Exhibit R-2, RDT&E Budget Item Justification: PB 2025 Air Force											Date: March 2024	
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602204F / *Aerospace Sensors*							
COST ($ in Millions)	**Prior Years**	**FY 2023**	**FY 2024**	**FY 2025 Base**	**FY 2025 OCO**	**FY 2025 Total**	**FY 2026**	**FY 2027**	**FY 2028**	**FY 2029**	**Cost To Complete**	**Total Cost**
Total Program Element	-	249.300	216.269	193.029	0.000	193.029	193.065	199.897	218.538	222.759	Continuing	Continuing
622002: *Electronic Component Technology*	-	71.879	50.368	50.392	0.000	50.392	40.958	35.284	39.122	39.882	Continuing	Continuing
622003: *EO Sensors & Countermeasures Tech*	-	26.870	26.838	25.965	0.000	25.965	26.525	26.725	29.216	29.785	Continuing	Continuing
622005: *Cyber Technology*	-	12.008	15.075	13.839	0.000	13.839	14.134	14.315	15.336	15.660	Continuing	Continuing
624920: *Electronic Warfare Technology*	-	43.391	41.944	40.981	0.000	40.981	41.878	42.209	46.231	47.140	Continuing	Continuing
626095: *Sensor Fusion Technology*	-	60.751	37.642	17.995	0.000	17.995	24.642	37.903	41.060	41.810	Continuing	Continuing
627622: *RF Sensors and Countermeasures Tech*	-	34.401	44.402	43.857	0.000	43.857	44.928	43.461	47.573	48.482	Continuing	Continuing

A. Mission Description and Budget Item Justification

This program develops the technology base for Air Force aerospace sensors and electromagnetic combat. Advances in aerospace sensors are required to increase combat effectiveness by providing anytime, anywhere surveillance, reconnaissance, precision targeting, and electromagnetic warfare (EW) capabilities. To achieve this progress, this program pursues simultaneous advances in: 1) generating, controlling, receiving, and processing electronic and photonic signals for radio frequency (RF) sensor aerospace applications; 2) electro-optical (EO) and infrared (IR) aerospace sensor technologies for a variety of offensive and defensive uses; 3) radio frequency antennas and associated electronics for airborne and space surveillance, together with active and passive electro-optical/infrared sensors; 4) technologies to manage and fuse on-board sensor information for timely, comprehensive situational awareness; 5) technology for affordable, trusted, resilient, and reliable, all-weather surveillance, reconnaissance, and precision strike radio frequency sensors and electronic combat systems; and 6) technologies that aid in the development of agile and resilient mission systems. This program has been coordinated through the Department of Defense Science and Technology Executive Committee process to harmonize efforts and eliminate duplication.

Funds in this program element may be used to investigate specified technology advancements in multiple domains.

This program element may include necessary expenses to support the operation and maintenance of facilities to manage, execute, and deliver science and technology capabilities

Exhibit R-2, RDT&E Budget Item Justification: PB 2025 Air Force	Date: March 2024
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602204F / *Aerospace Sensors*

This program element may include necessary civilian pay expenses required to manage, execute, and deliver science and technology capabilities. The use of program funds in this PE would be in addition to the civilian pay expenses budgeted in program elements 0601102F, 0602020F, 0602102F, 0602201F, 0602202F, 0602203F, 0602602F, 0602605F, 0602788F, 1206601SF, 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.

B. Program Change Summary ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
Previous President's Budget	260.833	216.269	209.316	0.000	209.316
Current President's Budget	249.300	216.269	193.029	0.000	193.029
Total Adjustments	-11.533	0.000	-16.287	0.000	-16.287
• 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	-3.824	0.000			
• Other Adjustments	-7.709	0.000	-16.287	0.000	-16.287

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2023	FY 2024
Project: 622002: *Electronic Component Technology*		
Congressional Add: *Program increase: low cost sensors for UAVs*	4.926	-
Congressional Add: *Program increase: Zero-trust environment for semiconductor technology*	9.853	-
Congressional Add: *Heterogeneous integration of microelectronics*	4.926	-
Congressional Add: *Field programmable gate arrays*	6.897	-
Congressional Add: *Reliability of combat cloud communications systems*	6.897	-
Congressional Add Subtotals for Project: 622002	33.499	-
Project: 622005: *Cyber Technology*		
Congressional Add: *Automated legacy code modernization*	4.039	-
Congressional Add Subtotals for Project: 622005	4.039	-

Exhibit R-2, RDT&E Budget Item Justification: PB 2025 Air Force	Date: March 2024
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602204F / *Aerospace Sensors*

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2023	FY 2024
Project: 626095: *Sensor Fusion Technology*		
Congressional Add: *Cyber kinetic combat environment*	29.556	-
Congressional Add Subtotals for Project: 626095	29.556	-
Congressional Add Totals for all Projects	67.094	-

Change Summary Explanation

Decrease in FY 2025 funding is due to re-prioritization to meet the nation's future security needs.

Exhibit R-2A, RDT&E Project Justification: PB 2025 Air Force			Date: March 2024
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602204F / *Aerospace Sensors*	Project (Number/Name) 622002 / *Electronic Component Technology*	

COST ($ in Millions)	Prior Years	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total	FY 2026	FY 2027	FY 2028	FY 2029	Cost To Complete	Total Cost
622002: *Electronic Component Technology*	-	71.879	50.368	50.392	0.000	50.392	40.958	35.284	39.122	39.882	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project focuses on electronics and optoelectronics technologies that generate, control, receive, and process electromagnetic spectrum for aerospace sensor and electronic warfare applications. The enabling technologies developed under this project will be used for intelligence, surveillance, reconnaissance, electromagnetic warfare, battlespace access, and precision engagement capabilities. The technologies developed include exploratory electronic and optoelectronic devices, components, microsystems, and subsystems.

