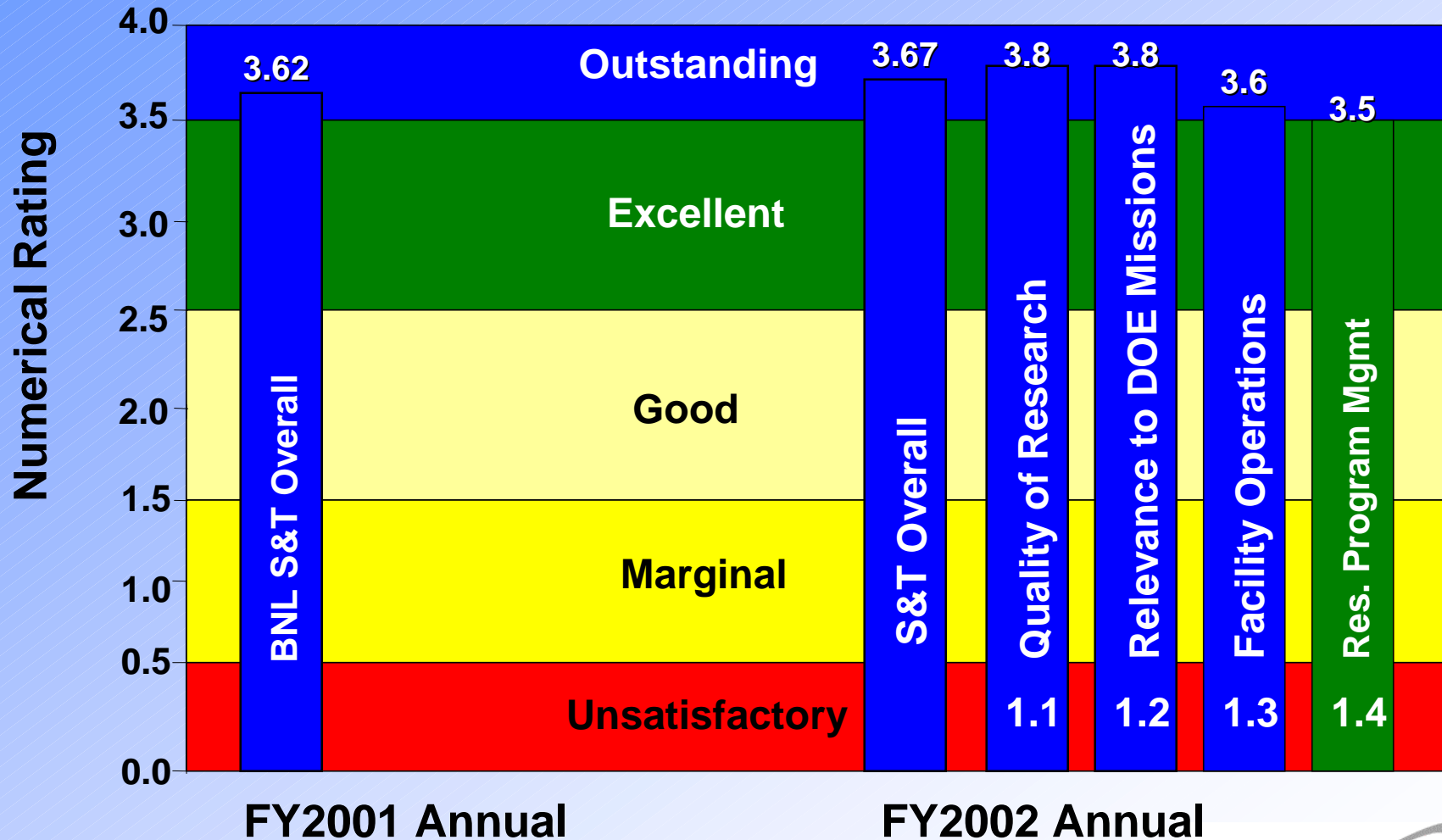
With the implementation of the Performance Based Contract between Brookhaven Science Associates (BSA) and the Department of Energy (DOE) for operating Brookhaven National Laboratory (BNL), BSA is required to execute a Performance Based Management System (PBMS). The PBMS is designed to include clear,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

For FY2002, 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 draft 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, in mid-November.

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Critical Outcome 1: Science & Technology

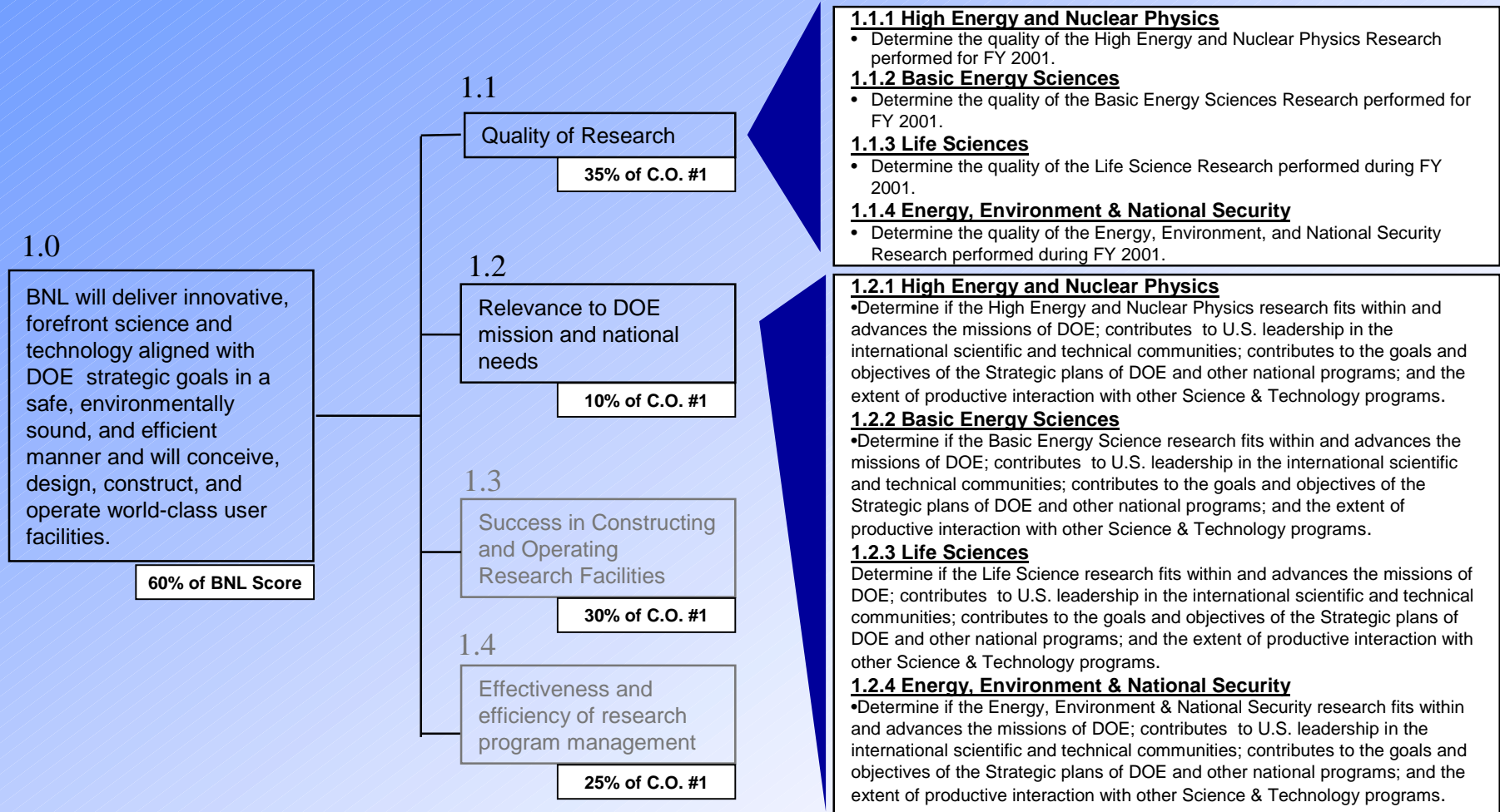


1.0 Basic Science & Technology

Critical Outcome

Objectives

Performance Measures



1.0 Basic Science & Technology

Critical Outcome

Objectives

Performance Measures

1.0

BNL will deliver innovative, forefront science and technology aligned with DOE strategic goals in a safe, environmentally sound, and efficient manner and will conceive, design, construct, and operate world-class user facilities

60% of BNL Score

1.1

Quality of Research

35% of C.O. #1

1.2

Relevance to DOE mission and national needs

10% of C.O. #1

1.3

Success in Constructing and Operating Research Facilities

30% of C.O. #1

1.4

Effectiveness and efficiency of research program management

25% of C.O. #1

1.3.1 High Energy and Nuclear Physics, 1.3.2 Basic Energy Sciences, 1.3.3 Life Sciences, 1.3.4 Energy, Environment & National Security

- Performance specifications and objectives
- Reliability and safety of operation achieved
- Adherence to planned schedules
- Cost effectiveness of maintenance and facility improvements
- Assess new facilities design and development
- Effectiveness of user access program

1.3.5 SNS-Spallation Neutron Source Project

- Reviewers will consider the extent to which BNL provides effective and efficient leadership in the development of the Spallation Neutron Source (SNS) Project. In this project the Laboratory will perform assigned tasks and produce scheduled deliverables for the Spallation Neutron Source in accordance with the Inter-lab Memorandum of Agreement (MOA) and the approved annual work plans.

1.4.1 High Energy and Nuclear Physics

- Determine the effectiveness and efficiency of High Energy and Nuclear Physics research program management.

1.4.2 Basic Energy Sciences

- Determine the effectiveness and efficiency of Basic Energy Sciences research program management.

1.4.3 Life Sciences

- Determine the effectiveness and efficiency of Life Sciences research program management.

1.4.4 Energy, Environment & National Security

- Determine the effectiveness and efficiency of Energy, Environment & National Security research program management.

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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) 2002 performance as *Outstanding* with a corresponding score of 3.67. 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 each of the four 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	3.8
Success in Constructing and Operating Research Facilities	30%	Outstanding	3.6
Effectiveness and Efficiency in Research Program Management	25%	Excellent	3.5
Overall	100%	Outstanding	3.67

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.

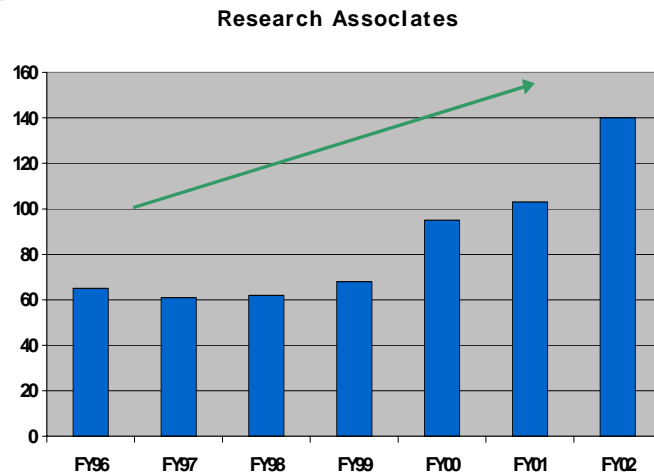
1.2 INSTITUTIONAL LEVEL PERFORMANCE

As BSA approaches the end of its first contractual cycle, it is important to remember the initial focus for this contract period; namely to improve in the areas of Environmental, Safety and Health (ES&H) and Community Relations while maintaining an excellence in science. We believe we have accomplished this goal and more. There has been continuous and sustained improvements 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 have focused on addressing the core areas and major initiatives, in prioritized manner, to achieve and sustain outstanding performance. As reported in previous years, however, many of the management changes are still maturing and will take several more improvement cycles before full benefits are realized. Initiatives adopted to attract and retain key scientific staff, improve strategic planning, and improve LDRD management have matured and we continue to see benefits in committing our resources in this area. Also improved is the integration of BNL capabilities and collaboration to maximize benefits of National Laboratory based research.

1.2.1 Initiatives

1.2.1.1 Scientific Staff

BSA continued its effort to retain and recruit top-level scientific staff at all levels to maintain its core scientific strength. Dr. Ralph James, who joined the Laboratory in June 2001 as the Associate Laboratory Director for Energy, Environment and National Security, played a pivotal role in aligning the Laboratory with DOE's mission for Homeland Security. Dr. Steven Dierker, who joined the Laboratory as the Chairman of NSLS instituted the organizational change in the Department to streamline its user oriented operations.



With an aggressive and focused hiring effort, the S&T sector was able to attract many new scientists, and technical staff. Some of the significant hires were in the Laboratory's strategic areas such as the nanomaterial center development (Dr. Ron Pindak) and biomedical research (Drs. Helene Benveniste and Huilin Li). 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 an increased population of young scientists; the number reaching about 140, more than 20% of the total scientific staff. BNL's target is to reach 150. Noting that the salaries of postdoctoral Research Associates at BNL are significantly below the DOE average, measures were taken this year to boost the salaries with a large increase. However, it still stands significantly below the DOE Laboratory average.

Laboratory management established joint appointments with universities such as SUNY at Stony Brook as a viable means to attract key scientific personnel. Joint appointments enable the Laboratory to share resources with the universities, making the cost of top scientists more affordable for both the University and the Lab. Joint appointments also improve program integration, foster broader collaboration and bring graduate students into the Laboratory. Examples of previous successful joint appointments at Stony Brook are listed below together with the DOE program for which the research is focused.

- James Glimm - ASCR (Head Center for Data-Intensive Computing)
- Stanislas Wong - BES (Materials Science)
- Arthur Suits - BES (Chemistry)
- Michael White – BES (Chemistry)

During this reporting period, the following joint appointments were also established:

- Helene Benveniste - OBER (Medical)
- DaXiong FU - OBER (Biology)

Science and Technology Diversity Programs

In 1998 BSA made a commitment to improve the representation of women and under-represented minorities on the scientific staff through a six-year program. Recruitment measures were initiated by utilizing the expertise and experience of a retired African American BNL scientist, Gus Prince to establish a liaison program with Brookhaven National Laboratory and Historically Black Colleges and Universities for the recruitment of minority and women scientists. In addition, partial funding for 13 positions targeting women and under-represented minority postdoctoral Research Associate and Assistant Scientists was provided. To date, the initiative has resulted in one African American Assistant Scientist, three African American and three women postdoctoral Research Associate hires.

1.2.1.2 Planning (Long and Short Term)

Introduction

The Laboratory engages in several aspects of planning, i.e., basic process elements such as Facilities Initiatives Planning, program planning and integration, staff planning, and planning to meet user needs. The Laboratory continues to improve and integrate the

planning processes, although some aspects of the Planning System still need to mature. Those elements of planning that provide a firm basis for the overall planning at BNL continue to be performed in an outstanding manner. These are the 3PBP 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 ALDs. Plans for staff and program realignment and integration are being executed and should be rated as *Excellent*. Bottom to top planning and integration is improving and should be rated *Good* to *Excellent*. Some organizations are doing an outstanding job of both short- and long-range planning while the planning in other organizations, especially long range planning, needs to improve. However, this tends to be in organizations where the long-range uncertainties in sponsor drive direction and funding makes long range planning difficult at best. It is our evaluation that overall the organizational planning should be rated *Good*. The integration across organizations also needs to improve, but integration of the major directions for programs and initiatives, as determined by senior management, is excellent.

Justification

Significant efforts were made this year to continue the realignment of programs along the DOE missions and to integrate programs to assure consistency with DOE's current and future needs. The following are examples of institutional planning and execution of that plan.

- Four years ago the Laboratory planned and implemented steps to rejuvenate and expand key capabilities at the Laboratory. BNL now has more than 140 young scientists in the post-doctoral Research Associates and Fellowship program. The Goldhaber Fellowship currently funds 8 top scientists and this year alone more than 100 applications have been received. BNL hired young, highly sought after scientists to reinforce and expand key programs (e.g., theoretical physics, life science, chemical and materials science), and has embarked on a plan for joint university/ Lab appointments to both augment capabilities at the Lab as well as offset the cost of highly recognized senior scientists.
- Planning by senior management has provided a roadmap for new facilities and capabilities and a vision of how the Laboratory will continue to serve the nation and DOE, our international users and partners, and the Northeastern Region of the US. In conjunction with DOE, the Laboratory is pursuing plans to bring to fruition its top priority science facilities, the BNL Nano Center (BES), RHIC II (NP), NSLS Upgrades (BES), and CIRC (NE). Preliminary plans are in place for these projects. BNL Nanocenter received DOE's CD 0 approval. BNL will meet the request of the Director for the Office of Science to provide the appropriate justifications and data needed to move forward with these facility developments.
- NSLS is moving rapidly to a structure that will be more responsive to and accommodate user needs by moving from the PRC concept to the "full service" concept. This concept is key to the Structural Biology Program at the NSLS. This program is an unqualified success and the "Fed Ex" approach is highly responsive to user needs. While the NIH funded this, it demonstrates that careful planning based on

user needs and the unique capabilities of the DOE facilities can attract substantial financial input for other key agencies.

- The NSLS Upgrades will provide the synchrotron light source user community with the cutting edge capabilities well into the future and will better serve the Nano Center, a key resource to the materials science community in the Northeast and a complement to the capabilities of other DOE Nano Centers.
- The Laboratory has planned and is working in conjunction with interested universities to make the NSF RSVP project a reality. This project, and others such as the NASA Radiobiology Program and Facility will make use of cutting edge capabilities of the AGS and provide these unique capabilities to other sponsoring agencies.
- Plans for RHIC II and eRHIC began even before completion of the RHIC facility. 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.
- In 1998, the Director of BNL, J. Marburger stated in his message in the Institutional Plan that “rapidly advancing large-scale computing and visualization was necessary to merge the macroscopic and microscopic world”. The Laboratory embarked on plans to make computation serve science. Already, BNL was involved in high-end computing for RHIC in conjunction with RIKEN and the Laboratory embarked on other avenues to strengthen our existing capabilities and to expand the application of advanced computation to other areas. The formation of the CDIC in conjunction with Stony Brook was just one step. Our plans for ATLAS and the transparent integration of capabilities with RHIC computing, and the success of our competition in SiDAC for the Lattice Gauge program demonstrate the soundness of this plan and rigor with which we have pursued our plans. In the recent Genomes to Life proposal, the computation goals were to support the research goals and provide a key tool to the research community for understanding complex microbial communities.
- Program realignment and response to DOE needs has been a major goal of the Laboratory for the past four years. Some of the key elements of the plan included consolidation and integration of material science capabilities, realignment of the Life Science Programs with a focus on the key capabilities of BNL and how they might best serve DOE. A systematic restructuring of the NSLS and long range planning will help to better serve users now and in the future. The newly formed Materials Science Department is only the first step in concentrating our capabilities in materials. It will fully complement and support the programs at the Nano Center. The integration of capabilities in materials and chemical sciences has lead to more success in competing for key funds in nanoscience. The plans for the Life Sciences programs included new staff, focused on DOE issues and more collaborative (both internal and external) approaches to research. The success of these efforts becomes evinced by the success of our competition in bioengineering initiatives and the expansive, highly integrated and collaborative response to the Genomes to Life Call. While BNL did not win funding, the approach has provided a basis on which to move forward and further improve the integration and collaborative nature of its Life Science programs. In the future, plans in Life Sciences will focus on key issues in DOE missions with plans such as that for the Center for Complex Membrane

Proteins. This initiative draws on the facility and core structural biology capabilities of BNL and provides the DOE with a new user capability for understanding the complex biological protein processes involved in cell signaling, so important in human health, in carbon management, and in environmental remediation.

- Site Master Planning continues to focus on providing space appropriate for science in the 21st Century and 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 new facilities such as the Research Support Facility in FY 03 and the User Facility in FY 04. The Laboratory also uses the 3PBP process to balance overall infrastructure improvements, ESH improvements, and current and future programmatic improvements (e.g., laboratory upgrades and new space for programs).

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. 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.

1.2.1.3 Overall Integration and Collaborations

Introduction

Integration and collaboration includes both internal to the Laboratory, as well as external with other institutions. The Laboratory has a strong history of collaboration in High Energy and Nuclear Physics and that strength continues. The NSLS has long been a star in laboratory, university and industrial collaborations and it continues to expand its role as a major focal point for collaborations, and will be an integrating element in our New Nano Center programs. Internal collaborations (within the organization and across organizations) continue to grow and small program integration and collaboration with organizations outside the Laboratory are becoming more and more common.

Justification

- Results from the four major detector groups at STAR, PHENIX, PHOBOS and BRAHMS, dominated the Quark 2002 conference, something that could not have occurred if the operations of the facility did not accommodate the users and if the users were not focused and coordinated in their goals. The NSLS continues to be heavily used and in demand. This year's request for beam time is at an all time high, again a feat that could not occur if the operations did not meet the user needs, if the user groups did not work together to assure a strong program, and if the organization did not foster collaboration and integration for efficient and responsive operations.

- The RIKEN-BNL program is an unqualified success in collaboration, as evinced by the signing of another 5-year agreement.
- Advanced computation for HE and NP is moving toward transparent integration. This is a result of the Laboratory's move to make computation serve science and not have computation for computation's sake.
- In HE and NP, BNL and others collaborate to recommend to DOE the long-range directions for the programs and facilities, a National Program. In response to these long-range plans, BNL, in collaboration with several universities and other DOE and foreign Laboratories, is moving to a new concept for RHIC, eRHIC, and will continue to participate in the long range neutrino program plans.
- The Nano Center that will be built at BNL was the result of both internal and external collaborations and the integration of BNL's efforts in nano science. This center will serve the northeastern US, and represents the efforts of several BNL internal department staff as well as external university staff. In conjunction with the Nano Center, BNL also formed the Materials Science Department – pooling the talent and capabilities of researchers from several organizations.
- In several cases, new staff and post-docs have been hired to expand the capabilities of programs and to help integrate aspects of one discipline into another. For example, staff in theoretical physics integrate their capabilities with experimental programs, and new joint BNL/university appointments help integrate programs such as those in catalysis and nanoscience.
- Other indicators include the involvement of the Laboratory in applying computational methods to several focused experimental/programmatic problems such as in imaging, catalysis and bioinformatics. It also involves the Laboratory's recent responses to DOE initiatives that involved interdepartmental, inter-DOE Laboratory and university participation, such as the Genomes to Life proposal.

Summary

Overall, we rate Program Integration and Collaboration *low to medium Outstanding*. Clearly our major program efforts in HE and NP are *high Outstanding*. Efforts in BES are *high Excellent to Outstanding* depending on the program and our small program integration and collaboration efforts are moving for *low Excellent 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 Others. 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. More advanced guidance from DOE programs could expedite this process. Our proposal response to new initiatives in DOE has depended on the program, the DOE program expectations, and the quality of the reviewers. Overall, we rate the

major proposals we have submitted this year *Excellent*, as evinced by the review comments.

Over this past year the Laboratory has embarked on a more systematic approach to proposals and it will take time to mature before it can be fully evaluated. We believe our process is *high Good to Excellent* and we believe we are evolving a process that should improve both the quality of our proposals and their success. Our model is one that comes from the development of the Nano Center Proposal and the Genomes to Life Proposal, one successful, one not. Both proposals relied on a team concept, the development of a schedule, distribution of responsibilities, and internal and external reviews. 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 of scientists, administrators and project management specialists, where applicable, to implement the program. We believe that this process produces quality proposals and the success of the proposal then rests on the impartial evaluation and capabilities of the reviewers. We may disagree with the reviewers and their decision, but we believe we have produced proposals that answer the call, and represent cutting edge research for DOE.

In our Work For Others proposal, we have been quite successful with several agencies, most notably NIH. Based on the improved quality and success rate, we rate this as *Excellent*.

1.2.1.5 Laboratory Directed Research and Development

In FY 2002, the LDRD Program continued to improve under the leadership of the newly appointed Scientific Director, Leonard Newman. He came from the ranks of BNL and has a longstanding and broad expertise of the research activities at the Laboratory. In this position he has full responsibility in all aspects of the program, which enabled the program to function more efficiently and effectively. In FY 2002, the program received the results of a formal Baldrige type self-assessment performed on the administration of the program. The assessment highlighted the improvement in the selection process and administration that could be directly attributed to having a dedicated Scientific Director of the LDRD Program. Again in FY 2002, the Scientific Director and a committee, consisting of senior science and technology management of the Laboratory and two senior scientific staff, reviewed all proposals, obtained additional information deemed necessary, and selected the projects to be funded and the amount of each award. Awards were typically funded for two years with the possibility of funding for a third year. The Scientific Director of the LDRD Program 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 Scientific 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. Significant new requirements were imposed on the LDRD Program in FY 2002 as a result of congressional inquires on the DOE LDRD Program. BNL supported the new requirements by:

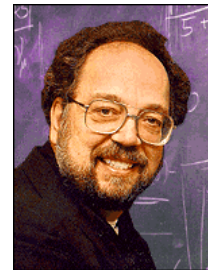
- Participating in the DOE SC LDRD working group to develop new guidelines
- Participating in the development of the new CFO LDRD database
- Ensuring that all projects support the DOE security missions and missions of other federal agencies
- Identifying potential use/benefits to the DOE security missions 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 2002, BSA increased its expenditure level from \$6 Million to \$7 Million, approximately 1.5 percent of BNL operating funds. 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 2003 to \$8.5 Million, approximately 2%.

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 year 2002.

William Marciano, a theoretical physicist, won the J.J. Sakuri Prize for Theoretical Particle Physics for 2002. The award recognizes Marciano for his “pioneering work” on calculations necessary for testing the consistency of the Standard Model, the physics theory that seeks to explain interactions between all known particles.



William Marciano

The American Association for the Advancement of Science has awarded Deputy Chair of the Physics Department, Doon Gibbs, the distinction of Fellow for the Advancement of Science. Gibbs was recognized for his distinguished contributions to condensed matter physics using sophisticated and elegant x-ray scattering techniques.



Doon Gibbs

James Reilly, a retired chemist who continues to participate in groundbreaking research, was awarded a 2002 Design & Engineering Award by Popular Mechanics magazine. Reilly was cited in the science category for his work on developing a new metal alloy that promises to improve the performance of rechargeable batteries.



Garman Harbottle, a senior chemist, was named the 2002 recipient of the Archeological Institute of America's Pomerance Award for his outstanding Scientific Contributions to Archaeology. Harbottle has an international reputation as an expert in dating and authenticating historically important items.



Garman Harbottle

Richard Setlow, a senior biophysicist, was the recipient of the 2002 Environmental Mutagen Society (EMS) Award. He was recognized for his research contributions to the field of environmental mutagenesis, which involves the study of how various agents in the environment, such as chemicals and radiation, lead to DNA damage and how that damage is repaired.



Richard Setlow

The Joint Institute for Nuclear Research has named Nicholas Samios, a senior physicist the 2001 recipient of the prestigious Bruno Pontecorvo Prize in Dubna, Moscow. The award recognizes Samios for his contributions both as a researcher in elementary particle physics, particularly neutrino physics, and as a scientific administrator.



Nicholas Samios

Ralph James, Associate Laboratory Director for Energy Environment & National Security was named a Fellow of The Institute of Electrical and Electronics Engineers (IEEE). James was recognized in the development of wide band gap compound semiconductor devices used for detecting and imaging X- and gamma ray radiation.



Ralph James

Louis DiMauro, a senior chemist, was named a Fellow of the Optical Society of America (OSA). DiMauro was recognized for his work on the development of a new laser technology that generates intense pulses of light over an extremely short time span.



Louis DiMauro

Yonjae Lee, a postdoctoral fellow in the Physics Department, won the 2002 Alvin Van Valkenburg Award for his work on a newly discovered class of materials that expand under pressure.



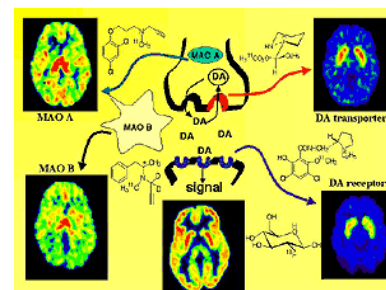
Yonjae Lee

Vasilis Fthenakis, a senior research chemical engineer, was elected a Fellow of the American Institute of Chemical Engineers, in recognition and appreciation of superior attainments, valuable contributions, and service to Chemical Engineering.



Vasilis Fthenakis

Joanna Fowler, a senior chemist, won the American Chemical Society's (ACS) 2002 Glenn T. Seaborg Award for Nuclear Chemistry. Fowler was honored for her pioneering contributions to positron emission tomography [PET], including the development of fluorine-18-fluorodeoxyglucose [FDG], a radiotracer used worldwide for measuring brain function and for diagnosing cancer; and for the development of tracers for monoamine oxidase [MAO] found to be reduced in the brains of smokers.



Raymond Davis Jr., a chemist, was named recipient of the National Medal of Science, the nation's highest award for lifetime achievement in fields of scientific research. Davis was the first scientist to detect solar neutrinos, the signature of nuclear fusion reactions occurring in the core of the sun.



Raymond Davis

Senior Management

Members of Senior Management continue to participate in international and national laboratory advisory committees, DOE advisory committees, and are involved in organizing major international and national conferences.

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1.3 DEPARTMENT OF ENERGY RESEARCH PROGRAMS

1.3.1 High Energy Physics and Nuclear Physics (HEP&NP)

The fields of High Energy and Nuclear Physics are leading areas in the basic research mission of Brookhaven National Laboratory. BNL is the home of DOE's largest and newest nuclear physics research facility, the Relativistic Heavy Ion Collider (RHIC) as well as the world's highest intensity multi-GeV proton accelerator, the Alternating Gradient Synchrotron (AGS). These two large accelerator facilities enable physicists from universities and laboratories around the world to perform cutting edge research at BNL.

In addition to hosting the large accelerator facilities, BNL is also the home of several research groups in high energy and nuclear physics. These research groups both contribute directly to the advance of these two fields of basic research but they also enhance the contributions of the non-BNL researchers by facilitating effective access to the BNL accelerator facilities, usually by collaborating with the outside groups. BNL is also engaged in research on future accelerators and operates the Accelerator Test Facility (ATF) as an exploratory venue for university and outside laboratory scientists interested in advanced accelerator R&D.

Finally, BNL conducts research, development, design and limited production of advanced instrumentation used in all fields of science in the BNL Instrumentation Division and in the BNL Superconducting Magnet Division. Both of these divisions contribute uniquely to advances in their respective areas of science and technology.

1.3.1.1 Quality of Research

BNL research groups in theoretical and experimental high energy and nuclear physics are ranked among the leading groups in the world in the sub-fields in which they perform research work. Annual evaluations by the Office of Science, through the Nuclear and High Energy Physics Divisions frequently award ratings of *Outstanding* to their work. For the period July 1, 2001 – June 30, 2002, achievement highlights of these groups include:

Nuclear Physics

The record of scientific publications and presentations of RHIC research results at national and international conferences and workshops strongly increased its tempo in the current period of evaluation. The four RHIC experimental groups published a total of 25 peer reviewed papers in the period, with another 10 papers submitted. The two larger collaborations, PHENIX and STAR, have published 9 and 8 refereed papers, respectively, most of them in Physical Review Letters, the most prestigious journal in nuclear physics. The BNL Neutrino group under Richard Hahn, collaborated in the very important solar neutrino results from the SNO Collaboration, a path-breaking experiment in neutrino physics that has resolved a three-decade puzzle in measurement of solar neutrino fluxes. The BNL Medium Energy Physics group reported interesting new

results in hypernuclear states that have garnered press attention as well as publication in the peer-reviewed journal, Physical Review D. The complete list of publications is available from the Physics, Chemistry and Collider-Accelerator Departments as needed.

A BNL physicist, Dr. Tim Hallman was elected as the new Spokesperson for the STAR Collaboration in the past year, confirming the leadership strength of the BNL group in STAR. Dr. Les Bland joined the BNL STAR group last summer, bringing new expertise and leadership to the spin physics efforts of STAR at BNL. The nuclear theory group continued building its strength in this period, with the appointment of several new post docs and by continuing the productive collaboration with RBRC (RIKEN-BNL Research Center) theorists on nuclear physics topics. Many contributions at various levels were made by BNL nuclear physicists to the formulation of the latest long range plan for nuclear physics that was released in spring 2002. In the accelerator science area, Steve Peggs was elected to fellowship in the American Physical Society and many C-AD and Superconducting Magnet Division contributions were made to the advance of the field.

High Energy Physics

The AGS-based rare kaon experimental group published the observation of a second event of the very rare but highly important $K^+ \rightarrow \pi^+ \nu \bar{\nu}$ decay, a process of direct importance to the determination of the CP-violation parameters in the Standard Model (SM). New results from the Muon (g-2) measurement was presented to the International HEP Conference to be held in Amsterdam during July 2002. The new (g-2) measurement result will have a major impact on particle physics and on the experimental basis for the SM. BNL physicists continued to contribute to advances in the understanding of particle physics processes in the Standard Model, giving experimental and theoretical talks on expectations for future discoveries that could emerge from the upgraded Tevatron program now underway at Fermilab and, later, from the LHC collider at CERN in 2007 and beyond. Central to these contributions are the topics of search for the elusive higgs boson and evidence of physics beyond the SM. In the pursuit of these subjects, many BNL physicists participated in the assessment work leading up to the Long Range Plan for High Energy Physics, completed in Winter 2002.

Several now and former BNL physicists were awarded prestigious prizes during the last year. Dr. Ray Davis, retired from BNL, received the DOE's 2002 National Medal of Science for his solar neutrino measurements over three decades. Dr. William Marciano, BNL theorist, shared APS's 2002 J.J. Sakurai Prize in theoretical physics with his thesis advisor, William Sirlin of NYU, and Dr. Nick Samios, former BNL director, received the 2002 Bruno Pontecorvo Prize awarded by the Joint Institute for Nuclear Research, Dubna in Russia. Dr. Sara Dawson, BNL theorist, was elected incoming chair of the APS Division of Particles and Fields. Dr. Amarjit Soni was named a fellow of the American Physical Society.

1.3.1.2 Relevance to DOE Missions and National Needs

The HENP research and facilities-operation programs at BNL are commissioned, reviewed and funded annually by DOE program officers and are thereby assured of

conforming closely to the DOE missions in these areas. The relationship to national needs is defined and managed by DOE in the HENP program area through written and oral communications with BNL management as well as by the DOE program review process.

1.3.1.3 Success in Constructing and Operating Research Facilities

Nuclear Physics

BNL's largest user facility is the Relativistic Heavy Ion Collider (RHIC) accelerator used by the worldwide nuclear physics community. During the 2001-2002 reporting period, RHIC first reached its beam-energy design value for heavy ion collisions in June 2001 with all four RHIC experiments taking data in 100 GeV/amu Au-Au collisions. In addition, the PHENIX experiment also attained the Au-Au heavy ion average design luminosity of $2 \times 10^{26} \text{ sec}^{-1} \text{ cm}^{-2}$ in the latter part of the heavy ion run, while the other three RHIC experiments operated at about half this value. Peak Au-Au luminosity exceeded the design average value by about a factor of 2.5, showing that the goal of reaching the average design value on a routine basis can be achieved as the remaining accelerator technical limitations are addressed, one-by-one. During the month of December 2001, polarized proton beams in RHIC were first commissioned with circulating protons at 100 GeV/c, reaching peak polarizations of about 40% and average polarizations of 30%. Due to accelerator system reliability problems, typical of a new facility of this complexity, the availability of the collider was lower than expected for data runs in later years, but the integrated luminosity of the Au-Au run was sufficient for producing a dramatic flow of important new research results at this stage of the physics program. The four RHIC experiments STAR, PHENIX, PHOBOS and BRAHMS, plus the pp2pp elastic-scattering experiment, recorded initial polarized proton data. The speed at which RHIC came into full research-program use was remarkable for a facility of this degree of complexity.

BNL's venerable AGS machine also performed very well for medium energy nuclear physics users in this assessment period. In the fall, three nuclear physics experiments, E930 [Tamura] "High-Resolution γ spectroscopy of Hypernuclei using Large-Acceptance Germanium Detector", E931 [Hungerford], "A Study of the $\Delta I = 1/2$ Rule in the Weak Decay of S-Shell Hypernuclei" and E913 [Nefkens, et al] "Measurement of $\pi^- p \rightarrow$ Neutrals at 200-400 MeV/c" all took data at the AGS and all reported successful data taking outcomes for their experiments.

BNL's Superconducting Magnet Division has continued to design and build innovative superconducting accelerator magnets for the RHIC facility. During the past year, the superconducting spin snake and rotator magnets were completed and installed in the RHIC ring. In the FY 2003 data run, the entire complement of spin magnets will be operational as required for the production and manipulation of polarized proton beams at energies up to the full design energy of 250 GeV.

High Energy Physics

The Alternating Gradient Synchrotron (AGS) was operated for 13 weeks for high energy physics during this evaluation period. In the fall 2002 slow-spill run of the AGS for nuclear physics, high energy physics experiment, E949 [Bryman, Kettell, Sugimoto] “ $K^+ \rightarrow \pi^+ \nu \bar{\nu}$, Rare Kaon Decay”, commissioned their newly upgraded detector from the preceding version of the same experiment, E787, using parasitic beam during the nuclear physics run. E949 then recorded data successfully for 12 weeks in spring 2002. The successful upgrade of the detector enabled the rate of acquiring stopped-kaon triggers to proceed at nearly twice the best rate achieved in earlier years. Although short on running weeks, the 2002 run represented an efficient and very successful start for E949.

BNL also operates the Accelerator Test Facility (ATF), a coupled 71 MeV linear electron accelerator and 5 GW-150 ps, high-power CO₂ laser combination that provides the university community, as well as a BNL research group, with a core user facility for conducting frontier experiments in charged particle acceleration. Last year, 12 groups performed experiments on the machine. ATF also contributed to the education of accelerator science PhD students and publishing research papers on advanced accelerator topics. This facility is now being emulated by similar installations at SLAC and Fermilab.

In the area of facilities construction projects, BNL is a key partner in the joint DOE-NSF sponsored, U.S. participation in the Large Hadron Collider (LHC) construction project. This project, based at the CERN Laboratory in Geneva, Switzerland, is creating the world's highest energy proton-proton collider for the exploration of energy frontier particle physics, together with four large experimental detectors (ATLAS, CMS, ALICE and LHC-B). The LHC will be ready to begin high energy physics operations in 2007. BNL is the host Laboratory for U.S. participation in the ATLAS experiment and manages the U.S. participation in the detector and computing construction projects. The U.S. ATLAS Detector Project has continued performing successfully in the evaluation period, although the international ATLAS partnership is facing some serious budget problems in achieving the “working detector” envisioned by the ATLAS Collaboration. The BNL-managed project is seeking to help mitigate some of the budget problems in international ATLAS without compromising the successful outcome of the BNL-managed U.S. ATLAS Project. BNL will also be the host laboratory for U.S. participation in the ATLAS research program to follow.

BNL is also the home of 40% of the U.S. LHC Accelerator Project. This project is managed by Fermilab as the lead Lab for the U.S. project. The BNL portion of the project work continued in the evaluation period with good performance in cost, schedule and technical progress. Superconducting magnets are being completed at BNL and shipped to CERN and superconducting cable is being tested at BNL, albeit at a slow rate as a result of delayed cable shipments from CERN. This project is slightly behind the U.S. planned schedule but is far ahead of the CERN LHC schedule. BNL performance has been satisfactory as evaluated by DOE project reviews.

1.3.1.4 Effectiveness and Efficiency of Research Program Management

BNL has management responsibility for user facility operations, research programs and construction projects in the national high energy and nuclear physics programs. In addition, the responsibility extends to the safety and environmental aspects of these operations as well as for employee well-being and career advancement. All of these areas operated within successful parameters during the last evaluation period, in spite of continuing budget stress imposed by the flat funding profiles in these research areas. The flat funding contends with real rates of inflation for BNL HENP operations of about 3.5% per year. Maintaining a positive attitude among the staff and providing successful research operations outcomes has taxed the best talents of the BNL managers of the HENP program. The success of the nuclear and the high energy physics programs at BNL stands as a positive testament to the success of this management effort. The safety and environmental records of the HENP departments and divisions were excellent in the period of evaluation as a result of high-level and continuous attention to these crucial areas of management performance.

Nuclear Physics

The nuclear physics program at BNL evolved during the past year with many successes and with no serious shortcomings or failures in the management areas. Routine management challenges imposed by unanticipated problems such as the failure of the main AGS power supply generator and the failure of the AGS to produce the anticipated level of proton beam polarization during the first RHIC spin run were promptly addressed with effective management actions and the impact to the research program was minimized. Staff quality was maintained during the imposed staff reductions that were forced by continuing budget shortfalls in DOE programs. The expectation of future improvement in the RHIC operations budgets, fortified by the FY 2003 President's Budget in this area, provided strong positive incentives to staff morale and continued research productivity. Future funding prospects in the medium energy nuclear physics area did not share this optimism and management vigorously sought to begin re-programming the talents of permanent scientific staff in this area. The outcome of this process is ongoing.

In the area of construction and equipment project management, two, multi-year nuclear physics Additional Experimental Equipment (AEE) projects completed by BNL during the RHIC building era were successfully closed out with DOE during this evaluation period. Likewise, the Accelerator Improvement Projects (AIP) and the smaller scale equipment projects, such as RHIC accelerator upgrades and RHIC detector upgrades have been well managed and are all in good status relative to cost, schedule and technical performance.

High Energy Physics

The surprising news that AGS would be "terminated" in FY 2003 delivered in the President's Budget for FY 2003 presented a very serious management challenge for the second half of the evaluation period. This decision by DOE interrupts, perhaps ends, the high energy physics program in progress at the AGS. The AGS program consists of a

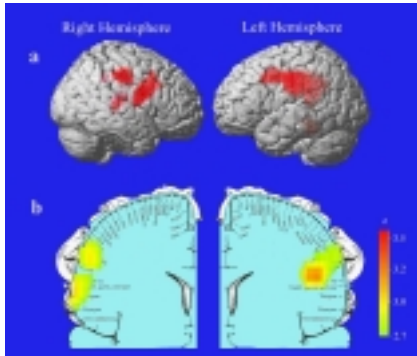
very compelling experiment in rare kaon decays plus the precision muon ($g-2$) measurement. Both experiments had earlier been approved for the AGS by DOE but this approval appears to be rescinded by the new budget decision. This problem comes on top of the very serious flat funding challenge for several years imposed on the HEP research program at BNL, a management challenge that the Laboratory has met with a determination to preserve, as best as possible, the most important research efforts of the program. This has been achieved in terms of BNL's commitment to the D0 experiment at Fermilab, where Jon Kotcher has accepted the role of project manager of the Run 2b upgrade of D0 and other BNL staff physicists have made important contributions across the board to the D0 Run 2 performance. Likewise, the HEP theory group has been maintained at an effective staffing level and has maintained its very high reputation in the national arena. By the time the impact reached the ATLAS physics group, severe gaps in staffing had to be tolerated and the remaining research groups involved with the rare kaon and muon ($g-2$) groups have suffered serious staffing setbacks. BNL's participation in the MINOS neutrino experiment at Fermilab has suffered the most severe staffing problem and has made only a fraction of the contributions intended for the experiment. We believe that BNL has responded as effectively to this management challenge as could be asked and has kept the remaining program going with effective contributions, negligible loss of the best scientific staff and with hopeful attitudes for the future of HEP at BNL.

In the area of management of DOE and NASA construction projects active during the evaluation period [U.S. ATLAS Detector and Computing Projects, LHC Accelerator Project, Spallation Neutron Source (SNS) and Booster Application Facility (BAF)], BNL has performed well and all these projects experience a good status position relative to cost, schedule and technical performance. Funding for these projects has been provided on-schedule by the funding agencies and progress has been as planned. Some delays have been announced by CERN for the LHC Project but the U.S. intends to stay approximately on the original schedule for nearly all its contributions, a management decision that will keep the U.S. part of LHC in good project status for cost and technical performance, even if the schedule doesn't really demand maintenance of the original intent.

1.3.2 Biological and Environmental Research

1.3.2.1 Quality of Research

Medical imaging and addiction studies remain a cornerstone of OBER research at BNL. This research mission creates great opportunities for collaborations and jointly funded initiatives with other agencies, principally the NIH. Specific accomplishments in Radiotracer Chemistry and Neuroimaging using Positron Emissions Tomography (PET) include:



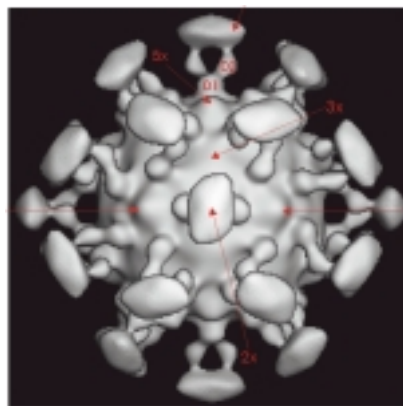
PET images showing the brain regions with metabolic activity (higher in obese subjects).

