Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Air Force										DATE: February 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*				R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*							
COST ($ in Millions)	**FY 2009 Actual**	**FY 2010 Estimate**	**FY 2011 Base Estimate**	**FY 2011 OCO Estimate**	**FY 2011 Total Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	130.902	136.012	157.497	0.000	157.497	137.261	140.206	144.546	147.563	Continuing	Continuing
622002: *Electronic Component Technology*	36.556	40.251	34.458	0.000	34.458	43.702	44.670	51.281	52.895	Continuing	Continuing
622003: *EO Sensors & Countermeasures Tech*	18.447	18.603	21.430	0.000	21.430	28.644	29.756	30.694	31.299	Continuing	Continuing
6244SP: *Space Sensors*	8.438	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
624916: *Electromagnetic Tech*	17.470	19.056	18.905	0.000	18.905	0.000	0.000	0.000	0.000	Continuing	Continuing
626095: *Sensor Fusion Technology*	25.187	22.179	27.008	0.000	27.008	24.962	25.520	26.017	26.239	Continuing	Continuing
627622: *RF Sensors & Countermeasures Tech*	24.804	35.923	55.696	0.000	55.696	39.953	40.260	36.554	37.130	Continuing	Continuing

A. Mission Description and Budget Item Justification

This program develops the technology base for Air Force aerospace sensors and electronic combat. Advances in aerospace sensors are required to increase combat effectiveness by providing "anytime, anywhere" surveillance, reconnaissance, precision targeting, and electronic warfare 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) 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 sensors; 4) technologies to manage and fuse on-board sensor information for timely, comprehensive situational awareness; and 5) technology for reliable, all-weather surveillance, reconnaissance, and precision strike radio frequency sensors and electronic combat systems. This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary sensor, electronics, and electronic combat technologies.

Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Air Force	DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	**R-1 ITEM NOMENCLATURE** PE 0602204F: *Aerospace Sensors*

B. Program Change Summary ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Previous President's Budget	128.447	121.768	0.000	0.000	0.000
Current President's Budget	130.902	136.012	157.497	0.000	157.497
Total Adjustments	2.455	14.244	157.497	0.000	157.497
• Congressional General Reductions		0.000			
• Congressional Directed Reductions		0.000			
• Congressional Rescissions	0.000	-0.576			
• Congressional Adds		14.820			
• Congressional Directed Transfers		0.000			
• Reprogrammings	0.000	0.000			
• SBIR/STTR Transfer	0.000	0.000			
• Other Adjustments	2.455	0.000	157.497	0.000	157.497

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2009	FY 2010
Project: 622002: *Electronic Component Technology*		
Congressional Add: *Optically Pumped Atomic Laser (OPAL).*	2.792	0.000
Congressional Add: *Low Voltage, Wideband Electro-Optic Polymer Modulator.*	2.992	0.000
Congressional Add: *Advanced Electronic Components for Sensor Arrays.*	0.000	2.390
Congressional Add: *Advanced Integrated Microsystems for Military Electronic Systems .*	0.000	2.470
Congressional Add: *On-Chip Integrated Photonic Polymer Transceiver.*	0.000	4.481
Congressional Add Subtotals for Project: 622002	5.784	9.341
Project: 622003: *EO Sensors & Countermeasures Tech*		
Congressional Add: *Super-resolution Sensor System (S3).*	1.995	0.000
Congressional Add: *Watchkeeper.*	0.798	1.593
Congressional Add Subtotals for Project: 622003	2.793	1.593

Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Air Force	DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	**R-1 ITEM NOMENCLATURE** PE 0602204F: *Aerospace Sensors*

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2009	FY 2010
Project: 624916: *Electromagnetic Tech*		
Congressional Add: *Wideband Digital Airborne Electronic Sensing Array (WDAESA).*	2.393	0.000
Congressional Add Subtotals for Project: 624916	2.393	0.000
Project: 626095: *Sensor Fusion Technology*		
Congressional Add: *Sensor Fusion.*	2.394	0.000
Congressional Add: *Advanced Data Exploitation and Visualization.*	0.798	0.000
Congressional Add: *Information Quality Tools for Persistent Surveillance Data Sets.*	1.596	1.434
Congressional Add: *Net-Centric Sensor Grids.*	0.798	2.390
Congressional Add: *Persistent Sensing Data Processing, Storage and Retrieval.*	1.596	0.000
Congressional Add Subtotals for Project: 626095	7.182	3.824
Project: 627622: *RF Sensors & Countermeasures Tech*		
Congressional Add: *Weather Sensors for Cursor On Target.*	1.596	0.000
Congressional Add Subtotals for Project: 627622	1.596	0.000
Congressional Add Totals for all Projects	19.748	14.758

Change Summary Explanation

Note: In FY 2010, Congress added $2.4 million for Advanced Electronic Components for Sensor Arrays, $2.48 million for Advanced Integrated Microsystems for Military Electronic Systems, $1.44 million for Information Quality Tools for Persistent Surveillance Data Sets, $2.4 million for Net-Centric Sensor Grids, $4.5 million for On-Chip Integrated Photonic Polymer Transceiver, and $1.6 million for Watchkeeper. The FY 2010 President's Budget submittal did not reflect FY 2011 through FY 2015 funding. A detailed explanation of changes between the two budget positions is not provided because it cannot be made in a relevant manner.

C. Performance Metrics

Under Development.

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 622002: *Electronic Component Technology*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
622002: *Electronic Component Technology*	36.556	40.251	34.458	0.000	34.458	43.702	44.670	51.281	52.895	Continuing	Continuing

Note

Note: In FY 2010, funds from Project 44SP are being moved to Project 2002 to better align efforts.

A. Mission Description and Budget Item Justification

This project focuses on generating, controlling, receiving, and processing electronic signals for radio-frequency sensor aerospace applications. The enabling technologies developed under this project will be used for intelligence, surveillance, reconnaissance (ISR), electronic warfare, battlespace access, and precision engagement capabilities. The technologies developed include: exploratory device concepts, solid state power devices and amplifiers; low noise and signal control components; photonic components; high-temperature electronics; signal control and distribution; signal processing; multi-function monolithic integrated circuits; high-speed analog-to-digital and digital-to-analog mixed mode integrated circuits; reconfigurable electronics; power distribution; multi-chip modules; and high density packaging and interconnect technologies. This project also designs, develops, fabricates, and evaluates techniques for integrating combinations of these electronic component technologies. The project aims to demonstrate significantly improved military sensors of smaller size, lower weight, lower cost, lower power dissipation, higher reliability, and improved performance. The device and component technology developments under this project are military unique; they are based on Air Force and other Department of Defense weapon systems requirements in the areas of radar, communications, electronic warfare, navigation, and smart weapons.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop compact, affordable, multi-function components for aerospace sensors. Develop advanced electronic and optoelectronic aperture subsystems for affordable and scalable sensors.	12.478	6.368	9.975	0.000	9.975
FY 2009 Accomplishments: In FY 2009: Demonstrated integrated wideband subarray for future multi-intelligence electronic warfare and radar applications. Designed and developed digital receiver components to enable full digital receiver and exciter capabilities per transmit/receive site to enable future software-controlled phased arrays. Developed new hardware to exploit emerging metamaterials for compact radiating					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 622002: *Electronic Component Technology*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
sensor applications including conformal array antennas and electronics based upon complex media. Evaluated the potential for highly-integrated electronics and apertures using low electromagnetic interference integrated devices and circuits through the use of metamaterials as three-dimensional electronic building blocks, including laboratory prototyping of electrically small, compact radiating elements. *FY 2010 Plans:* In FY 2010: Demonstrate prototype wideband digital channel. Continue to develop and exploit metamaterials for electronic and optoelectronic applications. Demonstrate sensing subsystem using most promising metamaterials technology. *FY 2011 Base Plans:* In FY 2011: Demonstrate and transition sensing and/or electronic warfare subsystem using metamaterials approaches. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A.					
MAJOR THRUST: Develop new microelectronic component and fabrication technologies for sensors and communications to support ISR, precision strike, and battlespace access. *FY 2009 Accomplishments:* In FY 2009: Fabricated and lab tested physical and chemical properties of microelectronics to develop models to predict failure modes and lifetimes. Further refined electronics modeling and assessment techniques. Demonstrated flexible and visually-transparent radio-frequency electronics.	6.315	4.255	4.692	0.000	4.692

