Exhibit R-2, RDT&E Budget Item Justification: PB 2019 Air Force											Date: February 2018	
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602601F / *Space Technology*							
COST ($ in Millions)	**Prior Years**	**FY 2017**	**FY 2018**	**FY 2019 Base**	**FY 2019 OCO**	**FY 2019 Total**	**FY 2020**	**FY 2021**	**FY 2022**	**FY 2023**	**Cost To Complete**	**Total Cost**
Total Program Element	-	119.670	116.503	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
621010: *Space Survivability & Surveillance*	-	39.864	39.100	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
624846: *Spacecraft Payload Technologies*	-	15.758	15.841	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
625018: *Spacecraft Protection Technology*	-	19.507	21.720	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
628809: *Spacecraft Vehicle Technologies*	-	44.541	39.842	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

A. Mission Description and Budget Item Justification

This program focuses on four major areas. First, the space survivability and surveillance area develops technologies to understand space weather and the geophysics environment for mitigation and exploitation of these effects to Air Force systems. Second, the spacecraft payload technologies area improves satellite payload operations by developing advanced component and subsystem capabilities. Third, the spacecraft protection area develops technologies for protecting United States space assets in potential hostile settings. The last major area, spacecraft vehicles, focuses on spacecraft platform and control technologies, and their interactions. Efforts in this program have been coordinated through the Department of Defense Science and Technology Executive Committee process to harmonize efforts and eliminate duplication.

In FY 2019, the entirety of PE 0602601F, Space Technology, will transfer to PE 1206601F, Space Technology, to provide increased transparency to the Office of the Secretary of Defense and Congress regarding Space Science and Technology Major Force Program 12 Space investment.

This program element may include necessary civilian pay expenses required to manage, execute, and deliver science & technology capabilities. The use of program funds in this PE would be in addition to the civilian pay expenses budgeted in program elements 0601102F, 0602102F, 0602201F, 0602202F, 0602203F, 0602204F, 0602602F, 0602605F, 0602788F, 1206601F, and 0602298F.

This program is in Budget Activity 2, Applied Research because this budget activity includes studies, investigations, and non-system specific technology efforts directed toward general military needs with a view toward developing and evaluating the feasibility and practicality of proposed solutions and determining their parameters.

Exhibit R-2, RDT&E Budget Item Justification: PB 2019 Air Force					Date: February 2018
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 2: *Applied Research*			R-1 Program Element (Number/Name) PE 0602601F / *Space Technology*		
B. Program Change Summary ($ in Millions)	**FY 2017**	**FY 2018**	**FY 2019 Base**	**FY 2019 OCO**	**FY 2019 Total**
Previous President's Budget	117.915	116.503	114.683	0.000	114.683
Current President's Budget	119.670	116.503	0.000	0.000	0.000
Total Adjustments	1.755	0.000	-114.683	0.000	-114.683
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	0.000			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	3.610	0.000			
• SBIR/STTR Transfer	-1.855	0.000			
• Other Adjustments	0.000	0.000	-114.683	0.000	-114.683

Change Summary Explanation

Increase in FY 2017 reflects reprogramming to support Research and Development Projects, 10 U.S.C. Section 2358.

Decrease in FY 2019 due to the transfer of the entire PE 0602601F, Space Technology, to PE 1206601F, Space Technology.

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force			Date: February 2018
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602601F / *Space Technology*	Project (Number/Name) 621010 / *Space Survivability & Surveillance*	

COST ($ in Millions)	Prior Years	FY 2017	FY 2018	FY 2019 Base	FY 2019 OCO	FY 2019 Total	FY 2020	FY 2021	FY 2022	FY 2023	Cost To Complete	Total Cost
621010: *Space Survivability & Surveillance*	-	39.864	39.100	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops technologies to understand and control the space environment for warfighter's future capabilities. The focus is on characterizing and forecasting the battlespace environment for more realistic space system design, modeling, and simulation, as well as the battlespace environment's effect on space systems' performance. This includes technologies to specify and forecast the space environment for planning operations, ensure uninterrupted system performance, optimize space-based surveillance operations, and provide capability to mitigate or exploit the space environment for both offensive and defensive operations. Finally, this project includes the seismic research program that supports national requirements for monitoring nuclear explosions.

