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 1206601F / *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	-	0.000	0.000	117.645	0.000	117.645	135.795	138.264	142.076	135.105	Continuing	Continuing
621010: *Space Survivability & Surveillance*	-	0.000	0.000	40.234	0.000	40.234	40.857	41.197	43.045	41.042	Continuing	Continuing
624846: *Spacecraft Payload Technologies*	-	0.000	0.000	15.981	0.000	15.981	17.540	17.946	18.348	17.475	Continuing	Continuing
625018: *Spacecraft Protection Technology*	-	0.000	0.000	18.591	0.000	18.591	22.486	23.153	24.047	22.665	Continuing	Continuing
628809: *Spacecraft Vehicle Technologies*	-	0.000	0.000	42.839	0.000	42.839	54.912	55.968	56.636	53.923	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 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 is an administrative only adjustment and not a new start.

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, 0602298F, 0602601F, 0602602F, 0602605F, and 0602788F.

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 1206601F / *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	0.000	0.000	0.000	0.000	0.000
Current President's Budget	0.000	0.000	117.645	0.000	117.645
Total Adjustments	0.000	0.000	117.645	0.000	117.645
• 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	0.000	0.000			
• SBIR/STTR Transfer	0.000	0.000			
• Other Adjustments	0.000	0.000	117.645	0.000	117.645

Change Summary Explanation

Increase in FY 2019 due to the transfer of the entire PE 0602601F, Space Technology, to 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 1206601F / *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*	-	0.000	0.000	40.234	0.000	40.234	40.857	41.197	43.045	41.042	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.

Prior to FY 2019, the entirety of Project 621010, Space Survivability and Surveillance was reported under PE 0602601F, Space Technology, Project 621010, Space Survivability and Surveillance. For FY 2019 and beyond, this project will be reported under 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 is an administrative only change and not a new start.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
Title: Space Environment Research	0.000	0.000	14.695
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: For FY 2018 and FY 2017, this work is performed under the Space Environment Research effort in PE 0602601F, Space Technology, Project 621010, Space Survivability & Surveillance.			
FY 2019 Plans: Exploit data from aged electrical and optical property changes to enhance predictive material property model and inform development of improved spacecraft materials. Select next-generation solar particle event model for development towards operational demonstration. Select next-generation electron specification model for development towards operational demonstration. Evaluate space environment sensor and anomaly attribution tool demonstration to identify key areas for future model improvements. Assess the performance of oblique ionosonde auto scaling technologies as applied to real-time characterization of over-the-horizon-radar performance. Assess and validate advanced regional and global assimilative ionospheric models for integration into next-generation operational support. Continue to assess impacts of the arctic ionosphere on defense radar system availability. Validate integrated version of space environment impact on space-ground radio frequency links attribution tool meeting space operations requirements for scintillation and solar impacts on satellite communications,			

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 1206601F / *Space Technology*	**Project (Number/Name)** 621010 / *Space Survivability & Surveillance*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
command, and control systems. Use data from the new weather satellite constellation 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, key parameters for Air Force space weather models and forecasts. Validate the advanced assimilative ionosphere-thermosphere model using these parameters. Continue work on hybrid supersonic solver code development and validation. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 increased compared to FY 2018 by $14.695 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:*** For FY 2018 and FY 2017, this work is performed under the Surveillance Technologies effort in PE 0602601F Space Technology, Project 621010, Space Survivability & Surveillance. ***FY 2019 Plans:*** Initiate technology development for missile warning prototyping, including target signatures, background phenomenology, satellite constellation architecture analyses, data analytics, and satellite demonstration concepts. Continue study of advanced surveillance and detection technologies for tracking emerging and evolving targets, including ballistic and non-ballistic targets, that pose new challenges for missile warning systems. Complete testing and transition innovative computational methods to missile warning System Program Office to significantly decrease satellite down-link bandwidth while maintaining high fidelity of missile warning data. Continue mission of demonstration satellite for prototyping advanced sensor and analytic methods of innovative hypertemporal imaging early missile warning concept, including the collection and analysis of missile and missile like data. Provide assessment of prototyping satellite's capabilities for detecting and tracking low signature targets with complex trajectories. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 increased compared to FY 2018 by $10.880 million due to the transfer of the entire PE 0602601F, Space Technology, to 1206601F, Space Technology.	0.000	0.000	10.880
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:***	0.000	0.000	0.100