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 622002: *Electronic Component Technology*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2010 Plans: In FY 2010: Demonstrate closed-loop modeling and prediction capability for emerging electronic device performance versus lifetime in militarily relevant environments. Investigate and test innovative electronic device concepts for wideband, reconfigurable and tunable applications. *FY 2011 Base Plans:* In FY 2011: Demonstrate predictive capability for a larger variety of emerging electronic devices to map performance versus lifetime in military relevant environments. Identify key failure mechanisms for previously prioritized electronic device technologies and their corresponding accelerants and chemistry. Fabricate and test innovative electronic device concepts for wideband, reconfigurable and tunable applications. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A.					
MAJOR THRUST: Develop optoelectronics for next generation imaging and electronic warfare sensors. Develop electro-optical devices for next-generation warfighter applications. *FY 2009 Accomplishments:* In FY 2009: Developed vertical external cavity surface emitting lasers as compact, efficient, high-brightness sources. Completed development of fiber-optics and optical components for high-power mid-infrared applications. Developed ultra-stable, tunable, mode-locked lasers to enable highly integrated optical waveform generation. *FY 2010 Plans:* In FY 2010: Demonstrate compact, efficient, high-brightness sources, optically- and/or electrically-pumped. Start the development for compact, tunable detector technology for advanced multi-spectral applications. Continue development of optical waveform generation subsystems. Initiate effort for	5.012	3.817	4.692	0.000	4.692

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APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 622002: *Electronic Component Technology*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
combined spectral and polarimetric filtering at detector pixel level; extending to next-generation spectro-polarimetric focal plane array development. *FY 2011 Base Plans:* In FY 2011: Continue development of agile/affordable advanced detector arrays with emphasis on combined spectro-polarimetric filtering. Start integration and application development of high-brightness and agile waveform sources for integration into components and subsystems. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A.					
MAJOR THRUST: Develop, fabricate, and test electronic and optoelectronic components and techniques to reduce power loss and power consumption for future imaging, electronic warfare, and ISR sensors. *FY 2009 Accomplishments:* In FY 2009: Developed tunable and reconfigurable wideband amplifiers for use in multi-function radar and electronic warfare sensors. Emphasized emerging electronics approaches for energy-starved circuit applications. *FY 2010 Plans:* In FY 2010: Demonstrate tunable and reconfigurable electronic and optoelectronic components for combined imaging and electronic warfare applications. Continue development of solutions for energy starved applications. *FY 2011 Base Plans:* In FY 2011: Refine and transition solutions for multi-function electronic and optoelectronic components for imaging and electronic warfare applications.	2.629	8.689	8.024	0.000	8.024

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 622002: *Electronic Component Technology*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 OCO Plans: In FY 2011 OCO: N/A.					
MAJOR THRUST: Develop and demonstrate innovative radio-frequency component technology to lower system cost through reduction of part count, chip size, and design, production, and integration costs. *FY 2009 Accomplishments:* In FY 2009: Developed and demonstrated highly integrated phase control components for use in wideband multi-function sensors. *FY 2010 Plans:* In FY 2010: Design and develop highly reconfigurable fully programmable microwave array and flexible optoelectronic integrated circuits using highly integrated techniques for lighter weight radio-frequency and optical apertures. *FY 2011 Base Plans:* In FY 2011: Not Applicable. Effort eliminated due to higher Air Force priorities. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A.	2.169	1.013	0.000	0.000	0.000
MAJOR THRUST: Develop integrated design, modeling and simulation tools, and integration techniques for complex mixed-signal component development in advanced electronic component technologies. *FY 2009 Accomplishments:* In FY 2009: Demonstrated closed loop characterization of performance driven component and device design, fabrication, and characterization with first pass success.	2.169	5.127	5.670	0.000	5.670

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APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 622002: *Electronic Component Technology*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2010 Plans: In FY 2010: Extend design and characterization capability to tunable, reconfigurable and multi-function electronic and optoelectronic devices and components. *FY 2011 Base Plans:* In FY 2011: Employ design, modeling, and simulation tools and integration techniques for complex mixed-technology (digital, radio-frequency, microwave, optical, mechanical) component development in both advanced and emerging electronic component technologies. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A.					
MAJOR THRUST: Develop advanced component and subsystem technologies for space-base sensors that focuses on improving performance and reducing size, mass, and prime power. *FY 2009 Accomplishments:* In FY 2009: Not Applicable. *FY 2010 Plans:* In FY 2010: Develop reconfigurable/tunable high performance electronics/circuits. Investigate pre-space qualification issues associated with newer component technologies to ensure more rapid and accurate transitions. Develop scalable/reconfigurable plug-and-play payload building blocks. *FY 2011 Base Plans:* In FY 2011: Continue to develop reconfigurable/tunable high performance electronics/circuits. Initiate development of space qualified adaptive/intelligent electronics. Initiate a cost, size, weight, and power (C-SWAP) phased array antenna producibility effort.	0.000	1.641	1.405	0.000	1.405

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APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 622002: *Electronic Component Technology*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 OCO Plans: In FY 2011 OCO: N/A.					
Accomplishments/Planned Programs Subtotals	30.772	30.910	34.458	0.000	34.458

	FY 2009	FY 2010
Congressional Add: Optically Pumped Atomic Laser (OPAL). *FY 2009 Accomplishments:* In FY 2009: Conducted Congressionally-directed effort for the OPAL. *FY 2010 Plans:* In FY 2010: Not Applicable.	2.792	0.000
Congressional Add: Low Voltage, Wideband Electro-Optic Polymer Modulator. *FY 2009 Accomplishments:* In FY 2009: Conducted Congressionally-directed effort for Low Voltage, Wideband Electro-Optic Polymer Modulator. *FY 2010 Plans:* In FY 2010: Not Applicable.	2.992	0.000
Congressional Add: Advanced Electronic Components for Sensor Arrays.	0.000	2.390

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 622002: *Electronic Component Technology*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010
FY 2009 Accomplishments: In FY 2009: Not Applicable. *FY 2010 Plans:* In FY 2010: Conduct Congressionally-directed effort for Advanced Electronic Components for Sensor Arrays.		
Congressional Add: Advanced Integrated Microsystems for Military Electronic Systems . *FY 2009 Accomplishments:* In FY 2009: Not Applicable. *FY 2010 Plans:* In FY 2010: Conduct Congressionally-directed effort for Advanced Integrated Microsystems for Military Electronic Systems.	0.000	2.470
Congressional Add: On-Chip Integrated Photonic Polymer Transceiver. *FY 2009 Accomplishments:* In FY 2009: Not Applicable. *FY 2010 Plans:* In FY 2010: Conduct Congressionally-directed effort for On-Chip Integrated Photonic Polymer Transceiver.	0.000	4.481
Congressional Adds Subtotals	5.784	9.341

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 622002: *Electronic Component Technology*

C. Other Program Funding Summary ($ in Millions)

Line Item	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
• PE Not Provided (8720): *Activity Not Provided*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0602500F: *Multi-Disciplinary Space Technology.*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0603203F: *Advanced Aerospace Sensors.*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

D. Acquisition Strategy

Not Applicable.

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 2011 Air Force			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 622003: *EO Sensors & Countermeasures Tech*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
622003: *EO Sensors & Countermeasures Tech*	18.447	18.603	21.430	0.000	21.430	28.644	29.756	30.694	31.299	Continuing	Continuing

Note

Note: In FY 2010, funds from Project 44SP move to Project 2003 within this Program Element to better align efforts.

