PE NUMBER: 0602500F
PE TITLE: MULTI-DISCIPLINARY SPACE TECH

Exhibit R-2, RDT&E Budget Item Justification

DATE: February 2006

BUDGET ACTIVITY: 02 Applied Research

PE NUMBER AND TITLE: 0602500F MULTI-DISCIPLINARY SPACE TECH

	Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	91.773	91.694	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
5023	Laser & Imaging Space Tech	7.941	8.044	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
5025	Space Materials Development	19.991	19.581	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
5026	Rocket Propulsion Component Tech	48.622	49.005	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
5027	High Speed Airbreathing Prop Tech	0.175	0.243	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
5028	Space Sensors, Photonics & RF Proc	1.806	1.914	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
5029	Space Sensor & CM Tech	4.910	1.095	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
5081	Space Antennas Tech	1.363	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
5082	Optical Networking Tech	6.965	11.812	0.000	0.000	0.000	0.000	0.000	Continuing	TBD

Note: In FY 2006, efforts in Project 5081 move to Project 5082 and the Air Force increased emphasis on developing optical networks for space-based applications. In FY 2007, Project 5023, Laser and Imaging Space Technology, efforts transfer to PE 0602605F, Directed Energy Technology, Project 6255SP, Laser and Imaging Space Technology; Project 5025, Space Materials Development, efforts transfer to PE 0602102F, Materials, Project 6210SP, Space Materials Development; Project 5026, Rocket Propulsion Component Technology, and Project 5027, High Speed Airbreathing Propulsion Technology, efforts transfer to PE 0602203F, Aerospace Propulsion, Project 6233SP, Space Rocket Component Technology; Project 5028, Space Sensors, Photonics and Radio Frequency (RF) Processes, and Project 5029, Space Sensor and Countermeasure (CM) Technology, efforts transfer to PE 0602204F, Aerospace Sensors, Project 6244 SP, Space Sensors; Project 5030, Applied Space Access Vehicle Technology, efforts transfer to PE 0602201F, Aerospace Vehicle Technologies, Project 6222SP, Applied Space Access Vehicle Technology; and Project 5082, Optical Networking Technology, efforts transfer to PE 0602702F, Command Control and Communication, Project 6266SP, Space Optical Network Technology, in order to more effectively manage and provide oversight of the efforts.

(U) A. Mission Description and Budget Item Justification

This program advances the technology base in multiple disciplines for future space applications with projects focusing on separate technology areas including: 1) laser and imaging space technologies, which develop concepts for advanced, very long-range optical systems and assess the vulnerability of satellites to the effects of high energy laser weapon systems; 2) space materials, which concentrate on the materials technology base for spacecraft and launch systems to improve affordability, maintainability, and performance; 3) rocket propulsion component technologies, which advance technology in liquid propulsion rocket engines, solid rocket motors, spacecraft and upper stage propulsion, ballistic missiles, and application of advanced materials for rockets to achieve revolutionary launch capabilities; 4) high-speed airbreathing propulsion technologies, which develop advanced and combined cycle engine technologies for revolutionary low-cost access to space; 5) space sensors, photonics, and radio frequency processes, which develop technologies to generate, control, process, receive, and transmit opto-electronic signals for space sensor applications; 6) space sensors and countermeasures technologies, which focus on generation, control, reception, and processing of electronic and electromagnetic signals for space sensor applications in intelligence, surveillance, reconnaissance, warning, electronic combat, and countermeasures; 7) applied space access vehicle technologies, which develop advanced concepts for affordable on-demand access to space; 8) lightweight satellite antenna technology and affordable antenna terminal technology for communications and surveillance; and 9) optical networking technology, which focuses on the space-based laser communications to provide the warfighter with unlimited communications to any place at any time. Note: In FY 2006, Congress added $4.3 million for Engineering Tool Improvement Program

Exhibit R-2, RDT&E Budget Item Justification	DATE February 2006
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602500F MULTI-DISCIPLINARY SPACE TECH**

(ETIP), $3.2 million for Space Qualification of the Common Data Link, and $4.2 million for Universal Small Launch Vehicle. This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary technologies.

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

		FY 2005	FY 2006	FY 2007
(U)	Previous President's Budget	95.402	81.339	106.114
(U)	Current PBR/President's Budget	91.773	91.694	0.000
(U)	Total Adjustments	-3.629	10.355	
(U)	Congressional Program Reductions	0.000	-0.022	
	Congressional Rescissions	-0.078	-1.323	
	Congressional Increases	0.000	11.700	
	Reprogrammings	-1.892		
	SBIR/STTR Transfer	-1.659		

(U) Significant Program Changes:

Efforts transfer to other programs in FY07 and out to more effectively manage and provide oversight of the efforts.

C. Performance Metrics

(U) Under Development.

Exhibit R-2a, RDT&E Project Justification		DATE: February 2006
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602500F MULTI-DISCIPLINARY SPACE TECH	PROJECT NUMBER AND TITLE: 5023 Laser & Imaging Space Tech

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
5023 Laser & Imaging Space Tech	7.941	8.044	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2007, efforts transfer to PE 0602605F, Directed Energy Technology, Project 6255SP, Laser and Imaging Space Technology, in order to more effectively manage and provide oversight of the efforts.

