

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)									DATE February 1999	
BUDGET ACTIVITY 1 - Basic Research				PE NUMBER AND TITLE 0601102F Defense Research Sciences						
COST (\$ In Thousands)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	188,216	209,731	209,505	177,513	178,523	182,013	186,185	200,020	Continuing	Continuing
2301 Physics	18,629	22,685	22,147	20,268	20,368	20,757	21,342	22,973	Continuing	Continuing
2302 Solid Mechanics and Structures	13,660	18,322	16,094	9,308	9,334	9,651	9,827	10,583	Continuing	Continuing
2303 Chemistry	24,185	25,826	27,536	24,641	24,805	25,262	25,707	27,701	Continuing	Continuing
2304 Mathematical and Computer Sciences	30,488	34,415	32,944	27,743	27,916	28,413	28,917	31,221	Continuing	Continuing
2305 Electronics	19,898	23,399	24,429	20,287	20,603	20,978	21,365	23,001	Continuing	Continuing
2306 Materials	10,116	12,122	13,257	13,380	13,556	13,773	14,093	15,099	Continuing	Continuing
2307 Fluid Mechanics	11,094	7,189	9,975	9,538	9,589	9,776	10,064	10,744	Continuing	Continuing
2308 Propulsion	12,757	14,629	17,263	16,553	16,633	16,950	17,447	18,755	Continuing	Continuing
2310 Atmospheric Sciences	5,584	5,544	5,661	5,082	5,106	5,207	5,365	5,721	Continuing	Continuing
2311 Space Sciences	5,103	6,805	8,625	8,541	8,540	8,691	8,932	9,514	Continuing	Continuing
2312 Biological Sciences	10,933	13,024	13,484	12,228	12,186	12,483	12,763	13,642	Continuing	Continuing
2313 Human Performance	10,500	12,528	13,212	9,944	9,887	10,072	10,363	11,066	Continuing	Continuing
4113 International Science Programs	15,269	13,243	4,878	0	0	0	0	0	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
--	------------------------------

BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences
---	---

(U) **A. Mission Description:** This Basic Research program, managed by the Air Force Office of Scientific Research (AFOSR), supports Air Force research efforts comprised of in-house investigations in Air Force laboratories and extramural activities in academia and industry. The program element funds broad-based scientific and engineering basic research in technologies critical to the Air Force mission. These technologies include aerospace structures, aerodynamics, materials, propulsion, power, electronics, computer science, directed energy, conventional weapons, life sciences, and atmospheric and space sciences. All projects are coordinated through the Reliance process to harmonize efforts, eliminate duplication, and ensure the most effective use of funds. All technology areas are subject to long-range research planning and technical review by tri-Service scientific planning groups that interface and support the Defense Technology Area Planning process. Due to budget reductions in the Human Performance Program in 2001, research efforts in cognitive workload training and personnel selection and work related to cockpit design will be eliminated. Beginning in FY 2000, the Air Force will reduce funding in the International Education Science Programs due to higher priorities within the Science and Technology (S&T) Program.

(U) **B. Budget Activity Justification:** This program is Budget Activity 1, Basic Research, since it includes efforts of scientific study and experimentation directed toward increasing knowledge and understanding in those fields of the physical, engineering, environmental, and life sciences related to long-term national security needs.

(U) **C. Program Change Summary (\$ in Thousands):**

	<u>FY 1998</u>	<u>FY 1999</u>	<u>FY 2000</u>	<u>FY 2001</u>	<u>Total</u> <u>Cost</u>
(U) Previous President's Budget/FY 1999 PB	196,251	209,395	228,104	230,992	Cont
(U) Appropriated Value	207,249	210,395			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-6,856	-664			
b. SBIR	-4,288				
c. Omnibus/Other Above Threshold Reprogrammings	-5,681				
d. Below Threshold Reprogrammings	-2,208				
(U) Adjustments to Budget Year Since FY 1999 PB			-18,599	-53,479	
(U) Current Budget Submit/FY 2000 PB	188,216	209,731	209,505	177,513	Cont

(U) **Significant Program Changes:** Changes to this program since the President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

FY 1999: \$5,524 identified as a source for SBIR

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
---	------------------------------

BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT 2301
---	---	-------------------------------

COST (\$ In Thousands)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2301 Physics	18,629	22,685	22,147	20,268	20,368	20,757	21,342	22,973	Continuing	Continuing

(U) **A. Mission Description:** This project provides the fundamental knowledge required to conceptualize and develop new Air Force weapons and also establishes the basis for many technologies critical to the Air Force. Research in physics has an impact on electromagnetic countermeasures, nuclear weapons effects, communications, and non-destructive and non-intrusive testing and analysis, as well as new materials development. Other technologies affected include avionics, laser technology, and propulsion research. The primary areas of research supported by this project are Photonic Physics, Optics, Plasma Physics, and Atomic and Molecular Physics.

(U) FY 1998 (\$ in Thousands):

- (U) \$6,351 Performed research on laser and optical physics for aerospace applications, optical devices for spoofing and damaging infrared seeking missiles, countermeasures, and devices for directed energy weapons; directed studies toward developing optimum lasers for high image quality telescopes for space surveillance. Examined the physics of lethal and nonlethal directed-energy for speed-of-light target kill.
- (U) \$3,987 Conducted plasma physics research for future directed-energy weapons, affordable low-observables, space communications and surveillance, and advanced explosive-driven power generators; examined the feasibility of using collisional ionized gas volumes to protect friendly assets from directed energy weapon threats.
- (U) \$5,259 Studied atomic, molecular, and imaging physics to enhance space surveillance capabilities in the area of target detection and recognition. Developed advanced atomic molecular processes to produce ideal performance time standards.
- (U) \$3,032 Performed basic research in adaptive optics for application in advanced ground-based telescopes.
- (U) \$18,629 Total

(U) FY 1999 (\$ in Thousands):

- (U) \$9,397 Perform research on laser and optical physics for aerospace applications, optical devices for spoofing and damaging infrared seeking missiles, countermeasures, and devices for directed energy weapons; direct studies toward developing optimum lasers for high image quality telescopes for space surveillance. Examine the physics of lethal and nonlethal directed-energy for speed-of-light target kill.
- (U) \$6,100 Conduct plasma physics research for future directed-energy weapons, affordable low-observables, space communications and surveillance, and advanced explosive-driven power generators; examine the feasibility of using collisional ionized gas volumes to protect friendly assets from directed energy weapon threats.
- (U) \$6,590 Study atomic, molecular, and imaging physics to enhance space surveillance capabilities in the area of target detection and recognition. Develop advanced atomic molecular processes to produce ideal performance time standards.

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT 2301
– (U) \$598	Identified as a source for SBIR.	
– (U) \$22,685	Total	
 (U) <u>FY 2000 (\$ in Thousands):</u>		
– (U) \$9,422	Perform research on laser and optical physics for aerospace applications, optical devices for spoofing and damaging infrared seeking missiles, countermeasures, and devices for directed energy weapons; direct studies toward developing optimum lasers for high image quality telescopes for space surveillance. Examine the physics of lethal and nonlethal directed-energy for speed-of-light target kill.	
– (U) \$6,117	Conduct plasma physics research for future directed-energy weapons, affordable low-observables, space communications and surveillance, and advanced explosive-driven power generators; examine the feasibility of using collisional ionized gas volumes to protect friendly assets from directed energy weapon threats.	
– (U) \$6,608	Study atomic, molecular, and imaging physics to enhance space surveillance capabilities in the area of target detection and recognition. Develop advanced atomic molecular processes to produce ideal performance time standards.	
– (U) \$22,147	Total	
 (U) <u>FY 2001 (\$ in Thousands):</u>		
– (U) \$8,519	Perform research on laser and optical physics for aerospace applications, optical devices for spoofing and damaging infrared seeking missiles, countermeasures, and devices for directed energy weapons. Examine the physics of lethal and nonlethal directed-energy for speed-of-light target kill.	
– (U) \$5,676	Conduct plasma physics research for future directed-energy weapons, affordable low-observables, space communications and surveillance, and advanced explosive-driven power generators.	
– (U) \$6,073	Study atomic and molecular physics to enhance space surveillance capabilities in the area of target detection and recognition. Develop advanced atomic molecular processes to produce ideal performance time standards.	
– (U) \$20,268	Total	

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	February 1999
PROJECT 2301		
<p>(U) B. <u>Project Change Summary - Description of Significant Changes:</u> Not Applicable.</p> <p>(U) C. <u>Other Program Funding Summary:</u></p> <p>(U) <u>Related Activities:</u></p> <ul style="list-style-type: none">- (U) PE 0602203F, Aerospace Propulsion.- (U) PE 0602601F, Phillips Laboratory. <p>(U) D. <u>Acquisition Strategy:</u> Not Applicable.</p> <p>(U) E. <u>Schedule Profile:</u> Not Applicable.</p>		
Project 2301	Page 5 of 39 Pages	Exhibit R-2A (PE 0601102F)

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)								DATE February 1999		
BUDGET ACTIVITY 1 - Basic Research				PE NUMBER AND TITLE 0601102F Defense Research Sciences					PROJECT 2302	
COST (\$ In Thousands)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2302 Solid Mechanics and Structures	13,660	18,322	16,094	9,308	9,334	9,651	9,827	10,583	Continuing	Continuing

(U) **A. Mission Description:** This project seeks to develop a fundamental understanding of the behavior of aerospace materials, structures, and supporting facilities, leading to cost-effective development and safe and reliable operation of superior weapons and defensive systems. Research includes such diverse topics as the micromechanical design of advanced materials, modeling and simulation of the dynamic behavior of aircraft, missiles, and large space structures, and technology integration for the performance and survivability enhancement of these systems. This research will result in expanding the fundamental knowledge base to better understand the mechanics of deformation and damage of aerospace materials and structures. Also, this research will lead to an improved understanding of the aeroelastic and acoustic behavior of airframe and engine structures, and the dynamic behavior of launch vehicles and space structures.