A. Mission Description and Budget Item Justification

This project determines the technical feasibility of advanced electro-optical aerospace sensor technologies for a variety of offensive and defensive uses. The sensor technologies under development range from the ultraviolet through the infrared portion of the spectrum. Related efforts include improvements in avionics integration, digital processing, analysis tools, and sensor architectures. One of the project's main 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. This project also develops the passive and active imaging sensors and algorithms needed to enable precision targeting in severe weather. These technologies are critical to future aerospace surveillance and targeting. Other project goals include advanced electro-optical threat warning and countermeasures.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop technology for non-cooperative detection and identification of airborne and ground-based targets.	2.719	2.334	10.972	0.000	10.972
FY 2009 Accomplishments: In FY 2009: Performed sensor concept demonstrations for multi-discriminant active and passive sensing and quantified expected system performance. Characterized target discrimination and shape extraction performance using passive multispectral and polarimetric sensing techniques. Demonstrated hybrid focal planes and read-out electronics for simultaneous multi-discriminant active and passive sensing, and refined image processing techniques for sensor data enhancement. Performed trade-off studies for long range target identification using passive and active techniques, including polarimetric discrimination and synthetic aperture laser radar.					

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APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 622003: *EO Sensors & Countermeasures Tech*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2010 Plans: In FY 2010: Perform sensor concept demonstrations for long range target identification using passive and active techniques, including multispectral/polarimetric imaging, vibrometry, sparse aperture and synthetic aperture laser radar. Develop fused active and passive, multi-discriminant image products based on individual and combined measurement performance. Continue characterization of hybrid focal planes and demonstrate in short range ladar systems. Begin design of multi-discriminant system utilizing common components to minimize size and optimize utility. Continue optical sensor enhancements for improved space situation awareness experiments. *FY 2011 Base Plans:* In FY 2011: Continue sensor concept demonstrations for long range target identification using passive and active techniques, including multispectral/polarimetric imaging, vibrometry, 3-D, sparse aperture and synthetic aperture laser radar. Refine techniques for long range object reconstruction based on either multi-aspect multispectral and polarimetric images or coherent laser radar data, with particular emphasis on synthetic and sparse aperture imaging techniques. Continue signature collection experiments with multispectral/polarimetric imaging systems to assess military utility. Perform proof of concept experiments to assess potential utility. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A.					
MAJOR THRUST: Develop optical transmitter and agile aperature technology capable of sensing multiple target characteristics for robust non-cooperative target identification. *FY 2009 Accomplishments:* In FY 2009: Developed and tested optical transmitter technologies for non-cooperative target identification at long standoff ranges. Performed multi-function signature collections for long-range identification including shape, polarization, and vibration using real-beam and synthetic aperture sensing techniques. Completed development of sparse aperture testbed supporting spatial synthesis	5.009	0.512	1.262	0.000	1.262

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APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 622003: *EO Sensors & Countermeasures Tech*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
imaging. Developed optimal system concepts using advanced active and passive sensor models. Continued tower and flight collections to quantify expected performance. Developed enabling sensor components for a long-range demonstration system. *FY 2010 Plans:* In FY 2010: Complete testing of optical transmitter technologies for non-cooperative target identification at long standoff ranges. Continue to refine optimal system concepts using advanced active and passive sensor models with emphasis on imaging through scattering media such as clouds and foliage. Develop enabling sensor components for a demonstration system. *FY 2011 Base Plans:* In FY 2011: Initiate development of beamsteering technology for long range sparse aperture and compact 3-D laser radar systems. Assess characteristics of beamsteering component technologies based on liquid crystal, micro electro-mechanical systems, and other optical phased array concepts. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A.					
MAJOR THRUST: Develop innovative techniques and components to target difficult objects in battlefield environments, including dynamic targets in urban areas. *FY 2009 Accomplishments:* In FY 2009: Developed techniques for targeting difficult objects in dynamic urban environments. Performed concept demonstrations of continuous passive infrared surveillance of broad areas with detection and tracking of dynamic targets and events. Developed sensor concept designs for optimizing revisit rate and performed design trade-off experiments. Developed concepts for close-in sensing from UAV or small UAVs in difficult environments. Investigated small unmanned aerial vehicles (SUAV) applications of non-mechanical beam steering for pointing and stabilization. Performed spectral, spatial, polarimetric, and radiometric signature collection experiments using	4.499	6.067	0.000	0.000	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 622003: *EO Sensors & Countermeasures Tech*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
laboratory passive and active laser detection and ranging sensors for moving target identification and track association in dense target areas. *FY 2010 Plans:* In FY 2010: Continue development of techniques for targeting difficult objects in dynamic urban environments. Explore compact active and passive sensor components with advanced signal processing for distributed operation from small platforms to provide close-in sensing of difficult targets in obscured and urban areas. Demonstrate individual sensor components for close in sensing from SUAVs in difficult environments. Conduct flight phenomenology experiments supporting ladar applications on SUAVs. *FY 2011 Base Plans:* In FY 2011: Not Applicable. Effort eliminated due to higher Air Force priorities. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A.					
MAJOR THRUST: Develop countermeasure technologies for use against infrared- and electro-optical guided missiles threats. *FY 2009 Accomplishments:* In FY 2009: Evaluated countermeasure techniques to defeat second-generation infrared-imaging missile seekers. Developed new countermeasure technique updates and refinements applicable to legacy systems. Identified discriminants for specific identification of new electro-optical sensors and missile threats. *FY 2010 Plans:* In FY 2010: Assess technologies to defeat advanced infrared missiles and infrared acquisition sensors. Support demonstration of proactive detection, discrimination, and defeat of second-	2.732	7.640	8.469	0.000	8.469

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 622003: *EO Sensors & Countermeasures Tech*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
generation infrared-imaging missile seekers and sensors systems. Refine techniques and discrimination processes test data. Develop and refine simulation capability to evaluate effectiveness across mission concepts of employment. *FY 2011 Base Plans:* In FY 2011: Continue the assessment of advanced infrared missiles and infrared acquisition sensors. Continue to develop proactive infrared countermeasures including the detection, discrimination, and defeat of second-generation, infrared, imaging missile seekers and sensors systems. Refine modeling and simulation capability to assess effectiveness of countermeasure techniques across mission concepts of employment. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A.					
MAJOR THRUST: Develop aerospace missile and laser warning technologies to accurately cue countermeasures. *FY 2009 Accomplishments:* In FY 2009: Developed new laser warning sensor technologies to address ultra-short and tunable laser threats. Identified clutter suppression techniques to increase signal to noise and improve detection ranges in urban operations. Evaluated algorithms to optimize detection and declaration ranges. *FY 2010 Plans:* In FY 2010: Support integration of new laser warning sensors with countermeasures system prototypes to provide robust capability to detect threats and cue defeat techniques. Refine sensor hardware and software design based on test data. Conduct demonstration testing of integrated capabilities. Develop new laser warning concepts to address emerging directed energy threats.	0.695	0.457	0.727	0.000	0.727

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 622003: *EO Sensors & Countermeasures Tech*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: In FY 2011: Demonstrate integrated beam rider laser, direct tactical and indirect tactical laser detection sensors supporting proactive infrared countermeasure hand-off goals. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A.					
Accomplishments/Planned Programs Subtotals	15.654	17.010	21.430	0.000	21.430

	FY 2009	FY 2010
Congressional Add: Super-resolution Sensor System (S3). *FY 2009 Accomplishments:* In FY 2009: Conducted Congressionally-directed effort for the Super-resolution Sensor System. *FY 2010 Plans:* In FY 2010: Not Applicable.	1.995	0.000
Congressional Add: Watchkeeper. *FY 2009 Accomplishments:* In FY 2009: Conducted Congressionally-directed effort for the Watchkeeper. *FY 2010 Plans:* In FY 2010: Conduct Congressionally-directed effort for Watchkeeper.	0.798	1.593
Congressional Adds Subtotals	2.793	1.593

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 622003: *EO Sensors & Countermeasures Tech*

C. Other Program Funding Summary ($ in Millions)

Line Item	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
• PE Not Provided (8997): *Activity Not Provided*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0602500F: *Multi-Disciplinary Space Technology.*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0603253F: *Advanced Sensor Integration.*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

D. Acquisition Strategy

Not Applicable.