The lower diagram of the brain identifies hot spots in the areas receiving input from the lips, tongue, and mouth

- BNL's unique expertise and brain imaging capabilities produced new research findings that may help to combat the cause of obesity. Using PET and MRI imaging techniques led to the conclusion that parts of the brain responsible for sensation in the mouth, lips, and tongue are more active in obese people than in normal-weight control subjects. The activation of the brain's dopamine motivation circuits is distinct from the role the brain chemical plays when people actually eat, and may be similar to what addicts experience when craving drugs.
- BNL's brain imaging capabilities (PET, with microdialysis) were used to obtain images of the affects of inhalants in the brain and why solvents (toluene) may be so addictive. This is important work because solvents are the most frequent form of substance abuse in children. These images show that toluene moves into the brain rapidly and initially affects the same brain regions as cocaine and other abused drugs. The study, which was performed in baboons and mice, appears in the April 26 issue of the journal Life Sciences.
- The PET scanner designed for rats and mice (microPET) has completed its first full year of operation as a new scientific tool for preclinical research to measure biochemical transformations and the movement of drugs in the living animal, including the genetically modified animal, over time.
- The use of Bioengineering techniques to advance imaging capabilities has been successful in developing two specialized PET devices to measure radiotracers in blood. One is a beta probe implanted in a blood vessel and the other is a co-incidence detector positioned external to the wrist to measure positron emitter concentration. Both hold the promise of making PET studies simpler and safer. In all these projects the BNL Instrumentation Division played a crucial rule. The program to "Image the

Awake Animal” has advanced due to the combination of unique capabilities that exist at BNL.

- As part of the Macromolecular Crystallography Program, the Laboratory established an Automated Structure Determination Platform for high-throughput in structural genomics and released it to a worldwide crystallography community by studying the bacteria that cause the Black Plague, plant infections, and colds. Researchers have discovered that these three very different microorganisms share a common strategy--- they all prevent the cells they are attacking from calling out for help. All three organisms produce a similar protein to interfere with the infected cells chemical signaling pathways, which are designed to alert the immune system to attack the germs.
- Short-lived positron emitting isotopes have been used to study the effects of environmental stressors on plants. The first images were produced which provided the proof-of – principle of this technique.
- BNL has used its high field Magnetic Resonance Imaging (MRI) capability to identify for the first time that high magnetic fields permit the detection of commonly employed contrast reagents at very low levels. This increased sensitivity may make it possible to detect the passage of contrast agents across the blood-brain-barrier (BBB) in the white matter of the normal human brain. This has tremendous potential for detecting slight perturbations of the BBB in conditions such as HIV infection and severe stress.
- BNL and Psimei Pharmaceuticals Ltd. have worked together under a CRADA to develop Brookhaven-invented boron compounds for use in experimental radiation therapy for cancer, as well as other cancer treatments.
- A method was developed for identifying and qualitatively analyzing genomic DNAs (called Genomic Signature Tags) that provides limited representation of all the DNA molecules in a given population without any prior knowledge of the DNA sequence. This method could potentially be used to detect the presence of biological warfare agents in crude environmental samples. This same method also will be used in the GTL project to characterize the composition and dynamics of natural populations of microbes in normal and contaminated soil samples.
- Scientists showed that a UV-sensitive rice called Norin 1 (progenitor of many commercial important rice strains) has a mutation in the DNA repair enzyme photolyase, probably a structural mutation. From this information, scientists could introduce the correct gene, thereby significantly increasing the productivity of this crop plant.
- The Genome Group tested and formulated improved methodologies for sequencing difficult regions of the human genome by using the Nested Deletion Strategy. This is



CryoEM Structure of CVB3-CAR Complex

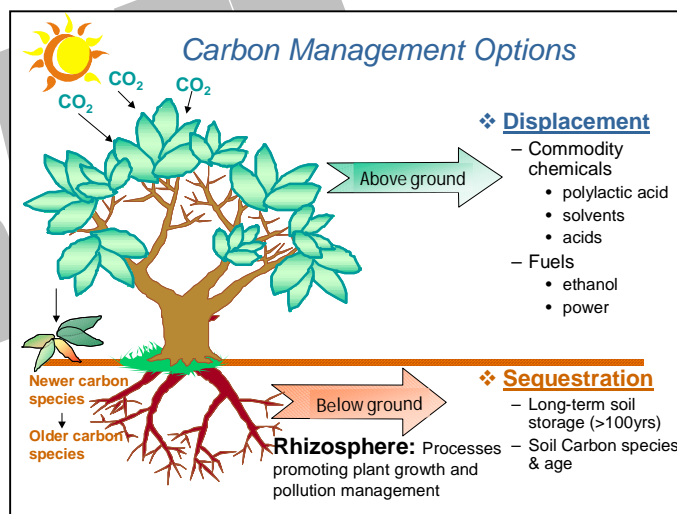
being used to help complete the sequence of the chromosomes being sequenced by the Joint Genome Institute. Nested deletions are being investigated for their possible advantages in sequencing highly repeated DNA, which can cause problems in sequencing human DNA.

- NASA supported collaborators conducted research at BNL this past year (BNL-8) that could help assess the radiation risks faced by astronauts, improve the cancer-killing potential of radiation therapy, and distinguish between DNA damage caused by normal metabolism and that caused by low-level radiation. Scientists at BNL developed a novel ultra-sensitive methodology to quantify varieties of radiation damage that previously could not be measured. Another run at the AGS is planned in the fall of 2002 which will probably be the last before the commissioning of the Booster Applications Facility in 2003.

1.3.1.2 Relevance to DOE Missions and National Needs

A major initiative in FY02 was aligning ourselves to effectively respond to DOE's

Genomes to Life Initiative. Elements of this alignment revolved around the hiring of key individuals, the procurement of essential equipment, and establishing collaborations with other renowned institutions. The new DOE initiative "Genomes To Life" (GTL) provides an exciting focus for the expertise developed over many years in the Biology Department to understand basic principles of biological interactions both at the molecular level and within ecosystems comprised of microbes and higher forms of life.



In response to the initial call for GTL proposals, a group of scientists from BNL and other National Laboratories and academic institutions submitted a joint proposal to develop cutting-edge, high throughput DNA sequencing methods to identify and quantify microbes in the environment, analyze gene expression profiles in microbes and plant roots within soil communities and track changes in gene expression in response to environmental stimuli and following contamination of soils with radionuclides or heavy metals. The development of these ultra sensitive sequencing methods will allow scientists to monitor microbial species that cannot be propagated as pure cultures in the laboratory and identify coordinately regulated genes that may define novel metabolic pathways responsive to environmental stress. The work is relevant to DOE's efforts to develop renewal resources for carbon management.

Associated with the GTL initiative is the formation of a Center for Complex Protein Structures (CSCP), which will focus on solving the structures of membrane proteins. Membrane proteins are critical elements of biological processes and are directly related to DOE missions in the environmental consequences of energy generation and use and human health. Membrane proteins and protein complexes are important targets in bioremediation, cell signaling, and human function; they function in microbes as transporters and in the brain as receptors for neurotransmitters, yet they account for less than one percent of the known protein structures. Funding for a cryogenic electron microscope was provided by DOE/OBER and will be operational in October 2002.

The PET Imaging Center was expanded in FY 01; the MicroPET and a new PET scanner were delivered to BNL. The focus of the upgrade in FY 02 is on a new cyclotron that will be installed in September 2002 and will greatly increase the efficiency and reliability of isotope production required to support clinical and non-clinical PET studies. The facility expansion and equipment acquisition received joint funding from DOE capital funds, NIH, and the President's Office of National Drug Control Policy. This interagency collaborative support further demonstrates the consensus for the importance of this ongoing research at BNL and its fulfillment of the national needs.

BNL has a long tradition of being the leader in radiochemistry. More recently, efforts were directed toward radiotracers that will target biologic processes and are relevant to important DOE initiatives. For example, components of adenoviral proteins are labeled to monitor the bio-distribution of these proteins for tumor imaging and gene therapy. BNL, through the Radioisotope Research and Production Program, continues to be a major provider of research radionuclides to U.S. investigators and clinical centers.

The NASA Space Biology Program had another successful year supporting the initiative to better understand the biological effects of space radiation. This program has required the coordination of over 80 visiting scientists annually since 1995. The results from the ongoing research will have tremendous implications for future plans of space travel and exploration. Due to this important national need, a partnership with NASA to build a Booster Application Facility at BNL is in progress. The new facility (the Booster Application Facility or BAF) will open in 2003. Additionally, visiting scientists as well as BNL staff will continue to use BNL Laboratories and equipment for experiments on biological materials irradiated at the BAF.

In response to the national need to train clinician scientists, the Medical Department, under the direction of John Gatley, has received a training grant from the National Institute on Drug Abuse/NIH. This will fund up to five two-year post-doctoral fellowships over the next four years.

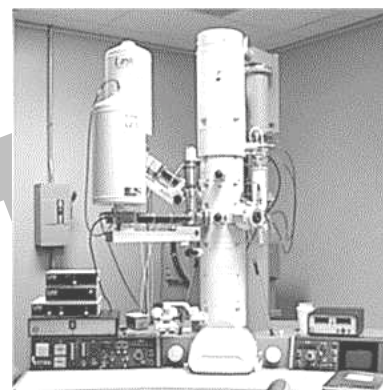
In the wake of the completion of the human genome sequencing project, BNL has joined four New York research institutions in a collaborative effort to turn that knowledge into promising drug targets. The National Institutes of Health awarded the New York Structural Genomics Research Consortium (NYSGRC) \$4.5 million to develop high-speed methods to decipher the three-dimensional structures of proteins. In addition to

BNL, the member institutions of the consortium are Albert Einstein College of Medicine, Mount Sinai School of Medicine, the Rockefeller University and Weill Medical College of Cornell University. This collaboration relies significantly on the capabilities at BNL for sequencing and structural determination.

1.3.2.3 Success in Constructing and Operating Research Facilities

In FY 2002, the BLIP (Brookhaven Linac Isotope Producer) successfully completed its scheduled operating period in support of the production of radioisotopes requested by DOE/NE. A quality program that meets the requirements of the FDA was implemented this past year. Issues associated with legacy equipment in the Target Processing Laboratory (Building 801) were problematic.

A new Cryogenic Electron Microscope (CryoEM) was ordered and plans approved for the construction of a facility to house this equipment. This facility will be closely aligned with the STEM facility, which has a large user interest group, and will allow unique experiments to be done in this area. This equipment will be used for the analysis of two-dimensional arrays of membrane proteins, isolated complex particles and frozen tissue sections. It can also support the imaging needs associated with the GTL Program. The instrument is due for delivery in September 2002 and should be operational shortly thereafter.



Cryogenic Electron Microscope



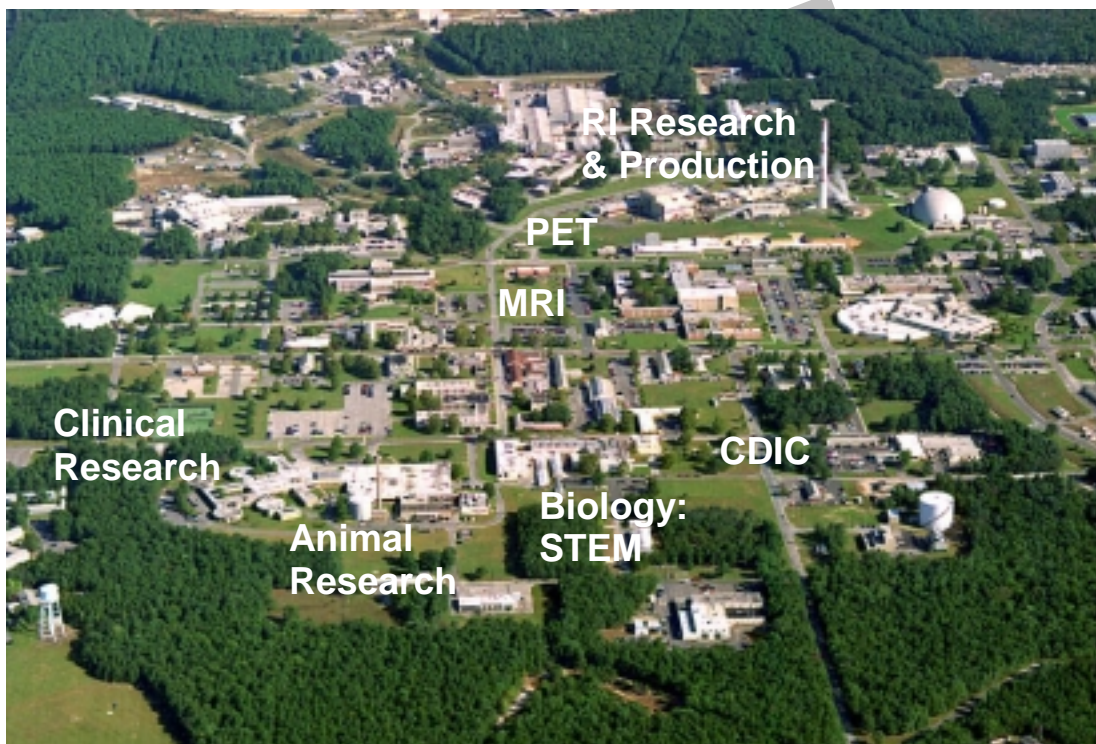
Shown here is part of the hot cell suite in the Medical Department where radioisotopes produced in the BLIP are processed for distribution to medical, industrial, and research users.

The Laboratory continues to upgrade facilities and equipment to advance Laboratory capabilities in biological and environmental research. Examples are noted below. Individually these may not be considered significant initiatives. However, collectively, they represent a substantial upgrade of the capabilities to meet the current and future needs of the DOE and the nation.

- The Macromolecular Crystallography Facility at the NSLS continues to be over-subscribed and fully utilized. “Fedex” operations have been expanded. This is the process wherein outside users mail specimens to BNL for data collection by our staff. Beamline X26C installed a triple beam diffractometer. Recently, visiting scientists utilized this diffractometer to advance their investigation of the protein-solvent interface on insulin.

- The planning for a high-field MRI (9.4 Tesla microMRI) for animal research has progressed rapidly. Detailed plans for the space and construction necessary for the installation of the microMRI have been completed. The equipment has been ordered and is expected to be delivered to BNL mid 2003.
- A high-performance gradient power supply and a high-performance gradient coil for the BNL 4T MRI instrument was installed and completed performance testing. These are the last components we have required for ultra-fast imaging, and will allow execution of the Echo Planar family of MRI pulse sequences, which can provide human images with sub-second time resolution. This will immeasurably enhance relaxographic imaging projects, functional and physiological imaging efforts, and fast spectroscopic imaging studies.

The microPET scanner received and installed in FY01 is being actively used in preclinical studies in combination with other biochemical and behavioral methods and for imaging genetically modified animals.



Facilities Operated or Used for Life Sciences Research

Several beamlines that comprise the Biology Department's crystallography facilities at the National Synchrotron Light Source underwent major upgrades.

- Beamline X12B was reconfigured to upgrade the optics for high-flux, broad spectral band-pass operation with a multi-layer monochromator (for small-angle scattering

and crystallography) and narrow-band-pass operation with a channel-cut crystal monochromator (for multi-wavelength anomalous diffraction crystallography).

- The optics of Beamline X12C were upgraded to provide narrower band-pass, greater reliability, and an increased range of energies.
- A new motor control system was built and installed at Beamline X26C so that the beamlines optical elements could be reliably adjusted and the diffractometer properly aligned.

1.3.2.4 Effectiveness and Efficiency of Research Program Management

A major focus of Life Sciences research program management this past year was to improve our alignment with the DOE and NIH missions, particularly the role that DOE/OBER expects to have in "Bringing Genomes to Life", and the expanding role of NIH in imaging (a new institute was formed) and addiction research. This focus moved us to hire several key scientific staff to establish the capabilities that are consistent with BNL's existing facilities and expertise. Specifically, strategic hires were made to lead the animal MRI facility, the CryoEM facility, and the research associated with complex microbial communities (Genomes to Life). Additionally, 12 research associates were hired to support the Directorate's initiatives.

Regulatory reviews of the Clinical Research Center and the Animal Facility were successfully completed. These facilities and their associated staff continue to support laboratory wide initiatives in pre-clinical and clinical research.

Research was conducted safely and, with several minor exceptions, in a regulatory compliant manner. Where opportunities for improvement exist, measures have been taken to solicit input from external groups to achieve the desired outcome. This is particularly evident in the radiological controls area where the Independent Oversight and Quality Offices have assisted us in evaluating where improvements can be made and in analyzing the effectiveness of actions that have been taken.

Research has been effectively managed to meet the goals of BNL's Environment Management system. Scientists in Life Sciences identified a significant number of pollution prevention projects, several of which were funded by the Laboratory because of their payback.

OBER research and the pace of discovery have provided frequent opportunities to communicate the positive aspects of DOE's science mission at BNL. The type of research (i.e., addiction, medicine, environmental sciences, etc.) is of a large cross section of the regional population. BSA has been aggressive in communicating the research initiatives as well as significant results through press releases, presentations at regional meetings, and research institutions.

1.3.3 Basic Energy Sciences (BES)

Basic Energy Sciences encompasses the science of condensed matter physics, materials sciences, chemical sciences, and nanoscience. The related facilities that are included here are the National Synchrotron Light Source, the Laser Electron Accelerator Facility, the Transmission Electron Microscope Facility, and the Deep Ultraviolet Free Electron Laser.

1.3.3.1 Quality of Research

Condensed Matter Physics, Materials and Engineering Sciences

Electron Microscopy

New advances were made in techniques of electron microscopy, which permit the observation and quantification of magnetic dynamics on the nanoscale. A new method of non-interferometric phase retrieval complimented by interferometric off-axis electron holography was used to reveal important new features of vortex domain structures in arrays of nanoscale cobalt islands.

New Complex Metal Oxides

A new method for growing thin films of metal oxides was developed, which promises to make the manufacturing of conducting and memory devices more efficient and of higher quality. Called epitaxial liquid-assisted growth (eLAG), this technique consists of using a precursor-formed liquid to deposit a crystalline substance on another, such that the deposited substance mimics the orientation of the substrate.

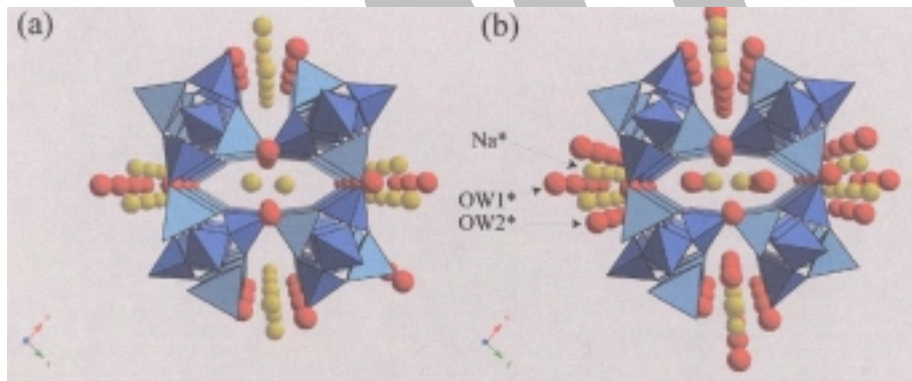
Research in complex functional metal oxides has generated new insight into their properties. For example, transport measurements of the cubic perovskite-related material calcium copper titanium oxide ($\text{CaCu}_3\text{Ti}_4\text{O}_{12}$) show that it has one of the highest known values of the static dielectric constant, $\sim 100,000$, at room temperature. However, it drops by a factor of 1000 below 100 K without any change in the long-range crystallographic structure. Optical measurements provided the first clues both to its high value, and to the mechanism behind this sudden decrease at low temperature [Science 293, 673 (2001)].

Ferroelectric relaxor compounds, the basis for actuators and transducers with superior piezoelectric properties, have been shown to be characterized by nanoscale domains that have a randomly oriented dielectric polarization. Inelastic neutron-scattering measurements demonstrated that the polar nanodomains very strongly dampen transverse optical phonons with wavelengths longer than the characteristic size of the nanodomains [Phys. Rev. Lett. 87, 277601 (2001)].

The high conductivity of the high-temperature superconductor $\text{La}_{2-x}\text{Sr}_x\text{CuO}$ has been shown to be achieved by doping holes into an antiferromagnetic parent compound. Neutron-diffraction studies of a series of single crystals established that in the doping

regime between the antiferromagnetic and superconducting phases, the magnetic moments on copper atoms become ordered within local antiferromagnetic domains with the antiphase domain walls oriented diagonally with the Cu-O planes. On doping into the superconducting phase, the domain walls rotate to become parallel with one of the directions of the Cu-O bonds [Phys. Rev. B 65, 064505 (2002)]. Inelastic x-ray scattering studies of the electronic excitation spectrum of the 2D cuprate $\text{La}_{2-x}\text{S}_x\text{CuO}_4$ showed that the gap excitation consists of two modes, both of which are two-dimensional. In the doped, $x=0.17$, compound, the gap was “filled in” and the lower energy excitation washed out, indicative of the “bad” metallic state (submitted to Physical Review Letters).

Finally, we have investigated superhydration, in advanced zeolites (aluminosilicates), namely the selective absorption of excess water under pressure into a fully hydrated zeolite. Reversible superhydration allows the immobilization of commonly occurring radioisotopes such as ^{90}Sr , ^{137}Cs , and ^{60}Co via a “trap-door mechanism,” i.e., exchanging ions in aqueous solutions at pressures of a few hundred bars will expand the pore of the zeolites due to the excess water entering the zeolite cages. Subsequently, larger cations can enter the nanopores (Journal of American Chemical Society, in press).



The hydrated zeolite is shown in figure (a) while the superhydrated structure is shown in (b).

Soft Matter

Initial research in soft matter has shown x-ray reflectivity of liquid wetting phenomena on nanopatterned substrates. We found that as the temperature difference between the liquid film and its vapor decreased, the film’s thickness increased from ~ 1 to ~ 10 nm. Interestingly, the rate of growth initially was much smaller than expected for van der Waals interactions, but then crossed over to a much faster rate. The crossover thickness was comparable to the depth of the etch pit.

Theory

Correlation profiles of several complex networks were calculated, and shown to be similar; they include the correlation profiles of interacting proteins in yeast, and of the

autonomous system connectivity of the internet. The general technique derived in this work can distinguish between designed (or evolved) and random features in a given network (Science, in press). A fast, stable algorithm was elaborated that solves the long-standing problem of “phase unwrapping” inherent in holography and many other interferometric techniques (Phys. Rev. Lett, submitted).

The Origin of Metallic Corrosion

It has been observed that aluminum and stainless steel corrode in different ways, a discovery that may lead to better corrosion-resistant aluminum alloys. Corrosion of stainless steel usually begins in localized spots on the corrosion-resistant film on the surface of the material. The scientists discovered that aluminum corrosion starts like stainless steel, but when the pits form, they are not as readily covered by the surface film as in stainless steel. Understanding these chemical processes will help the scientists devise ways to counter them and develop better anti-corrosion treatments for aluminum and possibly other metals and alloys (Electrochem and Solidstate Letters, accepted).

Chemical Sciences

Catalysis

The activation of gold on titania was achieved; this nanoscience success is related to the adsorption and reaction of SO_2 on $\text{Au/TiO}_2(110)$. Bulk metallic Au and TiO_2 exhibit a low reactivity for the dissociation of SO_2 than are commercial catalysts for SO_2 oxidation. Interactions with titania electronically perturb gold, making it chemically more active. Gold, in turn, enhances Titania's reactivity by facilitating the migration of O vacancies from the bulk of the oxide to its surface (Journal of American Chemical Society, in press).

Chemical Dynamics

A combination of nonresonant laser photoionization of hydrocarbon radicals and ion imaging in a crossed molecular beam apparatus has led to the first global measurements of differential cross sections for the abstraction of H atoms from hydrocarbons by energetic triplet oxygen atoms.

Measurement of the duration and coherence of time of high harmonic light has been achieved using a scaled interaction. This can lead to the formation of attosecond pulses, which can open a new frontier in optical physics.

Charge Transfer

Molecular engineering of synthetic porphyrins yielded new classes of chromophores and catalysts with tunable, controllable, and predictable physico-chemical properties with potential applications to artificial photosynthesis and biometric catalysis.

Using LEAF's pulse-probe capabilities, the very fast dissociation of aryl halide anions was easily and accurately measured for molecules previously immeasurable, or where published data was in error by factors of 10-100. This has enabled the spectrum of the solvated electron in an ionic liquid to be measured for the first time.

Theoretical work on the thermal-, photo-, and radiation-induced reactions in the Condensed Media program has enabled us to model charge transport through molecular assemblies over tens of nanometers (nm) by using combined classical and semi-classical kinetic models, and all-electron quantum chemical computational techniques.

1.3.3.2 Relevance to DOE Missions and National Needs

BNL has been very responsive to the DOE nanoscience initiative: six NSET proposals have been submitted (with 3 successes), as well as a successful Nanocenter proposal. These efforts were highly collaborative and involved the participation of the Chemistry-, Materials Science-, Physics-, Instrumentation-, and NSLS- organizations as well as collaborators from universities.

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. More than 2500 users from over 400 national and international institutions come to the NSLS annually.

Work at the NSLS, DUV-FEL, and the ATF contribute significantly to DOE's program for short wavelength Free Electron Laser technology development.

A plan has been developed to form a DOE Center for Catalysis Science. BNL has external collaborators from other national laboratories and universities.

The Center for Neutron Science (CNS) is designing neutron hybrid spectrometer for the SNS in Oak Ridge, Tennessee. The CNS is also modifying and installing at the ORNL HFIR reactor, the Japan-U.S. sponsored triple axis spectrometer.

The DOE Office of Basic Energy Sciences conducted peer reviews of three program areas during the fiscal year: Chemical Sciences, Condensed Matter Physics and Materials Chemistry, and Materials and Engineering Physics. There were no comments or concerns regarding alignment with DOE missions and relevance to national needs.

1.3.3.3 Success in Constructing and Operating Research Facilities

The Laser Electron Accelerator Facility (LEAF) significantly enhances Brookhaven's instrumental capability for research in both radiation chemistry and photochemistry. LEAF delivers synchronized picosecond electron and photon pulses, and provides a way to study the fundamentals of ionization in condensed media on fast time scales. Two operational detection systems obtain transient absorption data either rapidly with ~ 1 nanosecond time resolution or, in more time-consuming "pulse-probe" experiments, with 7 picosecond time resolution. Both modes were used this year in measurements of fast molecular dissociation reactions of great interest to organic chemists. Projects on ionic liquids, molecular wires, ion recombination and supercritical fluids are ongoing. An early version of a new ultrafast single shot detection method was demonstrated.

As mentioned in 1.3.3.2, the NSLS continues to be one of the most heavily used of the DOE's synchrotron light sources. The laboratory is committed to enhancing the facility's role as a national resource for materials-, chemical-, and biological-research. To enhance the capability of the NSLS to meet the increasing and changing user demands, major upgrades have been completed or are in progress: two new RF cavities for the X-ray ring, a new digital orbit feedback system for the X-ray ring, and the new NIST-funded X6A beamline. A major initiative has begun to upgrade all the insertion device beamlines on the X-ray ring to meet the demand of new scientific programs. A vigorous effort is underway to explore methods of supporting users by improving access to a full range of synchrotron-based experimental techniques for specific programs in the materials- and chemical-sciences. The first example is a pilot program in catalytic chemistry, to be followed by others, possibly including soft matter, high-pressure studies and high magnetic fields. The NSLS is pursuing two initiatives to develop the next generation synchrotron radiation source. The first initiative involves a staged upgrade beginning with a new state-of-the-art 3-4 GeV electron storage ring coupled with a superconducting linear accelerator. The second initiative, the Laser Seeded Free Electron Laser, seeks to develop a high peak power, short wavelength free-electron laser with excellent temporal and spatial coherence, capable of producing femtosecond pulses.

The BNL Nanocenter, which will be a center for functional nanomaterials, has received approval by the DOE of mission need (CD-0) via a formal announcement by the Secretary of Energy. The Nanocenter will integrate BNL'S unique capabilities in a broad range of synchrotron characterization techniques with new capabilities in nanomaterials synthesis and nanofabrication. Our focus of tailoring the chemical and physical response of functional materials complements those of other planned Centers. The centerpiece of the BNL Nanocenter is a new building located contiguous to the existing NSLS facility. The building will house clean rooms, general laboratories, and wet and dry laboratories, as well as office space for BNL staff, other university and industrial users, and space for seminars and conferences. The Nanocenter will have seven major laboratory clusters: nanopatterning, proximal probes, electron microscopy, materials synthesis, ultrafast optical sources, and theory and computation. The seventh cluster takes advantage of the capabilities of the NSLS; the Nanocenter will have dedicated beamlines at the NSLS, including a new small angle scattering beamline.



Artist's Rendering of the Nanocenter Building.

The Nanocenter is to the right of the NSLS.

In February of 2002, the BNL Deep Ultra-violet Free Electron Laser (DUV-FEL) facility reached an important milestone on the way to its ultimate goal, the production of 100 nm laser light by the process of high gain harmonic generation (HG). The DUV-FEL produced laser light at 400 nm at unexpected levels by the process of self-amplified spontaneous emission (SASE). The performance of the DUV-FEL gives researchers confidence that the goal of 100 nm is indeed attainable.

The BNL Transmission Electron Microscopy Facility has had a very successful year. It continues to implement its mission to develop and apply advanced techniques of quantitative electron microscopy to fundamental problems in materials science. In recognition of outstanding scientific contributions, the DOE program office has doubled its funding and encouraged the acquisition of another TEM. A new omega filter microscope with a monochromator has been ordered. This new TEM is partially funded by New York State. The new instrument will provide <0.2 eV energy resolution that will boost our research on nanoprobe electron energy-loss spectroscopy.

1.3.3.4 Effectiveness and Efficiency of Research Program Management

Brookhaven was very active this year in establishing a major nanoscience program. The theme for this program is "tailoring" the physical and chemical responses of nanoscale functional materials. The scientific goals of our nanoscience research are to establish an understanding of the chemical and physical response of functional nanomaterials and to develop new nanoscale materials probes, particularly involving the NSLS and the emerging high resolution TEM facility. As a result of two successful proposals, scientific work started on two new programs: Catalytic Nanomaterials and Charge Transfer at the Nanoscale. Additionally, a proposal for nanotemplate-directed assembly of soft matter and biomaterial was awarded and will begin later this year. It is intended that this research will be carried out under the auspices of the Nanocenter.

A workshop was held in March at BNL for the Center for Functional Nanomaterials (“Nanocenter”). It was an unqualified success, attracting over 400 attendees, representing 80 or more U.S. institutions from 21 states and three international visitors. In addition to presenting a strong technical program, the goal was to bring together representatives from academia, industry, and government to discuss the role of the Nanocenter in the Northeast region and to solicit advice and comments on instrumentation, operational principles, and science. The initial feedback was very positive and we were impressed with the strong showing of interest in a BNL Nanocenter. The input from the workshop participants is greatly appreciated and will be used during the conceptual design phase of the Center.

The revitalization of materials science programs at BNL has made extensive progress this year. Several actions were taken to integrate more closely the programs in materials physics, metallurgy, and materials chemistry with those in condensed matter physics and several areas of chemistry. Our goal is to strengthen traditional core programs and compete more effectively with interdisciplinary responses to DOE initiatives. A new Materials Science Department (MSD) has been formed within the Basic Energy Science Directorate with David Welch as the interim Chair. In addition, the programs in materials science were linked with those in condensed matter physics by establishing a Materials Center. The Materials Center is headed by Doon Gibbs and is intended to coordinate internal programs in materials science at the NSLS, the new Materials Science Department, the Condensed Matter Physics Section of the Physics Department, and the Chemistry Department. Thus far, this program has arranged for better access by Center members to all of the experimental resources on the site and begun to coordinate seminars and research initiatives. There are now strong collaborations within BNL between Condensed Matter Physics and the MSD, i.e., work on high T_C superconductivity and the new superconductor MgB_2 and various areas of nanoscience, such as nanoscale magnets, correlated electron systems, and transition metal oxides.

The Center for Neutron Science is progressing toward its goal of developing a comprehensive neutron research program to sustain the world-class neutron science capabilities at BNL. While BNL’S current neutron research is conducted at the NIST reactor and ISIS, we are developing a test facility beamline at the AGS to support research and development of spallation neutron instrumentation, and we are also developing state-of-the-art instrumentation for neutron sources in the U.S., primarily for the SNS.

A plan has been developed to establish a Catalysis Institute at BNL. The plan is aligned with the new DOE interest in centers of excellence in catalysis science. BNL has, at present, several initiatives in catalytic science, which are important and converging with the plan for this institute: a major program in nanocatalysis, a program to develop a suite of catalysis beamlines at the NSLS, and a major scientific research program in electrocatalysis. The institute is a major component of BNL’s strategic plan, and space will be allocated for the institute.

1.3.4 Advanced Scientific Computing Research (ASCR)

1.3.4.1 Center for Data Intensive Computing

The Center for Data Intensive Computing (CDIC) was formed to provide a focus for advanced scientific computing at the Laboratory and to contribute to the research mission of BNL's and DOE's programs.

The Center is headed by J. Glimm, Chair of the Department of Applied Mathematics and Statistics at Stony Brook. There is one joint appointment (with Stony Brook) at the Assistant Scientist level and four graduate students in Applied Mathematics, Computer Science, and Physics. In addition there are three Postdoctoral Research Associates, and several summer faculty were supported, along with two summer students.

Examples of recent projects include:

- Magnetohydrodynamics, with application to fluid instabilities in accelerator targets such as the Spallation Neutron Source and the proposed Muon Collider.
- Fluid dynamics of droplet formation in jets, with application to diesel fuel injectors as studied at the Advanced Photon Source.
- Magnetic properties of nanocrystalline wires adsorbed on solid surfaces.
- Electronic and atomic structure of uranium.
- Models of cardiac electrophysiology, in collaboration with Beth Israel Medical Center.
- Parallel algorithms for global aerosol transport in the atmosphere.
- Application of the new special purpose computer designed for elementary particle physics to classical molecular dynamics.
- Visualization and statistical analysis of very large data sets produced by brain imaging and by mass spectroscopic measurements on atmospheric aerosols.

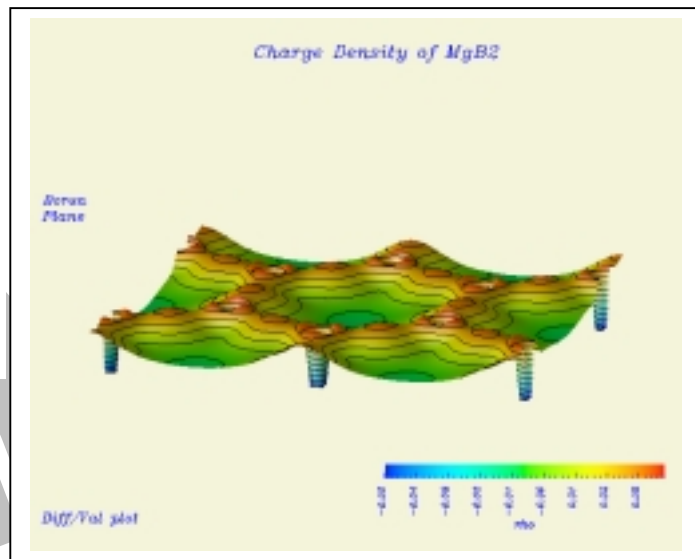
The Center Director leads a multi lab project which is part of The Office of Science's - Scientific Discovery through Advanced Computing Program (SciDAC). The goal of this project, The Terascale Simulation Tools and Technologies Center (TSTT) is, to eliminate the technical and human barriers preventing the effective use of powerful adaptive, composite, and hybrid methods in large scale scientific simulations. Work at Brookhaven is focussed on the diesel jet breakup problem. A separate SciDAC project is concerned with numerical methods and new software for the study of particle beams in accelerators including wake fields. This work is important for the national effort in accelerator simulation as well as to the needs of BNL's Alternating Gradient Synchrotron and a proposed next generation synchrotron light source.

The Center will play an important role in the recently announced Brookhaven NanoCenter serving as lead for the Theory and Modeling Group within the NanoCenter and focussing significant resources on computational nanoscience.

CDIC has acquired a 150 processor Linux cluster which is used to perform parallel calculations using the message passing interface (MPI). The cluster is managed by staff in BNL's Information Technology Division.

A primary goal of CDIC is to participate in the Department of Energy's long range research programs in scientific computing. Funding this year has been obtained from ASCR for the work in magnetohydrodynamics, for TSTT, and for the Accelerator Project in SciDAC. In addition, many projects which have benefited other program areas at the Laboratory have been started and several have been successfully completed. However it is clear that for lasting success in this area a larger funding base needs to be secured including funding from other programs within The Office of Science.

Charge density contours in magnesium diboride superconductor



1.3.5 Energy, Environment, and National Security

1.3.5.1 Energy Resource Mission (EE/FE/NE)

The Laboratory's role in the DOE Energy Resource mission is performed primarily under the auspices of DOE Offices of Energy, Efficiency, Fossil Energy, and Nuclear Energy Science and Technology, with some funding from other offices within DOE, such as the Office of Policy. In addition, the DOE Basic Energy Science Program described previously sponsors much of the underlying basic research supporting the DOE's Energy Resource mission. BNL is actively involved in three areas: reliable and diverse energy supply, clean and affordable power and efficiency and productive energy use. Highlights of accomplishments and focus areas are discussed below.

The Energy Sciences and Technology (ES&T) Department has diverse capabilities and expertise which supports DOE's Energy Resource mission. The ES&T portfolio includes programs and projects that range from fundamental studies of combustion to computer simulations of advanced nuclear reactors to advanced modeling to development and demonstration of energy-related technology. In addition, ES&T has specialized know-how and unique technology platforms that, through collaboration with its sponsors, enable it to deploy and establish energy projects that benefit the economy.

BNL continues to have local, national and international energy R&D partnerships that help to keep the laboratory in a position of US leadership in the energy field. Work in this area supports DOE as well as NRC, EPA, New York State, and private industry. Energy research programs continue to be recognized for outstanding contributions such as the 2002 R&D 100 Award (joint with NREL) for a Smart, High Performance Polyphenylenesulfide Coating System.

Advanced Nuclear Applications – ES&T's research addresses two significant program areas: proliferation-resistant reactor designs and advanced accelerator applications. ES&T staff are members of multi-laboratory teams that analyze waste transmutation studies utilizing accelerators and reactors, and also provide support to the Spallation Neutron Source (SNS). ES&T leads an international team, including industry, developing a new fuel cycle that will use thorium-based fuels in existing light-water reactors with minimal modifications.

Nuclear Safety – ES&T provides support to the NRC, DOE, and international organizations on nuclear safety and regulatory matters. Current international nuclear safety activities support the NRC's efforts to strengthen nuclear regulators in nations of the former Soviet Union and Eastern Europe and provide support to the International Atomic Energy Agency (IAEA). Analytic support is provided to the NRC and others in areas such as reactivity transients, life extension, and reactor pressure vessel safety. DOE's Integrated Safety Management (ISM) activities are supported in the areas of ISM safety guides and standards, and assisting DOE in audits and evaluations. ES&T also provides in-depth support to the NRC to help ensure that operating U.S. nuclear power plants provide electricity safely and reliably. Current programs are focused on aging of structures and components and environmental qualification of power cables. This work

includes both engineering and analytical support, and results support development of NRC regulatory guidelines. New programs have also been started in risk assessment for Nuclear Materials Safeguards and Security (NMSS) and in electric grid infrastructure modeling.

Economic/Environment/Economic Assessment- This program is centered on the MARKAL-MACRO computer code developed at BNL over the last two decades. The model is used in more than 60 countries to inform energy planning, including implementation of new energy technology, environmental and economic impacts, and issues related to climate change. MARKAL has been selected by the Energy Information Administration to be the main tool for the preparation of the next World Energy Outlook. MARKAL is also used by the DOE's EERE and the EPA. ES&T is currently working on projects that provide crucial information required to resolve issues in the national debate on climate change.

Liquid Fuels Research- ES&T's program on liquid fuels concentrates on developing alternative fuels that significantly reduce harmful emissions when burned. Projects under this program include testing blends of biofuels and oil, and ultra-deep removal of sulphur from fuel oil. ES&T led a team of government and industry participants that developed an initial "roadmap" for research, development and commercialization of new products, including alternative fuels.



Advanced Burner Testing

Materials for Energy Applications – ES&T is developing and testing materials for use by the geothermal industry that help combat the problems of corrosion and erosion. These include testing geothermal well cements and developing coatings to extend the life of carbon steel heat exchanger tubes. Special grouts developed in the department have been recognized by the industry as a key technology in the successful deployment of geothermal heat pumps in the Northeast. A method for non-destructive testing of erosion and corrosion in geothermal piping is also under development. The department is continuing to increase its support for its sponsors. We completed several tests of Building Combined Heat and Power (BCHP) equipment for EE, we have initiated the Significance Determination of Risk Process (SDRP) notebooks for NRC, and we have taken on management of Ukraine assistance activities.

1.3.5.2 Environmental Research

Significant achievements were also attained during this past year in BNL's Environmental Sciences Department for DOE's Atmospheric Chemistry, Atmospheric

Radiation Measurements (ARM), Free Air CO₂ Enrichment (FACE), Terrestrial Carbon Cycle, Water Cycle, Environmental Science, Environmental Remediation and Environmental Management programs.

Vasilis Fthenakis (Environmental Research & Technology Division) was honored as a Fellow of the American Institute of Chemical Engineers. Terry Sullivan was presented a Certificate of Appreciation by Jim Wright, Manager of SCFA, DOE in recognition of outstanding contributions to the Subsurface Contaminants Focus Area, DOE. Dr. A. J. Francis was awarded tenure at BNL for his pioneering contributions on the fundamental mechanism of the biotransformation of actinides and toxic metals by microbes. His findings of the speciation and localization of uranium ion is a particularly valuable original contribution to this field of understanding bioremediation mechanisms.

US Patent No. 6,399,849 was awarded to BNL for the Treatment of Mercury Containing Waste, twenty peer-reviewed publications were entered into the literature, and the staff was represented on seven major technical committees.

Continued operation of the North Carolina FACE Facility and the ARM External Data Center.



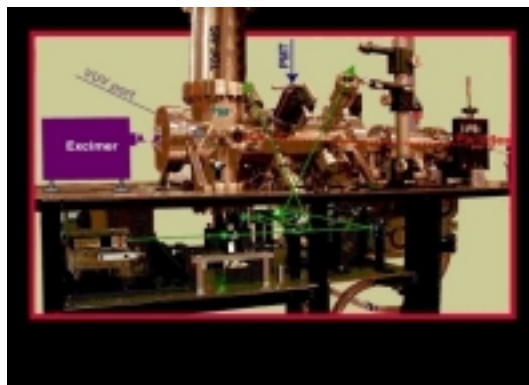
FACE Facility

TexAQS 2000, held in Houston, published scientific results showing a large industrial component of the ozone generation rate.

BNL Scientists used satellite measurements and chemical transport modeling to show the influence of anthropogenic aerosol on cloud optical depth. Their results were consistent with the Twomey mechanism of indirect radiative forcing of climate by aerosols.

BNL Scientists continued developing and reporting new algorithms for the retrieval of aerosol properties from moments of the particle size distribution.

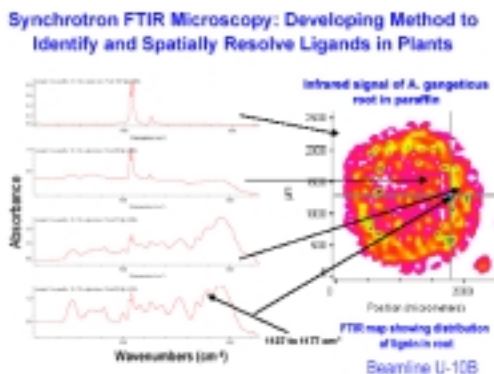
The first results and initial description of a particle-into-liquid collector for rapid measurement of aerosol bulk chemical composition were published. Ambient particles are mixed with saturated water vapor to produce droplets that are collected and analyzed by traditional ion chromatography techniques.



Single Particle Laser Mass Spectrometer

Environmental Scientists demonstrated that perfluorocarbon tracers are a cost-effective method to verify and monitor long-term performance of walls, floors, caps and cover systems.