For FY 2019 and beyond, the entirety of the Project 621010, Space Survivability and Surveillance, will be reported under PE 1206601F, Space Technology, Project 621010, Space Survivability and Surveillance. This administrative transfer will provide increased transparency to the Office of the Secretary of Defense and Congress regarding Space Science and Technology Major Force Program 12 Space investment.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
Title: Space Environment Research	13.606	13.460	0.000
Description: Develop techniques, forecasting tools, sensors, and technologies for specifying, monitoring, predicting, and controlling space environmental conditions hazardous to Department of Defense operational space and radar systems.			
FY 2018 Plans: Begin evaluation of next-generation solar particle event models for operational suitability. Develop suitable trapped energetic particle specification model for inclusion in rapid anomaly resolution tool. Begin chemical analysis of aged spacecraft materials for electrical and optical property changes. Begin exploitation of unique internal charging sensor with respect to space material aging. Continue analyzing and exploiting data from on-orbit assets. Continue to assess impacts of the arctic ionosphere on sensor systems. Continue to evaluate and refine Global Positioning System radio frequency exploitation algorithms for global scintillation specification. Continue improvements of state-of-the-art solar magnetic flux transport model for more reliable forecast of solar radio and extreme ultraviolet flux levels. Validate the advanced ionosphere-thermosphere model. Continue work on hybrid hypersonic solvers.			
FY 2019 Plans: For FY 2019, this work will be performed under the Space Environment Research effort in PE 1206601F, Space Technology, Project 621010, Space Survivability & Surveillance.			
FY 2018 to FY 2019 Increase/Decrease Statement:			

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force		Date: February 2018
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602601F / *Space Technology*	**Project (Number/Name)** 621010 / *Space Survivability & Surveillance*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
FY 2019 decreased compared to FY 2018 by $13.460 million due to the transfer of the entire PE 0602601F, Space Technology, to 1206601F, Space Technology.			
Title: Surveillance Technologies ***Description:*** Develop advanced target detection techniques, spectral signature libraries, and decision aids for space-based sensors and surveillance systems. ***FY 2018 Plans:*** Complete assessment of target detection methodologies for hypertemporal imaging-based, missile warning concepts. Continue evaluation of computational methods for reducing time-critical downlink of missile warning and surveillance data through state-of-the-art data compression capabilities. Analyze missile-like events observed by hypertemporal imaging-dedicated space experiment to continue evaluation of hypertemporal imaging concept for early warning of theater ballistic missile launches. Initiate study of analytic approaches to space-based sensing of new and emerging ballistic and non-ballistic threats in denied areas. ***FY 2019 Plans:*** For FY 2019, this work will be performed under the Surveillance Technologies effort in PE 1206601F, Space Technology, Project 621010, Space Survivability & Surveillance. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 decreased compared to FY 2018 by $8.202 million due to the transfer of the entire PE 0602601F, Space Technology, to 1206601F, Space Technology.	7.990	8.202	0.000
Title: Radiation Remediation Research ***Description:*** Conduct Radiation Belt Remediation research through development and validation of analytical performance models for remediation of Earth radiation belts following high altitude nuclear detonation. ***FY 2018 Plans:*** Complete reduction and exploitation of science data from the space experiments to finalize the validation of the end-to-end model. Complete study to determine technical feasibility of a fielded ground or space-based system using the final validated end-to-end model. ***FY 2019 Plans:*** For FY 2019, this work will be performed under the Radiation Remediation Research effort in PE 1206601F, Space Technology, Project 621010, Space Survivability & Surveillance. ***FY 2018 to FY 2019 Increase/Decrease Statement:***	3.946	2.625	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force		Date: February 2018
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602601F / *Space Technology*	**Project (Number/Name)** 621010 / *Space Survivability & Surveillance*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
FY 2019 decreased compared to FY 2018 by $2.625 million due to the transfer of the entire PE 0602601F, Space Technology, to 1206601F, Space Technology.			
Title: Seismic Technologies	6.565	6.281	0.000
Description: Develop seismic technologies to support national requirements for monitoring nuclear explosions with special focus on regional distances less than 2,000 kilometers from the sensors. ***FY 2018 Plans:*** Implement high performance computing capabilities to automate the detection, location, and discrimination of seismic events. Test and provide high-performance computing modeling and simulation codes to model full seismic waveforms for operational expert analysis of difficult-to-discriminate earthquakes and explosions. Provide improved understanding of the behavior of discriminants for local and regional seismic events. Explore the application of big-data heuristics to more quickly characterize seismic events. ***FY 2019 Plans:*** For FY 2019, this work is performed the under the Seismic Technologies effort in PE 1206601F, Space Technology, Project 621010, Space Survivability & Surveillance. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 decreased compared to FY 2018 by $6.281 million due to the transfer of the entire PE 0602601F, Space Technology, to 1206601F, Space Technology.			
Title: Alternative Navigation Technologies	7.757	8.532	0.000
Description: Develop new technologies based on cold atom physics that provide autonomous jam-proof precision inertial navigation to augment Global Positioning System in case of Global Positioning System-denial. Develop atomic clocks based on new technologies to replace legacy Global Positioning System atomic clocks. ***FY 2018 Plans:*** Begin testing of advanced compact atomic clocks with improved accuracy and stability to replace legacy atomic clocks. Complete testing of advanced clock from National Institute of Standards and Technology. Package system for flight on experimental satellite system. Begin testing of free-space, cold atom 3-axis gyroscope/accelerometer that will enable Global Positioning System-free precision navigation. Begin planning for packaging of system for test on aircraft flight experiment or other suitable platform. ***FY 2019 Plans:*** For FY 2019, this work is performed under Alternative Navigation Technologies effort in PE 1206601F, Space Technology, Project 621010, Space Survivability & Surveillance. ***FY 2018 to FY 2019 Increase/Decrease Statement:***			