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 1206601F / *Space Technology*	**Project (Number/Name)** 621010 / *Space Survivability & Surveillance*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
For FY 2018 and FY 2017, this work is performed under the Radiation Remediation Research effort in PE 0602601F Space Technology, Project 621010, Space Survivability & Surveillance. ***FY 2019 Plans:*** Complete space experiment operations, reduction and science data exploitation to finalize the validation of the end-to-end model for space-based remediation systems. Conduct assessment of feasibility and system requirements for space-based and combined ground and space-based remediation systems. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 increased compared to FY 2018 by $0.100 million due to the transfer of the entire PE 0602601F, Space Technology, to 1206601F, Space Technology.			
Title: Seismic Technologies ***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:*** For FY 2018 and FY 2017, this work is performed under the Seismic Technologies effort in PE 0602601F, Space Technology, Project 621010, Space Survivability & Surveillance. ***FY 2019 Plans:*** Test new algorithms on high performance computing capabilities to improve automation of the detection, location, and discrimination of seismic events. Assess earth models for use in high-performance computing modeling and simulation codes for operational expert analysis of difficult-to-discriminate earthquakes and explosions. Test specific algorithms for application of big data heuristics to more quickly characterize seismic events. Explore new statistical approaches to the behavior of discriminants for local (less than 200 kilometers) and regional (less than 2,000 kilometers) seismic events. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 increased compared to FY 2018 by $5.972 million due to the transfer of the entire PE 0602601F, Space Technology, to 1206601F, Space Technology.	0.000	0.000	5.972
Title: Alternative Navigation Technologies ***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:***	0.000	0.000	8.587

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 1206601F / *Space Technology*	**Project (Number/Name)** 621010 / *Space Survivability & Surveillance*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
For FY 2018 and FY 2017, this work is performed under the Alternative Navigation Technologies effort in PE 0602601F, Space Technology, Project 621010, Space Survivability & Surveillance. ***FY 2019 Plans:*** Complete testing of advanced compact atomic clocks with improved accuracy and stability to replace legacy atomic clocks. Complete packaging of system for flight on experimental satellite system. Continue transition of advanced compact atomic clocks to industry. Begin testing of free-space, cold atom 3-axis gyroscope/accelerometer that will enable Global Positioning System free precision navigation. Start packaging of system for test on aircraft flight experiment or other suitable platform. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 increased compared to FY 2018 by $8.587 million due to the transfer of the entire PE 0602601F, Space Technology, to 1206601F, Space Technology.			
Accomplishments/Planned Programs Subtotals	0.000	0.000	40.234

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 1206601F / *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*	-	0.000	0.000	15.981	0.000	15.981	17.540	17.946	18.348	17.475	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.

Prior to FY 2019, the entirety of Project 624846, Spacecraft Payload Technologies, was reported under PE 0602601F, Space Technology, Project 624846, Spacecraft Payload Technologies. For FY 2019 and beyond, this project will be reported under 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 is an administrative only change and not a new start.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
Title: Space-Based Detector Technologies	0.000	0.000	3.230
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:*** For FY 2018 and FY 2017, this work is performed under the Space-Based Detector Technologies effort in PE 0602601F, Space Technology, Project 624846, Spacecraft Payload Technologies. ***FY 2019 Plans:*** Delivery of an 8000 x 8000, 10 micrometer pitch focal plane arrays that will be hardened to the natural space environment as well as focused photons. Upon delivery of said hardware it will be characterized in representative environment to verify functionality and if any shortfalls arise they will be addressed with iterative development. This will enable whole earth starring for the Launch Detection and Missile Warning mission. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 increased compared to FY 2018 by $3.230 million due to the transfer of the entire PE 0602601F, Space Technology, to 1206601F, Space Technology.			
Title: Space Electronics Research	0.000	0.000	2.764

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 1206601F / *Space Technology*	**Project (Number/Name)** 624846 / *Spacecraft Payload Technologies*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
Description: Develop technologies for space-based payload components such as radiation-hardened electronic devices, microelectro-mechanical system devices, and advanced electronics packaging. ***FY 2018 Plans:*** For FY 2018 and FY 2017, this work is performed under the Space Electronics Research effort in PE 0602601F, Space Technology, Project 624846, Spacecraft Payload Technologies. ***FY 2019 Plans:*** Continue leadership role in Deputy Assistant Secretary of Defense Systems Engineering risk reduction strategy by development of trusted manufacturing techniques that reduce risk to National Security Strategy systems. Continue to benchmark advanced algorithms on state-of-the-art electronics and transition results to acquisition community to enable data-informed architecture design decisions. Expanding capability to include assessments of classified requirements. Continue planning qualification efforts for next generation space processor. Continue research and development on ultra-low power and neuromorphic processing architectures to enable game-changing capabilities in future National Security Strategy systems. Continue development of alternative memory approaches for high density memory for use in space-based systems. Continue advanced transistor development, and transitioning techniques to mainstream manufacturing. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 increased compared to FY 2018 by $2.764 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:*** For FY 2018 and FY 2017, this work is performed under the Modeling and Simulation Tools for Space Applications effort in PE 0602601F, Space Technology, Project 624846, Spacecraft Payload Technologies. ***FY 2019 Plans:*** Conduct mission-level military utility analyses of various space sensing, satellite navigation, space control, 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	0.000	0.000	5.403