A collaborative effort between the Environmental Sciences Department and the NSLS at Brookhaven along with the Earth Sciences Department at SUNY Stony Brook proposed to create a new Environmental Molecular Sciences Institute. This NSF/DOE institute would provide end station upgrades to environmental beam lines and the development of new environmental applications.



Perfluorocarbon tracers, typically used in atmospheric studies, were successfully used to characterize the subsurface fan ducts at the Brookhaven Graphite Research Reactor. The novel project, an Accelerated Site Technology Deployment, provided a preliminary characterization that was then used to direct more traditional sampling and characterization.

1.3.5.3 National Security (NNSA/EM)

Brookhaven National Laboratory's Nonproliferation and National Security (NNS) Department has the capabilities to assist the nation in the areas of nonproliferation and security (both national and global). As a National Laboratory, Brookhaven has advanced capabilities and expertise that put it in a unique position to contribute to counterterrorism efforts in the U.S. and abroad.

NNS's national security initiatives have expanded as a result of the heightened awareness of the possibility of terrorist activities continuing in our country. We would like to elaborate on the initiatives we have put in place to address this very important issue.

In response to multiple requests from the Secretary of Energy, Office of Science, NNSA and others, BNL has established a Nonproliferation and Counterterrorism Division under the Department of Nonproliferation and National Security. The Division will serve as a

focal point for the BNL efforts in counterterrorism including advanced technologies for the detection of nuclear, biological and chemical agents, safeguarding and interdicting weapons of mass destruction and related materials, improved protection against attacks, consequence management, and medical counter measures.

On a local level, BNL organized and co-hosted a NNSA/DOE counterterrorism workshop, "New York Metropolitan Region: Counterterrorism and Infrastructure Assurance Technology Needs," in April. The workshop included 160 representatives from DOT, DOE, DOJ, FAA, NYC office of emergency management, other NYS organizations and industry. Recently, BNL provided a briefing in Albany on the security of radioactive materials at non-reactor sites in New York; this is leading to additional cooperative efforts between NY State organizations and BNL.



New York Region: Counterterrorism and Infrastructure Assurance Technology Needs Workshop

BNL developed an Emergency Response Planning Guideline (ERPG) for mercury vapor. This is the 100th ERPG developed with BNL participation. A BNL staff member was elected to Chairmanship of ERPG.

BNL continues to manage the U.S. Support Program of Technical Assistance to IAEA Safeguards. Under this program, BNL supports the decision making process for the interagency Subgroup on Safeguards Technical Support. In October 2001, BNL hosted the "Workshop on Design and Testing for High Reliability," which provided a forum for industry experts to discuss issues impacting the reliability of safeguards instrumentation.

BNL has developed absorption characteristics for Tera Hertz radiation in selected plastic materials as part of underground infrastructure imaging system project.

BNL developed a high precision, local survey system providing two-dimensional positioning to an accuracy of 1 cm.

BNL continued to support the joint DOD/DOE Integrated Technology Implementation Plan that develops and evaluates methods for monitoring international arms control and non-proliferation agreements. This multi-lab effort involves participation in a number of studies and working groups, such as the Radiation Technology Working Group and the Authentication Working Group. BNL hosted a workshop, with participants from five other DOE laboratories and from the Defense Threat Reduction Agency, to discuss the

applications of template methods for confirming the identity of controlled items, such as nuclear warheads or special nuclear material components.

Also under the same program, BNL defined, contracted, and monitored a program with the Russian Research Institute of Automatics (VNIIA) to build and improve the BNL-developed CIVET information-barrier technology. The problem is to build a simple, computerized measurement system that can be fully authenticated by both parties so that it can be relied upon by both sides to make classified measurements without revealing sensitive information while providing high-confidence in unclassified outputs. A program review was held at BNL to exchange ideas between BNL and VNIIA technical experts.

BNL continues to play a major role in the Nuclear Materials Conversion and Consolidation (MCC) project, which is an important component of the MPC&A program. Current MCC activities are underway at the Luch and Dmitrovgrad facilities in Russia. A critical goal of the MCC project is to reduce the number of sites and buildings that contain weapons-usable nuclear material, as well as to reduce the attractiveness of existing highly enriched uranium by downblending it to low enriched uranium.



Nuclear Materials Protection and Control Programs

Under the MPC&A program, technologies and assistance provided to Russian institutes included the development and implementation of comprehensive physical inventory-taking statistical sampling plans, measurement requirements, measurement procedures, and measurement control techniques. The transfer of these technologies has provided unprecedented access to several Russian nuclear sites. Our activities involve direct interaction and collaboration with Russian technical specialists.

A BNL staff member continues to lead the MPC&A Operational Monitoring Project. Under this activity, a system was designed, constructed and installed at the Moscow State Engineering Physics Institute to monitor MPC&A system upgrades at this institute to ensure that they continue to detect, delay, and respond to attempts to divert nuclear materials.

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 and monitoring the improved and more comprehensive safeguards for nuclear materials.

BNL is assisting the DOE Office of International Safeguards and the Department of State in evaluating and suggesting improvements in IAEA safeguards for light-water reactors, both as currently applied and under the new Integrated Safeguards regime. BNL is also evaluating and proposing improvements in IAEA safeguards for gas centrifuge enrichment plants located in non-nuclear weapons states.

1.3.5.4 Success in Constructing and Operating Research Facilities

In terms of constructing and operating research facilities, EENS has not constructed any new research facilities during the past several years, but plans have been developed for a new Energy Sciences Building and DOE approval (CD-O) has been obtained for the new building. Finding authorization continues to be a major concern and discussions are ongoing with DOE to develop a viable funding strategy which will allow this critical construction project to move forward.

EENS operates laboratories, offices, and other facilities that are located in 12 buildings. During FY02, EENS has continued its space consolidation initiative and has nearly completed its efforts to vacate buildings that were underutilized and no longer compatible with current research programs. In FY02, EENS vacated Buildings 938, 939, and 490D, and will soon be vacating building 801. In addition, due to the reorganization of the Material Science Department, EENS is no longer occupants of buildings 555 and 480. Over the past two years, EENS has consolidated its staff and equipment from 21 buildings to 12, which has resulted in a very significant reduction in Directorate space charges. Further consolidation is not anticipated. In terms of facility upgrades, EENS has an ongoing program to renovate laboratories in building 815. It is expected that lab renovations to laboratory C-4 will begin next year to provide a state-of-the-art Laboratory for BNL's expanding research program in methane hydrates. Further lab renovations in building 815 will be proposed for subsequent years, as this facility will become the focal point for BNL's environmental research programs.

EENS manages its safety and environmental aspects of its activities through the Research Operations group. Research Operations provides support to the EENS science departments in Facilities management, Environmental Management Systems, Integrated Safety Management Programs, and property management. EENS Environmental and Safety Management consistently meet or exceed BNL's goals for waste generation, pollution prevention, Tier 1 inspections, and work planning and controls. EENS' performance in the areas of worker training and safety have also been exemplary.

1.3.5.5 Effectiveness and Efficiency of Research Program Management

EENS has made significant improvement in the area of research program management. The Directorate has dedicated a great deal of effort to the establishment of a comprehensive strategic plan, which will guide the future research initiatives of EENS. EENS management (ALD and Chairs), as well as Departmental Strategic Planning Committees, jointly contributed to the development of strategic planning and to the identification of future research initiatives.

Strategic research initiatives were developed after a careful examination of Directorate capabilities and research strengths, coupled with a thorough analysis of the future

research needs and priorities of DOE and other potential sponsors. These were several research initiatives that were identified through this process which have been recognized as high-priority BNL initiatives and EENS opportunities for significant future growth.

- Counterterrorism and Homeland Security
- Advanced Sensors
- Advanced Fuels
- Nuclear Energy Revival
- Climate Change
- Carbon Cycle
- EnviroSuite
- Renewable Energy

For each of the identified research initiatives, a written plan was developed to outline specific objectives, marketing strategies, and political considerations, and to identify EENS Managers who are responsible for implementing the plan. EENS' strategic initiatives were endorsed by Laboratory Management, and the initiatives have been communicated to the entire EENS staff.

EENS has been proactive in fostering progress in its new strategic initiatives. EENS and BNL have committed resources for lab renovations needed to support the Advanced Fuels initiative, a strategic hire will be supported for the Advanced Sensors initiative, capital equipment investments have been made for Advanced Fuels, Nuclear Energy, and EnviroSuite initiatives, and significant investments have been made to support the Counterterrorism/Homeland Security initiative.

Perhaps the most impressive measure of progress in developing new research programs which are aligned to the EENS initiatives, was the quantity and quality of LDRD proposals generated by EENS staff. EENS staff developed 70 LDRD proposals, 62 of which were relevant to the Directorate's strategic initiatives. After an extremely competitive evaluation process, BNL has committed to funding for 15 of EENS' proposals. This represents a significant increase in LDRD funds for the Directorate as compared to previous years, and will provide much-needed seed funding for exciting new research programs.

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. Since 1998, the BNL Budget Office has had responsibility for work for other federal agencies while the Office of Intellectual Property and Industrial Partnerships ("OIP") has had responsibility for work for non-federal sponsors. In July 2002 the Laboratory undertook a consolidation of the work for others program under which OIP will have responsibility for the complete program. Implementation of this change is underway and should be effective at the start of FY03.

The work for others program permits the Laboratory to conduct research that is of scientific interest, that complements its DOE mission work, and that contributes to sustaining its core research capabilities. As part of the consolidated work for others program, OIP staff will serve as relationship managers to build productive and informed relationships with program managers at other federal agencies where the Laboratory's research capabilities complement the agencies' technology interests and needs. The relationship managers will play three distinct roles--identify funding opportunities from other federal agencies, work with the BNL research team in the preparation of a high quality, responsive proposal, and champion the proposal with the program manager after submission.

1.4.1 WFO - Other Federal Agencies

1.4.1.1 National Institutes of Health (NIH)

Several of our biomedical programs and facilities operate with joint funding from DOE and NIH. These programs/facilities include our Imaging and Neuroscience Center which encompasses the PET and MR programs in the Medical and Chemistry Departments, the Scanning Transmission Electron Microscope in the Biology Department, and the Structural Biology beamlines at the NSLS.

More than 800 biologists from Brookhaven, other national laboratories, universities, and pharmaceutical companies use nine of the NSLS experimental stations to study biological structures by crystallography. Four of these are involved directly in a cooperative effort, funded roughly equally by DOE OBER and the National Center for Research Resources (NCRR) of NIH. The total annual budget of approximately \$4M supports the activities of 20 workers who provide support to users, maintain the facilities, engage in R&D programs to improve them, and carry out fundamental research on experimental methods and structural biological subjects. Several important innovations have been made possible by the NCRR funding: to provide an on-site technical specialist to support users, 20 hours per day, seven days per week; to provide personnel and facilities for a mail-in data collection service ("FedEx Data"); and to provide web-based observation of the experiment and the possibility for remote control. NIH also provides substantial support for biomedical research through grants to individual investigators. Such grants support work at the Imaging and Neuroscience Center, investigations on DNA damage

and repair, protein structure and folding, viral proteases and receptors, and the Lyme disease bacterium.

1.4.1.2 National Aeronautics and Space Administration (NASA)

The construction and operation of the Booster Applications Facility (BAF) in the Collider Accelerator Department represents DOE's ongoing partnership with NASA to provide extraordinary facilities and capabilities for research on issues related to the NASA mission. The BAF will be a new experimental facility and accelerator that takes advantage of heavy-ion beams from the Alternating Gradient Synchrotron Booster for studies on radiation effects related to the space program. BAF will provide protons and heavy ions (Fe, Si, C, Ni, Ar, Au, etc) for space radiobiology studies and radiation effects on microelectronics. The BAF construction is on time and the facility is slated to be fully operational in 2003. The facility will have laboratories to meet the specific needs of NASA's Space Radiation Health Program (SRHP) and National Space Biomedical Research Institute (NSBRI) research programs. BAF will include laboratories for *in vitro* and *in vivo* experiments, as well as for physics experiments.

1.4.1.3 Environmental Protection Agency (EPA)

Brookhaven's capabilities have been applied to international work supporting DOE and other federal agencies in transferring technology to friendly nations. The near-term focus of these programs is the States of the Former Soviet Union, specifically in the areas of reactor safety and decommissioning the nuclear navy. BNL participates in several environmental cleanup projects in Kazakstan funded by EPA's Office of International Affairs and DOD.

1.4.2 WFO - Non-Federal Sponsors

BNL has many unique capabilities and facilities not available in the private sector that offer opportunities for sponsored research in environmental sciences, energy technologies, materials sciences and biotechnology. The Laboratory's work for non-federal sponsors program encompasses the research the Laboratory conducts under funding from state and local government, industry, non-profit foundations, universities, medical centers, and foreign sponsors.

1.4.2.1 Private Firms

BNL scientists perform research for a number of private firms often taking advantage of BNL's unique facilities. Currently the majority of work for private firms is in the energy sciences area and includes the following:

- Insight Technologies: (funding from the New York State Energy Research and Development Authority)
 - "Development of a Two-Stage Oil Burner with Wide Hand Tracking Control"
 - "Field Tests of the Flame Quality Monitor"

- KeySpan Energy Corporation
 - "Determination of Gas Flow Rates at LILCO Gas-Fired Power Stations (PFTs)"
 - "Development and Demonstration of an Asbestos-Spray Treatment in a Utility Environment"
 - "Polymer Grouts and Polymer Composite Liners for Retaining Excavated Wall Foundations"
 - "Recycled Waste-based Cement Composite Materials for Rapid Permanent Road Restoration and Grout for Soil Stabilization"
- Aerodyne Research Corporation (funding from DOE SBIR)
 - "Developing a Versatile Aerosol Mass Spectrometer for Organic Aerosol Analysis"
- Energy Research Center, Inc. (funding from the New York State Energy Research and Development Authority)
 - "New York State Premium Low-Sulfur Fuel Marketplace Demonstration"
- ITT Industries (funding from DOD)
 - "Ultraviolet Raman Spectral Signature Acquisition"

1.4.2.2 Non-Profit Organizations/Institutions

The largest segment of our work for non-profit organizations/institutions is in our biomedical research programs, utilizing BNL's capabilities in Positron Emission Tomography (PET) and Magnetic Resonance Imaging (MRI) extensively. Currently work for non-profit organizations/institutions includes the following:

- New England Medical Center Hospitals, Inc. (funding from NIH)
 - "In Vivo Proton MRS Studies of Cerebral Injury in HIV Infection"
- St. Luke's-Roosevelt Hospital Center (funding from NIH)
 - "Medical Application Accuracy of Neutron Activation"
- The Scripps Research Institute (funding from NIH)
 - "Methamphetamine and AIDS: Toxic Interactions in Animals"
- National Multiple Sclerosis Society
 - "Quantitation of Blood-Brain Barrier Permeability in MS Lesion Development"

1.4.2.3 Universities

BNL's atmospheric chemistry and oceanography programs are extensively involved in sponsored research programs for educational institutions; several leverage DOE's investments in atmospheric chemistry. Educational institutions also extensively utilize our capabilities in biomedical research, and PET studies funded by universities have been extremely effective in monitoring the brain's metabolic functions and providing new insight into treatments for schizophrenia and Alzheimer's disease. Current work for educational institutions includes the following:

- Georgia Institute of Technology (funding from NASA)
 - "Measurement of Particle Chemical Composition During NASA Trace-P"
- Pennsylvania State University (funding from DOE)
 - "Development of Cloud Property Retrieval Algorithms at Boundary Facilities"
- State University of New York System
 - "Regulation of Tissue Repair" (funding from NIH)
 - "PM2.5 Technology and Characterization Study in N.Y." (funding from EPA)
 - "A Study of the Outer Shelf, Shelf Break, Front and Slope From Long Term ADCP and Hydrographic Observations from the MV Oleander" (funding from the NSF)
- Rockefeller University (funding from NIH)
 - "Center for Structural Genomics"
- University of California at San Diego (funding from NSF)
 - "The Collection of Shipboard Acoustic Doppler Current Profiler Data During the Shelf Basin Interaction Program"
- University of Colorado at Boulder (funding from DOD)
 - "Single Molecule Field-Effect Transistor"
- University of Rochester (funding from NSF)
 - "U.S. Atlas Barrel Cryostat Design and Procurement"
- Woods Hole Oceanographic Institution
 - "GLOBEC: Long-Term ADCP Moored and Lagrangian Measurement and Analysis as Part of a Georges Bank Study" (funding from NSF)
 - "GLOBEC: Frontal Exchange Processes for Eastern Georges Bank" (funding from NSF)
 - "Analysis of Acoustic Backscatter Data from the Japan/East Sea" (funding from DOD)

1.4.2.4 State Agencies

The majority of funding from state agencies comes from the New York State Energy Research and Development Authority (NYSERDA). Current work from state agencies includes the following:

- NYSERDA
 - "Improved Electric Power Efficiency in Heating Equipment"
 - "The Use of Biodiesel Fuel Blends in Space Heating Equipment"
 - "High Efficiency, Condensing Heating Appliance Firing Low Sulfur Oil"
 - "Variable Firing Rate Oil Burner Using Pulsed Fuel Flow Control"
- Texas Natural Resource Conservation Commission
 - "Analysis of TexAQs 2000 Data"

1.4.2.5 Foreign Sponsors

BNL's expertise in conducting risk-assessment studies and other work for the Nuclear Regulatory Commission has resulted in a significant amount of foreign sponsored research, for which we perform similar studies at foreign nuclear power plants. Current work for foreign sponsors includes the following:

- ENCONET Consulting (Austria)
 - "Risk-Informed Applications for Nuclear Power Plants"
- Japan Nuclear Cycle Development Institute
 - "A Joint Study of No-Notice Randomized Inspection for Reactors with MOX Fuels"
- Korea Atomic Energy Research Institute
 - "BNL Safety for the KALIMER Project"
- Swedish Nuclear Power Inspectorate
 - "Assistance in Nuclear Power Plant Control Room Modernization"
- Tokyo Electric Power Company
 - "AC Losses in Conductors Based on High-TC Superconductors"
- Union Fenosa Group (Spain)
 - "Review of CNJC Design Documentation for Proposed Control Room Modification"

1.4.3 Technology Transfer

BNL's technology transfer program has two primary objectives, to complement our DOE research mission through involvement in technology transfer projects that enhance our research capabilities, and to be a resource to U.S. industry, thereby enhancing the competitiveness of U.S. companies in domestic and international markets. Key components of BNL's technology transfer program are collaborative research projects under Cooperative Research and Development Agreements (CRADAs) and intellectual property protection and licensing.

1.4.3.1 Intellectual Property Program

The Laboratory's intellectual property protection program continues to be effective. OIP received 38 invention disclosures in FY01 and 18 through June 2002; OIP filed 28 U.S. patent applications in FY01 and 13 through June 2002, and BSA received 16 U.S. patents in FY01 and 13 through June 2002.

Inventions arising from BNL's biotechnology research programs continue to be of particular licensing interest to industry. Technologies related to medical imaging, radiopharmaceuticals, nuclear medicine, molecular genetics, genomics, structural biology, and protein engineering are licensed to industry. Technology based on our T7

gene expression system continues to evolve with new patents issued and new commercial licenses granted. In FY01 over 60 new licenses were granted covering the T7 technology and through June 2002 47 new T7 licenses were executed. In all the Laboratory entered into 77 new licenses in FY01 and over 50 new licenses through June 2002. There are over 150 technologies in BSA's Patent Licensing Portfolio; close to half these technologies are licensed to industry; and a dozen new products are on the market based upon technologies licensed by the Laboratory. The net revenue generated by the licensing program which is re-invested in the Laboratory's research programs, has been over \$1.5M for the last three years. The licensing program continues to be very cost effective, with the costs of patent prosecution, patent maintenance, and licensing being 23% of the gross revenue in FY99, 29% in FY00 and 27% in FY01.

1.4.3.2 CRADA Program

CRADAs are a valuable component of BNL's research portfolio. These programs enhance BNL's research capabilities and provide access to industrial expertise and capabilities. CRADA projects have generated new technologies and numerous patents, created new commercial products and processes, and demonstrated the societal relevance and public benefit of DOE funded research. BNL's participation in CRADAs has been funded primarily from the following three sources:

- DOE's Office of Science Laboratory Technology Research (LTR) Program that in the mid-90's supported most of BNL's CRADA programs, but over the last several years has experienced severe cuts in funding.
- DOE's Initiative for Proliferation Prevention Program for the Newly Independent States of the former Soviet Union (IPP-NIS), and,
- industrial partners who fully fund BNL's CRADA research activities.

The LTR program supports high-risk, multidisciplinary research partnerships to investigate challenging scientific problems whose solutions have promising commercial potential. BNL's strengths in research on electronics/instrumentation, energy, the environment, and biotechnology underpin our participation in this enterprise. Examples of these projects include work with two Long Island Companies. In the first, we are working with Advanced Energy Systems to design, fabricate, and test a high duty factor, high-brightness, all niobium superconducting RF gun. The second project, with Brookhaven Technology Group, is to generate a compact, cost-effective, high-brightness 5 MeV electron gun. Such high-brightness electron beams are needed for high-luminosity electron colliders and efficient short-wavelength free electron lasers.

The IPP-NIS program supports research partnerships at BNL conducted under CRADAs which take advantage of the research capabilities of established scientific institutions in the NIS and the commercialization expertise of U.S. industry. DOE supports the research conducted by BNL and the NIS institute, while the industrial partner supports its own work. BNL is currently a participant in nine IPP-NIS CRADAs. Examples of these projects include the BNL/Radkowsky Thorium Power Corp. CRADA under which we are working with the Kurchatov Institute to develop a new type of fuel for nuclear reactors,

and the BNL/MIT CRADA under which we are working with GE's Global Nuclear Fuels and Kaz Atom to develop fuel processing technologies.

The Laboratory has successfully attracted research funding from industry to support research collaborations. BNL is working with Dow Chemical Company to create environmentally beneficial agricultural plants with novel applications for human health and nutrition. BNL is working with Psimei Pharmaceuticals to develop new boron containing drugs for neutron capture therapy of different malignant tumors and with GlaxoSmithKline to evaluate the addiction potential of a new drug to treat depression.

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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 2002 has been organized into the following data categories.

- Significant Accomplishments
- Significant Awards
- Peer-Reviewed 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

Significant Achievements

- RHIC is operational at full collision energy; all experiments collecting data and publishing
- RHIC operating at average luminosity equal to 33% of design
- Fifth RHIC experiment, PP2PP, installed and taking data
- AGS proton slow-beam intensity delivered 5.7×10^{19} on target for E949, Rare Kaon Decay experiment
- ISO 14001 Registration recertified in FY 2002
- First regular operation of AGS for fixed target experiments concurrent with RHIC operation. Context switching time as planned.
- KOPI0 AGS beam target tests continued (NSF-HEPHEP)
- Radiobiology experiments continued (NASA)
- RHIC II collaboration began (NOVOSIBIRSK, DUBNA, Bates, TJNAF)
- Five AGS Nuclear Physics experiments were operational concurrent with HEP

Significant Instrumentation Developments

- Incremental developments leading to superior RHIC performance
- EBIS R&D successfully completed and ready for construction

Significant computer/software developments

- Accelerator mode switching under program control

Significant Awards

- S. Peggs – APS Fellowship
- A. Hershcovitch – Acceleron Grant Winner

Peer-Reviewed Publications

- For FY 2002, C-A has a total of 89 publications in refereed journals, major reports and proceedings. List is available upon request.

Number of Patents, Disclosures, Licenses and Royalties

Total: two

- US Patent: Wide tracking range, auto ranging, low jitter phase lock loop for swept and fixed frequency systems, T. Kerner, October 23, 2001
- Record of invention: Plasm shielding for in-air and under-water beam processes, A. Hershcovitch, March 27, 2002

Significant New Hires

- Twenty-six new hires and transfers into C-A from other BNL Departments
- Six temporary to support BAF construction
- Five temporary positions for studies
- Fifteen replacements for staff lost through attrition

Proposals

- RHIC - Collider-Accelerator Operation
- RHIC Experimental Operations (partial)
- Accelerator Operation for HEP
- Experimental Facility Operation for HEP
- Accelerator Operation for Medium Energy Physics
- Spallation Neutron Source Project
- NASA - Booster Application Facility Project
- NASA - Genetic and Epigenetic Effects - E960
- Proton Radiography - E955

Technical Committees

Review of BNL

- DOE SNS Review, November 2001, W.T. Weng, Y.Y. Lee, J. Wei, M. Nekulak, J. Sandberg, J. Tuozzolo
- DOE/NASA BAF Project Review, December 2001, A. McNerney, J. Becker, K. Brown, J. Feldman, D. Lowenstein, D. Phillips, R. Prigl, B. Sutherland, M. Vasquez
- SNS ASAC Review, February 2002, J. Wei, Y.Y. Lee, P. Cameron, D. Davino
- DOE RHIC Operations Review, February 2002, D. Lowenstein, A. McNerney, E. Lessard, T. Roser, P. Pile, J. Sandberg, J. Tuozzolo, M. Brennan
- DOE/NASA BAF Project Review, February 2002, D. Lowenstein, A. McNerney, P. Pile, A. Rusek, B. Sutherland
- DOE RHIC Program Review, July 2002, D. Lowenstein, T. Roser, Y. Makdisi

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

- AHF B-Tag Review, October 2001, D. Lowenstein
- NLC MAC, October 2001, S. Peggs
- BOGSNS, October 2001, W.T. Weng, D.I. Lowenstein
- JLab HKS Readiness Review, November 2001, P. Pile
- SNS HEBT Vacuum System Review, November 2001, H.C. Hseuh
- CERN LHC Vacuum System Review, November 2001, H.C. Hseuh
- NLC MAC, January 2002, S. Peggs
- RCMS Collaboration Internal Review, January 2002, S. Peggs, D. Lowenstein
- SNS DOE Review, February 2002, S. Peggs
- NuMi DOE Review at FNAL, February 2002, S. Peggs
- Peer Review Panel for Muon Ionization Cooling Experiment Proposal at Rutherford Appleton Laboratory, March 2002, D. Lowenstein
- NuMi DOE Review at FNAL, May 2002, D. Lowenstein
- HRIBF Operations Review, ORNL, June 2002, D. Lowenstein
- DOE SNS Review - ORNL - May 2002, T. Roser
- Accelerator Advisory Committee - Batavia, IL - May 2002, T. Roser
- DPB Nominating Meeting - Albuquerque, New Mexico- April 2002, T. Roser
- Review of the Kopio Application to the 'Canadian Foundation of Innovation' - Ottawa,
- US Particle Accelerator School Board of Overseers, Yale, June 2002, D. Lowenstein - Canada - March 2002, T. Roser
- Muon Collaboration TECh. Board Meeting - Chicago, IL - Feb 2002, T. Roser
- FNAL Accelerator Advisory Committee Mtg. - Chicago, IL - Dec 2002, T. Roser
- SNS Review - ORNL - Nov 2001, T. Roser
- Review of GSI Upgrade by the German Science Council - Darmstadt, GM - Nov. 2001, T. Roser
- US/Japan HENP Committee, FNAL, June 2002, D. Lowenstein
- US/Russia Joint Coordinating Committee on Fundamental Properties of Matter, D. Lowenstein
- SNS Accelerator Safety Review Committee, Jan 2002, E. Lessard

BNL Committees

- OPSEC, D. Lowenstein, P. Pile
- SBMS Steering Committee, D. Lowenstein
- Employment Benefit Committee, D. Lowenstein
- PAAA Working Group, D. Lowenstein
- BNL Institutional Review Board, E. Lessard
- BNL Radioactive Drug Research Committee, E. Lessard
- BNL Environment, Health and Safety Committee, E. Lessard
- BNL Radiation Protection Work Group, E. Lessard
- SNS SAD Review, E. Lessard
- BNL Fire Alarm Committee, R. Karol, E. Lessard
- C-AD Radiation Safety Committee, E. Lessard

- C-AD ALARA Committee, E. Lessard
- C-AD Experimental Safety Review Committee, E. Lessard
- C-AD Accelerator Systems Safety Review Committee, E. Lessard

1.1.1.2 Physics Department

Significant Accomplishments

Nuclear Physics (NP) Summary. RHIC experiments have now had a significant second run, collecting an order of magnitude more data than in the first run and at the full energy of the machine. Analyses are in progress and many preliminary results will be presented at Quark Matter 2002 later this month. Meanwhile the analyses of the first run are nearly complete and more than 20 papers have appeared in the published literature or are currently in press. Results on the suppression of hadron production at high transverse momentum, on elliptic flow, on interferometry and on correlations are new to RHIC and extremely interesting. RCF performed according to expectations and had made the processing of the large new data set possible. RCF is now in the process of getting ready for the even larger data set expected from run 3. LEGS commissioned the new polarized target and had an encouraging first run at NSLS. The Theory Group had an extremely active year, with many visitors and workshops. The RHIC spin group is in place and growing, with the expectation of being able to grow on the PHENIX side in the coming fiscal year. BNL's NP programs, including RHIC, RHIC II, EIC and Spin Physics all are well represented in the final Long Range Plan.

- RHIC Experiments:

BRAHMS: Detector operational. Successful data taking run completed in January. Early results from the full energy run already submitted for publication. BRAHMS explores kinematic regions not accessible to the other experiments.

PHENIX: The detector, minus one muon spectrometer, is operational and completed a very successful run in January. High-level triggers were implemented, allowing PHENIX to measure rare events. Some interesting studies were limited by the available machine luminosity, which will be improved in subsequent runs. Many papers were published, including the first publication on the suppression of high-pT hadrons; a number more are in press. The Group continues to play a major role in the data analysis and preparation of physics results. It is a strong young group with excellent leadership. Need to continue to make sure Physics Department maintains a real physics role and not just a detector support role. Looks very promising right now. New post-docs have been added.

STAR: The detector is operational and completed a very successful run in January. Many physics papers were produced from the first year's data and a number more are in press. The detector performed extremely well in the 2001 running. The Physics Department group continues to do an excellent job in running the operations. A number of post-docs

were added and the local group's physics visibility is increasing under the direction of the senior physicist hired last year.

- Theory: Tenure was granted to a young nuclear theorist in the group, adding to a very solid core of senior people. The group continues to attract excellent young theorists and to work synergistically with the RIKEN/BNL Research Center theorists. The combination has made the department a world-class center for strong interaction theory. Progress is being made in right-sizing the base budget of this group.
- RCF: Continued to perform well during and after the second run, providing the needed resources to process and analyze the data. After the run RCF convened a working group from among the experiments to consider how the next hardware and software acquisitions should be optimized in response to expectations of the third run.
- LEGS: This project had a successful first run with the new frozen spin target and a successful review by the DOE in the spring.
- RHIC Spin: RHIC Spin Group development is continuing, especially the recruitment of scientific personnel to work on the STAR spin program at Brookhaven. However, the development is currently funding-limited and efforts are underway to increase the funding and to focus the group's activities more exclusively on RHIC Spin. This group, together with RBRC was active and productive in making PHENIX and STAR ready for the first RHIC polarized proton run in FY 2001. Although the delivered polarization was less than hoped for, the spin program made some important first measurements of polarization and of asymmetry in hadron production.
- Hypernuclear Physics: This effort is being wound down in the Physics Department as we concentrate the Medium Energy research more on Spin physics at RHIC. We are in the process of redirecting the staff working in this area to other activities, both ongoing and new.

High Energy Physics (HEP) Summary. Very strong program in diverse areas. Very well reviewed by DOE this year. Need to maintain strengths in theory, D0, ATLAS and Kaons while trying to expand in a reasonable way in MINOS, MECO and muon collider related efforts.

- Theory: Lattice gauge theory is a major effort of the HET group and this year saw physics results for ϵ'/ϵ , g_V/g_A , and theoretical studies of the accuracy of domain wall fermions. Next-to-next-to-leading order QCD corrections to Higgs boson production at the Tevatron and the LHC were completed, leading to significant enhancements in the rates over the next-to-leading order predictions. Studies of the theoretical implications of the $(g-2)_\mu$ measurement in both the Standard Model and supersymmetric models showed that the $(g-2)_\mu$ measurement was consistent with low scale supersymmetry. There was also participation in the HEPAP Subpanel for Long Range Planning.
- D0: Very strong team – Excellent rating from D0 spokespersons. Jon Kotcher named Run 2b Project Manager. Leading efforts on software algorithms and DAQ.

- Muon (g-2): Result published in February 2001 received over 130 citations. The analysis of all the μ^+ data will be presented at the International Conference on High Energy Physics in Amsterdam, July 2002.
- E787/E949: A second event was found in the final analysis of E787 and published in January 2002 leading to a branching ratio $B(K^+ \rightarrow \pi^+ \nu \bar{\nu}) = 1.57^{+1.75}_{-0.82} \times 10^{-10}$. This result prompted many publications and real constraints on the unitarity triangle. The E949 experiment collected a significant number of K^+ decays with sensitivity comparable to that of E787. More AGS running is required to achieve the goal of 5-10 events and this is in jeopardy due to the FY 2003 Presidential Budget.
- MINOS: Leading study of $\nu_\mu \rightarrow \nu_e$ feasibility – important physics goal. Heavily involved in beam studies and beam instrumentation groups.
- MECO: W. Morse is in charge of the muon beam, which includes the muon stopping target, the absorber for the p_s^{-1} , the muon beam stop. Peter Yamin is calculating the neutron flux in the anti-counters surrounding the solenoid. Funding in FY03 is expected from the NSF.
- Muon Collider/Storage Ring: The simulation efforts of the Advanced Accelerator Group have focused on changes to the neutrino factory design that will reduce costs. There has been much progress in the design of muon cooling rings, which could also play a vital role for muon colliders. The simulations show significant 6D cooling for the first time.
- Accelerator Test Facility (ATF):
 - Measurement of the effect of Rough-Surface Wake Field: This wake field is important in high performance machines such as linear colliders and X-ray FELs as it affects the energy spread of short-pulse, high-current electron pulses. The interaction is due to the surface roughness and it is a relatively new phenomenon. There are a few theories, not always in agreement, and until recently no experiment. An ATF group and a DESY group reported results nearly at the same time. A paper has been submitted to PRL.
 - ATF Experiment AE28 concluded successfully. Detectors designed to monitor beam quality via muons and tolerate the high radiation environment of the MINOS/NuMI beam line at Fermilab were tested at the ATF facility for linearity, stability and saturation effects. The data show that the detectors will be an adequate solution for the beam monitoring of the MINOS neutrino beam line. A paper has been submitted to NIM-A.
 - The 11th Annual BNL Accelerator Test Facility Program Committee and Users Meeting took place on January 31 to February 1, 2002. The ATF and its experiment were reviewed and drew complementary remarks from the committee headed by Professor C. Joshi of UCLA. One new experiment was approved, "Optical

Diffraction-Transition Radiation Interferometry Diagnostics for Low Emittance Beams".

- The effect of laser non-uniformity on the emittance of a photoinjector has been characterized. This is a fundamental issue for the performance of high-brightness electron guns and this is the first systematic experimental investigation of the effect. The results have been accepted for publication in Phys. Rev. ST-AB.
- The Fast Optical Detector of Charged Particles, AE23, succeeded in observing the effect of a short electron bunch passing close to an electro-optic crystal using a streak-camera.
- Experiment AE22 obtained a first-of-its-kind result relevant to the generation of polarized electrons for a linear collider. A high-energy CO₂ laser was channeled in a capillary discharge. Plasma dynamic simulations confirm occurrence of laser guiding conditions at the relatively low axial plasma density $1.4 \times 10^{17} \text{ cm}^{-3}$. A relativistic electron beam transmitted through the capillary changes its properties depending upon the plasma density. The experiment observed focusing, defocusing or steering of the e-beam. Counter-propagation of the electron and laser beams inside the plasma channel generated intense picosecond x-ray pulses. This is the first time a laser beam and an electron beam have interacted in a plasma channel which is used to guide the laser and electron beams.
- NLC: BNL had a major theory role in preparing case for NLC. Efforts in silicon tracking and hadron calorimetry are proceeding at a modest level.

Condensed Matter Physics (CMP) Summary. The quality of the science remains "*Outstanding*" in Condensed Matter Physics at BNL. Among the most prominent scientific achievements so far this year are included:

- Development of theoretical techniques to distinguish evolved and random features in complex networks (such as interacting proteins in yeast),
- New insights into the electronic structure of calcium copper titanate, one of the highest dielectric constant materials known, on the basis of infrared studies,
- Demonstration that polar nanodomains result in the damping of optical phonons in ferroelectric thin films,
- Development of high pressure superhydration techniques in zeolite nanopores to trap radioisotopes, and
- Novel inelastic x-ray scattering studies of the double-mode gap excitation in La(2-x)Sr(x)CuO₄.

Several prestigious Awards were given to scientists within CMP this year, including the BNL R&D Award to Ben Ocko, a member of the X-ray Scattering group, and the Van Valkenburg Award for High Pressure Studies to Yongjae Lee, a post doc in the Powder Diffraction Group. All senior staff but one have been elected as Fellows of the American Physical Society--that person was nominated for the first time this year.

Condensed Matter Physicists have submitted nearly 200 publications to refereed journals and Conference Proceedings since October 2001. BNL Physicists continue to give prominent invited talks at major national and international meetings with members from all of the research groups contributing. They also serve on many important national and international committees, including a Review Committee for Physical Review Letters, Editorial Boards for the Journal of Physics and The Physical Review, The Main User Group for the SNS, the Award Committee for the Adler Prize of the American Physical Society, and many others including program committees for numerous conferences.

The relevance of CMP's programs to the DOE mission remains "Outstanding."

New programs have been initiated in materials synthesis and in soft condensed matter physics. Concerning the former, BNL has recruited an expert in oxide single crystal growth, successfully commissioned a new facility for Pulsed Laser Deposition, and hired an Assistant Physicist to focus on nanofabrication and characterization of self-assembled block copolymer systems. Each of these efforts has in its first year of operation already grown important new materials, which are presently being studied by groups within CMP. More recently, we hired an Assistant Physicist to set up a more general growth and characterization lab in direct response to comments made in earlier DOE Reviews. Concerning the latter, a successful NSET proposal was submitted to the DOE last year to start a new group within CMP, working collaboratively with a group at the NSLS, in the general area of nanotemplate directed assembly of soft matter and biomaterials. New funding is anticipated in August to initiate this effort. Both of these efforts involve cross-departmental collaborations at BNL, and are part of BNL's response to the DOE Initiatives in Nanoscience and Complex Materials.

Referring to the BNL Nanocenter, now planned for construction in FY 2004, CMP physicists have been instrumental in helping to plan both the Laboratory Clusters, as well as the Science Thrusts, which will comprise the Center's central mission.

Significant Awards

Total: 15 (HEP 6, NP 4, CM 5)

- W. Marciano - Sakurai Prize, Humboldt Senior Scientist Award
- F. Paige - BNL R & D Award
- S. Prelovsek-Komelj - The Jozef Stefan Golden Emblem prize Awards - Awarded for doctoral thesis in Solvenia
- A. Soni - APS Fellow
- L. Littenberg - DOE outstanding Mentor Award
- S. Kahana - Alexander von Humboldt prize Winner
- L. McLerran - Alexander von Humboldt Prize Winner, American Physical Society Fellow
- Foreign Member of the Finnish Academy of Arts and Sciences
- P. D. Johnson - Fellow, American Physical Society, Fellow, Institute of Physics, UK, BNL Science and Technology Award
- M. Strongin - Fellow, American Physical Society
- B. Ocko - Brookhaven Award

Peer-Reviewed Publications

- Total: 746 (HEP 299, NP 279, CM 168)
- Total referred journals - 458
- Total unreferred journals - 70
- Total conference proceedings – 218

Number of Patents, Disclosures, Licenses and Royalties

- Total: 2 (HEP 0, NP 0, CM 2)

Significant New Hires

- B. Surrow (Goldhaber Fellow) into the RHIC Spin Group
- F. Essler into the Condensed Matter Theory Group

Proposals

- FWP's – 23

LDRD Initiatives

- Total: 10 (HEP 2, NP 1, CM 7)

Editorial Activity and Major Book Articles

- Total: 5 (HEP 0, NP 0, CM 5)

Technical Committees

- Total: 137 (HEP 49, NP 73, CM 15)

Notes, Issues, Trends and Assumptions

- Nuclear Physics: The long-term future of the RHIC Spin Group's activities in hypernuclear physics and elastic scattering remains unclear. The main concern for the LEGS Group is the completion of the TPC as we run up against the likely conclusion of this program at the NSLS in FY 2006. So far, RCF is keeping pace with the expected growth of data volume. However there are still concerns. The staffing is still marginal and despite efforts to hire more staff the net gains are slow, though somewhat less difficult in the post dot-com era. This fiscal year has seen a net gain of 2. The leanness of the staff is likely to be a problem as data rates and volumes continue to increase in the future.
- High Energy Physics: The sharp decline in support for FY 2002 and FY 2003 for HEP has led to many RIFs and this trend will continue.
- Condensed Matter Physics: The major concern facing condensed matter physics remains flat funding of the core programs. Another is the role of core programs relative to facilities like the NSLS and BNL Nanocenter.

1.1.1.3 Instrumentation Division

Significant Accomplishments

Silicon Detectors

- Followed up on the new concept developed for pixel detectors with position resolution in the range of 1-5 microns with the simulation, design, and processing of the first batch prototype detectors. Initial tests on the test structures have shown good results and the proof of the principle of the new concept. A patent application regarding this new concept is now put forward by BNL with a filing date in Sept. 2002.

Developed and processed a number of novel Si strip/pixel detectors for various experiments:

- Produced 12 planes of large area Si strip detectors with novel ion implantation bias resistors for the RHIC PP2PP experiment with successful beam run in last December (12/01) at RHIC;
- Fabricated 16 planes of novel segmented Si strip detectors with double metal technology for the CERN NA60 experiment with successful beam run in June,2002 at CERN;
- Made pixel array pad detectors for NSLS with extremely good testing results;
- Made the first batch prototype Active Matrix Si detectors for protein crystallography;
- Made the first batch prototype submicron resolution Si stripixel detector for NASA human tissue ion radiation studies.

Gas Detectors

- A curved, 1D, position-sensitive detector, with fast encoding electronics has been constructed for the NSLS.
- New, ionization mode, neutron detectors are in the development stage as the next generation, high rate devices for new Spallation Neutron Sources.

Microelectronics

- Pendulum Titlmeter for Electric Dipole Moment of the muon experiment(EDM)with 100 nrad resolution.

Monolithic circuits.

- Photon-counting ASIC for high-rate EXAFS with Si pad detector.
- Amplitude-and time-measuring ASIC with derandomization.
- Active-pixel linear array ASIC with 512 elements.
- Requirements study of readout electronics for MECO calorimeter and tracker.
- Microelectronics group: readout software system for EXAFS detector, test software for ATLAS preamp/shaper ASIC.

Micro/Nano Fabrication

- Determination of the exposure and process parameters for SU-8 (a novel e-beam resist with a sensitivity over 100 times that of PMMA) has been completed using the SEM/electron beam lithography attachment.
- Development of a BioMEMS sensor using high aspect ratio fabrication methods for the Dept. of Biomedical Engineering, SUNYSB.
- Fabrication of a hybrid semiconductor-superconducting device using e-beam lithography in collaboration with the Dept. of Physics, SUNYSB.
- Use of SEM for research in LDRD project 01-85: Carbon Nanotube Chemical Probes for Biological Membrane Attachment Quantification.

Laser and Optics

- Femtosecond electron bunches have been generated and beam profiles measured.
- Multiphoton-assisted laser micromachining to sub-micro dimension structures.
- A 5 mega volt pulse generator with 1 nanosecond pulse width has been tested for photo cathode studies and high brightness electron gun development.

Optical Metrology

- Measurement of the complete 3-D surface topography on a cylinder mirror was achieved with a special Long Trace Profiler instrument installed on an ultra-precision grinding machine at RIKEN in Tokyo.

- Development of a portable Long Trace Profiler was completed. The entire system, including optical head, translation stage, and computer, can be transported in a single suitcase to remote locations.

Significant Awards

Awards and other Recognition

- Science and Technology Award, T. Srinivasan-Rao, Jan. 2002
- Brookhaven Award, R. DiNardo
- 1 Life Fellow of IEEE
- 1 Adjunct Professor at SUNY
- 1 Dual professor in Xiangtan University, China,
- Visiting professor in Beijing Institute of Semiconductors, China.

Peer-Reviewed Publications

- Total: 28

Most publications have been in Nuclear Instruments and Methods, and in IEEE Transactions on Nuclear Science.

Number of Patents, Disclosures, Licenses and Royalties

Patents: 3

- Beam Splitter and Method for Generating Equia; Optical Path Length Beams.
- Novel Stripixel Detector configuration.
- Offset-Free Rail-to-Rail Derandomizing Peak Detect and Hold Circuit.