(U) FY 1998 (\$ in Thousands):

- (U) \$5,470 Studied thermomechanical behavior of advanced structural materials, including micromechanics of high-temperature composite materials for aerospace structural systems and coatings. Investigated the fracture behavior and thermomechanical behavior of high temperature alloys and composite materials for engine and hypersonic vehicle applications.
- (U) \$5,105 Modeled development of materials for aerospace structures, including dynamics and mechanics of materials at very small scales, as necessary for the development of micro-electromechanical systems. Developed fundamental understanding of the behavior of aeroelastic structures and conducted research into the behavior of actuator/structure interaction for control of shell structures in vibro/acoustic environments.
- (U) \$3,085 Sought fundamental particulate mechanics knowledge, including quantitative relationships to describe the fundamental mechanics governing the behavior of geomaterial systems. Investigated the fundamental relationship of geomaterials undergoing high strain rate loadings with increasing confining pressures, as occurs when impacted by penetrating weapons.
- (U) \$13,660 Total

(U) FY 1999 (\$ in Thousands):

- (U) \$6,557 Study thermomechanical behavior of advanced structural materials, including micromechanics of high-temperature composite materials for aerospace structural systems and coatings. Investigate the fracture behavior and thermomechanical behavior of high temperature alloys and composite materials for engine and hypersonic vehicle applications.

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT 2302
<ul style="list-style-type: none"> – (U) \$6,022 Model development of materials for aerospace structures, including dynamics and mechanics of materials at very small scales, as necessary for the development of micro-electromechanical systems. Develop fundamental understanding of the behavior of aeroelastic structures and conduct research into the behavior of actuator/structure interaction for control of shell structures in vibro/acoustic environments. – (U) \$5,261 Seek fundamental particulate mechanics knowledge, including quantitative relationships to describe the fundamental mechanics governing the behavior of geomaterial systems. Investigate the fundamental relationship of geomaterials undergoing high strain rate loadings with increasing confining pressures, as occurs when impacted by penetrating weapons. – (U) \$482 Identified as a source for SBIR. – (U) \$18,322 Total <p>(U) <u>FY 2000 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> – (U) \$5,915 Study thermomechanical behavior of advanced structural materials, including micromechanics of high-temperature composite materials for aerospace structural systems and coatings. Investigate the fracture behavior and thermomechanical behavior of high temperature alloys and composite materials for engine and hypersonic vehicle applications. – (U) \$5,432 Model development of materials for aerospace structures, including dynamics and mechanics of materials at very small scales, as necessary for the development of micro-electromechanical systems. Develop fundamental understanding of the behavior of aeroelastic structures and conduct research into the behavior of actuator/structure interaction for control of shell structures in vibro/acoustic environments. – (U) \$4,747 Seek fundamental particulate mechanics knowledge, including quantitative relationships to describe the fundamental mechanics governing the behavior of geomaterial systems. Investigate the fundamental relationship of geomaterials undergoing high strain rate loadings with increasing confining pressures, as occurs when impacted by penetrating weapons. – (U) \$16,094 Total <p>(U) <u>FY 2001 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> – (U) \$5,289 Study thermomechanical behavior of advanced structural materials, including micromechanics of high-temperature composite materials for aerospace structural systems and coatings. Investigate the fracture behavior and thermomechanical behavior of high temperature alloys and composite materials for engine and hypersonic vehicle applications. – (U) \$3,149 Model development of materials for aerospace structures, including dynamics and mechanics of materials at very small scales, as necessary for the development of micro-electromechanical systems. Develop fundamental understanding of the behavior of aeroelastic structures and conduct research into the behavior of actuator/structure interaction for control of shell structures in vibro/acoustic environments. – (U) \$870 Investigate and integrate material and structural behavior for future aerospace structures such as multifunctional systems as necessary for the development of smart structures and MEMS. Develop fundamental understanding of the energy dissipation mechanisms within these materials and structures. – (U) \$9,308 Total 		
Project 2302	Page 7 of 39 Pages	Exhibit R-2A (PE 0601102F)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT 2302
<p>(U) B. <u>Project Change Summary - Description of Significant Changes:</u> Changes to this program since the President's Budget are due to higher priorities within the Science and Technology (S&T) Program.</p> <p>(U) C. <u>Other Program Funding Summary:</u></p> <p>(U) <u>Related Activities:</u></p> <ul style="list-style-type: none"> - (U) PE 0602102F, Materials. - (U) PE 0602201F, Aerospace Flight Dynamics. - (U) PE 0602202F, Human Systems Technology. - (U) PE 0603211F, Aerospace Structures. - (U) PE 0602203F, Aerospace Propulsion. <p>(U) D. <u>Acquisition Strategy:</u> Not Applicable.</p> <p>(U) E. <u>Schedule Profile:</u> Not Applicable.</p>		
Project 2302	Page 8 of 39 Pages	Exhibit R-2A (PE 0601102F)

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)								DATE February 1999		
BUDGET ACTIVITY 1 - Basic Research				PE NUMBER AND TITLE 0601102F Defense Research Sciences					PROJECT 2303	
<i>COST (\$ In Thousands)</i>	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2303 Chemistry	24,185	25,826	27,536	24,641	24,805	25,262	25,707	27,701	Continuing	Continuing
<p>(U) A. <u>Mission Description:</u> In the chemistry research program, knowledge and understanding is sought in chemical synthesis and reactivity, polymer chemistry, surface science, and molecular dynamics. The focus is on building the knowledge base required to develop new materials and to improve the synthesis of existing materials. Specific research focus areas include functional and structural materials, electronic and photonic materials, biomimetic materials, electromagnetic and conventional weaponry, propellants, and environmentally safer materials. This program conducts novel synthesis and characterization of higher performance and lower cost nonmetallic and biomimetic materials for application as infrared sensors, and safer, more efficient fire suppressants and deicer/anti-ice materials, and mechanistic studies of biological corrosion and semiconductor nanolithography. The chemistry program also investigates effects of chemical and morphological structures on functional and mechanical properties of polymeric materials. The program also explores atomic and molecular surface interactions that can limit performance of electronic devices, compact power sources, and lubricant materials, and investigates molecular energy release mechanisms and energy storage in metastable molecular systems to foster advances in laser weapons development and new chemical propellants.</p> <p>(U) <u>FY 1998 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> – (U) \$7,080 Studied chemical synthesis of compounds with tailored functional and structural properties for improved aerospace vehicle performance by investigating the long-term durability of polymers that operate in extreme environments. Developed organic coatings for aircraft protection applications and created functional polymers for optical signal processing and control of phased-array radar and laser radar. – (U) \$6,372 Investigated a chemical process at surfaces and interfaces to improve performance and maintainability of Air Force systems by formulating an atomistic model for corrosion prevention in aluminum aircraft components. Developed new vapor phase lubricants for operations in extreme temperature environments. – (U) \$10,733 Performed research on molecular-level energy transfer, energy extraction, and chemical reactivity research for advanced aerospace applications by investigating high-energy, metastable molecular states, and by developing and applying methods for simulating molecular energy transfer in extreme aerospace environments to predict and interpret aircraft and spacecraft signatures. Investigated the formation and stability of molecular clusters for use as nanoscale sensors in aircraft, spacecraft, and air vehicles. – (U) \$24,185 Total <p>(U) <u>FY 1999 (\$ in Thousands):</u></p>										
Project 2303			Page 9 of 39 Pages				Exhibit R-2A (PE 0601102F)			