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 1206601F / *Space Technology*	**Project (Number/Name)** 624846 / *Spacecraft Payload Technologies*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
capabilities. Progress the development of baseline modeling and simulation capabilities to support quick-turn analysis and trade studies. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 increased compared to FY 2018 by $5.403 million due to the transfer of the entire PE 0602601F, Space Technology, to 1206601F, Space Technology.			
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 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:*** For FY 2018 and FY 2017, this work is performed under the Alternative Positioning, Navigation, and Timing Technology effort in PE 0602601F, Space Technology, Project 624846, Spacecraft Payload Technologies. ***FY 2019 Plans:*** Begin characterization of amplifiers, multiplexers and digital waveform generators being developed under Small Business Innovation Research Phase II contracts. Continue studies to identify alternative and innovative technologies that are viable for positioning, navigation, and timing payloads and ground systems and to investigate advanced signal and system concepts. Begin integration of positioning, navigation, and timing payload components developed under various contracts into positioning, navigation, and timing payloads to explore the concept of positioning, navigation, and timing payload modularity. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 increased compared to FY 2018 by $4.584 million due to the transfer of the entire PE 0602601F, Space Technology, to 1206601F, Space Technology.	0.000	0.000	4.584
Accomplishments/Planned Programs Subtotals	0.000	0.000	15.981

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 1206601F / *Space Technology*	**Project (Number/Name)** 624846 / *Spacecraft Payload 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.

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 1206601F / *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*	-	0.000	0.000	18.591	0.000	18.591	22.486	23.153	24.047	22.665	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 development of technologies to mitigate the effects of both intentional and unintentional threats.

Prior to FY 2019, the entirety of Project 625018, Spacecraft Protection Technology, was reported under PE 0602601F, Space Technology, Project 625018, Spacecraft Protection Technology. For FY 2019 and beyond, this project will be reported under 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 is an administrative only change and not a new start.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
Title: Threat Warning Research	0.000	0.000	18.591
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: For FY 2018 and FY 2017, this work is performed under the Threat Warning Research effort in PE 0602601F, Space Technology, Project 625018, Spacecraft Protection Technology.			
FY 2019 Plans: Develop techniques to detect, track, identify, and characterize satellites using multi-phenomenology to address gaps in knowledge for space situational awareness. Consider the tasking, collection, processing, exploitation and dissemination needs. Assess timeliness and persistence of space situational awareness capability and develop techniques that address the growing number of objects that must be monitored. Develop techniques to mitigate the growing population of objects that need to be monitored, from newly launched objects to debris. Assess utilizing commercial and international space situational awareness sources. Continue maturation of the space resiliency testbed to enhance ability to conduct full-spectrum space control RED-vs-BLUE experimentation with ops, network, command and control, and hardware in the loop. Conduct space cyber experimentation using on-orbit science satellite. Initiate research into advanced methods for net-centric space command and control architectures, to include cloud-based paradigms and other advanced computational methods across the full scope of the ground and space-based enterprise. Continue development of advanced algorithms for sensor data fusion and satellite threat detections, assessment,			

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 1206601F / *Space Technology*	**Project (Number/Name)** 625018 / *Spacecraft Protection Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
response and protection. Complete space situational awareness-focused data analysis methods including physics-based sensor model development for data filtering and space command and control architectures. Complete advancing 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. Continue incorporating customer feedback of 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 and methods development with commercial space data providers for testing new enabling technologies on commercial satellites. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 increased compared to FY 2018 by $18.591 million due to the transfer of the entire PE 0602601F, Space Technology, to 1206601F, Space Technology.			
Accomplishments/Planned Programs Subtotals	0.000	0.000	18.591

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 1206601F / *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*	-	0.000	0.000	42.839	0.000	42.839	54.912	55.968	56.636	53.923	Continuing	Continuing