LDRD Initiatives

- Carbon Nanotube Chemical Probes for Biological Membrane attachment Quantification.
Principal Investigator: J. Warren

Editorial Activity and Major Book Articles

- G. Smith completed book chapter for Wiley's 'Encyclopedia of Imaging Science and Technology'
- Z. Li was one of the editors for the Proceedings of the International Symposium of Young Scholars on Mechanics and Material Engineering for Science and Experiments.

Technical Committees

- V. Radeka served as a reviewer for the following journals: Nuclear Instruments and Methods, Review of Scientific Instruments, IEEE Trans. on Nuclear Science.
- V. Radeka served as reviewer for LHC Experiments: ATLAS, CMS and LHCb.
- P. O'Connor, G. DeGeronimo and A. Kandasamy served as journal reviewers.
- P. O'Connor served as review for the ATLAS TRT front-end chip.
- Z. Li reviewed for IEEE Trans., Nucl. Sci. and Nucl. Instr. & Meth. A., and for DOE SBIR and Advanced Detector Program.

1.1.1.4 Superconducting Magnet Division

Significant Accomplishments

- Delivered the final four helical dipole magnets to RHIC for spin physics program.

- Delivered the final spare magnet to DESY for HERA luminosity upgrade.
- Completed testing on all five D1 dipole magnets for LHC at CERN; preparation for shipping underway.
- Completed assembly on eight D2 dipole magnets for LHC at CERN; testing underway.
- Tested 325 samples of superconducting cable for LHC at CERN.
- Completed magnetic measurements for six first article SNS magnets and the entire production run of 32 ring dipoles and 39 21cm diameter quadrupoles.
- Tested several coils made with brittle high-field superconductors. Test magnet made with two Nb3Sn coils using 'react & wind technology' reached short sample in first quench. Also, successfully tested coils made with HTS.

Peer-Reviewed Publications

- Test Results for Initial Production of LHC Insertion Region Dipole Magnets
- The SNS Ring Dipole Magnetic Field Quality
- Magnet Engineering and Test Results of the High Field Magnet R&D Program at BNL
- Next Generation IR Magnets for Hadron Colliders
- Interstrand Resistance Measurements in Cored Rutherford Cables

Significant New Hires

- Post Doc appointment - Rainer Soika

LDRD Initiatives

- Neutrino factory storage ring magnet R&D
- High field NMR
- GSI rapid cycling magnet R&D

Technical Committees

- U.S. LHC Accelerator Steering Committee
- U.S. ATLAS Project Advisory Panel
- LHC Machine Advisory Committee
- Muon Collider Technical Advisory Committee
- Cornell CESR/CLEO PAC
- DPF Wilson Prize Committee
- SNS Accelerator Systems Advisory Committee
- 2003 Particle Accelerator Conference Program Committee
- 2004 Magnet Technology Conference Program Committee
- Cornell CESR Review Committee - Superconducting Undulator Magnet
- Cornell CESR Review Committee - NSF Grant Renewal
- Fermilab Review Committee for Internal Review of Superconducting Magnet R&D
- BEPC-II Review Committee at IHEP

1.1.2 Basic Energy Sciences

1.1.2.1 Chemistry Department

Significant Accomplishments

BES Programs

Gas Phase Molecular Dynamics

- New theoretical approaches have been developed for the rovibronic problem of large amplitude motion in combination with the Renner effect, using substituted carbenes as a test case.
- A combination of nonresonant laser photoionization of hydrocarbon radicals and ion imaging in a crossed molecular beam apparatus has led to the first global measurements of differential cross sections for the abstraction of H atoms from hydrocarbons by energetic triplet oxygen atoms.
- The rate of the reaction of triplet CH₂ with methyl radicals was measured using laser photolysis and a continuous sampling TOF mass spectrometer. The source of disagreement of our directly measured rate with previous estimates was traced to a problem with the methyl recombination rate in He, which has now been remedied.
- We have developed a general and efficient method to calculate vibrational energy levels of tetra-atomic molecules without any dynamical approximation. The computer code implementing this algorithm is being made freely available to the scientific community.

Photoinduced Molecular Dynamics

- The formation of attosecond (10⁻¹⁸ s) light pulses will open a new frontier in optical physics providing a dynamical probe on the electronic time-scale. Understanding how to form such pulses is intimately linked to novel techniques in ultra-fast metrology. We have been able to measure the duration and coherence time of high harmonic light using a scaled interaction. High harmonic radiation is one route to the formation of attosecond pulses.

Catalysis: Reactivity and Structure

- Neither bulk metallic gold nor TiO₂ react to dissociate SO₂, yet gold nanoparticles supported on TiO₂ makes a superior catalyst for SO₂ oxidation. Interactions with titania electronically perturb gold, making it chemically more active. Gold in turn enhances the reactivity of titania by facilitating the migration of O vacancies from the bulk to the surface of the oxide.
- The photodesorption of neutral atoms and molecules from cold metal surfaces has been characterized by the measurement of angular distributions strongly peaked along the surface normal, using a novel ion imaging spectrometer recently designed and constructed in our laboratory. The results support a non-thermal photo-desorption mechanism proposed in earlier studies.
- The first state-resolved product measurements of a surface reaction under steady state conditions have been achieved for the ammonia oxidation reaction on an oxygenated polycrystalline Ag surface. The velocity and rotational distributions of the NO product are not in equilibrium with the surface temperature, and thus give a direct probe of the reaction dynamics.
- The product-forming step in catalytic ionic hydrogenations is a hydride transfer reaction from a metal hydride. Kinetics measurements show that the ruthenium hydride (C₅Me₅)(CO)₂RuH has much higher reactivity as a hydride donor than either the Fe or Os analogues, and the different reaction products formed from the different metals demonstrate that the ruthenium complex also exhibits reactivity as a strong nucleophile.

Thermal, Photo- and Radiation-Induced Reactions in Condensed Media

- Using LEAF's pulse-probe capabilities, the very fast dissociation of aryl halide anions was easily and accurately measured for molecules previously unmeasurable, or where published data was in error by factors of 10-100.

- The spectrum of the solvated electron in an ionic liquid was measured for the first time.
- Long-lived, photo-induced, multiple charge separation was observed in a dendrimeric system consisting of a viologen core and peripheral naphthalene groups. Pulse radiolysis studies showed that the charge-separated state is stabilized against recombination by the formation of naphthalene dimer cations.
- Quantum chemical calculations estimated the sensitivity of electronic tunneling through molecular assemblies extending over tens of nanometers to several variables including chemical substitution, molecular conformation, electronic spacer type and length, and charge carrier injection gaps.
- Photo-activated Re-based catalysts are being investigated for the reduction of CO₂. Reactions of CO₂ with photochemically produced Re-ligand radicals, as well as excited state properties of the Re dimer have been studied. A CO₂ bridged bimetallic structure has been identified as an intermediate leading to CO.

Charge Transfer on the Nano-scale

- Prospective materials for molecular wire studies have been obtained through collaboration and charges were injected chemically and/or using the LEAF accelerator. Two materials displayed intense visible and near infrared optical absorption spectra, a key indicator for charge transport in molecular wires.

NanoCatalysis

- A laser-ablation source has been developed for generating neutral gas-phase clusters of molybdenum atoms alloyed with carbon, nitrogen and sulfur, i.e., $M_nC_mN_nS_n$. These materials are $M_nC_mN_nS_n$, with sizes in the range of (m, n) $M_nC_mN_nS_n$ (X at the center of the BNL-Chemistry nanocatalysis effort and this source will be used in deposition and spectroscopy experiments for characterization and reactivity studies.
- Parallel theoretical studies have also been performed on the analogous, first-row Ti_nC_n clusters including the well-known met-car, Ti_8C_{12} . High level ab initio methods have been applied to the latter system resulting in a detailed description of the electronic structure and a new prediction of the ground state geometry. High-level ab initio calculations of met-car “building blocks” such as TiC_2 and MoC_2 are also being carried out.
- Recent STM experiments have shown a novel growth mode for Mo nanoparticles on Au(111). Using first-principles density functional calculations, the interactions between Mo clusters and Au(111) are being studied, and the chemical reactivity of this system towards CO, O₂, S and C₂H₄ is being explored.

BER Programs

Radiotracer Chemistry and Neuroimaging

- PET Imaging Studies of Inhalant Abuse: Toluene, the most widely abused solvent was labeled with carbon-11 and the first imaging studies were carried out in the baboon, showing a very high uptake and rapid clearance in brain regions involved in reward and reinforcement. This sets the stage for a comprehensive study of the neurobiology of solvent abuse.
- New PET tracers have been developed for future studies on the effects of smoking on organs other than the brain, and carbon-11 labeled amino acids have been prepared for the assessment of amino acid transport and metabolism by tumors.

Magnetic Resonance Imaging

- We have developed a quantifiable concept – the MR 'Shutter-Speed' – to account for variations in the rate of water exchange between distinct biological compartments contained within a MR resolution volume element. Failure to account for this variation usually leads to significant errors in pathophysiological properties extracted from an MRI study. Clinical imaging for stroke, cancer, heart attack, and multiple sclerosis could all be affected by such errors.

HENP Programs

Solar Neutrino Research

- The SNO (Sudbury Neutrino Observatory) has announced the solution of the solar neutrino problem. The total neutrino flux was found to agree closely with the prediction of the Standard Solar Model, while the flux of electron-flavor neutrinos, measured by SNO via the charge-current interaction, was only about one third of the total flux. The observations are consistent with transformation among neutrino flavors as they travel from the sun to the earth, a process which requires neutrinos to have mass. The massive neutrino is “New Physics,” not contained within the current theory of elementary particles.
- A metal-loaded liquid scintillator is under development at BNL for the LENS low-energy neutrino collaboration to measure the flux and energy distribution of the lowest energy solar neutrinos. Several promising candidates have been identified for an indium-loaded liquid scintillator.

Phobos Heavy Ion Collaboration

- Collected data from the latest RHIC run - the highest energy heavy ion collisions ever achieved, along with some pp data at the same energy.
- Convinced RHIC to run collisions for one day at injection energy for easy comparison to CERN-SPS experiments.
- Published the first full-energy RHIC paper that rules out an important particle production mechanism (gluon radiation from jet quenching) in one of the leading heavy ion collision models (HIJING).

Significant Awards

- October 2001, Garman Harbottle, 2002 Recipient of the Pomerance Award of the Archaeological Institute of America for Scientific Contributions to Archaeology
- 2001, Joanna Fowler, Keynote Speaker, Marie Curie Exhibit, SUNY at Farmingdale
- November 2001, Louis DiMauro, Fellow of the Optical Society of America
- November 2001, D. Cabelli, US DOE National Award for Pollution Prevention, Outstanding Leadership - ISO 14001 EMS Project
- January 2002, Morris Bullock Science & Technology Award
- April 7, 2002, Joanna Fowler, Glen T. Seaborg Award
- March 2002, Richard Ferrieri, DOE Outstanding Mentor Award – ERULF Program
- May 9, 2002, Ray Davis named recipient of the National Medal of Science Award for his lifetime achievement in science for his solar neutrino work. The announcement was made by the White House.
- July 2002, James Lightstone, a graduate student at USB working with Michael White in the Chemistry Department, has been chosen by the Department of Energy as one of twenty-six graduate students nationwide to participate in the 52nd Meeting of Nobel Laureates to be held in Lindau, Germany.

- 2002, Joanna Fowler, Keynote Speaker, Marie Curie Exhibit, Georgia Tech, Atlanta

Peer-Reviewed Publications

BES - 72

BER - 17

HENP - 4

Total: 93

Selected Papers Published in Top Journals: Science, J Amer Chem Soc, Phys Rev Lett, Phys Rev B, Synapse

Direct Evidence for Neutrino Flavor Transformation from Neutral-Current Interactions in the Sudbury Neutrino Observatory

Q. R. Ahmad, R. C. Allen, T. C. Andersen, J. D. Anglin, J. C. Barton, E. W. Beier, M. Bercovitch, J. Bigu, S. D. Biller, R. A. Black, I. Blevis, R. J. Boardman, J. Boger, E. Bonvin, M. G. Boulay, M. G. Bowler, T. J. Bowles, S. J. Brice, M. C. Browne, T. V. Bullard, G. Buhler, J. Cameron, Y. D. Chan, H. H. Chen, M. Chen, X. Chen, B. T. Cleveland, E. T. H. Clifford, J. H. M. Cowan, D. F. Cowen, G. A. Cox, X. Dai, F. Dalnoki-Veress, W. F. Davison, P. J. Doe, G. Doucas, M. R. Dragowsky, C. A. Duba, F. A. Duncan, M. Dunford, J. A. Dumore, E. D. Earle, S. R. Elliott, H. C. Evans, G. T. Ewan, J. Farine, H. Fergani, A. P. Ferraris, R. J. Ford, J. A. Formaggio, M. M. Fowler, K. Frame, E. D. Frank, W. Frati, N. Gagnon, J. V. Germani, S. Gil, K. Graham, D. R. Grant, R. L. Hahn, A. L. Hallin, E. D. Hallman, A. S. Hamer, A. A. Hamain, W. B. Handler, R. U. Haq, C. K. Hargrove, P. J. Harvey, R. Hazama, K. M. Heeger, W. J. Heintzelman, J. Heise, R. L. Helmer, J. D. Hepburn, H. Heron, J. Hewett, A. Hime, J. G. Hykawy, M. C. P. Isaac, P. Jagam, N. A. Jelley, C. Jillings, G. Jonkmans, K. Kazkas, P. T. Keener, J. R. Klein, A. B. Knox, R. J. Komar, R. Kouzes, T. Kutter, C. C. M. Kyba, J. Law, I. T. Lawson, M. Lay, H. W. Lee, K. T. Lesko, J. R. Leslie, I. Levine, W. Locke, S. Luoma, et al. Phys. Rev. Lett. (submitted)

Measurement of Rate of $\bar{\nu}_e + d \rightarrow p + p + e^-$ Interactions Produced by 8B Solar Neutrinos at the Sudbury Neutrino Observatory

Q. R. Ahmad, R. C. Allen, T. C. Andersen, J. D. Anglin, G. Böhler, J. C. Barton, E. W. Beier, M. Bercovitch, J. Bigu, S. Biller, R. A. Black, I. Belvis, R. J. Boardman, J. Boger, E. Bonvin, M. G. Boulay, M. G. Bowler, T. J. Bowles, S. J. Brice, M. C. Browne, T. V. Bullard, T. H. Burritt, K. Cameron, J. Cameron, Y. D. Chan, M. Chen, H. H. Chen, X. Chen, M. C. Chon, B. T. Cleveland, E. T. H. Clifford, J. H. M. Cowan, D. F. Cowen, G. A. Cox, Y. Dai, X. Dai, F. Dalnoki-Veress, W. F. Davidson, P. J. Doe, G. Doucas, M. R. Dragowsky, C. A. Duba, F. A. Duncan, J. Dunmore, E. D. Earle, S. R. Elliott, H. C. Evans, G. T. Ewan, J. Farine, H. Fergani, A. P. Ferraris, R. J. Ford, M. M. Fowler, K. Frame, E. D. Frank, W. Frati, J. V. Germani, S. Gil, A. Goldschmidt, D. R. Grant, R. L. Hahn, A. L. Hallin, E. D. Hallman, A. Hamer, A. A. Hamian, R. U. Haq, C. K. Hargrove, P. J. Harvey, R. Hazama, R. Heaton, K. M. Heeger, W. J. Heintzelman, J. Heise, R. L. Helmer, J. D. Hepbur, H. Heron, J. Hewett, A. Hime, M. Howe, J. G. Hykawy, M. C. P. Isaac, P. Jagam, N. A. Jelley, C. Jillings, G. Jonkmans, J. Karn, P. T. Keener, K. Kirch, J. R. Klein, A. B. Knox, R. J. Komar, R. Kouzes, T. Kutter, C. C. M. Kyba, J. Law, I. T. Lawson, M. Lay, H. W. Lee, K. T. Lesko, J. R. Leslie, et al. Phys. Rev. Lett. 87, 071301-1-071301-6 (2001)

Measurement of Day and Night Neutrino Energy Spectra at SNO and Constraints on Neutrino Mixing Parameters

Q. R. Ahmad, R. C. Allen, T. C. Andersen, J. D. Anglin, J. C. Barton, E. W. Beier, M. Bercovitch, J. Bigu, S. D. Biller, R. A. Black, I. Blevins, R. J. Boardman, J. Boger, E. Bonvin, M. G. Boulay, M. G. Bowler, T. J. Bowles, S. J. Brice, M. C. Browne, T. V. Bullard, G. Buhler, J. Cameron, Y. D. Chan, H. H. Chen, M. Chen, X. Chen, B. T. Cleveland, E. T. H. Clifford, J. H. M. Cowan, D. F. Cowen, G. A. Cox, X. Dai, F. Dalnoki-Veress, W. F. Davison, P. J. Doe, G. Doucas, M. R. Dragowsky, C. A. Duba, F. A. Duncan, M. Dunford, J. A. Dumore, E. D. Earle, S. R. Elliott, H. C. Evans, G. T. Ewan, J. Farine, H. Fergani, A. P. Ferraris, R. J. Ford, J. A. Formaggio, M. M. Fowler, K. Frame, E. D. Frank, W. Frati, N. Gagnon, J. V. Germani, S. Gil, K. Graham, D. R. Grant, R. L. Hahn, A. L. Hallin, E. D. Hallman, A. S. Hamer, A. A. Hamain, W. B. Handler, R. U. Haq, C. K. Hargrove, P. J. Harvey, R. Hazama, K. M. Heeger, W. J. Heintzelman, J. Heise, R. L. Helmer, J. D. Hepburn, H. Heron, J. Hewett, A. Hime, J. G. Hykawy, M. C. P. Isaac, P. Jagam, N. A. Jelley, C. Jillings, G. Jonkmans, K. Kazkas, P. T. Keener, J. R. Klein, A. B. Knox, R. J. Komar, R. Kouzes, T. Kutter, C. C. M. Kyba, J. Law, I. T. Lawson, M. Lay, H. W. Lee, K. T. Lesko, J. R. Leslie, I. Levine, W. Locke, S. Luoma, et al. Phys. Rev. Lett. (submitted)

Baryon Rapidity Loss in Relativistic Au + Au Collisions

B. B. Back, R. R. Betts, J. Chang, W. C. Chang, C. Y. Chi, Y. Y. Chu, J. B. Cumming, J. C. Dunlop, W. Eldredge, S. Y. Fung, R. Ganz, E. Garcia, A. Gillitzer, G. Heintzelman, W. F. Henning, D. J. Hofmann, B. Holzman, J. H. Kang, E. J. Kim, S. Y. Kim, Y. Kwon, D. McLeod, A. C. Mignerey, M. Moulson, V. Nanal, C. A. Ogilvie, R. Pak, A. Ruangma, D. E. Russ, R. K. Seto, P. J. Stankas, G. S. F. Stephans, H. Q. Wang, F. L. H. Wolfs, A. H. Wuosmaa, H. Xiang, G. H. Xu, H. B. Yao and C. M. Zou
Phys. Rev. Lett. 86, 1970-1973 (2001)

Distance-Dependent Activation Energies for Hole Injection from Protonated 9-Amino-6-chloro-2-methoxyacridine into Duplex DNA

W. B. Davis, S. Hess, I. Naydenova, R. Haselsberger, A. Ogrodnik, M. D. Newton and M.-E. Michel-Beyerle
J. Am. Chem. Soc. (in press)

Self-referencing, Spatially Encoded Spectral Interferometry for the characterization of Attosecond Electromagnetic Pulses

C. Dorrer, E. Cormier, I. A. Walmsley and L. F. DiMauro
Phys. Rev. Lett. (submitted)

New Mode of Coordination for the Dinitrogen Ligand: Formation, Bonding, and Reactivity of a Tantalum Complex with a Bridging N₂ Unit That is Both Side-On and End-On

M. D. Fryzuk, S. A. Johnson, B. O. Patrick, A. Albinati, S. A. Mason and T. K. Koetzle
J. Am. Chem. Soc. 123, 3960-3973 (2001)

Pulse Radiolysis Studies of Dendritic Macromolecules with Biphenyl Peripheral Groups and a Ruthenium Tris-bipyridine Core

T. H. Ghaddar, J. F. Wishart, J. P. Kirby, J. K. Whitesell and M. A. Fox
J. Am. Chem. Soc. 123, 12832-12836 (2001)

A Dendrimer-Based Electron Antenna: Multiple Electron Transfer Reactions in Dendrimers with a 4,4'-Bipyridine Core and Naphthalene Peripheral Groups
T. H. Ghaddar, J. F. Wishart, D. W. Thompson, J. K. Whiteshell and M. A. Fox
J. Am. Chem. Soc. (submitted)

Identification of Intermediate Rhenium(I) Species in CO₂ Reduction with fac-Re(\square -diimine)CO)₃X
Y. Hayashi, S. Kita, B. S. Brunshwig and E. Fujita
J. Am. Chem. Soc. (Commun.) (submitted)

Kinetics and Mechanism of the \square - to \square -CuA1C14 Phase Transition: A Time-Resolved ⁶³Cu MAS NMR and Powder X-ray Diffraction Study
H. Liu, R. M. Sullivan, J. C. Hanson, C. P. Grey and J. D. Martin
J. Am. Chem. Soc. 123, 7564-7573 (2001)

"Heavy Electron" Photoelectron Spectroscopy: Rotationally-Resolved Ion Pair Imaging of CH₃⁺
X.-H. Liu, R. Gross and A. G. Suits
Science 294, 2527-2529 (2001)

Observation of Benzene Radical Ion in Equilibrium with Solvated Electrons
R. A. Marasas, T. Iyoda and J. R. Miller
J. Am. Chem. Soc. (submitted)

Chemistry of NO₂ on Oxide Surfaces: Formation of NO₃ on TiO₂(110) and NO O Vacancy Interactions
J. A. Rodriguez, T. Jirsak, G. Liu, J. Hrbek, J. Dvorak and A. Maiti
J. Am. Chem. Soc. 123, 9597-9605 (2001)

Experimental and Theoretical Studies on the Reaction of H₂ with NiO: Role of O Vacancies and Mechanism for Oxide Reduction
J. A. Rodriguez, J. C. Hanson, A. I. Frenkel, J.-Y. Kim and M. Pérez
J. Am. Chem. Soc. 124, 346-354 (2002)

Importance of O Vacancies in the Behavior of Oxide Surfaces: Adsorption of Sulfur on TiO₂(110)
J. A. Rodriguez, J. Hrbek, Z. Chang, J. Dvorak, T. Jirsak and A. Maiti
Phys. Rev. B (in press)

Topiramate Selectively Attenuates Nicotine-Induced Increases in Monoamine Release
W. K. Schiffer, M. R. Gerasimov, D. A. Marsteller, J. Geiger, C. Barnett, D. L. Alexoff and S. L. Dewey
Synapse 42, 196-198 (2001)

Rapid Electron Tunneling Through Oligophenylenevinylene Bridges

H. D. Sikes, J. F. Smalley, S. P. Dudek, A. R. Cook, M. D. Newton, C. E. D. Chidsey and S. W. Feldberg
Science 291, 1519-1523 (2001)

Relationship Between Blockade of Dopamine Transporters by Oral Methylphenidate and the Increases in Extracellular Dopamine: Therapeutic Implications

N. D. Volkow, G.-J. Wang, J. S. Fowler, J. Logan, D. Franceschi, L. Maynard, Y.-S. Ding, S. J. Gatley, A. Gifford, W. Zhu and J. M. Swanson
Synapse 43, 181-187 (2002)

A First-Principles Study of the Adsorption of Sulfur on Pt(111): S Core-Level Shifts and the Nature of the Pt-S Bond

Z. Yang, R. Wu and J. A. Rodriguez
Phys. Rev. B. 65, 155409-1 - 155409-9 (2002)

Number of Patents, Disclosures, Licenses and Royalties

Patents Filed: 5

- Stephen L. Dewey, Charles R. Ashby, Jonathan Brodie, "Treatment of PCP Addiction and PCP Addiction - Related Behavior"
- Stephen L. Dewey, Charles R. Ashby, Jonathan D. Brodie, "Novel treatment for Obsessive-Compulsive Disorders (OCD) and OCD-related disorders using GVG"
- Stephen L. Dewey, Charles R. Ashby, Jonathan D. Brodie, "Prevention of Addiction in Pain Management"
- Stephen L. Dewey, Charles R. Ashby, Jonathan D. Brodie, "Treatment of Addiction and Addiction Related Behavior"
- Stephen L. Dewey, Charles R. Ashby, Jonathan D. Brodie, "Treatment of Addiction and Addiction-Related Behavior"

Disclosure Submitted:

BNL 01-26, Morris R. Bullock and Jeong-Su Song, "Preparation of Alcohol Complexes of Tungsten"

Significant New Hires

- Michael White, Sr. Chemist and Arthur Suits, Chemist - First Joint Appointments with the State University of New York at Stony Brook and Brookhaven National Laboratory.
- Mingfang Yeh - Promoted from Research Associate to Assistant Scientist under supervision of Richard Hahn, Solar Neutrino Research Group.

Proposals

New & Significant Proposals:

- "PET Investigations of Abused Inhalants", Madina R. Gerasimov, NIH NIDA Funding: \$389K per year.
- Nanocatalysis \$550K yearly. P.I. Michael White, Jan Hrbek, James Muckerman
- Nanocharge Transfer \$650K yearly. P.I. Carol Creutz

Ten Proposals Submitted on Counter Terrorism:

- Chemical and Biochemical Toxin Remediation by Modified TiO₂ Nanoparticles, Bruce Brunschwig, Etsuko Fujita
- New Routes to Sensors By Imprinting of Receptors in Non-Polar Polymers, R. Morris Bullock, Vladimir K. Dioumaev and Bruce S. Brunschwig
- Understanding Radioprotection in *Deinococcus radiodurans*, Diane Cabelli
- Surface-Enhanced Raman Spectroscopy on Optically-Confined Particles for Characterization of CBW Agents, Christopher Fockenberg and Trevor J. Sears
- Chemical Warfare Remediation by TiO₂-Containing Zeolites, Etsuko Fujita, Bruce Brunschwig, Jonathan Hanson and Clare Grey (SUNY, SB)
- Destruction of Chemical Weapons: Chemical bond activation of models for toxic compounds on gold/oxide catalysts, J. Hrbek and J.A. Rodriguez
- Molecular Basis for Microbicidal Action of Inorganic Oxidants: Implications for Improving Sterilization by Radiation, Sergei V. Lyamar
- Molecular Wiring for Remediation and Detection, John R. Miller and Andrew Cook
- Radiation Chemistry and Chemical Kinetics Studies in Ionic Liquids: Applications for Treatment of Radioactive Contamination, James F. Wishart
- Imaging Tandem Mass Spectrometry for High-Throughput “Fingerprint” Detection of Complex Molecules, Arthur G. Suits and Gregory E. Hall
- Photodynamic Necrosis Using Porphyrin Photosensitizers (Catalytic destruction of bio and chemical threats), Jack Fajer
- Wide range pH solutions with peroxides for surface decontamination, Hugh S. Isaacs
- Magnetic MFM BioSensors, L. H. Lewis

LDRD Initiatives

Fourteen LDRD Initiatives submitted:

1. New Development of Norepinephrine Transporter Radioligands for PET Studies of Substance Abuse, Depression and ADHD, Yu-Shin Ding, Nora Volkow, Joanna Fowler
2. Supercritical Extraction of Radioisotopes from Production Targets, David Schlyer, Richard Ferrieri, Michel Schueller
3. Infrared Spectroscopic Probes of Mass-Independent Isotope Effects in Reactions of Atmospheric Significance, J. Preses, Ralph Weston
4. Infrared Diode Laser Absorption of Studies of Adsorbed Metal Carbonyls and Chemical Agents, J. Preses, Jan Hrbek
5. Development of Polarization-Dependent Detection Schemes for Noise Reduction and High-Pressure Catalysis Applications of Surface at the U41R Beam Line at the NSLS, M. White, M. Wu
6. Chemical Warfare Remediation by Modified TiO₂ and TiO₂-Containing Zeolites/Silicates, E. Fujita, J. Hanson, and B. Brunschwig
7. Condition: Green Chemistry Radiolytic Studies of Ionic Liquids in Service of Security and the Environment, J. Wishart
8. Hydrogen Atom Transfer from Carbon to Metal – Relevance of a Novel Reaction to Catalyzed Hydrocarbon Conversions, R. M. Bullock, B. Brunschwig
9. New Routes to Sensors by Imprinting of Receptors in Non-Polar Polymers, V. Dioumaev, R. M. Bullock
10. Large Scale Collaborative Computing for RHIC Experiments, P. Steinberg, Burt Holzman

11. Scientific Program for the DUV-FEL , L. DiMauro, A. Suits, M. White
12. Optical Fiber Bundles for Ultrafast Single Shot Detection at LEAF, A. Cook, J. Miller
13. Imaging Tandem Mass Spectrometry, A. Suits, G. Hall
14. Radioprotection in *D. radiodurans*, a radiation resistant bacterium , D. Cabelli

Fifteen LDRD Projects Awarded in October (FY02):

A. Cook, C. Creutz, J. Miller, J. Hrbek, T. Sears, M. White, D. Schlyer, M. Newton, B. Brunschwig, N. Camillone, R. Ferrieri, C. Fockenberg, M. Merasimov, R. Hahn, A. Suits.

Editorial Activity and Major Book Articles

Editorial Activity and Major Book Articles

BES - 4

BER - 4

Technical Committees

BNL Committees:

- BNL Council - G. Hall, R. M. Bullock
- 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 - T. Koetzle, G. Hall
- BSA 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 - C. S. Springer, Jr.
- Technology Transfer Coordinating Committee - M. Bullock

Meetings Chaired:

Total: 15

- Chemical Sciences Workshop
- O.,S.A. Annual Meeting
- 35th Winter Conference on Brain Research
- Sudbury Neutrino Observatory Collaboration Meeting
- Dynamics of Molecular Collisions
- American Chem. Society National Meeting
- DOE/Nano Workshop
- NIST Seminar
- Symposium on High Resolution IR Spectroscopy
- Combustion Contractors Meeting
- Gordon Research Conference on Photoionization
- Conference on Dynamics of Molecular Collisions,

- O S A I L A - XVII,
- Gordon Research Conf. Photoions,
- Photonization & Dev. International Conf on Neutron Physics and Astrophysics

1.1.2.2 National Synchrotron Light Source

Significant Accomplishments

- Source Development Laboratory lases at 400 nm. The BNL Deep Ultra-Violet Free Electron Laser (DUV-FEL) facility marked an important milestone, generating laser light at 400 nm by the process of Self Amplified Spontaneous Emission (SASE). Achieving intensity 20,000 times higher than the spontaneous emission, the result showed that the electron beam and the undulator system can support lasing down to 88 nm where there is strong user interest in the chemical physics community.
- Digital orbit feedback systems improved. Already in regular operation for some time in the VUV ring, a sophisticated correction algorithm has been implemented which has all but eliminated 60 Hz residual beam motion. The IR science program derives the most benefit from this improvement. Hardware for implementation of digital feedback on the X-ray ring has been installed and tested during studies. Full implementation including local feedbacks around insertion devices is under development.
- East Coast NIH-NIGMS Structural Biology Facility is fully operational. The X6A beamline will provide rapid access to beam time for a community of life scientists interested in the 3-dimensional molecular structure of biomolecules. Together with the adjoining biochemistry laboratory, this facility addresses problems from purification and crystallization to the 3-D structural modeling of biomolecules.
- A new end-station for spin-polarized photoemission. The new end-station for beamline U5UA hosts an Omicron EM125 hemispherical electron analyzer. Compared to the old analyzer, this new analyzer operates with better energy resolution as well as an improved signal-to-noise level. The analyzer is coupled to a mini-Mott (Rice University design) for spin-resolved photoemission spectroscopy. Additionally, the new end-station is equipped with a load-lock chamber for fast sample transfer. This will diminish the down time between different experiments, avoiding long bake-out procedures.
- Soft x-ray undulator beamline monochromator upgrade. A new water-cooled, 6-position interferometrically-controlled grating chamber was installed at beamline X1B. At present, four new gratings (300, 600, 1200, and 1600 lines/mm), covering the soft x-ray photon energy range from 100eV to 1600eV, were outfitted. Resolving power of more than 10,000 was achieved. The high energy resolution and extended energy range provided by the new monochromator will benefit greatly all the experimental programs using the beamline, including soft x-ray resonant scattering, emission, and imaging.
- Ultra-high vacuum compatible soft x-ray scattering end station operational. A novel resonant soft x-ray scattering instrument has become operational at the X1B undulator beamline at the NSLS. The instrument combines the element and electronic state specificity

of soft x-ray spectroscopy with x-ray diffraction, which enables the direct probing of intrinsic inhomogeneities in strongly correlated electron systems and nanoscale magnetic systems. For example, the spatial distribution of the doped holes in an epitaxial film of oxygen-doped $\text{La}_2\text{CuO}_{4+d}$ was determined recently using this instrument for the first time.

Peer-Reviewed Publications

Users:

- 1 book chapter
- 264 journal articles, of which 78 are premier

NSLS Staff:

- 6 journal articles, of which 1 is premier
- A complete list will not be available until year end.

Number of Patents, Disclosures, Licenses and Royalties

- 1 patent granted (6,353,232: Holder assembly system and method in an emitted energy system for photolithography), 2 patents pending
- A complete list will not be available until year end.

Significant New Hires

- A senior hire was made to lead the development of soft condensed matter research at the NSLS and assist the development BNL Nanoscience Center.
- A junior hire was made to lead the development of magnetism research at the NSLS.
- One half time science writer and a full time web master were hired to improve the information and outreach to the users community.

Proposals

- 1: Laser Seeded Free Electron Lasers and High Gain Harmonic Generation Experiments at the Source Development Laboratory of the National Synchrotron Light Source, submitted to The Office of Naval Research

LDRD Initiatives

- NSLS has actively sought LDRD support for developing initiatives important to its programs. We have 13 LDRDs that were funded in FY02, with 11 continued for funding in FY03. In addition, three new LDRDs were approved for funding start in FY03.

Editorial Activity and Major Book Articles

- 1- Editorial Board of "Physical Review E"
- 1- Editorial Board of "Liquid Crystals"
- 1- Referee for Review of Science Instruments
- 1 - Co-editor of Journal of Synchrotron Radiation
- Please note that this is not a complete list, which will not be available until year end.

Technical Committees

4 people participated in the following:

- National Institute of General Medical Sciences
- National Cancer Institute Synchrotron Advisory Board and Technical Advisory Committee
- SNS Ring HEBT & Injection Vacuum Design Review of Diamond, Third generation Light Source, BNL
- Member: Review Oversight Committee for the Canadian Light Source

1.1.2.3 Material Science Department

Significant Accomplishments

- Molecular engineering of synthetic porphyrins yielded new classes of chromophores and catalysts with tuneable, controllable, and predictable physico-chemical properties with potential applications to artificial photosynthesis, biomimetic catalysis, photonic devices, and photodynamic therapy (a photochemical cancer treatment).
- New advances were made in techniques of electron microscopy which permit the observation and quantification of magnetic dynamics on the nanoscale. A new method of non-interferometric phase retrieval complimented by interferometric off-axis electron holography was used to reveal important new features of vortex domain structures in arrays of nanoscale cobalt islands, as well as to quantify the dynamics of magnetic induction in the nanoscale structure of advanced Nd₂Fe₁₄B permanent magnets.
- The development and application of new in situ techniques of imaging, visualization, and electrochemical noise measurements have resulted in an important new understanding of the relationship of localized corrosion ("pitting") of aluminum surfaces and the electrochemistry of the aluminum oxide passive film. The new studies show that electrochemical noise reveals valuable information about pit growth, rather than the conventional interpretation which is based on breakdown and repair of the passive oxide.

Significant Awards

- Masaki Suenaga was elected to fellowship in the American Physical Society, based on his achievements in the understanding of factors which control critical current densities in superconductors, both conventional and high-T_c.
- Robert Klie was awarded a Goldhaber fellowship based on his achievements in transmission electron microscopy.
- J. McBreen, Fellow of The Electrochemical Society, September 3, 2001.

Peer-Reviewed Publications

CONTRIBUTED PAPERS:

- X. Sun, H. S. Lee, X. Q. Yang and J. McBreen, Improved Elevated Temperature Cycling of LiMn₂O₄ Spinel Through the Use of a Composite LiF Based Electrolyte, *Electrochem. Solid-State Lett.*, 4, A184 (2001).
- M. Balasubramanian, J. McBreen, I. J. Davidson, P. S. Whitfield and I. Kargina, In Situ X-ray Absorption Study of a Layered Manganese-Chromium Oxide Based Cathode Material, *J. Electrochem. Soc.*, 149, A176 (2002)
- X. Sun, X. Q. Yang, M. Balasubramanian, J. McBreen, Y. Xia, and T. Sakai, In Situ Investigation of Phase Transitions of Li_{1+y}Mn₂O₄ Spinel During Li-ion Extraction and Insertion, *J. Electrochem. Soc.* 149, A842 (2002).
- X. Sun, H. S. Lee, X. Q. Yang, and J. McBreen, A New Additive for Lithium Battery Electrolytes Based on an Alkyl Borate Compound, *J. Electrochem. Soc.* 149, A355 (2002).
- Y. Xia, T. Sakai, T. Fujieda, X. Q. Yang, X. Sun, Z. F. Ma, J. McBreen, and M. Yoshio, Correlating Capacity Fading and Structural Changes in Li_{1+y}Mn_{2-y}O₄* Spinel Cathode

Materials: A Systematic Study on the Effects of Li/Mn Ratio and Oxygen Deficiency, *J. Electrochem. Soc.* 148, A723 (2001).

- M. Giorgetti, S. Mukerjee, S. Passerini, J. McBreen, and W. H. Smyrl, Evidence for Reversible Formation of Metallic Cu in $\text{Cu}_{0.1}\text{V}_2\text{O}_5$ Xerogel Cathodes During Intercalation Cycling of Li^+ Ions as Detected by X-Ray Absorption Spectroscopy, *J. Electrochem. Soc.* 148, A768 (2001).
- X. Q. Yang, X. Sun, M. Balasubramanian, J. McBreen, Y. Xia, T. Sakai, and M. Yoshio. The Population of Oxygen Vacancies in $\text{Li}_1 + y\text{Mn}_{2-y}\text{O}_4$ Type Cathode Materials: The Primary Factor of Temperature Dependent Structural Changes, *Electrochem. Solid-State Lett.* 4, A117 (2001).
- X. Sun, X. Q. Yang, J. McBreen, Y. Gao, M. V. Yakovleva, X. K. Xing and M. L. Daroux, New Phase and Phase Transitions Observed in Over-Charged States of LiCoO_2 -Based Cathode Materials, *J. Power Sources*, 97, 274 (2001).
- Yang, M. Balasubramanian, J. McBreen, and C. P. Grey, Investigation of the Local Structure of the $\text{LiNi}_{0.5}\text{Mn}_{0.5}\text{O}_2$ Cathode Material during Electrochemical Cycling by X-ray Absorption and NMR Spectroscopy. *Electrochem. Solid-State Lett.* accepted.
- X.-Q. Yang, J. McBreen, W.-S. Yoon, and C. Grey, Crystal Structure Changes of $\text{LiMn}_{0.5}\text{Ni}_{0.5}\text{O}_2$ Cathode Materials During Charge and Discharge Studied by Synchrotron Based In Situ XRD, *Electrochem Commun.* accepted.
- M. Balasubramanian, H. S. Lee, X. Sun, X. Q. Yang, A. R. Moodenbaugh, J. McBreen, D. A. Fischer, and Z. Fu, Formation of Solid Electrolyte Interface on Cycled Lithium-Ion Battery Cathodes: Soft X-ray Absorption Study, *Electrochem. and Solid State Lett.*, 5(1), A22 (2002).
- D. P. Abraham, R.D. Twisten, M. Balasubramanian, I. Petrov, J. McBreen, K. Amine, Surface Changes on $\text{LiNi}_{0.8}\text{Co}_{0.2}\text{O}_2$ Particles During Testing of High-Power Lithium-Ion Cells, *Electrochem. Commun.* accepted.
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- Incorporation of Cr in the Passive Film on Fe from Chromate Solutions. H S Isaacs, S. Virtanen, M. P. Ryan, P. Schmuki, L. J. Oblonsky, *Electrochimica Acta*, accepted.
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- M. W. Renner and J. Fajer “Oxidative chemistry of nickel porphyrins.” *J. Biol. Inorg. Chem.* 6, 915 (2001) (Invited paper).
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- Cyclic Polarization Behavior of Aluminum Oxide Films in Near Neutral Solutions, H. Lee, H. Isaacs, and F. Xu, in Corrosion and corrosion control, J. D. Sinclair, E. Kalman, M. W. Kendig, W. Plieth, W. H. Smyrl, Editors PV 2001- 22, (Conference Proceedings) The Electrochemical Society, Inc., Pennington, NJ, in press.
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- The Role of Chromate in the Mechanisms of Passivation and Repassivation of Undermining Coatings on Hot-Dip Galvanized Steel Surfaces, N. Le Bozec, A. Nazarov, D. Thierry, and H. Isaacs, in Corrosion and corrosion control, J. D. Sinclair, E. Kalman, M. W. Kendig, W. Plieth, W. H. Smyrl, Editors PV 2001- 22, (Conference Proceedings) The Electrochemical Society, Inc., Pennington, NJ, in press.
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- Effects of Anion, pH, and Temperature on Dissolution Behavior of Aluminum Oxide Films, H. Lee and H. Isaacs, in Corrosion and corrosion control, J. D. Sinclair, E. Kalman, M. W. Kendig, W. Plieth, W. H. Smyrl, Editors PV 2001- 22, (Conference Proceedings) The Electrochemical Society, Inc., Pennington, NJ, in press.

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Number of Patents, Disclosures, Licenses and Royalties

FY 01

- BNL No.01-14: Adzic, Radoslav; Brankovic, Stanko; Wang, Jia; CO-tolerant Fuel Cell Electrocatalyst with a very Low Pt Loading and a Process for its Preparation.
- BNL No. 01-15: Lewis, Laura J. Henderson; Double Magnetocaloric Effect Nanocomposites.
- BNL No. 01-28: Sun, Xuehui; Lee, Hung Sui; Yang, X. Q.; McBreen, James; Composite Electrolytes Containing LiF Salt which Improve the Elevated Temperature Cycling of Spinel LiMn₂O₄ Electrode.

Patent Applications Filed:

- BSA No. 01-07: Adzic, Radoslav; Brankovic, Stanko; Wang, Jia; CO-tolerant Fuel Cell Electrocatalyst with a very Low Pt Loading and a Process for its Preparation.
- BSA No. 00-28: Wiesmann, Harold; Solovyov, Vyacheslav; Synthesis of Y Ba₂Cu₃O₇ Using Sub-atmospheric Processing.
- Patents Issued:
- BSA No. 98-17: Lee, Hung Sui; Yang, X. Q.; McBreen, James; Patent 6,120,941; 9/19/2000; Anion Receptor Compounds for Non-Aqueous Electrolytes.
- BSA No. 99-05: Adzic, Radoslav; Marinkovic, Nebojsa; Patent 6,183,894; 2/6/2001; Electrocatalysts for Alcohol Oxidation in Fuel Cells.
- BSA No. 98-24: Reilly, James J.; Adzic, Gordana D.; Johnson, John; Vogt, Thomas; McBreen, James Q.; Patent 6,238,823; 5/29/2001; Non-Stoichiometric AB₅ Alloys for Metal Hydride Electrodes.

New Licenses in FY 01: 0

Gross Royalties in FY01: \$0

FY02

- BNL No. 02-07: Wiesmann, Harold; Solovyov, Vyacheslav; Method for Fluorinating Films Containing Rare Earths, Barium and Copper.

- BNL No. 02-08: Sun, Xuehui; Lee, Hung Sui; McBreen, James; Yang, X. Q.; Using Boron-Based Anion Receptors to Improve the Thermal Stability of the Commercial LiPF₆-based Electrolyte for Lithium Batteries.
- BNL No. 02-13: Lewis, Laura J. Henderson; Simple Magnetic Field Amplification for Functional Magnetic Materials.
- BNL No. 02-14: Isaacs, Hugh S.; Observing Changes in Video Images.

Patent Applications Filed: NONE

Patents Issued:

- BSA No. 00-11: Lee, Hung Sui; Yang, X. Q.; McBreen, James; Xiang, Caili; Patent 6,352,798; 3/5/2002; Phenyl Boron-Based Compounds as Anion Receptors for Non-Aqueous Battery Electrolytes.

