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 3: *Advanced Technology Development (ATD)*					R-1 Program Element (Number/Name) PE 0603203F / *Advanced Aerospace Sensors*							
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	-	39.854	40.978	39.968	0.000	39.968	41.662	42.039	43.547	43.515	Continuing	Continuing
63665A: *Advanced Aerospace Sensors Technology*	-	16.711	19.734	19.992	0.000	19.992	21.277	21.324	21.750	21.970	Continuing	Continuing
6369DF: *Target Attack and Recognition Technology*	-	23.143	21.244	19.976	0.000	19.976	20.385	20.715	21.797	21.545	Continuing	Continuing

A. Mission Description and Budget Item Justification

The program develops and demonstrates advanced technologies for electro-optical sensors, radar sensors and electronic counter-countermeasures, and components and algorithms. It also develops and demonstrates radio frequency (RF) and electro-optical (EO) sensors for detecting, locating, and targeting airborne, fixed, and time-critical mobile ground targets obscured by natural or man-made means. This program develops the means to find, fix, target, track, and engage air and ground targets anytime, anywhere, and in any weather. This program has been coordinated through the Department of Defense Science and Technology Executive Committee process to harmonize efforts and eliminate duplication.

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, 0602601F, 0602602F, 0602605F, 0602788F, 1206601F, and 0602298F.

This program is in Budget Activity 3, Advanced Technology Development because this budget activity includes development of subsystems and components and efforts to integrate subsystems and components into system prototypes for field experiments and/or tests in a simulated environment.

B. Program Change Summary ($ in Millions)	FY 2017	FY 2018	FY 2019 Base	FY 2019 OCO	FY 2019 Total
Previous President's Budget	40.945	40.978	43.010	0.000	43.010
Current President's Budget	39.854	40.978	39.968	0.000	39.968
Total Adjustments	-1.091	0.000	-3.042	0.000	-3.042
• 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	-0.027	0.000			
• SBIR/STTR Transfer	-1.064	0.000			
• Other Adjustments	0.000	0.000	-3.042	0.000	-3.042

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 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603203F / *Advanced Aerospace Sensors*

Change Summary Explanation

Decrease in FY 2019 due to realignment of Sensors Science & Technology (S&T) Advanced Technology Development activities to Sensors S&T Applied Research.