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT 2303
– (U) \$7,544	Study chemical synthesis of compounds with tailored functional and structural properties for improved aerospace vehicle performance by investigating the long-term durability of polymers that operate in extreme environments. Develop organic coatings for aircraft protection applications and create functional polymers for optical signal processing and control of phased-array radar and laser radar.	
– (U) \$7,041	Investigate a chemical process at surfaces and interfaces to improve performance and maintainability of Air Force systems by formulating an atomistic model for corrosion prevention in aluminum aircraft components. Develop new vapor phase lubricants for operations in extreme temperature environments.	
– (U) \$10,561	Perform research on molecular-level energy transfer, energy extraction, and chemical reactivity research for advanced aerospace applications by investigating high-energy, metastable molecular states, and by developing and applying methods for simulating molecular energy transfer in extreme aerospace environments to predict and interpret aircraft and spacecraft signatures. Investigate the formation and stability of molecular clusters for use as nanoscale sensors in aircraft, spacecraft, and air vehicles.	
– (U) \$680	Identified as a source for SBIR.	
– (U) \$25,826	Total	
(U) FY 2000 (\$ in Thousands):		
– (U) \$8,261	Study chemical synthesis of compounds with tailored functional and structural properties for improved aerospace vehicle performance by investigating the long-term durability of polymers that operate in extreme environments. Develop organic coatings for aircraft protection applications and create functional polymers for optical signal processing and control of phased-array radar and laser radar.	
– (U) \$7,710	Investigate a chemical process at surfaces and interfaces to improve performance and maintainability of Air Force systems by formulating an atomistic model for corrosion prevention in aluminum aircraft components. Develop new vapor phase lubricants for operations in extreme temperature environments.	
– (U) \$11,565	Perform research on molecular-level energy transfer, energy extraction, and chemical reactivity research for advanced aerospace applications by investigating high-energy, metastable molecular states, and by developing and applying methods for simulating molecular energy transfer in extreme aerospace environments to predict and interpret aircraft and spacecraft signatures. Investigate the formation and stability of molecular clusters for use as nanoscale sensors in aircraft, spacecraft, and air vehicles.	
– (U) \$27,536	Total	

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic Research	0601102F Defense Research Sciences	2303
<p>(U) <u>FY 2001 (\$ in Thousands):</u></p> <ul style="list-style-type: none">- (U) \$7,146 Study chemical synthesis of compounds with tailored functional and structural properties for improved aerospace vehicle performance by investigating the long-term durability of polymers that operate in extreme environments. Create functional polymers for optical signal processing and control of phased-array radar and laser radar.- (U) \$6,603 Investigate a chemical process at surfaces and interfaces to improve performance and maintainability of Air Force systems by formulating an atomistic model for corrosion prevention in aluminum aircraft components.- (U) \$10,892 Perform research on molecular-level energy transfer, energy extraction, and chemical reactivity research for advanced aerospace applications by investigating high-energy, metastable molecular states, and by developing and applying methods for simulating molecular energy transfer in extreme aerospace environments to predict and interpret aircraft and spacecraft signatures. Investigate the formation and stability of molecular clusters for use as nanoscale sensors in aircraft, spacecraft, and air vehicles.- (U) \$24,641 Total <p>(U) B. <u>Project Change Summary - Description of Significant Changes:</u> Not Applicable.</p> <p>(U) C. <u>Other Program Funding Summary:</u></p> <p>(U) <u>Related Activities:</u></p> <ul style="list-style-type: none">- (U) PE 0602102F, Materials.- (U) PE 0602601F, Phillips Laboratory. <p>(U) D. <u>Acquisition Strategy:</u> Not Applicable.</p> <p>(U) E. <u>Schedule Profile:</u> Not Applicable.</p>		
Project 2303	Page 11 of 39 Pages	Exhibit R-2A (PE 0601102F)

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)								DATE February 1999		
BUDGET ACTIVITY 1 - Basic Research				PE NUMBER AND TITLE 0601102F Defense Research Sciences				PROJECT 2304		
<i>COST (\$ In Thousands)</i>	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2304 Mathematical and Computer Sciences	30,488	34,415	32,944	27,743	27,916	28,413	28,917	31,221	Continuing	Continuing
<p>(U) A. <u>Mission Description:</u> This research focuses on mathematical modeling, simulation, and control of complex systems and provides analytical and computational methods. Topics include: effective utilization of high-performance computers; control of aerospace systems; models and computational tools for the design of aircraft, missiles, or other weapons; efficient production of large-scale, well documented computer programs and software; communication and information theory; signal processing; artificial intelligence in surveillance systems or independent weapons; reliability and maintainability; and the allocation of resources in logistics or operational activities using ideas from optimization and linear programming theories.</p> <p>(U) <u>FY 1998 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> – (U) \$10,113 Studied physical mathematics, control and signal processing, and modeling of advanced materials including composites and smart skins in support of the Air Force's New World Vista (NWV) programs. Developed modeling, identification, control, and signal processing capabilities necessary for the integrated control of jet engines, aerodynamics, and combustor instabilities. – (U) \$10,962 Performed research on computer software and systems for battlespace information management. Expanded research in transportable agent technology to support defensive information warfare applications and real-time problem solving strategies to support dynamic planning and execution. – (U) \$9,413 Investigated computational science for improved design and simulation of advanced aerospace systems. Integrated new multidisciplinary optimization design strategies with higher order, time accurate flow solvers for improved design of jet engines and other aerospace components. Developed algorithms incorporating active control procedures. – (U) \$30,488 Total <p>(U) <u>FY 1999 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> – (U) \$11,393 Study physical mathematics, control and and signal processing, and modeling of advanced materials including composites and smart skins in support of the Air Force's NWV programs. Develop modeling, identification, control, and signal processing capabilities necessary for the integrated control of jet engines, aerodynamics, and combustor instabilities. – (U) \$12,064 Perform research on computer software and systems for battlespace information management. Expand research in transportable agent technology to support defensive information warfare applications and real-time problem solving strategies to support dynamic planning and execution. 										
Project 2304			Page 12 of 39 Pages				Exhibit R-2A (PE 0601102F)			

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT 2304
– (U) \$10,052	Investigate computational science for improved design and simulation of advanced aerospace systems. Integrate new multidisciplinary optimization design strategies with higher order, time accurate flow solvers for improved design of jet engines and other aerospace components. Develop algorithms incorporating active control procedures.	
– (U) \$906	Identified as a source for SBIR.	
– (U) \$34,415	Total	
(U) FY 2000 (\$ in Thousands):		
– (U) \$12,200	Study physical mathematics, control and signal processing, and modeling of advanced materials including composites and smart skins in support of the Air Force's New World Vista (NWV) programs. Develop modeling, identification, control, and signal processing capabilities necessary for the integrated control of jet engines, aerodynamics, and combustor instabilities.	
– (U) \$11,861	Perform research on computer software and systems for battlespace information management. Expand research in transportable agent technology to support defensive information warfare applications and real-time problem solving strategies to support dynamic planning and execution.	
– (U) \$9,883	Investigate computational science for improved design and simulation of advanced aerospace systems. Integrate new multidisciplinary optimization design strategies with higher order, time accurate flow solvers for improved design of jet engines and other aerospace components. Develop algorithms incorporating active control procedures.	
– (U) \$32,944	Total	
(U) FY 2001 (\$ in Thousands):		
– (U) \$11,228	Study physical mathematics, control and signal processing, and modeling of advanced materials including composites and smart skins in support of the Air Force's NWV programs. Develop modeling, identification, control, and signal processing capabilities necessary for the integrated control of jet engines, aerodynamics, and combustor instabilities.	
– (U) \$8,884	Perform research on computer software and systems for battlespace information management. Continue research in transportable agent technology to support defensive information warfare applications and real-time problem solving strategies to support dynamic planning and execution.	
– (U) \$7,631	Investigate computational science for improved design and simulation of advanced aerospace systems. Integrate new multidisciplinary optimization design strategies with higher order, time accurate flow solvers for improved design of jet engines and other aerospace components. Develop algorithms incorporating active control procedures.	
– (U) \$27,743	Total	

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic Research	0601102F Defense Research Sciences	2304
<p>(U) B. <u>Project Change Summary - Description of Significant Changes:</u> Changes to this program since the President's Budget are due to higher priorities within the Science and Technology (S&T) Program.</p> <p>(U) C. <u>Other Program Funding Summary:</u></p> <p>(U) <u>Related Activities:</u></p> <ul style="list-style-type: none">- (U) PE 0602201F, Aerospace Flight Dynamics.- (U) PE 0602702F, Command, Control, and Communications.- (U) PE 0603728F, Advanced Computer Technology. <p>(U) D. <u>Acquisition Strategy:</u> Not Applicable.</p> <p>(U) E. <u>Schedule Profile:</u> Not Applicable.</p>		
Project 2304	Page 14 of 39 Pages	Exhibit R-2A (PE 0601102F)

