Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Air Force											Date: February 2016	
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 1: *Basic Research*					R-1 Program Element (Number/Name) PE 0601102F / *Defense Research Sciences*							
COST ($ in Millions)	**Prior Years**	**FY 2015**	**FY 2016**	**FY 2017 Base**	**FY 2017 OCO**	**FY 2017 Total**	**FY 2018**	**FY 2019**	**FY 2020**	**FY 2021**	**Cost To Complete**	**Total Cost**
Total Program Element	-	382.332	374.721	340.812	0.000	340.812	344.609	350.264	359.395	366.191	Continuing	Continuing
613001: *Physics and Electronics*	-	116.113	111.598	100.067	0.000	100.067	101.181	102.843	105.523	107.519	Continuing	Continuing
613002: *Aerospace, Chemical and Material Sciences*	-	122.110	119.000	105.484	0.000	105.484	106.660	108.409	111.236	113.339	Continuing	Continuing
613003: *Mathematics, Information and Life Sciences*	-	113.159	113.081	101.258	0.000	101.258	102.386	104.066	106.779	108.798	Continuing	Continuing
613004: *Education and Outreach*	-	30.950	31.042	34.003	0.000	34.003	34.382	34.946	35.857	36.535	Continuing	Continuing

Note

Realigned funding in PE0601102F to project 613004 to put more emphasis on educational outreach.

A. Mission Description and Budget Item Justification

Defense Research Sciences consists of extramural research activities in academia and industry along with in-house investigations performed in the Air Force Research Laboratory. This program supports fundamental broad-based scientific and engineering research in areas critical to Air Force weapon, sensor, and support systems. All research areas are subject to long-range planning and technical review by both Air Force and tri-Service scientific planning groups. Efforts in this program have been coordinated through the Department of Defense (DoD) Science and Technology (S&T) Executive Committee process to harmonize efforts and eliminate duplication.

This program is in Budget Activity 1, Basic Research, because this budget activity includes scientific study and experimentation directed toward increasing fundamental knowledge and understanding in those fields of the physical, engineering, environmental, and life sciences related to long-term national security needs.

B. Program Change Summary ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Previous President's Budget	389.979	329.721	337.648	0.000	337.648
Current President's Budget	382.332	374.721	340.812	0.000	340.812
Total Adjustments	-7.647	45.000	3.164	0.000	3.164
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	45.000			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	0.000	0.000			
• SBIR/STTR Transfer	-7.647	0.000			
• Other Adjustments	0.000	0.000	3.164	0.000	3.164

Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Air Force	Date: February 2016
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 1: *Basic Research*	**R-1 Program Element (Number/Name)** PE 0601102F / *Defense Research Sciences*

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2015	FY 2016
Project: 613001: *Physics and Electronics*		
Congressional Add: *Program Increase*	23.782	15.666
Congressional Add Subtotals for Project: 613001	23.782	15.666
Project: 613002: *Aerospace, Chemical and Material Sciences*		
Congressional Add: *Program Increase*	26.424	11.167
Congressional Add Subtotals for Project: 613002	26.424	11.167
Project: 613003: *Mathematics, Information and Life Sciences*		
Congressional Add: *Program Increase*	18.041	11.167
Congressional Add Subtotals for Project: 613003	18.041	11.167
Project: 613004: *Education and Outreach*		
Congressional Add: *Program Increase*	7.250	7.000
Congressional Add Subtotals for Project: 613004	7.250	7.000
Congressional Add Totals for all Projects	75.497	45.000

Change Summary Explanation

Increase in FY 2017 due to DoD cost factor adjustment.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Air Force			Date: February 2016
Appropriation/Budget Activity 3600 / 1	R-1 Program Element (Number/Name) PE 0601102F / *Defense Research Sciences*	Project (Number/Name) 613001 / *Physics and Electronics*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
613001: *Physics and Electronics*	-	116.113	111.598	100.067	0.000	100.067	101.181	102.843	105.523	107.519	Continuing	Continuing

A. Mission Description and Budget Item Justification

Basic research in the Physics and Electronics Project seeks to enable revolutionary advances and expand the fundamental knowledge supporting technologies critical to the future of the Air Force. Research stresses high-risk, far-term, game-changing capability breakthroughs essential for future leaps in warfighter system performance, functionality, reliability, and survivability while simultaneously reducing component and system power, size, mass, and life cycle costs. Major areas being investigated in this project are complex electronics and fundamental quantum processes; plasma physics and high energy density non-equilibrium processes; and lasers and optics, electromagnetics, communication, and signal processing. While the following specific sub-areas are the focus of the project, there is interest in exploring novel ideas that may bridge these major efforts as well as those in the other projects within this program.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
Title: Complex Electronics and Fundamental Quantum Processes	42.390	44.043	40.491

Description: Scientific focus areas are atomic and molecular physics, photonics, quantum electronic solids, adaptive multi-mode sensing and ultra-high speed electronics, semiconductor and electromagnetic materials, and optoelectronics.