(U) A. Mission Description and Budget Item Justification

Develop advanced, long-range, optical technologies such as advanced beam control; beam acquisition, tracking, and pointing; adaptive optics; dual line-of-sight pointing; large, lightweight optics; and optical coatings that support relay mirror systems. Relay mirror systems can greatly extend the range of high-power laser weapons, as well as low-power imaging systems.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop advanced, long-range, optical technologies such as advanced beam control; beam acquisition, tracking, and pointing; adaptive optics; dual line-of-sight pointing; large, lightweight optics; and optical coatings that support relay mirror systems. Relay mirror systems can greatly extend the range of high-power laser weapons, as well as low-power imaging systems.	6.005	6.118	0.000
(U) In FY 2005: Developed dual line-of-sight pointing technology for tracking a satellite with a relay mirror. Developed miniature, micro electro-mechanical systems (MEMS), liquid crystals, and novel adaptive optic devices for both monolithic and phased array telescope systems to be used for imaging and beam projection from space.			
(U) In FY 2006: Investigate two-beam propagation techniques in support of a demonstration which tracks and illuminates a cruise missile through a relay mirror. Investigate critical advanced wavefront control devices for both monolithic and phased array imaging and beam projection from space. Develop selected devices to meet application requirements.			
(U) In FY 2007: Not Applicable.			
(U)			
(U) MAJOR THRUST: Assess the vulnerability of satellites to the effects of high-energy laser weapons and maintain and update catalogued satellites.	1.936	1.926	0.000
(U) In FY 2005: Updated target system response databases for continued improvement of predictive avoidance analyses and provided data to U.S. Space Command for their performance of Laser Clearinghouse functions. Updated previously completed assessments on catalogued satellites. Enhanced and refined finite state modeling process and models for space systems that should enable rapid characterization of new launches and provided a better estimate of on-orbit space systems capabilities for improved space situational awareness. Updated lethality assessment methodology by anchoring modeling tools to empirical data. Performed finite state modeling of laser targets to better			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602500F MULTI-DISCIPLINARY SPACE TECH**	PROJECT NUMBER AND TITLE **5023 Laser & Imaging Space Tech**

(U) B. Accomplishments/Planned Program ($ in Millions)

		FY 2005	FY 2006	FY 2007
	understand vulnerabilities and identify indicators of battle damage assessment. Incorporated improved algorithms and hardware for rapidly characterizing space objects and new launches into current data fusion workstations needed for satellite assessments and for the space situational awareness mission.			
(U)	In FY 2006: Assess the survivability and vulnerability of aerospace systems to the effects of high-energy laser and other directed energy systems. Update response databases for continued improvement of predictive avoidance analyses and provide data to U.S. Strategic Command for the performance of Laser Clearinghouse functions. Update previously completed assessments on catalogued satellites. Enhance and refine finite state modeling process, physical, and functional models for space systems that will enable rapid characterization of new launches and provide a better estimate of on orbit space systems capabilities for improved space situational awareness. Continue to update assessment methodology by anchoring modeling tools to empirical data. Incorporate improved algorithms and hardware for rapidly characterizing space objects and new launches into current data fusion workstations needed for satellite assessments and for the space situational awareness mission.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	7.941	8.044	0.000

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602605F, Directed Energy Technology.									
(U) PE 0603444F, Maui Space Surveillance Systems.									
(U) PE 0603500F, Multi-Disciplinary Adv Dev Space Technology.									
(U) PE 0603605F, Advanced Weapons Technology.									
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602500F MULTI-DISCIPLINARY SPACE TECH	PROJECT NUMBER AND TITLE 5023 Laser & Imaging Space Tech

(U) **D. Acquisition Strategy**

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: **February 2006**

BUDGET ACTIVITY: **02 Applied Research**

PE NUMBER AND TITLE: **0602500F MULTI-DISCIPLINARY SPACE TECH**

PROJECT NUMBER AND TITLE: **5025 Space Materials Development**

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
5025 Space Materials Development	19.991	19.581	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2007, efforts transfer to PE 0602102F, Materials, Project 6210SP, Space Materials Development, in order to more effectively manage and provide oversight of the efforts.

(U) A. Mission Description and Budget Item Justification

This project develops the materials and processing technology base for spacecraft and launch systems to improve affordability, maintainability, and performance of current and future Air Force space systems. Families of affordable lightweight materials are being developed, including metals, polymers, ceramics, metallic composites, and nonmetallic composites to provide new capabilities for spacecraft, ballistic missile, and propulsion systems to meet the future space requirements. Rocket propulsion materials development in this project supports the Integrated High Payoff Rocket Propulsion Technology (IHPRPT) program. Advanced high-temperature protection materials are being developed that are affordable, lightweight, dimensionally stable, thermally conductive, and/or ablation and erosion resistant to meet space and ballistic missile requirements. Materials technologies are also being developed to enable surveillance and terrestrial situational awareness systems and subsystems for space and ballistic missile applications.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop materials and processes to dramatically improve performance, durability, and cost of rocket propulsion systems.	10.205	11.037	0.000

(U) In FY 2005: Evaluated materials in an appropriate test environment for high-speed turbopump housings, ducts, valves, solid rocket casings, insulation, nozzle throats, and spacecraft propulsion. Established performance of test articles with representative geometry using high-temperature metals, ceramics, and composite materials to validate material characteristics and processing capabilities for solid rocket nozzles, throats, and spacecraft propulsion. Evaluated engine component suitability using direct replacement of materials or enabling new design based on established material properties. Evaluated materials for pursuing applications, such as thrust chambers, nozzles, and propellant catalysts at high-temperature, high-pressure, and cryogenic environments.