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)								DATE February 1999		
BUDGET ACTIVITY 1 - Basic Research				PE NUMBER AND TITLE 0601102F Defense Research Sciences				PROJECT 2305		
<i>COST (\$ In Thousands)</i>	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2305 Electronics	19,898	23,399	24,429	20,287	20,603	20,978	21,365	23,001	Continuing	Continuing
<p>(U) A. <u>Mission Description:</u> Research in this project emphasizes electronic devices and systems that enable new Air Force capabilities such as battle information management systems, countermeasures, sensors, and the more electric aircraft concept. The goals are to increase the data and information processing speed of electronic systems, to firmly control their complexity and reliability, and to improve the security and reliability of information and data transmission. Research is conducted in electronic processes which will enable the engineer to model and predict performance of electronic materials, devices, and systems for high-speed digital and analog signal processing, microwave and millimeter wave signal and power generation, superconducting, optical signal processing, and radiation effects.</p> <p>(U) <u>FY 1998 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> - (U) \$11,137 Studied semiconductor electronic materials, advanced devices, interface control, and stability for improved laser and detector applications. Investigated methods to electronically tailor compound semiconductors and examined high-temperature electronics for use in hostile environments. - (U) \$6,052 Sought fundamental understanding of optoelectronic information processing and storage. Investigated advanced communications, signal processing, and computing; and examined novel micro-lasers and ultra-high density information storage and retrieval. - (U) \$2,709 Investigated superconducting and nanoscopic materials, devices, and applications for advanced communications and higher speed signal processing and denser memory. Created high current, high temperature, superconducting materials for power generation and storage on space platforms. - (U) \$19,898 Total <p>(U) <u>FY 1999 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> - (U) \$12,279 Study semiconductor electronic materials, advanced devices, interface control, and stability for improved laser and detector applications. Investigated methods to electronically tailor compound semiconductors and examine high-temperature electronics for use in hostile environments. - (U) \$6,559 Seek fundamental understanding of optoelectronic information processing and storage. Investigate advanced communications, signal processing, and computing; and examine novel micro-lasers and ultra-high density information storage and retrieval. 										
Project 2305			Page 15 of 39 Pages				Exhibit R-2A (PE 0601102F)			

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences PROJECT 2305	
– (U) \$3,945	Investigate superconducting and nanoscopic materials, devices, and applications for advanced communications and higher speed signal processing and denser memory. Create high current, high temperature, superconducting materials for power generation and storage on space platforms.	
– (U) \$616	Identified as a source for SBIR.	
– (U) \$23,399	Total	
(U) <u>FY 2000 (\$ in Thousands):</u>		
– (U) \$13,167	Study semiconductor electronic materials, advanced devices, interface control, and stability for improved laser and detector applications. Investigate methods to electronically tailor compound semiconductors and examine high-temperature electronics for use in hostile environments.	
– (U) \$7,034	Seek fundamental understanding of optoelectronic information processing and storage. Investigate advanced communications, signal processing, and computing; and examine novel micro-lasers and ultra-high density information storage and retrieval.	
– (U) \$4,228	Investigate superconducting and nanoscopic materials, devices, and applications for advanced communications and higher speed signal processing and denser memory. Create high current, high temperature, superconducting materials for power generation and storage on space platforms.	
– (U) \$24,429	Total	
(U) <u>FY 2001 (\$ in Thousands):</u>		
– (U) \$11,395	Study semiconductor electronic materials, advanced devices, and stability for improved detector applications. Investigate methods to electronically tailor compound semiconductors and examine high-temperature electronics for use in hostile environments.	
– (U) \$4,634	Examine novel micro-lasers and ultra-high density information storage and retrieval.	
– (U) \$4,258	Investigate superconducting and nanoscopic materials, devices, and applications for advanced communications and higher speed signal processing and denser memory. Create high current, high temperature, superconducting materials for power generation and storage on space platforms.	
– (U) \$20,287	Total	

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	February 1999
<p>(U) B. <u>Project Change Summary - Description of Significant Changes:</u> Not Applicable.</p> <p>(U) C. <u>Other Program Funding Summary:</u></p> <p>(U) <u>Related Activities:</u></p> <ul style="list-style-type: none">- (U) PE 0602204F, Aerospace Avionics.- (U) PE 0602702F, Command, Control, and Communications.- (U) PE 0603728F, Advanced Computer Technology. <p>(U) D. <u>Acquisition Strategy:</u> Not Applicable.</p> <p>(U) E. <u>Schedule Profile:</u> Not Applicable.</p>		
Project 2305	Page 17 of 39 Pages	Exhibit R-2A (PE 0601102F)

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
---	------------------------------

BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT 2306
---	---	-------------------------------

COST (\$ In Thousands)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2306 Materials	10,116	12,122	13,257	13,380	13,556	13,773	14,093	15,099	Continuing	Continuing

(U) **A. Mission Description:** Research focuses on metallic, polymeric, ceramic, and nonmetallic structural materials. Materials research provides the knowledge for improving the performance, cost, and reliability of structural materials. Structural materials research studies a broad range of material properties such as strength, toughness, fatigue resistance, and corrosion resistance of airframe, turbine engine, and spacecraft materials. Emphasis is on refractory alloys, intermetallics, polymer composites, metal and ceramic matrix composites, and advanced ceramics, such as alumina, silicon carbide, silicon nitride, and carbon/carbon. Research in new processing methods complements research on materials properties. Direct goals of this program are to increase the operating temperature of engine materials which will further increase thrust-to-weight ratio of engines, develop improved aerospace vehicle structural materials, and control or eliminate advance material reliability issues related to high temperature strength, toughness, fatigue, and environmental conditions.

(U) FY 1998 (\$ in Thousands):

- (U) \$5,152 Performed fundamental studies of very-high temperature, non-metallic materials for air-breathing engine and space vehicle applications. Investigated coupled thermal and mechanical stability of very-high temperature oxide composites and eutectics for engine blade applications and ultra-high temperature materials systems based on carbides for rocket propulsion applications.
- (U) \$4,032 Performed research on metallic systems for engines and airframe applications. Studied thermal and mechanical stability of refractory metal systems for very-high temperature applications and investigated functionally gradient structures for thermal barrier coatings.
- (U) \$932 Studied life and reliability of polymeric composites by researching non-destructive evaluation techniques on adhesive-bonded structures. Investigated free-volume effect in controlling moisture absorption mechanisms and rates in polymer matrix composites.
- (U) \$10,116 Total

(U) FY 1999 (\$ in Thousands):

- (U) \$6,373 Perform fundamental studies of very-high temperature, non-metallic materials for air-breathing engine and space vehicle applications. Investigate coupled thermal and mechanical stability of very-high temperature oxide composites and eutectics for engine blade applications and ultra-high temperature materials systems based on carbides for rocket propulsion applications.
- (U) \$4,248 Perform research on metallic systems for engines and airframe applications. Study thermal and mechanical stability of refractory metal systems for very-high temperature applications and investigate functionally gradient structures for thermal barrier coatings.

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	
		PROJECT 2306
– (U) \$1,181	Study life and reliability of polymeric composites by researching non-destructive evaluation techniques on adhesive-bonded structures. Investigate free-volume effect in controlling moisture absorption mechanisms and rates in polymer matrix composites.	
– (U) \$320	Identified as a source for SBIR.	
– (U) \$12,122	Total	
(U) FY 2000 (\$ in Thousands):		
– (U) \$7,159	Perform fundamental studies of very-high temperature, non-metallic materials for air-breathing engine and space vehicle applications. Investigate coupled thermal and mechanical stability of very-high temperature oxide composites and eutectics for engine blade applications and ultra-high temperature materials systems based on carbides for rocket propulsion applications.	
– (U) \$4,772	Perform research on metallic systems for engines and airframe applications. Study thermal and mechanical stability of refractory metal systems for very-high temperature applications and investigate functionally gradient structures for thermal barrier coatings.	
– (U) \$1,326	Study life and reliability of polymeric composites by researching non-destructive evaluation techniques on adhesive-bonded structures. Investigate free-volume effect in controlling moisture absorption mechanisms and rates in polymer matrix composites.	
– (U) \$13,257	Total	
(U) FY 2001 (\$ in Thousands):		
– (U) \$7,225	Perform fundamental studies of very-high temperature, non-metallic materials for air-breathing engine and space vehicle applications. Investigate coupled thermal and mechanical stability of very-high temperature oxide composites and eutectics for engine blade applications and ultra-high temperature materials systems based on carbides for rocket propulsion applications.	
– (U) \$4,816	Perform research on metallic systems for engines and airframe applications. Study thermal and mechanical stability of refractory metal systems for very-high temperature applications and investigate functionally gradient structures for thermal barrier coatings.	
– (U) \$1,339	Study life and reliability of polymeric composites by researching non-destructive evaluation techniques on adhesive-bonded structures. Investigate free-volume effect in controlling moisture absorption mechanisms and rates in polymer matrix composites.	
– (U) \$13,380	Total	