This project also assesses designs, develops, fabricates, and demonstrates the associated technologies for integrating combinations of these component technologies. The project demonstrates significantly smaller size, lower weight, lower cost, lower power dissipation, higher reliability, trustworthiness, and improved performance. The device and subsystem technology developments under this project are military unique; they are based on Department of the Air Force and other Department of Defense weapon systems requirements in the areas of radar, communications, electromagnetic warfare, positioning, navigation, timing, and smart weapons.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: Sensor Subsystems	6.970	8.631	8.740
Description: Develop, analyze, demonstrate, and perform engineering trade studies for technologies for compact, affordable, multi-function subsystems for aerospace sensors. ***FY 2024 Plans:*** Continue research into autonomous low size, weight and power sensor processing. Continue research into digital at every element technology for multifunction microwave and millimeter wave arrays. Continue development of low size weight and power wideband multifunction radio frequency sensor subsystem suitable for Group 4 unmanned aircraft system operation. Continue millimeter wave digital array demonstrations. Continue wideband phased array emulation utilizing digital beamforming demonstrator. Initiate system build phase for multifunction wideband digital active electronically scanned array. ***FY 2025 Plans:*** - Continue research into autonomous low size, weight, and power sensor processing. - Continue research into digital at every element technology for multifunction microwave and millimeter wave arrays. - Continue development of low size weight and power wideband multifunction radio frequency sensor subsystem suitable for Group 4 uncrewed aircraft system operation. - Continue millimeter wave digital array demonstrations. - Continue wideband phased array emulation utilizing digital beamforming demonstrator.			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Air Force		Date: March 2024
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602204F / *Aerospace Sensors*	**Project (Number/Name)** 622002 / *Electronic Component Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
- Continue system build phase for multifunction wideband digital active electronically scanned array. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** FY 2025 increased compared to FY 2024 by $0.109 million. Justification for this increase is described in plans above.			
Title: Electronic Devices ***Description:*** Assess, research, develop, demonstrate and transition revolutionary and evolutionary electronic devices and their associate technologies. ***FY 2024 Plans:*** Continue modeling efforts on integrated chip-level radio frequency device, power conversion modeling, and predictive analysis using higher order harmonics. Continue development of wide bandgap device and power conversion integration technologies. Continue demonstration of high efficiency microwave power modules with integrated high speed power conversion switching. Continue development of high frequency characterization capability and evaluation of next generation wide bandgap radio frequency materials. ***FY 2025 Plans:*** - Complete modeling efforts on integrated chip-level radio frequency device, power conversion modeling, and predictive analysis using higher order harmonics. - Continue development of wide bandgap device and power conversion integration technologies. - Continue demonstration of high efficiency microwave power modules with integrated high speed power conversion switching. - Continue development of high frequency characterization capability and evaluation of next generation wide bandgap radio frequency materials. - Initiate advanced wide-bandgap demonstration. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** FY 2025 increased compared to FY 2024 by $0.016 million. Justification for this increase is described in plans above.	6.306	8.411	8.427
Title: Photonic Components and Circuits ***Description:*** Research, develop, demonstrate and transition photonic, electro-optical, and infrared components for next generation intelligence, surveillance, reconnaissance and countermeasures. In FY 2025 this effort was renamed from Electro-Optical/Infrared (EO/IR) Components to Photonic Components and Circuits. ***FY 2024 Plans:***	6.796	9.550	9.500

Exhibit R-2A, RDT&E Project Justification: PB 2025 Air Force		Date: March 2024
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602204F / *Aerospace Sensors*	**Project (Number/Name)** 622002 / *Electronic Component Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Continue photonic and quantum substructure technology development. Continue research into non-linear devices for tunablity and power scaling. Continue development of high power, narrow line width lasers sources for advanced sensing and countermeasure applications. Continue laser component packaging for laser detection and ranging. ***FY 2025 Plans:*** - Continue photonic and quantum substructure technology development. - Continue research into non-linear devices for tunablity and power scaling - Continue development of high power, narrow line width lasers sources for advanced sensing and countermeasure applications. - Continue laser component packaging for laser detection and ranging. - Initiate development of chip-scale photonic/electronic wideband transceiver components. - Initiate resilient and assured optoelectronic/infrared and photonic analysis. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** FY 2025 decreased compared to FY 2024 by $0.050 million. Justification for this decrease is described in plans above.			
Title: Trusted and Assured Electronics	8.286	10.781	15.942
Description: Investigate and develop designs of resilient and assured electronic systems that enable revolutionary capabilities for the Department of the Air Force, assure operational mission systems, and impede unwanted technology transfer thus enabling timely adoption and integration of commercial solutions with government-off-the-shelf microelectronic technologies. Areas of development include: multi-function radio frequency and electro-optical subsystems, advanced electronic materials, on-board sensor processing, high-frequency power modules, and resilient, assured, and reliable electronics. ***FY 2024 Plans:*** Continue development of prototype trustworthiness assessment capability. Continue reliability assessments of advanced heterogeneously integrated microsystems. Continue verification and validation of security techniques and methodologies for integrated circuit designs. Continue disaggregated multi chip System in Package demonstration using fine pitch for assurance. Initiate application of trust in design to digital engineering and virtual prototyping for assured design. In FY 2024 this effort was renamed from Trusted Electronics for Intelligence, Surveillance, Reconnaissance and Avionics Mission Systems to Trusted and Assured Electronics. ***FY 2025 Plans:*** - Continue development of prototype trustworthiness assessment capability and advanced exploitation tool development to assess modern threat capability. - Continue reliability assessments of advanced heterogeneously integrated microsystems. - Continue verification and validation of security techniques and methodologies for integrated circuit designs. - Continue disaggregated multi-chip System in Package demonstration using fine pitch for assurance.			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Air Force		Date: March 2024
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602204F / *Aerospace Sensors*	**Project (Number/Name)** 622002 / *Electronic Component Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
- Initiate application of digital engineering and virtual prototyping to develop resilience and assurance techniques for microelectronic designs. - Continue protective technology development for integration of commercial and government technologies for sensors and sensor systems to deter reverse engineering and exploitation of critical hardware and software to impede unwanted technology transfer, alteration of system capability, or development of countermeasures to our systems. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** FY 2025 increased compared to FY 2024 by $5.161 million. This is a result of realignment of funding and technical work from Program Aerospace Sensors, 0602204F; Project Electronic Component Technology, 622002; Microelectronics & Embedded System Assurance effort to this effort.			
Title: Advanced Highly Integrated Microsystems for Intelligence, Surveillance, Reconnaissance and Electronic Warfare ***Description:*** Perform research and development of electronic circuit and microsystem technologies focused on miniaturization, power reduction, reconfigurability and reduced cost. ***FY 2024 Plans:*** Continue development of next generation reconfigurable transceiver. Continue development of microsystem integration solutions that integrate advanced components and thermal management technologies for cost, size, weight and power constrained microwave and millimeter wave applications. Continue development of chip-scale photonic/electronic wideband transceiver components. Continue development of high-Q passive components for heterogeneous integration. Continue identification of application areas and development of heterogeneous integration concepts. ***FY 2025 Plans:*** - Complete development of next generation reconfigurable transceiver. - Continue development of chip-scale photonic/electronic wideband transceiver components. - Complete identification of application areas and development of heterogeneous integration concepts. - Continue development of microsystem integration solutions that integrate advanced components and thermal management technologies for cost, size, weight and power constrained microwave and millimeter wave applications. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** FY 2025 increased compared to FY 2024 by $0.010 million. Justification for this increase is described in plans above.	5.798	7.773	7.783
Title: Microelectronics & Embedded System Assurance ***Description:*** Investigate and develop microelectronics security technologies to impede unwanted technology transfer and enable timely adoption of commercial and government-off-the-shelf microelectronic technologies that enable revolutionary capabilities for the Air Force.	4.224	5.222	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2025 Air Force		Date: March 2024
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602204F / *Aerospace Sensors*	**Project (Number/Name)** 622002 / *Electronic Component Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
FY 2024 Plans: Continue development of techniques to deter reverse engineering and exploitation of critical program information. Continue advanced exploitation tool development to assess modern threat capability. Initiate protective technology development for sensors and sensor systems. This may involve commercial and government technologies to deter reverse engineering and unwanted technology transfer, alteration of system capability, and prevent development of countermeasures. ***FY 2025 Plans:*** In FY 2025 funding from this effort was realigned to Program Aerospace Sensors, 0602204F; Project Electronic Component Technology, 622002; Trusted and Assured Electronics effort. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** FY 2025 decreased compared to FY 2024 by $5.222 million. This is a result of realignment of funding from this project to Program Aerospace Sensors, 0602204F; Project Electronic Component Technology, 622002; Trusted and Assured Electronics effort.			
Accomplishments/Planned Programs Subtotals	38.380	50.368	50.392