FY 2015 Accomplishments:

Air Force Research Laboratory joined with the University of Hawaii at Manoa quantum computing research group to explore the frontiers of theoretical and experimental quantum physics. This technology advanced a wide-range of applications including Atom interferometry for precision navigation in GPS-denied environments. Explored a wide range of complex materials and devices, including non-linear optical materials, photonics, optoelectronics, meta-materials, cathodes, dielectric and magnetic materials, semiconductor lasers, memristive systems, new classes of high-temperature superconductors, quantum dots, quantum wells and graphene. Included generating and controlling quantum states, such as superposition and entanglement, in photons and ultracold atoms and molecules.

FY 2016 Plans:

Explore a wide range of complex materials and devices, including non-linear optical materials, photonics, optoelectronics, meta-materials, cathodes, dielectric and magnetic materials, semiconductor lasers, memristive systems, new classes of high-temperature superconductors, quantum dots, quantum wells and graphene. Includes generating and controlling quantum states, such as superposition and entanglement, in photons and ultracold atoms and molecules.

FY 2017 Plans:

Continue to explore a wide range of complex materials and devices, including non-linear optical materials, photonics, optoelectronics, meta-materials, cathodes, dielectric and magnetic materials, memristive systems, new classes of high-

Exhibit R-2A, RDT&E Project Justification: PB 2017 Air Force		Date: February 2016
Appropriation/Budget Activity 3600 / 1	**R-1 Program Element (Number/Name)** PE 0601102F / *Defense Research Sciences*	**Project (Number/Name)** 613001 / *Physics and Electronics*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
temperature superconductors, quantum dots, quantum wells and graphene. Includes generating and controlling quantum states, such as superposition and entanglement, in photons and ultracold atoms and molecules.			
Title: Plasma Physics and High Energy Density Non-Equilibrium Processes ***Description:*** Scientific focus areas are plasma, electro-energetic physics and space sciences. ***FY 2015 Accomplishments:*** Co-funded research to develop a simple, inexpensive way to alter the thermal conductivity of the widely used material lead zirconate titanate (PZT) at room temperature with application for signal processing, which span many dimensions, spatial, temporal, and frequency. Explored a wide range of activities characterized by processes sufficiently energetic to require the understanding and managing of plasma phenomenology and the non-linear response of materials to high electric and magnetic fields. Included space weather, plasma control of boundary layers in turbulent flow, plasma discharges, Radio Frequency (RF) propagation, RF-plasma interaction, and high-power, beam-driven microwave devices. ***FY 2016 Plans:*** Explore a wide range of activities characterized by processes sufficiently energetic to require understanding and managing plasma phenomenology and the non-linear response of materials to high electric and magnetic fields. Includes space weather, plasma discharges, RF propagation, RF-plasma interaction, and high-power, beam-driven microwave devices. ***FY 2017 Plans:*** Continue to explore a wide range of activities characterized by processes sufficiently energetic to require understanding and managing plasma phenomenology and the non-linear response of materials to high electric and magnetic fields. Included space weather, plasma discharges, RF propagation, RF-plasma interaction, and high-power, beam-driven microwave devices.	18.596	19.321	20.856
Title: Lasers and Optics, Electromagnetics, Communication and Signal Processing ***Description:*** Scientific focus areas are physical mathematics and applied analysis, novel computational methods, dynamics sensing capability, electromagnetics, remote sensing and imaging physics, and surveillance and navigation. ***FY 2015 Accomplishments:*** Funded the creation of a magnetic-free, small (75x reduction) and more efficient radio wave circulator for use in wireless device at double the current bandwith. This smaller size can be easily integrated into circuit boards of modern communications devices, providing cost savings due to weight reduction. Explored all aspects of producing and receiving electromagnetic and electro-optical signals, as well as their propagation through complex media, including adaptive optics and optical imaging. Investigated aspects of the phenomenology of lasers including high energy lasers, non-linear optics, and ultra-short pulse laser science.	31.345	32.568	38.720