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic Research	0601102F Defense Research Sciences	2306
<p>(U) B. <u>Project Change Summary - Description of Significant Changes:</u> Not Applicable.</p> <p>(U) C. <u>Other Program Funding Summary:</u></p> <p>(U) <u>Related Activities:</u></p> <ul style="list-style-type: none"> - (U) PE 0602102F, Materials. - (U) PE 0603211F, Aerospace Structures. - (U) PE 0708011F, Manufacturing Technology. - (U) PE 0602203F, Aerospace Propulsion. - (U) PE 0602201F, Aerospace Flight Dynamics. <p>(U) D. <u>Acquisition Strategy:</u> Not Applicable.</p> <p>(U) E. <u>Schedule Profile:</u> Not Applicable.</p>		
Project 2306	Page 20 of 39 Pages	Exhibit R-2A (PE 0601102F)

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
---	------------------------------

BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT 2307
---	---	-------------------------------

COST (\$ In Thousands)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2307 Fluid Mechanics	11,094	7,189	9,975	9,538	9,589	9,776	10,064	10,744	Continuing	Continuing

(U) **A. Mission Description and Budget Item Justification:** Research involves turbulence prediction and control, unsteady and separated flows, hypersonics, and internal fluid dynamics. This research provides fundamental knowledge, tools, data, concepts, and methods for improving the efficiency, effectiveness, and reliability of aerospace vehicles. Research provides an understanding of key fluid flow phenomena, improves theoretical models for aerodynamic prediction and design, and originates flow control concepts and predictive methods to expand current flight performance boundaries. Research includes the development of computational methods for complex flows, prediction of real gas effects in high-speed flight, control and prediction of turbulence in flight vehicles, propulsion systems, aero-optic applications, the dynamics of unsteady and separated flows, thrust vectoring and high lift concepts associated with enhanced performance and maneuverability, heat transfer and compressor instabilities in gas turbine engines, flow-structure interactions in both external and internal flows, and transport phenomena in structural materials processing.

(U) FY 1998 (\$ in Thousands):

- (U) \$2,262 Conducted external aerodynamics and hypersonics basic research for improved flight performance and control of Air Force air vehicle systems. Developed fluid/structural interaction models based on flow field interaction research. Investigated novel concepts for hypersonic flow control to reduce the size and weight of new hypersonic air vehicles.
- (U) \$5,467 Performed turbulence and flow control research to enhance air vehicle stability, performance, and control. Developed microelectromechanical systems (MEMS) actuators and sensors for micro-air vehicle systems and investigated the use of MEMS devices on swept wing air vehicles.
- (U) \$3,365 Conducted internal flow research to improve the performance and reliability/maintainability of airbreathing propulsion systems. Developed MEMS devices for turbine engine control and Large Eddy Simulation (LES) methodology for turbomachinery flows.
- (U) \$11,094 Total

(U) FY 1999 (\$ in Thousands):

- (U) \$1,610 Conduct external aerodynamics and hypersonics basic research for improved flight performance and control of Air Force air vehicle systems. Develop fluid/structural interaction models based on flow field interaction research. Investigate novel concepts for hypersonic flow control to reduce the size and weight of new hypersonic air vehicles.
- (U) \$3,342 Perform turbulence and flow control research to enhance air vehicle stability, performance, and control. Develop MEMS actuators and sensors for micro-air vehicle systems and investigate the use of MEMS devices on swept wing air vehicles.
- (U) \$2,048 Conduct internal flow research to improve the performance and reliability/maintainability of airbreathing propulsion systems. Develop MEMS devices for turbine engine control and LES methodology for turbomachinery flows.
- (U) \$189 Identified as a source for SBIR.
- (U) \$7,189 Total

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT 2307
<p>(U) <u>FY 2000 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> - (U) \$2,294 Conduct external aerodynamics and hypersonics basic research for improved flight performance and control of Air Force air vehicle systems. Develop fluid/structural interaction models based on flow field interaction research. Investigate novel concepts for hypersonic flow control to reduce the size and weight of new hypersonic air vehicles. - (U) \$4,762 Perform turbulence and flow control research to enhance air vehicle stability, performance, and control. Develop microelectromechanical systems (MEMS) actuators and sensors for micro-air vehicle systems and investigate the use of MEMS devices on swept wing air vehicles. - (U) \$2,919 Conduct internal flow research to improve the performance and reliability/maintainability of airbreathing propulsion systems. Develop MEMS devices for turbine engine control and Large Eddy Simulation (LES) methodology for turbomachinery flows. - (U) \$9,975 Total <p>(U) <u>FY 2001 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> - (U) \$2,262 Conduct external aerodynamics and hypersonics basic research for improved flight performance and control of Air Force air vehicle systems. Develop fluid/structural interaction models based on flow field interaction research. Investigate novel concepts for hypersonic flow control to reduce the size and weight of new hypersonic air vehicles. - (U) \$4,399 Perform turbulence and flow control research to enhance air vehicle stability, performance, and control. Develop MEMS actuators and sensors for micro-air vehicle systems and investigate the use of MEMS devices on swept wing air vehicles. - (U) \$2,877 Conduct internal flow research to improve the performance and reliability/maintainability of airbreathing propulsion systems. Develop MEMS devices for turbine engine control and LES methodology for turbomachinery flows. - (U) \$9,538 Total 		
Project 2307	Page 22 of 39 Pages	Exhibit R-2A (PE 0601102F)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic Research	0601102F Defense Research Sciences	2307
<p>(U) B. <u>Project Change Summary - Description of Significant Changes:</u> Not Applicable.</p> <p>(U) C. <u>Other Program Funding Summary:</u></p> <p>(U) <u>Related Activities:</u></p> <ul style="list-style-type: none"> - (U) PE 0602102F, Materials. - (U) PE 0602203F, Aerospace Propulsion. - (U) PE 0602201F, Aerospace Flight Dynamics. - (U) PE 0603211F, Aerospace Structures. <p>(U) D. <u>Acquisition Strategy:</u> Not Applicable.</p> <p>(U) E. <u>Schedule Profile:</u> Not Applicable.</p>		
Project 2307	Page 23 of 39 Pages	Exhibit R-2A (PE 0601102F)

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)								DATE February 1999		
BUDGET ACTIVITY 1 - Basic Research				PE NUMBER AND TITLE 0601102F Defense Research Sciences				PROJECT 2308		
COST (\$ In Thousands)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2308 Propulsion	12,757	14,629	17,263	16,553	16,633	16,950	17,447	18,755	Continuing	Continuing
<p>(U) A. Mission Description: Efforts include space power and propulsion, airbreathing propulsion, and propulsion diagnostics. Research is focused on the efficient utilization of energy in airbreathing engines and chemical and non-chemical rockets. Research is organized into the areas of chemically reacting flow, non-chemical energetics. Chemically reacting flows involve complex coupling between energy release through chemical reaction and the flow processes which transport chemical reactants, products, and energy. Non-chemical energetic systems include plasma and beamed energy propulsion for orbit raising space missions and efficient ultra-high energy techniques for space-based energy utilization. Thermal management of space-based power and propulsion systems will be addressed.</p> <p>(U) <u>FY 1998 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> - (U) \$5,922 Performed research on space and rocket propulsion and power through the development of supercritical combustion models for rocket propulsion and model predictions of mini-satellite propulsion and performance for high precision clusters of cooperating autonomous microsatellite operations. Performed experimental and numerical studies of high altitude ultraviolet (UV) and infrared (IR) signatures to protect space assets. - (U) \$5,357 Studied airbreathing combustion for propulsion systems for hypersonic flight capability by examining combustion product formation in gas turbine engines and exploring supercritical fuel behavior under high temperatures and pressure conditions. Studied the coupling mechanisms between turbulence and liquid hydrocarbon fuel injection in gas turbine and scramjet engines. - (U) \$1,478 Investigated propulsion diagnostics of new propulsion system concepts through data reduction and interpretation approaches. Extended diode-laser spectroscopic technique for on-board control of propulsion system operation and performance. - (U) \$12,757 Total <p>(U) <u>FY 1999 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> - (U) \$5,697 Perform research on space and rocket propulsion and power through the development of supercritical combustion models for rocket propulsion and model predictions of mini-satellite propulsion and performance for high precision clusters of cooperating autonomous microsatellite operations. Perform experimental and numerical studies of high altitude UV and IR signatures to protect space assets. - (U) \$7,790 Study airbreathing combustion for propulsion systems for hypersonic flight capability by examining combustion product formation in gas turbine engines and explore supercritical fuel behavior under high temperatures and pressure conditions. Study the coupling mechanisms between turbulence and liquid hydrocarbon fuel injection in gas turbine and scramjet engines. 										
Project 2308			Page 24 of 39 Pages				Exhibit R-2A (PE 0601102F)			

