Exhibit R-2, RDT&E Budget Item Justification: PB 2013 Air Force										DATE: February 2012	
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*				R-1 ITEM NOMENCLATURE PE 0602601F: *Space Technology*							
COST ($ in Millions)	**FY 2011**	**FY 2012**	**FY 2013 Base**	**FY 2013 OCO**	**FY 2013 Total**	**FY 2014**	**FY 2015**	**FY 2016**	**FY 2017**	**Cost To Complete**	**Total Cost**
Total Program Element	114.718	115.158	98.375	-	98.375	109.644	117.250	117.348	117.310	Continuing	Continuing
621010: *Space Survivability & Surveillance*	49.356	43.211	30.199	-	30.199	33.508	38.092	35.848	34.409	Continuing	Continuing
624846: *Spacecraft Payload Technologies*	23.703	21.577	22.336	-	22.336	21.902	20.862	20.379	22.595	Continuing	Continuing
625018: *Spacecraft Protection Technology*	5.079	5.915	4.230	-	4.230	4.905	7.549	6.689	6.902	Continuing	Continuing
628809: *Spacecraft Vehicle Technologies*	36.580	44.455	41.610	-	41.610	49.329	50.747	54.432	53.404	Continuing	Continuing

A. Mission Description and Budget Item Justification

This Program Element focuses on four major areas. First, space survivability and surveillance develops technologies to understand space weather and the geophysics environment for mitigation and exploitation of these effects to Air Force systems. Second, spacecraft payload technologies improve satellite payload operations by developing advanced component and subsystem capabilities. Third, spacecraft protection develops technologies for protecting U.S. space assets in potential hostile settings. The last major area, spacecraft vehicles, focuses on spacecraft platform and control technologies, and their interactions. Efforts in this program have been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary space technologies.

B. Program Change Summary ($ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
Previous President's Budget	111.857	115.285	114.885	-	114.885
Current President's Budget	114.718	115.158	98.375	-	98.375
Total Adjustments	2.861	-0.127	-16.510	-	-16.510
• Congressional General Reductions	-	-0.127			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	5.342	-			
• SBIR/STTR Transfer	-1.222	-			
• Other Adjustments	-1.259	-	-16.510	-	-16.510

Exhibit R-2, RDT&E Budget Item Justification: PB 2013 Air Force	DATE: February 2012
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602601F: *Space Technology*

Change Summary Explanation

FY11: Other Adjustments include -1.259 Congressional General Reductions

Decrease in FY13 is due to higher Department of Defense priorities.

Exhibit R-2A, RDT&E Project Justification: PB 2013 Air Force			DATE: February 2012
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602601F: *Space Technology*	PROJECT 621010: *Space Survivability & Surveillance*	

COST ($ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
621010: *Space Survivability & Surveillance*	49.356	43.211	30.199	-	30.199	33.508	38.092	35.848	34.409	Continuing	Continuing

A. Mission Description and Budget Item Justification

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
Title: Major Thrust 1.	8.612	7.653	5.420	-	5.420
Description: Develop technologies for specifying, monitoring, predicting, and controlling space environmental conditions hazardous to Department of Defense (DoD) operational space systems. ***FY 2011 Accomplishments:*** Developed improved solar energetic particle models. Completed validation of energetic particle measurements in multiple orbital regimes. Incorporated new simulation technologies into model of spacecraft electromagnetic and plasma environment. ***FY 2012 Plans:*** Complete improved database for solar flare prediction tool. Develop a new instrument to measure energetic electrons, ions, and neutral atoms in low earth orbit. Refine and expand models of the radiation belts using new data sets from recently launched spacecraft. ***FY 2013 Base Plans:*** Refine the concept-of-operations for solar flare prediction unit and complete the set up of the associated solar optics laboratory. Explore properties of spacecraft materials and novel coatings to understand effects of temperature and aging on spacecraft charging and develop new techniques for charge mitigation. Continue development of space environment models and tools to support improved spacecraft design and space mission planning. ***FY 2013 OCO Plans:***					