Exhibit R-2A, RDT&E Project Justification: PB 2017 Air Force		Date: February 2016
Appropriation/Budget Activity 3600 / 1	**R-1 Program Element (Number/Name)** PE 0601102F / *Defense Research Sciences*	**Project (Number/Name)** 613001 / *Physics and Electronics*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
Included the development of sophisticated mathematics and algorithm development for extracting information from complex and/ or sparse signals. ***FY 2016 Plans:*** Explore all aspects of producing and receiving electromagnetic and electro-optical signals, as well as their propagation through complex media, including adaptive optics and optical imaging. Continue to investigate aspects of the phenomenology of lasers including high energy lasers, non-linear optics, and ultra-short pulse laser science. Includes the development of sophisticated mathematics and algorithm development for extracting information from complex and/or sparse signals. ***FY 2017 Plans:*** Continue to explore all aspects of producing and receiving electromagnetic and electro-optical signals, as well as their propagation through complex media, including adaptive optics and optical imaging. Continue to investigate aspects of the phenomenology of lasers including high energy lasers, non-linear optics, and ultra-short pulse laser science. Includes the development of sophisticated mathematics and algorithm development for extracting information from complex and/or sparse signals.			
Accomplishments/Planned Programs Subtotals	92.331	95.932	100.067

	FY 2015	FY 2016
Congressional Add: Program Increase ***FY 2015 Accomplishments:*** Conducted congressionally directed effort. ***FY 2016 Plans:*** Conduct Congressionally directed effort.	23.782	15.666
Congressional Adds Subtotals	23.782	15.666

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Air Force			Date: February 2016
Appropriation/Budget Activity 3600 / 1	R-1 Program Element (Number/Name) PE 0601102F / *Defense Research Sciences*	Project (Number/Name) 613002 / *Aerospace, Chemical and Material Sciences*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
613002: *Aerospace, Chemical and Material Sciences*	-	122.110	119.000	105.484	0.000	105.484	106.660	108.409	111.236	113.339	Continuing	Continuing

A. Mission Description and Budget Item Justification

Basic research in the Aerospace, Chemical, and Materials Sciences Project seeks to enable revolutionary advances and expand the fundamental knowledge supporting technologies critical to the future of the Air Force. Research stresses high-risk, far-term, game-changing capability breakthroughs essential for future leaps in warfighter system performance, functionality, reliability, and survivability while simultaneously reducing component and system power, size, mass, and life cycle costs. Major thrust areas being investigated in this project are aero-structure interactions and control; energy, power, and propulsion; and complex materials and structures. Although the major thrust descriptions that follow are specific sub-areas of focus within this project, there is interest in exploring novel ideas that may bridge these major thrusts as well as those in the other projects within this program.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
Title: Aero Structure Interactions and Control	27.543	31.041	31.105
Description: Scientific focus areas are high temperature aerospace materials, hypersonics, aerothermodynamics and turbulence, and flow interactions and control.			
FY 2015 Accomplishments: Supported a wind tunnel test to better understand the vortex ring state, a well-known problem in helicopter descent. This research will lead to techniques to avoid severe loss of lift in small-scale aerial vehicles. Investigated the characterization, modeling, and exploitation of interactions between the unsteady aerodynamic flow field and the dynamic air vehicle structure to enable enhanced performance in next generation Air Force systems. Explored the synergy gained from an interdisciplinary look at multiple technologies and the integration of core disciplines of fluid mechanics, material properties, high-performance structures, and thermodynamics.			
FY 2016 Plans: Investigate the characterization, modeling, and exploitation of interactions between the unsteady aerodynamic flow field and the dynamic air vehicle structure to enable enhanced performance in next generation Air Force systems. Explore the synergy gained from an interdisciplinary look at multiple technologies and the integration of core disciplines of fluid mechanics, material properties, high-performance structures, and thermodynamics.			
FY 2017 Plans: Continue to investigate the characterization, modeling, and exploitation of interactions between the unsteady aerodynamic flow field and the dynamic air vehicle structure to enable enhanced performance in next generation Air Force systems. Explore the			