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 2011 Air Force			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 6244SP: *Space Sensors*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
6244SP: *Space Sensors*	8.438	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

Note

Note: In FY 2010, funds from Project 44SP are being moved to Projects 2002, 2003, and 7622 to better align efforts.

A. Mission Description and Budget Item Justification

This project focuses on developing methods of generating, controlling, receiving, transmitting, and processing electronic, photonic, optical, and opto-electronic (mixed) signals for radio frequency space sensor applications. The enabling technologies will be used for intelligence, surveillance, reconnaissance, electronic warfare, and precision engagement sensors based in space. This project develops the baseline technologies required to manage and perform on-board space sensor information fusion for timely and comprehensive communications and situational awareness. Through modeling and simulation, this project develops and evaluates innovative electromagnetic and electronic countermeasures for space applications. This project aims to demonstrate significantly improved military space sensors of smaller size, lower weight, lower cost, lower power dissipation, higher reliability, and improved performance. This project also develops and assesses multi-dimensional adaptive techniques in radar technology for affordable and reliable space surveillance and reconnaissance systems.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop hybrid space-based sensor solutions to be responsive to space needs and detect difficult targets. Develop jam-resistant space-qualified time, position, and velocity sensors.	2.600	0.000	0.000	0.000	0.000
FY 2009 Accomplishments: In FY 2009: Experimentally assessed responsive "plug-and-play" satellite implementation concept. Designed size-, weight-, and power-restricted precision time, position, and velocity sensor techniques for space-based applications. Demonstrated constructive systems engineering model to assess space-based assured reference techniques in terms of measures of performance and warfighter utility.					
FY 2010 Plans: In FY 2010: Not Applicable.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 6244SP: *Space Sensors*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: In FY 2011: Not Applicable. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A.					
MAJOR THRUST: Develop advanced active phased array antenna subsystems and apertures to meet the unique requirements of affordable space-based sensing including restrictions on mass, size, and power. *FY 2009 Accomplishments:* In FY 2009: Experimentally assessed enhanced antenna signal interference compatibility capability. *FY 2010 Plans:* In FY 2010: Not Applicable. *FY 2011 Base Plans:* In FY 2011: Not Applicable. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A.	2.118	0.000	0.000	0.000	0.000
MAJOR THRUST: Study adaptive processing techniques for large, multi-mission, space-based conformal arrays to meet the demands of wide area sensing in severe clutter and interference environments. *FY 2009 Accomplishments:* In FY 2009: Integrated the developed algorithms, waveforms, and space platform scenarios into a surveillance network of sensors. *FY 2010 Plans:* In FY 2010: Not Applicable.	0.978	0.000	0.000	0.000	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 6244SP: *Space Sensors*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: In FY 2011: Not Applicable. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A.					
MAJOR THRUST: Develop advanced component technology for space-based sensors that focuses on improving performance and reducing size, mass, and prime power. *FY 2009 Accomplishments:* In FY 2009: Developed compact tunable filters for interference signal rejection in dense signal environments. *FY 2010 Plans:* In FY 2010: Not Applicable. *FY 2011 Base Plans:* In FY 2011: Not Applicable. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A.	1.425	0.000	0.000	0.000	0.000
MAJOR THRUST: Develop sensor techniques to achieve highly accurate and robust navigation performance for hypersonic air vehicles in prompt global strike applications. *FY 2009 Accomplishments:* In FY 2009: Designed a radio-frequency hardware-in-the-loop testbed to implement hypersonic air vehicle plasma characteristics, platform trajectories, and highly accurate and robust navigation techniques for space-based applications. Developed a constructive systems engineering model to assess hypersonic navigation techniques in terms of measures of performance and warfighter utility.	1.317	0.000	0.000	0.000	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 6244SP: *Space Sensors*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2010 Plans: In FY 2010: Not Applicable. *FY 2011 Base Plans:* In FY 2011: Not Applicable. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A.					
Accomplishments/Planned Programs Subtotals	8.438	0.000	0.000	0.000	0.000

C. Other Program Funding Summary ($ in Millions)

Line Item	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
• PE Not Provided (9214): *Activity Not Provided*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0602500F: *Multi-Disciplinary Space Tech.*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0603203F: *Advanced Aerospace Sensors.*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

D. Acquisition Strategy

Not Applicable.

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 2011 Air Force			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 624916: *Electromagnetic Tech*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
624916: *Electromagnetic Tech*	17.470	19.056	18.905	0.000	18.905	0.000	0.000	0.000	0.000	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops technologies for sensor systems that cover the electromagnetic spectrum from radio-frequency to electro-optical. It develops radio-frequency antennas and associated electronics for airborne and space-based surveillance. It also investigates radio-frequency scattering phenomenology for applications in ground and air moving target indicators in extremely cluttered environments. The project develops active and passive electro-optical sensors for use in concert with radio-frequency sensors. It develops low-cost active sensors that use reliable high-performance solid state components for target detection and identification and missile threat warning. The project also develops passive multi-dimensional sensors to improve battlefield awareness and identify threats at long-range.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Investigate detection of difficult airborne and ground-based targets in clutter from airborne or space-based surveillance platforms.	2.462	3.131	3.489	0.000	3.489
FY 2009 Accomplishments: In FY 2009: Developed analytical and computationally efficient tools for multi-sensor integration for target detection, tracking, and classification in a knowledge-aided framework exploiting physics-based and data dependent electromagnetic models of targets and clutter.					
FY 2010 Plans: In FY 2010: Continue to develop analytical and computationally efficient tools for multi-sensor integration for target detection, tracking, and classification in a knowledge-aided framework exploiting physics-based and data dependent electromagnetic models of targets and clutter.					
FY 2011 Base Plans: In FY 2011: Complete development of analytical and computationally efficient tools for multi-sensor integration for target detection, tracking, and classification in a knowledge-aided framework exploiting					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 624916: *Electromagnetic Tech*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
physics-based and data dependent electromagnetic models of targets and clutter, as well as waveform diversity and dynamic sensor responses to the evolving problem solution. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A.					
MAJOR THRUST: Design and develop antennas for airborne and space-based surveillance. Develop metamaterials for conformal arrays. *FY 2009 Accomplishments:* In FY 2009: Developed new low-cost digital beamforming techniques for miniature unmanned aerial vehicles. Integrated new detection algorithm with low cost seeker hardware. Integrated and tested new conformal digital beamforming phased array antennas on airborne radar platforms. Developed new hardware to exploit emerging metamaterials for compact radiating sensor applications including conformal array antennas and electronics based upon complex media. Assessed the viability of obtaining metamaterial properties consistent with the demonstration of highly integrated subsystems based upon radio frequency integrated circuit applications to enable small, highly directional antenna element device drivers. *FY 2010 Plans:* In FY 2010: Continue to develop new low-cost digital beamforming techniques for miniature unmanned aerial vehicles. Integrate new detection algorithm with low cost seeker hardware. Continue integration and test of new conformal digital beamforming phased array antennas on airborne radar platforms. Continue to develop new hardware to exploit emerging metamaterials for compact radiating sensor applications including conformal array antennas and electronics based upon complex media. Continue to assess the viability of obtaining metamaterial properties consistent with the demonstration of highly integrated subsystems based upon radio frequency integrated circuit applications to enable small, highly directional antenna element device drivers.	6.174	6.777	6.255	0.000	6.255

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 624916: *Electromagnetic Tech*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: In FY 2011: Continue integration of new detection algorithm with low cost seeker hardware. Continue integration and test of new conformal digital beamforming phased array antennas on airborne radar platforms. Continue to develop new hardware to exploit emerging metamaterials for compact radiating sensor applications including conformal array antennas and electronics based upon complex media. Continue to assess the viability of obtaining metamaterial properties consistent with the demonstration of highly integrated subsystems based upon radio frequency integrated circuit applications to enable small, highly directional antenna element device drivers. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A.					
MAJOR THRUST: Design and develop new electro-optical techniques and components for detecting and identifying concealed targets. *FY 2009 Accomplishments:* In FY 2009: Developed new quasi-phase matched materials such as Gallium Phosphate and techniques for efficient optical sources in the mid- and long-wave infrared applications. New materials systems were developed to enable conversion from pump wavelengths between 1 and 2 microns. Tested integrated focal plane arrays. *FY 2010 Plans:* In FY 2010: Continue to develop new quasi-phase matched materials such as Gallium Phosphate and techniques for efficient optical sources in the mid- and long-wave infrared applications. Continue developing new materials systems to enable conversion from pump wavelengths between 1 and 2 microns. Continue testing of integrated focal plane arrays.	3.654	5.500	5.456	0.000	5.456