Exhibit R-2A, RDT&E Project Justification: PB 2013 Air Force		DATE: February 2012
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602601F: *Space Technology*	PROJECT 621010: *Space Survivability & Surveillance*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
N/A					
Title: Major Thrust 2. ***Description:*** Develop advanced target detection techniques, spectral signature libraries, and decision aids for space-based sensors and surveillance systems. ***FY 2011 Accomplishments:*** Demonstrated space-based detection of large booster missile launch through clouds. Conducted critical test of maneuver characterization sensor system with go-no-go decision point. Developed multi-phenomenology space situational awareness (SSA) sensors for space-based systems. Continued study of thermal infrared (IR) imaging spectrometer feasibility for space missions. ***FY 2012 Plans:*** Investigate space-based hypertemporal (HT) detection methods and data processing. Investigate utilization of HT detection methods for monitoring concealed activity. Continue to develop a search sensor system to monitor and characterize resident space objects and maneuver signatures. Refine concepts and applications for space-based thermal IR hyperspectral imaging payloads. Develop atmospheric compensation and temperature-emissivity separation models for space-based thermal infrared hyperspectral imaging. ***FY 2013 Base Plans:*** Evaluate space-based HT sensor performance. Complete HT data processing methodology and continue investigation of HT detection methods for concealed activity monitoring. Continue trade-space studies of components used in space-based thermal IR hyperspectral imaging payloads. Begin development of case scenarios and sensitivity analyses of atmospheric compensation and temperature-emissivity separation codes required for space-based thermal infrared hyperspectral imaging. ***FY 2013 OCO Plans:*** N/A	14.752	10.923	5.213	-	5.213
Title: Major Thrust 3. ***Description:*** Develop techniques, forecasting tools, and sensors for ionospheric specification and forecasting, space-based geolocation demonstrations, and determination of potential radar degradation. ***FY 2011 Accomplishments:***	8.919	7.601	8.441	-	8.441

Exhibit R-2A, RDT&E Project Justification: PB 2013 Air Force		DATE: February 2012
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602601F: *Space Technology*	PROJECT 621010: *Space Survivability & Surveillance*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
Delivered validated algorithm to simulate ionospheric effects on wideband radio frequency waveforms for arbitrary propagation paths to support many applications. Improved assimilation of ionospheric models and identified deficiencies in forecast models. Tested physics-based neutral density models forecasting capabilities, particularly during magnetic storms. ***FY 2012 Plans:*** Investigate methods to exploit grid-free calculations of plasma processes in the magnetosphere and ionosphere, as well as in the solar atmosphere and solar wind. Study energy flow between solar and terrestrial environments to improve solar weather forecasts. Study plasma instabilities and plasma processes in the equatorial and solar ionospheres. Incorporate coupled physics-based models into space weather forecasts. ***FY 2013 Base Plans:*** Incorporate methods to exploit grid-free calculations of plasma processes in the magnetosphere and ionosphere to improve solar weather forecasts. Begin modeling energy flow between solar and terrestrial environments. Study plasma instabilities and processes in the equatorial ionosphere to predict global positioning system and communication impacts. ***FY 2013 OCO Plans:*** N/A					
Title: Major Thrust 4.	10.822	10.890	4.933	-	4.933
Description: Conduct Radiation Belt Remediation (RBR) and ionospheric research at the High-frequency Active Auroral Research Program (HAARP) site and maintain and upgrade the transmitting and diagnostic instrument infrastructure. ***FY 2011 Accomplishments:*** Conducted research programs to develop controlled processes of triggered optical and infrared emissions and radio scintillation for potential DoD applications. Developed experiment using Demonstration and Science Experiment (DSX) satellite and HAARP based on studies and feedback from physical models. ***FY 2012 Plans:*** Conduct applications-related demonstrations exploiting ionosphere ducts for very long-range, beyond the horizon, communications and surveillance purposes. Conduct research to characterize the interactions of radio waves and charged particles in the earth's radiation belts, using DSX satellite experiments. Develop Radiation					

