PE NUMBER: 0601108F
PE TITLE: High Energy Laser Research Initiatives

Exhibit R-2, RDT&E Budget Item Justification

DATE: February 2004

BUDGET ACTIVITY: 01 Basic Research

PE NUMBER AND TITLE: 0601108F High Energy Laser Research Initiatives

Cost ($ in Millions)	FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total
Total Program Element (PE) Cost	0.000	11.961	12.331	12.467	12.716	12.872	13.096	0.000	0.000
5097 High Energy Laser Research Initiatves	0.000	11.961	12.331	12.467	12.716	12.872	13.096	0.000	0.000

Note: In FY 2004, this program was transferred to the Air Force by the Office of the Secretary of Defense. The Air Force continues the tri-Service operation of the program under the High Energy Laser (HEL) Joint Technology Office (JTO).

(U) A. Mission Description and Budget Item Justification

This program funds basic research aimed at developing fundamental scientific knowledge to support future DOD HEL systems. HEL systems have many potential advantages, including speed-of-light velocity, high precision, significant magazine depth, low-cost per kill, and reduced logistics requirements. As a result, HELs have the potential to perform a wide variety of military missions including interception of ballistic missiles in boost phase; defeat of high-speed, maneuvering anti-ship and anti-aircraft missiles; and ultra-precision negation of targets in urban environments with no collateral damage. This program is part of an overall DOD effort in HEL science and technology conducted by the HEL JTO. In general, efforts funded under this program are chosen for their potential to have a broad impact on multiple HEL systems and Service missions while complementing Service/Agency programs that are directed at more specific Service needs. A broad range of technologies are addressed in key areas such as chemical lasers, solid state lasers, beam control, optics, propagation, and free electron lasers. The program funds theoretical, computational, and experimental investigations.

This program is in Budget Activity 1, Basic Research, because it funds scientific study and experimentation. Through this program, the Air Force invests in research directed toward increasing knowledge and understanding in those fields of science and engineering related to long-term national security needs.

(U) B. Program Change Summary ($ in Millions)

		FY 2003	FY 2004	FY 2005
(U)	Previous President's Budget	0.000	12.063	12.363
(U)	Current PBR/President's Budget	0.000	11.961	12.331
(U)	Total Adjustments	0.000	-0.102	
(U)	Congressional Program Reductions			
	Congressional Rescissions		-0.102	
	Congressional Increases			
	Reprogrammings			
	SBIR/STTR Transfer			

(U) Significant Program Changes:

In FY 2004, this program was transferred to the Air Force by the Office of the Secretary of Defense. The Air Force continues the tri-Service operation of the program under the HEL JTO.

Exhibit R-2a, RDT&E Project Justification			DATE February 2004
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601108F High Energy Laser Research Initiatives**	PROJECT NUMBER AND TITLE **5097 High Energy Laser Research Initiatves**	

Cost ($ in Millions)		FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total
5097	High Energy Laser Research Initiatves	0.000	11.961	12.331	12.467	12.716	12.872	13.096	0.000	0.000
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This program funds basic research aimed at developing fundamental scientific knowledge to support future DOD HEL systems. HEL systems have many potential advantages, including speed-of-light velocity, high precision, significant magazine depth, low-cost per kill, and reduced logistics requirements. As a result, HELs have the potential to perform a wide variety of military missions including interception of ballistic missiles in boost phase; defeat of high-speed, maneuvering anti-ship and anti-aircraft missiles; and ultra-precision negation of targets in urban environments with no collateral damage. This program is part of an overall DOD effort in HEL science and technology conducted by the HEL JTO. In general, efforts funded under this program are chosen for their potential to have a broad impact on multiple HEL systems and Service missions while complementing Service/Agency programs that are directed at more specific Service needs. A broad range of technologies are addressed in key areas such as chemical lasers, solid state lasers, beam control, optics, propagation, and free electron lasers. The program funds theoretical, computational, and experimental investigations.