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 624916: *Electromagnetic Tech*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: In FY 2011: Continue to develop new quasi-phase matched materials such as Gallium Phosphate and techniques for efficient optical sources in the mid- and long-wave infrared applications. Demonstrate new materials systems to enable conversion from pump wavelengths between 1 and 2 microns. Conclude testing of integrated focal plane arrays. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A.					
MAJOR THRUST: Develop hardware and software for passive multi-dimensional sensing in the thermal infrared spectral wavelength range at high frame rates. *FY 2009 Accomplishments:* In FY 2009: Developed new electro-optical sensor hardware for detecting chemical, biological, radioactive, nuclear, or high explosive weapons using spectral/hyperspectral intelligence. Performed initial testing to assess sensor detection and identification viability and initiate plan for transition. Developed hyperspectral and multispectral sensors and create a small, deployable instrument suitable for moving into transition with an advanced technology demonstrator. Initiated utility assessment of hyperspectral sensors for collecting data at millisecond sample rates for space-based applications. *FY 2010 Plans:* In FY 2010: Continue to develop new electro-optical sensor hardware for detecting chemical, biological, radioactive, nuclear, or high explosive weapons using spectral/hyperspectral intelligence. Continue testing to assess sensor detection and identification viability and initiate plan for transition. Continue development of hyperspectral and multispectral sensors and create a small, deployable instrument suitable for moving into transition with an advanced technology demonstrator. Continue utility assessment of hyperspectral sensors for collecting data at millisecond sample rates for space-based applications. Apply spectral temporal sensor technology for cueing electro-optical and infrared persistent surveillance sensors.	2.787	3.648	3.705	0.000	3.705

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 624916: *Electromagnetic Tech*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: In FY 2011: Continue development of electro-optical sensor hardware for detecting chemical, biological, radioactive, nuclear or high explosive weapons using spectral or spectral temporal intelligence. Continue development of chemical biological standoff detection hardware. Complete spectral temporal sensor demonstration for cueing electro-optical and infrared persistent surveillance sensors. *FY 2011 OCO Plans:* In FY 2011 OCO: Not applicable.					
Accomplishments/Planned Programs Subtotals	15.077	19.056	18.905	0.000	18.905

	FY 2009	FY 2010
Congressional Add: Wideband Digital Airborne Electronic Sensing Array (WDAESA). *FY 2009 Accomplishments:* In FY 2009: Conducted Congressionally-directed effort for WDAESA. *FY 2010 Plans:* In FY 2010: Not Applicable.	2.393	0.000
Congressional Adds Subtotals	2.393	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 624916: *Electromagnetic Tech*

C. Other Program Funding Summary ($ in Millions)

Line Item	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
• PE Not Provided (9431): *Activity Not Provided*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0602500F: *Multi-Disciplinary Space Technology.*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

D. Acquisition Strategy

Not Applicable.

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 2011 Air Force			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 626095: *Sensor Fusion Technology*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
626095: *Sensor Fusion Technology*	25.187	22.179	27.008	0.000	27.008	24.962	25.520	26.017	26.239	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops the technologies required to perform management and fusion of sensor information for timely, comprehensive situational awareness, automatic target recognition, integrated fire control, and bomb damage assessment. This project determines the feasibility of technologies and concepts for fire control that help to precisely locate, identify, and target airborne and surface targets. The project emphasizes finding reduced signature targets and targets of opportunity. It will enable new covert tactics for successful air-to-air and air-to-surface strikes. This project also develops the technologies required to create trusted autonomic, distributed, collaborative, and self-organizing sensor systems that provide anticipatory and persistent intelligence, surveillance, and reconnaissance (ISR), situational awareness, and decision support for multi-layered sensing. This program provides the technologies for: 1) trusted sensors and trusted sensor systems that will deter reverse engineering and exploitation of our critical hardware and software technology and impede unwanted technology transfer, alteration of system capability, and prevent the development of countermeasures to U.S. systems; 2) collaborative tasking of our own distributed heterogeneous sensor networks across a region and co-opted tasking of both traditional and non-traditional adversary sensors; 3) secure sensor web backbone technologies, sensor web physical topologies, and related protocols to assure reliable trusted sensor interactions; and 4) defining architectures for distributed trusted collaborative heterogeneous sensor systems and semantic sensor networks, developing new methodologies for system of systems sensor engineering and analysis, and new techniques for sensor network situation awareness and predictive analytics.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop and assess single and multi-sensor automatic target recognition (ATR) and sensor fusion algorithms for rapidly finding, tracking, and targeting mobile targets.	1.387	2.010	7.261	0.000	7.261
FY 2009 Accomplishments: In FY 2009: Assessed the image formation and processing of synthetic aperture radar, electro-optical/infrared/hyper-spectral imagery data from research and development data collections taking advantage of disparate phenomenology to improve automatic target recognition detection, classification and identification performance. Developed and validated multi-sensor/multi-					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 626095: *Sensor Fusion Technology*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
frequency synthetic data generation tools required to augment and enhance collected research, development, and operational data sets. Initiated development of tools and technology supporting other phenomenological features that heretofore have not been exploited. Conducted laboratory tests and assessment of multi-sensor and sensor fusion algorithms for automated exploitation and weapon delivery systems. Enhanced automatic target recognition performance evaluation theory for radar automatic target recognition technology and for electro-optical and multiple-sensor automatic target recognition technologies. Assessed methods and measures for moving target tracking and identification approaches using multiple sensor types. Developed analysis methods and measures for assessing automated exploitation and rapid response systems proposed for post-conflict force protection, stability, and security operations.					
FY 2010 Plans: In FY 2010: Continue to assess the image formation and processing of synthetic aperture radar, electro-optical/infrared/hyper-spectral imagery data from research and development data collections taking advantage of disparate phenomenology to improve automatic target recognition detection, classification and identification performance. Continue to develop and validate multi-sensor/multi-frequency synthetic data generation tools required to augment and enhance collected research, development, and operational data sets. Search out unexploited phenomenological features and initiate development of tools and technology required to exploit said features. Continue laboratory tests and assessment of multi-sensor and sensor fusion algorithms for automated exploitation and weapon delivery systems. Continue enhancements to databases, tools and laboratory environments as required to support assessment and validation of models and exploitation technologies. Continue to improve automatic target recognition performance evaluation theory for automatic target recognition technologies. Continue to develop assessment methods and measures for moving target tracking and identification approaches using multiple sensor types. Continue development of analysis methods and measures for assessing automated exploitation and rapid response systems proposed for post-conflict force protection, stability, and security operations.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 626095: *Sensor Fusion Technology*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: In FY 2011: Complete initial assessment of image formation and processing of synthetic aperture radar, electro-optical/infrared/hyper-spectral imagery data from research and development data collections taking advantage of disparate phenomenology to improve automatic target recognition detection, classification and identification performance. Continue to develop and perform initial validation of multi-sensor/multi-frequency synthetic data generation tools required to augment and enhance collected research, development, and operational data sets. Search out unexploited phenomenological features and continue development of tools and technology required to exploit said features. Continue laboratory tests and assessment of multi-sensor and sensor fusion algorithms for automated exploitation and weapon delivery systems. Continue enhancements to databases, tools and laboratory environments as required to support assessment and validation of models and exploitation technologies. Continue to improve automatic target recognition performance evaluation theory for automatic target recognition technologies. Continue to develop assessment methods and measures for moving target tracking and identification approaches using multiple sensor types. Complete initial development of analysis methods and measures for assessing automated exploitation and rapid response systems proposed for post-conflict force protection, stability, and security operations. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A.					
MAJOR THRUST: Develop, evaluate, and demonstrate target signature models to support ATR and sensor fusion algorithm development and testing for reconnaissance and strike mission applications. *FY 2009 Accomplishments:* In FY 2009: Matured target signature models for signature exploitation of radio-frequency sensors, electro-optical multi-spectral systems, and signals intelligence sensors. Developed signatures, algorithms, and modeling support for multiple radio-frequency and electro-optical phenomenology	3.427	4.817	6.250	0.000	6.250