Exhibit R-2A, RDT&E Project Justification: PB 2013 Air Force		DATE: February 2012
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602601F: *Space Technology*	PROJECT 621010: *Space Survivability & Surveillance*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
Belt Remediation (RBR) end-to-end model and validate to improve understanding of wave particle interaction, space transmitter, and lightning phenomenology. Investigate options for future use of HAARP. ***FY 2013 Base Plans:*** Conduct research to characterize the interactions of radio waves and charged particles in the earth's radiation belts, using DSX satellite experiments. Apply understanding of very low frequency (VLF) propagation from space sources and the resulting wave particle interactions. Develop a validated end-to-end model to assess the feasibility of a fielded RBR system. Implement selected options for HAARP operations. ***FY 2013 OCO Plans:*** N/A					
Title: Major Thrust 5. ***Description:*** Develop seismic technologies to support national requirements for monitoring nuclear explosions with special focus on regional distances less than 2,000 kilometers from the sensors. ***FY 2011 Accomplishments:*** Tested and implemented refined techniques for automated processing of increasing numbers of seismic events. Tested and refined unified model results of seismic calibration and observational studies of seismic wave propagation, including propagation in Eurasia. Conducted detailed studies of particular challenge areas in local seismic monitoring. ***FY 2012 Plans:*** Complete refinement of unified model results of seismic calibration and observational studies of seismic wave propagation, including propagation in Eurasia. Evaluate the results of using three-dimensional earth models in test processing of seismic events for some regions of high interest. Test potential improvements in high-frequency regional discrimination. Continue detailed studies of particular challenge areas in local seismic monitoring. ***FY 2013 Base Plans:*** Migrate unified models of seismic calibration and wave propagation in Eurasia to three-dimensional physics-based models. Begin to extend coverage of unified model to all of Eurasia. Test new processing approaches to image local seismic structure. ***FY 2013 OCO Plans:***	6.251	6.144	6.192	-	6.192

Exhibit R-2A, RDT&E Project Justification: PB 2013 Air Force		DATE: February 2012
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602601F: *Space Technology*	PROJECT 621010: *Space Survivability & Surveillance*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
N/A					
Accomplishments/Planned Programs Subtotals	49.356	43.211	30.199	-	30.199

C. Other Program Funding Summary ($ in Millions)

Line Item	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
• N/A: *N/A*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

D. Acquisition Strategy

N/A

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2A, RDT&E Project Justification: PB 2013 Air Force			DATE: February 2012
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602601F: *Space Technology*	PROJECT 624846: *Spacecraft Payload Technologies*	

COST ($ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
624846: *Spacecraft Payload Technologies*	23.703	21.577	22.336	-	22.336	21.902	20.862	20.379	22.595	Continuing	Continuing

A. Mission Description and Budget Item Justification

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
Title: Major Thrust 1.	5.716	6.092	6.618	-	6.618
Description: Develop advanced infrared device technologies that enable hardened space detector arrays with improved detection to perform acquisition, tracking, and discrimination of space objects and missile warning. ***FY 2011 Accomplishments:*** Demonstrated tuning from 15 to 20 microns in 1 micron increments. Demonstrated field enhancement technology. Completed predictive capability for next generation of large format technology challenges. Initiated predictive capability for next generation of large format detector array and readout array technology challenges. Began space object remote characterization study. ***FY 2012 Plans:*** Expand predictive capability for next generation large format detector array and readout array technology challenges toward Wide Area, Global Access Detection and Tracking. Further explore space object remote characterization for adaptive, comprehensive SSA. Study effects of surface roughness on distant object polarization signature. Develop methodologies and technologies for on-orbit payload calibration and planning, emphasizing electro-optical payloads. ***FY 2013 Base Plans:*** Continue predictive capability for next generation large format detector array and readout array technology challenges toward Wide Area, Global Access Detection and Tracking. Explore new detector architectures/					