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force		Date: February 2018
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602601F / *Space Technology*	**Project (Number/Name)** 621010 / *Space Survivability & Surveillance*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
FY 2019 decreased compared to FY 2018 by $8.532 million due to the transfer of the entire PE 0602601F, Space Technology, to 1206601F, Space Technology.			
Accomplishments/Planned Programs Subtotals	39.864	39.100	0.000

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 2019 Air Force			Date: February 2018
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602601F / *Space Technology*	Project (Number/Name) 624846 / *Spacecraft Payload Technologies*	

COST ($ in Millions)	Prior Years	FY 2017	FY 2018	FY 2019 Base	FY 2019 OCO	FY 2019 Total	FY 2020	FY 2021	FY 2022	FY 2023	Cost To Complete	Total Cost
624846: *Spacecraft Payload Technologies*	-	15.758	15.841	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops advanced technologies that enhance spacecraft payload operations by improving component and subsystem capabilities. The project focuses on development of advanced, space-qualified, survivable electronics, and electronics packaging technologies; development of advanced space data generation and exploitation technologies, including infrared sensors; and development of high-fidelity space simulation models that support space-based surveillance and space asset protection research and development for the warfighter.

In FY 2019, the entirety of Project 624846, Spacecraft Payload Technologies will be reported under PE 1206601F, Space Technology, Project 624846, Spacecraft Payload Technologies. This administrative transfer will provide increased transparency to the Office of the Secretary of Defense and Congress regarding Space Science and Technology Major Force Program 12 Space investment.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
Title: Space-Based Detector Technologies	3.341	3.290	0.000
Description: Develop advanced infrared device technologies that enable hardened space detector arrays with improved detection to perform acquisition, tracking, and discrimination of space objects and missile warning. ***FY 2018 Plans:*** Focus on growing larger infrared detectors with emphasis on noise-equivalent operability reflective of space-based launch detection missile warning applications with derivative benefits for tactical applications. Characterize detectors in a representative space environment to include surface charging, latch-up, and displacement damage. Iterate upon design to ensure suitability for space operation. ***FY 2019 Plans:*** For FY 2019, this work is performed under the Space-Based Detector Technologies effort in PE 1206601F, Space Technology, Project 624846, Spacecraft Payload Technologies. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 decreased compared to FY 2018 by $3.290 million due to the transfer of the entire PE 0602601F, Space Technology, to 1206601F, Space Technology.			
Title: Space Electronics Research	2.723	2.715	0.000
Description: Develop technologies for space-based payload components such as radiation-hardened electronic devices, micro-electro-mechanical system devices, and advanced electronics packaging.			