	FY 2023	FY 2024
Congressional Add: Program increase: low cost sensors for UAVs ***FY 2023 Accomplishments:*** Conduct Congressional directed efforts	4.926	-
Congressional Add: Program increase: Zero-trust environment for semiconductor technology ***FY 2023 Accomplishments:*** Conduct Congressional directed efforts	9.853	-
Congressional Add: Heterogeneous integration of microelectronics ***FY 2023 Accomplishments:*** Conduct Congressional directed efforts	4.926	-
Congressional Add: Field programmable gate arrays ***FY 2023 Accomplishments:*** Conduct Congressional directed efforts	6.897	-
Congressional Add: Reliability of combat cloud communications systems ***FY 2023 Accomplishments:*** Conduct Congressional directed efforts	6.897	-
Congressional Adds Subtotals	33.499	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

Exhibit R-2A, RDT&E Project Justification: PB 2025 Air Force		Date: March 2024
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602204F / *Aerospace Sensors*	**Project (Number/Name)** 622002 / *Electronic Component Technology*

D. Acquisition Strategy

Not applicable

Exhibit R-2A, RDT&E Project Justification: PB 2025 Air Force			Date: March 2024
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602204F / *Aerospace Sensors*	Project (Number/Name) 622003 / *EO Sensors & Countermeasures Tech*	

COST ($ in Millions)	Prior Years	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total	FY 2026	FY 2027	FY 2028	FY 2029	Cost To Complete	Total Cost
622003: *EO Sensors & Countermeasures Tech*	-	26.870	26.838	25.965	0.000	25.965	26.525	26.725	29.216	29.785	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops advanced electro-optical aerospace sensor technologies for a variety of offensive and defensive applications. The sensor technologies under development cover the ultraviolet through the infrared portion of the spectrum. Technical efforts include improvements in system integration, digital processing, analysis tools, and sensor architectures. One of the project's goals is to improve electro-optical and related technologies for the detection, tracking, and identification of non-cooperative and difficult targets, such as those obscured by camouflage or operating at significant range. This project also develops the passive and active sensors and algorithms needed to enable precision targeting in challenging operating environments as well as advanced electro-optical threat warning and countermeasures technologies. These technologies are critical to future aerospace surveillance and targeting.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: Passive Electro-Optical/Infrared Sensing in Contested Environments	13.153	12.960	12.248
Description: Develop innovative passive optical sensing technology to support surveillance, reconnaissance and targeting in contested environments. Develop high performance cameras, aperture technologies, novel sensing architectures, advanced exploitation, and imaging techniques capable of detection, tracking and identification of multi-domain threats.			
FY 2024 Plans: Continue development of advanced processing algorithms for hyperspectral imaging. Continue development of low-earth orbit sensing systems for critical Department of the Air Force needs, including event-based sensors and passive interferometry. Continue development of large format, long wave infrared detector array for infrared search and track in preparation for future testing. Continue development of low size, weight and power processor for infrared search and track.			
FY 2025 Plans: - Complete development of baseline advanced processing algorithms for hyperspectral imaging. Initiate development of thermal infrared hyperspectral technologies to enable day/night capability. - Complete development of multi-domain sensing systems for critical Department of the Air Force needs, including visible-band event-based sensors and passive interferometry. - Continue development of novel multi-domain sensing concepts, including infrared event-based sensors and motion target indicator technology. - Complete development of large format, long wave infrared detector array for infrared search and track and perform system testing. - Complete development of low size, weight and power processor for infrared search and track.			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Air Force		Date: March 2024
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602204F / *Aerospace Sensors*	**Project (Number/Name)** 622003 / *EO Sensors & Countermeasures Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
- Initiate development of low size, weight and power infrared search and track sensors. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** FY 2025 decreased compared to FY 2024 by $0.712 million. Justification for this decrease is described in plans above.			
Title: Laser Radar Sensing in Contested Environments ***Description:*** Develop innovative laser sensing technology for non-cooperative identification and targeting of airborne and surface targets in contested environments. Develop optical spectrum transmitters, detectors, agile aperture and exploitation technologies capable of sensing multiple target characteristics for robust non-cooperative target identification. ***FY 2024 Plans:*** Initiate multi-mode laser radar system demonstration for attritable platforms and benchmark model with collected data, including validation of data processing algorithms. Initiate effort to reduce size, weight, and power of laser radar systems. Continue development of processing software for multi-mode laser radar with a focus on processing efficiency. Initiate work on non-mechanical beam steering methods for optical apertures. Continue designing large aperture laser radar for high-resolution imaging needs, with a focus on improving performance post demonstration, while working with customers to investigate transition potential of existing designs. ***FY 2025 Plans:*** - Complete multi-mode laser radar system demonstration and validation for attritable platforms. - Complete effort to reduce size, weight, and power of laser radar systems. - Continue development of processing software for multi-mode laser radar with a focus on processing efficiency. - Complete work on nonmechanical beam steering methods for optical apertures. - Complete designing large aperture laser radar for high-resolution imaging needs. - Initiate effort to improve performance, size, weight and power of laser radar components. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** FY 2025 decreased compared to FY 2024 by $0.161 million. Justification for this increase is described in plans above.	13.717	13.878	13.717
Accomplishments/Planned Programs Subtotals	26.870	26.838	25.965