Exhibit R-2A, RDT&E Project Justification: PB 2013 Air Force		DATE: February 2012
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602601F: *Space Technology*	PROJECT 624846: *Spacecraft Payload Technologies*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
methods of space object remote characterization for adaptive, comprehensive SSA. Demonstrate automated checkout and calibration technologies in a testbed environment. ***FY 2013 OCO Plans:*** N/A					
Title: Major Thrust 2. ***Description:*** Develop spectral sensing and data exploitation methodologies for military imaging and remote sensing applications. ***FY 2011 Accomplishments:*** Further refined models for space-based spectral imaging to include additional space-based situational awareness imaging concepts and operationally responsive SSA scenarios. ***FY 2012 Plans:*** Continue analysis and basic experimentation in new sensing methods using radio frequency (RF) bands, polarimetry, and non-traditional interferometric techniques. ***FY 2013 Base Plans:*** Continue algorithm development and performance simulation to synthesize sensor input from multiple sources, onboard and off-board, to provide executable defensively based situational awareness. ***FY 2013 OCO Plans:*** N/A	5.366	5.382	5.771	-	5.771
Title: Major Thrust 3. ***Description:*** Develop technologies for space-based payload components such as radiation-hardened electronic devices, micro-electro-mechanical system devices, and advanced electronics packaging. ***FY 2011 Accomplishments:*** Applied the basic physical understanding of the operation of phase change materials to analog computing and device trimming applications. Transitioned radiation mitigation processes using minimally invasive techniques into libraries at major commercial foundries at the 95 nanometer (nm) and 65nm nodes. Initiated program to capitalize on high performance thermoelectric cooling devices applied to focal plane arrays. ***FY 2012 Plans:***	6.726	4.861	4.614	-	4.614

Exhibit R-2A, RDT&E Project Justification: PB 2013 Air Force		DATE: February 2012
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602601F: *Space Technology*	PROJECT 624846: *Spacecraft Payload Technologies*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
Investigate high power microwave hardening techniques for satellite systems to develop methodologies to mitigate against narrowband high power microwaves over a wide frequency range. Begin research on advanced system-on-chip integration for improved performance of space sensor systems. Complete development of radiation hardened plug-and-play interface module for reconfigurable spacecraft hardware. Initiate development of integrated modules using three-dimensional techniques to reduce size, weight, and power and increase performance. ***FY 2013 Base Plans:*** Continue investigation of hardening techniques to protect satellites from high power microwaves. Continue research on advanced system-on-chip integration for improved performance of space sensor systems. Continue development of integrated modules using three-dimensional techniques to reduce size, weight, and power and increase performance. ***FY 2013 OCO Plans:*** N/A					
Title: Major Thrust 4. ***Description:*** Develop modeling and simulation tools for space-based ground surveillance systems, rendezvous and proximity operations, imaging of space systems, distributed satellite architecture, and space control payloads. ***FY 2011 Accomplishments:*** Began development of engineering, military utility, and cost tools that model object characterization for space superiority analysis of SSA and defensive space control technologies. Integrated data from flight experiments to refine simulations. Finished development of first-generation decision support tools for space superiority. Expanded testbed to include resource management testing capability. ***FY 2012 Plans:*** Develop engineering and military utility models for space superiority analysis of SSA and defensive operations technologies. Support more autonomous space flight experiments with cost modeling and trade studies. ***FY 2013 Base Plans:***	5.030	4.692	4.362	-	4.362