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT 2308
– (U) \$756	Investigate propulsion diagnostics of new propulsion system concepts through data reduction and interpretation approaches. Extend diode-laser spectroscopic technique for on-board control of propulsion system operation and performance.	
– (U) \$386	Identified as a source for SBIR.	
– (U) \$14,629	Total	
(U) FY 2000 (\$ in Thousands):		
– (U) \$6,906	Perform research on space and rocket propulsion and power through the development of supercritical combustion models for rocket propulsion and model predictions of mini-satellite propulsion and performance for high precision clusters of cooperating autonomous microsatellite operations. Perform experimental and numerical studies of high altitude ultraviolet (UV) and (IR) signatures to protect space assets.	
– (U) \$9,441	Study airbreathing combustion for propulsion systems for hypersonic flight capability by examining combustion product formation in gas turbine engines and explore supercritical fuel behavior under high temperatures and pressure conditions. Study the coupling mechanisms between turbulence and liquid hydrocarbon fuel injection in gas turbine and scramjet engines.	
– (U) \$916	Investigate propulsion diagnostics of new propulsion system concepts through data reduction and interpretation approaches. Extend diode-laser spectroscopic technique for on-board control of propulsion system operation and performance.	
– (U) \$17,263	Total	
(U) FY 2001 (\$ in Thousands):		
– (U) \$6,992	Perform research on space and rocket propulsion and power through the development of supercritical combustion models for rocket propulsion and model predictions of mini-satellite propulsion and performance for high precision clusters of cooperating autonomous microsatellite operations. Perform experimental and numerical studies of high altitude UV and IR signatures to protect space assets.	
– (U) \$4,906	Study airbreathing combustion for propulsion systems for hypersonic flight capability by examining combustion product formation and explore supercritical fuel behavior under high temperature and pressure conditions. Examine the impact of weakly ionized flows on hypersonic propulsion.	
– (U) \$4,655	Study the coupling mechanisms between turbulence and liquid hydrocarbon fuel injection in gas turbine engines. Investigate reduced models for turbulence/chemistry interactions affecting combustor system operations and performance.	
– (U) \$16,553	Total	

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic Research	0601102F Defense Research Sciences	2308
<p>(U) B. <u>Project Change Summary - Description of Significant Changes:</u> Not Applicable.</p> <p>(U) C. <u>Other Program Funding Summary:</u></p> <p>(U) <u>Related Activities:</u></p> <ul style="list-style-type: none"> - (U) PE 0602102F, Materials. - (U) PE 0602203F, Aerospace Propulsion. - (U) PE 0602601F, Phillips Laboratory. - (U) PE 0603211F, Aerospace Structures. <p>(U) D. <u>Acquisition Strategy:</u> Not Applicable.</p> <p>(U) E. <u>Schedule Profile:</u> Not Applicable.</p>		
Project 2308	Page 26 of 39 Pages	Exhibit R-2A (PE 0601102F)

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
---	------------------------------

BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT 2310
---	---	-------------------------------

COST (\$ In Thousands)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2310 Atmospheric Sciences	5,584	5,544	5,661	5,082	5,106	5,207	5,365	5,721	Continuing	Continuing

(U) **A. Mission Description and Budget Item Justification:** Areas of emphasis include ionospheric research and meteorology. This research includes the physics, dynamics, and chemistry of processes that determine the structure and variability of the earth's atmosphere. Atmospheric properties such as wind, density, clouds and precipitation, ionization, and optical/infrared (IR) transmission/emissivity all affect the performance of Air Force systems. Research includes new measurement techniques and the development of models for specifying and predicting weather and other atmospheric conditions. Emphasis is placed on understanding fundamental atmospheric processes and their impacts on optical and IR weapon systems, and on understanding the dynamics and structure of the ionosphere that affect communications and surveillance systems. Major research efforts focus on ionospheric dynamics, mesoscale meteorology, triggered and natural lightning, cloud prediction, and models which define the optical structure of the atmosphere.

(U) FY 1998 (\$ in Thousands):

- (U) \$1,521 Improved space weather specification and forecast models, and studied the coupling between the solar wind, the interplanetary magnetic field (IMF), and the earth's magnetosphere by using satellites to analyze the IMF and solar wind ions. Developed a Coordinated Community Modeling Center to bring researchers directly in touch with the DoD user community.
- (U) \$1,038 Analyzed atmospheric physics to understand and exploit the aerospace environment and improved atmospheric radiative transfer models to estimate the impacts of weather limitations on the employment of directed energy weapons. Investigated gravity wave interactions with ambient atmospheric vorticity fields that affect optical atmospheric emissions observed from orbit.
- (U) \$3,025 Studied ionospheric physics to enhance global surveillance capability and investigated ionosphere phenomena. Examined signatures of solar activity which disrupt global radio communications and space surveillance.
- (U) \$5,584 Total

(U) FY 1999 (\$ in Thousands):

- (U) \$1,658 Improve space weather specification and forecast models, and study the coupling between the solar wind, the IMF, and the earth's magnetosphere by using satellites to analyze the IMF and solar wind ions. Develop a Coordinated Community Modeling Center to bring researchers directly in touch with the DoD user community.
- (U) \$1,132 Analyze atmospheric physics to understand and exploit the aerospace environment and improved atmospheric radiative transfer models to estimate the impacts of weather limitations on the employment of directed energy weapons. Investigate gravity wave interactions with ambient atmospheric vorticity fields that affect optical atmospheric emissions observed from orbit.

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT 2310
<ul style="list-style-type: none"> – (U) \$2,608 Study ionospheric physics to enhance global surveillance capability and investigate ionosphere phenomena. Examine signatures of solar activity which disrupt global radio communications and space surveillance. – (U) \$146 Identified as a source for SBIR. – (U) \$5,544 Total 		
(U) FY 2000 (\$ in Thousands):		
<ul style="list-style-type: none"> – (U) \$1,739 Improve space weather specification and forecast models, and study the coupling between the solar wind, the interplanetary magnetic field (IMF), and the earth’s magnetosphere by using satellites to analyze the IMF and solar wind ions. Develop a Coordinated Community Modeling Center to bring researchers directly in touch with the DoD user community. – (U) \$1,187 Analyze atmospheric physics to understand and exploit the aerospace environment and improved atmospheric radiative transfer models to estimate the impacts of weather limitations on the employment of directed energy weapons. Investigate gravity wave interactions with ambient atmospheric vorticity fields that affect optical atmospheric emissions observed from orbit. – (U) \$2,735 Study ionospheric physics to enhance global surveillance capability and investigate ionosphere phenomena. Examine signatures of solar activity which disrupt global radio communications and space surveillance. – (U) \$5,661 Total 		
(U) FY 2001 (\$ in Thousands):		
<ul style="list-style-type: none"> – (U) \$1,222 Improve space weather specification and forecast models, and study the coupling between the solar wind, the IMF, and the earth’s magnetosphere by using satellites to analyze the IMF and solar wind ions. Develop a Coordinated Community Modeling Center to bring researchers directly in touch with the DoD user community. – (U) \$1,168 Analyze atmospheric physics to understand and exploit the aerospace environment and improved atmospheric radiative transfer models to estimate the impacts of weather limitations on the employment of directed energy weapons. Investigate gravity wave interactions with ambient atmospheric vorticity fields that affect optical atmospheric emissions observed from orbit. – (U) \$2,692 Study ionospheric physics to enhance global surveillance capability and investigate ionosphere phenomena. Examine signatures of solar activity which disrupt global radio communications and space surveillance. – (U) \$5,082 Total 		
Project 2310	Page 28 of 39 Pages	Exhibit R-2A (PE 0601102F)

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	February 1999
PROJECT 2310		
<p>(U) B. <u>Project Change Summary - Description of Significant Changes:</u> Not Applicable.</p> <p>(U) C. <u>Other Program Funding Summary:</u></p> <p>(U) <u>Related Activities:</u></p> <ul style="list-style-type: none">- (U) PE 0305160F, Defense Meteorological Satellite Program.- (U) PE 0602601F, Phillips Laboratory.- (U) PE 0603220C, Surveillance, Acquisition, Tracking, and Kill. <p>(U) D. <u>Acquisition Strategy:</u> Not Applicable.</p> <p>(U) E. <u>Schedule Profile:</u> Not Applicable.</p>		
Project 2310	Page 29 of 39 Pages	Exhibit R-2A (PE 0601102F)