Exhibit R-2A, RDT&E Project Justification: PB 2017 Air Force		Date: February 2016
Appropriation/Budget Activity 3600 / 1	**R-1 Program Element (Number/Name)** PE 0601102F / *Defense Research Sciences*	**Project (Number/Name)** 613002 / *Aerospace, Chemical and Material Sciences*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
synergy gained from an interdisciplinary look at multiple technologies and the integration of core disciplines of fluid mechanics, high-performance structures, and thermodynamics.			
Title: Energy, Power, and Propulsion ***Description:*** Scientific focus areas are thermal control, theoretical chemistry, molecular dynamics, space power and propulsion, and combustion and diagnostics. ***FY 2015 Accomplishments:*** Supported a Hall thruster experiment onboard the X-37B reusable space plane. The experiment will enable in-space characterization of Hall thruster design modifications intended to improve performance relative to current state-of-the-art units. This results in increased payload carrying capacity and a greater number of on-orbit maneuvers for a spacecraft versus using traditional rocket engines. Exploited technological innovations and developed potentially revolutionary technologies by integrating core disciplines of combustion, plasma dynamics, chemistry, hybrid simulation, structures, and materials. Investigated processes associated with the generation, storage, and utilization of energy, specifically for Air Force systems. Included developing novel energetic materials as well as understanding and optimizing combustion processes. ***FY 2016 Plans:*** Exploit technological innovations and develop potentially revolutionary technologies by integrating core disciplines of combustion, plasma dynamics, chemistry, hybrid simulation, structures, and materials. Investigate processes associated with the generation, storage, and utilization of energy, specifically for Air Force systems. This includes developing novel energetic materials as well as understanding and optimizing combustion processes. ***FY 2017 Plans:*** Continue to exploit technological innovations and develop potentially revolutionary technologies by integrating core disciplines of combustion, plasma dynamics, chemistry, hybrid simulation, and structures. Investigate processes associated with the generation, storage, and utilization of energy, specifically for Air Force systems. This includes developing novel energetic materials as well as understanding and optimizing combustion processes.	33.645	37.916	33.513
Title: Complex Materials and Structures ***Description:*** Scientific focus areas are mechanics of multifunctional materials and microsystems, multi-scale mechanics and prognosis, low density materials, and polymer chemistry. ***FY 2015 Accomplishments:*** Supported the development of a next-generation lithium-ion battery made using Kevlar membrane that demonstrated a 20% increase in storage capacity. Investigated multifunctional materials and structures composed of different classes of materials that may be able to change functionality or performance characteristics to enhance the mission versatility of future air and	34.498	38.876	40.866

Exhibit R-2A, RDT&E Project Justification: PB 2017 Air Force		Date: February 2016
Appropriation/Budget Activity 3600 / 1	**R-1 Program Element (Number/Name)** PE 0601102F / *Defense Research Sciences*	**Project (Number/Name)** 613002 / *Aerospace, Chemical and Material Sciences*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
space systems, with a key goal of increasing functionality while decreasing weight and volume. Explored complex materials, microsystems, and structures that incorporate hierarchical design and functionality from the nano-scale through the meso-scale, ultimately leading to controlled, well-understood material or structural behavior capable of dynamic functionality and/or performance characteristics to enhance mission versatility. ***FY 2016 Plans:*** Investigate multifunctional materials and structures composed of different classes of materials, both organic and inorganic, that may be able to change functionality or performance characteristics to enhance the mission versatility of future air and space systems, with a key goal of increasing functionality while decreasing weight and volume. Explore complex materials, microsystems, and structures that incorporate hierarchical design and functionality from the nano-scale through the meso-scale, ultimately leading to controlled, well-understood material or structural behavior capable of dynamic functionality and/or performance characteristics to enhance mission versatility. ***FY 2017 Plans:*** Continue to investigate multifunctional materials and structures composed of inorganic materials that may be able to change functionality or performance characteristics to enhance the mission versatility of future air and space systems, with a key goal of increasing functionality while decreasing weight and volume. Explore materials, microsystems, and structures that incorporate hierarchical design and functionality from the nano-scale through the meso-scale, ultimately leading to controlled, well-understood material or structural behavior capable of dynamic functionality and/or performance characteristics to enhance mission versatility.			
Accomplishments/Planned Programs Subtotals	95.686	107.833	105.484

	FY 2015	FY 2016
Congressional Add: Program Increase	26.424	11.167
FY 2015 Accomplishments: Conducted Congressionally directed effort.		
FY 2016 Plans: Conduct Congressionally directed effort.		
Congressional Adds Subtotals	26.424	11.167

