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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Air Force **Date:** March 2023

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602605F / <i>Directed Energy Technology</i>
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
Total Program Element	-	109.529	120.947	129.961	0.000	129.961	125.474	117.680	120.193	131.935	Continuing	Continuing
624866: <i>Lasers & Imaging Technology</i>	-	0.000	25.305	26.254	0.000	26.254	23.471	23.991	24.493	28.703	Continuing	Continuing
624867: <i>Advanced Weapons & Survivability Technology</i>	-	32.371	60.896	80.652	0.000	80.652	79.350	70.182	71.839	78.507	Continuing	Continuing
625173: <i>Laser Technology</i>	-	77.158	34.746	23.055	0.000	23.055	22.653	23.507	23.861	24.725	Continuing	Continuing

A. Mission Description and Budget Item Justification

This program covers research in Directed Energy (DE) technologies, primarily High Energy Lasers (HEL) and High Power Electromagnetics (HPEM). High Energy Lasers (HEL) research includes moderate to high continuous power laser devices that are applicable to a wide range of applications, optical technologies to propagate laser beams through the atmosphere, and integration of these technologies into demonstration packages. High power microwaves research examines technologies for applications such as counter-electronics and nonlethal weapons. This program conducts research into other novel Directed Energy applications; conducts Directed Energy vulnerability/lethality assessments; develops protection technologies versus Directed Energy; conducts research into other advanced non-conventional/innovative weapons; develops and uses tools to compare solutions to determine the most effective and efficient Directed Energy technologies to meet Air Force needs; coordinates efforts through the Department of Defense Science and Technology Executive Committee process to harmonize efforts and eliminate duplication.

This program element may include necessary civilian pay expenses required to manage, execute, and deliver science & technology capabilities. The use of program funds in this PE would be in addition to the civilian pay expenses budgeted in program elements 0601102F, 0602102F, 0602201F, 0602202F, 0602203F, 0602204F, 0602602F, 0602788F, 1206601SF, and 0602298F.

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

Funds in this PE may be used to investigate specified technology advancements in air, space and/or cyber domains.

This program is in Budget Activity 2, Applied Research because this budget activity includes studies, investigations, and non-system specific technology efforts directed toward general military needs with a view toward developing and evaluating the feasibility and practicality of proposed solutions and determining their parameters.

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B. Program Change Summary (\$ in Millions)	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total
Previous President's Budget	116.456	109.302	112.221	0.000	112.221
Current President's Budget	109.529	120.947	129.961	0.000	129.961
Total Adjustments	-6.927	11.645	17.740	0.000	17.740
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	20.000			
• Congressional Directed Transfers	0.000	-8.355			
• Reprogrammings	0.000	0.000			
• SBIR/STTR Transfer	-6.920	0.000			
• Other Adjustments	-0.007	0.000	17.740	0.000	17.740

Congressional Add Details (\$ in Millions, and Includes General Reductions)

Project: 625173: *Laser Technology*

Congressional Add: *Program Increase - directed energy research*

Congressional Add: *Program increase - counter-UAS directed energy effectiveness*

Congressional Add: *Program increase - early detection of threats*

Congressional Add Subtotals for Project: 625173

Congressional Add Totals for all Projects

	FY 2022	FY 2023
	-	5.000
	-	5.000
	-	10.000
	-	20.000
	-	20.000

Change Summary Explanation

Funding increase due to multi-year surge of funding developing and building sources supporting high priority, real-world events and higher Air Force priorities.

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Appropriation/Budget Activity 3600 / 2					R-1 Program Element (Number/Name) PE 0602605F / <i>Directed Energy Technology</i>				Project (Number/Name) 624866 / <i>Lasers & Imaging Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
624866: <i>Lasers & Imaging Technology</i>	-	0.000	25.305	26.254	0.000	26.254	23.471	23.991	24.493	28.703	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project explores the technical feasibility of moderate to high power lasers, including beam control, for applications such as aircraft protection, force protection, and precision engagement from the Department of the Air Force platforms. This project investigates the effects of laser weapons on a wide range of systems and components as well as producing, modifying, validating and applying Directed Energy and non-Directed Energy concept development and assessment tools to determine which technology solutions to pursue.

In FY 2022, a portion of PE 0602605F, the optical space domain awareness and satellite vulnerability efforts of PE 0602605F, Directed Energy Technology, Project 624866, Lasers & Imaging Technology, was transferred to Appropriation 3620, Research, Development, Test & Evaluation, Space Force, PE 1206601SF, Space Technology, Project 624866, Lasers & Imaging Technology from Appropriation 3600, Budget Activity 2 due to the creation of a new Appropriation for Space Force.