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)								DATE February 1999		
BUDGET ACTIVITY 1 - Basic Research				PE NUMBER AND TITLE 0601102F Defense Research Sciences				PROJECT 2311		
<i>COST (\$ In Thousands)</i>	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2311 Space Sciences	5,103	6,805	8,625	8,541	8,540	8,691	8,932	9,514	Continuing	Continuing
<p>(U) A. <u>Mission Description:</u> The objective of this project is to provide basic knowledge of the space environment and solar activity for the design and calibration of advanced Air Force systems relevant to operations in and through near-Earth space. The project also supports the Air Weather Service (AWS) by improving observing and forecasting techniques that support operational military systems in space environments. Theoretical and empirical descriptions and models of the physics of the sun and the earth's magnetosphere, which are critical elements of future AWS prediction models and radiation belt codes, are being investigated.</p> <p>(U) <u>FY 1998 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> - (U) \$1,864 Analyzed physics of solar magnetic fields, flares, and coronal mass ejections to provide a physical basis for predictive models of the effects of solar disturbances on near-Earth space to predict the state of the interplanetary medium using solar magnetic field and coronal data that can be related to disturbances. - (U) \$1,739 Studied the particle and interplanetary magnetic field properties of the solar wind which transports solar disturbances to the Earth's magnetosphere and evaluated techniques to study solar source regions and infer the magnetic structures of interplanetary disturbances. Tested solar wind shock detection algorithms. - (U) \$1,500 Studied magnetospheric and radiation belt processes to eliminate operational deficiencies, and fluid and particle dynamics to determine criteria for substorm onset and modeled rapid variations in the interaction between the solar wind and magnetosphere using diffusion coefficients estimated from electric field propagation studies. - (U) \$5,103 Total <p>(U) <u>FY 1999 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> - (U) \$1,953 Analyze physics of solar magnetic fields, flares, and coronal mass ejections to provide a physical basis for predictive models of the effects of solar disturbances on near-Earth space to predict the state of the interplanetary medium using solar magnetic field and coronal data that can be related to disturbances. - (U) \$2,670 Study the particle and interplanetary magnetic field properties of the solar wind which transports solar disturbances to the Earth's magnetosphere and evaluate techniques to study solar source regions and infer the magnetic structures of interplanetary disturbances. Test solar wind shock detection algorithms. 										
Project 2311			<i>Page 30 of 39 Pages</i>				Exhibit R-2A (PE 0601102F)			

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT 2311
– (U) \$2,003	Study magnetospheric and radiation belt processes to eliminate operational deficiencies, and fluid and particle dynamics to determine criteria for substorm onset and model rapid variations in the interaction between the solar wind and magnetosphere using diffusion coefficients estimated from electric field propagation studies.	
– (U) \$179	Identified as a source for SBIR.	
– (U) \$6,805	Total	
(U) FY 2000 (\$ in Thousands):		
– (U) \$2,542	Analyze physics of solar magnetic fields, flares, and coronal mass ejections to provide a physical basis for predictive models of the effects of solar disturbances on near-Earth space to predict the state of the interplanetary medium using solar magnetic field and coronal data that can be related to disturbances.	
– (U) \$3,476	Study the particle and interplanetary magnetic field properties of the solar wind which transports solar disturbances to the Earth's magnetosphere and evaluate techniques to study solar source regions and infer the magnetic structures of interplanetary disturbances. Test solar wind shock detection algorithms.	
– (U) \$2,607	Study magnetospheric and radiation belt processes to eliminate operational deficiencies, and fluid and particle dynamics to determine criteria for substorm onset and model rapid variations in the interaction between the solar wind and magnetosphere using diffusion coefficients estimated from electric field propagation studies.	
– (U) \$8,625	Total	
(U) FY 2001 (\$ in Thousands):		
– (U) \$2,749	Analyze physics of solar magnetic fields, flares, and coronal mass ejections to provide a physical basis for predictive models of the effects of solar disturbances on near-Earth space to predict the state of the interplanetary medium using solar magnetic field and coronal data that can be related to disturbances.	
– (U) \$3,759	Study the particle and interplanetary magnetic field properties of the solar wind which transports solar disturbances to the Earth's magnetosphere and evaluate techniques to study solar source regions and infer the magnetic structures of interplanetary disturbances. Test solar wind shock detection algorithms.	
– (U) \$2,033	Study magnetospheric and radiation belt processes to eliminate operational deficiencies, and fluid and particle dynamics to determine criteria for substorm onset and model rapid variations in the interaction between the solar wind and magnetosphere using diffusion coefficients estimated from electric field propagation studies.	
– (U) \$8,541	Total	

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic Research	0601102F Defense Research Sciences	2311
<p>(U) B. <u>Project Change Summary - Description of Significant Changes:</u> Not Applicable.</p> <p>(U) C. <u>Other Program Funding Summary:</u></p> <p>(U) <u>Related Activities:</u></p> <ul style="list-style-type: none"> - (U) PE 0302101F, Geophysics. - (U) PE 0602702F, Command, Control, and Communications. - (U) PE 0603410F, Space System Environmental Interactions. <p>(U) D. <u>Acquisition Strategy:</u> Not Applicable.</p> <p>(U) E. <u>Schedule Profile:</u> Not Applicable.</p>		
Project 2311	Page 32 of 39 Pages	Exhibit R-2A (PE 0601102F)

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)								DATE February 1999		
BUDGET ACTIVITY 1 - Basic Research				PE NUMBER AND TITLE 0601102F Defense Research Sciences					PROJECT 2312	
<i>COST (\$ In Thousands)</i>	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2312 Biological Sciences	10,933	13,024	13,484	12,228	12,186	12,483	12,763	13,642	Continuing	Continuing
<p>(U) A. <u>Mission Description:</u> This project consists of two research areas: biodegradation and the toxicology of biohazards and chronobiology and neural adaptation. The Understanding how microbes degrade Air Force chemicals will enable the development of efficient and cost-effective strategies for cleaning up Air Force bases and preventing exposure to hazards due to Air Force operations. Likewise, knowledge of the mechanisms by which Air Force chemical and physical (lasers and microwaves) agents produce toxic effects will enable the development of safety assessment strategies and technologies to ensure the hazard-free development and use of future aerospace materials and systems. Basic research in neuroscience and chronobiology will result in new strategies to prevent G-induced loss of consciousness in pilots, impaired performance due to jet-lag and shift-work, night operations, and the loss of life and aircraft due to stress, inattention, or lack of vigilance.</p> <p>(U) <u>FY 1998 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> – (U) \$6,638 Studied toxicology of biohazardous agents to investigate molecular and biochemical effects in the brain and the neurobehavioral correlates associated with the inhalation of JP-8 jet fuel; and developed mathematical models to predict retinal damage. Used molecular biological techniques for modifying microbial enzyme capacity to engineer bio-catalysis of reactions in the synthesis and manufacture of materials. – (U) \$3,074 Investigated biological mechanisms responsible for circadian rhythmicity by examining individual differences in circadian systems to predict effects of night operations and jet lag on military personnel. – (U) \$1,221 Performed research in mechanisms of animal sensing systems through investigation of insect infrared systems. – (U) \$10,933 Total <p>(U) <u>FY 1999 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> – (U) \$6,333 Study toxicology of biohazardous agents to investigate molecular and biochemical effects in the brain and the neurobehavioral correlates associated with the inhalation of JP-8 jet fuel; and develop mathematical models to predict retinal damage. Use molecular biological techniques for modifying microbial enzyme capacity to engineer bio-catalysis of reactions in the synthesis and manufacture of materials. – (U) \$5,065 Investigate biological mechanisms responsible for circadian rhythmicity by examining individual differences in circadian systems to predict effects of night operations and jet lag on military personnel. – (U) \$1,283 Perform research in mechanisms of animal sensing systems through investigation of insect infrared systems. – (U) \$343 Identified as a source for SBIR. – (U) \$13,024 Total <p>(U) <u>FY 2000 (\$ in Thousands):</u></p>										
Project 2312			Page 33 of 39 Pages				Exhibit R-2A (PE 0601102F)			

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic Research	0601102F Defense Research Sciences	2312
<ul style="list-style-type: none"> – (U) \$6,734 Study toxicology of biohazardous agents to investigate molecular and biochemical effects in the brain and the neurobehavioral correlates associated with the inhalation of JP-8 jet fuel; and develop mathematical models to predict retinal damage. Use molecular biological techniques for modifying microbial enzyme capacity to engineer bio-catalysis of reactions in the synthesis and manufacture of materials. – (U) \$5,385 Investigate biological mechanisms responsible for circadian rhythmicity by examining individual differences in circadian systems to predict effects of night operations and jet lag on military personnel. – (U) \$1,365 Perform research in mechanisms of animal sensing systems through investigation of insect infrared systems. – (U) \$13,484 Total <p>(U) <u>FY 2001 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> – (U) \$5,364 Use molecular biological techniques for modifying microbial enzyme capacity to engineer bio-catalysis of reactions in the synthesis and manufacture of materials. – (U) \$5,475 Investigate biological mechanisms responsible for circadian rhythmicity by examining individual differences in circadian systems to predict effects of night operations and jet lag on military personnel. – (U) \$1,389 Perform research in mechanisms of animal sensing systems through investigation of insect infrared systems. – (U) \$12,228 Total <p>(U) B. <u>Project Change Summary - Description of Significant Changes:</u> Not Applicable.</p> <p>(U) C. <u>Other Program Funding Summary:</u></p> <p>(U) <u>Related Activities:</u></p> <ul style="list-style-type: none"> – (U) PE 0602202F, Human Systems Technology. <p>(U) D. <u>Acquisition Strategy:</u> Not Applicable.</p> <p>(U) E. <u>Schedule Profile:</u> Not Applicable.</p>		
Project 2312	Page 34 of 39 Pages	Exhibit R-2A (PE 0601102F)