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

Exhibit R-2A, RDT&E Project Justification: PB 2025 Air Force		Date: March 2024
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602204F / *Aerospace Sensors*	**Project (Number/Name)** 622003 / *EO Sensors & Countermeasures Tech*

D. Acquisition Strategy

Not applicable

Exhibit R-2A, RDT&E Project Justification: PB 2025 Air Force			Date: March 2024
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602204F / *Aerospace Sensors*	Project (Number/Name) 622005 / *Cyber Technology*	

COST ($ in Millions)	Prior Years	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total	FY 2026	FY 2027	FY 2028	FY 2029	Cost To Complete	Total Cost
622005: *Cyber Technology*	-	12.008	15.075	13.839	0.000	13.839	14.134	14.315	15.336	15.660	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project focuses on technologies for enabling agile and resilient Air Force mission systems. This project improves our understanding of cyber vulnerabilities of mission systems by investigating the fundamental nature of those vulnerabilities including: how they come about, how they can be discovered, how they can be quantified and categorized, how they can be exploited, and how they can be removed or mitigated to secure the system. This project develops adaptable and resilient hardware/software for real-time avionics cyber-attack pattern recognition and develops a protection system with the capability for autonomous learning, adaptation, and self-protection. This project investigates open architecture concepts and technologies to deliver capability flexibility to Department of the Air Force mission systems. These technologies are matured via integrated capability demonstrations.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: Flexible and Secure Avionics	7.969	15.075	13.839
Description: Develop avionics protection tools and capabilities to enable manned and unmanned aircraft, avionics, and related support equipment to automatically adapt to and withstand cyber attacks. Research and develop tools, methodologies and architecture guidelines that enable the design of avionics systems with sense, learn and adapt capabilities. Support test, maintenance, and acquisition communities with cyber subject matter expertise and techniques through consultation and technical interchange. Support other Services with cyber resiliency capabilities for air, ground and sea platforms and develop Open Mission Systems architectures incorporating cyber protections and resilience technologies.			
FY 2024 Plans: Continue investigation and development of techniques to enable resilient cyber protections for mission systems. Continue laboratory demonstrations on flight worthy hardware. Share expertise with other services and test, maintenance, and acquisition communities. Continue investigating protection technologies applied to open system architectures to enable resilience in next-generation mission systems and facilitate agility in mission system capability. Continue development of advanced modular architecture for agile avionics mission systems. Initiate investigation of model-based systems engineering applications to improve agility and resiliency of legacy and next-generation avionics mission systems architectures. Leverage models and open system architecture standards to quicken integration and transition of critical sensors technology.			
FY 2025 Plans: - Continue investigation and development of techniques to enable resilient cyber protections for mission systems. - Continue laboratory demonstrations on flight worthy hardware. - Share expertise with other services and test, maintenance, and acquisition communities. - Continue investigating protection technologies applied to open system architectures to enable resilience in next-generation mission systems and facilitate agility in mission system capability.			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Air Force		Date: March 2024
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602204F / *Aerospace Sensors*	**Project (Number/Name)** 622005 / *Cyber Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
- Continue development of advanced modular architecture for agile avionics mission systems. - Continue investigation of model-based systems engineering applications to improve agility and resiliency of legacy and next-generation avionics mission systems architectures. - Continue to leverage models and open system architecture standards to quicken integration and transition of critical sensors technology. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** FY 2025 decreased compared to FY 2024 by $1.236 million. Decrease is a result of decreased emphasis on the investigations into, and utility of, legacy avionics systems.			
Accomplishments/Planned Programs Subtotals	7.969	15.075	13.839

	FY 2023	FY 2024
Congressional Add: Automated legacy code modernization	4.039	-
FY 2023 Accomplishments: Conduct Congressional directed efforts		
Congressional Adds Subtotals	4.039	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable

Exhibit R-2A, RDT&E Project Justification: PB 2025 Air Force											Date: March 2024	
Appropriation/Budget Activity 3600 / 2					R-1 Program Element (Number/Name) PE 0602204F / *Aerospace Sensors*				Project (Number/Name) 624920 / *Electronic Warfare Technology*			
COST ($ in Millions)	**Prior Years**	**FY 2023**	**FY 2024**	**FY 2025 Base**	**FY 2025 OCO**	**FY 2025 Total**	**FY 2026**	**FY 2027**	**FY 2028**	**FY 2029**	**Cost To Complete**	**Total Cost**
624920: *Electronic Warfare Technology*	-	43.391	41.944	40.981	0.000	40.981	41.878	42.209	46.231	47.140	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops and assesses affordable, reliable, all weather radio frequency countermeasure concepts for aerospace applications covering the range of radio frequency sensors including communications, navigation, intelligence, surveillance and reconnaissance (ISR), and radar, both active and passive, across the air, land, sea, space and cyber domains. It develops and evaluates technology for electronic warfare, integrated radar and electronic warfare systems, and electro-optical/ infrared seeker defeat. This project develops the radio frequency warning and countermeasure technology for advanced electronic warfare and information operations applications. The project also explores technologies to maintain a military advantage in positioning, navigation and timing integrity, accuracy, and resiliency as well as on aircraft mission assurance - the protection of airborne platforms, manned and unmanned, in contested environments. The ultimate goal of the project is to ensure unrestricted access to the airspace and the electromagnetic spectrum in contested and congested environments.