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2017 Air Force		Date: February 2016
Appropriation/Budget Activity 3600 / 1	**R-1 Program Element (Number/Name)** PE 0601102F / *Defense Research Sciences*	**Project (Number/Name)** 613002 / *Aerospace, Chemical and Material Sciences*

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Air Force			Date: February 2016
Appropriation/Budget Activity 3600 / 1	R-1 Program Element (Number/Name) PE 0601102F / *Defense Research Sciences*	Project (Number/Name) 613003 / *Mathematics, Information and Life Sciences*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
613003: *Mathematics, Information and Life Sciences*	-	113.159	113.081	101.258	0.000	101.258	102.386	104.066	106.779	108.798	Continuing	Continuing

A. Mission Description and Budget Item Justification

Basic research in the Mathematics, Information, and Life Sciences Project seeks to enable revolutionary advances and expand the fundamental knowledge supporting technologies critical to the future of the Air Force. Research stresses high-risk, far-term, game-changing capability breakthroughs essential for future leaps in warfighter system performance, functionality, reliability, and survivability while simultaneously reducing component and system power, size, mass, and life cycle costs. Major areas being investigated in this project are information and complex networks, decision making, dynamical systems, optimization and control, and natural materials and systems. While the following are specific sub-areas within this project, there is a continuing interest to explore novel ideas to bridge projects within this program.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
Title: Information and Complex Networks	25.867	27.715	25.825
Description: Scientific focus areas are systems and software, information operations and security, information fusion, and complex networks.			
FY 2015 Accomplishments: Supported the development of efficient and intelligent algorithms for multifunctional reconfigurable antennas that can adapt to better detect a signal's direction, frequency and polarization. Designed and analyzed techniques to enable reliable and secure exchange of information and predictable operation of networks and systems. Included traditional aspects of information assurance, software engineering, and reliable systems, but the emphasis was on the underlying mathematics of secure-by-design architectures of networked communications and neural information processing. Sub-areas included system and network performance prediction, design and analysis, and modeling of human-machine systems.			
FY 2016 Plans: Design and analyze techniques to enable reliable and secure exchange of information and predictable operation of networks and systems, including hardware and software interactions. This includes traditional aspects of information assurance, software engineering, and reliable systems, but the emphasis is on the underlying mathematics of secure-by-design architectures of networked communications and neural information processing. Sub-areas include system and network performance prediction, design and analysis, and modeling of human-machine systems.			
FY 2017 Plans: Continue to design and analyze techniques to enable reliable and secure exchange of information and predictable operation of networks and systems. This includes traditional aspects of information assurance, software engineering, and reliable systems, but the emphasis is on the underlying mathematics of secure-by-design architectures of networked communications and neural			

Exhibit R-2A, RDT&E Project Justification: PB 2017 Air Force		Date: February 2016
Appropriation/Budget Activity 3600 / 1	**R-1 Program Element (Number/Name)** PE 0601102F / *Defense Research Sciences*	**Project (Number/Name)** 613003 / *Mathematics, Information and Life Sciences*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
information processing. Sub-areas include system and network performance prediction, design and analysis, and modeling of human-machine systems.			
Title: Decision Making	18.590	19.918	20.140
Description: Scientific focus areas are mathematical modeling of cognition and decision making, trust between humans and autonomous agents, and mixed human-machine decision making. ***FY 2015 Accomplishments:*** Transitioned university research effort on cultural and organizational factors that affect trust of and reliance on automated systems to Program 0602202, Human Effectiveness Applied Research. Investigated new mathematical laws, scientific principles, and robust algorithms that underlie intelligent, mixed human-machine decision making to achieve accurate real-time projection of expertise and knowledge into and out of the battlespace. Included efforts to advance the critical knowledge base in information sciences and information fusion, and to model individual and group cognitive processing and decision making. ***FY 2016 Plans:*** Investigate new mathematical laws, scientific principles, and robust algorithms that underlie intelligent, mixed human-machine decision making to achieve accurate real-time projection of expertise and knowledge into and out of the battlespace. This includes efforts to advance the critical knowledge base in information sciences and information fusion, and to model individual and group cognitive processing and decision making. ***FY 2017 Plans:*** Continue to investigate new mathematical laws, scientific principles, and robust algorithms that underlie intelligent, mixed human-machine decision making to achieve accurate real-time projection of expertise and knowledge into and out of the battlespace. This includes efforts to advance the critical knowledge base in information sciences, and to model individual and group cognitive processing and decision making.			
Title: Dynamical Systems, Optimization, and Control	27.010	28.941	26.575
Description: Scientific focus areas are computational mathematics, dynamics and control, and optimization and discrete mathematics. ***FY 2015 Accomplishments:*** Funded the development of a dynamic multi-robot control algorithm that fuels a tablet-based control system. Developed new scientific concepts supported by rigorous analysis for advancing the science of autonomy and promoting the understanding necessary to analyze and design complex multi-scale systems as well as provide guaranteed levels of performance. Included			