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 626095: *Sensor Fusion Technology*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
automatic target recognition of tactical ground targets. Initiated the development of signatures, algorithms, target modeling, and phenomenological modeling of other phenomenological features that heretofore have not been exploited. Generated synthetic air and ground target signatures with sufficient fidelity to support automatic recognition of targets in operationally realistic mission environments. Demonstrated a synthetic scene data generation capability for radio-frequency scenes and developed an electro-optical scene capability applicable to large area reconnaissance coverage. Investigated model-driven spectral signal processing and exploitation techniques. Developed automatic target recognition algorithm-driven radio-frequency sensor design, new modes of operation for existing sensors, and signal processing/exploitation for high-diversity data. *FY 2010 Plans:* In FY 2010: Continue to mature target signature models for signature exploitation of radio-frequency sensors, electro-optical multi-spectral systems, and signals intelligence sensors emphasizing one target model for application to all parts of the spectrum. Continue to develop signatures, algorithms, and modeling support for multiple radio-frequency and electro-optical phenomenology automatic target recognition of ground targets. Continue search for and the development of signatures, algorithms, target modeling and phenomenological modeling of other phenomenological features that heretofore have not been exploited. Continue to generate synthetic air and ground target signatures with sufficient fidelity to support development and assessment of automatic recognition of targets in operationally realistic mission environments. Continue demonstration of large area, reconnaissance coverage, synthetic scene data generation capability for radio-frequency and electro-optical sensors. Continue investigation of model-driven spectral signal processing and exploitation techniques. Continue development of automatic target recognition algorithm-driven radio-frequency sensor design, new modes of operation for existing sensors, and signal processing/exploitation for high-diversity data. *FY 2011 Base Plans:* In FY 2011: Complete initial target signature models for signature exploitation of radio-frequency sensors, electro-optical multi-spectral systems, and signals intelligence sensors emphasizing one					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 626095: *Sensor Fusion Technology*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
target model for application to all parts of the spectrum. Continue to develop signatures, algorithms, and modeling support for multiple radio-frequency and electro-optical phenomenology automatic target recognition of ground targets. Continue the development of signatures, algorithms, target modeling, and phenomenological modeling of other phenomenological features not previously exploited. Continue to generate synthetic air and ground target signatures with sufficient fidelity to support development and assessment of automatic recognition of targets in operationally realistic mission environments. Continue investigation of model-driven spectral signal processing and exploitation techniques. Continue development of automatic target recognition algorithm-driven radio-frequency sensor design, new modes of operation for existing sensors, and signal processing/exploitation for high-diversity data. Initiate measurements and prediction technology to analyze space object signatures in support of space situational awareness. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A.					
MAJOR THRUST: Develop ATR, sensor management, and sensor fusion technologies for target detection, tracking, and identification in ISR and combat identification applications. *FY 2009 Accomplishments:* In FY 2009: Completed initial fusion capability for radar, electro-optical/infrared, laser detection and ranging, and hyperspectral features for target detection, tracking, and identification with sensor management techniques. Evaluated and improved physics-based techniques for target detection and identification for intelligence, surveillance, and reconnaissance and combat identification applications. Developed and initiated evaluation of automated battle space behavior analysis. Developed technology that will capitalize on precision time, position, attitude, and velocity sensor data to enable improved geo-location capabilities for future distributed time and distributed platform sensing; initiated its inclusion into fusion functions. Completed and evaluated multi-sensor, pixel level registration techniques. Developed capabilities to represent and utilize sensor parameters and errors, along with other uncertainty reference information, for improved fused geo-location accuracy. Researched	5.058	1.932	2.290	0.000	2.290

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		DATE: February 2010
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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
bio-inspired automatic target recognition for robustness and initiated evaluation of these techniques for urban applications. Evaluated automatic target recognition, sensor management, and sensor fusion research for urban intelligence, surveillance, and reconnaissance from small unmanned aerial vehicles. *FY 2010 Plans:* In FY 2010: Demonstrate and assess fusion capability for radar, electro-optical/infrared, laser detection and ranging, and hyperspectral features for target detection, tracking, and identification with sensor management techniques. Enhance physics-based techniques to meet the target detection and identification requirements for intelligence, surveillance, and reconnaissance and combat identification applications. Continue development and evaluation of automated battle space behavior analysis. Continue development and assessment of technology that will fuse precision time, position, attitude, and velocity sensor data to enable improved geo-location capabilities for future distributed time and distributed platform sensing. Enhance multi-sensor, pixel level registration techniques as necessary to support requirements. Continue to assess and develop capabilities to represent and utilize sensor parameters and errors, along with other uncertainty reference information, for improved fused geo-location accuracy. Continue research of bio-inspired automatic target recognition technologies and continue to assess and evaluate these techniques for all missions with emphasis on urban applications. Evaluate automatic target recognition, sensor management, and sensor fusion research for urban intelligence, surveillance, and reconnaissance from small unmanned aerial vehicles. *FY 2011 Base Plans:* In FY 2011: Enhance and assess physics-based techniques to meet the target detection and identification requirements for intelligence, surveillance, and reconnaissance and combat identification applications. Continue development and evaluation of automated battle space behavior analysis. Continue					

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APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 626095: *Sensor Fusion Technology*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
development and assessment of technology that will fuse precision time, position, attitude, and velocity sensor data to enable improved geo-location capabilities for future distributed time and distributed platform sensing. Enhance multi-sensor, pixel level registration techniques as necessary to support requirements. Continue to assess and develop capabilities to represent and utilize sensor parameters and errors, along with other uncertainty reference information, for improved fused geo-location accuracy. Continue research of bio-inspired automatic target recognition technologies and continue to assess and evaluate these techniques for all missions with emphasis on urban applications. Complete assessment of automatic target recognition, sensor management, and sensor fusion algorithms for urban intelligence, surveillance, and reconnaissance from small unmanned aerial vehicles. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A.					
MAJOR THRUST: Develop technical methods required for algorithm performance models, ATR driven sensing, layered sensing and other sensing and exploitation technologies impacted by ATR capabilities. *FY 2009 Accomplishments:* In FY 2009: Evaluated new innovations in automatic target recognition-related technologies. Developed fundamental automatic target recognition approaches for subcomponents. Began development of an integrated, unified automatic target recognition methodology, building upon the various automatic target recognition subcomponent efforts. *FY 2010 Plans:* In FY 2010: Continue evaluation of new innovations in automatic target recognition-related technologies. Continue development of fundamental automatic target recognition approaches for subcomponents. Begin development of a capability to model the performance of these technologies. Determine methods of performance modeling validation. Develop databases and tools required to support performance modeling and assessment. Continue development of an integrated,	1.477	1.471	5.638	0.000	5.638

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APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 626095: *Sensor Fusion Technology*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
unified automatic target recognition methodology building upon the modeling and assessment tools developed. *FY 2011 Base Plans:* In FY 2011: Continue investigations of sensor exploitation techniques. Continue development of a capability to model the performance of these technologies. Initiate validation of algorithm performance models. Continue development of databases and tools required to support performance modeling and assessment. Continue and enhance development of an integrated, unified automatic target recognition methodology building upon the modeling and assessment tools developed. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A.					
MAJOR THRUST: Develop, evaluate, and demonstrate methodologies, techniques, and strategies to instill trust in distributed, heterogeneous sensing systems within air, space, and cyber domains. *FY 2009 Accomplishments:* In FY 2009: Developed new technologies and methodologies for defining adaptive architectures for distributed trusted collaborative heterogeneous sensor systems and semantic sensor networks. Developed new techniques for system of systems sensor engineering and analysis. Developed new techniques for sensor network situational awareness and predictive analytics to optimize object driven, self-organizing collaborative sensor systems for multi-layered sensing. Initiated research into sensor network science to identify critical areas and technologies needed for next generation semantic sensor networks. *FY 2010 Plans:* In FY 2010: Complete development of new techniques for systems sensor engineering and analysis. Complete development of new techniques for sensor network situational awareness and global measures of trust for multi-layered sensing. Complete development of representative measures of	4.420	4.785	2.496	0.000	2.496