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2023**	**FY 2024**	**FY 2025**
Title: Positioning, Navigation and Timing in Contested/Denied Environments	13.165	13.204	12.875
Description: Develop resilient positioning, navigation and timing science and technologies. Explore positioning, navigation and timing solutions to enable novel distributed radio frequency sensing and countermeasure techniques. Science and Technology being developed feed capabilities that overcome evolving positioning, navigation, and timing threats.			
FY 2024 Plans: Continue research and demonstrations of integrated positioning, navigation and timing alternatives to satellite navigation aiding of inertial measurement units. Such environmentally sensed alternatives include radio frequency signals of opportunity, magnetic gradient sensing, and sensor derived vision aiding. Continue developing technologies to support airborne precise time and frequency transfer in contested environments, to enable missions such as coherent sensing (intelligence, surveillance, reconnaissance), coherent effects (electromagnetic warfare), and operational concepts such as the Air Battle Management System. Continue developing and demonstrating trust techniques and operational concepts such as distribution of trusted satellite trajectories/information to enable blue force use of foreign satellite navigation signals. Continue research of software defined antenna electronics to complement software defined navigation receiver efforts. Continue to explore advanced algorithms for software defined navigation.			
FY 2025 Plans: - Continue research and demonstrations of integrated positioning, navigation, and timing alternatives of advanced satellite navigation user equipment and alternatives to satellite navigation; alternatives to satellite navigation include environmentally sensed magnetic gradient sensing & map generation, and sensor-derived vision aiding and wide-area vision position acquisition.			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Air Force		Date: March 2024
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602204F / *Aerospace Sensors*	**Project (Number/Name)** 624920 / *Electronic Warfare Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
- Continue developing technologies to support airborne precise time and frequency transfer in contested environments, to enable missions such as coherent sensing (intelligence, surveillance, reconnaissance), coherent effects (electromagnetic warfare), and operational concepts such as the Air Battle Management System. - Continue developing and demonstrating trust techniques and apply to Global Navigation Satellite System-based software defined receivers. - Continue research, and initiate development, of software defined antenna electronics; including implementation of advanced techniques on reference hardware. - Continue to explore advanced algorithms for software defined navigation. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** FY 2025 decreased compared to FY 2024 by $0.329 million. Justification for this decrease is described in plans above.			
Title: Radio Frequency Electronic Warfare Technologies	23.554	22.089	21.587
Description: This project develops the radio frequency warning and countermeasure technology for advanced electromagnetic warfare and information operations applications. This project develops techniques and technologies to detect and counter the communications links and sensors of threat integrated air defense systems and hostile command and control networks. ***FY 2024 Plans:*** Continue to develop, assess and mature radio frequency electromagnetic warfare technologies to identify, address, and reason about capabilities and intentions of complex emitters in contested environments. Expand specific threat identification to generalized techniques and logic, evolving traditional strategies towards adaptive capabilities that lead towards autonomous implementation for optimized response at tactically relevant timescale. Continue to develop and mature capabilities to defeat advanced radio frequency and multi-spectrum (integrated electro-optical and radio frequency) threats utilizing a common architecture that will feed into multiple advanced technology development programs. Initiate development of radio frequency environment signal based simulations that are moving towards a modular open systems approach. Continue to enhance and upgrade hardware in the loop assessment capabilities to keep pace with complex electromagnetic spectrum background environments and emerging threats. Continue robust modeling, simulation, and assessment capability, completing an effort looking at a particular advanced threat kill chain defeat concept. ***FY 2025 Plans:*** - Continue to develop, assess, and mature radio frequency electromagnetic warfare technologies to identify, address, and reason about capabilities and intentions of complex emitters in contested environments; enhance generalized techniques and logic to strengthen adaptive capabilities that lead towards autonomous implementation for optimized response at tactically relevant timescale.			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Air Force		Date: March 2024
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602204F / *Aerospace Sensors*	**Project (Number/Name)** 624920 / *Electronic Warfare Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
- Continue to develop and mature capabilities to defeat advanced radio frequency and multi-spectrum (integrated electro-optical and radio frequency) threats utilizing a common architecture that will feed into multiple advanced technology development programs. - Continue development of radio frequency environment signal-based simulations utilizing a modular open systems approach. - Continue to enhance and upgrade hardware in the loop assessment capabilities to keep pace with complex electromagnetic spectrum background environments and emerging threats. - Continue robust modeling, simulation, and assessment capabilities to analyze and develop advanced threat kill web defeat concepts. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** FY 2025 decreased compared to FY 2024 by $0.502 million. Justification for this decrease is described in plans above.			
Title: Electro-Optical/Infrared Threat Warning and Countermeasures Technologies	6.672	6.651	6.519
Description: Develop electro-optical/infrared sensor countermeasure technologies. Explore novel concepts to enable electro-optical/infrared threat seeker exploitation and surrogate modeling. Conduct fundamental research in countermeasures to defeat electro-optical/infrared threat seekers. Conduct fundamental research on integrated electro-optical/infrared threat warning systems. ***FY 2024 Plans:*** Continue protection of aircraft and aircrew against advanced electro-optical/infrared guided threats by developing new or improved threat detection and countermeasure techniques. Continue investigate long-range missile warning and develop laser warning technology concepts to improve aircraft and aircrew survivability. Continue to validate threat warning results and missile signature modeling using data collected in live fire tests. Continue developing the digital engineering ecosystem to create/improve countermeasure techniques and evaluate novel infrared countermeasures system concepts. Continue the perform verification and validation activities on digital twin models within this digital ecosystem by collecting data in static flight tests, laboratory measurement, and peer assessments. Continue development and usage of threat surrogates to gain technical knowledge of future and emerging threats. Continue development of digital engineering components for electro-optical/infrared/radio frequency multi-spectrum threat assessment. ***FY 2025 Plans:*** - Continue protection of aircraft and aircrew against advanced electro-optical/infrared guided threats by developing new or improved threat detection and countermeasure techniques. - Continue investigation of long-range missile warning and develop laser warning technology concepts to improve aircraft and aircrew survivability. - Continue to validate threat warning results and missile signature modeling using data collected in live-fire tests.			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Air Force		Date: March 2024
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602204F / *Aerospace Sensors*	**Project (Number/Name)** 624920 / *Electronic Warfare Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
- Continue developing the digital engineering ecosystem to create/improve countermeasure techniques and evaluate novel infrared countermeasures system concepts. - Continue to perform verification and validation activities on digital twin models within this digital ecosystem by collecting data in static flight tests, laboratory measurements, and peer assessments. - Strengthen development and usage of threat surrogates to gain technical knowledge of future and emerging threats. - Continue development of digital engineering components to expand electro-optical and infrared models and information to enhance multi-spectrum threat assessment and develop advanced threat kill web defeat concepts. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** FY 2025 decreased compared to FY 2024 by $0.132 million. Justification for this decrease is described in plans above.			
Accomplishments/Planned Programs Subtotals	43.391	41.944	40.981

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable

Exhibit R-2A, RDT&E Project Justification: PB 2025 Air Force			Date: March 2024
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602204F / *Aerospace Sensors*	Project (Number/Name) 626095 / *Sensor Fusion Technology*	