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)								DATE February 1999			
BUDGET ACTIVITY 1 - Basic Research				PE NUMBER AND TITLE 0601102F Defense Research Sciences					PROJECT 2313		
COST (\$ In Thousands)		FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2313	Human Performance	10,500	12,528	13,212	9,944	9,887	10,072	10,363	11,066	Continuing	Continuing
<p>(U) A. <u>Mission Description:</u> This project provides fundamental knowledge of information processing in humans and other complex organisms needed to advance technologies for autonomous systems, command and control, human systems integration, and personnel selection and training. Research on sensory systems impacts technologies of computer image and speech processing, human interface, sensors, and sensor fusion. Research on cognitive and perceptual processes impacts technologies of selection, education and training, command and control, and adaptive autonomous systems. Supported areas of research include sensory systems, with emphasis on: vision and hearing; Cognition, Perception, and Intelligent Tutors; and Team Situational Awareness.</p> <p>(U) <u>FY 1998 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> - (U) \$3,168 Performed sensory and perceptual system analysis for human-machine interface and image exploitation by developing image representation theory and investigating algorithms for visual attention to improve performance in command and control environments; also supported model-based predictions of limits in speech communication. - (U) \$4,065 Conducted cognitive workload analysis for crew training and performance enhancement by examining cognitive performance models, developing a theory of cognitive workload, and extending the cognitive models to include characterization of on-line job aiding systems used in command and control environments. - (U) \$3,267 Studied synthetic task environments for baseline performance measurement and conducted experiments leading to a more general theory of utility for performance enhancement techniques. Extended experimental techniques for command and control team performance and developed multi-ship modeling for unmanned aerial vehicles (UAVs) surveillance and targeting. - (U) \$10,500 Total <p>(U) <u>FY 1999 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> - (U) \$3,254 Perform sensory and perceptual system analysis for human-machine interface and image exploitation by developing image representation theory and investigating algorithms for visual attention to improve performance in command and control environments; also support model-based predictions of limits in speech communication. - (U) \$4,684 Conduct cognitive workload analysis for crew training and performance enhancement by examining cognitive performance models, developing a theory of cognitive workload, and extending the cognitive models to include characterization of on-line job aiding systems used in command and control environments. 											
Project 2313			Page 35 of 39 Pages				Exhibit R-2A (PE 0601102F)				

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT 2313
– (U) \$4,260	Study synthetic task environments for baseline performance measurement and conduct experiments leading to a more general theory of utility for performance enhancement techniques. Extend experimental techniques for command and control team performance and develop multi-ship modeling for unmanned aerial vehicles (UAVs) surveillance and targeting.	
– (U) \$330	Identified as a source for SBIR.	
– (U) \$12,528	Total	
(U) FY 2000 (\$ in Thousands):		
– (U) \$3,524	Perform sensory and perceptual system analysis for human-machine interface and image exploitation by developing image representation theory and investigating algorithms for visual attention to improve performance in command and control environments; also support model-based predictions of limits in speech communication.	
– (U) \$5,074	Conduct cognitive workload analysis for crew training and performance enhancement by examining cognitive performance models, developing a theory of cognitive workload, and extending the cognitive models to include characterization of on-line job aiding systems used in command and control environments.	
– (U) \$4,614	Study synthetic task environments for baseline performance measurement and conduct experiments leading to a more general theory of utility for performance enhancement techniques. Extend experimental techniques for command and control team performance and develop multi-ship modeling for UAV surveillance and targeting.	
– (U) \$13,212	Total	
(U) FY 2001 (\$ in Thousands):		
– (U) \$2,094	Perform sensory and perceptual system analysis for human-machine interface and image exploitation by developing image representation theory and investigating algorithms for visual attention to improve performance in command and control environments; also support model-based predictions of limits in speech communication.	
– (U) \$3,172	Conduct cognitive workload analysis for crew training and performance enhancement by examining cognitive performance models, developing a theory of cognitive workload, and extending the cognitive models to include characterization of on-line job aiding systems used in command and control environments.	
– (U) \$4,678	Study synthetic task environments for baseline performance measurement and conduct experiments leading to a more general theory of utility for performance enhancement techniques. Extend experimental techniques for command and control team performance and develop multi-ship modeling for UAV surveillance and targeting.	
– (U) \$9,944	Total	

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	February 1999
<p>(U) B. <u>Project Change Summary - Description of Significant Changes:</u> Changes to this program since the President's Budget are due to higher priorities within the Science and Technology (S&T) Program.</p> <p>(U) C. <u>Other Program Funding Summary:</u></p> <p>(U) <u>Related Activities:</u></p> <ul style="list-style-type: none">– (U) PE 0602202F, Human Systems Technology.– (U) PE 0602702F, Command, Control, and Communication. <p>(U) D. <u>Acquisition Strategy:</u> Not Applicable.</p> <p>(U) E. <u>Schedule Profile:</u> Not Applicable.</p>		
Project 2313	Page 37 of 39 Pages	Exhibit R-2A (PE 0601102F)

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
---	------------------------------

BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT 4113
---	---	-------------------------------

COST (\$ In Thousands)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
4113 International Science Programs	15,269	13,243	4,878	0	0	0	0	0	Continuing	Continuing

(U) A. Mission Description: This project stimulates scientific and engineering education and increases the interaction between the broader research community (including the international research community) and the Air Force research sites. Emphasis is placed on increasing the number of U.S. citizens, especially women and minorities, with advanced degrees in science and engineering. These programs include: the Summer Faculty Research Program under which selected university faculty members conduct research at Air Force research sites; the Graduate Student Research Program where graduate students in areas of interest to the Air Force perform research at Air Force research sites; the University Resident Research Program where faculty members spend one year at an Air Force research site contributing to Air Force research needs and operations; the U.S. Air Force National Research Council (NRC) Resident Research Associateship Program which provides outstanding post-doctoral and senior scientists and engineers opportunities to research problems of their own choice that are compatible with the research interests of selected Air Force research sites; the Laboratory Graduate Fellowship Program which is designed to stimulate doctoral candidate interest in Air Force research sites and the research programs at the research sites; and the National Defense Science and Engineering Graduate Fellowship Program which is jointly sponsored by the Army, Navy, Air Force, and the Defense Advanced Research Projects Agency for the purpose of increasing the number of U.S. citizens trained in science and engineering, and various international programs such as Windows on Science which provides insight and experience in international research.

(U) FY 1998 (\$ in Thousands):

- (U) \$4,924 Funded international science and personnel exchange programs and technology liaison missions in Europe and Asia to support scientists and engineers performing laboratory research in foreign countries. Provided Air Force share of funding for NATO-affiliated research institutes.
- (U) \$5,956 Supported science and technology personnel exchanges within the United States, through various exchange programs for faculty, students, and researchers at the Air Force Research Laboratory.
- (U) \$4,389 Conducted fellowship awards program and roundtable on national science and technology policy for senior leaders from industry, government, and academia to formulate a national science technology policy. Funded outstanding university research scientists to pursue research relevant to Air Force Research Laboratory issues.
- (U) \$15,269 Total

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT 4113
<p>(U) <u>FY 1999 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> - (U) \$4,254 Fund international science and personnel exchange programs. - (U) \$5,057 Support technology liaison missions in Europe and Asia to support scientists and engineers performing laboratory research in foreign countries. - (U) \$3,583 Provide Air Force share of funding for NATO-affiliated research institutes. - (U) \$349 Identified as a source for SBIR. - (U) \$13,243 Total <p>(U) <u>FY 2000 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> - (U) \$1,611 Fund international science and personnel exchange programs. - (U) \$1,913 Support technology liaison missions in Europe and Asia to support scientists and engineers performing laboratory research in foreign countries. - (U) \$1,354 Provide Air Force share of funding for NATO-affiliated research institutes. - (U) \$4,878 Total <p>(U) <u>FY 2001:</u> Not Applicable.</p> <p>(U) B. <u>Project Change Summary - Description of Significant Changes:</u> Changes to this program since the President's Budget are due to higher priorities within the Science and Technology (S&T) Program.</p> <p>(U) C. <u>Other Program Funding Summary:</u></p> <p>(U) <u>Related Activities:</u></p> <ul style="list-style-type: none"> - (U) PE 0601103D, University Research Initiative. <p>(U) D. <u>Acquisition Strategy:</u> Not Applicable.</p> <p>(U) E. <u>Schedule Profile:</u> Not Applicable.</p>		
Project 4113	Page 39 of 39 Pages	Exhibit R-2A (PE 0601102F)

THIS PAGE INTENTIONALLY LEFT BLANK