(U) In FY 2006: Evaluate suitability of materials for high-speed turbopumps, ducts, valves, solid rocket casings, insulation, nozzle throats, and spacecraft propulsion applications. Fabricate subscale articles and test in representative rocket engine environment to validate materials performance. Analyze material behavior in rocket combustion environment for solid rocket nozzles, exit cones, throats, and spacecraft propulsion components. Validate materials performance goals for direct replacement of materials. Evaluate processes for scale-up from coupon-level testing to more complex shapes and sizes. Demonstrate innovative concepts and technologies that could enable new engine designs. Characterize material candidates, analyze material performance, and identify ways to improve thrust chambers, nozzles, and catalysts.

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602500F MULTI-DISCIPLINARY SPACE TECH	PROJECT NUMBER AND TITLE 5025 Space Materials Development

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	MAJOR THRUST: Develop nanostructured materials technology for insertion into structures, propulsion, and subsystems applications such as rocket engine components and cryogenic components and structures to enable lighter weights, better performance, and lower costs. Note: In FY 2006 only, effort slipped due to higher priorities.	0.324	0.000	0.000
(U)	In FY 2005: Developed nanoparticle and nanostructured fabrication, characterization, processing techniques, and models for the efficient, low-cost assembly of nanomaterials.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	MAJOR THRUST: Develop affordable, advanced structural and non-structural materials and processing technologies for Air Force space applications.	6.720	6.993	0.000
(U)	In FY 2005: Established performance of high-temperature metallic, high-temperature protection systems using gamma-titanium-aluminide as an external skin for reusable access to space vehicles. Assessed aluminum-lithium metallic cryotank materials for multiple mission access to space. Explored candidate metallic systems for thin gage structures for component operation in robust high-temperature, long duration cruise or access to space environments. Expanded experimental data and analytical results of liquid oxygen compatibility research. Further derived a more representative test series for composite materials. Developed subscale novel high-temperature protection systems in conditions that simulate representative reentry and high-Mach vehicles flight profiles. Initiated testing of candidate space materials to validate test procedures. Matured all-composite heat-pipe radiators for Air Force space systems. Explored oxidation-protected carbon-carbon materials. Established capability of optically tailorable active thermal control coatings with controlled heat dissipation to provide three-fold increase in service life for spacecraft thermal control. Further developed and evaluated baseline effects of the space environment on thermal control coatings, space lubricants, and other organic/inorganic space materials. Explored wear-resistant materials, lubricants, and Micro-Electro-Mechanical System (MEMS) devices for moving mechanical assemblies on spacecraft. Developed non-oxide ceramic composites for stand-off high temperature protection systems. Evaluated rapid inspection techniques for both advanced ceramic tile and stand-off high-temperature protection system materials. Assessed techniques to validate candidate space materials performance. Established suitability of repair processes for non-metallic space materials.			
(U)	In FY 2006: Develop candidate metallic systems for thin gage structures for component operation in robust high-temperature, long duration cruise or access to space environments. Refine analytical methods to understand behavior of materials in cryogenic environments and analyze liquid oxygen (LOX) compatibility research results			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602500F MULTI-DISCIPLINARY SPACE TECH	PROJECT NUMBER AND TITLE 5025 Space Materials Development

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	through integrated technical working groups with industry and National Aeronautics and Space Administration (NASA). Develop subscale high-temperature protection systems for leading edges, nosetips, and aeroshells for expendable and reusable high-speed vehicle applications. Demonstrate oxidation-protected carbon-carbon materials in environments relevant to high-speed vehicle applications. Develop advanced composite technologies for thermal management and dimensionally stable structural space applications. Develop wear-resistant materials, lubricants, and MEMS devices for moving mechanical assemblies on spacecraft. Evaluate candidate space materials and collect critical data to facilitate materials transition.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	MAJOR THRUST: Develop materials and materials processing technologies to enable improved performance and affordability of surveillance, tracking, targeting, and situational awareness systems.	2.742	1.551	0.000
(U)	In FY 2005: Developed electro-optic polymers for optical communications, data links, and radio frequency (RF) system control architectures. Demonstrated the detection performance of very long wavelength alternative materials operating at 40 Kelvin. Investigated materials and process technologies capable of providing solutions for mixed-mode (optical and RF) communications apertures.			
(U)	In FY 2006: Demonstrate electro-optic polymers for optical communications, data links, and RF system control architectures. Explore processes to allow advanced materials design and architecture development for very long wavelength alternative materials operating at 40 Kelvin. Develop materials and materials process technologies for application in combined optical and RF communication system apertures.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	19.991	19.581	0.000

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost

(U) Related Activities:
(U) PE 0602102F, Materials.
(U) PE 0603112F, Advanced Materials for Weapon Systems.
(U) This project has been coordinated through the Reliance process to harmonize efforts and

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602500F MULTI-DISCIPLINARY SPACE TECH**	PROJECT NUMBER AND TITLE **5025 Space Materials Development**

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

eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602500F MULTI-DISCIPLINARY SPACE TECH	PROJECT NUMBER AND TITLE: 5026 Rocket Propulsion Component Tech	

Cost ($ in Millions)		FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
5026	Rocket Propulsion Component Tech	48.622	49.005	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2007, efforts transfer to PE 0602203F, Aerospace Propulsion, Project 6233SP, Space Rocket Component Technology, in order to more effectively manage and provide oversight of the efforts.