COST ($ in Millions)	Prior Years	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total	FY 2026	FY 2027	FY 2028	FY 2029	Cost To Complete	Total Cost
626095: *Sensor Fusion Technology*	-	60.751	37.642	17.995	0.000	17.995	24.642	37.903	41.060	41.810	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops foundational and applied technologies required for closed-loop autonomous sensing employing multiple information domains, diverse sensor phenomena, and multiple platform types to provide intelligence, surveillance, and reconnaissance; target recognition; situational awareness and battlespace visualization; fire control; and battle damage assessment capabilities against a wide variety of air and ground based targets engaged in multitudes of behaviors in a broad range of operational environments. This project conducts exploratory and applied investigations to determine technology feasibility and estimate operational capability constraints associated with missions in future contested and highly contested operating environments, using cooperative and non-cooperative sensing sources. This project develops techniques to automate multi-sensor exploitation and information processing which leverage data fusion, adaptive signal processing, sensor and platform orchestration, leveraging artificial intelligence / machine learning research communities. This project develops concepts and algorithms for efficient processing at the edge, parallel processing, distributed processing, and high-performance computing in sensor data processing and synthetic data generation.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: Battlespace Awareness Sensing Fusion	14.757	18.912	9.033
Description: Develop novel techniques for behavioral and physical knowledge generation from multiple sensors, intelligence sources, domains and sources to include algorithm development, assessment, and experiments across multiple distributed, homogeneous and heterogeneous sensors and platforms. This effort will focus on technology areas of data association, entity detect/track/identification, information fusion, training with limited data, and data/performance modeling. The application of machine learning techniques to address technical challenges in contested environments is a particular emphasis.			
FY 2024 Plans: Initiate a system of systems construct, bringing opportunistic sensing capabilities to tactical edge information integration. Continue generating knowledge through fusion of multiple spatial and temporal sensors, improving the state of the art in fusion exploitation. Continue to provide solutions for contested environments wherein data is extremely limited. Continue to apply novel state of the art deep and machine learning techniques to the recognition of stationary and moving objects in air/ground/surface based systems, pattern of life understanding, applying advanced information understanding tools and emerging techniques, over a broad set of sensing operating conditions. Continue advancing research techniques learned in air/space to ground application; where applicable expand sensing domain to include surface. Continue investigating fusion of hard and soft information sources for military relevant applications. Continue improving the time between development and demonstration of integration capabilities with a development, secure, operations and algorithm containerization. Initiate a research and development push to standardized			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Air Force		Date: March 2024
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602204F / *Aerospace Sensors*	**Project (Number/Name)** 626095 / *Sensor Fusion Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
integration environments and expand simulation capabilities to estimate performance across a wide spectrum of operating conditions. ***FY 2025 Plans:*** - Continue a system of systems construct utilizing the latest in DevSecOps and Open Mission Standards to generate capability at the tactical edge. - Continue to generate knowledge through multiple spatial and temporal sensing systems through improved information fusion. - Continue to research solutions in a train/test data limited environment. - Continue to leverage state of the art algorithm techniques leveraging artificial intelligence with deep learning and machine learning. - Continue to exploit stationary and moving objects of interest in multiple domains by way of pattern of life understanding, applying next-generation information understanding tools and emerging techniques, over a broad set of sensing operating conditions. - Continue to advance research in multi-domain sensing applied to air, ground and surface targets. - Continue to improve fusion of hard and soft information sources. - Continue to improve the amount of time required to move research from basic to applied to advanced demonstrations. - Continue to standardize integration environments, expand simulation capabilities and investigate model-based systems engineering best practices. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** FY 2025 decreased compared to FY 2024 by $9.879 million due to re-prioritization to meet the nation's future security needs.			
Title: Multi-Domain Sensing Effects and Analysis	3.192	3.948	1.871
Description: This effort focuses on two primary areas: (1) Multi domain sensing and effects mission analysis and (2) performance understanding and assessments. It develops methodologies and modeling, simulation, and analysis tools to enable multi-domain analysis and technology development, informing other efforts and projects across the directorate. Investments in modeling, simulation and analysis represent current and next generation sensing platforms to include multiple domains. Technologies include: fusion of information, battlespace understanding, and the ability to simulate sensor and platform performance at the mission level, engagement level, and physics level, to understand performance and trade space amongst these domains. ***FY 2024 Plans:*** Continue development of autonomy performance evaluation techniques adapted to specific artificial intelligence and machine learning challenges. Continue to perform empirical performance estimation for intelligence, surveillance, and reconnaissance automated sensing exploitation of military-critical targets with limited training data. Continue the employment of data as-a-service research environment across unclassified to classified networks, leveraging research cluster compute, cloud environments and high-performance compute facilities, further enabling sensing autonomy developers and warfighting analysts. Continue the transition to defense applications data tagging and automated data availability architecture to a service-wide application along			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Air Force		Date: March 2024
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602204F / *Aerospace Sensors*	**Project (Number/Name)** 626095 / *Sensor Fusion Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
with our intelligence community partners. Continue the transition of test and evaluation harness software to department-wide performance analysis community, leveraging standardize test metrics and performance measurement understanding. ***FY 2025 Plans:*** - Continue development of performance evaluation techniques addressing both single-intelligence sensing systems as well as closed-loop systems-of-systems. - Continue to perform empirical performance measurements in addition to performance prediction estimates for automated/ autonomous intelligence, surveillance and reconnaissance exploitation systems of military-critical targets with limited train and test data. - Continue the employment of data-as-a-service research environment across unclassified and classified networks. - Continue to leverage cluster compute, cloud compute, and high-performance compute facilities to enable autonomy developers and warfighting analysts. - Continue to transition to defense applications, data tagging, automated data availability architecture in a service-wide application along with our intelligence community partners. - Continue the development of the test and evaluation test harness for department-wide evaluation analysis community leveraging standardized test metrics and performance measurement understanding. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** FY 2025 decreased compared to FY 2024 by $2.077 million due to re-prioritization to meet the nation's future security needs.			
Title: Knowledge and Execution Management ***Description:*** This effort focuses on Artificial Intelligence, Machine Learning, Machine Understanding, and Autonomous Decision Making. Develop, evaluate, and demonstrate models for sensing and models for adversary behavior that support anticipatory asset tasking, characterization of latencies and related uncertainties, and joint inference and control. Develop multisource sensing techniques to include sensor and platform optimization and control, providing environment characterization consistent with the needs of automated and autonomous systems. The goal of this research and development is to mature closed loop mission/ sensing autonomy and orchestration efforts. ***FY 2024 Plans:*** Continue improving mission resource management techniques for distributed sensing/effects capabilities through open autonomy architectures and state of the art AI/ML techniques. Initiate applied research in direct support of systems of systems programs. Continue to accomplish performance understanding through simulation, demonstration, and blended simulation/live testing (multiple vehicles & sensors). Continue improving representational and computational efficiency of on-board reasoning about ground/surface targets and target groupings, and target behaviors. Continue research in foundational knowledge of emerging management algorithms for battlespace awareness incorporating interacting air/ground targets, air/air targets, and air/surface	10.420	10.371	4.986