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force			Date: February 2018
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603203F / *Advanced Aerospace Sensors*	Project (Number/Name) 63665A / *Advanced Aerospace Sensors 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
63665A: *Advanced Aerospace Sensors Technology*	-	16.711	19.734	19.992	0.000	19.992	21.277	21.324	21.750	21.970	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project area develops and demonstrates aerospace sensor and processing technologies for intelligence, surveillance, reconnaissance, target, and attack radar applications in both manned and unmanned platforms, including electro-optical sensors and electronic counter-countermeasures for radars. It provides aerospace platforms with the capability to precisely detect, track, and target both airborne (conventional and low radar cross-section) and ground-based, high-value, time-critical targets in adverse clutter and jamming environments. Project activities include developing multi-function radio-frequency systems including radar and electronic warfare technology and the position and timing information to enable distributed sensing. Desired warfighting capabilities include the ability to detect concealed targets in difficult background conditions.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
Title: Persistent Sensing in Contested Environment Technologies	2.016	2.381	2.412
Description: Develop active radio frequency sensor solutions to use against difficult-to-detect targets in challenging environments, and advanced RF architectures for open and reconfigurable systems. Enable persistent intelligence, surveillance and reconnaissance over wide areas, and detect advanced air and ground targets.			
FY 2018 Plans: Develop multichannel transmit and receive hardware for distributed multiple input multiple output applications. Explore methodologies for coherent signal processing modes supporting electronic support and passive radar receivers.			
FY 2019 Plans: Conduct controlled environment ground-based data collections to validate distributed coherent radar proof-of-concept at X and S-bands for synthetic aperture radar.			
FY 2018 to FY 2019 Increase/Decrease Statement: FY 2019 increased compared to FY 2018 by $0.031 million. Justification for this increase is described in plans above.			
Title: Passive Radio Frequency Sensing Technologies	3.780	4.464	4.523
Description: Develop advanced techniques and prototype passive radio frequency sensors to intercept, collect, locate and track enemy radio frequency sensor systems for intelligence, surveillance and reconnaissance of air and ground targets.			
FY 2018 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force		Date: February 2018
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603203F / *Advanced Aerospace Sensors*	**Project (Number/Name)** 63665A / *Advanced Aerospace Sensors Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
Conduct system engineering analysis to provide architectural trades and test criteria for multi-function passive radio frequency sensors at frequencies above 18 gigahertz (millimeter-wave) requiring increased sensitivity. ***FY 2019 Plans:*** Integrate millimeter-wave hardware and software radio frequency sensor suite for proof-of-concept to intercept, collect, locate and track evolving adversary air and ground sensor systems with evolving agile radio frequency signals of interest. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 increased compared to FY 2018 by $0.059 million. Justification for this increase is described in plans above.			
Title: Long Range Sensing Technologies ***Description:*** Develop radio frequency sensor technology to detect, locate, and identify air and ground targets at long ranges, including those that are low-observable, or use deception or camouflage. ***FY 2018 Plans:*** Extend open architecture constructs to incorporate electronic warfare and communication functions. Continue to develop radar systems and algorithms for multi-static cooperative radar to address the challenges of long stand-off radio frequency sensing in air and space domains. Collect multi-static data with cooperative targets to test algorithms. ***FY 2019 Plans:*** Integrate Passive Radar Illumination Selection Manager hardware and software and conduct data collection on a finite number of radio frequency emitters (cooperative/non-cooperative) and assess the utility of correlated multi-mode operation. Evaluate data collected from experiments that coordinate air and space radio frequency sensors for detection and location of air and ground radio frequency emitters. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 increased compared to FY 2018 by $0.029 million. Justification for this increase is described in plans above.	1.891	2.233	2.262
Title: Passive Electro-Optical Sensing for Surveillance and Reconnaissance Technologies ***Description:*** Advance, demonstrate, and transition innovative imaging and non-imaging optical sensing technologies for surveillance and reconnaissance of airborne and ground-based objects of interest in an anti-access/area denial environment. This effort includes the development of systems, subsystems, and components necessary to yield new capabilities. ***FY 2018 Plans:*** Complete construction of infrared search and track brassboard system and test under laboratory conditions. Modify as appropriate to meet performance goals. Refine and integrate advanced subsystem technology for infrared search and track systems. Test in a laboratory environment to enhance system and subsystem technology readiness level. Advance refinement	5.795	6.843	6.933