(U) A. Mission Description and Budget Item Justification

This project develops advances in rocket propulsion technologies for space access, space maneuver, and ballistic missiles. Analytical and experimental areas of emphasis are propellants, propellant management, combustion, rocket material applications, Technology for Sustainment of Strategic Systems (TSSS) Phase 1, and novel space propulsion concepts. Technologies of interest will improve reliability, performance, survivability, affordability, and environmental compatibility of future space and missile launch subsystems. Technologies are developed to reduce the weight and cost of components using new materials and improved designs and manufacturing techniques. All efforts in this project contribute to the IHPRPT program, a joint Department of Defense, NASA, and industry effort to focus rocket propulsion technology on national needs.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop, characterize, and test advanced hydrocarbons, energetics, and reduced-toxicity monopropellants to increase space launch payload capability and refine new propellants synthesis methods. Efforts include evaluation and development of reduced-toxicity ionic salt, high-energy-density oxidizers, nano-materials, catalyst, and polymeric binders; determining optimized paths for incorporating these materials into propellants; and for selected propellants perform laboratory and demonstrator engine evaluations. Efforts seek monopropellants with performance equivalent to bipropellants that reduce the cost of space access and space operations. Phases are referring to the IHPRPT program phases.	3.869	3.478	0.000

(U) In FY 2005: Furthered downselection and scaled-up promising high energy-density materials candidates. Evaluated scaled-up and new selected propellants in advanced combustion devices to determine materials compatibility and performance, and addressed ballistic property concerns. Matured solid propellants ingredients into Phase III solid propellant formulations. Initiated efforts to address ablation effects on laser-propelled lightcraft fuel and fuel system. Modeled and analyzed advanced propulsion concepts with enhanced performance and reliability such as rocket-based combined cycle engines.

(U) In FY 2006: Further downselect and continue scaling-up promising high energy-density materials candidates. Evaluate scaled-up and new selected propellants in advanced combustion devices to determine materials compatibility and performance and prepare for large-scale motor tests. Complete initial solid propellants ingredients incorporation into Phase III solid propellant formulations. Complete efforts to address ablation effects on laser-propelled lightcraft fuel and fuel system. Continue to model and analyze advanced propulsion concepts with

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602500F MULTI-DISCIPLINARY SPACE TECH	PROJECT NUMBER AND TITLE 5026 Rocket Propulsion Component Tech

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	enhanced performance and reliability such as rocket-based combined cycle engines.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	MAJOR THRUST: Develop advanced liquid engine combustion technology for improved performance, while preserving chamber lifetime and reliability needs for engine uses in heavy lift space vehicles. Efforts include modeling and analyzing advanced propulsion concepts with enhanced performance and reliability such as aerovehicles and potential launch systems. Phases are referring to the IHPRPT program phases.	7.069	8.090	0.000
(U)	In FY 2005: Completed characterizing, studying, and evaluating gas-centered swirl injector performance for hydrocarbon boost engine and increase emphasis on chamber/injector compatibility for upper stage engines. Completed the initial stage of advanced multi-phase modeling and subscale combustion evaluation of new high density refined and advanced hydrocarbon fuels to meet Phase II goals. Completed preliminary selection and modeling for several advanced propulsion concepts.			
(U)	In FY 2006: Initiate characterization, studies, and evaluations of shear coaxial injector performance to ensure chamber/injector compatibility and prevent damage to upper stage engines. Develop experiments to enhance the thermal management of upper stage engines for better performance, chamber life, and reliability. Initiate analysis and test to characterize causes and issues that lead to combustion instability in hydrocarbon fueled liquid rocket engines reducing the need for conducting large numbers of costly full-scale component and engine tests. Develop advanced synthetic hydrocarbon fuels to meet Phase II goals.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	MAJOR THRUST: Develop advanced material applications for lightweight components and material property enhancements for use in advanced combustion devices and propulsion systems for current and future rocket propulsion systems.	3.936	5.248	0.000
(U)	In FY 2005: Completed first subset of additional development for advanced ablatives for use in low-cost, sprayable processing. Characterized and developed new high temperature polymers incorporating synergistic effects of multiple nanomaterials and furthered development of a carbon-carbon composite processing method that reduces cost and processing time. Furthered transition of specific advanced high temperature materials to air and space systems to reduce system weight and cost, and increase performance. Explored promising nanocomposites for liquid rocket engine tanks with multi-functional capability (lightweight, inert, in situ passivation).			
(U)	In FY 2006: Develop advanced, recyclable, ablative components using nano-reinforced hybrid polymers that are two times better than previously developed materials. Continue to characterize and develop processing technologies to improve nano-reinforced high temperature polymers and carbon-carbon materials. Continue developing new			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602500F MULTI-DISCIPLINARY SPACE TECH	PROJECT NUMBER AND TITLE 5026 Rocket Propulsion Component Tech