New Licenses in FY 02: 0

Gross Royalties in FY02: \$0

H. S. Isaacs, A. Shipley and E. Karplus, Observing Changes in Video Images, BSA.

Proposals

- Three-year CRADA, total funding \$750K:
- K. Barkigia and M. Renner, P.I.'s, "Synchrotron-based Structural Studies of Hydroporphyrin Sensitizers for Photodynamic Therapy," with Miravant Medical Technologies.
- The funding of the BES program, "Studies of Nanoscale Structure and Structural Defects of Advanced Materials," (KC0201010), Y. Zhu, P.I., was increased by \$1000K per year.
- M. Suenaga, P.I., "Use of Transmission Electronic Microscopy and New Developed Precursor-Deposition Method to Improve Fabrication of High Current Superconducting," with Oxford Superconducting Technology.
- H. Isaacs, P.I., "Non-Invasive Techniques to Study Local Passivity Breakdown of Metal Alloys in Aqueous Media," with Applicable Electronics, Inc.
- H. Isaacs, P.I., "Inhibition of Magnesium Corrosion for Automobile Coolant Applications," with Honeywell.

LDRD Initiatives

- S. Wong: "Size Dependence of Catalytic Reactivity of Iron Oxide Nanocrystals," \$85K
- M. Renner: "Immobilization of Organometallic Complexes into Sol-Gel Matrices," \$82K
- L. Lewis: "Magnetic Nanodispersions (NANO IV)," \$73K
- K. Barkigia, "Mapping Electron Densities in Porphyrin Radical Crystals Using the NSLS," \$70K
- Q. Li, "High Resolution Magneto-Optical Study of Magnetic Nanostructures, Nanocomposite Functions & Superconducting Materials (NANO IV)," \$46K

Editorial Activity and Major Book Articles

- R. Adzic, Editorial Board: Journal of the Serbian Chemical Society.

- R.R. Adzic, J.W. Wang, B.M. Ocko, J. McBreen, Surface X-ray scattering and X-ray Absorption spectroscopy techniques, Handbook of Fuel Cells Technology, W. Vielstich, D. Lamm, H. Geistarg (Eds.), J. Wiley & Sons, New York, in press.
- R.R. Adzic, Electrocatalysis on surfaces modified by metal monolayers deposited at underpotent "Encyclopedia of Electrochemistry", Vol 1, A. Bard, M. Stratmann, eds., Wiley-VCH, New York, 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, A. V. Narlikar, Ed., (Nova, Huntington, NY, 2002). In press.
- M. Suenaga, "BaF₂ Post-deposition Reaction Processing for Thick YBCO Films", in: Next Generation High Temperature Superconducting Wires, A. Goyal, Ed., (Plenum Publishing Corp., New York, NY 2002). In press.
- D.O. Welch, "Normal State vs. Superconductor," in Handbook of Superconducting Materials, D. Ginley and D. Cardwell, Eds., (Institute of Physics Publishing, Bristol), in press.
- Y. Zhu and V.V. Volkov, "Magnetic structure and magnetic imaging of RE₂Fe₁₄B (RE=Nd, Pr) permanent magnets", in Magnetic imaging and its applications in materials, Eds. M. De Graef and Y. Zhu, Academic Press, 2001, p227-270.
- Jack Fajer is on the editorial board of the journal, Spectrochimica Acta.
- J. McBreen, Invited Guest Editor of a Special Issue of Electrochimica Acta on X-Rays in Electrochemistry, Issue will be published July 27, 2002.

Technical Committees

- David Welch was elected Chairman of the Superconducting and Magnetic Materials Committee of the Minerals, Metals and Materials Society (TMS).
- L.H. Lewis: Program Committee, 46th Annual Conference on Magnetism and Magnetic Materials; Program Chair, InterMag 2003; Internal Advisory Board, International Training Institute for Materials Science, Hanoi, Vietnam; Executive Committee, BNL Nanoscience Center: "Center for Functional Nanomaterials;" Scientific Thrust Leader & Spokesperson, "Magnetic Nanoassemblies," BNL Nanoscience Center: "Center for Functional Nanomaterials;" Organizer & core member, DOE CESP Annual meeting: "Magnetic Nanocomposites" (meeting to be held 10/02); National Advisory Board, 17th Annual International Workshop on Rare Earth Magnets and their Applications (Aug. 18-22, 2002, Newark, Delaware); Search committees: Chair, BNL MSD; Director, BNL Nanoscience Center.
- R. Adzic, International Society for Electrochemistry, Co-Chairman, Division 1, Fundamental Interfacial Electrochemistry (1987-1989); Society, Member, Executive Committee, Physical Electrochemistry Division (1995-1998); Advisory Board, International Conference on Electrocatalysis, Como, Italy (2001-present).
- G.S. Frankel, J.R. Scully, H.S. Isaacs and J.D. Sinclair, Organizers. Corrosion Science: A Retrospective and Current Status, The Electrochemical Society, 201st Meeting. Philadelphia, PA, May 12-17, 2002.
- H. Isaacs: Corrosion Division Uhlig Award Committee for 2002 and 2003, The Electrochemical Society Inc. Pennington NJ. Whitney Award Committee for 2003, NACE International, Houston, TX.

Notes, Issues, Trends and Assumptions

Note this is the first year of Departmental status for the Materials Science Department. __

1.1.3 Life Sciences

1.1.3.1 Biology Department

Significant Accomplishments

The new DOE initiative "Genomes To Life" (GTL) provides an exciting focus for the expertise developed over many years in the Biology Department to understand basic principles of biological interactions both at the molecular level and within ecosystems comprised of microbes and higher forms of life. In response to the initial call for GTL proposals, a group of scientists from BNL and other National Laboratories and academic institutions both US and abroad, submitted a joint proposal to develop cutting-edge, high throughput DNA sequencing methods to analyze gene expression profiles in microbes and plant roots within soil communities and to track changes in gene expression following contamination of soils with radionuclides or heavy metals. The development of these ultra sensitive sequencing methods will allow scientists to monitor microbial species that cannot be propagated as pure cultures in the laboratory and identify coordinately regulated genes that may define novel metabolic pathways responsive to environmental stress. While this proposal was unsuccessful in its initial attempt this was mainly due to the lack of pilot data. LDRD funds will be used to generate pilot data for this initiative.

Subsequent calls for GTL proposals will focus on the major goal of characterizing interactions that enable proteins to function together as cooperative "molecular machines". This goal is strongly supported by Biology Department strengths in structural biology and protein expression and its long experience with characterizing the biochemistry of protein complexes derived from bacterial, plant and mammalian cells. The Biology Department STEM and new CryoEM microscopy facilities also are well matched to the GTL objective of developing methods for imaging protein complexes in living cells or in fixed sectioned cells. Therefore, several areas of Biology Department expertise have excellent prospects to flourish under the GTL program. Incorporated into the GTL initiative is a technique we recently developed for identifying and qualitatively analyzing genomic DNAs (called Genomic Signature Tags) that provides limited representation of all the DNA molecules in a given population without any prior knowledge of the DNA sequence. This method could potentially be used to detect the presence of biological warfare agents in crude environmental samples. This same method also will be used in the GTL project to characterize the composition and dynamics of natural populations of microbes in normal and contaminated soil samples.

Other major accomplishments in basic research and technology development include:

- As part of an ongoing effort to understand how viruses infect cells, Biology Department scientists deciphered the molecular-level interaction between coxsackie virus, which infects the heart, brain, pancreas, and other organs, and the human cell protein to which it attaches.
- We have found a way to make a plant enzyme that is 100 times more efficient than similar enzymes found in nature. The research offers insight into how enzymes evolve, and may one day lead to methods to boost production of other useful plant products.

- Several beamlines that comprise the Biology Department's crystallography facilities at the National Synchrotron Light Source underwent major upgrades:
- Beamline X12B was reconfigured to upgrade the optics for high-flux, broad spectral band-pass operation with a multi-layer monochromator (for small-angle scattering and crystallography) and narrow-band-pass operation with a channel-cut crystal monochromator (for multi-wavelength anomalous diffraction crystallography).
- The optics of Beamline X12C were upgraded to provide narrower band-pass, greater reliability, and an increased range of energies.
- A new motor control system was built and installed at Beamline X26C so that the beamline's optical elements could be reliably adjusted and the diffractometer properly aligned.

Significant Awards

- Richard Setlow, recipient of the Environmental Mutagen Society (EMS) Award for 2002 in recognition of outstanding research contributions in the area of environmental mutagenesis.
- The Biology Department had two SUNY Stony Brook graduate students receive PhDs this year.
- Mark Brown received his from the School of Pharmacology and Brenda Daniels from Biochemistry and Structural Biology.

Peer-Reviewed Publications

The Department had two cover articles worth noting:

1. A collaboration between our Proteomics group and SUNY SB lead to a cover of Journal of Biological Chemistry, Vol. 277(22), May 31, 2002. The cover shows a DNA repair enzyme "caught in the act." A Schiff base intermediate of Escherichia coli formamidopyrimidine-DNA glycosylases (Fpg), an enzyme responsible for excising oxidatively damaged purines from DNA, has been chemically reduced, and the resulting trapped complex was structurally determined. The structure, shown here with a modeled everted 8-oxoG base, reveals for the first time the mode of Fpg interactions with damaged DNA. For details see the article by Gilboa et al., pages 19811-19816.
2. An international collaboration lead to a cover of Environmental Science & Technology, Vol. 35(21), November 1, 2001. The redroot pigweed plant (*Amaranthus retroflexus*), shown in artist Loel Barr's cover illustration, has until now been mainly known as a highly toxic, nuisance plant commonly found in pastures. Plant ingestion by cattle, swine, sheep and goats can cause breathing problems, trembling, weakness, abortions, coma, and ultimately death. The leaves, stems, and roots of the plant are all dangerous to these and other animals. Why then, you might ask, would anyone want to cultivate such a plant? In their assessment of phytoremediation's progress in the United States and Europe, researchers Daniel van der Lelie, Jean-Paul Schwitzgubel, David Glass, Jaco Vangronsveld, and Alan Baker provide an answer. The redroot pigweed plant is particularly useful for phytoremediating radionuclide-contaminated sites. In field trials it was successfully used to accumulate significant amounts of radioactive cesium (Cs-137) in its leaf and stem biomass. In a growing market on both sides of the Atlantic Ocean, this and other plants are increasingly being used to phytoremediate site contamination.

Peer-Reviewed Publications

Total: 24

- Baniecki, M. L., McGrath, W. J., McWhirter, S. M., Li, C., Toledo, D. L., Pellicena, P., Barnard, D. L., Thorn, K. S., and Mangel, W. F. Interaction of the human adenovirus proteinase with its 11-amino acid cofactor pVIc. *Biochemistry* 40(41), 12349-12356 (October, 2001).
- Bewley, M. C., Marohnic, C. C., and Barber, M. J. The structure and biochemistry of NADH-dependent cytochrome b5 reductase are now consistent. *Biochemistry* 40(45), 13574-13582 (November, 2001).
- Bonanno, J. B., Edo, C., Eswar, N., Pieper, U., Romanowski, M. J., Ilyin, V., Gerchman, S. E., Kycia, H., Studier, F. W., Sali, A., and Burley, S. K. Structural genomics of enzymes involved in sterol/isoprenoid biosynthesis. *Proceedings of the National Academy of Sciences USA* 98(23), 12896-12901 (November, 2001).
- Eswaramoorthy, S., Kumaran, D., and Swaminathan, S. Crystallographic evidence for doxorubicin binding to the receptor-binding site in *Clostridium botulinum* neurotoxin B. *Acta Crystallographica*, D57 (Pt. 11), 1743-1746 (November, 2001).
- Hainfeld, J. F., Furuya, F. R., Powell, R. D., and Liu, W. DNA nanowires. *Microscopy and Microanalysis* 7 (Suppl 2: Proceedings), 1034-1035 (2001).
- He, Y., Chipman, P. R., Howitt, J., Bator, C. M., Whitt, M. A., Baker, T. S., Kuhn, R. J., Anderson, C. W., Freimuth, P., and Rossmann, M. G. Interaction of coxsackievirus B3 with the full length coxsackievirus-adenovirus receptor. *Nature Structural Biology* 8(10), 874-878 (October, 2001).
- Lacks, S. A., and Greenberg, B. Constitutive competence for genetic transformation in *Streptococcus pneumoniae* caused by mutation of a transmembrane histidine kinase. *Molecular Microbiology* 42(4), 1035-1045 (November, 2001).
- McGrath, W. J., Baniecki, M. L., Li, C., McWhirter, S. M., Brown, M. T., Toledo, D. L., and Mangel, W. F. Human adenovirus proteinase: DNA binding and stimulation of proteinase activity by DNA. *Biochemistry* 40(44), 13237-13245 (November, 2001).
- McGrath, W. J., Baniecki, M. L., Peters, E., Green, D. T., and Mangel, W. F. Roles of two conserved cysteine residues in the activation of human adenovirus proteinase. *Biochemistry* 40(48), 14468-14474 (December, 2001).
- Parker, S. D., Wall, J. S., and Hunter, E. Analysis of Mason-Pfizer monkey virus Gag particles by scanning transmission electron microscopy. *Journal of Virology* 75(19), 9543-9548 (October, 2001).
- Retailleau, P., Yin, Y., Hu, M., Roach, J., Bricogne, G., Vornrhein, C., Roversi, P., Blanc, E., Sweet, R. M., and Carter, Jr., C. W. High-resolution experimental phases for tryptophanyl-RNA synthetase (TrpRS) complexed with tryptophanyl-5' AMP. *Acta Crystallographica* D57 (Pt. 11), 1595-1608 (November, 2001).
- Sutherland, B. M., Bennett, P. V., Saparbaev, M., Sutherland, J. C., and Laval, J. Clustered DNA damages as dosimeters for ionising radiation exposure and biological responses. *Radiation Protection Dosimetry* 97(1), 33-38 (2001).
- Sutherland, B. M., Bennett, P. V., Weinert, E., Sidorkina, O., and Laval, J. Frequencies and relative levels of clustered damages in DNA exposed to gamma rays in radioquenching vs. nonradioquenching conditions. *Environmental and Molecular Mutagenesis* 38, 159-165 (October, 2001).

- van der Lelie, D., Schwitzguebel, J.-P., Glass, D. J., Vangronsveld, J., and Baker, A. Assessing phytoremediation's progress in the United States and Europe. *Environmental Science & Technology* 35(21), 446A-452A (November, 2001).
- Cover of *Environmental Science & Technology*, Vol. 35(21), November 1, 2001. The redroot pigweed plant (*Amaranthus retroflexus*), shown in artist Loel Barr's cover illustration, has until now been mainly known as a highly toxic, nuisance plant commonly found in pastures. Plant ingestion by cattle, swine, sheep and goats can cause breathing problems, trembling, weakness, abortions, coma, and ultimately death. The leaves, stems, and roots of the plant are all dangerous to these and other animals. Why then, you might ask, would anyone want to cultivate such a plant? In their assessment of phytoremediation's progress in the United States and Europe, researchers Daniel van der Lelie, Jean-Paul Schwitzguebel, David Glass, Jaco Vangronsveld, and Alan Baker provide an answer. The redroot pigweed plant is particularly useful for phytoremediating radionuclide-contaminated sites. In field trials it was successfully used to accumulate significant amounts of radioactive cesium (Cs-137) in its leaf and stem biomass. In a growing market on both sides of the Atlantic Ocean, this and other plants are increasingly being used to phytoremediate site contamination.
- Special Issue of *Environmental and Molecular Mutagenesis* (Journal of the Environmental Mutagen Society), Vol. 38, No. 2/3, pp. 87-260 (2001) published "A Richard B. Setlow Festschrift" (volume of writings by different authors presented as a tribute to a scholar). This festschrift was dedicated to the "Father of DNA Repair," Richard B. Setlow, in the year of his 80th birthday. They include contributions from many of his former students and colleagues who welcome the opportunity to say "Thank you, Dick!" The website where the table of contents and abstracts for the issue are located is <http://www3.interscience.wiley.com/cgi-bin/issuetoc?ID=86511335>
- Behrouzian, B., Savile, C. K., Dawson, B., Buist, P. H., and Shanklin, J. Exploring the hydroxylation-dehydrogenation connection: Novel catalytic activity of castor stearyl-ACP)9 desaturase. *Journal of American Chemical Society* 124(13), 3277-3283 (April, 2002).
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- Bulavin, D. V., Demidov, O. N., Saito, S., Kauraniemi, P., Phillips, C., Amundson, S. A., Ambrosino, C., Sauter, G., Nebreda, A. R., Anderson, C. W., Kallioniemi, A., Fornace, Jr., A. J., and Appella, E. Amplification of PPM1D in human tumors abrogates p53 tumor-suppressor activity. *Nature Genetics* 31, 210-215 (June, 2002).
- Burr, B. Mapping and sequencing the rice genome. *The Plant Cell* 14(3), 521-523 (March, 2002).
- Chance, M. R., Bresnick, A. R., Burley, S. K., Jiang, J. S., Lima, C. D., Sali, A., Almo, S. C., Bonanno, J. B., Buglino, J. A., Boulton, S., Chen, H., Eswar, N., He, G., Huang, R., Ilyin, V., McMahan, L., Pieper, U., Ray, S., Vidal, M., and Wang, L. K. Structural genomics: A pipeline for providing structures for the biologist. *Protein Science* 11(4), 723-738 (April, 2002).
- Georgakilas, A. G., Bennett, P. V., and Sutherland B. M. High efficiency detection of bi-stranded abasic clusters in gamma-irradiated DNA by putrescine. *Nucleic Acids Research* 30(13), 2800-2808 (July, 2002).

- Gilboa, R., Zharkov, D. O., Golan, G., Fernandes, A. S., Gerchman, S. E., Matz, E., Kycia, J. H., Grollman, A. P., and Shoham, G. Structure of a formamidopyrimidine DNA glycosylase-DNA complex. *Journal of Biological Chemistry* 277(22), 19811-19816 (May, 2002).
- Cover of *Journal of Biological Chemistry*, Vol. 277(22), May 31, 2002. The cover shows a DNA repair enzyme “caught in the act.” A Schiff base intermediate of *Escherichia coli* formamidopyrimidine-DNA glycosylases (Fpg), an enzyme responsible for excising oxidatively damaged purines from DNA, has been chemically reduced, and the resulting trapped complex was structurally determined. The structure, shown here with a modeled everted 8-oxoG base, reveals for the first time the mode of Fpg interactions with damaged DNA. For details see the article by Gilboa et al., pages 19811-19816.
- Luft, B. J., Dunn, J. J., and Lawson, C. L. Approaches toward the directed design of a vaccine against *Borrelia burgdorferi*. *Journal of Infectious Diseases* 185(4 Suppl 1), S46-S51 (February, 2002).
- McGrath, W. J., Aherne, K. S., and Mangel, W. F. In the virion, the 11-amino-acid peptide cofactor pVIc is covalently linked to the adenovirus proteinase. *Virology* 296(2), 234-240 (May, 2002).
- Mosesson, M. W., Siebenlist, K. R., Hernandez, I., Wall, J. S., and Hainfeld, J. F. Fibrinogen assembly and crosslinking on a fibrin fragment E template. *Thrombosis and Haemostasis* 87, 651-658 (April, 2002).
- Rithidech, K., Dunn, J. J., Roe, B. A., Gordon, C. R., and Cronkite, E. P. Evidence for two commonly deleted regions on mouse chromosome 2 in gamma ray-induced acute myeloid leukemic cells. *Experimental Hematology* 30(6), 564-570 (June, 2002).
- Saito, S., Goodarzi, A. A., Hagashimoto, Y., Noda, Y., Lees-Miller, S. P., Appella, E., and Anderson, C. W. ATM mediates phosphorylation at multiple p53 sites, including Ser46, in response to ionizing radiation. *Journal of Biological Chemistry* 277(15), 12491-12494 (April, 2002).
- Schwitzguebel, J.-P., van der Lelie, D., Baker, A., Glass, D. J., and Vangronsveld, J. Phytoremediation: European and American trends, successes, obstacles and needs. *Journal of Soils and Sediments*, pp. 1-9 (Online First: March, 2002).
- Setlow, R. B. Shedding light on proteins, nucleic acids, cells, humans and fish. *Mutation Research/Reviews in Mutation Research* 511(1), 1-14 (March, 2002).
- Snellinx, Z., Nepovim, A., Taghavi, S., Vangronsveld, J., Vanek, T., and
- van der Lelie, D. Biological remediation of explosives and related nitroaromatic compounds. *Environmental Science Pollution Research International* 9(1), 48-61, Review (2002).
- Song, J. M., Milligan, J. R., and Sutherland, B. M. Bistranded oxidized purine damage clusters: Induced in DNA by long-wavelength ultraviolet (290-400 nm) radiation? *Biochemistry* 41(27), 8683-8688 (July, 2002).
- Sutherland, B. M., Bennett, P. V., Sutherland, J. C., and Laval, J. Clustered DNA damages induced by X-rays in human cells. *Radiation Research* 157, 611-616 (June, 2002).
- Tubbs, R., Pettay, J., Skacel, M., Powell, R., Stoler, M., Roche, P., and Hainfeld, J. Gold-facilitated in situ hybridization: A bright-field autometallographic alternative to fluorescence in situ hybridization for detection of her-2/neu gene amplification. *American Journal of Pathology* 160(5), 1589-1595 (May, 2002).
- Watts, N. R., Jones, L. N., Cheng, N., Wall, J. S., Parry, D. A., and Steven, A. C. Cryo-electron microscopy of trichocyte (hard alpha-keratin) intermediate filaments reveals a low-density core. *Journal of Structural Biology* 137(1-2), 109-118 (January, 2002).

- Wu, Z., Earle, J., Saito, S., Anderson, C. W., Appella, E., and Xu, Y. Mutation of mouse p53 Ser23 and the response to DNA damage. *Molecular and Cellular Biology* 22(8), 2441-2449 (April, 2002).
- Zharkov, D. O., Golan, G., Gilboa, R., Fernandes, A. S., Gerchman, S. E., Kycia, J. H., Rieger, R. A., Grollman, A. P., and Shoham, G. Structural analysis of an *Escherichia coli* endonuclease VIII covalent reaction intermediate. *EMBO Journal* 21(4), 789-800 (February, 2002).

Number of Patents, Disclosures, Licenses and Royalties

- Biology's Gross Licensing Revenue for FY01 was \$1,682,811.00
- New Licenses in FY 01: 75

Disclosures Submitted in FY 01:

- 01-06 Dunn, John, J. Studier, William F. Luft, B. J. "Nucleotide Sequences Encoding *Borrelia* sp. LMP1 and Uses Thereof"
- 01-07 Shanklin, J. Whittle, Edward J. "Isoform of Castor Oleate Hydroxylase"
- 01-08 Shanklin, J. Blewitt, Michael G., Warikoo, Veena "Bacterial Oleic Acid Hydratase"
- 01-12 Freimuth, Paul I., Zhang, Yian-Biao, Howitt, Jason "Cis-acting Peptide Chaperone"
- 01-27, Subrahmanyam, Satyam, Shanklin, J., "Inhibition of desaturase activity by the co-expression of a mutant acyl-ACP desaturase"
- 01-29, Mendelman, Victoria Lynn, "Chip-Based Species Identification from Environmental Samples"
- 01-38, Shanklin, John Broadwater, John A., "Improved *Lesquerella* Oleate Hydroxylase"

Patent Applications Filed in FY 01:

- 01-01 Dunn, John J. Luft, B. J. "Recombinant Constructs of *Borrelia burgdorferi*"
- 01-02 Anderson, Carl W. Connelly, Margery A. "DNA-PK Assay"
- 00-22 Sutherland, Betsy M. "Method for Assaying Clustered DNA Damages"
- 01-05 Shanklin, J. Whittle, Edward J. "Isoform of Castor Oleate Hydroxylase"

U.S. Patents Issued in FY01:

- 99-13 6,248,569 6/19/2001 Dunn, John J. Randesi, Matthew, Quesada, Mark A. "Method for Introducing Unidirectional Nested Deletions"
- 94-14 6,248,562 6/19/2001 Dunn, John J. Luft, B. J. "Novel Chimeric Proteins Comprising *Borrelia* Polypeptides and Uses Therefor"

US Patents Issued FY02:

Anderson, C. W., Appella, E., and Sakaguchi, K., Inventors. Methods for generating phosphorylation site-specific immunological reagents. U.S. Patent No. 6,309,863 B1, October 30, 2001.

Significant New Hires

During this reporting period the Biology Department successfully recruited and hired two soil microbiologists as well as five research associates. We also have an offer out to a CryoElectron Microscopist. These scientists will enhance the Laboratory's research portfolio and, coupled with

the staff we already had, put us in better alignment with DOE missions for not only the Genomes to Life Initiative but for bioremediation and counterbioterrorism research.

The Department also hired a crystallographer to manage the operation of beamline X26C, a collaborative crystallography beamline (BNL, Cold Spring Harbor Lab, SUNY SB, and Georgia Universities).

Proposals

The following four significant proposals have been submitted to funding agencies:

- 'An Integrated Functional Genomics Consortium to Increase Carbon Sequestration in Poplars: The Poplar-Mycorrhizal Symbiosis as a System to Improve Carbon Sequestration (Submitted 5/30/02 by J. Dunn/N. van der Lelie. Response to DOE's call on 'Terrestrial Carbon Sequestration Using the Poplar').
- 'Structural Studies on C. botulinum progenitor toxin B' (Submitted 2/02 to NIH by S. Swaminathan).
- 'STEM Mass Mapping and Heavy Atom Labeling of Biomolecules' (Submitted 2/02 to NIH by J. Wall).
- The Biology Department was awarded three Seed Grant by SUNYSB. While the funding levels are not significant the program is worth noting as it was set up to strengthen the programmatic links between BNL and SUNYSB. Proposal titles are as follows:
 - 'Gene Expression Profiles Following in-Vivo Exposure to Ionizing Radiation' (J. Dunn)
 - 'Toxin Knowledge Base Management using Artificial Intelligence and Database Technologies' (S. Swaminathan)
 - 'Development of Transgenic Fish Model for use in vivo Exposure to Ionizing Radiation' (R. Setlow)

LDRD Initiatives

Total: 11

- Understanding the Pathways of Ubiquitin Dependent Proteolysis-Bewley, M.
- New Protein Expression Tools for Proteomics-Freimuth, P.I.
- 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.
- DNA-Nano Wires that AutoConnect in 3 Dimensions (NANO III)-Hainfeld, J.
- 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-Lymar, 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 mettallidurans Two-Hybrid Protein System for Studying Signaling Pathways Regulating Heavy Metal Homeostatis and Resistance-Taghavi, S.

Editorial Activity and Major Book Articles

Total: 13

- Anderson, C. W. and Appella, E. Signaling to the p53 tumor suppressor through pathways activated by genotoxic and non-genotoxic stresses. *Handbook of Cell Signaling*, R. A. Bradshaw and E. Dennis, Editors, Academic Press (in press, 2002).
- Flanagan, J. M. and Bewley, M. C. Protein quality control in bacterial cells: Integrated networks of chaperones and ATP-dependent proteases. *Genetic Engineering, Principles and Methods*, Vol. 24, J. K. Setlow, Editor, Kluwer Academic/Plenum Publishers, NY (in press, 2002).
- Becker, M. and Berman, L. NSLS 2001 Annual Users' Meeting Workshops: Frontiers in Structural Biology at High-Brightness X-Ray Sources. *Synchrotron Radiation News* 14(6), 7-9 (November/December, 2001).
- Lacks, S. Cotransformation. *Encyclopedia of Genetics*, S. Brenner and J. H. Miller, editors, Academic Press, pp. 471-472, San Diego, CA (October, 2001).
- Lacks, S. Pneumonia bacteria. *Encyclopedia of Genetics*, S. Brenner and J. H. Miller, editors, pp. 1491-1494, Academic Press, San Diego, CA (October, 2001).
- Lacks, S. Repair mechanisms. *Encyclopedia of Genetics*, S. Brenner and J. H. Miller, editors, pp. 1661-1669, Academic Press, San Diego, CA (October, 2001).
- Fu, D., Libson, A., and Stroud, R. The structure of GlpF, a glycerol conducting channel. *Ion Channels: From Atomic Resolution Physiology to Functional Genomics*, Novartis Foundation Symposium No. 245, pp. 51-61; discussion pp. 61-65 and 165-168. John Wiley & Sons Ltd., Chichester, UK (2002).
- Hainfeld, J. F. and Powell, R. D. Silver- and gold-based utometallography of nanogold. *Advances in Pathology, Microscopy & Molecular Morphology Series: Gold and Silver Staining: Techniques in Molecular Morphology*, G. W. Hacker and J. Gu, Editors, Chapter 3, pp. 29-46, CRC Press LLC, Boca Raton, FL (2002).
- Hainfeld, J. F., Powell, R. D., and Furuya, F. R. Microscopic uses of nanogold. *Advances in Pathology, Microscopy & Molecular Morphology Series: Gold and Silver Staining: Techniques in Molecular Morphology*, G. W. Hacker and J. Gu, Editors, Chapter 6, pp. 85-106, CRC Press LLC, Boca Raton, FL (2002).
- Powell, R. D. and Hainfeld, J. F. Combined fluorescent and gold probes for microscopic and morphological investigators. *Advances in Pathology, Microscopy & Molecular Morphology Series: Gold and Silver Staining: Techniques in Molecular Morphology*, G. W. Hacker and J. Gu, Editors, Chapter 7, pp. 107-118, CRC Press LLC, Boca Raton, FL (2002).
- Sutherland, J. C. Simultaneous measurement of circular dichroism and fluorescence polarization anisotropy. *Clinical Diagnostic Systems: Technology and Instrumentation*, G. E. Cohn, Editor, *Proceedings of SPIE*, Vol. 4625, pp. 126-136 (June, 2002).
- Swaminathan, S. and Eswaramoorthy, S. Crystal structure of Clostridium botulinum neurotoxin serotype B. *Scientific and Therapeutic Aspects of Botulinum Toxin*, International Conference 1999: Basic and Therapeutic Aspects of Botulinum and Tetanus Toxins, Orlando, FL, November 16-18, 1999, M. F. Brin, J. Jankovic, and M. Hallett, Editors, Chapter 3, pp. 29-39, Lippincott Williams & Wilkins, Philadelphia, PA (June, 2002).
- Tubbs, R. R., Pettay, J., Grogan, T., Cheung, A. L. M., Powell, R. D., Hainfeld, J., Hauser-Kronberger, C., and Hacker, G. W. Supersensitive in situ hybridization by tyramide signal amplification and nanogold® silver staining: The contribution of autometallography and catalyzed reporter deposition to the rejuvenation of in situ hybridization. *Advances in Pathology, Microscopy & Molecular Morphology Series: Gold and Silver Staining:*

Techniques in Molecular Morphology, G. W. Hacker and J. Gu, Editors, Chapter 9, pp. 127-144, CRC Press LLC, Boca Raton, FL (2002).

Technical Committees

Members of the scientific staff serve on the editorial boards and as reviewers for many journals such as Proceedings of the National Academy of Science, Photochemistry and Photobiology, Biochemistry, Cancer Research, Mutation Research, Acta Crystallography D, Biochimica Biophysica Acta, J. Biological Chemistry, and Molecular and Cell Biology.

21 of the Department's 24 scientific staff are members of graduate programs at SUNY Stony Brook (Genetics, Biochemistry and Structural Biology, and Molecular Microbiology, and the Medical Scientist Training Program).

Many of the scientific staff also participate in review panels for funding agencies (i.e. J. Flanagan BES, Carl Anderson DOE "Genomes to Life" for universities)

In addition, the staff participates as members on advisory boards such as:

- Scientific Advisory Board of the Institute for Molecular Biotechnology, Jena Germany
- Scientific Advisory Board of Structural GenomiX, California
- National Scientific Advisory Panel For American Foundation for Aging Research
- Advisory Committee for MacCHESS
- NASA Iterative Biological Crystallization Project
- Battelle Technical Council
- Member, Board of Directors National Space Biomedical Research Institute.
- Advisory committee, Wyeth Pharmaceuticals

The staff also participates in workshops and meetings which lead to the development of funded programs such as:

- The steering committee for the DOE's GTL Imaging workshop to formulate the call for proposals (<http://gtlimaging.emsl.pnl.gov/proj/gtlimaging/index.html>).
- Co-organized and participated in a NIH Workshop on Protein Posttranslational Modifications and Cancer Prevention that will advise NCI on funding opportunities.
- Organized a p53 workshop in Rome, Italy that lead to an application to NIH for development of mouse models for cancer research by a team on international scientists.

1.1.3.2 Medical Department

Significant Accomplishments

Medical imaging and addiction studies remain the cornerstone of OBER research at The Laboratory. This research mission creates great opportunities for collaborations and jointly funded initiatives with other agencies, principally the NIH. The following describes specific accomplishments in Radiotracer Chemistry and Neuroimaging using Positron Emission Tomography (PET) and Magnetic Resonance Imaging (MRI):

- PET and microdialysis were used to continue the first comprehensive study of solvent abuse (the most frequent form of abuse in children) in living systems, beginning with the pharmacokinetic and pharmacodynamic effects of toluene, the solvent most widely abused.

- The experimental medication, gamma vinyl GABA (GVG), which has shown great promise in diminishing addictive behaviors in animals, was labeled with carbon-11 for the first imaging studies of its distribution and pharmacokinetics in primates.
- Drug abusers frequently relapse when they again encounter an environment where they formerly used the drug. We showed that exposure to environmental cues produces similar neurochemical changes to the drug itself, illustrating the powerful role that the environment plays on drug-related behavior.
- Aromatic amino-acids, which may accumulate in rapidly growing tumors, were labeled with carbon-11 for PET studies in primates to determine their utility as tracers for detecting cancer. D- and L-boronphenylalanine also were labeled with carbon-11 for investigations of amino-acid transport, melanoma imaging, and BNCT therapy for brain tumors.
- The PET scanner designed for rats and mice (microPET), which was commissioned in FY 2001, was used by Brookhaven's scientists and outside collaborators as a new scientific tool for pre-clinical research to measure biochemical transformations and the movement of drugs in living animals. Two specialized PET devices were developed in FY 2002 to measure radiotracers in blood. One is a beta probe implanted in a blood vessel, and the other is a coincidence detector positioned external to the wrist to measure the concentration of positron emitters. Both promise to make PET studies simpler and safer.
- A collaboration was established to use the short-lived positron-emitting isotopes to study environmental stressors on plants.
- Progress continues on functional MRI studies using the BNL 4 Tesla scanner. The increased sensitivity resulting from last year's upgrade allow us to detect the passage of contrast agents across the blood-brain-barrier (BBB) in the white matter of the normal human brain.
- Brookhaven and Psimei Pharmaceuticals Ltd. continue to work together under a CRADA to develop Brookhaven-invented boron compounds for experimental radiation therapy for cancer, as well as other cancer treatments. In March 2002, our progress was measured in experiments at MIT.

Significant Awards

- Linda Chang, Brookhaven Town Award for contributions in science.
- Gene-Jack Wang, 2001, Man of the Year in Medicine – The Village Beacon-Record (UPS 001-056), Setauket, New York.
- Nora Volkow, NYS Senate's 'Woman of Distinction' Award, 2001
- Nora Volkow, Council member NARSAD, 2001
- Nora Volkow, Recognition Award, Suffolk Coalition to Prevent Alcohol and Drug Dependencies, Inc., 2002

Peer-Reviewed Publications

Total: 77

1. Benczik J., Hopewell J.W., Snellman M., Morris G.M., Tenhunen M., Seppala T., Joensuu R. and Joensuu H. Normal dog brain tolerance to irradiation with photons. Radiation Research. (In press).
2. Chang L, Ernst T, Speck O, Patel H, DeSilva M, Leonido-Yee M, Miller E. Perfusion MRI Abnormalities and Computerized Cognitive Deficits in Abstinent Methamphetamine Users. Psychiatry Research: Neuroimaging 2002 Jun 15;114(2):65-79.

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Number of Patents, Disclosures, Licenses and Royalties

- New Licenses in FY 01: 1
- Gross Royalties in FY01: \$426,480.00

Disclosures Received in FY01:

- 01-18 Srivastava, Suresh C., Meinken, George E., Li, Zizhong "A New Formulation of Tin-117m DTPA for Therapy of Cancer in Bone"
- 01-19 Srivastava, Suresh C., Li, Zizhong, Meinken, George E. "A New Method for Direct Synthesis of Sn-117m(4+) DTPA Chelate"

Patent Applications Filed in FY 01:

- 01-13 Srivastava, Suresh C., Li, Zizhong, Meinken, George E "A New Method for Direct Synthesis of Sn-117m(4+) DTPA Chelate"
- 01-10 Miura, Michiko, Slatkin, Daniel N. "Novel Metalloporphyrins and their Uses as Imageable Tumor-Targeting Agents for Ionizing and/or Non-Ionizing Radiation Therapy"

Patents Issued in FY 01:

- 97-19 Srivastava, Suresh C., Meinken, George E. 6,231,832, 5/15/2001 "Radiopharmaceutical Compositions"

Significant New Hires

- BNL's MR Imaging Program has been growing. In the beginning of this reporting period, Helene Benveniste, an MR scientist joined BNL's Medical Department. She has a joint appointment with SUNY Stony Brook. She will be responsible for the new Animal MR machine and research program.
- Linda Chang's MR group has expanded to include three new post docs as well as a new medical associate.
- A research associate was also hired as part of a project to target Tin-117m to estrogen receptors for breast cancer therapy.

Proposals

Total: 17 Proposals

- NIH, Beneviste, Helene. "Imaging Illicit Drug Abuse: Development of a New Test Bed Using MRI..."
- NIH, Chang, Linda. "Project 5: Proton Magnetic Resonance Spectroscopy (1h MRS) in Schizophrenia"
- NI Drug Abuse, Chang Linda. "Neuroimaging and Mentoring in Drug Abuse Research"
- NIH, Chang, Linda. "GCRC Supplement to the SUNY Stony Brook GCRC Site"
- NI Neurological Disorders and Stroke, Dilmanian, F. Avraham. "Microbeam Radiation Therapy for Gliomas"
- US Department of Defense, Dimanian, F. Avraham. "Comparing X-Ray Microbeams and Broad Beams at Optimal configurations..."
- US Department of Energy, Dimanian, F. Avraham. "Bystander Effects and Adaptive Responses Elicited in Low Doses of Low..."
- NIH, Dimanian, F. Avraham. "Effects and Techniques in Microbeam Radiation Therapy"
- NIH, Gatley, Samuel John. "Feto-Maternal Pharmacokinetics of Abused Inhalants"
- NI Drug Abuse, Goldstein, Rita Z. "Behavioral Correlates of fMRI Response in Cocaine Users (K23)"
- NIH, Pena, Louis. "Synthetic FGF Analog for Medical Devise Applications"
- US Department of Energy, Srivastava, Suresh. "Radiolabeled Progenitor Stem Cells for InVivo PET Imaging and..."
- NIH, Thanos, Panayotis (Peter) K. "microPET Imaging and Rodent Models of Drug Abuse"
- NIH, Volkow, Nora. "PET Studies of Brain DA in Stimulent Abusers"
- NI Drug Abuse, Volkow, Nora. "Studies in Cocaine Abuse"
- NIH, Wang, Gene-Jack. "Brain Dopamine Pathology in Obese Individuals"
- NIH, Wang, Gene-Jack. "Brain Dopamine Pathology in Obese Individuals"
- NIH. Gatley, S. John 'PET Studies of Alcohol Distribution and Metabolism'

LDRD Initiatives

Total: Six Initiatives

- Creating a MicroMRI Facility for Research and Development-Benveniste H.
- 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 Microassays-Vazquez M.
- 'Functional Spectral Signature' (FSS) Method for Signal to Noise-Enhancement of Brain Patterns in PET Images-Felder C.
- Targeting Tin-117m to Estrogen Receptors for Breast Cancer Therapy-Kolsky K.

Editorial Activity and Major Book Articles

Total: Eight

- Alia-Klein N, O'Rourke T, Malaspina D, Goldstein RZ, Amador X. Reliability and validity of the Violence Assessment Scale. (*American Journal of Psychiatry*).
- Dilmanian, G.M. Morris, N. Zhong, T. Bacarian, J. Tammam, M. Miura, P.L. Micca, L. Rigon, B. Scharf, D.N. Slatkin, R. Yakupov, and E.M. Rosen. Response of subcutaneous murine mammary carcinoma EMT-6 to synchrotron-generated segmented X-ray microbeams", *Proceedings of the Joint Symposium on Bio?Sensing and Bio?Imaging'*, August 27-4, 2001, Yamagata, Japan, pp 118-122, A. Akatsuka, Ed., *The Japan Society for Analytical Chemistry, 2002 Tokyo (CD ROM)*.
- Hurwitz BE, Goldstein R, Massie CA, Llabre MM, Schneiderman N. (2000). Low-flow circulatory state and the pathophysiological development of cardiovascular disease: A model of autonomic mediation of cardiovascular regulation. In P.M. McCabe, N. Schneiderman, T. Field, & A. R. Wellens (Eds.), *Stress, Coping, and Cardiovascular Disease*. Lawrence Erlbaum Associates. Mahwah, NJ, pp 85-122.
- Mausner, L.F., 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 (in press).
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- Volkow ND, Wang GJ, Fowler JS, Chang L. Imaging Studies of Stimulant Abuse: Linking findings from non-human primates to those in human studies. *College of Problems in Drug Dependence (CPDD) Symposium: NIDA Monograph 2002 (in press)*

Technical Committees

The Scientific staff of the Medical Department participate on the following types of technical committees (list is not all inclusive):

Journal Article Peer Review:

- Synapse
- Nuclear Medicine and Biology
- Journal of Pharmacology and Experimental Therapeutics
- Neuropharmacology
- Journal of Medicinal Chemistry

Grant Proposal Peer Review

- NIDA
- NIAAA
- DOE
- VA
- MRC (Canada)
- Welcome Trust (UK)

Board Membership/Advisory/Visiting Committees:

- NIAA Board
- Design Review Committee, LANL
- National Space Biomedical Research Institute (NSBRI) Board

Professional Society Officerships:

- SNM Board of Directors

Graduate Program Participation:

- SUNY Stony Brook (Biomedical Engineering, Neurology and the Medical Scientist Training Program)

1.1.4 Energy, Environment and National Security

1.1.4.1 Environmental Sciences

Significant Accomplishments

BNL continues to work for DOE's Atmospheric Chemistry, ARM, FACE, Terrestrial Carbon Cycle, Water Cycle, Environmental Science, Environmental Remediation and Environmental Management programs.

Achievements include:

- Continued operation of the North Carolina Face facility and the ARM External Data Center.
- Houston 2000 scientific results showing a large industrial component of the ozone generation rate were published.
- Scientists used satellite measurements and chemical transport modeling to show the influence of anthropogenic aerosol on cloud optical depth. Their results were consistent with the Twomey mechanism of indirect radiative forcing of climate by aerosols.
- Scientists continued developing and reporting new algorithms for the retrieval of aerosol properties from moments of the particle size distribution.
- The first results and initial description of a particle-into - liquid collector for rapid measurement of aerosol bulk chemical composition were published. Ambient particles are mixed with saturated water vapor to produce droplets that are collected and analyzed by traditional ion chromatography techniques.
- Environmental scientists demonstrated that perfluorocarbon tracers are a cost-effective method to verify integrity and monitor long-term performance of walls, floors, caps and cover systems.

- In response to the DOE BER Environmental Management Science Program, three interdisciplinary research efforts were proposed. These interdisciplinary efforts build on the scientific strengths of current programs and include extensive use of the NSLS.
- The Environmental Science Department, the NSLS and the Earth Sciences Department at SUNY Stony Brook proposed to create a new Environmental Molecular Sciences Institute. This NSF/DOE institute would provide end station upgrades to environmental beam lines and the development of new environmental applications.
- Perfluorocarbon tracers, typically used in atmospheric studies, were used to characterize the subsurface fan ducts at the Brookhaven Graphite Research Reactor. The novel project, an Accelerated Site Technology Deployment, provided a preliminary characterization that was then used to direct further more traditional sampling and characterization.
- A BNL scientist was appointed Chairman of the ARM Cloud Properties Working Group. The Group oversees all cloud sensing and cloud science activities in the ARM program. It consists of 50 members worldwide and is the largest working group within the ARM program.
- A BNL scientist was nominated to serve as a member of the USGCPR Water Cycle Science Steering Committee. This committee reviews and makes recommendations concerning Global Water Cycle Science.

Significant Awards

- Vasilis Fthenakis, Environmental Research & Technology Division, was honored as a Fellow of the American Institute of Chemical Engineers. The AIChE, founded in 1908, is a professional organization with more than 50,000 members. Dr. Fthenakis is one of eight Fellows chosen in 2002.
- Dr. A. J. Francis, Environmental Research & Technology Division, was awarded Tenure at BNL for his tenure on May 13, 2002.
- Memo of appreciation by Jim Wright, Manager of SCFA, DOE, awarded to Terry Sullivan - Certificate of Appreciation presented to Terry Sullivan in recognition of outstanding contributions to the Subsurface Contaminants Focus Area, DOE.