B. Accomplishments/Planned Programs (\$ in Millions)

	FY 2022	FY 2023	FY 2024
Title: High Energy Laser Technologies and Directed Energy Assessments	0.000	25.305	26.254
Description: This effort explores the technical feasibility of moderate to high power lasers, including beam control, for applications such as aircraft protection, force protection, and precision engagement from the Department of the Air Force platforms. This project investigates the effects of laser weapons on a wide range of systems and components as well as producing, modifying, validating and applying Directed Energy and non-Directed Energy concept development and assessment tools to determine which technology solutions to pursue.			
FY 2023 Plans: Complete testing of the effects of a 2 micron (um) wavelength laser on targets of interest and make decision on path for improving compactness and power. Continue planning to demonstrate 100 Watt average power for Beacon Illuminating Laser used for target acquisition. Continue development of fiber optic amplifiers that are more resistant to nonlinear effects. Complete fiber optic gyro to enable next generation optical Inertial Reference Unit (IRU).			
FY 2024 Plans: Continue assessment and development of sources for beacon/tracking illuminator lasers and associated tracking and pointing improvements. Continue planning to demonstrate 100 Watt average power for beacon illuminating laser used for target acquisition. Continue development of fiber optic amplifiers that are more resistant to nonlinear effects.			
FY 2023 to FY 2024 Increase/Decrease Statement:			

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Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602605F / <i>Directed Energy Technology</i>	Project (Number/Name) 624866 / <i>Lasers & Imaging Technology</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
FY 2024 increased compared to FY 2023 by \$0.949 million. Funding increase as described in the plans above.			
Accomplishments/Planned Programs Subtotals	0.000	25.305	26.254

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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Appropriation/Budget Activity 3600 / 2					R-1 Program Element (Number/Name) PE 0602605F / <i>Directed Energy Technology</i>				Project (Number/Name) 624867 / <i>Advanced Weapons & Survivability Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
624867: <i>Advanced Weapons & Survivability Technology</i>	-	32.371	60.896	80.652	0.000	80.652	79.350	70.182	71.839	78.507	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project explores the use of High Power Microwave and other unconventional/innovative weapon concepts to support applications on the Department of the Air Force platforms such as base defense and electronic warfare including disruption, degradation, and damage of electronic infrastructure. This research includes weapon technology that can provide covert effects and/or no collateral or human damage. The project also investigates the effects of potential adversary High Power Microwave weapons and how to mitigate those effects on US assets, as well as producing and applying Directed Energy and non-Directed Energy concept development and assessment tools to determine which technology solutions to pursue. This project includes but is not limited to high power microwaves, plasmas, particle beams, and millimeter waves

B. Accomplishments/Planned Programs (\$ in Millions)

	FY 2022	FY 2023	FY 2024
Title: High Power Microwave and Unconventional Weapon Technologies	12.504	23.522	38.417
Description: Investigate technologies for High Power Microwave and unconventional weapon components. Investigate High Power Microwave and other unconventional weapon concepts using innovative technologies. Investigate advanced technologies that support force protection tactical applications, including non-kinetic/non-lethal counter-electronics applications.			
FY 2023 Plans: Continue effects testing and propagation experiments to define the performance requirements to develop an ultra-short pulsed laser system. Continue designing and developing high power microwave technology that will be integrated into an airborne platform for the next generation Department of the Air Force airborne high power microwave technology demonstration. Continue developing smaller, higher power source technology with all support components to enable the next generation Department of the Air Force high power microwave demonstration. Continue testing high power microwave components for ground and aerial high power microwave demonstrators. Continue supporting the modeling, simulation, and analysis tools that have been transitioned to the broader modeling, simulation, and analysis community.			
FY 2024 Plans: Complete effects testing and propagation experiments to define the performance requirements to develop an ultra-short pulsed laser system. Complete design and develop high power microwave technology that could be integrated into an airborne platform for the next generation Department of the Air Force airborne high power microwave technology demonstration. Continue developing smaller, higher power source technology with all support components to enable the next generation Department of the Air Force high power microwave demonstration. Continue testing high power microwave components for ground and aerial high power microwave demonstrators. Continue supporting the modeling, simulation, and analysis tools that have been transitioned			