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	advanced materials for use with high-energy propellants. Complete transition of specific advanced high temperature materials to air and space systems to reduce system weight and cost, and increase performance. Develop processing methodology for using nanocomposites for liquid rocket engine tanks.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	MAJOR THRUST: Develop advanced liquid engine technologies for improved performance, while increasing life and reliability needs for engine uses in expendable and reusable launch vehicles.	20.160	19.519	0.000
(U)	In FY 2005: Completed initial assessment and continued tool improvement for advanced cryogenic upper stage technologies - turbopumps and thrust chambers. Evaluated first set of potential hydrocarbon fuels and adjust/modify/develop fuel characterization test rig. Completed development of first of two concepts for new lightweight nozzles for liquid rocket engines.			
(U)	In FY 2006: Advance modeling and simulation tool development for advanced cryogenic liquid rocket upper stage technologies. Commence hardware design for advanced cryogenic upper stage technologies - turbopumps and thrust chambers. Evaluate second set of potential hydrocarbon fuels and adjust/modify/ develop fuel characterization test rig. Continue development of second concept for lightweight nozzles for liquid rocket engines.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	MAJOR THRUST: Develop solar electric, solar thermal, chemical, and advanced propulsion technologies for stationkeeping, repositioning, and orbit transfer for large communication satellites, microsatellites, and satellite constellations. Phases are referring to the IHPRPT program phases.	4.828	4.292	0.000
(U)	In FY 2005: Completed initial stage developments of monopropellant thruster component technologies for chemical-based space propulsion - catalyst and thrust chamber. Completed Hall thruster Phase II system lifetest and commenced Phase III development efforts. Integrated components and initiated Phase II plasma thruster lifetests for microsatellites propulsion systems. Completed development and test of a controlled solid propellant.			
(U)	In FY 2006: Complete initial development and test of monopropellant thruster component technologies for chemical-based space propulsion. Complete Hall thruster Phase II lifetest and continue Phase III development efforts. Complete Phase II lifetest and begin evaluating Phase III plasma thrusters for microsatellites propulsion systems. Complete development and test of a controlled solid propellant.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Engineering Tool Improvement Program (ETIP).	4.866	4.238	0.000

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BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602500F MULTI-DISCIPLINARY SPACE TECH	PROJECT NUMBER AND TITLE 5026 Rocket Propulsion Component Tech

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	In FY 2005: Improved existing and developed new modeling and simulation tools to address spacecraft component interactions and solid rocket motor heat transfer, insulation performance, plume dispersion, and liquid rocket engine power balance. Developed the integrated reusable launch vehicle analysis tool, which will be used to determine weight, size and performance of future two-stage-to-orbit vehicle concepts.			
(U)	In FY 2006: Provide additional modeling, simulation tool development for Hall-effect thruster physical models, improvements to the ROCket Engine Transient Simulation graphical user interface, and add rocket-based combined cycle models to the Integrated Propulsion Analysis Tool code for future fully reusable launch vehicle concepts. Add capability to analyze advanced propulsion concepts such as Field Reversed Configuration.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Upperstage Engine Technology (USET).	3.894	0.000	0.000
(U)	In FY 2005: Provided for additional validation hardware and risk reduction to existing core effort to develop advanced modeling and simulation design tools for liquid rocket engines.			
(U)	In FY 2006: Congress added $1.0 million for Upperstage Engine Technology, in PE 0603500F, Multi-Disciplinary Advanced Development Space Technology, Project 5033, Rocket Propulsion Demonstration.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Universal Small Launch Vehicle	0.000	4.140	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Integrate propellant tanks with clusters of axi-symmetric aero-spike engine rocket plug nozzles to gain increases in mission performance by employing a vortex combustion, cold-walled liquid oxygen/methane rocket engine concept. This technology could be used on highly operable, highly reusable space transportation systems.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	48.622	49.005	0.000

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0601102F, Defense Research Sciences.									
(U) PE 0602114N, Power Projection									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602500F MULTI-DISCIPLINARY SPACE TECH**	PROJECT NUMBER AND TITLE **5026 Rocket Propulsion Component Tech**

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

Applied Research.

(U) PE 0602203F, Aerospace Propulsion.

(U) PE 0602303A, Missile Technology.

(U) PE 0602805F, Dual Use Science and Technology.

(U) PE 0603216F, Aerospace Propulsion and Power Technology.

(U) PE 0603500F, Multi-Disciplinary Adv Dev Space Technology.

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

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: **February 2006**

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
02 Applied Research	**0602500F MULTI-DISCIPLINARY SPACE TECH**	**5027 High Speed Airbreathing Prop Tech**

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
5027 High Speed Airbreathing Prop Tech	0.175	0.243	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2007, efforts transfer to PE 0602203F, Aerospace Propulsion, Project 6233SP, Space Rocket Component Technology, in order to more effectively manage and provide oversight of the efforts.

(U) A. Mission Description and Budget Item Justification

This project develops revolutionary, airbreathing, hypersonic propulsion technology options to enable affordable, on demand access to space for the Air Force. The short-term focus is on hydrocarbon fueled engines capable of operating over a broad range of flight Mach numbers and longer term focus will be on hydrogen fueled scramjet powered engines that can enable the higher Mach numbers to achieve access to space. Technologies developed under this program enable capabilities of interest to both the Department of Defense and the NASA. Efforts include modeling and simulation, proof of concept tests of critical components, advanced component development, and ground-based tests.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Conduct assessments, system design trades, and simulations to integrate combined cycle engines (CCEs) and advanced cycle airbreathing hypersonic propulsion technologies in support of the development of affordable, on-demand access to space vehicles to meet future warfighter needs.	0.175	0.243	0.000
(U) In FY 2005: Conducted system trade studies to determine military payoff and establish component technology goals. Defined new component and engine performance objectives to enable development of affordable hypersonic CCEs.			
(U) In FY 2006: Conduct system trade studies to determine military payoff and establish component technology goals. Continue to define new component and engine performance objectives to enable development of affordable hypersonic CCEs.			
(U) In FY 2007: Not Applicable.			
(U) Total Cost	0.175	0.243	0.000

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0601102F, Defense Research Sciences.									
(U) PE 0602201F, Aerospace Flight Dynamics.									
(U) PE 0602203F, Aerospace									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602500F MULTI-DISCIPLINARY SPACE TECH**	PROJECT NUMBER AND TITLE **5027 High Speed Airbreathing Prop Tech**

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

Propulsion.