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force		Date: February 2018
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602601F / *Space Technology*	**Project (Number/Name)** 624846 / *Spacecraft Payload Technologies*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
FY 2018 Plans: Continue development of trusted electronics path as it applies to space technology tools and fabrication. Continue development of three-dimensional electronics to extend technology node density. Investigate alternative memory approaches for high density memory. Continue advanced transistor efforts transitioning techniques to mainstream manufacturing. Finalize Gallium Nitride transistor radiation mitigation results and techniques to the electronics manufacturing community. Continue to transition benchmarking results to user for selection of technology path while updating capability to keep pace with state-of-the-art. ***FY 2019 Plans:*** For FY 2019, this work is performed under the Space Electronics Research effort in PE 1206601F, Space Technology, Project 624846, Spacecraft Payload Technologies. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 decreased compared to FY 2018 by $2.715 million due to the transfer of the entire PE 0602601F, Space Technology, to 1206601F, Space Technology.			
Title: Modeling and Simulation Tools for Space Applications ***Description:*** Develop modeling and simulation tools for space-based ground surveillance systems, rendezvous and proximity operations, imaging of space systems, disaggregated satellite architecture, and space control payloads. ***FY 2018 Plans:*** Define mission-level military utility analyses of various space sensing, satellite navigation and communication architecture approaches. Refine guidelines and checkpoints to evaluate maturity and applicability of emerging space technologies to support various Air Force Research Laboratory technical programs, Department of Defense customers and wargame events. Continue development of models and mission simulations enabling analysis of contested space environment and space enterprise capabilities. ***FY 2019 Plans:*** For FY 2019, this work is performed under the Modeling and Simulation Tools for Space Applications effort in PE 1206601F, Space Technology, Project 624846, Spacecraft Payload Technologies. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 decreased compared to FY 2018 by $5.306 million due to the transfer of the entire PE 0602601F, Space Technology, to 1206601F, Space Technology.	5.054	5.306	0.000
Title: Alternative Positioning, Navigation, and Timing Technology ***Description:*** Identify and develop technologies that enable new, or enhance existing, United States positioning, navigation, and timing satellite capabilities by increasing resiliency and availability of accuracy, and/or increasing the affordability of providing	4.640	4.530	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force		Date: February 2018
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602601F / *Space Technology*	**Project (Number/Name)** 624846 / *Spacecraft Payload Technologies*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
current capabilities. Develop technologies to meet identified Air Force Space Command/Space and Missile Systems Center positioning, navigation, and timing space payload technology needs. ***FY 2018 Plans:*** Complete in-house laboratory feasibility experiments on an advanced digital payload for future Global Positioning System application. Conduct in-house experiment to prove the ability of at least two advanced signal concepts to overcome adversarial countermeasures. Continue studies to identify alternative and innovative technologies that are viable for positioning, navigation, and timing payloads and to investigate advanced signal concepts. ***FY 2019 Plans:*** For FY 2019, this work is performed under the Alternative Positioning, Navigation, and Timing Technology effort in PE 1206601F, Space Technology, Project 624846, Spacecraft Payload Technologies. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 decreased compared to FY 2018 by $4.530 million due to the transfer of the entire PE 0602601F, Space Technology, to 1206601F, Space Technology.			
Accomplishments/Planned Programs Subtotals	15.758	15.841	0.000

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 2019 Air Force			Date: February 2018
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602601F / *Space Technology*	Project (Number/Name) 625018 / *Spacecraft Protection Technology*	

COST ($ in Millions)	Prior Years	FY 2017	FY 2018	FY 2019 Base	FY 2019 OCO	FY 2019 Total	FY 2020	FY 2021	FY 2022	FY 2023	Cost To Complete	Total Cost
625018: *Spacecraft Protection Technology*	-	19.507	21.720	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops the technologies for protecting United States space assets in potentially hostile environments to assure continued space system operation without performance loss in support of warfighter requirements. The project focuses on identifying and assessing spacecraft system vulnerabilities, developing threat warning technologies, and developing technologies to mitigate the effects of both intentional and unintentional threats.