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APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 626095: *Sensor Fusion Technology*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
system trustworthiness for collaborative and distributed heterogeneous sensing system architectures and semantic sensor networks. Continue development of new technologies and methodologies for producing adaptive, trusted architectures for multi-layered sensing. *FY 2011 Base Plans:* In FY 2011: Complete development of new technologies and methodologies for producing adaptive, trusted architectures for multi-layered sensing. Initiate development of advanced trusted sensor web services, middleware, and frameworks for multi-layered sensing and cyber sensing. Initiate development of methodologies and techniques for visualization and portrayal of a global trust picture. Initiate development of technologies for assessing, evaluating, and managing trust at a distance in for distributed heterogeneous sensor systems. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A.					
MAJOR THRUST: Develop technologies that enable autonomic trusted features in sensor systems to deter reverse engineering and exploitation of critical military hardware and software systems. *FY 2009 Accomplishments:* In FY 2009: Not Applicable. *FY 2010 Plans:* In FY 2010: Develop and demonstrate critical technologies for trusted sensors for multi-layered ISR sensing systems to assure anti-tamper and software protection of key military capabilities. Assess and evaluate commercial technologies for application to military trusted systems. Develop and demonstrate secure cyber sensing station for ISR and cyberspace applications. Initiate development of autonomic trusted sensor technologies to address self-ware, self-healing, and self-organizing sensor systems.	0.000	1.098	1.429	0.000	1.429

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APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 626095: *Sensor Fusion Technology*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: In FY 2011: Continue to develop key technologies for trusted sensors for multi-layered ISR sensing systems to assure anti-tamper and software protection of key military capabilities. Continue to assess and evaluate commercial technologies for application to military trusted systems. Continue development of autonomic trusted sensor technologies to address self-ware, self-healing, and self-organizing sensor systems. Initiate development of integrated anti-tamper and software protection solutions. Initiate development of key technology experiments to test and demonstrate trusted sensor technologies on military weapon systems. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A.					
MAJOR THRUST: Develop secure backplane, integration technology, physical topologies, and protocols to support multi-layered sensing and trusted sensor networks for air, space, and cyber domains. *FY 2009 Accomplishments:* In FY 2009: Initiated development of conceptual design of sensor web backbone technology to assure trusted sensor interactions for multi-layered persistent ISR sensing, leveraging commercial infrastructure and components. Initiated development of sensor web backbone integration laboratory to assess and evaluate critical sensor data link technologies and physical topologies for secure sensor networks. *FY 2010 Plans:* In FY 2010: Complete conceptual design conceptual design of sensor web backbone technology to assure trusted sensor interactions for multi-layered persistent ISR sensing. Continue development of sensor web backbone integration laboratory. Complete initial assessment of available sensor technologies for trusted sensing. Initiate development of advanced sensor bus technologies for trusted sensing. Initiate analysis to exploit wired and wireless sensor web systems.	2.236	2.242	1.644	0.000	1.644

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APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 626095: *Sensor Fusion Technology*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: In FY 2011: Continue demonstration of laboratory prototype of sensor web backbone and physical topologies. Continue development of advanced sensor bus technologies for trusted sensing. Continue analysis to exploit wired and wireless senor web systems and begin analysis of technologies to defend sensor web systems. Complete development of the sensor web backbone integration laboratory. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A.					
Accomplishments/Planned Programs Subtotals	18.005	18.355	27.008	0.000	27.008

	FY 2009	FY 2010
Congressional Add: Sensor Fusion. *FY 2009 Accomplishments:* In FY 2009: Conducted Congressionally-directed effort for Sensor Fusion. *FY 2010 Plans:* In FY 2010: Not Applicable.	2.394	0.000
Congressional Add: Advanced Data Exploitation and Visualization. *FY 2009 Accomplishments:* In FY 2009: Conducted Congressionally-directed effort for Advanced Data Exploitation and Visualization.	0.798	0.000

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APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 626095: *Sensor Fusion Technology*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010
FY 2010 Plans: In FY 2010: Not Applicable.		
Congressional Add: Information Quality Tools for Persistent Surveillance Data Sets. *FY 2009 Accomplishments:* In FY 2009: Conducted Congressionally-directed effort for Information Quality Tools for Persistent Surveillance Data Sets. *FY 2010 Plans:* In FY 2010: Conduct Congressionally-directed effort for Information Quality Tools for Persistent Surveillance Data Sets.	1.596	1.434
Congressional Add: Net-Centric Sensor Grids. *FY 2009 Accomplishments:* In FY 2009: Conducted Congressionally-directed effort for Net-Centric Sensor Grids. *FY 2010 Plans:* In FY 2010: Conduct Congressionally-directed effort for net-centric sensor grids	0.798	2.390
Congressional Add: Persistent Sensing Data Processing, Storage and Retrieval. *FY 2009 Accomplishments:* In FY 2009: Conducted Congressionally-directed effort for Persistent Sensing Data Processing, Storage and Retrieval.	1.596	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010
FY 2010 Plans: In FY 2010: Not Applicable.		
Congressional Adds Subtotals	7.182	3.824

C. Other Program Funding Summary ($ in Millions)

Line Item	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
• PE Not Provided (9846): *Activity Not Provided*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0602500F: *Multi-Disciplinary Space Technology.*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0603203F: *Advanced Aerospace Sensors.*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0602602F: *Conventional Munitions.*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0603270F: *Electronic Combat Technology.*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0603226E: *Experimental Evaluation of Major Innovative Technologies.*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

D. Acquisition Strategy

Not Applicable.

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 2011 Air Force			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 627622: *RF Sensors & Countermeasures Tech*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
627622: *RF Sensors & Countermeasures Tech*	24.804	35.923	55.696	0.000	55.696	39.953	40.260	36.554	37.130	Continuing	Continuing

Note

Note: In FY 2010, funds from Project 44SP are being moved to Project 7622 to better align efforts.

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, reconnaissance, and radar, both active and passive, across the air, land, sea, space and cyber domains. This project also develops and evaluates technology for intelligence, surveillance, and reconnaissance sensors, fire control radars, electronic warfare, integrated radar and electronic 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 the radio-frequency warning and countermeasure technology for advanced electronic warfare and information operations applications. Specifically, it develops techniques and technologies to detect and counter the communications links and sensors of threat air defense systems and hostile command and control networks. The project also exploits emerging technologies and components to provide increased capability for offensive and defensive radio-frequency sensors, including radar warning, radio-frequency electronic warfare, and electronic intelligence applications.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop technology to reduce size, weight, and power of RF sensors. Develop technology to enable affordable upgrades and optimally control RF and multi-intelligence sensors.	7.668	5.380	4.588	0.000	4.588
FY 2009 Accomplishments: In FY 2009: Demonstrated integration of an electronic warfare and surveillance suite in a size, weight, and power constrained environment. Developed and evaluated advanced mode control concepts to					