Exhibit R-2A, RDT&E Project Justification: PB 2017 Air Force		Date: February 2016
Appropriation/Budget Activity 3600 / 1	**R-1 Program Element (Number/Name)** PE 0601102F / *Defense Research Sciences*	**Project (Number/Name)** 613003 / *Mathematics, Information and Life Sciences*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
study of novel adaptive control strategies for coordinating heterogeneous, autonomous, or semi-autonomous aerospace vehicles in uncertain, information rich, dynamically changing, adversarial, and networked environments. ***FY 2016 Plans:*** Develop new scientific concepts supported by rigorous analysis for advancing the science of autonomy and promoting the understanding necessary to analyze and design complex multi-scale systems as well as provide guaranteed levels of performance. Develop novel adaptive control strategies for coordinating heterogeneous, autonomous, or semi-autonomous aerospace vehicles in uncertain, information rich, dynamically changing, adversarial, and networked environments. ***FY 2017 Plans:*** Continue to develop new scientific concepts supported by rigorous analysis for advancing the science of autonomy and promoting the understanding necessary to analyze and design complex multi-scale systems as well as provide guaranteed levels of performance. The includes developing novel adaptive control strategies for coordinating heterogeneous, autonomous, or semi-autonomous aerospace vehicles in uncertain, information rich, dynamically changing, adversarial, and networked environments.			
Title: Natural Materials and Systems ***Description:*** Scientific focus areas are renewable energy, natural materials and nature inspired systems. ***FY 2015 Accomplishments:*** Supported the successful fabrication of the first organic quantum dot light-emitting diodes (LEDs) by using a 3-D printer. The proof of concept activity is a significant step toward using 3-D printing to create on-demand, simple parts and devices. Investigated multi-disciplinary approaches for studying, using, mimicking, synthesizing and adapting to the ways natural systems accomplish their required tasks. Studied how to adapt and mimic existing natural sensory systems and add existing capabilities to these organisms with the intent to gain more precise control over their material production. ***FY 2016 Plans:*** Investigate multi-disciplinary approaches for studying, using, mimicking, synthesizing and adapting to the ways natural systems accomplish their required tasks. Study how to adapt and mimic existing natural sensory systems and add existing capabilities to these organisms with the intent to gain more precise control over their material production. ***FY 2017 Plans:*** Continue to investigate multi-disciplinary approaches for studying the ways natural systems accomplish their required tasks. Study how to adapt and mimic existing natural sensory systems and add existing capabilities to these organisms with the intent to gain more precise control over their material production.	23.651	25.340	28.718
Accomplishments/Planned Programs Subtotals	95.118	101.914	101.258

Exhibit R-2A, RDT&E Project Justification: PB 2017 Air Force		Date: February 2016
Appropriation/Budget Activity 3600 / 1	**R-1 Program Element (Number/Name)** PE 0601102F / *Defense Research Sciences*	**Project (Number/Name)** 613003 / *Mathematics, Information and Life Sciences*

	FY 2015	FY 2016
Congressional Add: Program Increase	18.041	11.167
FY 2015 Accomplishments: Conducted Congressionally directed effort.		
FY 2016 Plans: Conduct Congressionally directed effort.		
Congressional Adds Subtotals	18.041	11.167

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Air Force			Date: February 2016
Appropriation/Budget Activity 3600 / 1	R-1 Program Element (Number/Name) PE 0601102F / *Defense Research Sciences*	Project (Number/Name) 613004 / *Education and Outreach*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
613004: *Education and Outreach*	-	30.950	31.042	34.003	0.000	34.003	34.382	34.946	35.857	36.535	Continuing	Continuing