In FY 2019, the entirety of Project 625018, Spacecraft Protection Technology will be reported under PE 1206601F, Space Technology, Project 625018, Spacecraft Protection Technology. This administrative transfer will provide increased transparency to the Office of the Secretary of Defense and Congress regarding Space Science and Technology Major Force Program 12 Space investment.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
Title: Threat Warning Research	19.507	21.720	0.000
Description: Develop satellite threat warning technologies and tools for space defense. Exploit on-board inherent satellite resources, satellite-as-a-sensor, and self-aware satellite technologies. Develop technologies to detect, assess, and respond to threats and anomalies.			
FY 2018 Plans: Begin satellite protection techniques to continued development of advanced algorithms for sensor data fusion and satellite threat detection, assessment, and response. Expand space situational awareness-focused data analysis methods including physics-based sensor model development for use in data filtering. Develop additional advanced filtering techniques accommodating nonlinear dynamics and non-normal random variable distributions. Mature concepts of new electro-optical and radio frequency sensors for space object identification and characterization. Incorporate customer feedback into closed loop sensor tasking concept for space surveillance combining commercial and government sensor assets. Continue assessment and development of commercial remote sensing data and information to fill gaps in coverage for monitoring and tracking ground and space objects. Continue engagements with commercial space data providers for testing new enabling technologies on commercial satellites. Operate ground test facility to evaluate performance of integrated technology solutions in contested space, cyber, and radio frequency environment. Conduct red-teaming to evaluate effectiveness of specific space cyber resiliency technologies. Develop and refine bare-metal hypervisor and associated security modules and expand to multiple computer architectures. Continue development of hosted payload options for enhanced satellite survivability and mission assurance in contested environments.			
FY 2019 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force		Date: February 2018
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602601F / *Space Technology*	**Project (Number/Name)** 625018 / *Spacecraft Protection Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
For FY 2019, this work is performed under the Threat Warning Research effort in PE 1206601F, Space Technology, Project 625018, Spacecraft Protection Technology. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 decreased compared to FY 2018 by $21.720 million due to the transfer of the entire PE 0602601F, Space Technology, to 1206601F, Space Technology.			
Accomplishments/Planned Programs Subtotals	19.507	21.720	0.000

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 2019 Air Force			Date: February 2018
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602601F / *Space Technology*	Project (Number/Name) 628809 / *Spacecraft Vehicle Technologies*	

COST ($ in Millions)	Prior Years	FY 2017	FY 2018	FY 2019 Base	FY 2019 OCO	FY 2019 Total	FY 2020	FY 2021	FY 2022	FY 2023	Cost To Complete	Total Cost
628809: *Spacecraft Vehicle Technologies*	-	44.541	39.842	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project focuses on spacecraft platforms (for example, structures, power, and thermal management); satellite control (such as, signal processing and control); and space experiments of maturing technologies for space qualification.

In FY 2019, the entirety of Project 628809, Spacecraft Vehicle Technologies, will be reported under PE 1206601F, Space Technology, Project 628809, Spacecraft Vehicle Technologies. This administrative transfer will provide increased transparency to the Office of the Secretary of Defense and Congress regarding Space Science and Technology Major Force Program 12 Space investment.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
Title: Space Power/Thermal Research	4.933	4.547	0.000
Description: Develop technologies for advanced space platform subsystems such as cryocoolers, compact, high efficiency solar power cells and arrays, and innovative power generation concepts. ***FY 2018 Plans:*** Continue research into approaches for greater than 40% solar cell efficiency. Complete initial investigation of photon management approaches for increased end-of-life performance. Continue development of advanced array technologies to meet 70-80 kilowatt per cubic meter array performance. ***FY 2019 Plans:*** For FY 2019, this work is performed under the Space Power/Thermal Research effort in PE 1206601F, Space Technology, Project 628809, Spacecraft Vehicle Technologies. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 decreased compared to FY 2018 by $4.547 million due to the transfer of the entire PE 0602601F, Space Technology, to 1206601F, Space Technology.			
Title: Space Structures and Controls Research	11.437	8.527	0.000
Description: Develop revolutionary and enabling technologies, including lighter weight, lower cost, high performance structures for space platforms; guidance, navigation, and controls hardware and software for next generation of space superiority systems. ***FY 2018 Plans:***			