Exhibit R-2A, RDT&E Project Justification: PB 2013 Air Force		DATE: February 2012
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602601F: *Space Technology*	PROJECT 624846: *Spacecraft Payload Technologies*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
Continue to refine and test spacecraft simulations that model system performance, mission planning, and experiments for future flight experiments. Develop a data center to be able to archive telemetry from flight experiments. ***FY 2013 OCO Plans:*** N/A					
Title: Major Thrust 5. ***Description:*** Develop technologies for next-generation space communications terminals and equipment and methods/techniques to enable future space system operational command and control concepts. ***FY 2011 Accomplishments:*** Completed engineering model and selected technology for space experiment on enhanced communication platform. ***FY 2012 Plans:*** Research technologies/components that support optical communication, reconfigurable and cognitive communication, advanced RF communication, and communication security to increase the capacity and flexibility of current and future space protected communication system concepts. ***FY 2013 Base Plans:*** Continue development of compact, low power satellite communication systems and components with focus on flexibility and resilience for Air Force specific missions. ***FY 2013 OCO Plans:*** N/A	0.865	0.550	0.971	-	0.971
Accomplishments/Planned Programs Subtotals	23.703	21.577	22.336	-	22.336

C. Other Program Funding Summary ($ in Millions)

Line Item	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
• N/A: *N/A*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2013 Air Force		DATE: February 2012
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602601F: *Space Technology*	PROJECT 624846: *Spacecraft Payload Technologies*

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2A, RDT&E Project Justification: PB 2013 Air Force			DATE: February 2012
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602601F: *Space Technology*	PROJECT 625018: *Spacecraft Protection Technology*	

COST ($ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
625018: *Spacecraft Protection Technology*	5.079	5.915	4.230	-	4.230	4.905	7.549	6.689	6.902	Continuing	Continuing

A. Mission Description and Budget Item Justification

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
Title: Major Thrust 1.	5.079	5.915	4.230	-	4.230
Description: Develop satellite threat warning technologies and tools for space defense. Exploit on-board inherent satellite resources, satellite-as-a-sensor, and self-aware satellite technologies. ***FY 2011 Accomplishments:*** Completed laboratory testing of potential defensive subsystems. Developed performance goals using engineering models. Transitioned dual usage sensor technology to multiple satellite systems. ***FY 2012 Plans:*** Develop technologies for on-orbit threat detection, assessment, and response, including development of algorithms for pursuit-evasion, space-based tasking, and co-orbital threat detection. Reduce size, weight, and power requirements for next-generation proximity detection sensors. ***FY 2013 Base Plans:*** Continue technology development of advanced on-orbit threat detection, assessment, and response, including data processing and handling for course of action determination, space-based tasking, and co-orbital threat detection. Reduce size, weight, and power for next-generation proximity detection sensors. ***FY 2013 OCO Plans:*** N/A					
Accomplishments/Planned Programs Subtotals	5.079	5.915	4.230	-	4.230

Exhibit R-2A, RDT&E Project Justification: PB 2013 Air Force		DATE: February 2012
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602601F: *Space Technology*	PROJECT 625018: *Spacecraft Protection Technology*

C. Other Program Funding Summary ($ in Millions)

Line Item	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
• N/A: *N/A*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

D. Acquisition Strategy

N/A

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2A, RDT&E Project Justification: PB 2013 Air Force			DATE: February 2012
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602601F: *Space Technology*	PROJECT 628809: *Spacecraft Vehicle Technologies*	

COST ($ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
628809: *Spacecraft Vehicle Technologies*	36.580	44.455	41.610	-	41.610	49.329	50.747	54.432	53.404	Continuing	Continuing

A. Mission Description and Budget Item Justification

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
Title: Major Thrust 1.	4.682	7.575	4.977	-	4.977
Description: Develop technologies for advanced space platform subsystems such as cryocoolers, compact, high efficiency solar power cells and arrays, and innovative power generation concepts. ***FY 2011 Accomplishments:*** Completed cryocooler component and system models with experimental data, and began to analyze cryocoolers as a single unit. Began to develop full-scale design equations for cryocoolers, increasing efficiency by 20% and decreasing manufacturing time by 200%. Demonstrated integrated, monolithic thin-film tandem solar cell. Demonstrated subcomponents of ultra high efficiency solar cell. ***FY 2012 Plans:*** Begin effort to increase cryocooler efficiency from 12% to 30% through in-house modeling, energy analysis of single and multi-stage coolers, and distributed cooling. Begin to research effective low and zero vibration cryocooler technologies, including solid state coolers. Model spacecraft thermal radiation signature phenomenology to understand the physics of IR sensing of resident space objects. Continue development of materials and concepts for 40% or greater solar cells. Demonstrate cell interconnect and module technologies to enable flexible arrays. ***FY 2013 Base Plans:*** Continue to increase cryocooler efficiency from 12% to 30% through modeling, energy analysis of single and multi-stage coolers, and cross gimbal/distributed cooling. Continue to research effective low and zero vibration cryocooler technologies, including solid state coolers. Continue to investigate approaches and concepts for					