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APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 627622: *RF Sensors & Countermeasures Tech*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
provide concurrent radio-frequency sensors and electronic warfare with electro-optical compatibility on a single platform. Defined approaches allowing the simultaneous design and development of sensors and their back-end exploitation functions. Developed advanced electronic support digital receiver concepts/techniques for spatial and temporal adaptivity to overcome limitations to precision emitter parameterization in complex environments. Developed and evaluated advanced adaptive digital receiver/exciter technologies for electronic support, electronic protection, electronic attack, and active and passive multi-mode sensor applications. Conducted digital receiver simulation, modeling, and analysis for electronic warfare scenarios in modern signal environments. Refined reductions in size, weight, and power in radio-frequency sensors compatible with severely constrained unmanned air platforms. *FY 2010 Plans:* In FY 2010: Continue demonstration of advanced RF receiver hardware and digital receiver/ techniques generators technologies. Initiate new effort for the development of an adaptable (cognitive) ES and/or EA capability. *FY 2011 Base Plans:* In FY 2011: Continue the research and exploration of an adaptable ES/EA capability, including exploration of the synergy of real-time ES coupled with tailorable EA techniques. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A.					
MAJOR THRUST: Develop robust, ultra-wide bandwidth aerospace electronic aperture technologies and next generation applied radio-frequency aperture technology for manned and unmanned platforms. *FY 2009 Accomplishments:* In FY 2009: Demonstrated and tested thin-profile array with integrated receiver and exciter.	4.845	4.879	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2010 Plans: In FY 2010: Complete design and development of multi-function thin-profile array with integrated receiver and exciter. *FY 2011 Base Plans:* In FY 2011: Not Applicable. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A.					
MAJOR THRUST: Develop RF sensing and electronic warfare/information operations concepts and technologies for concurrent multi-mode operation and digital beam forming. *FY 2009 Accomplishments:* In FY 2009: Demonstrated autonomous constellations of active and passive air, space, and ground sensor techniques for close-in sensing and electronic warfare/information operations applications using distant sources of opportunity. Demonstrated and tested multi-mode array with element-level digital beam forming. *FY 2010 Plans:* In FY 2010: Design and develop highly digital electronically scanned array with transmit and receive capabilities for multi-mode radio frequency sensing. Develop integrated receiver/exciter and digital beamforming concepts to support wideband multi-INT sensing systems including modeling and simulation capability, critical components, algorithms, and subsystem architectures. *FY 2011 Base Plans:* In FY 2011: Continue development of highly digital electronically scanned array. Design and develop an integrated receiver, exciter and digital beamforming subsystem to support wideband multi-INT sensing systems. Characterize and assess emerging over-the-horizon (OTH) radar technologies	2.978	2.784	17.960	0.000	17.960

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APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 627622: *RF Sensors & Countermeasures Tech*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
using modeling and simulation, experimentation, and demonstrations. Identify further research and development needed to advance the state-of-the-art in OTH radar. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A.					
MAJOR THRUST: Develop waveforms using transmit adaptivity and multi-mode operation, and multi-platform, multi-mission sensor and EW adaptive processing algorithms to improve sensor performance. *FY 2009 Accomplishments:* In FY 2009: Initiated and conducted experiments to demonstrate the advantages and performance improvements of adaptive transmit waveforms, new distributed signal processing techniques, and distributed sensing and electronic warfare/information operations for multi-band, multi-platform, multi-mode, and shared aperture applications. *FY 2010 Plans:* In FY 2010: Investigate and evaluate waveform diversity techniques and multiple-input/multiple-output adaptive processing algorithms to improve electronic protection functions in conventional and advanced radio-frequency systems. Continue development of distributed signal processing techniques to obtain high spatial resolution with limited transmit bandwidth, and to detect challenging targets such as those with low radar cross-section. *FY 2011 Base Plans:* In FY 2011: Develop new electronic protection techniques exploiting waveform diversity techniques and multiple-input/multiple-output adaptive processing algorithms. Develop operationally relevant approaches to the employment of distributed signal processing techniques to obtain high spatial resolution with limited transmit bandwidth, and to detect challenging targets such as those with low radar cross-section.	7.717	14.636	25.376	0.000	25.376

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APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 627622: *RF Sensors & Countermeasures Tech*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 OCO Plans: In FY 2011 OCO: N/A.					
MAJOR THRUST: Develop hybrid space-based sensor solutions to be responsive to space needs and detect difficult targets. Develop jam-resistant space-qualified time, position, and velocity sensors. *FY 2009 Accomplishments:* In FY 2009: Not Applicable. *FY 2010 Plans:* In FY 2010: Investigate optimal means of tightly coupling networked sensing platforms with their reference systems by leveraging onboard sensors observations as feedback to robustly calibrate the distributed, multi-platform reference. Conduct ground-based demonstration of modular payload building blocks compatible with operationally responsive space rapid integration requirements. *FY 2011 Base Plans:* In FY 2011: Continue to investigate optimal means of tightly coupling networked sensing platforms with their reference systems by leveraging onboard sensor observations as feedback to robustly calibrate the distributed, multi-platform reference. Demonstrate tightly coupled reference system technology both non-real-time and real time. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A.	0.000	5.243	4.633	0.000	4.633
MAJOR THRUST: Study adaptive processing techniques for large, multi-mission, space-based conformal arrays to meet the demands of wide area sensing in severe clutter and interference environments. *FY 2009 Accomplishments:* In FY 2009: Not Applicable.	0.000	1.725	0.821	0.000	0.821

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APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 627622: *RF Sensors & Countermeasures Tech*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2010 Plans: In FY 2010: Evaluate advanced surface moving target indication algorithms and computing architectures for high altitude, environmentally constrained radio frequency sensing system applications. Evaluate emissions mapping and bistatic radar techniques for providing space situational awareness. *FY 2011 Base Plans:* In FY 2011: Demonstrate an integrated radio frequency and electro-optical modeling and simulation toolset for an advanced space situational awareness architecture. Develop electronic protection (EP) techniques for space-based sensors, exploiting waveform diversity techniques and multiple-input/ multiple-output adaptive processing algorithms. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A.					
MAJOR THRUST: Develop multi-band and multi-beam forming technologies. Address technologies for antenna array operations in dynamic sensor networks. *FY 2009 Accomplishments:* In FY 2009: Not Applicable. *FY 2010 Plans:* In FY 2010: Demonstrate a responsive space payload. *FY 2011 Base Plans:* In FY 2011: Not Applicable. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A.	0.000	0.160	0.000	0.000	0.000

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APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 627622: *RF Sensors & Countermeasures Tech*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop sensor techniques to achieve highly accurate and robust navigation performance for hypersonic air vehicles in prompt global strike applications. *FY 2009 Accomplishments:* In FY 2009: Not Applicable. *FY 2010 Plans:* In FY 2010: Design a radio-frequency hardware-in-the-loop testbed to implement hypersonic air vehicle plasma characteristics, platform trajectories, and highly accurate and robust navigation techniques for space-based applications. Demonstrate a constructive systems engineering model to assess hypersonic navigation techniques in terms of measures of performance and warfighter utility. *FY 2011 Base Plans:* In FY 2011: Complete the design of a radio-frequency hardware-in-the-loop testbed to implement hypersonic air vehicle plasma characteristics, platform trajectories, and highly accurate and robust navigation techniques for space-based applications. Continue to demonstrate a constructive systems engineering model to assess hypersonic navigation techniques in terms of measures of performance and warfighter utility. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A.	0.000	1.116	2.318	0.000	2.318
Accomplishments/Planned Programs Subtotals	23.208	35.923	55.696	0.000	55.696

	FY 2009	FY 2010
Congressional Add: Weather Sensors for Cursor On Target.	1.596	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 627622: *RF Sensors & Countermeasures Tech*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Weather Sensors for Cursor On Target. *FY 2010 Plans:* In FY 2010: Not Applicable.		
Congressional Adds Subtotals	1.596	0.000

C. Other Program Funding Summary ($ in Millions)

Line Item	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
• PE Not Provided (10219): *Activity Not Provided*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0602500F: *Multi-Disciplinary Space Technology.*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0603203F: *Advanced Aerospace Sensors.*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0603253F: *Advanced Avionics Integration.*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0602782A: *Command, Control, Communications Technology.*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0602232N: *Navy C3 Technology.*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

D. Acquisition Strategy

Not Applicable.

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	**R-1 ITEM NOMENCLATURE** PE 0602204F: *Aerospace Sensors*	**PROJECT** 627622: *RF Sensors & Countermeasures Tech*

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.