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force		Date: February 2018
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602601F / *Space Technology*	**Project (Number/Name)** 628809 / *Spacecraft Vehicle Technologies*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
Continue collaborative autonomous multi-spacecraft control algorithms in laboratory and high-fidelity simulations/hardware test boards including embedded processor implementations. Continue reactive maneuver strategies for spacecraft resiliency in laboratory simulation and initiate high-fidelity simulations/hardware test boards. Continue research in verification and validation techniques for autonomous spacecraft flight software. Initiate improved estimation algorithms for on-orbit navigation software. Complete development of energy responsive technologies to control electromagnetic interactions of spacecraft structures and antennas. Continue development of United States space asset protection technologies including deployable structures enabling affordable protection concepts, thermal technologies for threat identification and mitigation, and local area sensing concepts. Continue development of advanced, agile manufacturing and assembly technologies for satellite production to improve system performance and affordability. Initiate research in affordable, high-performance phased arrays and electrically steerable antennas for tactical communication and radar concepts. ***FY 2019 Plans:*** For FY 2019, this work is performed under the Space Structures and Controls Research effort in PE 1206601F, Space Technology, Project 628809, Spacecraft Vehicle Technologies. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 decreased compared to FY 2018 by $8.527 million due to the transfer of the entire PE 0602601F, Space Technology, to 1206601F, Space Technology.			
Title: Space Experiments ***Description:*** Develop flight experiments to improve the capabilities of existing operational space systems and to enable new transformational space capabilities. ***FY 2018 Plans:*** Complete on-orbit early checkout for radiation remediation proof-of-concept experiment and complete one year of experimental activities. Initiate on-orbit testing and verification of a fourth generation geosynchronous orbit based missile warning payload to demonstrate hypertemporal imaging capabilities to detect missile launches under sun-lit clouds, potentially enabling all weather early missile detection. Begin on-orbit testing and verification of an integrated, on-board sensing, assessment, and autonomy technology demonstration payload at geosynchronous orbit, demonstrating geosynchronous orbit asset resiliency to a specific set of on-orbit events enabling system mission assurance in a degraded space environment. Continue development and testing of next-generation small satellite space experiment. Continue development of on-orbit experiment plan and mission objectives/ data requirements for space based integrated demonstration of an advanced Global Positioning System payload for contested environments. ***FY 2019 Plans:***	18.829	18.435	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force		Date: February 2018
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602601F / *Space Technology*	**Project (Number/Name)** 628809 / *Spacecraft Vehicle Technologies*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
For FY 2019, this work is performed under the Space Experiments effort in PE 1206601F, Space Technology, Project 628809, Spacecraft Vehicle Technologies. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 decreased compared to FY 2018 by $18.435 million due to the transfer of the entire PE 0602601F, Space Technology, to 1206601F, Space Technology.			
Title: Space Communication Technologies ***Description:*** Develop technologies for next-generation space communications terminals and equipment and methods/techniques to enable future space system operational command and control concepts. ***FY 2018 Plans:*** Support integration and test of the W and V frequency band flight instrument onto the host spacecraft. Fabricate, test, and deploy the last three operational, remotely controlled W and V frequency band ground terminals and shelter units. Establish and test network connections to remote ground terminals. Establish W and V frequency band flight experiment operations center, prepare staff, and test data analysis tools. Establish interface to host mission operations center for receiving telemetry. Conduct initial design and hardware test board testing of the W and V frequency band follow-on project. Continue to support development of critical space and ground terminal technology, such as multi-beam antenna, high power amplifiers, low noise amplifiers, reconfigurable radios, and wideband modem and signal processing technology. ***FY 2019 Plans:*** For FY 2019, this work is performed under the Space Communication Technologies effort in PE 1206601F, Space Technology, Project 628809, Spacecraft Vehicle Technologies. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 decreased compared to FY 2018 by $8.333 million due to the transfer of the entire PE 0602601F, Space Technology, to 1206601F, Space Technology.	9.342	8.333	0.000
Accomplishments/Planned Programs Subtotals	44.541	39.842	0.000

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force		Date: February 2018
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602601F / *Space Technology*	**Project (Number/Name)** 628809 / *Spacecraft Vehicle Technologies*

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.