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force		Date: February 2018
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603203F / *Advanced Aerospace Sensors*	**Project (Number/Name)** 63665A / *Advanced Aerospace Sensors Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
of prototypes for low cost and low size, weight and power hyperspectral imaging to achieve operationally useful radiometric sensitivity, detection performance, and area coverage rates. Continue improvements in algorithms and software required for target detection and tracking and clutter suppression. Advance and refine engineering trades and system optimization for this novel approach, through modeling and simulation. Initiate refinement and prototyping of novel software/hardware combined sensing strategy for turbulence mitigation in passive electro-optical/infrared reconnaissance systems to improve the useful range beyond the current state of the art. Initiate examination of approaches and technologies to reduce size, weight and power of an infrared search and track system while maintaining operationally relevant performance. ***FY 2019 Plans:*** Complete focal plane and other component technologies to enhance performance of a staring infrared search and track architecture. Prepare for a flight test of a staring infrared search and track architecture. Continue examination of approaches and technologies to reduce size, weight and power of an infrared search and track system while maintaining operationally relevant performance. Continue improvements in algorithms and software required for target detection and tracking and clutter suppression. Test candidate systems and subsystems in a laboratory environment. Advance and refine engineering trades and system optimization for this novel approach, through modeling and simulation. Continue refinement and prototyping of novel software/hardware combined sensing strategy for turbulence mitigation in passive electro-optical/infrared reconnaissance systems to improve the useful range beyond the current state of the art. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 increased compared to FY 2018 by $0.090 million. Justification for this increase is described in plans above.			
Title: Laser Radar for Non-Cooperative Identification ***Description:*** Advance, demonstrate, and transition innovative laser radar sensing technologies for non-cooperative identification of airborne and ground objects of interest in an anti-access/area denial environment. This effort includes the development of systems, subsystems and components necessary to yield new capabilities. ***FY 2018 Plans:*** Complete further flight testing on a synthetic aperture laser radar system with component upgrades under more challenging atmospheric and target conditions. Continue atmospheric characterization, processing, and analysis of synthetic aperture ladar performance based on flight test data and model comparison. Refine and test synthetic aperture laser radar technology under development based on modeling and simulation to enhance spatial resolution beyond the diffraction limit of equivalent optical apertures. Fabricate, modify, and test critical components and subsystems for a synthetic aperture laser radar demonstration in a laboratory environment. Continue research on components needed for improving system capabilities to provide high confidence identification at standoff ranges. Integrate these technologies into a prototype architecture if judged sufficiently mature. Advance sensor automatic target recognition software by applying previous phenomenology research and advanced mathematical	3.229	3.813	3.862

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force		Date: February 2018
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603203F / *Advanced Aerospace Sensors*	**Project (Number/Name)** 63665A / *Advanced Aerospace Sensors Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
concepts to simulated and measured data. Continue emphasizing long range air-to-air laser radar concepts through modeling and simulation to support system design and analysis of alternatives. Prepare for future technology demonstrations to advance system, subsystem, and component technology readiness levels. ***FY 2019 Plans:*** Establish predictive synthetic aperture laser radar performance model based on measured data and theoretical modeling. Continue development and integration of enhanced components and subsystems. Demonstrate the associated improvement in performance in a laboratory environment. Refine and test holographic aperture laser radar technology under development based on modeling and simulation to enhance spatial resolution beyond the diffraction limit of individual optical apertures. Fabricate, modify, and test critical components and subsystems for a holographic aperture laser radar demonstration in a laboratory environment. Continue sensor automatic target recognition software by applying previous phenomenology research and advanced mathematical concepts. Continue emphasizing long range air-to-air laser radar concepts through modeling and simulation to support system design and analysis of alternatives. Prepare for future technology demonstrations to advance system, subsystem, and component technology readiness levels. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 increased compared to FY 2018 by $0.049 million. Justification for this increase is described in plans above.			
Accomplishments/Planned Programs Subtotals	16.711	19.734	19.992