Exhibit R-2A, RDT&E Project Justification: PB 2013 Air Force		DATE: February 2012
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602601F: *Space Technology*	PROJECT 628809: *Spacecraft Vehicle Technologies*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
development of greater than 40% solar cells. Continue development of novel flexible array technologies to enable greater launch volume stowage efficiency. ***FY 2013 OCO Plans:*** N/A					
Title: Major Thrust 2. ***Description:*** Develop revolutionary and enabling technologies, including lighter weight, lower cost, high performance structures for space platforms; guidance, navigation, and controls hardware and software for next generation of space superiority systems. ***FY 2011 Accomplishments:*** Developed integrated thermal management subsystems for satellites. Developed nano-reinforced structures for space applications. Developed advanced guidance, navigation, and control algorithms for rapid integration and test of satellite hardware. Developed autonomous guidance, navigation, and control algorithms for proximity operations. ***FY 2012 Plans:*** Complete integrated thermal management subsystem for satellites applications. Develop novel technologies for high-efficiency deployable structures for RF frequencies and electro-optical payloads for SSA. Develop automated guidance, navigation, and control subsystem design tools for spacecraft. Investigate non-cooperative control techniques for orbital debris removal applications. Initiate development of advanced estimation-based algorithms for search, detect and track of space objects. Initiate development of next-generation electronics to enable more rapid spacecraft build and reduce spacecraft cost. Develop technologies for integrated satellite bus checkout and sensor calibration using autonomous flight architecture. ***FY 2013 Base Plans:*** Produce experimental flight hardware for thermal management of high power systems. Develop capabilities for characterizing novel, structural materials in a relevant environment. Complete efforts for automated guidance, navigation, and control subsystem design tools for spacecraft. Demonstrate and transition advanced estimation-based algorithms for search, detect, and track of space objects. Continue development of next-generation electronics to enable rapid spacecraft build and reduce spacecraft cost. Demonstrate autonomous flight architecture enabling rapid software configuration and checkout. ***FY 2013 OCO Plans:***	17.232	15.683	11.714	-	11.714

Exhibit R-2A, RDT&E Project Justification: PB 2013 Air Force		DATE: February 2012
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602601F: *Space Technology*	PROJECT 628809: *Spacecraft Vehicle Technologies*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
N/A					
Title: Major Thrust 3. ***Description:*** Develop flight experiments to improve the capabilities of existing operational space systems and to enable new transformational space capabilities. ***FY 2011 Accomplishments:*** Performed ground-based experiments in support of radiation belt remediation technologies. Completed DSX and payload integration and functional/environmental testing for radiation belt remediation payload. Completed development of ground support equipment and software. ***FY 2012 Plans:*** Complete assembly, integration, and test of the DSX satellite to launch ready. Continue operations concept planning and development and design and build DSX mission planning tools for on-orbit operations. ***FY 2013 Base Plans:*** Begin launch readiness preparations, electrical trailblazer, insertion of flight batteries and communications security equipment, and regression testing with satellite operations center in preparation for integration on the launch vehicle. ***FY 2013 OCO Plans:*** N/A	14.666	21.197	24.919	-	24.919
Accomplishments/Planned Programs Subtotals	36.580	44.455	41.610	-	41.610

C. Other Program Funding Summary ($ in Millions)

Line Item	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
• N/A: *N/A*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

D. Acquisition Strategy

N/A

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.