This program is in Budget Activity 1, Basic Research, because it funds scientific study and experimentation. Through this program, the Air Force invests in research directed toward increasing knowledge and understanding in those fields of science and engineering related to long-term national security needs.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2003	FY 2004	FY 2005
(U) For FY 2003, this activity was performed under PE 0601108D8Z, High Energy Laser Initiative, and the funding for FY 2003 was approximately $12.1 million.			
(U)			
(U) MAJOR THRUST: Conduct fundamental research in solid state lasers focused on breaching the cost, power, and efficiency barriers to achieving the promise of simplified logistics and platform integration.	0.000	2.320	2.420
(U) In FY 2003: Not Applicable.			
(U) In FY 2004: Conduct research in areas of interest including laser materials with large fluorescence lifetime and cross-section and the ability to operate at high temperatures, athermal laser gain media, modular and scalable architectures for laser power scaling, means of increasing efficiency in excess of 20%, operation in harsh environments, and corrections for thermally induced distortions in gain media. Research focuses on ceramic gain material fabrication methods, low absorption laser gain media, laser-diode pump sources, fiber lasers, and vertical external cavity laser brightness and power extraction through advancements in cooling and fabrication techniques. Pursuant to the nature of the university-led multidisciplinary research initiative program, all of the efforts to address the above research areas begun during FY 2002 continue to receive funding.			
(U) In FY 2005: Conduct research in areas of interest including laser materials with large fluorescence lifetime and cross-section and the ability to operate at high temperatures, athermal laser gain media, modular and scalable			

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architectures for laser power scaling, means of increasing efficiency in excess of 20%, operation in harsh environments, and corrections for thermally induced distortions in gain media. Pursuant to the nature of the university-led multidisciplinary research initiative program, all of the efforts to address the above research areas begun during FY 2002 will continue to receive funding.

(U)

(U)	MAJOR THRUST: Conduct fundamental research in high-power, lightweight optics.	0.000	1.910	1.960

(U) In FY 2003: Not Applicable.

(U) In FY 2004: Conduct research in areas of interest including basic materials and fabrication techniques, large optics lightweight structure and deployment concepts, HEL optical coatings, multipurpose materials (e.g., wavefront correction combined with aperture adjustment), and control mechanisms. Develop negative thermal expansion optical coating materials to match zero expansion substrates and measure thermal and strain responses of these coatings. Begin investigation of heat transfer in micromachined adaptive mirrors. Develop methods to fabricate, measure, align, and coat large off-axis aspherical optics. Pursuant to the nature of the university-led multidisciplinary research initiative program, all of the efforts to address the above research areas begun during FY 2002 will continue to receive funding.

(U) In FY 2005: Conduct research in areas of interest including basic materials and fabrication techniques, large optics lightweight structure and deployment concepts, HEL optical coatings, multipurpose materials (e.g., wavefront correction combined with aperture adjustment), and control mechanisms. Pursuant to the nature of the university-led multidisciplinary research initiative program, all of the efforts to address the above research areas begun during FY 2002 will continue to receive funding.

(U)

(U)	MAJOR THRUST: Conduct research focused on the scientific concerns associated with atmospheric beam control including atmospheric characterization in aerial, battlefield, and maritime-like environments. These efforts could lead to substantial increases in the lethality of HEL systems without the need for significantly increased power levels.	0.000	3.313	3.351

(U) In FY 2003: Not Applicable.

(U) In FY 2004: Conduct research in areas of interest including improved theoretical and computer-based analysis of propagation effects, advanced wavefront sensing and reconstruction (especially in the presence of thermal blooming), and the effects of extended reference sources used for wavefront correction. Research focuses on new methods for wavefront control, imaging and tracking through turbulence, and modeling and simulation of beam propagation. Pursuant to the nature of the university-led multidisciplinary research initiative program, all of the efforts to address the above research areas that were begun during FY 2002 continue to receive funding.

(U) In FY 2005: Conduct research in areas of interest including improved theoretical and computer-based analysis of propagation effects, advanced wavefront sensing and reconstruction (especially in the presence of thermal blooming), and the effects of extended reference sources used for wavefront correction. Pursuant to the nature of the

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university-led multidisciplinary research initiative program, all of the efforts to address the above research areas that were begun during FY 2002 will continue to receive funding.