(U) PE 0602602F, Conventional Munitions.

(U) PE 0602702E, Tactical Technology.

(U) PE 0603111F, Aerospace Structures.

(U) PE 0603216F, Aerospace Propulsion and Power Technology.

(U) PE 0603601F, Conventional Weapons Technology.

(U) Program is reported to/coordinated by the Joint Army/Navy/NASA/Air Force (JANNAF) Executive Committee.

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

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602500F MULTI-DISCIPLINARY SPACE TECH	PROJECT NUMBER AND TITLE: 5028 Space Sensors, Photonics & RF Proc	

Cost ($ in Millions)		FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
5028	Space Sensors, Photonics & RF Proc	1.806	1.914	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2007, efforts transfer to PE 0602204F, Aerospace Sensors, Project 6244SP, Space Sensors, in order to more effectively manage and provide oversight of the efforts.

(U) A. Mission Description and Budget Item Justification

This project focuses on developing methods of generating, controlling, receiving, transmitting, and processing photonic, optical, and opto-electronic (mixed) signals for RF space sensor applications. The enabling technologies will be used for intelligence, surveillance, reconnaissance, electronic warfare, and precision engagement sensors based in space. The project aims to demonstrate significantly improved military space sensors of smaller size, lower weight, lower cost, lower power dissipation, higher reliability, and improved performance. This project also develops and assesses multi-dimensional adaptive techniques in radar technology for affordable and reliable space surveillance and reconnaissance systems.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Design and develop high performance integrated photonic technologies for use in space. Note: In FY 2006, effort moves to advanced photonic component technology for space-based sensors thrust in this Project.	0.250	0.000	0.000
(U) In FY 2005: Tested and evaluated high performance integrated photonic technology link, interconnect, and switching components and subsystems for wideband radio frequency phased array antenna beamforming/control, and for high data rate space sensors and communication systems.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Not Applicable.			
(U)			
(U) MAJOR THRUST: Design and develop efficient, high coefficient chip-scale optical waveguide technologies. Note: In FY 2006, effort moves to advanced photonic component technology for space-based sensors thrust in this Project.	0.335	0.000	0.000
(U) In FY 2005: Tested and evaluated efficient, high coefficient chip-scale optical waveguide technology for mixed signal component subsystems.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Not Applicable.			
(U)			
(U) MAJOR THRUST: Perform independent modeling, test, and evaluation for space-based sensors. Note: In FY 2006, effort moves to advanced photonic component technology for space-based sensors thrust in this Project.	0.183	0.000	0.000
(U) In FY 2005: Designed and developed photonic digital and analog mixed signal multi-gigahertz component architectures for high data rate space sensors and communication systems.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602500F MULTI-DISCIPLINARY SPACE TECH	PROJECT NUMBER AND TITLE 5028 Space Sensors, Photonics & RF Proc

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	MAJOR THRUST: Study adaptive processing techniques for large, multi-mission, space-based conformal arrays.	1.038	1.062	0.000
(U)	In FY 2005: Developed adaptive processing techniques suitable for implementation on space-qualified computing architectures for multi-intelligence Intelligence, Surveillance, and Reconnaissance (ISR) sensing from space-based platforms.			
(U)	In FY 2006: Continue to develop adaptive processing techniques suitable for implementation on space-qualified computing architectures for multi-intelligence ISR sensing from space-based platforms. Study signal processing methods and novel adaptive transmit waveform techniques for a space surveillance platform.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	MAJOR THRUST: Develop advance photonic component technology for space-base sensors that focuses on improving performance and reducing size, mass, and prime power. Supports ISR capability. Note: In FY 2006, photonics technology efforts move into this thrust from previous major thrusts in this Project.	0.000	0.852	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Develop and demonstrate photonic component technology enabling low loss true time delay for wideband phased array applications			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	1.806	1.914	0.000

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Funding:									
(U) PE 0602204F, Aerospace Sensors.									
(U) PE 0603203F, Advanced Aerospace Sensors.									
(U) PE 0603500F, Multi-Disciplinary Adv Dev Space Technology.									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602500F MULTI-DISCIPLINARY SPACE TECH**	PROJECT NUMBER AND TITLE **5028 Space Sensors, Photonics & RF Proc**

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

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

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification		DATE: February 2006
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602500F MULTI-DISCIPLINARY SPACE TECH	PROJECT NUMBER AND TITLE: 5029 Space Sensor & CM Tech

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
5029 Space Sensor & CM Tech	4.910	1.095	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2007, efforts transfer to PE 0602204F, Aerospace Sensors, Project 6244SP, Space Sensors, in order to more effectively manage and provide oversight of the efforts.