Peer-Reviewed Publications

- Bardos, R., Mariotti, C., Marot, F., Sullivan, T. Framework for decision support used in contaminated land management in Europe and North America. *Land Contamination & Reclamation* 36, 2094-2100 (2002).
- Dodge, C. J., Francis, A. J. Photodegradation of a ternary iron(III)–Uranium(VI)–Citric acid complex. *Environmental Science Technology* 36, 2094-2100 (2002)
- Fthenakis, V. Multilayer protection analysis for photovoltaic manufacturing facilities. *Process Safety Progress* 20(2), 87-94 (2001).
- Fuhrmann, M., Zhou, H., Neiheisel, J., Dyer, R. Sorption of radioactive contaminants by sediment from the Kara Sea. *Marine Pollution Bulletin* 43(1-6), 102-110 (2001).
- Fuhrmann, M., Lasat, M., Ebbs, S., Kochian, L., and Cornish, J. Uptake of ¹³⁷Cs and ⁹⁰Sr from contaminated soil by three plant species; Application to phytoremediation. *J. Environ. Qual.* 31, 904-909, May-June 2002.
- Fuhrmann, M., Melamed, D., Kalb, P. D., Adams, J. W., Milian, L. W. Sulfur polymer solidification/stabilization of elemental mercury waste. *Waste Management* 22, 327-333 (June 2002).

- Harshvardhan, Schwartz, S. E., Benkovitz, C. M., Guo, G. Aerosol influence on cloud microphysics examined by satellite measurements and chemical transport modeling. *J. of the Atmospheric Sciences* 59, 714-725 (2002).
- Jones, K. W., Feng, H., Stern, E. A., Lodge, J., Clesceri, N. L. Dredged material decontamination demonstration for the port of New York/New Jersey. *J. Hazardous Materials* 85, 127-143 (2001).
- Kalb, P. Sulfur Polymer Encapsulation. In *Hazardous and Radioactive Waste Treatment Technologies Handbook*, Chapter 6.6, Dr. Chang H. Oh, Editor, CRC Press, LLC, 2001.
- Kalb, P. Polyethylene Encapsulation. In *Hazardous and Radioactive Waste Treatment Technologies Handbook*, Dr. Chang H. Oh, Editor, CRC Press, LLC, 2001.
- Kleinman, L. I., Daum, P. H., Lee, Y-N., Nunnermacker, L. J., Springston, S. R. Sensitivity of ozone production rate to ozone precursors. *Geophys. Res. Lett.* 28(15), 2903-2906 (2001).
- Kleinman, L. I., Daum, P. H., Imre, D., Lee, Y-N., Nunnermacker, L. J., Springston, S. R., Weinstein-Lloyd, J., Rudolph, J. Ozone production rate and hydrocarbon reactivity in 5 urban areas: A cause of high ozone concentration in Houston. *Geophys. Res. Lett.* 29(0), 10.1029 (2002).
- Liu, Yangang, Daum, Peter H. A generalized systems theory for the effect of varying fluctuations on cloud droplet size distributions. *American Meteorological Society* 59, 2279-2290 (2002).
- Martin, R. R., Sham, T. K., Won, G. Wong, Jones, K. W., Feng, H. Synchrotron x-ray fluorescence and secondary ion mass spectrometry in tree ring microanalysis: applications to dendroanalysis. *X-Ray Spectrometry* 30, 338-341 (2001).
- Naftel, S. J., Martin, R. R., Sham, T. K., Macfie, S. M., Jones, K. W. Micro-synchrotron x-ray fluorescence of cadmium-challenged corn roots. *J. Electron Spectroscopy and Related Phenomena* 119, 235-239 (2001).
- Rogers, A., Ellsworth, D. S., Humphries, S. W. Possible explanation of the disparity between the in vitro and in vivo measurements of Rubisco activity: a study in loblolly pine grown in elevated pCO₂. *J. Experimental Botany* 52(360), 1555-1561 (2001).
- Schwartz, S. E., Harshvardhan, Benkovitz, C. M. Influence of anthropogenic aerosol on cloud optical depth and albedo shown by satellite measurements and chemical transport modeling. *Proc. of the National Academy of Sciences* 99(4), 1784-1789 (2002).
- Song, S-R., Jones, K. W., Lindquist, W. B., Dowd, B. A., Sahagian, D. L. Synchrotron x-ray computed microtomography: studies on vesiculated basaltic rocks. *Bulletin of Volcanology* 63, 252-263 (2001).
- Weber, R. J., Orsini, D., Daun, Y., Lee, Y-N., Klotz, P. J., Brechtel, F. A particle-into-liquid collector for rapid measurement of aerosol bulk chemical composition. *Aerosol Science and Technology* 35, 718-727 (2001).
- Wright, D. L., Shaocai Yu, Kasibhatla, P. S., McGraw, R., Schwartz, S. E., Saxena, V. K., Yue, G. K. Retrieval of aerosol properties from moments of the particle size distribution for kernels involving the step function: cloud droplet activation. *J. Aerosol Science* 33, 319-337 (2002).

Number of Patents, Disclosures, Licenses and Royalties

- Kalb, P., Melamed, D., Patel, B., Fuhrmann, M. Treatment of Mercury Containing Waste, U.S. Patent No. 6,399,849 (June 2002).

Significant New Hires

- Alla Zelenyuk, Associate Scientist, Atmospheric Sciences Division
- Yangang Liu, Associate Scientist, Atmospheric Sciences Division
- Alistair Rogers, Associate Scientist, Earth Systems Science Division

Significant New Proposals

- 'Real Time Tailpipe Emission Measurements.' - DOE B&R EE0602000.
- 'A Field Program to Identify TRI Chemicals and Determine Emission Factors from DOD Munitions Activities.' - Non-Federal Work for Others.
- 'Innovative Waste Segregation and Near Real-Time Field Characterization for RCRA Metals in Stockpiled Soil' Accelerated Site Technology Deployment- ASTD project, CH32SS30.

LDRD Initiatives

Total: Three Initiatives

- Simulated Observatory of Atmospheric Processes (SOAP)- P. Daum, PI
- Biomineralization of Actinides: A Mechanistic Study of the Microbial Genesis of Novel and Stable Compounds - A. J. Francis, PI
- Using Mini-CO₂-DIAL for Verification and Long-Term Monitoring of Cover Systems - J. Heiser, PI

Editorial Activity and Major Book Articles

- Kalb, P. Sulfur Polymer Encapsulation. In 'Hazardous and Radioactive Waste Treatment Technologies Handbook,' Chapter 6.6, Dr. Chang H. Oh, Editor, CRC Press, LLC, 2001.
- Kalb, P. Polyethylene Encapsulation. In 'Hazardous and Radioactive Waste Treatment Technologies Handbook,' Dr. Chang H. Oh, Editor, CRC Press, LLC, 2001.

Technical Committees

- Member National Research Council Committee on Air Quality Management- C. Benkovitz
- Member DOE EM-50 Strategic Laboratory Council- C. Wirick
- Member Rocky Flats Advisory Committee- A. J. Francis
- Member DOE EM Subsurface Lead Laboratory Committee- T. Sullivan
- Member DOE EM Long term capping Committee- J. Heiser
- Chairman ARM Cloud Properties Working Group (CPWG)- M. Miller
- Member USGCRP Water Cycle Science Steering Committee- M. Miller

1.1.4.2 Energy Sciences and Technology

Significant Accomplishments

The department is continuing to increase its support for its sponsors. We completed several tests of BHP equipment for EE, we have initiated the SDRP notebooks for NRC, and have taken on management of Ukraine assistance activities. New programs have started in risk assessment for NMSS and we have started work on electric grid infrastructure modeling.

The thorium fuel cycle project started irradiations in Russia and non-fuel flow testing was completed. We continued our support of accelerator based projects, including the SNS.

Significant Awards

2002 R&D 100 Award (joint with NREL) for Smart, High Performance Polyphenyenesulfide Coating System

Peer-Reviewed Publications

62

Number of Patents, Disclosures, Licenses and Royalties

In FY-02, there were 3 disclosure statement, 3 patent applications and six patent awarded as of June 30, 2002.

Proposals

The department submitted eleven proposals to the NERI program and two proposal for NEPO. One NEPO proposal was funded.

We have also submitted proposals for work in methane hydrates and deep sulfur removal to DOE.

LDRD Initiatives

Total: Four Initiatives

- Catalytic Microcombustion Systems
- Electrical Systems Reliability
- Liquid Fuel Gasifier for Combustion and Fuel Cells
- Study of a Power Source for Nano-Devices

Editorial Activity and Major Book Articles

Eleven

Technical Committees

Twenty one

Notes, Issues, Trends and Assumptions

We have increasing activity for the NRC as their research budget has started to increase. New programs are being started in methane hydrates. Our thorium work is maturing, but may be poised for growth next year.

1.1.4.3 Nonproliferation and National Security

Significant Accomplishments

- Organized and co-hosted for DOE and International Atomic Energy Agency - Contact Expert Group "Workshop on Spent Nuclear Fuel and Radioactive Waste Management at Andreeva Bay, Russia."
- Organized and co-hosted for NNSA/DOE workshop on "New York Metropolitan Region: Counterterrorism and Infrastructure Assurance Technology Needs", April 9-11, 2002. This workshop included 160 representatives from DOT, DOE, DOJ, FAA, NYC Office of Emergency Management, other NYS organizations, and industry.
- Supported BNL efforts to respond to multiple requests from the Secretary of DOE, Office of Science, NNSA and elsewhere regarding BNL capabilities in Counterterrorism research, development, demonstration, testing and evaluation.

- The International Safeguards Project Office initiated a program of one-year internships with the International Atomic Energy Agency for recent graduates in the field of software development. Four interns were given assignments for the period June 2002 to May 2003.
- Developed an Emergency Response Planning Guideline (ERPG) for mercury vapor, in cooperation with ORNL Spallation Neutron Source project, estimated to save them over \$20 million in project costs. BNL staff member was elected to Chairmanship of Emergency Response Planning Guidelines (ERPG) Committee; published 100th ERPG.
- Developed absorption characteristics for Terra Hertz radiation in selected plastic materials as part of underground infrastructure imaging system project.
- Developed an accurate global survey system providing two-dimensional positioning to an accuracy of 1cm. Prototype called "Lighthouse" was developed under a DOE CRADA program.
- Conducted high-level, annual progress reviews of 46 MPC&A Program Projects, analyzing the information obtained in these reviews and providing the DOE Program Director with both summary and comprehensive reports on each project.
- 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 Conversion and Consolidation (MCC) project, which is an important component of the MPC&A program. A critical goal of the MCC project is to reduce the number of sites and buildings that contain weapons-usable nuclear material, as well as to reduce the attractiveness of existing highly enriched uranium by downblending it to low enriched uranium.
- A BNL staff member was appointed lead of the MPC&A Education and Awareness Project. Under this project, a two-hour MPC&A Culture module was developed as the front-end to technical and administrative courses conducted by Atomenergo, ISTC, RMTC, MEPHI, Kurchatov Institute, and Navy.
- A BNL staff member continues as lead of the MPC&A Operations Monitoring Project. Under this activity as system was designed, construct and installed at the Moscow State Engineering Physics Institute to monitor MPC&A system upgrades at this sites in order to ensure that they continue to detect, delay, and respond to attempts to divert nuclear material.

Peer-Reviewed Publications

Approximately: 21

- Rawool-Sullivan, M. Moskowitz, P.D. and Shelenkova, L.M., "Technical and Proliferation-Related Aspects of the Dismantlement of Russian Alfa-Class Nuclear Submarines," The Nonproliferation Review/Spring 2002, pages 161-171.
- Moskowitz, P.D. et al., Technical Editor, "Russian Federation Reports on Conditions, Priorities and Response Options for Spent Nuclear Fuel and Radioactive Waste Management at Andreeva Bay," Published by the US Department of Energy, Washington, DC.
- S. Pepper, 'INMM Panel Discussion in Recognition of Twenty-Five Years of MSSP,' Journal of Nuclear Materials Management, Volume XXX, Number 2, Winter 2002.
- Hansen, DJ and DK Craig, eds., Handbook: DOE SCAPA TEELs Rev18 January 31, 2002, Brookhaven National Laboratory, January 31, 434 pp.

- Hansen, DJ, ed., “The American Industrial Hygiene Association 2002 Emergency Response Planning Guidelines and Workplace Environmental Exposure Level Guides Handbook,” AIHA 2002.
- AIHA ERP Committee, “Emergency Response Planning Guideline: Carbon Disulfide (Update),” AIHA, 2002.
- AIHA ERP Committee, “Emergency Response Planning Guideline: Chlorine Dioxide,” AIHA, 2002.
- AIHA ERP Committee, “Emergency Response Planning Guideline: Chlorosulfonic Acid (Update),” AIHA, 2002.
- AIHA ERP Committee, “Emergency Response Planning Guideline: Chlorotrifluoroethane (Update),” AIHA, 2002.
- AIHA ERP Committee, “Emergency Response Planning Guideline: Hydrazine,” AIHA, 2002.
- AIHA ERP Committee, “Emergency Response Planning Guideline: Hydrogen Selenide,” AIHA, 2002.
- AIHA ERP Committee, “Emergency Response Planning Guideline: Mercury,” AIHA, 2002.
- AIHA ERP Committee, “Emergency Response Planning Guideline: n-Butyl Acetate,” AIHA, 2002.
- AIHA ERP Committee, “Emergency Response Planning Guideline: 1,2 Dichloroethane,” AIHA, 2002.
- AIHA ERP Committee, “Emergency Response Planning Guideline: Phosgene (Update),” AIHA, 2002.
- AIHA ERP Committee, “Emergency Response Planning Guideline: Toluene Diisocyanate,” AIHA, 2002.
- AIHA ERP Committee, “Emergency Response Planning Guideline: Thionyl Chloride,” AIHA, 2002. Sabelnikov, A.S., “Bioaugmenting Grease Traps: a Model Study, “ submitted for publication.
- Impact of the Nuclear Option on Environment and Economy', Nuclear Technology, March, 2002
- Neutronics Design and Fuel Cycle Analysis of a High Conversion BWR with Pu-Th Fuel', International Congress on Advanced Nuclear Power Plants, (ICAPP), Hollywood, Florida, June 9-13 2002
- Steam Line Break and Station Blackout transients for Proliferation Resistant Hexagonal Tight Lattice BWR ' International Congress on Advanced Nuclear Power Plants, (ICAPP), Hollywood, Florida, June 9-13 2002
- Construction of Complex Images by an adaptive Neuron-Like research System' Singapore, 2002

Significant New Hires

Two Significant Hires:

- Barbara Hoffheins, MS, BS Electrical Engineer
- Alex Sabelnikov, Ph.D, Sci.D, Biology

Proposals

Approximately: 24

- MeHg Health Risks to DOE FE – Accepted and funded by DOE FE.

- CT and Infrastructure Needs in the NY Metropolitan Region - Accepted and funded by NNSA.
- Pipeline Coating Facility – Accepted and funded by NNSA Nuclear Cities Initiative.
- Pb-Bi Alfa-Class Reactors – Under review by NNSA NN.
- Safeguards of SNF at the Andreeva Bay Site – Under review by NNSA NN.
- Multiple proposals under review by NNSA and DOE, DoD on counterterrorism (» 10).
- U.S. DOE Field Work Proposal B&R DP0909112 resulting in FY2002 \$500,000.
- Two funded NERI projects in collaboration with Purdue University
- DEPSCor Proposal," Modeling of Multiphase Flow in The agitated Mixer, with University of Wyoming
- NERI Proposals, " Risk Informed Approach to Evaluate Effectiveness of Passive Safety Systems Against External Events", with General Electric
- NERI Proposal," Development of the In-vessel Technology Basis for a Natural Circulation Boiling Water Reactor with University of Florida
- NERI Proposal," Technology Basis and Licensing Methods for Advanced Plants using Passive Safety Features", University of California and GE
- NERI," DEEP UNDERGROUND REACTOR PROTECTED FROM TERRORIST ATTACK" with University of California
- NERI," Novel Modular Natural Circulation BWR Design", with Purdue University

LDRD Initiatives

LDRD Proposals Submitted: 17

Editorial Activity and Major Book Articles

- INMM Associate Editor
- Journal of Environmental Systems Associate Editor

Technical Committees

- DOE Task Force on Energy Assurance for Deputy Secretary Frank Blake.
- Department of Energy Subcommittee on Consequence Assessment & Protective Actions (SCAPA)
- Department of Energy Hazardous Material Risk Quantification Project Team
- American Industrial Hygiene Association Emergency Response Planning Guidelines Committee, Chairman
- National Academy of Sciences/Environmental Protection Agency National Advisory Committee on Acute Exposure Guideline Levels
- Centers for Disease Control Anthrax Remediation Working Group
- AIHA Emergency Response Planning Guideline (ERPG) Committee
- EPA Federal Advisory Committee (FACA) for Acute Exposure Guideline Limits (AEGl)
- ASME Special Committee on Standard Planning
- NYC / WTC Buildings Code Task Force
- NYC Green Building Technologies
- SUSB/BNL Calverton High Technology Incubator
- INMM Technical Program Committee
- INMM Executive Committee

- INMM Government Industry Liaison Committee, a Standing INMM Committee
- Associate Technical Editor, Journal of Nuclear Materials Management
- Organized and chaired the Closing Plenary - Combating Nuclear Terrorism, 43rd INMM Annual Meeting, Orlando, FL, 23-27 June 2002.
- Technical Center program at the State Department, Member of IPP Inter-Laboratory Board, Chair of IPP Support Institute Committee.
- Health Physics Society Committee on Homeland Security
- BNL Community Advisory Council
- BNL Advocacy Panel
- Vice Chair of the ANS Technical Journal Committee
- Chair of the ANS Committee on Standards for Reactor Design

DRAFT

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 Science - Program Title: Nuclear Physics (KB)	
Approximate Dollar Value: \$140.7M	
Sub Program (\$K)	Mission Alignment
KB01 (\$5,100) Medium Energy Nuclear 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 (\$121,000) Heavy-Ion Nuclear 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.
KB02 (\$15,500) Landlord function	Infrastructure Support – The Nuclear Physics Office provides the “landlord” function at BNL. This category includes ongoing waste management issues, general plant projects for major modifications to site facilities and utilities and site general equipment
KB03 (\$4,400) Theoretical Nuclear Physics	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 (\$710) Low Energy Nuclear 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: High Energy Physics (KA)	
Approximate Dollar Value: \$38.3M	
Sub Program (\$K)	Mission Alignment
KA04 (\$16,500) Research and Technology	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
KA05 (\$21,800) Facility Operations	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

DOE Office of Science - Program Title: Basic Energy Sciences (KC)

Approximate Dollar Value: \$75.9M

Sub Program (\$K)	Mission Alignment
KC0201-01/02/03 (\$3230) 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 (\$4516) 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.
KC0202-022/03 (\$3983) Condensed Matter Physics: Theory & Experimental	New Energy Sources, Presidential Energy Plan, 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 (\$1111) 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, KC0301045 (\$33,200) 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.
KC0204012 (\$17130) High Flux Beam Reactor Transition Project	Environmental Cleanup: Project transitioning to EM.
KC03010 (\$4615) 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 (\$2952) Chemical Physics	New Energy Sources and Presidential Energy Plan: Gas phase molecular dynamics, imaging and characterization studies, dynamic properties of catalytic materials
KC030201 (\$2184) Chemical Energy	New Energy Sources and Presidential Energy Plan: Catalysis studies of the reactivity and structure of surfaces and the growth of overlayers.
KC030202 (\$352) 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 (\$1386) 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.
KCO4 (\$333) Geosciences	New Energy Sources and Presidential Energy Plan: Program explores understanding of rock characterization, energy exploration and recovery.

DOE Office of Science - Program Title: Basic Energy Sciences (KC)	
Approximate Dollar Value: \$75.9M	
Sub Program (\$K)	Mission Alignment
KC06 (\$1225) 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.

DOE Office of Science - Program Title: Biological and Environmental Research (KP)	
Approximate Dollar Value: \$23.6M	
Sub-Program (\$K)	Missions Alignment
KP-11-01-01 (\$4590) NSLS Structural Biology Facility Operation and Analysis of Proteins.	National Trust Science, Environmental Cleanup, and the Climate Change Initiative. This funding supports the operation, maintenance, and continuing development of x-ray crystallography used to probe the structure of biological systems. The x-radiation from the NSLS is used for diffraction studies of crystals of macromolecules, macromolecular complexes, and viruses. Funds also support operation of the STEM and development of biophysical instruments.
KP-11-02-02 (\$550) DNA Damage Clusters in Low Level Radiation Responses of Human Cells	Environmental Cleanup and National Trust Science. This research is essential among DOE's strategic goals in Science and Technology, seeking to understand biological impacts of energy by-products, and to protect human health and the environment.
KP-11-03-01 (\$940) Genome Sequencing and Analysis	Climate Change Initiative and New Energy Sources. The research objective is to provide a basic understanding of the biomolecular building blocks of all matter and life as well as the effects of radiation and chemicals on organisms at the level of biological molecules as a means to protect human health and the environment. Genome scale tools and resources developed as part of this research are needed for developing new biological strategies for greenhouse gas control and for technology breakthroughs in fuel development.
KP-12 (\$6,061) Environmental Research	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.
KP-13 (\$585) Research for Environmental Restoration	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.
KP-14-01-02 (\$2810) Radiotracer Chemistry and Neuroimaging	National Trust Science. The PET Program and the radiotracer research associated with it supports the "Protect Our Living Planet" theme of the DOE's research mission. This program advances our knowledge in the areas of radioisotope research, radiotracer synthesis with short-lived isotopes, and basic neuroscience such as the interactions between chemical compounds and biological systems.

DOE Office of Science - Program Title: Biological and Environmental Research (KP)	
Approximate Dollar Value: \$23.6M	
Sub-Program (\$K)	Missions Alignment
KP-14-01-03 (\$1310) High Field Magnetic Resonance Imaging)	National Trust Science. The MRI Program and the functional magnetic resonance research associated with it supports the “Protect Our Living Planet” theme of the DOE’s research mission as well as providing “extraordinary tools for extraordinary science”. As part of BNL’s Center for Imaging and Neurosciences, the MRI Program investigates the synergistic uses of multiple imaging modalities in studies of the human and animal brain, and other organs. As part of DOE’s AMI Program, nuclear medicine imaging systems that can image animals and humans in real time without anesthesia are being developed (<i>Imaging the Awake Animal Brain</i> project)
KP-14-01-04 (\$824) Physiological Imaging	National Trust Science. This project takes advantage of the combination of imaging technologies available at BNL to investigate physiological and neurochemical mechanisms underlying addictive behaviors and aging. It provides “extraordinary tools for extraordinary science” while also being aligned to the Protect Our Living Planet theme of DOE’s science mission.
KP-14-01-05 (\$2420) BNCT Research	National Trust Science: These projects focus on developing Boron Neutron Capture Therapy for the treatment of cancers.
KP-14-01-05 (\$2366) Medical Research Reactor Operations	None. This project was terminated following an in-depth Laboratory review of its costs and its future role in DOE’s scientific missions.
KP-14-01-06 (\$1080) Imaging Gene Expressions and Neuroreceptor Radioligands	National Trust Science. These projects support the conduct of experiments to evaluate receptor selectivity essential for understanding the therapeutic effects of drugs and the ability to image tumors in the development stages.

DOE Office of Science: Miscellaneous Programs	
Program Title: Computation and Technology (KJ) and University and Science Education (KX)	
Approximate Dollar Value: \$2.6M	
Sub Program (\$K)	Mission Alignment
KJ02 (\$1856) Computational and Technology Research	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..
KJ01 (\$342) Computational and Technology Research	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.

DOE Office of Science: Miscellaneous Programs

Program Title: Computation and Technology (KJ) and University and Science Education (KX)

Approximate Dollar Value: \$2.6M

Sub Program (\$K)	Mission Alignment
KX (\$400) University and Science Education	<p>National Trust Science: Supports the DOE education objectives by building the capacity of undergraduate institution in support of DOE’s scientific mission, by providing educational a career pathways in math, science and engineering for a diverse population of undergraduate students and precollege institutions, and by increasing science literacy of precollge math, science and engineering teachers.</p>

DOE - NNSA

Program Title: Non Proliferation and National Security

Approximate Dollar Value: \$31M

Sub Program (\$K)	Mission Alignment
NN-50 (\$27,800) Nonproliferation and National Security Program	<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> <ul style="list-style-type: none"> 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>Support the development of regulatory documents pertaining to nuclear materials protection, control and accounting in Russian facilities.</p>
NN40 (\$1800) Nonproliferation and National Security Program	<p>Nuclear Proliferation 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>
NN31, NN20, and NN10 (\$462) Nonproliferation and National Security Program –	<p>Nuclear Proliferation; 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.</p>

DOE – Conservation and Renewable Energy, Fossil Energy, Energy Information Administration

Program Title: Energy Efficiency, Fossil Fuels, National Energy Information Systems

Approximate Dollar Value: \$6.4M

Sub Program (\$K)	Mission Alignment
TA01 (\$170) National Energy Information System (NEIS)	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.
EE05 and EE06 (\$2646) Transportation Sector	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
EC09 (\$1400) Building System Design	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 NO _x oil burner technologies for use in homes and commercial buildings.
EB40 (\$1040) Solar and Renewable Resource Technologies	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 (\$550): Solar and Renewable Resource Technologies	Energy Sources: BNL continues work on the development of practical conductor for Electric Power Systems.
EB22 (\$330) Solar and Renewable Resource Technologies –	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 play an important role in planning for increased utilization of PV as an energy source.
EH (\$100) Policy and Management for EERE	Energy Infrastructure: BNL provides assistance to DOE in area of policy and management of energy.
AC10, AA20 (\$200) Fossil Energy	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 – Environmental Management

Program Title: EW

Approximate Dollar Value: \$1.5M

Sub Program (\$K)	Mission Alignment
EW40 (\$1540) Environmental and Waste Management	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 Nuclear Energy, Science and Technology

Program Title: Isotope Production and Distribution (ST) and Nuclear Energy Research and Development (AF)

Approximate Dollar Value: \$3M

Sub Program (\$K)	Mission Alignment
ST-01-01-02 (\$2400) Radioisotope Production at BLIP	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”.
AF (\$600) Nuclear Energy Research and Development	Environmental Cleanup and Homeland Defense: BNL provides technical support (analysis and small scale experiments) the Advanced Accelerator Applications program whose primary focus is RD&D related to accelerator driven systems from transmutation of radioactive nuclear waste.

Work For Others - Non DOE

Approximate Dollar Value: \$44M

Sub Program (\$K)	Missions Alignment
DOD (\$600)	Environmental Cleanup and Nuclear Proliferation: BNL continues to provide programmatic support for the Artic Military Environmental Cooperation (AMEC). BNL’s involvement includes several programs dealing with radiation monitoring and containment from Russian nuclear submarines, which are awaiting dismantlement.

Work For Others - Non DOE

Approximate Dollar Value: \$44M

Sub Program (\$K)	Missions Alignment
DHHS (NIH); (\$8900)	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 (\$6,700)	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 (\$1,800)	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 (\$8300)	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.
NASA & NSBRI (\$1500)	National Trust Science. As part of DOE's research theme for protecting our living planet, researchers at BNL are funded by NASA and its research arm, NSBRI, to perform basic and applied research related to the effects of ionizing radiation on animals and humans. This research makes use of BNL's accelerator facilities.
NRC (\$7,400)	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.
Other Federal Agencies (\$1,000)	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.
Work for Others Non-Federal (\$6,000): State, local gov't., non-profits, utilities and universities	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.
CRADAs (\$1,800): industry	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.

Work For Others – Other DOE Labs/Field Offices	
Approximate Dollar Value: \$32.2M	
Sub-Program (\$K)	Missions Alignment
Battelle-PNL, Oakland, Idaho, Sandia (\$800)	Nuclear Proliferation and Energy Infrastructure: 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.
Battelle, ANL, ORNL, (\$2470)	Climate Change and National Trust Science: 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
Sandia, Rocky Flats, Nevada, Battelle-PNL, ORNL (\$480)	Environmental Cleanup: BNL work includes technical and experimental support to WIPP for the examination of the role of microorganisms in colloidal transport of actinides under relevant test conditions., support to ORNL in managing mercury wastes and the PNL in management of Double walled tanks.
Oakland Ops, Midwest Research Institute, NREL and LLNL (\$230)	Energy Sources: BNL projects include Nuclear Energy Research Initiatives, development of biodiesel fuels for space applications and Generation IV technology roadmaps.
Albuquerque Ops, Sandia, Oakland Ops, Battelle, LBNL, ORNL, LANL, SLAC, Fermi (\$1380)	National Trust Science: BNL executes specific projects that are consistent with our core capabilities in basic sciences such as accelerator and detector design, advanced instrumentation and materials. In addition, work for other DOE includes projects at our unique facilities, such as the Alternating Gradient Synchrotron Accelerator Complex.
Spallation Neutron Source (\$26,900)	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.

DOE – Miscellaneous: Laboratory Support Programs and Programs in Support of DOE	
Approximate Dollar Value: \$55.4M	
Sub Program (\$K)	Mission Alignment
KG – Multipurpose Energy Laboratory Facility Support (\$6400)	Landlord Infrastructure: Maintain infrastructure of the Laboratory
SO, GD, FS, ND – Office of Security and Emergency Operations (\$9,600)	Homeland Defense: Provide site safeguards and security
EW – Environmental Management (\$37,400)	Environmental Clean-up: Remediate contamination from past practices. Provides for program management and remediation and decontamination/decommissioning activities
CN – Office of Counter-Intelligence (\$1,000)	Homeland Defense: Supports the CI activities at the site.

DOE – Miscellaneous: Laboratory Support Programs and Programs in Support of DOE

Approximate Dollar Value: \$55.4M

Sub Program (\$K)	Mission Alignment
HC-10 (\$127) Environment, Safety and 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 (\$900) 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.

DRAFT

1.3 Success in Constructing and Operating Research Facilities

Supporting information for BSA Constructing and Operating Research Facilities performance for Fiscal Year 2002 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 2002 were all either achieved or exceeded.

Performance:

- RHIC operational with gold and polarized proton beams at full collision energy, all experiments collecting data and publishing
- Peak luminosity approx. $5 \times 10^{26} \text{cm}^{-2} \text{sec}^{-1}$ (Au-Au), $2 \times 10^{30} \text{cm}^{-2} \text{sec}^{-1}$ (p-p)
- Average store luminosity approx. $1-1.5 \times 10^{26} \text{cm}^{-2} \text{sec}^{-1}$ (Au-Au), $\sim 1 \times 10^{30} \text{cm}^{-2} \text{sec}^{-1}$ (p-p)
- First acceleration of polarized protons to 100 GeV with approx. 25% polarization
- Storage times up to 12 hours
- Refill time of 45 minutes between stores
- RHIC operating with Au x Au at 40 TeV
- AGS slow beam averages 6.4×10^{13} protons/pulse with world record peak at 7.4×10^{13}
- FY 2002 protons delivered (5.7×10^{19})

Facility Availability

HEP = 87.7%

NP (RHIC) = 82.5%

1.3.1.2 Physics Department

Budget and Schedule Performance

Success in Constructing and Operating Research Facilities

Nuclear Physics (NP) Summary: A major RHIC shutdown is presently under way, preceding the third run scheduled to start in the fall of 2002. Major new capabilities have been added to the detectors, including PHENIX's second muon arm and a large piece of STAR's electromagnetic calorimeter. The RHIC Computing Facility (RCF) followed a successful data processing and analysis performance after the 2000 run with a significant increase in capability to handle the data expected in 2001. These efforts are on schedule and within budget.

- RHIC Experiments

PHENIX: The second muon spectrometer, the last major piece of the baseline detector is being installed in the current shutdown. All mechanical and electronic installation is complete; the detector is being turned on and run in.

STAR: During the present shutdown a large portion of the detector's electromagnetic calorimeter is being installed. This will increase STAR's capabilities for the next run, especially in polarized proton physics.

- LEGS: Very productive efforts to complete the TPC, especially its electronics, have started in concert with the Instrumentation Division.

High Energy Physics (HEP) Summary: The major construction efforts in HEP are the ATLAS Project and preparations for the KOPIO Project. A significant new ATF experiment is also complete and in operation.

- ATLAS Project Management - Good Lehman review. Developing Research Program, which includes Pre-Operations (commissioning and integration), Maintenance and Operations, R&D for Upgrades and Computing.

Technical Coordination – David Lissauer continues to lead both the BNL and ATLAS Technical Coordination. This is having a major constructive role for ATLAS.

Calorimeter – Major event is the complete installation of the BNL-built Signal Feedthroughs in the ATLAS barrel cryostat and successful vacuum tests of the cryostat allowing the start of installation of the Electromagnetic Modules. Also the development of a radiation-tolerant power supply has been accomplished. BNL is preparing for the system test of a crate full of Front End Boards.

Muon System Fabrication of Cathode Strip Chambers has started.

Computing – Excellent progress on the Tier I center and software. BNL is making a significant contribution to Data Challenge 1 (DC1). BNL is leading the Event Data Model for ATLAS and with the discarding of the Objectivity Database is leading the effort on the hybrid event store using open source components. BNL is leading the Liquid Argon reconstruction and data base efforts in ATLAS and is contributing to the object-

oriented muon reconstruction (MOORE). Torre Wenaus is working at CERN part time as the Applications Leader of the LHC Grid Computing Project.

- ATF - Experiment AE22, the Staged Electron Laser Accelerators phase II has been constructed and initial results obtained, including the largest acceleration in an Inverse Free-Electron Laser accelerator.

Condensed Matter Physics (CMP) Summary: CMP scientists continue to play key roles in the construction and operation of two facilities at the Advanced Photon Source, the CMC-CAT and IXS-CAT beam lines for advanced x-ray scattering studies. They also play the leading role in development of a new spectrometer for SNS called HYSPEC. Overall, our performance has been "EXCELLENT."

Facility Performance Assessment

Overall, the performance of those facilities already in operation meets or exceeds expectations. The RHIC experiments are evolving toward their baseline configurations. In their first two runs the detectors' up-time generally exceeded the 50% planning number. Following each run there has been an extensive shutdown during which major detector enhancements have been performed on schedule and within budget. The performance of the APS beam lines has been judged to be excellent.

1.3.1.4 Superconducting Magnet Division

Budget and Schedule Performance

LHC magnet program - within budget and ahead of CERN installation schedule

LHC superconducting testing - within budget and on schedule

RHIC helical magnet program - within budget and on schedule

DESY/HERA magnet program - final spare magnet delivered in support of installation schedule

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

Measure 1-'Evaluation of infrastructure support for LEAF'. In an environment of tight operating budgets the need for machine operators was analyzed to see if program money could be saved by having one of its principal operators absorb certain tasks of the Building Manager. It was determined there was enough infrastructure support to reduce its operators by .2 FTEs. This reduction saved the program approximately 30K, and enabled other program objectives to be met.

Measure 2-'Facilitate the installation of a new Cyclotron'.

Facility Performance Assessment

Measure 1-'Evaluation of infrastructure support for LEAF'. In the future the Safety Assessment Document (SAD) will be modified to allow individuals to run the machine with an operator "on call."

1.3.2.2 National Synchrotron Light Source

Budget and Schedule Performance

During FY2002, the NSLS implemented a planning model which included a Department Strategic Plan, an Annual Operating Plan and Individual Staff Objectives that were designed to meet Department goals. As part of this planning process a new budgeting system was implemented which required individual plans for all routine operations and for proposed projects for FY2002. This process was initiated early in FY2002 with a call operating requirements and project proposals. Operating funds were allocated according to need and proposals for non-routine tasks were prioritized to meet Department goals. Funds were allocated as appropriate. Later in the year, progress was reviewed and adjustments were made where necessary.

Facility Performance Assessment

The storage rings continue to operate in a remarkable fashion. The NSLS was the first of the 'second generation' light sources and has been in continuous operation for over 20 years. There are some aspects of the machine that 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. It is noteworthy that some unanticipated failures have occurred, but the lost time has been kept to a minimum largely through the experience and dedication of the staff. As an example, just prior to the May 2002 shutdown, the injection shutter for the UV ring developed a significant leak in the actuator bellows. Work around solutions were developed that facilitated operations and a replacement shutter was fabricated in two weeks that was successfully installed during the shutdown. Including the discovery of the problem, troubleshooting, and field measurements to make the new shutter, the total lost operations time was only 34 hours.

Facility Availability

During FY 2002 through June 30, the NSLS has operated compared to its schedule as follows:

VUV X-ray

Scheduled Time [hr] 4322 3528

Operations [hr] 4215 3394

Unscheduled Operations [hr] 141 510

Reliability [%] 98% 96%

Availability [%] 101% 111%

User Survey Results

At the end of beam run users are asked to provide feed-back in a number of key areas such as machine performance, beam capability, and NSLS infrastructure support such as training, safety program, beam turn-on, etc. Although not utilized by every research team, the NSLS management receives considerable feedback from the User Administrative offices that collect and tabulate the responses on a monthly basis. Copies of the monthly reports are distributed to NSLS managers for their information and action as appropriate. The feedback is very positive on NSLS programs, though specific issues about particular performance areas is periodically raised that require examination by the appropriate managers.

1.3.3 Life Sciences

1.3.3.1 Biology Department

Budget and Schedule Performance

Three of our NSLS macromolecular crystallography beamline underwent significant upgrades during the NSLS winter shutdown. The upgrades to facilities were performed within budget and on schedule.

The NASA funded Booster Applications Facility, currently being constructed for the radiobiology user community, is on schedule and within budget.

Facility Performance Assessment

All the facilities have had outstanding performance by operating on schedule and within budget even during periods of major re-construction.

Facility Availability

The Scanning Transmission Electron Microscopy Facility continues to operate 40 hours/week. The Biology Department operates five beamlines at the NSLS for Macromolecular Crystallography. Operations are limited to NSLS availability. Operations are about 215 days/yr, beamline maintenance and upgrades are scheduled during NSLS shutdowns. This year three beamlines were totally rebuilt during the NSLS winter shutdown.

The NASA Radiobiology Program had one run this year consisting of 150 hours of AGS beamtime. It was used by 80 researchers conducting 27 different experiments.

User Survey Results

All macromolecular crystallography user comments have been positive (as evidenced by the End of Run reports). Advisory committee feedback is used to develop a path forward for the facilities.

1.3.3.2 Medical Department

Budget and Schedule Performance

In the Isotope Production Facility, the production expenses are on budget and billing of isotopes shipped is on schedule (within 4 days of shipment).

The construction project for NASA funded Booster Applications Facility for the Radiobiology program is on schedule and on budget.

Facility Performance Assessment

The Medical Department is responsible for and/or provided oversight to the following facilities, all of whom achieved outstanding performance as evidenced by the following:

1. BNL Clinical Research Center:

Approximately 343 human subject visits, under 42 IRB-approved protocols, were coordinated and processed by the CRC. The CRC provides core support to clinical researchers in the areas of protocol coordination and implementation, subject scheduling, administrative assistance, clinical facility housekeeping, pharmacy services, infection control monitoring and clinical record maintenance for all human subject research conducted at BNL. They also underwent a successful audit by the Office of Human Research Protection (OHRP) this spring.

The CRC operations are accredited by the Joint Commission on Accreditation of Healthcare Organization (JCAHO). During the reporting period, investigators from the Medical and Chemistry Departments, as well as collaborators under the NASA/AGS program, utilized the CRC to carry out IRB-approved research involving human subjects.

Efforts were initiated by L. Chang during FY 2001 to pursue NIH/NCRR funding as a General Clinical Research Center (GCRC). Preliminary investigations led BNL to initiate a relationship with SUNY, SB that currently has funding for its GCRC. Efforts continued into the current fiscal year to submit a supplemental proposal to NIH so that the BNL facility could operate and be funded by NIH as a satellite of the Stony Brook Facility. These efforts will continue into FY 2002; due to NIH grant review timetables, funding is not likely to occur until at least FY 2003.

2. BNL Animal Facility (BLAF):

The BLAF housed a population of rodents, rabbits and baboons. The facility maintains accreditation by the Association for the Assessment and Accreditation of Laboratory Animal Care International (AAALAC) and is periodically inspected by U.S. Department of Agriculture. The facility houses, maintains and cares for all animals used in approved animal studies at BNL. Such research includes, on average, 25 active protocols held by approximately 15 investigators including members of the Medical, Chemistry and Biology departments as well as collaborators utilizing the AGS/NASA facility and NSLS.

In June, 2002 the BLAF successfully underwent its triennial AALAC inspection.

3. Radiation Therapy Facility (RTF):

The RTF, operated under agreement with the Department of Radiation Oncology at SUNY, Stony Brook, provides radiation therapy to local cancer patients. The facility treated approximately 800 patients during the fiscal year, while providing a foundation for related research and collaborations between SUNY, Stony Brook and the Medical Department.

4. The NASA Radiobiology Program had one run this year consisting of 150 hours of AGS beamtime. It was used by 80 researchers conducting 27 different experiments.

5. The Isotope Production Facility had 3 process improvements on Co-55, Co-57, Ge-68 development which are all underway. The MS Project schedules were submitted and all projects to date are on schedule.

Facility Availability

All facilities managed by the Medical Department were available as planned during the year. This is evidenced by the following:

- The Clinical Research Center is utilized by all investigators involved in human subject research at BNL. There were 12 internal users from the medical and Chemistry departments. FY 2002 BNL external users included our collaborators from SUNY SB, Albert-Einstein School of Medicine and NYU.
- The BNL Animal Facility is responsible for the housing and care of all animals used in approved IACUC protocols at BNL. Users included members of the Medical and chemistry departments; total number of investigators was 17. External users during the past included NASA/AGS users and NSLS users from NIH.

- The Radiation Therapy Facility, located in Pavilion 4 of Building 490 is operated by Medical Department collaborators from the Department of Radiation Oncology at SUNY, Stony Brook.
- The NASA Radiobiology Program had one run this year consisting of 150 hours of AGS beamtime. It was used by 80 researchers conducting 27 different experiments. Researchers are NASA funded and from BNL, other universities as well as some from the Italian Space Agency.
- The Isotope Production Facility had 3 process improvements on Co-55, Co-57, Ge-68 development which are all underway. The MS Project schedules were submitted and all projects to date are on schedule.

1.3.4 Energy, Environment and National Security

1.3.4.1 Environmental Sciences

Budget and Schedule Performance

Environmental Sciences does not operate a DOE Facility. The FACE facility in Duke, North Carolina, is not an official DOE Facility.

1.3.4.3 Nonproliferation and National Security

Notes, Issues, Trends and Assumptions:

There are no facilities within the Nonproliferation and National Security Department.

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 ~\$29 M in FY 2002 funding

In summary, the milestones identified in the work packages that cover FY 2002 work have been fulfilled.

1.4 Effectiveness and Efficiency of Research Program Management

Supporting information for BSA Research Program Management performance for Fiscal Year 2002 has been organized into the following data categories:

- Management Goals and Processes for Fiscal Year 2003
- Number of New Associate Scientists (or Above) Hired
- Number of 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
- List of WFO Projects and Sponsors
- Staff Profile
- Visiting Scientist 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 2003

- 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 & BAF) and with non-federal entities for a RCMS

Number of New Associate Scientists (or Above) Hired

- One Senior Scientist

Number of 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. 2-3 years at present funding left to go.
- AGS: Siemens MG Set under installation after failure caused by General Electric Corporation faulty QA program
- Booster: slow extraction system under installation for BAF
- LINAC: Polarized proton ion source is operational
- BAF: Construction is on schedule

Safety Enhancements

- Consolidating and updating all of the C-A facility Safety Assessment Documents into a unified C-A SAD. Approximately 30% complete.
- Prepared and issued the Acceptance Plan for Routine Operations of the TTB with Low Mass Ions and RHIC with Deuterons, February 5, 2002
- Prepared and issued the Accelerator Safety Envelope (ASE) for the Tandem Van de Graaff and Tandem to Booster Transfer Line, December 1, 2001
- Prepared and issued the Commissioning and Acceptance Plan for the Operation of Booster Application Facility, February 15, 2002
- Prepared and issued a USI associated with the BAF SAD: Change to Critical Devices Listed in BAF SAD, April 9, 2002

Steps Toward Development of Next Generation Facilities and Research Tools

- RHIC II: Electron cooling R&D commenced with DOE support, including Bates Lab, TJNAF and BINP
- eRHIC: Conceptual design commenced
- Neutrino Source: Conceptual design commenced
- RCMS: Conceptual design was completed. Seeking non-federal funding.
- RSVP: Canadian funding obtained. Currently awaiting NSF funding

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)

Facts and Figures for FY 2002

List of Projects/Programs Involving Collaboration with Others

Non-DOE Funded Programs That Connect To DOE:

- NASA radiobiology at AGS and BAF
- RCMS (Pennsylvania), Stony Brook, etc., Medical Synchrotron
- NSF High-Energy Physics RSVP experiments (R&D funding, construction funds pending) TRIUMF etc.