A. Mission Description and Budget Item Justification

The major efforts in the Science and Technology (S&T) Education and Outreach Project are to facilitate interactions between the international and domestic research communities and Air Force researchers, and to support and develop scientists and engineers with an awareness of Air Force basic research priorities. These professional interactions and collaborations benefit the Air Force by increasing awareness of Air Force basic research priorities in the research community as a whole, and attracting talented scientists and engineers to address Air Force needs. International interactions facilitate future interoperability of coalition systems and foster relationships with future coalition partners. This project also seeks to enhance interactions with Historically Black Colleges and Universities, Hispanic serving institutions, and other minority institutions.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
Title: Outreach to International S&T Community	10.292	10.440	11.978

Description: Foster international S&T cooperation by supporting direct interchanges with a broad range of key international researchers and communities. Identify and leverage international scientific advances when appropriate.

FY 2015 Accomplishments:

Established a new international partnership that allows Australian scientists to participate in research efforts at the Air Force Research Laboratory and affiliated U.S. universities. Leveraged international expertise and support international technology liaison missions to identify and maintain awareness of foreign science and technology developments. Explored current foreign investments and influence world-class scientific research on specific topics of Air Force interest. Pursued access to technical information on foreign research capabilities within our interests. Supported international visits by scientists and high-level Department of Defense (DoD) S&T delegations, and provide primary interface to coordinate international S&T participation among DoD organizations.

FY 2016 Plans:

Leverage international expertise and support international technology liaison missions to identify and maintain awareness of foreign science and technology developments. Explore current foreign investments and influence world-class scientific research on specific topics of Air Force interest. Pursue access to technical information on foreign research capabilities within our interests. Support international visits by scientists and high-level DoD S&T delegations, and provide primary interface to coordinate international S&T participation among DoD organizations.

FY 2017 Plans:

Continue to leverage international expertise and support international technology liaison missions to identify and maintain awareness of foreign science and technology developments. Explore current foreign investments and influence world-class

Exhibit R-2A, RDT&E Project Justification: PB 2017 Air Force		Date: February 2016
Appropriation/Budget Activity 3600 / 1	**R-1 Program Element (Number/Name)** PE 0601102F / *Defense Research Sciences*	**Project (Number/Name)** 613004 / *Education and Outreach*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
scientific research on specific topics of Air Force interest. Pursue access to technical information on foreign research capabilities within our interests. Support international visits by scientists and high-level DoD S&T delegations.			
Title: Outreach to U.S. S&T Workforce ***Description:*** Strengthen science, mathematics, and engineering research and infrastructure in the U.S., thereby strengthening current and future Air Force S&T capabilities. ***FY 2015 Accomplishments:*** Awarded 57 grants to 43 research institutions under the Air Force's Young Investigator Research Program. Increased awareness of Air Force research needs and opportunities throughout the civilian scientific community, while simultaneously identifying, recruiting, and increasing opportunities for new young investigators to participate in critical Air Force research. Supported science, mathematics, and engineering research, and educational outreach programs at U.S. colleges and universities, including Historically Black Colleges and Universities, Hispanic serving institutions, and other minority institutions. ***FY 2016 Plans:*** Increase awareness of Air Force research needs and opportunities throughout the civilian scientific community, while simultaneously identifying, recruiting, and increasing opportunities for new young investigators to participate in critical Air Force research. Support science, mathematics, and engineering research, and educational outreach programs including Historically Black Colleges and Universities, Hispanic serving institutions, and other minority institutions. ***FY 2017 Plans:*** Continue identifying, recruiting, and increasing opportunities for new young investigators to participate in critical Air Force research. Support science, mathematics, and engineering research including Historically Black Colleges and Universities, Hispanic serving institutions, and other minority institutions. Support science activities that encourage elementary/middle/ high school youths to develop an interest in and pursue higher education and employment in the science, mathematics, and engineering (STEM) fields.	13.408	13.602	22.025
Accomplishments/Planned Programs Subtotals	23.700	24.042	34.003

	FY 2015	FY 2016
Congressional Add: Program Increase ***FY 2015 Accomplishments:*** Conducted Congressionally directed effort. ***FY 2016 Plans:*** Conduct Congressionally directed effort.	7.250	7.000
Congressional Adds Subtotals	7.250	7.000

Exhibit R-2A, RDT&E Project Justification: PB 2017 Air Force		Date: February 2016
Appropriation/Budget Activity 3600 / 1	**R-1 Program Element (Number/Name)** PE 0601102F / *Defense Research Sciences*	**Project (Number/Name)** 613004 / *Education and Outreach*

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.