(U) A. Mission Description and Budget Item Justification

This project focuses on developing processes and techniques for electronic and electromagnetic signal processing for ISR space sensor applications. This project develops the baseline technologies required to manage and perform on-board space sensor information fusion for timely and comprehensive communications and situational awareness. Through modeling and simulation, this project develops and evaluates innovative electromagnetic and electronic countermeasures for space applications.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop and integrate microwave technologies for advanced radio frequency apertures and phased array antennas used in military ISR space sensors. Note: In FY 2006, effort moves to array antenna subsystems and advanced materials thrust in this Project.	1.614	0.000	0.000
(U) In FY 2005: Developed T/R channels that are able to withstand radiation, limited or no active cooling, and strong, undesired electromagnetic radiation.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Not Applicable.			
(U)			
(U) MAJOR THRUST: Develop X-band sub-assemblies based on flexible RF membranes. Note: In FY 2006, effort moves to array antenna subsystems and advanced materials thrust in this Project.	0.478	0.000	0.000
(U) In FY 2005: Developed and investigated approaches and techniques to produce large area (>40 m2) active spaceborne aperture using advanced highly integrated and lightweight RF subassemblies. Demonstrated ten-fold reduction in assembly cost and aperture mass.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Not Applicable.			
(U)			
(U) MAJOR THRUST: Develop two- and three-dimensional interconnects for space applications. Note: In FY 2006, effort moves to array antenna subsystems and advanced materials thrust in this Project.	0.430	0.000	0.000
(U) In FY 2005: Performed environmental testing of the multi-functional flex assemblies two-dimensional and three-dimensional interconnect approaches to determine their applicability for operation in a hostile environment.			
(U) In FY 2006: Not Applicable.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602500F MULTI-DISCIPLINARY SPACE TECH	PROJECT NUMBER AND TITLE 5029 Space Sensor & CM Tech

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	MAJOR THRUST: Develop techniques to accurately predict scattering phenomenology associated with electromagnetic radiation. Note: In FY 2005, effort is complete.	0.525	0.000	0.000
(U)	In FY 2005: Completed refinement of the accuracy of exploitation of the scattering phenomenology associated with electromagnetic radiation returned from objects or backgrounds when viewed from space. Evaluated performance and enhancements to target recognition using these techniques.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	MAJOR THRUST: Develop space-qualified precision time, position, and velocity sensors capable of operating in jamming environments enabling multiple platform sensor-to-shooter operations. Note: In FY 2006, effort is complete.	1.543	0.339	0.000
(U)	In FY 2005: Developed robust precision time, position, and velocity sensor technologies for multi-platform network centric engagement. Evaluated synergistic global positioning system jamming mitigation techniques for operation in hostile RF environments.			
(U)	In FY 2006: Demonstrate highly accurate and robust precision time, position, and velocity sensor techniques for space-based applications. Develop constructive systems engineering model to assess space-based assured reference techniques in terms of measures of performance and warfighter utility.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	MAJOR THRUST: Develop technology to enable affordable upgrades to space-qualified RF signal receivers. Note: In FY 2006, effort terminated due to higher Air Force priorities.	0.320	0.000	0.000
(U)	In FY 2005: Further modeled threat identification algorithms for next generation threat warning receivers. Evaluated state-of-the-art digital and software receiver techniques for radar, electronic warfare, and narrowband space applications.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	MAJOR THRUST: Develop advanced active phased array antenna subsystems to meet the unique requirements of affordable space based sensing including the restrictions on mass, size, power. Utilize advanced materials, to demonstrate low-mass, low cost, reliable and scalable apertures. Supports intelligence, surveillance, and	0.000	0.756	0.000

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602500F MULTI-DISCIPLINARY SPACE TECH	PROJECT NUMBER AND TITLE 5029 Space Sensor & CM Tech

(U) B. Accomplishments/Planned Program ($ in Millions)

		FY 2005	FY 2006	FY 2007
(U)	reconnaissance capability. Note: In FY 2006, efforts on advanced RF apertures, membranes, and interconnects move into this thrust from previous major thrusts in this Project.			
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Develop low-mass shallow-depth microwave antenna panels with integrated active elements and low RF distribution loss.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	4.910	1.095	0.000

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602204F, Aerospace Sensors.									
(U) PE 0603203F, Advanced Aerospace Sensors.									
(U) PE 0603500F, Multi-Disciplinary Adv Dev Space Technology.									
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.									

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: **February 2006**

BUDGET ACTIVITY: **02 Applied Research**

PE NUMBER AND TITLE: **0602500F MULTI-DISCIPLINARY SPACE TECH**

PROJECT NUMBER AND TITLE: **5081 Space Antennas Tech**

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
5081 Space Antennas Tech	1.363	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2006, efforts in this project move to Project 5082 in this PE.

(U) A. Mission Description and Budget Item Justification

This project develops the technology base for satellite antenna technology and affordable terminal technology for communications. Enabling technologies developed under this project for satellite terminals will focus on significantly lowering the life cycle cost communications system ownership, while increasing performance. The project will include new approaches to optical and RF communications transmit and receive technologies to improve network communications performance.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop and demonstrate heterogeneous, seamless, secure, self-configuring, high capacity air/space/surface wireless network, ensuring applicability relevance to space missions. Develop variable data rate, networked data link hardware and the associated RF ground stations for such wireless networks.	1.363	0.000	0.000
(U) In FY 2005: Developed variable data rate, networked data link hardware and the associated RF ground stations. Further continued Optical Local Area Networks and gateways for optical communications between space and airborne assets/platforms. Initiated characterization and development of industry standard single mode optical communications bus for airborne platforms and air-to-air or air-to-ground-to-air RF and laser networked communications.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Not Applicable.			
(U) Total Cost	1.363	0.000	0.000

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) PE 0602204F, Aerospace Sensors.									
(U) PE 0603203F, Advanced Aerospace Sensors.									
(U) PE 0603500F, Multi-Disciplinary Adv Dev Space Technology.									
(U) This project has been									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602500F MULTI-DISCIPLINARY SPACE TECH**	PROJECT NUMBER AND TITLE **5081 Space Antennas Tech**

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

coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602500F MULTI-DISCIPLINARY SPACE TECH	PROJECT NUMBER AND TITLE: 5082 Optical Networking Tech	

Cost ($ in Millions)		FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
5082	Optical Networking Tech	6.965	11.812	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2007, efforts transfer to PE 0602702F, Command Control and Communications, Project 6266SP, Space Optical Network Technology, in order to more effectively manage and provide oversight of the efforts.