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
to the broader modeling, simulation, and analysis community. Initiate research to build sources to address high priority, real-world events. Initiate increased effort to research microwave propagation through arctic environments and effects to support future airborne applications. FY 2023 to FY 2024 Increase/Decrease Statement: FY 2024 increased compared to FY 2023 by \$14.895 million. Funding increase due to multi-year surge of funding developing and building sources supporting high priority, real-world events and reflects increased emphasis on microwave propagation and effects in support of future airborne microwave applications.				
Title: High Power Microwave Effects Description: Assess the effects/lethality of High Power Microwave technologies. Develop and apply sophisticated models to enhance the development of High Power Microwave and related technology. Develop tools and perform assessments which allow comparisons among Directed Energy concepts and tradeoffs between Directed Energy and non-Directed Energy solutions. FY 2023 Plans: Continue supporting software applications that are hosted in the directed energy High Performance Computing Software Applications Institute for broad spectrum directed energy sources. Continue populating database of high power sources. Continue conducting military utility assessment of high power microwave weapon technology that is integrated into various platforms for multiple target engagements using end-to-end modeling. Continue assessing synergistic weapon concepts that merge kinetic energy and non-kinetic high power microwave weapon capabilities into one weapon system. Continue supporting the modeling, simulation, and analysis tools that have been transitioned to the broader modeling, simulation, and analysis community. Continue validation of the modeling, simulation, and analysis tools that have been transitioned to the broader modeling, simulation, and analysis community. FY 2024 Plans: Complete the transition of software applications hosted in the directed energy High Performance Computing Software Applications Institute for a broad spectrum directed energy sources. Continue populating the database of high power sources to include solid-state sources. Initiate increased effort conducting military utility assessments of high power microwave weapon technology integrated into the kill-chain for multiple target engagements using end-to-end mission level modeling. Continue assessing synergistic weapon concepts that merge kinetic energy and non-kinetic high power microwave weapon capabilities into one weapon system. Continue supporting the modeling, simulation, and analysis tools that have been transitioned to the broader modeling, simulation, and analysis community. Complete validation of the modeling, simulation, and analysis tools that have been transitioned to the broader modeling, simulation, and analysis community. Complete transitioning of the validated modeling, simulation, and analysis tools to the broader modeling, simulation, and analysis community. FY 2023 to FY 2024 Increase/Decrease Statement:		19.867	37.374	42.235

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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
FY 2024 increased compared to FY 2023 by \$4.861 million. Funding increase due to emphasis on the development of full kill chain integration of high-power microwave weapons.			
Accomplishments/Planned Programs Subtotals	32.371	60.896	80.652

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not Applicable

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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
625173: <i>Laser Technology</i>	-	77.158	34.746	23.055	0.000	23.055	22.653	23.507	23.861	24.725	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project explores the technical feasibility of moderate to high continuous power lasers, including beam control, for applications such as aircraft protection, base protection, and precision engagement from the Department of the Air Force platforms. This project investigates the effects of laser weapons on a wide range of systems and components as well as producing, modifying, validating and applying Directed Energy and non-Directed Energy concept development and assessment tools to determine which technology solutions to pursue.

B. Accomplishments/Planned Programs (\$ in Millions)

	FY 2022	FY 2023	FY 2024
<p>Title: Laser Technology</p> <p>Description: Develop and demonstrate High Energy Laser device technologies for the Department of the Air Force applications. Develop and demonstrate laser beam control technologies including atmospheric propagation and pointing and tracking. Perform laser system level modeling and simulation validated by laser effects and vulnerability testing. Develop tools and perform assessments which allow comparisons among concepts and tradeoffs between Directed Energy and non-Directed Energy solutions. Integrate optical beam control technologies with laser device technologies and demonstrate the combined technologies. Develop and use modeling, testing and diagnostic technologies to better understand the vulnerability of adversary weapon systems to High Energy Lasers.</p> <p>FY 2023 Plans: Continue development and validation of the predictive physics-based End-to-End model that covers all elements of laser weapon systems (LWS)-photon "birth to death". Continue to develop laser vulnerability models for high-priority emerging threat systems. Continue to transition the models to the Department of Defense and Industry Modeling, Simulation and Analysis community. Conduct table top exercises and focused wargames to develop concepts of employment for directed energy weapons in representative scenarios and vignettes.</p> <p>FY 2024 Plans: Continue development and validation of the predictive physics-based end-to-end model that covers all elements of laser weapon systems (LWS)-photon "birth to death". Initiate increase emphasis assessment of electric laser sources for all Air Force Directed Energy applications. Continue and increase effort on developing laser vulnerability models for high-priority emerging threat systems. Continue transitioning models to the Department of Defense and industry modeling, simulation, and analysis community. Continue tabletop exercises and focused wargames to develop concepts of employment for directed energy weapons in representative scenarios and vignettes.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement:</p>	77.158	14.746	23.055

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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
FY 2024 increase compared to FY 2023 by \$8.309 million. Funding increase due to additional emphasis of electric laser sources and development laser vulnerability models.			
Accomplishments/Planned Programs Subtotals	77.158	14.746	23.055

	FY 2022	FY 2023
Congressional Add: Program Increase - directed energy research <i>FY 2023 Plans:</i> Conduct Congressional directed efforts.	-	5.000
Congressional Add: Program increase - counter-UAS directed energy effectiveness <i>FY 2023 Plans:</i> Conduct Congressional directed efforts.	-	5.000
Congressional Add: Program increase - early detection of threats <i>FY 2023 Plans:</i> Conduct Congressional directed efforts.	-	10.000
Congressional Adds Subtotals	-	20.000

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

Non Applicable