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 / 3	R-1 Program Element (Number/Name) PE 0603203F / *Advanced Aerospace Sensors*	Project (Number/Name) 6369DF / *Target Attack and Recognition 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
6369DF: *Target Attack and Recognition Technology*	-	23.143	21.244	19.976	0.000	19.976	20.385	20.715	21.797	21.545	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project area develops and demonstrates advanced technologies for attack management, fire control, and target identification and recognition. This includes developing and demonstrating integrated and cooperative fire control techniques to provide for adverse-weather precision air strikes against multiple targets per pass and at maximum weapon launch ranges. Specific fire control technologies under development include attack management, sensor fusion, automated decision aids, advanced tracking for low radar cross section threats, and targeting using both on-board and off-board sensor information. This project area also evaluates targeting techniques to support theater missile defense efforts in surveillance and attack. These fire control technologies will provide force multiplication and reduce warfighter exposure to hostile fire. This project area also develops and demonstrates target identification and recognition technologies for positive, high confidence cueing, recognition, and identification of airborne and ground-based, high-value, time-critical targets at longer ranges than are currently possible. The goal is to apply these technologies to tactical air-to-air and air-to-surface weapon systems so they are able to operate in all weather conditions, during day or night, and in high-threat, multiple target environments. Model-based vision algorithms and target signature development techniques are the key to target identification and recognition. This project is maturing these technologies in partnership with the Defense Advanced Research Projects Agency and evaluating the techniques to support theater missile defense efforts in surveillance and attack. Fire control and recognition technologies developed and demonstrated in this project area are high leverage efforts, providing for significant advancements in operational capabilities largely through software improvements readily transitionable to new and existing weapon systems.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
Title: Integrated Sensor Targeting Technologies	4.283	3.932	3.697
Description: Develop an advanced suite of sensors with automatic target recognition, fusion, and target tracking, all working in concert to provide a high-confidence identification capability.			
FY 2018 Plans: Continue developing multi-intelligence detection for single named area of interest incorporating multiple weapons systems. Demonstrate closed loop sensor exploitation using deep reinforcement learning.			
FY 2019 Plans: Extend development of multi-intelligence detection for multiple named areas of interest in multiple areas of regard. Conduct laboratory test of task flexibility with payload management and knowledge reasoning with electronic support measure and intelligence, surveillance and reconnaissance. Initiate development of multi-platform resource management aggregate planning capability.			
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 / 3	**R-1 Program Element (Number/Name)** PE 0603203F / *Advanced Aerospace Sensors*	**Project (Number/Name)** 6369DF / *Target Attack and Recognition Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
FY 2019 decreased compared to FY 2018 by $0.235 million. Justification for this decrease is described in plans above.			
Title: Multi-Sensor Target Recognition ***Description:*** Develop and assess multi-sensor automatic target recognition for intelligence, surveillance, reconnaissance, strike, and weapon systems. ***FY 2018 Plans:*** Develop template based electro-optical full motion video automatic target recognition reference implementation. Initiate development of multi-sensor decision level fusion for stationary targets. ***FY 2019 Plans:*** Demonstrate flyable, real-time deep learning-based synthetic aperture radar target identification. Conduct large electro-optical data collection/characterization and assessment in conjunction with the National Geospatial-Intelligence Agency. Develop performance model for deep learning synthetic aperture radar target recognition. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 decreased compared to FY 2018 by $0.521 million. Justification for this decrease is described in plans above.	9.518	8.737	8.216
Title: Wide-Angle Continuously-Staring Technologies ***Description:*** Develop wide angle, continuous staring, multi-sensor/wavelength sensing and automated exploitation technology to detect, track, and identify targets over large areas at high sensor update rates. ***FY 2018 Plans:*** Continue development of stand-off (air and space) and episodic stand-in sensing capabilities for contested and denied environments. Demonstrate tracking, change detection, and image processing capabilities for data representative of contested and denied environments. Collect, process, and catalogue data from advanced wide-angle sensor. Develop feature aided tracking methods for wide angle radio frequency sensors. ***FY 2019 Plans:*** Continue development of stand-off (air and space) and episodic stand-in sensing capabilities for contested and denied environments. Continue to demonstrate tracking, change detection, and image processing capabilities for data representative of contested and denied environments. Collect, process, and catalogue data from advanced wide-angle sensor. Develop feature aided tracking methods for wide angle radio frequency sensors. Initiate multi-target tracking, improvement to three-dimensional radar products, and surrogate radar sensing capability. ***FY 2018 to FY 2019 Increase/Decrease Statement:***	9.342	8.575	8.063

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force		Date: February 2018
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603203F / *Advanced Aerospace Sensors*	**Project (Number/Name)** 6369DF / *Target Attack and Recognition Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
FY 2019 decreased compared to FY 2018 by $0.512 million. Justification for this decrease is described in plans above.			
Accomplishments/Planned Programs Subtotals	23.143	21.244	19.976

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.