A. Mission Description and Budget Item Justification

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

Prior to FY 2019, the entirety of Project 628809, Spacecraft Vehicle Technologies, was reported under PE 0602601F, Space Technology, Project 628809, Spacecraft Vehicle Technologies. For FY 2019 and beyond, this project will be reported under 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 is an administrative only change and not a new start.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
Title: Space Power/Thermal Research	0.000	0.000	4.804
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:*** For FY 2018 and FY 2017, this work is performed under the Space Power/Thermal Research effort in PE 0602601F, Space Technology, Project 628809, Spacecraft Vehicle Technologies. ***FY 2019 Plans:*** Continue research into approaches for greater than 40% solar cell efficiency. Begin evaluation of approaches for high radiation orbit optimized solar cells. Continue development of advanced array technologies to meet 70-80 kilowatt per cubic meter array performance. Initiate research incorporating photon management schemes into III-V devices for increased efficiency and end of-life. Initiate cell level resiliency research efforts. Develop panel level resilient approaches. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 increased compared to FY 2018 by $4.804 million due to the transfer of the entire PE 0602601F, Space Technology, to 1206601F, Space Technology.			
Title: Space Structures and Controls Research	0.000	0.000	9.007
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.			

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 1206601F / *Space Technology*	**Project (Number/Name)** 628809 / *Spacecraft Vehicle Technologies*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
FY 2018 Plans: For FY 2018 and FY 2017, this work is performed under the Space Structures and Controls Research effort in PE 0602601F, Space Technology, Project 628809, Spacecraft Vehicle Technologies. ***FY 2019 Plans:*** Continue reactive maneuver strategies for spacecraft resiliency in laboratory simulation and initiate high-fidelity simulations/ breadboards. Continue research in verification and validation techniques for autonomous spacecraft flight software. Continue improved estimation algorithms for on-orbit navigation software. Initiate laboratory and high-fidelity simulations/breadboard implementation for navigation algorithms with hardware-in-the-loop. Transition development of United States space asset protection, threat identification, and mitigation technologies including deployable structures, structural sensing, and thermal technologies to advanced development and flight experimentation. Perform test bed develop and integrated proof-of-concept experiments for advanced, agile manufacturing and assembly technologies for satellite production to improve performance and affordability. Continue research efforts in high-power small satellite technologies and affordable, high-performance phased arrays and electrically steerable antennas for tactical communication and radar concepts for agile, intelligent targets. Initiate research in functionalized structures using multi-material additive manufacturing. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 increased compared to FY 2018 by $9.007 million due to the transfer of the entire PE 0602601F, Space Technology, to 1206601F, Space Technology.			
Title: Space Experiments	0.000	0.000	21.705
Description: Develop flight experiments to improve the capabilities of existing operational space systems and to enable new transformational space capabilities. ***FY 2018 Plans:*** Previous work for the Space Experiments effort was accomplished under Space Experiments effort, under 0602601F Space Technology, Spacecraft Vehicle Technologies project 628809. In FY 2019, the entirety of the Space Experiments effort will move to Space Experiments effort under 1206601F Space Technology, Spacecraft Vehicle Technologies project 628809. This 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. ***FY 2019 Plans:*** Continue and complete one year of experimental satellite on-orbit operations. Complete program and close-out. Conclude on-orbit testing and verification of a fourth 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. Conclude on-orbit testing and verification of an integrated, on-board sensing, assessment, and autonomy technology demonstration payload at			

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 1206601F / *Space Technology*	**Project (Number/Name)** 628809 / *Spacecraft Vehicle Technologies*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
geosynchronous orbit, demonstrating geosynchronous orbit asset resiliency to a specific set of on-orbit events enabling system mission assurance in a degraded space environment. On-orbit demonstration of the first geosynchronous orbit CubeSat providing enhanced capability to the space enterprise. On-orbit demonstration of three formation flying satellites for near autonomous formation control. Refine on-orbit experiment plan and mission objectives to align with payload development progress, and continue developing data requirements and risk management plan for space-based integrated demonstration of an advanced Global Positioning System payload for contested environments. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 increased compared to FY 2018 by $21.705 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:*** For FY 2018 and FY 2017, this work is performed under the Space Communication Technologies effort, in PE 0602601F, Space Technology, Project 628809, Spacecraft Vehicle Technologies project. ***FY 2019 Plans:*** Support launch of W and V frequency band flight instrument. Support execution of a W and V band propagation experiment. Conduct research and development to address future military satellite communications capability and technology needs, for example, high-gain antenna, high-power amplifiers, low-noise amplifiers, cognitive / resilient networks, reconfigurable satellite radios / transponders, and anti-jam signal processing technologies. Support development and demonstration of novel laser communications technology. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 increased compared to FY 2018 by $7.323 million due to the transfer of the entire PE 0602601F, Space Technology, to 1206601F, Space Technology.	0.000	0.000	7.323
Accomplishments/Planned Programs Subtotals	0.000	0.000	42.839

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

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 1206601F / *Space Technology*	**Project (Number/Name)** 628809 / *Spacecraft Vehicle Technologies*

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.