Collaborations with Other Laboratories or Universities:

- 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

- The number of users that were administered through the RHIC & AGS Users' Center:

AGS:	433
ATF:	17
RHIC:	1028
Tandem:	120
Total:	1598

List of WFO Projects and Sponsors

- Booster Application Facility: NASA
- Genetics and Epigenetic Effects: NASA

Staff Profile

Tenured	12	Professional	152
Continuing	26	Scientific	51
Term	10	Technical	247
Research Associates	0	Administrative	28
Post Docs	3	Management	4
		Total	482

Funding Profile for the Last Seven (7) Years

2002	133,912,000
2001	127,859,000
2000	116,475,000
1999	N/A
1998	N/A
1997	N/A
1996	N/A

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

- CRADA # BNL-C-01-03, Non-Vacuum Electron Beam Welding with Acceleron Inc.
- CRADA # BNL-C-02-07, Accelerator design of a proton therapy facility with Accel Instruments, GMBH

Co-Authored Papers:

- The majority of C-A publications have co-authors. As stated in Metric 1.1.1.1, Peered-Reviewed Publications for FY 2002, C-A has a total of 89 publications in referred journals, major reports and proceedings. 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 2003

- Nuclear Physics Summary: Nuclear Physics management goals in the Physics Department center on maintaining and improving the research capability of the groups working at RHIC. New post-docs have been hired (especially in the STAR and RHIC Spin Groups) and scientists with critical expertise in the RHIC experiments are being recruited and promoted. The PHENIX Group is currently searching for a senior scientific hire with leadership potential. NP and HEP management is also involved in developing a small but highly leveraged effort in relativistic heavy ion collisions at CERN's Large Hadron Collider.
- High Energy Physics Summary: The HEP effort will be right-sized by department management to face the challenge of new operating budget levels. HEP management will also continue to develop new areas of research where BNL expertise can play a high impact

role in the U.S. HEP effort. These areas include very long baseline neutrino oscillations and linear colliders. The Accelerator Test Facility (ATF) is being integrated into the Physics Department. It is under HEP but will have a role in the eventual luminosity upgrade of RHIC, therefore it is also connected to ongoing NP efforts.

- Condensed Matter Physics (CMP) Summary: CMP's Effectiveness and Efficiency of Program Management is 'OUTSTANDING.' Significant steps have been taken toward rebuilding the Theory Group through the hiring of Alexei Tsvelik, a world-renowned theorist as Group Leader, and a second Associate Physicist, Fabian Essler. We are presently searching for a junior or mid-career level theorist in Electronic Structure. In addition, a number of new post docs and students have been added to the staff during the last two years.
- A collaborative effort within the Center for Neutron Science and the Neutron Scattering Group has accomplished its near-term goals of moving instrumentation from the HFBR to HFIR and NIST as well as establishing a BNL presence at HFIR associated with the US-Japan Cold Source. The latter includes the hiring of a junior level scientist who is now stationed at ORNL. In addition, a Science-Alliance has been established with NIST to set up a permanent presence of BNL at the NIST reactor, including the hiring of a junior level beam line scientist.
- The activity described here and in Section 1.1.1.2 represent significant new developments in BNL's CMP programs and are directly responsive to DOE requests.

Number of New Associate Scientists (or Above) Hired

- Eight Associate Scientists*

*Includes the transfers and movement to and from professional staff

Number of New Research Associates Hired

- Seventeen Research Associates*

*Includes transfers and movement to and from professional staff

Significant Improvements in Infrastructure and Management Systems that Support Research

- Department management undertook a comprehensive review and restructuring of administrative support within the department. The restructuring is expected to be completed within the next few months.

Safety Enhancements

- Physics has an excellent safety record and approach to the safe conduct of research. The Department continues to develop processes and documentation that finds uses within the Laboratory beyond the Physics Department.
- The expertise of safety management is currently expanding to encompass the needs of the ATF group, whose transition to Physics brings along with it aspects of accelerator operation not currently in the Physics portfolio.

Steps Toward Development of Next Generation Facilities and Research Tools

- NP: The management of the department will oversee the process of detector upgrades for the RHIC program during the coming year.
- HEP: The management of the department was involved in design and development work for the KOPIO project, as well as targets and beams for long baseline neutrino oscillation experiments.

- CMP: A Letter of Intent was submitted for the purpose of building a BNL-based spectrometer called HSYPEC at SNS.

List the Number of International Collaborations

- The Physics Department participates in international collaborations at RHIC, AGS, NSLS, etc. which, in the aggregate, has several hundred international participants.

Facts and Figures for FY 2002

List of Projects/Programs Involving Collaboration with Others:

- Almost every NP, HEP and CMP effort involves collaboration - national, international or both. They are listed in the annual Field Work Proposals to the DOE.

Number of Users

- The average number of Visiting Appointments, Guest Appointments, and Research Collaborators in Physics is about 125 in total. In addition, at any given time there are several hundred users of RHIC, AGS, NSLS and other BNL facilities who are supported through the Physics Department.

List of WFO Projects and Sponsors

- COBASE Grant (Shapiro): National Research Council
- EPSCoR (Strongin): NSF
- Dynamics of Thin Metal Films (Gibbs): Sandia
- Assist ORAU in EPSCoR Conference (Strongin): ORAU
- D-0 Run 2b Upgrade (Kotcher): FERMILAB
- Japan Coop. Prog. Neutron Scatt. (Shapiro): Univ. Tokyo
- US ATLAS Barrel Cryostat (Gordon): Univ. Rochester
- KOPIO Detector R&D (Sivertz): Yale Univ. (NSF)

Staff Profile

Tenured	41	Professional	62
Continuing	34	Scientific	161
Term	56	Technical	40
Research Associates	30	Administrative	32
Post Docs	3	Management	2
		Total	297

Visiting Scientist Profile

- Four Total: (HEP 1, NP 2, CM 1)

Other Awards

- Awards are listed in 1.1.1.2

Other Publications, Citations, Press Releases for this Fiscal Year

- Publications are enumerated in 1.1.1.2

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

Publications are enumerated in 1.1.1.2

1.4.1.3 Instrumentation Division

Management Goals and Processes for Fiscal Year 2003

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 & microscopy;
- Protein crystallography.

•

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;
- New small animal PETs;
- Neutron detectors for SNS;
- Solar neutrino detectors;

Nano-fabrication

- Pattern generation;
- Deposition/ablation;
- Characterization.

Significant Improvements in Infrastructure and Management Systems that Support Research

- Real Time X-ray Inspection System was purchased for quality control and process verification of our Printed Circuit Boards.

Safety Enhancements

- Installed in our Printed Circuit Fabrication Facility a third tank in accordance with Suffolk County Article 12 requirements for secondary containment.

Steps Toward Development of Next Generation Facilities and Research Tools

R&D for future facilities (LHC, FNAL, Linear Collider):

- Si-detector technology, prototype fabrication, radiation hardness (the only facility for the U.S. HEP program),
- Microelectronics, low noise, submicron-to-nanoscale;
- Neutrino detectors, new concepts;
- Vertex-tracker;
- Picosec/femtosec beam diagnostics for future accelerators

List the Number of International Collaborations

- Ten

Facts and Figures for FY 2002

List of Projects/Programs Involving Collaboration 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

- MPPO PNNL Post Doc
- NSBRI
- LANL SPDs
- Argonne Detector

Staff Profile

Tenured	5	Professional	10
Continuing	8	Scientific	21
Term	4	Technical	17
Research Associates	2	Administrative	4
Post Docs	2	Management	
		Total	52

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

2002	5,690,000
2001	5,900,000
2000	5,880,000
1999	5,709,000
1998	5,081,400
1997	5,026,000
1996	4,789,000

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

- CRADA's: 5
- Co-Authored Papers: 19

1.4.1.4 Superconducting Magnet Division

Safety Enhancements

- Established operating budget for ES&H issues.
- Updated website to include listing of personnel authorized to perform LOTO and initiate group LOTO; and areas with high noise level.

Steps Toward Development of Next Generation Facilities and Research Tools

- Neutrino factory storage ring design and magnet R&D
- High Field NMR
- GSI rapid cycling magnet R&D
- eRHIC
- Next Generation Hadron Colliders - High field magnet R&D
- NLC - Final focus magnet R&D

List the Number of International Collaborations

Total: Five

- GSI - rapid cycling superconducting magnets
- CERN - LHC superconducting magnet magnets and superconductor testing; ATLAS detector
- DESY - HERA luminosity upgrade magnets
- IHEP - BEPC-II magnets
- NLC

Facts and Figures for FY 2002

List of Projects/Programs Involving Collaboration with Others

- GSI - rapid cycling superconducting magnets
- LANL - large aperture quadrupole magnets for AHF Project
- ORNL - testing of SNS magnets
- FNAL - LHC superconducting magnets and superconductor testing
- LBL - superconductor testing
- CERN - LHC superconducting magnets and superconductor testing; ATLAS detector
- DESY - HERA luminosity upgrade magnets
- IHEP - BEPC-II magnets
- Neutrino factory and muon collider
- eRHIC
- NLC

Staff Profile

Tenured	2	Professional	18
Continuing	94	Scientific	12
Term	1	Technical	64
Research Associates		Administrative	3
Post Docs	1	Management	1
		Total	98

Funding Profile for the Last Seven (7) Years

2002	15.4M
2001	13.4M
2000	17.0M
1999	N/A
1998	N/A
1997	N/A
1996	N/A

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

Total: Two

- Design Study of Super-Conducting Partial Snake for AGS
- Inter-strand Resistance and AC Losses in Cored Rutherford Cables

1.4.2 Basic Energy Sciences

1.4.2.1 Chemistry Department

Management Goals and Processes for Fiscal Year 2003

Chemistry involvement within BNL plan in nanoscience (aligned with the DOE nanoscience goals) involves two funded proposals:

- Nanocatalytic materials focus on the electronic structure of metal-containing nanoparticles as a basis for understanding and controlling their catalytic activity and selectivity.
- Charge transfer in molecular nanosystems focuses on obtaining a fundamental understanding of the mechanism of charge transport on the nanoscale and in nanomaterials.
- LEAF Experiments combining electron pulse and laser pulse excitation are anticipated to achieve ~ 0.1 picosecond time resolution. This will give LEAF a unique ability to combine the well-defined energetics of accelerator experiments with the high time-resolution of laser experiments. The LEAF facility also holds significant promise as a unique core instrument in support of BNL's nanoscience initiatives.
- Catalysis program will focus on reactivity and structure correlations of nanoscale materials. Success in this area will require new expertise in materials synthesis as well as the development of characterization tools that can index in situ chemical activity with the spatial resolution of proximity probes. This will position the program to compete for the proposed DOE program "National Catalysis Research Institute."
- Gas-phase Reaction Dynamics program involves collaboration between BNL and Stony Brook University to investigate the dynamics of radical reactions using novel ion imaging and intense VUV radiation from the DUV-FEL facility at BNL.
- Imaging programs are integrating Micro-PET with radiotracer R&D efforts to validate its use in quantitative PET studies. DOE has provided funding for a new cyclotron dedicated to isotope production for the PET program. The recent upgrade of the Magnetic Resonance Imaging (MRI) scanner makes it possible to perform functional and physiological measurements using ultrafast MRI scans.

Number of New Associate Scientists (or Above) Hired

- One Associate Scientist

Number of New Research Associates Hired

- Twelve new postdoctoral Research Associates

Significant Improvements in Infrastructure and Management Systems that Support Research

- Removed cooling tower from Roof of Building 555
- Roof Repaired in Building 555
- Two new air conditioners for Building 906
- Two portal monitors installed along with shelving in Building 906
- Upgrade of reheat system in Building 555
- Computer upgrades
- Access to internet upgraded

Safety Enhancements

- Electrical drops installed in hallways so custodians could access outlets and not tie-up labs or have extension cords extending throughout the halls.

Steps Toward Development of Next Generation Facilities and Research Tools

- Improved the laser system of the LEAF by installing a 30HZ YAG laser.
- Purchased Ebco Cyclotron which is presently under construction in Vancouver.
- Upgraded Magnetic Resonance Imaging (MRI) scanner.

Steps Toward Improvement of Proposal Quality and Opportunities

- Attending DOE and NAS organized National Workshop on Counterterrorism, Catalysis and Energy to position us for submission of proposals and improve ability to respond to calls from funding agencies. Four scientists attended three workshops.

List the Number of International Collaborations

- Twelve

Facts and Figures for FY 2002

List of Projects/Programs Involving Collaboration with Others

- Solar Neutrino Research
- Thermal, Photo- and Radiation-Induced Reactions in Condensed Media
- Gas-Phase Molecular Dynamics
- Photoinduced Molecular Dynamics in the Gas and Condensed Phases
- Catalysis: Reactivity and Structure
- Radiotracer Chemistry and Neuroimaging
- High-Field Magnetic Resonance Imaging
- Positron Emitter Labeled L-Boronophenylalanine for BNCT
- Injection of Electrons and Holes into Nanostructures
- Catalysis on the Nanoscale: Preparation, Characterization and Reactivity of Metal-Based Nanostructures
- Universal/Imaging Studies of Chemical Dynamics
- PHOBOS Research
- PHOBOS Operations

List of WFO Projects and Sponsors

- Molecular Logic Gates, P.I. John Miller
- PET Studies in Cocaine Abusers, P. I. Nora Volkow
- Radiotracer R&D in Nuclear Medicine and Neuroscience, P.I. J. Fowler
- Brain Metabolism in Alcoholics with and without Challenge, P.I. N. Volkow
- Pharmacokinetics of Physcostimulants and Reinforcement, P.I. N. Volkow
- Nondiamagnetic Agents in In Vivo ^{23}Na and $^1\text{H}_2\text{O}$ MR, P.I. C. Springer
- 4 Tesla MRI Bolus CR Studies of Human BBB Permeability, P.I. C. Springer
- Optimizing Intensity and Duration of GVG Pharmacotherapy, P.I. S. Dewey
- PET Investigations of Abused Inhalants, P.I. M. Gerasimov
- Catalytic Mechanism of Human Mn Superoxide Dismutase, P.I., D. Cabelli

Staff Profile

Tenured	17	Professional	7
Continuing	10	Scientific	63
Term	10	Technical	8
Research Associates	26	Administrative	5
Post Docs		Management	
		Total	83

Visiting Scientist Profile

- One hundred forty-two total collaborators.
- Twelve scientists collaborating from National Laboratories.
- Remaining guests from academia or BNL retirees.

Funding Profile for the Last Seven (7) Years:

2002	16271
2001	17362
2000	15240
1999	15225
1998	14612
1997	13610
1996	14171

Other Publications, Citations, Press Releases for this Fiscal Year

- N/A (Department does not keep track of this information) Public Affairs has information pertaining to our community outreach.

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

- Ninety-three peer reviewed papers.

1.4.2.2 National Synchrotron Light Source

Management Goals and Processes for Fiscal Year 2003

- Provide highest priority to establishing a major upgrade to the NSLS facility to provide increased photon brightness and beam line capability.
- Provide high priority to the allocation of resources to upgrade existing beam lines.
- Maintain the injector systems and storage rings in a manner to ensure continued high reliability.
- Improve beam line productivity and management; and eliminate non-productive beam lines, which do not have upgrade possibilities

- Stimulate increased interest and awareness of NSLS accelerator and beam line research and provide high priority to improving communication with NSLS stakeholders regarding NSLS accomplishments

Number of New Associate Scientists (or Above) Hired

- One Associate Scientist

Number of New Research Associates Hired

- Five Research Associates

Significant Improvements in Infrastructure and Management Systems that Support Research

- A major reorganization to better align department resources and to encourage improved planning of department priorities and commitments was completed.
- The budget process was revised to permit better definition and prioritization of department needs. Each operating organization was asked to examine their FY 2001 operating budget and to justify their FY 2002 budget requests in writing.
- A new process was developed for the submission, review and approval process for NSLS projects utilizing operating, capital and AIP funds.
- Significant progress in communicating with users and external stakeholders was achieved through the establishment of the Information & Outreach Program.

Safety Enhancements

- NSLS safety record was very positive in FY 2002 and continues trends of recent years. Highlights are as follows:
- Only one recordable injury has been experienced and NSLS injury rates continue significantly lower than the BNL average.
- Radiation exposures to NSLS staff and users continue at very low levels. Total collective whole body dose equivalent has been averaging about 50 mrem per year for several years.
- Environmental issues have a very positive trend. No reportable spills have occurred in several years, compliance with environmental regulations is very high, and hazardous waste generation rates continue to decline. The NSLS was audited this year for ISO 14001 compliance and was found to be in good shape.
- Three occurrences were experienced in the first half of calendar year involving our users that required considerable investment of time to review and address. These incidents were a strong reminder that the biggest challenge facing our facility involves our highly transient user population who come from all types of institutions, many of whom do not have the same safety culture and expectations that are present at BNL.

Steps Toward Development of Next Generation Facilities and Research Tools

- NSLS has vigorously pursued several aspects of long-range facility development with an eye toward the next generation of facilities and research. In experimental capabilities, NSLS has expanded its research program with special emphasis on tools to support soft condensed matter and nanoscience research. These include coherent imaging techniques (photon correlation spectroscopy or 'speckle'), microprobes methods, magnetic scattering, and a

nascent ultrafast program based in part on the existing Source Development Laboratory (SDL) capabilities. These investments have been made to provide expertise within the staff that will help provide the next generation of experimental tools, as well as integrating with the thrust areas of the BNL Nanoscience Facility.

- In a parallel effort the NSLS has a research program in accelerator based source development. The SDL continued supporting high brightness electron beam based research including collaborations with the SLAC Linac Coherent Light Source, and the DESY TTF-FEL that is expected to be a key component of next generation sources. The SDL achieved a major milestone in the first phase of the Deep Ultra-Violet Free Electron Laser (DUV-FEL) this year with its first lasing in Self Amplified Spontaneous Emission mode. Work for supporting laser seeded operation is well underway with initial direct seeding anticipated by the end of fiscal 2002.
- Armed with knowledge from our existing facility operation and our research program in source and science technology, the NSLS examined a number of facility upgrade pathways through the fiscal year. These ranged from in-place upgrade of the existing x-ray ring to a new purpose built machine with capabilities not currently available in any synchrotron facility. A thorough examination of the in-place options and hybrids that would introduce new technology to the existing storage ring revealed unacceptable compromises in potential machine performance and/or research program interruption. Therefore work is shifting to full time consideration of options that provide an ultra low emittance storage ring based source that would provide more high performance insertion devices than can be supported by the existing NSLS x-ray ring. In addition, a possible upgrade to an energy recovery system that would provide for single pass operation of the machine is being developed. This approach opens up the possibility of significant enhancements in photon beam brightness for user experiments through reduced overall electron beam emittance and symmetric beam size (round beams) that are a substantial benefit to some imaging methods. In addition, the single pass configuration can in principle support extremely short pulses that would constitute a completely new tool at higher photon energies (x-rays as contrasted to visible light) for the growing ultrafast science community.

Discussion of Make up of the Facility User Community

- The NSLS user community continues to be one of the largest user populations in the world. In the last few years, greater than 2500 users per year participate in the research programs conducted on the experimental floors. More than half of our users come from the Northeastern states indicating the importance of the NSLS to the region. However, 25% come from other parts of the US and 16% come from foreign indicating the importance of the facility at the national and international level.
- A wide variety of research is also conducted at the NSLS with more than 6 major fields of research involved. The greatest numbers of users are in the life and material sciences, with very significant numbers from chemical, geology and environmental sciences. The publication rate from NSLS research exceeds 800 per year, with nearly 150 per year in premier journals.

Steps Toward Improvement of Proposal Quality and Opportunities

- This year we initiated a major outreach program to increase the awareness of external stakeholders of NSLS capabilities with the objective of providing new opportunities for use of the facility. A new information and outreach section was created to provide users and potential users up-to-date technical information about beamlines and end stations, to hold regular short courses to train inexperienced users of specific experimental techniques, and to sponsor scientific workshops to explore new opportunities and encourage new collaborations.

List the Number of International Collaborations

- Five International Collaborations

Facts and Figures for FY 2002

List of Projects/Programs Involving Collaboration with Others:

- “High Brightness Electron Beams” in collaboration with Wasadec University, Tokyo
- “High Brightness Electron Beams” in collaboration with IHEP, Beijing,
- “Small Gap Super Conducting Insertion Devices” in collaboration with Anka Light Source, Karlsruhe
- “High Brightness Electron Beams for FEL Applications” in collaboration with DESY and SLAC
- “High Gain Harmonic Generation in FELs” in collaboration with Sincrotron Trieste
- Hard X-ray Micro fabrication Applications Research is being undertaken in collaboration with Sandia Livermore and Honeywell Federal Manufacturing & Technologies.

Number of Users

- The total number of users for FY 2002 will not be available until Oct. 2002. The total number in FY 2001 was 2523.

List of WFO Projects and Sponsors

- “Design, construction and operation of a new beam line at X-6a” NIH - \$5M over several years
- “Short Wavelength High Gain Harmonic Generation Free Electron Laser” Air Force Office of Scientific Research Medical FEL Research Program (\$200 K FY 02).
- “Laser Seeded FEL and HGHG Experiments” Office of Naval Research (\$200K – FY2002)

Staff Profile

Tenured	11	Professional	36
Continuing	6	Scientific	41
Term	12	Technical	73
Research Associates	6	Administrative	18
Post Docs	6	Management	8
		Total	176

Visiting Scientist Profile

- Students: 8
- Postdocs: 2
- Scientists: 17

Funding Profile for the Last Seven (7) Years

2002	34,301,000
2001	34,725,000
2000	32,111,000
1999	32,176,000
1998	30,996,000
1997	27,670,000
1996	31,203,000

Other Awards

- Mentor recognition for FY01 mentoring of PST student; in FY02, mentor to two PST students evaluating X-ray and VUV magnet position data.

Other Publications, Citations, Press Releases for this Fiscal Year

Users: Three Dissertations

Staff: One Book,

Eight Press Releases:

- July 25, 2002: Nanoscale Crystallography Reveals Hidden Structural Details
Thomas Vogt, BNL; Valeri Petkov, et al., Michigan State University
<http://www.bnl.gov/bnlweb/pubaf/pr/2002/bnlpr072502.htm>
- July 18, 2002: Scientists Create New Material With Varying Densities of Gold Nanoparticles
Rajendra Bhat and Jan Genzer, North Carolina State University (NCSU); Daniel Fischer, National Institute of Standards and Technology (NIST)
<http://www.bnl.gov/bnlweb/pubaf/pr/2002/bnlpr071802.htm>
- June 27, 2002: Scientist Wins Award for High-Pressure Research
Yongjae Lee, Physics Dept, BNL
<http://www.bnl.gov/bnlweb/pubaf/pr/2002/bnlpr062702.htm>
- June 17, 2002: New Insight Into Origin of Superconductivity in Magnesium Diboride Daniel Fischer, Yimei Zhu, Genda Gu, Arnold Moodenbaugh, Johan Taftø, Tom Vogt and James Davenport, Guenter Schneider and Qiang Li (Brookhaven National Laboratory, National Institute of Standards and Technology (NIST), and the University of Oslo in Norway)
<http://www.bnl.gov/bnlweb/pubaf/pr/2002/bnlpr061702.htm>
- June 5, 2002: Conducting-Insulating Materials Reveal Their Secrets, Tonica Valla, Peter Johnson (Physics Dept, BNL)
<http://www.bnl.gov/bnlweb/pubaf/pr/2002/bnlpr060502.htm>
- December 19, 2001: Scientists Identify Molecular Structure of Cancer-Related Proteins
<http://www.bnl.gov/bnlweb/pubaf/pr/2001/bnlpr121901.htm>
- December 13, 2001: Scientists Discover New Material That Expands Under Pressure
<http://www.bnl.gov/bnlweb/pubaf/pr/2001/bnlpr121301.htm>
- December 4, 2001: Enzyme Studies at Brookhaven Lab May Lead to New Antiviral Agents
<http://www.bnl.gov/bnlweb/pubaf/pr/2001/bnlpr120401.htm>

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

- Users: Two hundred sixty four journal articles, of which seventy eight are premier
- NSLS Staff: Six journal articles, of which one is premier

Please note that this is not a complete list at this time.

1.4.2.3 Materials Sciences Department

Management Goals and Processes for Fiscal Year 2003

- The main goals for the Materials Science Department (MSD) are concerned with implementing new management and operating procedures for the new department.
- An active search is underway for a permanent chair and new plans and procedures for operations and administration (business and personnel) are being constructed and will be implemented in FY 2003.
- A departmental strategic Planning Committee is in place and is producing a strategic plan and proposed new initiatives for the department.
- Discussions are in progress with the Technology Transfer Office (M. Bogosian, et al) concerning more efficient and effective approaches to obtaining WFO funding from DARPA, NASA, etc. Discussions between the Interim Chair of MSD and the Chair of the Biology Department to initiate the planning of new initiatives in Biomaterials research.
- MSD staff are playing vital roles in planning and implementing research thrusts and instrumental clusters in the new BNL Center for Nanoscale Functional Materials.

Number of New Associate Scientists (or Above) Hired

- None

Number of New Research Associates Hired

- Four, these are:
- K. Sasaki (McBreen/Adzic group)
- M. Beleggia (Zhu group)
- Y. Mo (McBreen/Adzic group)
- R. Klie (Goldhaber fellow, Zhu group)

Significant Improvements in Infrastructure and Management Systems that Support Research

- The essential committees and Memoranda of Understanding (MOU's) with other Departments (Chemistry) and directorates (EENS) necessary for the operations of the new Materials Science Department are in place and are functional.
- Improvements and revisions of the Departmental operational procedures, based on the first year of operations, are in progress.
- Research plans have been implemented for interdepartmental (BES directorate) collaborations under the aegis of the Materials Center

Safety Enhancements

- Considerable progress was made in the disposal of legacy waste. Improved housekeeping procedures for the Materials Science Building (480) have been implemented.

Steps Toward Development of Next Generation Facilities and Research Tools

- A new world-class, state-of-the-art high-energy-resolution monochromator for transmission electron microscopy has been ordered. This instrument will greatly enhance chemical mapping and detection energy spectroscopy in nanoscale systems

Steps Toward Improvement of Proposal Quality and Opportunities

- The MSD Strategic Planning Committee was created to consider new initiatives and to recommend departmental procedures for 'quality control' on LDRD proposals.

List the Number of International Collaborations

There are a total of 11 for the Materials Science Department. They are as follows:

- Two international collaborations are in place and a third has been planned in the area of transmission electron microscopy and electron-beam methods for the synthesis of nanoscale materials. These involve Y. Zhu et al (BNL) with:
J. Taftø, et al, University of Oslo (Norway)
R. Egerton, M. Malac, et al, University of Alberta (Canada)
G. Van Tandeloo, et al, University of Antwerp (Belgium) [planned].
- M. Suenaga (MSD) is a participant in the 'U.S. - Japan Collaborative R & D Program on AC Electrical Power Applications of High-Temperature Superconductors: AC Loss Measurements and Analysis and Conductors Development' (NSF funded).
- L.H. Lewis is a participant in the NSF Division of International Programs Sponsored Research Program, 'Structure-Property Relations in High Coercivity Bulk Amorphous Alloys' with Hanoi National University, Vietnam National Center for Science and Technology, and the International Training Center for Materials Science, Hanoi Institute of Technology.
- J. Fajer, et al, involved in collaborations on porphyrin research with these international groups:
Prof.D.Mansuy, Universite' Paris V, (Paris, France): Biomimetic cytochrome P450 catalysts; self-assembled macromolecular assemblies for light harvesting.
Prof.A.Giraudeau and Dr.J.P.Gisselbrecht, Universite' Louis Pasteur, (Strasbourg, France): synthesis and electrochemistry of novel porphyrins for catalysis.
- Dr.C.Kay, Free University of Berlin, (Berlin, Germany): magnetic resonance and theoretical calculations of excited states and radicals of photosensitizers for photodynamic therapy and artificial photosynthesis
- Hugh Isaacs is involved in three international collaborations on corrosion research:
Study of atmospheric corrosion of metals in marine environments using the NSLS, Aaron K. Neufeld, CSIRO - Sustainable Materials Engineering (Australia).
Study of the corrosion of steel in concrete and the action of corrosion inhibitors, Mary P. Ryan, Department of Materials, Imperial College of Science, Technology and Medicine. (London, UK)
Development of current and impedance techniques for the study of corrosion, Dominique Thierry, Swedish Corrosion Inst, (Stockholm, Sweden)

Facts and Figures for FY 2002

Staff Profile:

Tenured	6	Professional	6
Continuing	8	Scientific	28
Term	6	Technical	3
Research Associates	0	Administrative	1
Post Docs	8	Management	0
		Total	38

Visiting Scientist Profile:

- There have been three scientists visiting in the Materials Science Department during FY2002 for periods of 1 month or longer:
 - Prof. Johan Tafto, University of Oslo
 - Prof. Ray Egerton, University of Alberta
 - Prof. Marc deGraef, Carnegie Mellon University

Funding Profile for the Last Seven (7) Years

2002	FY 02 \$7.4M – note2
2001	NA – see note1
2000	NA – see note1
1999	NA – see note1
1998	NA – see note1
1997	NA – see note1
1996	NA – see note1

Notes, Issues, Trends and Assumptions

Note 1: This is the first year of Departmental status for Materials Science.

Note 2: FY2002 total funding: \$7.4M

This is made up of the following components:

- Office of Science, BES/DMS: \$4070K
- Office of Science, BES/DCS: \$1410K
- Office of Energy Efficiency and Renewable Energy: \$1040K
- LDRD: \$440K
- CRADA: \$220K
- Other: \$220K

1.4.3 Life Sciences

Accomplishments - Summary

- A major focus of Life Sciences research program management this past year was to improve our alignment with the DOE and NIH missions, particularly the role that DOE/OBER expects to have in 'Bringing Genomes to Life', and the expanding role of NIH in imaging (a new institute was formed) and addiction research. This focus moved us to hire several key scientific staff to establish the capabilities that are consistent with BNL's existing facilities and expertise. Specifically, strategic hires were made to lead the animal MRI facility, the CryoEM facility, and the research associated with complex microbial communities (Genomes to Life). Additionally, 12 research associates were hired to support the Directorate's initiatives.
- Regulatory reviews of the Clinical Research Center and the Animal Facility were successfully completed. These facilities and their associated staff continue to support laboratory wide initiatives in pre-clinical and clinical research.
- Research was conducted safely and, with several minor exceptions, in a regulatory compliant manner. Where opportunities for improvement exist, measures have been taken to solicit input from external groups to achieve the desired outcome. This is particularly evident in the radiological controls area where the Independent Oversight and Quality Offices have assisted us in evaluating where improvements can be made and in analyzing the effectiveness of actions that have been taken.
- Research has been effectively managed to meet the goals of BNL's Environment Management system. Scientists in Life Sciences identified a significant number of pollution prevention projects, several of which were funded by the Laboratory because of their payback.

Notes, Issues, Trends and Assumptions

- The Business Management aspect of the Life Sciences Directorate went through a significant transition this past year. Administrative support needs and resources continue to be evaluated to identify ways to conduct our activities more effectively.
- Infrastructure improvements that are supported by Laboratory funds need to continue in order for initiatives like the animal MRI facility and the cryoEM capability to be successful. Upgrades of aging research laboratories and building support systems are also part of the need for continued investment in infrastructure improvements.

1.4.3.1 Biology Department

Management Goals and Processes for Fiscal Year 2003

- The Center for Complex and Membrane Protein Structure will continue to be a large initiative for the Biology Department.
- In FY03, the Department's efforts will focus on the recruitment of a Bioinformaticist. The Bioinformaticist will complement the current components of the Center which, in addition to the already existing protein expression, protein complex, and protein engineering programs, include a new Membrane Protein Crystallographer, two new Soil Molecular Microbiologists, and a cryoElectron Microscopist, who will start late in FY02.

- The Biology Department will propose a partnership in the BNL nanotechnology initiative in an effort to add a biological component to the initiative and to connect it with the Center for Complex and Membrane Protein Structure.
- To promote the new cryoElectron Microscope and microscopist, the Biology Department will organize a cryoEM workshop with presentations by several prominent cryoEM scientists as well as local (BNL, SUSB, CSHL) microscopists and structural biologists to present uses for the technique to internal and external scientists as well as DOE and NIH program managers.
- The Biology Department will collaborate with SUNY Stony Brook in the development of a graduate degree program in Bioinformatics, which will be run similarly to the already existing SUNYSB-BNL graduate programs in Molecular Biology, Genetics, and Pharmacology.
- In collaboration with the Medical and Chemistry Departments, the Biology Department will begin development of an Imaging Program in Cancer. Initial efforts will be directed toward imaging gene expression and function as well as tumor development in transgenic mouse models. This effort also will connect with the new NIH Cancer Institute at SUNY-SB.
- In collaboration with the Medical Department, we will participate in the development of a Space Medicine Program which will concentration on understanding and developing countermeasures for radiation effects as well as understanding behavioral changes through brain imaging.
- The Biology Department will continue to develop a seminar and visitor exchange program with other National Laboratories to promote scientific collaborations.
- The Biology Department will continue to develop graduate program opportunities for students at BNL by providing limited support for graduate students at SUNY-SB and other institutions and by participating in or hosting graduate program retreats.

Number of New Associate Scientists (or Above) Hired

- During this reporting period the Biology Department successfully recruited and hired a Membrane Protein Crystallographer and two soil microbiologists. A new cryoElectron Microscopist recently accepted an offer of employment. He will start at the end of FY02. These scientists will enhance the Laboratory's research portfolio and, coupled with the staff we already had, put us in better alignment with DOE missions for not only the Genomes to Life Initiative but for bioremediation and counterbioterrorism research.
- In addition, a new crystallographer was hired to manage the operation of one of our NSLS crystallography beamlines (X26C).

Number of New Research Associates Hired

- Five Research Associates were hired. A Goldhaber fellowship was just awarded to a research associate who will work in John Shanklin's lab starting at the end of this Fiscal Year.

Significant Improvements in Infrastructure and Management Systems that Support Research

- Many of the laboratory facilities being used by the Center for Complex and Membrane Protein Structure have either been renovated or are in the process of being renovated. A new

laboratory and supporting areas have been completely renovated for the new membrane crystallographer (completed 5/02).

- Space for the two soil microbiologists is currently in the process of being renovated.
- The room for the CryoElectron Microscope has been modified to meet the needs of the instrument and plans have been drafted for the renovation of supporting wet lab and image processing space for the instrument.
- Pollution Prevention funding was obtained to purchase a digital imaging system for the Department. This will improve the quality of the research data being collected and will reduce the amount of photographic waste generated.
- DOE capital funds were used to purchase other shared equipment such as a phosporimager, high-end digital imager and ultracentrifuge.

Safety Enhancements

- BNL has management systems in place. We are now in the process of refining them to make them work more effectively and efficiently. This is done through participation on advisory teams and subject area development (and re-development) teams (Work Planning and Control, Biological Safety, CMS advisory group). Those refinements done at the lab-level have given us more flexibility at the Department level so that we can improve our programs.
- Significantly upgraded our Controlled Environment Radiation Facility (both by the physical state and the documentation) to make it compliant with the new Radiation Generating Device regulations. This was done through a team effort, lead in large part by our Facility Support Rep. and Facility Manager. Funding for the upgrade was supplied by the Biology Department.
- In process of developing a biosafety in research subject area. The Biology Department is critical in this effort as we manage the Institutional Biosafety Committee and work with the majority of the etiologic agents on the site. We have already enhanced the membership on the BNL Institutional Biosafety Committee to include members of affected laboratory organizations such as Occupational Medicine, Emergency Response, Security as well as a member from DOE-BAO.

Steps Toward Development of Next Generation Facilities and Research Tools

- Recently secured OBER funding to build a new x-ray crystallography beamline at the NSLS. This beamline, X29, will produce an x-ray beam that is five times as bright as our wiggler beamline, X25, and 75 times as bright as our bending magnet line, X12C. X29 will be the brightest x-ray source east of the Advanced Photon Source in Chicago.
- A cryoElectron Microscope, supported by OBER, will arrive soon as a component of the Center for Structure of Complex Membrane Proteins for the analysis of two-dimensional arrays of membrane proteins, isolated complex particles, and frozen tissue sections. This will complement the Scanning Transmission Electron Microscopy Facility. This microscope will facilitate the analysis of protein complexes such as heavy metal antiporters, and other molecular machines of relevance to the DOE bioremediation effort.

- The NASA funded Booster Applications Facility is still under construction and is on schedule and within budget.

Discussion of Make up of the Facility User Community

- The user facility community for all our facilities is made up of universities, government facilities, a private industry both from the US and abroad.
- The Scanning Transmission Electron Microscopy Facility: 75 Investigators from 47 different institutions; 5 from other DOE facilities, 42 from universities
- NSLS Macromolecular Crystallography Users: 114 Groups came consisting of 5 Industry, 4 from other DOE facilities, 105 from universities. 7 were from foreign institutions.

Steps Toward Improvement of Proposal Quality and Opportunities

Several steps have been made, both at the Directorate and Department levels, toward improvement of proposal quality and opportunities:

- Key Biology Department scientific staffs have been involved in workshops to formulate DOE's call for proposals in key areas such as the Imaging component of the Genomes to Life Initiative.
- For our larger proposals (Genomes to Life, Carbon Sequestration) the Directorate has provided critical resources to put together a quality proposal. These include: Graphic Designers, Project Managers, Printing Services, as well as a coordinator at the Directorate level.
- Lobbying in congress by BSA and others (such as the recent visit to Congress by members of the Center for Molecular Toxicology) has helped our stature on proposals we submit.

List the Number of International Collaborations

The Biology Department has many international collaborators.

- One of our main initiatives, The Genomes to Life program, involves collaboration with Limburgs Universitair Centrum in Belgium as well as other US institutions.
- We organized a p53 Workshop in Rome, Italy, which lead to an application to NIH for development of mouse models for cancer research by an international team of senior scientists.
- One of our NASA-funded Radiobiology experiments involving the use of fish as a model system to study heavy ion effects is a collaborative effort with a group from University of Tokyo, Japan.
- A researcher from the Hungarian Academy of Sciences Biological Research Center in Szeged, Hungary came to BNL to collaborate on a project to study thylakoid lipids.
- A collaboration with a group from Nagoya City University School of Medicine in Japan is about to yield a publication in EMBO Journal on defective p53 mediated transcription and increased resistance to ionizing radiation in Chk2-deficient mice.

Facts and Figures for FY 2002

List of Projects/Programs Involving Collaboration with Others

The Biology Department has several large collaborations with others:

- Brookhaven is a member of the 'National Space Biomedical Research Institute. As a result of this membership, BNL is represented on the NSBRI Board of Directors.
- The Biology Department also partners with SUNYSB on the National Institute of Environmental Health Sciences (NIEHS) funded Center For Molecular Toxicology. 36 Faculty from SUNYSB and BNL participate in this broad effort to understand the molecular and cellular mechanisms whereby toxic agents impact human health and the environment.
- BNL Life Sciences partners with the State University of New York at Stony Brook (SUNYSB) to run several graduate programs including: Genetics, Biochemistry and Structural Biology, Molecular Microbiology, Biomedical Engineering, and Neuroscience.
- The Biology Department is a member of the New York Structural Genomics Research Consortium (NYSGRC), which is supported by the Protein Structure Initiative of the National Institute of General Medical Sciences (NIGMS) to be a Pilot Structural Genomics Center. Procedures are being developed for high-throughput x-ray crystallography of proteins.

Number of Users

- Scanning Transmission Electron Microscopy Facility: 75
- Macromolecular Crystallography Facilities: 235
- NASA Radiobiology Program: 80

List of WFO Projects and Sponsors

- DOD, Differential Expression of DNA Double-Strand Break Repair Proteins in Breast Cells, ANDERSON
- DOD, Structural Studies of Intact Clostridium Botulinum and Neurotoxins Complexed with Inhibitors Leading to Drug Design, SWAMINATHAN
- NASA, Germ Cell Mutagenesis in Medaka Fish Following Exposure to Heavy, High Energy Cosmic Ray Nuclei, SETLOW
- NASA, Genetic and Epigenetic Effects Produced by High Energy Heavy Ions, B. SUTHERLAND
- NIH, Genetic Variation in Human NHEJ DNA Repair Genes, ANDERSON
- NIH, Vaccine Intervention for Lyme Borreliosis, DUNN
- NIH, Clp: An Archetypal ATP-Dependent Protease, FLANAGAN
- NIH, Adenovirus-Receptor Interaction: Structure, Function and Retargeting, FREIMUTH
- NIH, The Structural Basis of Selective Permeability in Aquaporins, FU
- NIH, Adenovirus Protease Reg & Antiviral Dev, MANGEL
- NIH, DNA Damage Clusters: Repair in Mammalian Cells, B. SUTHERLAND
- NIH, DNA Damage Quantitation by Single Molecule Laser Sizing, J. SUTHERLAND
- NIH, Macromolecular Crystallography at the NSLS, SWEET
- NIH, STEM Mass Mapping and Heavy Atom Labeling of Bimolecules, 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, B. SUTHERLAND

Staff Profile

Tenured	14	Professional	27
Continuing	5	Scientific	40
Term	13	Technical	7
Research Associates	8	Administrative	13
Post Docs		Management	0
		Total	87

Visiting Scientist Profile

The Biology Department has had many visiting scientists over the past year. They have come from the Department of Defense, other DOE facilities, universities and many foreign institutions.

Funding Profile for the Last Seven (7) Years

2002	17.9 Million
2001	15.25 Million
2000	15.76 Million
1999	16.00 Million
1998	16.52 Million
1997	15.53 Million
1996	15.0 Million

Other Awards

- BNL Spotlight Awards - FY 2001: Thomas Langdon, Richard Sautkulis, Edward Whittle
- Perfect Attendance Award - CY 2001: Phyllis Tinsley-Smith

Other Publications, Citations, Press Releases for this Fiscal Year

- Special Issue of Environmental and Molecular Mutagenesis (Journal of the Environmental Mutagen Society), Vol. 38, No. 2/3, pp. 87-260 (2001) published "A Richard B. Setlow Festschrift" (volume of writings by different authors presented as a tribute to a scholar). This festschrift was dedicated to the "Father of DNA Repair," Richard B. Setlow, in the year of his 80th birthday. They include contributions from many of his former students and colleagues who welcome the opportunity to say "Thank you, Dick!" The website where the table of contents and abstracts for the issue are located is <http://www3.interscience.wiley.com/cgi-bin/issuetoc?ID=86511335>
- A collaboration between our Proteomics group and SUNY SB lead to a cover of the Journal of Biological Chemistry, Vol. 277(22), May 31, 2002. The cover shows a DNA repair enzyme "caught in the act." A Schiff base intermediate of Escherichia coli formamidopyrimidine-DNA glycosylases (Fpg), an enzyme responsible for excising oxidatively damaged purines from DNA, has been chemically reduced, and the resulting

trapped complex was structurally determined. The structure, shown here with a modeled everted 8-oxoG base, reveals for the first time the mode of Fpg interactions with damaged DNA. For details see the article by Gilboa et al., pages 19811-19816.

- An international collaboration led to a cover of *Environmental Science & Technology*, Vol. 35(21), November 1, 2001. The redroot pigweed plant (*Amaranthus retroflexus*), shown in artist Loel Barr's cover illustration, has until now been mainly known as a highly toxic, nuisance plant commonly found in pastures. Plant ingestion by cattle, swine, sheep and goats can cause breathing problems, trembling, weakness, abortions, coma, and ultimately death. The leaves, stems, and roots of the plant are all dangerous to these and other animals. Why then, you might ask, would anyone want to cultivate such a plant? In their assessment of phytoremediation's progress in the United States and Europe, researchers Daniel van der Lelie, Jean-Paul Schwitzguebel, David Glass, Jaco Vangronsveld, and Alan Baker provide an answer. The redroot pigweed plant is particularly useful for phytoremediating radionuclide-contaminated sites. In field trials it was successfully used to accumulate significant amounts of radioactive cesium (Cs-137) in its leaf and stem biomass. In a growing market on both sides of the Atlantic Ocean, this and other plants are increasingly being used to phytoremediate site contamination.
- Press Releases: Four
 1. 12/19/01 'Scientists Identify Molecular Structure of Cancer-Related Proteins' (Rajashankar)
 2. 12/4/01 'Enzyme Studies at Brookhaven Lab May Lead to New Antiviral Agents' (Mangel)
 3. 9/25/01 'Scientists Discover How Some Viruses Take Strong Hold of Cells' (Freimuth)
 4. 6/30/01 'Scientists Push Enzyme Evolution Into High Gear, work could lead to mass production of useful plant products' (Shanklin)

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

The majority of Biology Department publications are co-authored. Biology had twenty-four peer-reviewed publications.