(U)

(U) MAJOR THRUST: Conduct fundamental research in chemical lasers to improve the understanding of the processes necessary for the realization of truly closed cycle, lightweight, high-power, continuously operating chemical lasers.	0.000	1.208	1.200

(U) In FY 2003: Not Applicable.

(U) In FY 2004: Conduct research in areas of interest including studies of chemical processes and reactions for a closed-cycle chemical laser system, new sources of the high-energy chemical species needed to produce the lasing event, and electrically driven oxygen iodine laser architectures. Measure chemical kinetics for an all gas phase chemical laser and study plasma physics of an electrically driven oxygen iodine laser system. Pursuant to the nature of the university-led multidisciplinary research initiative program, all of the efforts to address the above research areas that were begun during FY 2002 continue to receive funding.

(U) In FY 2005: Conduct research in areas of interest including studies of chemical processes and reactions for a closed-cycle chemical laser system, new sources of the high-energy chemical species needed to produce the lasing event, and novel recovery systems for regeneration of the laser fuels. Pursuant to the nature of the university-led multidisciplinary research initiative program, all of the efforts to address the above research areas that were begun during FY 2002 will continue to receive funding.

(U)

(U) MAJOR THRUST: Conduct fundamental research in high-average-power ultra-short-pulse free electron lasers to significantly increase the average power obtainable by ultra-short-pulse free electron lasers, while decreasing relative size and cost.	0.000	1.710	1.900

(U) In FY 2003: Not Applicable.

(U) In FY 2004: Conduct research in areas of interest including high-current devices and control methods, higher damage threshold resonator optics, advanced optical cavity designs for high power and compact spaces, and design methods for scaling free electron lasers to reach multi-megawatt class average power levels. Research focuses on dispenser photocathodes, free electron laser beam dynamics, methods to measure high average current beams, and methods to improve free electron laser energy recovery process. Pursuant to the nature of the university-led multidisciplinary research initiative program, all of the efforts to address the above research areas that were begun during FY 2002 continue to receive funding.

(U) In FY 2005: Conduct research in areas of interest including high-current devices and control methods, higher damage threshold resonator optics, advanced optical cavity designs for high power and compact spaces, and design methods for scaling free electron lasers to reach multi-megawatt class average power levels. Pursuant to the nature of the university-led multidisciplinary research initiative program, all of the efforts to address the above research areas that were begun during FY 2002 will continue to receive funding.

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(U)				
(U)	MAJOR THRUST: Conduct fundamental research in modeling and simulation for HELs.	0.000	1.500	1.500
(U)	In FY 2003: Not Applicable.			
(U)	In FY 2004: Continue development of models and simulation techniques to achieve a balance between high-fidelity technical analyses, engineering trade studies that allow analyses of a wide range of systems, and analyses of HEL systems' military utility in a broad range of missions.			
(U)	In FY 2005: Continue development of models and simulation techniques to achieve a balance between high-fidelity technical analyses, engineering trade studies that allow analyses of a wide range of systems, and analyses of HEL systems' military utility in a broad range of missions.			
(U)	Total Cost	0.000	11.961	12.331

(U) C. Other Program Funding Summary ($ in Millions)

	FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
(U) PE 0602500F, Multi-Disciplinary Space Technology.									
(U) PE 0602890F, High Energy Laser Research.									
(U) PE 0603444F, Maui Space Surveillance System.									
(U) PE 0603500F, Multi-Disciplinary Advanced Development Space Technology.									
(U) PE 0603605F, Advanced Weapons Technology.									
(U) PE 0603924F, High Energy Laser Advanced Technology Program.									
(U) PE 0603883C, Ballistic Missile Defense Boost Phase Segment.									
(U) PE 0602605F, Directed Energy Technology.									

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(U) C. Other Program Funding Summary ($ in Millions)

(U) PE 0602307A, Advanced Weapons Technology.

(U) PE 0602114N, Power Projection Applied Research.

(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.