(U) A. Mission Description and Budget Item Justification

This project develops the technology base for the next generation of ultra-wide- bandwidth, multi-channeled, air and space-based communications networks on and between platforms. As the application of laser-based, point-to-point communications between satellites emerges, air and space-based optical networks, whose communications capacities are thousands of times greater than current communications satellites, become a realistic possibility. This project will assess and adapt the emerging communication and information technologies, for applications in air and space. This project will explore technologies for implementing photonic chip scale optical Code Division Multiple Access (CDMA) and Wavelength Division Multiplexed (WDM) transceivers and prototype networks, built to demonstrate the benefits associated with the advanced fiber optic, wireless, platform, and satellite networks that can be built from them. This project will develop and demonstrate technology to integrate current Radio Frequency with high data rate Optical LASER communications, along with network management techniques, tools and software to support them. These technologies have potential applications in specific military systems including reliable, high bandwidth, jam-resistant communications at the theater level, and multiplexing of multiple DoD users onto a common networking infrastructure for reduced manning and logistics.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop and assess optical network technologies for application in the space environment.	1.576	1.511	0.000
(U) In FY 2005: Completed assessment of next generation Internet arrayed-waveguide grating technologies for application in the space environment. Initiated design and development of a multi-path interconnection network that provides for redundancy, fault tolerance, self-routing and non-blocking switching required for space-based networks. Developed transmission technology and control concepts to support optically networked communications.			
(U) In FY 2006: Complete design and development of a multi-path interconnection network that provides for redundancy, fault tolerance, self-routing and non-blocking switching required for air and space-based networks. Initiate demonstration of highly integrated multi-gigabit optical network with 4 x 4 optical data router and optical backbone interface chips.			
(U) In FY 2007: Not Applicable.			
(U)			
(U) MAJOR THRUST: Develop and assess existing and emerging Optical CDMA and WDM modulation schemes and protocols for use in space-based optical networks.	1.529	2.997	0.000
(U) In FY 2005: Developed or adapted, along with industry and academia, appropriate standards to ensure the evolution of open systems architecture for space-based optical networks. Investigated emerging terrestrial optical burst			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602500F MULTI-DISCIPLINARY SPACE TECH	PROJECT NUMBER AND TITLE 5082 Optical Networking Tech

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	switching and optical label switching protocols for applicability to space-based optical networks.			
(U)	In FY 2006: Demonstrate industry standard single mode optical communications bus interface chip for airborne platforms. Initiate design and development of optical burst switching and optical label switching protocols for applicability to air and space-based optical networks. Initiate flight demonstration of industry standard single mode optical communications bus interface chip for airborne platforms.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	MAJOR THRUST: Develop and demonstrate heterogeneous, seamless, secure, self-configuring high capacity air/space/surface wireless networks that integrate current RF with high data rate Optical Laser communications.	0.273	4.150	0.000
(U)	In FY 2005: Developed variable data rate, networked data link RF/optical hardware and their associated ground stations.			
(U)	In FY 2006: Initiate design and development of waveform, coding, management, and atmospheric mitigation technologies for a combined RF/laser communications brassboard. Continue characterization and development of industry standard single mode optical communications bus for airborne platforms and air-to-air or air-to-ground RF and laser networked communication.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	MAJOR THRUST/CONGRESSIONAL ADD: Establish and maintain a capability to characterize, evaluate, and optimize network components and technologies for space applications. Note: Includes Congressional Add funding of $1.7 million in FY 2005. Additionally, program efforts complete in FY 2005.	2.614	0.000	0.000
(U)	In FY 2005: Developed and evaluated performance of passive and active optical/electronic chip-scale networking components (transmitters, receivers, switches) for CDMA and WDM on board networks operating at gigabits per second. Developed and demonstrated innovative technologies, such as 16-channel WDM laser array on one chip, 16-channel WDM array receivers on one chip, and compact high-speed optical transmission subsystems, that can provide the Air Forces with a secure means of transmitting high-speed data information (imagery, video, audio and text) from various platforms, while decreasing the size, power, and weight.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Internet Protocol Commanding of Satellites.	0.973	0.000	0.000
(U)	In FY 2005: Developed and demonstrated technology allowing a satellite to be commanded by a field commander for obtaining near-real-time sensor data of interest. Developed an end-to-end architecture for command and control			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602500F MULTI-DISCIPLINARY SPACE TECH	PROJECT NUMBER AND TITLE 5082 Optical Networking Tech

(U) B. Accomplishments/Planned Program ($ in Millions)

		FY 2005	FY 2006	FY 2007
	of a satellite based on a High Assurance Internet Protocol Encryption (HAIPE) architecture, where the interface of the HAIPE command and control system with the ground and Space payload will be fully defined.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Space Qualification of the Common Data Link.	0.000	3.154	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Modify the Common Data Link, previously developed for Joint Surveillance and Target Attack Radar System, U-2, Global Hawk, and Airborne Warning and Control System, and perform qualifications testing for operation in the space environment.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	6.965	11.812	0.000

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) PE 0602702F, Command, Control, and Communications.									
(U) PE 0603789F, C3I Advanced Development.									
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.									

(U) D. Acquisition Strategy

Not Applicable.