Exhibit R-2A, RDT&E Project Justification: PB 2025 Air Force		Date: March 2024
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602204F / *Aerospace Sensors*	**Project (Number/Name)** 626095 / *Sensor Fusion Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
environments, and operationally representative contingencies. Continue the development of emerging algorithms to perform information reasoning and continue to evolve forms of representations and combined representations and reasoning approaches. ***FY 2025 Plans:*** - Continue applying research to autonomy techniques for mission resource management, command & control, sense making, resource planning, and mission orchestration. - Continue applied research in direct support of systems of systems programs. - Continue to accomplish performance understanding through simulation, demonstration, and blended simulation/live testing (multiple vehicles & sensors). - Continue expanding the capabilities and scope of computational efficiency of on-board reasoning for tactical-edge Sensing Autonomy beyond specific high value airborne targets to improve prosecution of a broader set of air and surface targets. - Continue research in foundational knowledge of management algorithms for battlespace awareness incorporating interacting air/ground targets, air/air targets, and air/surface environments, and operationally representative contingencies. - Continue investigations of algorithms to perform information reasoning and continue to evolve forms of representations and combined representations and reasoning approaches. - Initiate investigation of lightweight, low power computational methods for edge computing solutions; to include neural emulation, cognitive processing, and machine learning techniques. - Initiate further applied research on the algorithmic tracking of multiple interacting targets across domains, environments, and operationally relevant contingencies. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** FY 2025 decreased compared to FY 2024 by $5.385 million due to re-prioritization to meet the nation's future security needs.			
Title: Cyber Physical Sensing ***Description:*** Cyber Physical Sensing is the opportunity to exploit the internet of things and other non-traditional intelligence, surveillance and reconnaissance sensing systems in a way other that what they were designed to do. This additional source of information closes the gap between current intelligence, surveillance and reconnaissance collection capabilities and the vision of all intelligence, surveillance and reconnaissance, all the time. This technology investment looks at the sensing opportunities which exist at the point where physics meets the cyber domain. This effort focuses on the proliferated sensing devices, extracting information from multi-intelligence sensors and translating that information into detection, tracking and identification by use of multi-intelligence fusion. This effort leverages processing at-the-edge and distributed processing, exploited using new-generation machine learning, artificial intelligence and deep learning techniques. ***FY 2024 Plans:*** Continue research of non-traditional intelligence, surveillance and reconnaissance collection opportunities, associate opportunities to intelligence, surveillance and reconnaissance collection capabilities, and invest appropriately in research and development	2.826	4.411	2.105

Exhibit R-2A, RDT&E Project Justification: PB 2025 Air Force		Date: March 2024
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602204F / *Aerospace Sensors*	**Project (Number/Name)** 626095 / *Sensor Fusion Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
of techniques to improve collection, processing, and dissemination of information, allowing for automation and autonomy. Continue research and development in edge to core/cloud. Initiate science and technology investment of cyber physical sensing capabilities into systems of systems information flows, bringing opportunistic/non-traditional/proliferated sensing products into Air Force integrated capability intelligence, surveillance and reconnaissance exploitation programs. Continue research in new novel techniques to exploit unforeseen information from these non-traditional ISR information sources. Continue research which advances tactics, techniques, and procedures by way of new exploitation techniques of cyber physical modalities. ***FY 2025 Plans:*** - Continue research in non-traditional intelligence, surveillance and reconnaissance collection and exploitation opportunities; understand through performance evaluation and estimation where the best return on investment opportunities in non-traditional collection are. - Continue improv collection, processing and dissemination of intelligence, allowing for automation and autonomy. - Continue research and development at the edge and edge-to-core/cloud. - Continue research in cyber-physical sensing capabilities through system of system information flows. - Continue investigating transition opportunistic/non-traditional/proliferated sensing products into Department of the Air Force integrated capability programs. - Continue research in new novel techniques to exploit unforeseen information from these non-traditional information sources. - Continue research and development for the advancement of tactics, techniques, and procedures by way of new cyber-physical modalities. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** FY 2025 decreased compared to FY 2024 by $2.306 million due to re-prioritization to meet the nation's future security needs.			
Accomplishments/Planned Programs Subtotals	31.195	37.642	17.995

	FY 2023	FY 2024
Congressional Add: Cyber kinetic combat environment ***FY 2023 Accomplishments:*** Conduct Congressional directed efforts	29.556	-
Congressional Adds Subtotals	29.556	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable

Exhibit R-2A, RDT&E Project Justification: PB 2025 Air Force			Date: March 2024
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602204F / *Aerospace Sensors*	Project (Number/Name) 627622 / *RF Sensors and Countermeasures Tech*	