1.4.3.2 Medical Department

Management Goals and Processes for Fiscal Year 2003

- Install new very high field animal magnetic resonance instrument for functional and spectroscopic studies in animals, now that additional funds have been obtained from the Office of national Drug Control Policy.
- Continue biomedical engineering initiative by expanding our capabilities in both PET and MRI, and in combined use of both modalities.
- Continue efforts to obtain funding for the Cyclotron Isotope Research Center (CIRC), a facility to serve as a year-round domestic source of medical isotopes for nuclear medicine, for R&D, and for education and training.
- In the isotope research and production program, to continue to investigate the use of the isotope Sn-117m for cancer therapy and for the treatment of painful bone metastases in

cancer patients, and to optimize development of bio-engineered molecules with potential for radiopharmaceutical utility.

- Extend x-ray microbeam radiation research with the NSLS by investigating the radiobiological mechanisms underlying the ability of microbeams to spare normal tissues kill tumors, and to evaluate the potential of microbeams for treating tumors.
- Continue evaluation of candidate radiopharmaceuticals in rodent and in vitro models, and the use of these models to extend observations made in human PET experiments.
- Use the small animal PET scanner (Micro-PET) to enhance integration of human PET technology with mainstream biomedical science, and begin similar use of the small animal MRI scanner.
- Expand the use of transgenic animals in Medical Department programs.
- Strengthen the Program in Space Radiation Biology by recruiting an established scientist in this area, and intensifying efforts to increase level of funding from NASA. This will enable us to better utilize the Booster Application Facility (BAF) when it commences operation during FY03.
- Enhance long-term ability to obtain funding from the National Institutes of Health by improved mentorship of young scientists and scientists-in-training.

Number of New Associate Scientists (or Above) Hired

- The Medical Department hired one new scientist, Helene Benveniste. She will be part of the MR Imaging program and will be responsible for the new Animal MR machine.

Number of New Research Associates Hired

- The Medical Department hired seven new Research Associates.

Significant Improvements in Infrastructure and Management Systems that Support Research

- A benchtop research laboratory was renovated for our new MR scientist using GPP funds.
- Currently renovating space in the Medical Department, Bldg 490 for an Animal MR machine and supporting preparatory space.
- The Department has also utilized it's own funds to dispose of some legacy issues. An old chemical incinerator that was located behind Bldg. 490 was removed. Two rooms, which contain large amounts of excess chemicals, are also in the process of being cleaned out.

Safety Enhancements

- BNL has management systems in place. We are now in the process of refining them to make them work more effectively and efficiently. This is done through participation on advisory teams and subject area development (and re-development) teams (Work Planning and Control, Biological Safety, CMS advisory group). Those refinements done at the lab-level have given us more flexibility at the Department level so that we can improve our programs.
- The Radiation Protection program in the Medical Department has been assessed due to several radiation related occurrences. We are in the process of working with the researchers and the Radiological Controls Division to develop procedures which enable the researchers to work efficiently and still maintain a compliant program.

Steps Toward Development of Next Generation Facilities and Research Tools

- The PET scanner designed for rats and mice (microPET) commissioned in FY 2001 was used by Brookhaven's scientists and outside collaborators as a new scientific tool for pre-clinical research to measure biochemical transformations and the movement of drugs in living animals.
- Two specialized PET devices were developed in FY 2002 to measure radiotracers in blood. One is a beta probe implanted in a blood vessel, and the other is a co-incidence detector positioned external to the wrist to measure the concentration of positron emitters. Both promise to make PET studies simpler and safer.

Discussion of Make up of the Facility User Community

- The Medical Department operates the Clinical Research Center, which is used by the Imaging programs to bring in human subjects for their clinical trials.
- As part of the NASA Radiobiology program, the Medical Department hosts users who are NASA funded and are mostly from U.S. 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.

Steps Toward Improvement of Proposal Quality and Opportunities

Several steps have been made, both at the Directorate and Department levels, toward improvement of proposal quality and opportunities:

- An internal review: The Medical Department Chair reviews or designates a reviewer for proposals developed by Investigators that may not have the expertise at grant writing, before they are sent out to funding agencies.
- Medical Department scientific staff were involved in workshops to formulate future calls for proposals in key areas (Ernst, NIMH Workshop on "Mental Health Research Issues in HIV Infection and Aging").
- For larger proposals the Directorate has recently been providing critical resources to put together a quality proposal. These include: Graphic Designers, Project Managers, Printing Services, as well as a coordinator at the Directorate level.
- Lobbying in congress by BSA and others has helped increase our visibility and therefore our stature on proposals we submit.

List the Number of International Collaborations

- As part of the NASA Radiobiology Program there are several groups who are funded by the Italian Space Agency who come here to study heavy ion effects.
- The Medical Department Scientific staff is involved in many international collaborations.

Facts and Figures for FY 2002

List of Projects/Programs Involving Collaboration with Others

- The Imaging Program collaborates with SUNY Stony Brook and others to develop the ability to monitor the brain function of an awake animal; this would be a major advance in neuroscience.

- Human Subjects are often recruited as part of collaborations with medical schools such as Albert Einstein and New York University.
- A collaboration with SUNY Stony Brook and Harvard University was established to use the short-lived positron-emitting isotopes to study environmental stressors on plants.
- Progress continues on functional MRI studies using the BNL 4 Tesla scanner. The increased sensitivity resulting from last year's upgrade allow us to detect the passage of contrast agents across the blood-brain-barrier (BBB) in the white matter of the normal human brain.
- Brookhaven and Psimei Pharmaceuticals Ltd. continue to work together under a CRADA to develop Brookhaven-invented boron compounds for experimental radiation therapy for cancer, as well as other cancer treatments. In March 2002, our progress was measured in experiments at MIT.
- S. J. Gatley and A. N. Gifford collaborate with the University of Connecticut on the study of the brain cannabinoid system.

Number of Users

- The Clinical Research Center processed 343 human subject visits for 42 active Institutional Review Board protocols. The protocols are for 12 internal Principal Investigators as well as scientists from external universities such as Albert Einstein, NYU and SUNY Stony Brook.
- The NASA Radiobiology Program hosted 80 researchers conducting 27 experiments during this reporting period.
- The Brookhaven Laboratory Animal Facility (BLAF) housed animals for 25 different IACUC protocols involving 15 principal investigators plus short-term care for NASA experimenters' animals.
- The SUNYSB operated Radiation Therapy Facility had 800 patient treatments.

List of WFO Projects and Sponsors

- NIH, Beneviste, Helene. "Imaging Illicit Drug Abuse: Development of a New Test Bed Using MRI..."
- NIH, Chang, Linda. "Methamphetamine and AIDS: Toxic Interactions in Animals"
- NIH, Chang, Linda. "Neuroimaging of HIV Progression in Cocaine Abusers"
- NIH, Chang, Linda. "Project 5: Proton Magnetic Resonance Spectroscopy (1h MRS) in Schizophrenia"
- NI Drug Abuse, Chang, Linda
- NI Drug Abuse, Chang Linda. "Neuroimaging and Mentoring in Drug Abuse Research"
- NIH, Chang, Linda. "GCRC Supplement to the SUNY Stony Brook GCRC Site"
- NIH, Dilmanian, F. Avraham. "Effects and Techniques in Microbeam Radiation Therapy"
- NI Neurological Disorders and Stroke, Dilmanian, F. Avraham. "Microbeam Radiation Therapy for Gliomas"
- US Department of Defense, Dimanian, F. Avraham. "Comparing X-Ray Microbeams and Broad Beams at Optimal configurations..."
- US Department of Energy, Dimanian, F. Avraham. "Bystander Effects and Adaptive Responses Elicited in Low Doses of Low..."
- NIH, Dimanian, F. Avraham. "Effects and Techniques in Microbeam Radiation Therapy"
- NIH, Ernst, Thomas. "Attentional Modulation in Early Sensory Processing"
- NI Mental Health, Ernst, Thomas. "Selegiline, Oxidative Stress and HIV Dementia"

- Tufts University, Ernst, Thomas. “In Vivo Proton MRS Studies of Cerebral Injury in HIV”
- NI Drug Abuse, Gatley, Samuel John. “Brain Imaging and Drug Abuse”
- NIH, Gatley, Samuel John. “Human Brain Pharmacokinetics of (-)-Delta-9 THC”
- NIH, Gatley, Samuel John. “Feto-Maternal Pharmacokinetics of Abused Inhalants”
- NI Drug Abuse, Goldstein, Rita Z. “Behavioral Correlates of fMRI Response in Cocaine Users (K23)”
- NIH, Pena, Louis. “Synthetic FGF Analog for Medical Device Applications”
- US Department of Energy, Srivastava, Suresh. “Radiolabeled Progenitor Stem Cells for InVivo PET Imaging and...”
- NIH, Telang, Frank. “fMRI response in Cocaine Users, Correlation with PET”
- NIH, Thanos, Panayotis (Peter) K. “microPET Imaging and Rodent Models of Drug Abuse”
- NIH, Volkow, Nora. “PET Studies of Brain DA in Stimulant Abusers”
- NIH, Volkow, Nora. “PET Studies of Brain Dopamine in Stimulant Abusers”
- NI Drug Abuse, Volkow, Nora. “Studies in Cocaine Abuse”
- NI Drug Abuse, Volkow, Nora. “Summer Research With NIDA”
- NI Drug Abuse, Volkow, Nora. “Summer Research With NIDA”
- NIH, Wang, Gene-Jack. “Brain Dopamine Pathology in Obese Individuals”
- NIH, Wang, Gene-Jack. “Brain Dopamine Pathology in Obese Individuals”

Staff Profile

Tenured	2	Professional	14
Continuing	6	Scientific	31
Term	16	Technical	3
Research Associates	7	Administrative	29
Post Docs		Management	
		Total	77

Visiting Scientist Profile

The Medical Department hosts many visiting scientists on a regular basis. They come from the US and abroad and from Universities, Government Labs, and private industry.

Funding Profile for the Last Seven (7) Years

2002	11.54 Million
2001	9.18 Million
2000	9.95 Million
1999	7.81 Million
1998	10.0 Million
1997	9.50 Million
1996	9.15 Million

Other Awards

- Spotlight Awards: Joan Terry, Karen Apelskog, Slawko Kurzak

Other Publications, Citations, Press Releases for this Fiscal Year

Press Releases:

- 6/2/01 A. Dilmanian, 'Experimental Microbeam Radiation Therapy May Offer Improvement Over Traditional Radiation Treatments'
- 9/9/01 P. Thanos, 'Gene Therapy Reduces Drinking in 'Alcoholic' Rats'
- 12/1/01 N. Volkow, 'Methamphetamine Delivers 'One-Two' Punch to the Brain'
- 12/1/01 N. Volkow, 'Brain Shows Ability to Recover From Some Methamphetamine Damage'
- 3/1/02 N. Volkow, 'Study Reveals Differences in Patients' Response to Ritalin'
- 3/22/02 L. Chang, 'Brookhaven Town Honors Two Brookhaven Lab Employees'
- 4/15/02 M. Gerasimov, 'Brain-Imaging Study Offers Clues to Inhalant Abuse'
- 4/16/02 T. Ernst, 'Tamoxifen and Estrogen Have Similar Effects on the Brain'
- 6/20/02 G-J Wang, 'More Clues About Obesity Revealed by Brain-Imaging Study'

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

The majority of Medical Department publications are co-authored papers.

DRAFT

1.4.4 Energy, Environment & National Security

1.4.4.1 Environmental Sciences

Management Goals and Processes for Fiscal Year 2003

- Formed a functional management team around a new Associate Laboratory Director
- Submitted a strong proposal to obtain funding for BNL's EnviroSuite Initiative
- Submitted strong LDRD proposals
- Strengthened Department's image at the Laboratory

Number of New Associate Scientists (or Above) Hired

- Three (3) Associate Scientists

Significant Improvements in Infrastructure and Management Systems that Support Research

- Proposal Tracking Data Base developed and operated by the EENS Business Operations Office

Safety Enhancements

- Prepared east hot cell in Bldg. 830 for scientific work

Steps Toward Development of Next Generation Facilities and Research Tools

- Successfully operated FACE facility at Duke Forest, North Carolina.
- Continued development of the Single-Particle Mass Spectrometer for characterization of aerosol particles and field-tested soil carbon measurement system.

Steps Toward Improvement of Proposal Quality and Opportunities

- Development and use of the Proposal Tracking Data Base

List the Number of International Collaborations

Four (4)

Facts and Figures for FY 2002

List of Projects/Programs Involving Collaboration with Others

Department Sponsor Project Activity Title

- Argonne National Laboratory
86375 86375 ARM Program
86375 86376 CSPHOT Instrument Mentor
86375 86377 MMCR Instrument Mentor
86375 86378 External Data Center
86375 86379 External Data Algorithms
- Battelle Memorial Institute
88389 88389 Common Household Activities and Exposure to Disinfection By-Products in Tap Water
- Battelle Pacific Northwest Laboratory
86028 86028 Battelle - PNNL ARM Program
86028 86029 External Data Algorithms
86028 86031 Site Management
86028 86313 PIF Data Management

86028 86314 Web Application
 86028 86315 SGP SDS Development
 86028 86316 Surface Characterization
 86028 86317 Satellite Data Coordination
 86028 86318 External Data Center
 86028 86319 Integrated Data Base
 86028 86322 Classified Satellite Data Products
 86028 86351 Instrument Mentoring (86028)
 86028 86352 NSA - Log
 86028 86353 TWP - LOG
 86320 86320 Reprocessing Data
 86555 86555 Tracer Preparation and Analysis for Fall 2000

- VTMX-CBNP Experiments

86584 86584 Aircraft Measurements PNL 2001 Field Experiment

- Lockheed Martin Energy Research Corporation

86540 86540 Assembly of a Control System for One 24-Valve Face Ring

- National Energy Technology Laboratory

86578 86578 CO₂ Sequestration Project - New Mexico

86585 86585 CATS Analyses - NETL Oak Ridge National Laboratory

86554 86554 Mercury Waste Profiling

88176 88176 EE ORAU Travel

- Oakland Operations Office (NERI)

18252 18252 Plant Response to Global Change:
 Physiological and Molecular Mechanisms Underlying Long-term Acclimation to Elevated
 Carbon Dioxide and Tropospheric Ozone

- Penn State

87581 87581 Development of Cloud Property Retrieval Algorithms at ARM Boundary Facilities

- Rocky Flats

86386 86386 Biomobility of Actinides

- Sandia National Laboratory

86304 86304 WIPP

86542 86542 UAV

- Savannah River

86552 86552 Subcon Focus Area Lead Laboratory

86591 86591 PUREX Alternative Treatment Review - Savannah River Site

- SUNY Albany

87504 87504 PMTACS-NY Supersite Program

- SUNY Stony Brook

87510 87510 A Study of the Outer Shelf, Shelfbreak Front, and Slope From Long-Term ADCP
 and Hydrographic Observations From the MV Oleander

- Univ. of California/Scripps Inst. Of Oceanography

87518 87518 The Collection of Shipboard Acoustic Doppler Current Profiler Data During the
 Shelf-Basin Interaction Program

- University of Miami

88191 88191 Technical Support for Fabrication Testing and Calibration for Two New PRP
 Instruments

88347 88347 Fabrication of a Portable Radiation Package for Atmospheric Optical Measurement

- University of Minnesota

87566 87566 FACE Facility at Cedar Creek

List of WFO Projects and Sponsors

Department Sponsor Project Activity Title:

- Aerodyne Research Incorporated

85652 85652 Aerosol Sampling

87505 87505 Develop a Versatile Aerosol Mass Spectrometer for Organic Aerosol Analysis

- ARCO El-Djazair Co. (BP Amoco Co.)

85682 85682 CATS Tracer Project Center for Energy and Environment

85696 85696 Center for Energy and Environment CATS Analysis

- CON ED

87597 87597 Equipment for Rapid Cable-Leak Locating and Detecting Capabilities

- Constellation Nuclear

85676 85676 Tracer Gas Study

- Department of Defense

05372 05372 A Field Program to Identify TRI Chemicals and Determine Emission Factors From DOD Munitions Activities

05584 05584 Collection and Processing of Shipboard Acoustic Doppler Profiler Data from the Japan/East Sea Project

- Enermodal Engineering Limited

85659 85659 CATS/PFT Testing

- Environmental Protection Agency

05351 05351 New York/New Jersey Harbor Contaminated Sediment Processing and Decontamination Technologies Full Scale Production Demonstration - Phase 2

Commercialization: Facility Planning/Infrastructure Development

05376 05376 Developing a Decision Support Technology Matrix and Reference Guide

05396 05396 Southern Oxidants Study Research Program at Brookhaven National Laboratory (SOS-BNL)

05509 05509 New York/New Jersey Harbor Contaminated Sediment Processing and Decontamination Technologies Full Scale Production Demonstration

81363 81363 CATS

- Georgia Institute of Technology

87509 87509 Measurement of Particle Chemical Composition During NASA TRACE-P

Guangzhou Institute of Geochemistry

85723 85723 Develop Particle-into-Liquid System

- Hikawa Shoji Kaisha, Ltd.

85702 85702 Portable Radiation Package

- ITT Industries

85625 85625 ITT - Dugway

87507 87507 Ultraviolet Raman Spectral Signature Acquisition and Short-Range Raman Lidar Optical Physics

- JAMSTEC

28599 28599 Shipboard Ocean and Atmospheric Radiation

- KeySpan
87564 87564 Determination of Gas Flow Rates at LILCO Gas-Fired Power Stations
87587 87587 Remediation of Soils Contaminated with Lead Paint
- Maine Yankee Atomic Power Company
85640 85640 Analysis of Soil Samples
85658 85658 Analysis of Soil Samples
85727 85727 PAB Test Pit Groundwater
- NAHB Research Center
85690 85690 PFT Testing
- National Academies
09712 09712 IAEA Training
- National Aeronautics and Space Administration
05517 05517 Validation of the Sea WiFS Atmospheric Correction Scheme Using Measurements of Aerosol Optical Properties
05578 05578 Tracer Study of Long-Range Transport in Support of the Big Bend National Park Regional Aerosol and Visibility Observational (BRAVO) Study
05587 05587 Representation of Aerosol Microphysics in Regional to Global Scale Models
- National Renewable Energy Laboratory
86569 86569 Support for PFT of Ventilation Effectiveness
- Newmont Metallurgical Services
85641 85641 Mercury Stabilization
- NSF-NOAA
05590 05590 Aerosol Measurements at Cheju Island During ACE-Asia: Aerosol Number Size Distribution, Particle Hygroscopicity, and Individual Particle Size and Chemical Composition
- Radiological Services Inc.
85621 85621 Radiological Services, Inc.
- Research Triangle Institute
85547 85547 Research Triangle Institute - CATS
- Royalty
09133 09133 Feasibility Studies for Technologies Used to Treat Mercury Contaminated Materials
- Suffolk County
87594 87594 Dissolved Organic Nitrogen and Brown Tide Blooms in Long Island's Coastal Waters: Testing the Groundwater Hypothesis
- Texas National Resources Conservation Commission
87506 87506 Analysis of G-1 Aircraft Data Collected During TexAQS 2000
- The Port Authority of New York and New Jersey
88309 88309 Newark Port Authority of New York and New Jersey Tracer Detection Technology Corporation
85689 85689 Tracer Detection Tech
- Usi
85648 85648 Tracer Technology
- Woods Hole Oceanographic Institute
87576 87576 GLOBEC: Frontal Exchange Processes Over Eastern Georges Bank
87598 47556 GLOBEC: Shipboard ADCP Data Collection and Retrospective Analyses

Staff Profile

Tenured	6	Professional	24
Continuing	15	Scientific	35
Term	8	Technical	4
Research Associates		Administrative	7
Post Docs	6	Management	1
		Total	71

Funding Profile for the Last Seven (7) Years

2002	\$20.8M
2001	\$19.5M
2000	Dept. created 2001
1999	N/A
1998	N/A
1997	N/A
1996	N/A

Other Publications, Citations, Press Releases for this Fiscal Year

- Peter Daum - Houston
- Paul Kalb - Mercury
- Larry Kleinman - Houston
- Dan Imre

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

- Sixteen (16) co-authored papers
- (One CRADA) Aquatic Plants for Phytoremediation of Toxic Metals and Radionuclides in Sediment.

1.4.4.2 Energy Sciences and Technology

Management Goals and Processes for Fiscal Year 2003

- The department has taken proactive measures to improve its planning process. We have established a strategic council to reduce stove-piping and increase the effectiveness of our initiatives. We are working on three initiatives for next year. Our major difficulty is the lack of significant program development funds. The department is having an external committee review the department this year to suggest improvements.

Number of New Associate Scientists (or Above) Hired

- None

Number of New Research Associates Hired

- One

Significant Improvements in Infrastructure and Management Systems that Support Research

- The PeopleSoft system is still very difficult to use, but progress is being made and we can now obtain useful information from it with less difficulty.
- Progress has not been made in integrating our many separate databases. This leads to significant difficulties in tracking progress and managing resources.

Safety Enhancements

- Continue to review and modify our safety processes; continuously review on 1.3.5 experimental safety review forms and associate training requirements.

Steps Toward Development of Next Generation Facilities and Research Tools

- The Department has drafted a white paper that was submitted to the laboratory director that would develop a new thermal hydraulic test facility for nuclear power plant applications.

Steps Toward Improvement of Proposal Quality and Opportunities

- Formed a strategic council that is charged with identifying and pursuing research opportunities.
- Established review procedures and committees for major calls, e.g. NERI, and have established a standard format for such proposals.
- Encouraging staff to participate on proposal review committees and have made funds available for that purpose.

List the Number of International Collaborations

- Ten

Facts and Figures for FY 2002

List of Projects/Programs Involving Collaboration with Others

- Albuquerque Operations Office
86333 86333 Enhanced Surveillance for Comprehensive Asset Tracking Technology
- Battelle Pacific Northwest Laboratory
86158 86158 SDRS BOA from PNNL (Cl. Status - Activities)
86158 86176 South Ukraine-Unit 1 (Task 8) (86158)
86158 86185 Rivne Unit 3 Full Scope Simulator - 1.2.16 (86158)
86158 86188 1.1.2.16 - Rivne NPP Unit 2 Full Scope Simulator (Task 17) (86158)
86158 86195 Technical Assistance for IBRAE Quality Assurance and Peer Review of Novovoronezh
Units 3 and 4 In-Depth Safety Assessment (NOVISA) (86158)
86158 86199 1.1.2.8 Ukraine Simulator SPDS Support (Task Order 31) (86158)
86158 86202 Task Order 28: Review of South Ukraine - 1 NPP In-Depth Safety Assessment
Project
(86158)
86158 86203 Ukraine Simulator Training Course (Task 34) (86158)
86158 86214 Task 35: Zaporizhzhya NPP Unit 1 Full Scope Simulator (86158)
86158 86221 Rivne-In-Depth Safety Analysis Project (86158)
86158 86224 Task 29A - 1.2.1.9 Zaporizhzhya Safe Shutdown Analysis (86158)
86158 86225 Task 42: TA for Eng. Technologies and Developments QA and Peer Review of Zaporizhzhya Nuclear Power Plant... (86158)

86158 86226 Task 43: TA for Engineering Technology and Developments QA and Peer Review of Khmelnytsky (86158)

86158 86227 Task 44: Comparative Analysis of the Results of Two VVER-1000 Level 1 PRA (86158)

86158 86228 Task 46: Probabilistic Risk Assessment Department of Scientific and Engineering Center for Nuclear Radiation Safety During Peer Review of the Novovoronezh NPP Unit 3 Level 1 PRA (86158)

86158 86381 Task 45: Technical Review and Analysis of Insights and Perspectives on Russian NPP Safety (86158)

- Cornell University

87739 87739 CADD-Based Expert System for Passive Snow Control

87751 87751 Torte Law Database

- Idaho Operations Office

86566 86566 Generation IV Technology Roadmap

- Los Alamos National Laboratory

86595 86595 HMS Modeling Code - LANL

- National Renewable Energy Laboratory

86571 86571 Support for Integrated Environmental Strategies - MARKAL - Shanghai, China

- Oak Ridge National Laboratory

88177 88177 ORAU TRVL - NE - Czajkowski and US DOE Lab Technology Research Program Review - Rohatgi; Travel Expenses for NERI Review

- Oakland Operations Office (NERI)

86365 86365 A Proliferation Resistant Hexagonal Tight Lattice BWR Fuel Core Design for Increase Burnup and Reduced Fuel Storage Requirements (CI Status - Activities)

86368 86368 Modular and Full Size Simplified Boiling Water Reactor Design With Fully Passive Safety Systems

86387 86387 Modular and Full Size Simplified Boiling Water Reactor Design With Fully Passive Safety Systems - Phase II

86389 86389 A Proliferation Resistant Hexagonal Tight Lattice BWR Fuel Core Design for Increase Burnup and Reduced Fuel Storage Requirements - FY 2001 (CI Status - Activities)

86389 86390 Safety of High Conversion Boiling Water Reactor - FY 2001 (86389)

86389 86391 Design of a High Conversion Boiling Water Reactor - FY 2001 (86389)

86392 86392 Optimization of Heterogeneous Utilization of Thorium in PWRs to Enhance Proliferation - FY 2001

86393 86393 NERI 01-022 Particle Bed Gas-Cooled Fast Reactor (PB-GCFR) Design

86395 86395 Development of GEN IV Advanced Gas-Cooled Reactors With Hardened/Fast Neutron Spectrum

86396 86396 M2AL67853 BNL Support to System Technologies

86397 86397 M2AL 67853 BNL Support to Systems Studies Extra

List of WFO Projects and Sponsors

Department Sponsor Project Activity Title:

- Agency of International Development
05378 05378 USAID-Sponsored BNL Workshop
- BioCat, Inc.

87600 87600 Biochemical Upgrading of Petroleum
87706 87706 Development of Methods to Enhance Heavy Oil Production in Offshore Environments

- CANDU Owners Group Inc.

85708 85708 Independent Expert Panel Review of Reactor Physics Uncertainties

- Chevron

87584 87584 Catalytic Coprocessing of CO and CO₂ into Methanol Via the BNL Low Temperature Methanol (BNL-LTM) Process

- Concurrent Technologies Corp.

87591 87591 Advanced Zinc Phosphate Conversion Coatings for Electrogalvanized Steel

- Department of Defense-U.S. Army

05554 05554 Enhance Burner Design (Continuation of Project ID 05591 and 05586)
05586 05586 Breadboard Prototype 500 Watt Thermophotovoltaic Power Source

- Department of Transportation

09710 09710 Applying Probabilistic Safety Assessment Approaches to Aircraft Safety

- Edtek, Inc.

88310 88310 EDTEK

- Electric Power Research Institute

87704 87704 Guidance for Digital Control Room Technologies

- Emission Control 2000 LLC

87727 87727 Evaluation of EC 2000 Devices for Oil-Fired Residential Heating Systems

- Enconet Consulting

87758 87758 PSA Applications for Regulatory Use

- Energy Research Center

87701 87701 New York State Premium Low Sulfur Fuel Marketplace Demonstration

- Environmental Protection Agency

04323 04323 AMEC 1.2

- Gas Research Institute

87752 87752 Development of a Device to Breakup Concrete Pavement

- Glaztec, Incorporated

87716 87716 Use of Chitosan as a Water-Based Anti-Corrosive Coating Material

- Insight Technologies, Inc.

87574 87574 Two-Stage Oil Burner with Load Tracking Control
87760 87760 Field Tests of the Flame Quality Monitor

- International Resources Group, Ltd.

87742 87742 Development of the MARKAL-MACRO Model for Hong Kong

- JAERI

87718 87718 Proton Nuclear Cascade Process

- KeySpan

87571 87571 Development and Demonstration of an Asbestos Treatment Process for Use in a Utility Environment
87715 87715 CBC-Filled Wire Mesh Composite Capping for Retaining Berm Foundation
87759 87759 Polymer Grouts and Polymer Composite Liners for Retaining Excavated Wall Foundations

- Mass. Institute of Technology

87710 87710 Joint Work With MIT on CRADA BNL C-01-07

- NASA

05518 05518 Reaction Pathways and Thermodynamic Studies of Atmospheric Reactions

- National Combustion Company Inc. (NATCO)

85704 85704 NATCO Testing and Analysis

- National Institute of Standards and Technology

05379 05379 Reactor Analysis in Support of the NIST Research Reactor (CI Status - Activities)

05379 05380 Task 1: System Thermal-Hydraulic Analysis (05379)

05379 05381 Task 2: Analysis of Neutronic Parameters (05379)

- National Oilheat Research Alliance

87765 87765 Maximizing Fuel Performance in Residential Heating Systems

- NOCO Energy Corporation

87711 87711 Low Cost Bioheating Oil Application

- North Atlantic Treaty Organization - NATO

09714 09714 The Structure and Risk Assessments of Nuclear Power Plants' (NPPs) Safety in Relation to Aircraft Crash

- NYSERDA

87580 87580 Variable Firing Rate Oil Burner Using Pulsed Fuel Flow Control

87585 87585 Improved Electric Power Efficiency in Heating Equipment - Phase II

87703 87703 High Efficiency, Condensing Heating Appliance Firing Low Sulfur Oil

87705 87705 The Use of Biodiesel Blends in Space Heating Equipment

- Radkowsky Thorium Power Corporation

87748 87748 Radkowsky Thorium Fuel Project

87761 87761 Thorium Fuel Project

87762 87762 Thorium Fuel Project - Subcontracts

- Raytheon Technical Services Company

85687 85687 Technical Services to Raytheon Technical Services Company for the FAA Wire Degradation Study

- Royalty

09010 09010 Upgrade the Electrical Component Test Facility in Building 815

09125 09125 Microcombustion Lab Measurement Equipment

09132 09132 Laser Doppler Flame Velocity Studies

- Swedish Nuclear Power Inspectorate

87709 87709 Assistance to the Swedish Nuclear Power Inspectorate (SKI)

- U.S. Nuclear Regulatory Commission

04172 04172 Technical Assistance in Support of DSSA Reactor Systems Issues (CI Status - Activities)

04174 04174 TA in Support of DSSA Review and Resolution of Licensing and Technical Issues Raised by the NRC (TIAs) (CI Status - Activities)

04231 04231 Japanese Collaboration on Seismic Issues

04641 04641 Nuclear Safety Research Information Meeting

13029 04601 Task 1.2 Administration of IMUG (13029)

13029 04739 Task 2.11: Modify Draft Letter Report and Submit Final Report

13029 13029 Technical Support in Risk Assessment (CI. Status - Activities)

13029 15285 Subtask 2.10 (13029)

13273 13273 Technical Support for the Russian Kalininskaya VVER-1000 Probabilistic Risk

Assessment (Beta Project) (94)
 13337 13337 NUREG-0700 - Rev. 2
 13342 13342 Screening Reviews of Seismic - IPEEE (Cl. Status - Activities)
 13342 13351 Task 3: Seismic Insights (13342)
 13355 13355 Support to State Nuclear Regulatory Committee of Ukraine
 13367 13367 Seismic Response of Degraded Structures & Components
 13388 13388 Technical Assistance in Support of Division Systems Safety and Analysis Plant Systems
 Branch Licensing Actions (Cl. Status - Activities)
 13388 15037 Task 3: Technical Assistance for Review of the Prairie Island Waterhammer and Two-Phase Flow Analysis (13388)
 13388 15038 Task 4: Technical Assistance for Resolution of Waterhammer and Two-Phase Flow Issues (13388)
 15089 15089 Support in Development of Consensus PRA Standards (Cl. Status - Activities)
 15089 15209 Task 4: Finalizing the ASME Standard Appendix (15089)
 15136 15136 Ukraine Priority 3.1 - Safety Analysis and Licensing Procedures – Ukrainian Regulator Training (Cl. Status - Activities)
 15136 15147 Task 1: Containment Analysis (15136)
 15173 15173 Russia Priority 1 - Licensing Basis and Safety Analysis - Russian Regulatory Authority (Cl. Status - Activities)
 15231 15231 Low Power and Shutdown Risk Study - Level 2
 15232 15232 Support to State Nuclear Regulatory Committee of Ukraine
 15238 15238 Credit for Operator Action
 15253 04930 Task 4: Igniter Cost Benefit (15253)
 15253 15253 Risk-Informing Part 50 (Cl. Status - Activities)
 15253 15254 Task 1: Plan for Risk Informing Part 50 Recommendations (15253)
 15253 15255 Task 2: Plan for Risk Informing Part 50 Changes (15253)
 15253 15256 Task 3: Meetings (15253)
 15253 15355 Task 2: Plan for Risk Informing Part 50 Changes (15253)
 15263 15263 Reactor Oversight Program Support (Cl. Status - Activities)
 15268 15268 TA License Renewal LRA (Cl. Status - Activities)
 15272 04798 Task 3: Review of Nuclear Energy Institute (NEI) Industry Initiative, NEI 00-01 Industry
 Integrated Methods for Addressing Circuit Failure Issues and Resolution of Associated Circuits Issue (15272)
 15272 15272 Technical Assistance in Support of DSSA Regulatory Licensing Improvements (Cl. Status - Activities)
 15276 04813 Task 8: South Texas Fire Protection Inspection (15276)
 15276 04843 Task 6: Oconee Fire Protection Inspection (15276)
 15276 04847 Task 7: Comanche Peak Fire Protection Inspection (15276)
 15276 04966 Task 9: Susquehanna Fire Protection Inspection (15276)
 15276 15276 Specialist Support for NPP Inspections (Cl. Status - Activities)
 15286 15286 Armenian Nuclear Regulatory Authority - Development of Safety Analysis Review Capability
 15288 15288 Technical Support for the Russian Kalininskaya VVER-1000 PRA
 15289 15289 Technical Assistance for Safety Analysis and Licensing Procedures - Ukrainian

Regulatory Training

15289 15290 Task 5: Training on Pressure Vessel Fluents (15289)
15292 04232 Task 1: Power Cables (15292)
15292 04233 Task 2: Splices (15292)
15292 04235 Task 4: Dissemination (15292)
15292 15292 EQ/Aging Power Cables and Electrical Penetrations (CI Status - Activities)
15293 04771 Task 4: Integration of Case Studies (15293)
15293 15293 TA for Risk Assessment of Nuclear Materials and Waste (CI Status - Activities)
15294 04731 Task 6: Review of Multi-Plant Submittals: Request for Relief From Certain of the ASME, Section XI Code Requirements for Inservice Inspection of Systems and Components (15294)
15294 04772 Task 7: Review of the Robinson, Unit 2, Request for Relief From Certain of the ASME, Section XI Code Requirements for Inservice Inspection of Systems and Components (15294)
15294 15294 TA in Support of the Div. Of Engineering Review of Inservice Inspection Relief Request Licensing Actions (CI Status - Activities)
15295 04295 DCS Specific Activities (15295)
15295 04297 General Reactor Analysis (15295)
15295 04703 Technical Assistance (15295)
15295 15295 Reactor Core Analysis (CI Status - Activities)
15296 04334 Task 1: Benchmarking and Maintenance of NRC Significance Determination Process Notebooks in Support of Inspection and Assessment Program Development and Oversight (15296)
15296 04335 Task 2: Technical Support for Phase 2 of the Shutdown Significance Determination Process (15296)
15296 04931 Task 4: Upgrading SDP Guidance Developed for IMC 0609 Appendix H (Containment Integrity SDP) (15296)
15296 13646 Task 1A: Benchmarking and Maintenance of NRC Significance Determination Process (SDP) Notebooks in Support of Inspection and Assessment Program Development and Oversight (15296)
15296 15296 Support for Inspection and Assessment Program Development and Oversight (CI Status - Activities)
15296 15313 Task 3: Development of Supplementary Guidance on External Events Risk Characterization for NRC Significance Determination Process (15296)
15297 15297 Boiling Water Reactor Fluence
15298 15298 Dry Cask PRA
15299 15299 TA in Support of the Division of Engineering Regulatory Licensing Improvement Activities (CI Status - Activities)
15300 15300 Peer Review BWR Internals
15302 04612 Task 1: Literature Review (15302)
15302 04614 Task 2: Technical Meetings (15302)
15302 04616 Task 3: Workshop (15302)
15302 04634 Task 4: Research Coordination (15302)
15302 15302 Collaborative Research on Wire System Aging (CI Status - Activities)
15303 15303 Strengthening Kazak Regulatory Authority

15304 15304 Support to State Nuclear Regulatory Committee of Ukraine (CI Status - Activities)
 15305 04668 Task 1: Technical Support and Training (15304)
 15306 15306 Support to State Nuclear Regulatory Committee of Ukraine - U-9550
 15309 15309 Improved Methods for Performing Importance Analysis
 15310 15310 Armenian Nuclear Regulatory Authority - Development of a Safety Analysis Review
 Capability
 15311 15311 SPAR Model Development Level 2/LERF
 15312 15312 Technical Assistance in Support of Technical Evaluation of Non-Power Reactors - University of Maryland License Renewal
 15314 15314 Reactor Analysis for High-Burnup Fuel
 15315 15315 Risk Informed Initiatives for Nuclear Materials
 15316 15316 Risk Associated With Cable Aging
 15317 15317 Advanced Reactor Regulatory Framework Development
 15318 15318 Digital Systems PRA
 15319 05147 Task 1: Review of AP1000 Design Control Document Sections 3.8.2, 3.8.3, 3.8.4, and 3.8.5 Pertaining to the Design of Nuclear Island Structures (15319)
 15319 05148 Task 2: Review of AP1000 Design Control Document Sections 3.1.1, 3.6.2, and 3.9 Pertaining to Piping Design Acceptance Criteria (15319)
 15319 15319 Technical Assistance in Support of the Division of Engineering Review of Design Certification Applications (CI Status - Activities)
 Union Fenosa Generacion
 87503 87503 Review of CNJC Design Documentation for Proposed Control Room Modifications

Staff Profile

Tenured	2	Professional	29
Continuing	41	Scientific	53
Term	7	Technical	4
Research Associates	3	Administrative	12
Post Docs		Management	3
		Total	100

Funding Profile for the Last Seven (7) Years

2002	24.8
2001	27.5
2000	N/A
1999	N/A
1998	N/A
1997	N/A
1996	N/A

Other Publications, Citations, Press Releases for this Fiscal Year

- Several press releases on our work for the G-8 Energy ministers conference, John O'Hara's work with the FEC, and our R&D 100 awards.

Notes, Issues, Trends and Assumptions

- The management systems are becoming more useful, but at a glacial pace. It is assumed that G&A will continue to increase, but yield less. An example is the environmental chargeback, which is being fixed even though it is reasonable to assume that we will have less waste to dispose of next Year.

1.4.4.3 Nonproliferation and National Security

Management Goals and Processes for Fiscal Year 2003

- Maintain current sponsorship for existing programs by ensuring that all work efforts are conducted with the utmost quality, on time and within budget.
- Establish new sponsors for counterterrorism work within NNSA, FEMA and ultimately the Dept. of Homeland Security.
- Ensure that all staff is aware of their overall responsibilities to the Department, Laboratory, sponsors and themselves.
- To continue to build existing SCAPA Program by building on activities and funding, including development of biological emergency exposure criteria.
- Encourage submittal of at least one LDRD proposal by each Scientific/Professional staff member.
- To integrate the CAP Program into existing NNS programs or proposals with the intent of adding value.
- To propose a process for development of "Safe-Return" numbers, that is, chemical or biological concentrations, analogous to ERPGs, that will not cause adverse health effects to returning residents or workers at disaster sites.
- Increase overall funding and increase number of Project Leads in the DOE MPC&A Program.
- Diversify funding sources to other parts of DOE and obtain funding from other organizations

Number of New Associate Scientists (or Above) Hired

- One: Ph.D, Sci.D, Biologist

Significant Improvements in Infrastructure and Management Systems that Support Research

- Continued improvement of SCAPA's existing reference system, including scanned, computer retrievable documents.
- Database for project, recommendation, guidance tracking TST Process Changes.

- Completed computer system for documentation required for foreign travel, particularly to Russia; this achievement is a combination of DOE/NNSA and BNL work.

Safety Enhancements

- Safety topic included in all Department Staff Meetings.
- Installation of night lights for hallways.
- Staff member is Building 197 Building Manager.
- Staff member is an advisor to BNL environmental restoration groups
- Staff member on the Environmental Management System Pollution Prevention Committee for the EENS Directorate.

Steps Toward Improvement of Proposal Quality and Opportunities

- Provide internal review of all proposals prior to their submission to outside organizations.
- Develop closer working relationship with DOE HQ by more frequent visits and temporary working assignments for staff in DC and through the use of consultants.
- Staff participated in courses to improve their technical capability in MPC&A and related technical subjects.
- Staff participated in BNL courses to improve communications capabilities.

List the Number of International Collaborations

- Eighty Three

Facts and Figures for FY 2002

List of Projects/Programs Involving Collaboration with Others

- Counterterrorism Workshop, 'New York Metropolitan Region: Counterterrorism and Infrastructure Assurance Technology Needs,' April 9-11, 2002.
- AMEC Project 1.5-1: Radiation Monitoring at an RF Naval Site.
- District Heating Pipe Coating Facility, Snezhinsk, Russia.
- DOE Task Force on Energy Assurance.
- International Workshop on Spent Nuclear Fuel Management at the Andreeva Bay Site.
- USDOE Emergency Management Advisory Committee (EMAC) Subcommittee on Consequence Assessment & Protective Actions (SCAPA), AIHA Emergency Response Planning Guideline (ERPG) Committee, EPA Federal Advisory Committee (FACA) for Acute Exposure Guideline Limits (AEG), CDC Working Group on Bioterrorism Research Priorities for Public Health Response.
- TEMASU - Terrestrial Magnetic Surveyor
- Terra Hertz Reflectometry Project (FAA)
- Green Building Technologies with Battery Park City Authority
- Calverton High Technology Incubator with Stony Brook University, Stony Brook
- TIRC programs with New York State
- Initiatives for Proliferation Prevention (IPP), International Science and Technology Centers.
- Technical Survey Team for DOE MPC&A Program.
- Several collaborations with Russian Institutes on Material Protection Control and Accounting upgrades on nuclear materials.
- 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

- AMEC Project 1.5-1: Radiation Monitoring at an RF Naval Site funded by the US Department of Defense.
- Terra Hertz Reflectometry - DOT / FAA
- Green Building Technology - Battery Park City Authority

Staff Profile

Tenured	0	Professional	12
Continuing	13	Scientific	14
Term	1	Technical	0
Research Associates	0	Administrative	8
Post Docs	0	Management	1
		Total	49

Funding Profile for the Last Seven (7) Years

2002	\$79,783,746
2001	\$56,884,462
2000	
1999	
1998	
1997	
1996	

Other Awards

- Brookhaven EENS Directorate Leadership Award

Other Publications, Citations, Press Releases for this Fiscal Year

- A report on PICASSO-AMEC was presented at the Russia-NATO Advanced Research Workshop on Unresolved Issues Remaining in the Decommissioning of Nuclear Powered Vessels and in the Environmental Remediation of Their Supporting Infrastructure, Moscow, 22-24 April 2002.
- A report on “Automated Environmental Radiation Monitoring at RTP Atomflot and the Polyarninsky Shipyard” was presented at the 5th International Conference on Environmental Radioactivity in the Arctic and Antarctic, St. Petersburg, 16-20 June 2002.
- Press Release: BNL Bulletin articles and press releases on BNL Counterterrorism activities.

International Safeguards Workshop: Design and Testing for High Reliability, 15-17 October 2001:

J. R. Lemley was a principal organizer of the Workshop and its Scientific Secretary
Executive Summary, J. R. Lemley, et al.
Technical Summary, J. R. Lemley, et al.
Proceedings published on CD
Summary of the Closing Plenary Session of the 42nd INMM Annual Meeting, J. R. Lemley, et al., Journal of Nuclear Materials Management 30(2), Winter 2002, 48.
Workshop on Design and Testing or High Reliability: Challenges and Progress, J. R. Lemley, et al., 43rd INMM Annual Meeting, Orlando, FL, 23-27 June 2002.
Review of BNL Atmospheric Sciences Division Research Projects for National Security Relevance, J. R. Lemley, BNL Report SAC 02-03, 30 January 2002.
Physical Security for a Photovoltaic Production Facility, J. R. Lemley, Draft Report for BNL Environmental Sciences Department, revised 3 May 2002.

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

- Twenty two

DRAFT