COST ($ in Millions)	Prior Years	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total	FY 2026	FY 2027	FY 2028	FY 2029	Cost To Complete	Total Cost
627622: *RF Sensors and Countermeasures Tech*	-	34.401	44.402	43.857	0.000	43.857	44.928	43.461	47.573	48.482	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops and assesses affordable, reliable all weather radio frequency sensing and countermeasure concepts for aerospace applications covering the range of radio frequency sensors including communications, navigation, intelligence, surveillance and reconnaissance, and radar, both active and passive, across multiple domains. This project also develops and evaluates technology for intelligence, surveillance and reconnaissance sensors, fire control radars, electromagnetic warfare, integrated radar and electromagnetic warfare systems, and offensive information operations systems. It emphasizes the detection and tracking of surface and airborne targets with radio frequency signatures that are difficult to detect due to reduced radar cross sections, concealment and camouflage measures, severe clutter, or heavy jamming. Techniques exploited include the use of multiple radio frequency phenomenologies, multi-dimensional adaptive processing, advanced waveforms and knowledge-aided processing techniques. This project also develops concepts to counter threats to our aerospace systems. It develops and evaluates technology for electromagnetic warfare, integrated radar and electromagnetic warfare systems, and electro-optical/infrared seeker defeat. This project develops the radio frequency warning and countermeasure technology for advanced electronic warfare and information operations applications. The project also explores technologies to maintain a military advantage in positioning, navigation and timing integrity, accuracy, and resiliency.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: Multiband Multifunction Radio Frequency Sensing	13.660	14.976	14.741
Description: Develop multi-band and multi-beam forming technologies. Address technologies for antenna array operations in dynamic sensor networks.			
FY 2024 Plans: Complete demonstrations of integrated electronic support measure/airborne moving target indicator/ground moving target indicator modes for passive multi-mode radar using ultra high frequency to S-band digital array demonstrator. Continue advanced mode development for multi-beam and multi-function digital arrays, implementing more complex modes and advanced waveforms with applications for Advanced Early Warning radar. Complete transition of ground-based modes to laboratory experimental airborne digital array system. Initiate migration of mode implementation from custom interfaces to Department of Defense and Department of the Air Force standardized interfaces. Continue integration of additively manufactured antennas and radar backend components to demonstrate low-cost, wide bandwidth, scalable, and conformal phased array antennas for unmanned sensing platforms. Initiate analysis identifying performance bounds and requirements for low-cost radio frequency sensors in selected mission scenarios. Continue development of techniques for analysis of complex active electronically scanned arrays on large platforms.			
FY 2025 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Air Force		Date: March 2024
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602204F / *Aerospace Sensors*	**Project (Number/Name)** 627622 / *RF Sensors and Countermeasures Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
- Continue advanced mode development for multi-beam and multi-function digital arrays, implementing more complex modes and advanced waveforms with applications for Advanced Early Warning radar. - Continue migration of mode implementation from custom interfaces to Department of Defense and Department of the Air Force standardized interfaces. - Initiate development of modes using standardized interfaces and utilizing hardware architectures representative of emerging Department of the Air Force systems. - Continue integration of additively manufactured antennas and radar backend components to demonstrate low-cost, wide bandwidth, scalable, and conformal phased array antennas for uncrewed sensing platforms. - Continue analysis identifying performance bounds and requirements for low-cost radio frequency sensors in selected mission scenarios. - Continue development of techniques for analysis of complex active electronically scanned arrays on large platforms. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** FY 2025 decreased compared to FY 2024 by $0.235 million. Justification for this decrease is described in plans above.			
Title: Passive Radio Frequency Sensing ***Description:*** Develop a system that performs traditional radar sensing modes through passive means. The research plan is designed to continue the development of the subsystems which make up the passive radar and to follow a spiral development path that involves the integration and testing of various technology instantiations to produce alternate versions of a full passive multi-mode system. Includes the development of low size-weight-and-power radio frequency signal detection and geolocation payloads for small uncrewed air systems and the integration of advanced receiver subsystems to meet a particular need of the Department of the Air Force. Explore combat identification technologies, modeling and simulation enhancements, and technologies supporting passive radar, electronic support, and signals intelligence. ***FY 2024 Plans:*** Continue development of small low cost direction finding payloads and advanced processing techniques for onboard signal characterization, geolocation/track, and signals pattern-of-life analysis. Continue demonstrating distributed multi-ship geolocation aboard an expanded set of small unmanned aircraft systems responsive to user requirements. Continue development of enhanced radio frequency modeling and simulation tools for evaluation of passive radar performance in complex environments. Expand clutter modelling capability by incorporating sea clutter models from the Navy into the Air Force analysis tools to support performance and mission modeling including maritime targets. Continue integrating high fidelity modeling and simulation with mission level modeling to demonstrate operational utility of passive radar concepts. Continue analysis of bi-static target/ground scattering phenomenology and bi-static high resolution radar data in conjunction with advanced automated target recognition algorithms to demonstrate improved accuracy and timeliness for combat identification of complex targets. Continue	8.677	15.071	14.759

Exhibit R-2A, RDT&E Project Justification: PB 2025 Air Force		Date: March 2024
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602204F / *Aerospace Sensors*	**Project (Number/Name)** 627622 / *RF Sensors and Countermeasures Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
the investigation of advanced processing techniques to enhance passive radar performance and enhance target ID performance. Initiate investigation of emerging receiver technology such as quantum enabled receivers. ***FY 2025 Plans:*** - Continue development of small low-cost direction-finding payloads and advanced processing techniques for onboard signal characterization, geolocation/track, and signals pattern-of-life analysis. - Continue demonstrating distributed multi-ship geolocation aboard an expanded set of small uncrewed aircraft systems responsive to user requirements. - Continue development of enhanced radio frequency modeling and simulation tools for evaluation of passive radar performance in complex environments. - Continue enhancement of clutter modelling capability by incorporating sea clutter models from the Navy into the Department of the Air Force analysis tools to support performance and mission modeling including maritime targets. - Continue integrating high-fidelity modeling and simulation with mission level modeling to demonstrate operational utility of passive radar concepts. - Initiate study of analysis tools and architectures in order to improve re-use across the Department of the Air Force research community. - Continue analysis of bi-static target/ground scattering phenomenology and bi-static high resolution radar data in conjunction with advanced automated target recognition algorithms to demonstrate improved accuracy and timeliness for combat identification of complex targets. - Continue the investigation of advanced processing techniques to enhance passive radar performance and enhance target ID performance. - Continue investigation of emerging receiver technology such as quantum enabled receivers. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** FY 2025 decreased compared to FY 2024 by $0.312 million. Justification for this decrease is described in plans above.			
Title: Distributed Radio Frequency Sensing ***Description:*** Develop innovative, timely, and affordable target detection, tracking, and characterization (namely imaging/ identification) capabilities that leverage two or more spatially-distributed receivers and transmitters that use cooperative radio frequency transmitters (illuminators), namely those radio frequency sources that have a common objective to the receiver systems being used. ***FY 2024 Plans:*** Continue development of robust non-traditional multi-static transmit waveforms and receive processing chains for operationally relevant multi-static ground moving target indicator systems. Continue investigation of platform constraints and implementations	12.064	14.355	14.357

Exhibit R-2A, RDT&E Project Justification: PB 2025 Air Force		Date: March 2024
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602204F / *Aerospace Sensors*	**Project (Number/Name)** 627622 / *RF Sensors and Countermeasures Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
of near real-time processing. Provide required technology enhancements to capstone flight experiment demonstrating multi-static detection and tracking of ground targets. Continue enhancements of multi-static synthetic aperture radar algorithms to support combat identification and automatic target recognition requirements on tactical timelines. Continue implementation and demonstration of multi-static synthetic aperture radar algorithms on cost and size constrained platforms. Continue development/ maturation of distributed 3-dimensional imaging algorithms that are scalable to a multi-domain approach. Continue data collection and analysis to assess performance of distributed radar systems for ground moving target indicator and synthetic aperture radar. Continue to explore multi- and cross-domain applications. ***FY 2025 Plans:*** - Continue development of multi-static transmit waveforms and receive processing chains for multi-static ground moving target indicator concepts. - Continue investigation of potential platform constraints. - Continue enhancements of multi-static synthetic aperture radar algorithms to support combat identification and automatic target recognition requirements on tactical timelines. - Complete implementation and demonstration of multi-static synthetic aperture radar algorithms on cost and size constrained platforms. - Complete development/maturation of distributed 3-dimensional imaging algorithms that are scalable to a multi-domain approach. - Continue data collection and analysis to assess distributed radar concepts for ground moving target indicator and synthetic aperture radar. - Continue to explore multi- and cross-domain applications. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** FY 2025 increased compared to FY 2024 by $0.002 million. Justification for this decrease is described in plans above.			
Accomplishments/Planned Programs Subtotals	34.401	44.402	43.857

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable