Exhibit R-2, RDT&E Budget Item Justification: PB 2025 Navy											Date: March 2024	
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 1: *Basic Research*					R-1 Program Element (Number/Name) PE 0601153N *I Defense Research Sciences*							
COST ($ in Millions)	**Prior Years**	**FY 2023**	**FY 2024**	**FY 2025 Base**	**FY 2025 OCO**	**FY 2025 Total**	**FY 2026**	**FY 2027**	**FY 2028**	**FY 2029**	**Cost To Complete**	**Total Cost**
Total Program Element	0.000	529.385	540.908	483.914	-	483.914	493.280	566.144	587.461	637.879	Continuing	Continuing
0000: *Defense Research Sciences*	0.000	469.411	520.984	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	990.395
1099: *Experimentation and Analysis*	0.000	0.000	0.000	6.478	-	6.478	6.391	6.977	7.131	8.440	Continuing	Continuing
1385: *Aerospace Sciences*	0.000	0.000	0.000	24.636	-	24.636	26.623	35.237	40.492	41.844	Continuing	Continuing
1386: *Biomedical*	0.000	0.000	0.000	4.794	-	4.794	4.864	5.150	5.183	5.643	Continuing	Continuing
1387: *Biotechnology*	0.000	0.000	0.000	27.215	-	27.215	28.553	32.399	32.866	35.704	Continuing	Continuing
1388: *Directed Energy*	0.000	0.000	0.000	8.326	-	8.326	5.015	6.052	6.779	8.245	Continuing	Continuing
1389: *Electromagnetic Spectrum*	0.000	0.000	0.000	9.097	-	9.097	9.344	14.294	18.035	17.710	Continuing	Continuing
1390: *Electronics*	0.000	0.000	0.000	50.277	-	50.277	51.892	61.093	63.147	68.848	Continuing	Continuing
1391: *Full Spectrum Cyber*	0.000	0.000	0.000	10.817	-	10.817	10.744	11.502	11.635	12.665	Continuing	Continuing
1392: *Human Systems*	0.000	0.000	0.000	38.644	-	38.644	38.930	41.392	41.980	45.714	Continuing	Continuing
1393: *Kinetic Weapons*	0.000	0.000	0.000	6.937	-	6.937	10.164	11.356	11.867	12.918	Continuing	Continuing
1394: *Manufacturing*	0.000	0.000	0.000	0.391	-	0.391	0.408	1.343	2.077	2.601	Continuing	Continuing
1395: *Materials*	0.000	0.000	0.000	55.448	-	55.448	56.641	64.745	66.776	72.687	Continuing	Continuing
1396: *Naval Engineering*	0.000	0.000	0.000	25.922	-	25.922	25.960	28.849	28.428	31.304	Continuing	Continuing
1398: *Ocean Atmosphere and Space Sciences*	0.000	0.000	0.000	118.935	-	118.935	120.602	137.247	139.539	151.897	Continuing	Continuing
1400: *Power and Energy*	0.000	0.000	0.000	21.014	-	21.014	21.203	23.865	24.391	27.417	Continuing	Continuing
1401: *Undersea Systems Payloads and Weapons*	0.000	0.000	0.000	5.782	-	5.782	5.765	6.262	6.364	6.927	Continuing	Continuing
1402: *Naval STEM*	0.000	0.000	0.000	17.482	-	17.482	18.143	19.433	19.776	21.527	Continuing	Continuing
3465: *In-House Lab Independent Res*	0.000	18.947	19.924	17.939	-	17.939	18.259	21.619	22.494	23.519	Continuing	Continuing
5893: *Decision Superiority*	0.000	0.000	0.000	33.780	-	33.780	33.779	37.329	38.501	42.269	Continuing	Continuing
9999: *Congressional Adds*	0.000	41.027	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	41.027

Exhibit R-2, RDT&E Budget Item Justification: PB 2025 Navy	Date: March 2024
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy* / BA 1: *Basic Research*	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*

A. Mission Description and Budget Item Justification

The Office of Naval Research (ONR) was established by Congress in 1946 to plan, foster and encourage scientific research in recognition of its paramount importance to the maintenance of American naval power and national security. ONR manages the Department of the Navy's (DON) portfolio of Basic Research (BA1), Applied Research (BA2) and Advanced Technology Development (BA3) investments to ensure naval forces can effectively deter conflict, but when called upon, are equipped and prepared to fight, win and return home safely. This Defense Research Sciences (DRS) Program Element (PE) supports the Basic Research (BA1) portion of the Department of the Navy (DON) science and technology (S&T) portfolio, laying the foundation for new innovative technologies and future capabilities for naval warfighters. Basic research conducted within this PE include theoretical and experimental investigations directed toward increasing our knowledge and understanding of the physical, chemical, engineering, environmental and life sciences. The preponderance of research conducted within this PE is performed by academia and government labs, both of which play significant roles in developing the S&T workforce of tomorrow in addition to delivery new knowledge and scientific discoveries.

This PE supports higher guidance defined by the National Defense Strategy, and responds to requirements identified by the Secretary of the Navy (SECNAV) through research priorities set by the Chief of Naval Research (CNR) and coordinated across the Naval Research Enterprise (NRE). Research activities support long-term investments as outlined in an S&T Strategic Plan. The basic research conducted within this PE supports areas of traditional, unique and emerging naval need to help ensure naval operational readiness and unsurpassed warfighting capabilities in the maritime domain.

Basic research conducted within this Defense Research Sciences (DRS) PE has been organized around the following research areas of priority naval interest:

- Information, Cyber and Spectrum Superiority
- Ocean Battlespace Sensing
- Mission capable, Persistent & Survivable Naval Platforms
- Warfighter Performance
- Naval Air Warfare and Weapons
- Naval Research Laboratory - Base
- ONR Global
- In-House Laboratory Independent Research

Research advancements and fundamental science breakthroughs within these research areas of naval priority interest establish a foundation that provides an opportunity to mature concepts through continued exploration and more narrowly focused applied research applications. The thoughtful, systematic study of fundamental phenomena towards more naval specific environments, applications and warfighting solutions is critical to long-term naval operational and security needs.

The basic research conducted within this PE is expected to be at Technology Readiness Level (TRL) 1 (basic principles observed and reported) up to TRL 2 (technology concept and/or application formulation). DRS basic research (BA1) results provide the foundation for later applied research (BA2) and advanced technology development (BA3) solution options for the Navy and Marine Corps.

Exhibit R-2, RDT&E Budget Item Justification: PB 2025 Navy	Date: March 2024
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DRS research advancements and technology development accomplishments influence candidate solutions to the Navy and Marine Corps technical and operational challenges experienced by acquisition Programs of Record (PoR) via the Future Naval Capabilities (FNCs) portfolio. DRS research advancements are also fundamentally relevant to more general, fundamental naval warfighting concepts and approaches by opening up new potential warfighting capability options via the Innovative Naval Prototypes (INPs) portfolio.

Due to the number of efforts in this PE, the projects described herein are representative of research conducted within this PE.

B. Program Change Summary ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
Previous President's Budget	541.513	540.908	558.812	-	558.812
Current President's Budget	529.385	540.908	483.914	-	483.914
Total Adjustments	-12.128	0.000	-74.898	-	-74.898
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-12.128	0.000			
• Program Adjustments	0.000	0.000	-74.898	-	-74.898
• Rate/Misc Adjustments	0.000	0.000	0.000	-	0.000

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2023	FY 2024
Project: 9999: *Congressional Adds*		
Congressional Add: *Basic Research*	24.134	0.000
Congressional Add: *Multifunctional structural batteries*	2.896	0.000
Congressional Add: *Silicon-germanium-tin alloy research*	4.826	0.000
Congressional Add: *Predictive modeling for next generation undersea vehicles*	2.896	0.000
Congressional Add: *Naval Research Laboratory S&T*	6.275	0.000
Congressional Add Subtotals for Project: 9999	41.027	0.000
Congressional Add Totals for all Projects	41.027	0.000

Exhibit R-2, RDT&E Budget Item Justification: PB 2025 Navy	Date: March 2024
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 1: *Basic Research*	**R-1 Program Element (Number/Name)** PE 0601153N *I Defense Research Sciences*

Change Summary Explanation

Funding: The 74.898M funding decrease to FY 2025 is due to a reduction in Basic Research for Strategic Competition investments and compliance with the Defense Planning Guidance for S&T Investments.

In order to provide greater transparency and execution oversight of Department of the Navy Defense Research Science investments, funding has been transferred into eighteen new Projects. These projects were previously funded in this PE, 0601153N, PU 0000 and are not new starts.

Technical: No significant change.

Schedule: No significant change

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy			Date: March 2024
Appropriation/Budget Activity 1319 / 1	R-1 Program Element (Number/Name) PE 0601153N / *Defense Research Sciences*	Project (Number/Name) 0000 / *Defense Research Sciences*	

COST ($ in Millions)	Prior Years	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total	FY 2026	FY 2027	FY 2028	FY 2029	Cost To Complete	Total Cost
0000: *Defense Research Sciences*	0.000	469.411	520.984	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	990.395

Note

Investments in Defense Research Sciences (DRS) PE 0601153N Project 0000 have been realigned to new research Projects funded within this same PE as follows:

- Proj: 1099 Experimentation and Analysis
- Proj: 1385 Aerospace Sciences
- Proj: 1386 Biomedical
- Proj: 1387 Biotechnology
- Proj: 1388 Directed Energy
- Proj: 1389 Electromagnetic Spectrum
- Proj: 1390 Electronics
- Proj: 1391 Full Spectrum Cyber
- Proj: 1392 Human Systems
- Proj: 1393 Kinetic Weapons
- Proj: 1394 Manufacturing
- Proj: 1395 Materials
- Proj: 1396 Naval Engineering
- Proj: 1398 Ocean Atmosphere and Space Sciences
- Proj: 1400 Power and Energy
- Proj: 1401 Undersea Systems Payloads and Weapons
- Proj: 1402 Naval STEM
- Proj: 5893 Decision Superiority
- Proj: 1099: ONR Global
- Proj: 3465: In-House Lab Independent Research

These new Projects were created to provide greater transparency and execution oversight for Basic Research investments in the Department of the Navy's annual budget request.

A. Mission Description and Budget Item Justification

The Office of Naval Research (ONR) was established by Congress in 1946 to plan, foster and encourage scientific research in recognition of its paramount importance to the maintenance of American naval power and national security. ONR manages the Department of the Navy's (DON) portfolio of Basic Research, Applied Research and Advanced Technology Development investments to ensure naval forces can effectively deter conflict, but when called upon, are equipped and prepared to fight,

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
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win and come home safely. This Defense Research Sciences (DRS) Program Element (PE) supports the Basic Research (BA1) portion of the Department of the Navy (DON) science and technology (S&T) portfolio, laying the foundation for new innovative technologies and future capabilities for naval warfighters. The basic research conducted within this PE include theoretical and experimental investigations directed toward increasing our knowledge and understanding of the physical, chemical, engineering, environmental and life sciences. The preponderance of research conducted within this PE is performed by academia and government labs, both of which play significant roles in developing the S&T workforce of tomorrow in addition to delivery new knowledge and scientific discoveries.

This PE, and the rest of Naval S&T, supports higher guidance defined by the National Defense Strategy, and responds to requirements identified by the Secretary of the Navy through research priorities set by the Chief of Naval Research (CNR) and coordinated across the Naval Research Enterprise (NRE). Research activities support long-term investments as outlined in an S&T Strategic Plan. Basic research conducted within this PE support additional areas of naval need such as ONR's National Naval Responsibilities (NNR). NNR's are examples of S&T investment areas in topic areas where the Navy has historically taken the lead (ocean acoustics, undersea weapons, naval engineering, undersea medicine and sea-based aviation) to ensure decisive naval capability in the maritime domain.

The basic research conducted within this Defense Research Sciences (DRS) PE is conducted in the following research areas of naval interest:

- Air, Ground & Sea Vehicles;
- Atmosphere & Space Sciences;
- Science Addressing Hybrid Threats;
- Human Systems;
- Mathematics, Computer, & Information Sciences;
- Materials/Processes;
- Medical and Biological Sciences;
- Ocean Sciences;
- Science & Engineering Education, Career Development & Outreach
- Sensors, Electronics & Electronic Warfare (EW); and
- Weapons.

Research advancements and fundamental science breakthroughs within these research areas of naval priority interest establish a foundation that provides an opportunity to mature concepts through continued exploration and more narrowly focused applied research applications. The thoughtful, systematic study of fundamental phenomena towards more naval specific environments, applications and warfighting solutions is critical to long-term naval operational and security needs. DRS basic research (BA1) results provide the foundation for applied research (BA2) and advanced technology development (BA3) solution options for the Navy and Marine Corps.

DRS research advancements and technology development become candidate solutions to Navy and Marine Corps technical challenges experienced by Program of Record via the Future Naval Capabilities (FNCs) portfolio. DRS research advancements are fundamentally relevant to more general, fundamental naval warfighting concepts and approaches by opening up new potential warfighting capability options via the Innovative Naval Prototypes (INPs) portfolio.

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
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Just as today's Sailors and Marines are enabled by past naval S&T investments, current investments hedge against uncertainty, providing the scientific basis for near-term solutions to commanders today and options for an unknown future. The research conducted within this PE is considered to be at Technology Readiness Level (TRL) 1 (basic principles observed and reported) and TRL 2 (technology concept and/or application formulation).

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
Title: Air, Ground and Sea Vehicles	55.901	57.168	0.000	0.000	0.000
Description: Sailors and Marines operate air, ground and sea vehicles in some of the most extreme environments on the planet. Basic research advances the capacity of naval platforms operating under, on and above the seas, and to project power ashore. Ongoing research in the Air, Ground and Sea Vehicles activity will increase platform performance, reliability, improve human-machine teaming, reduce the cost of at-sea operations and enhance the effectiveness of distributed maritime operations. The efforts research focus include: surface and subsurface signatures; free-surface, subsurface, and propulsor hydromechanics; hull life assurance; advanced ship concepts; distributed intelligence for automated survivability; advanced electrical power systems; air vehicles; air platforms propulsion and power; air platforms survivability and signature control; special aviation projects; environmental quality; logistics; power generation, energy conversion, and storage; and advancements in naval technology innovations. ***FY 2024 Plans:*** Aerospace Structures and Materials Research focused on the development of lightweight, reliable, survivable, sustainable, and affordable airframes for naval and marine corps aircraft and weapons. Research efforts include the following: - Continue research on galvanic corrosion and mitigation strategies for metallic airframes in naval environment. - Continue research on high fidelity composites prediction methodologies that span multiple length scales. - Continue investigations of novel out-of-autoclave and out-of-oven curing technologies. - Continue research efforts on short fiber thermoplastic composite forming and joining. - Continue research investigations of high strain rate characterizations of materials. - Continue material development efforts regarding armor applications. - Continue investigating lightweight material solutions for multifunctional structures for airframes and weapons. - Complete computer-assisted iterative material development for armor applications. - Complete research efforts regarding multiaxial fatigue of hybrid airframes. - Initiate fundamental research on manipulating material micro structure for function.					

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
Flight Dynamics & Control Research to develop the theory and analysis methods necessary to understand the phenomena and natural dynamics of air vehicles operating in the marine environment. Collaborative research efforts in this area improve our knowledge of control system interactions between piloted aircraft and human performance. Research efforts include the following: - Continue research investigations to increase the operational envelop for air vehicles, tailor airframe dynamics with novel control effectors, improve threat engagement performance, develop fundamentals for coupled human/machine dynamics, adapt to variable airframe conditions. - Continue research regarding multibody control systems and the ability to demonstrate guaranteed performance relative to a desired end-state. - Continue research efforts to achieve robust and precise control in the presence of highly turbulent flow fields. - Continue research efforts to develop software algorithms that enable precise ship-relative navigation in GPS-denied environments. Aerodynamics Research efforts focused on enhancing our understanding of Naval-unique aerodynamic challenges by developing advanced computational and experimental methods. Research efforts include the following: - Continue researching the fully coupled aerodynamic interface between ships and aircraft. - Continue investigating novel state-of-the-art in-situ diagnostics and reduced-order modeling of complex flow fields. - Continue researching innovative technologies enabling increased range and/or maneuverability suitable for aircraft operating from the maritime environment and attritable systems such as unmanned aerial systems and high-speed weapons. - Continue research on the interactional and transitional aerodynamics of multi-rotor systems in complex fluid dynamic environments involving multi-body relative motion. Science of Autonomy and Control of Unmanned Systems Research investigations regarding critical multidisciplinary autonomy challenges that cut across areas/domains, including air, sea, undersea and ground. Research efforts include the following: - Continue investigating the scalable and robust distributed collaboration among autonomous systems. - Continue research on human/unmanned system collaboration. - Continue work on perception-based adaptation across uncertain naval environments. - Continue investigating embodied and situated intelligence and architectures.					

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 0000 / *Defense Research Sciences*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
- Continue developing theory-based tools and methods for safe, assured, robust, verifiable, and trustable autonomy. Propulsion, Power and Thermal Management Research efforts with focused emphasis regarding critical areas such as propulsion cycles, subsystems, propulsion integration, turbo machinery and drive systems, and high-temperature (hot section) materials and coatings. Research efforts include the following: - Continue research to advance the technical superiority of Naval Aircraft - Propulsion, Power and Thermal management with emphasis on propulsion cycles, subsystems, propulsion integration, turbo machinery and drive systems, and hot section materials and coatings - Continue research to improve the power density, fuel efficiency, speed, range and operating reliability of future large, medium and small engines. - Continue studies with Rotating Detonation Engines and integration into platforms and weapon systems using thermodynamic models, Computational Fluid Dynamics and sub-scale experiments. - Continue research for high stage-loading and efficient turbomachinery including distortion tolerant fans, casing treatments and advanced methods in blade-disk aerodynamics; advanced cooling and thermal management for engines and auxiliary systems including new concepts of heat collection, distribution and rejection; advanced turbine engine materials and coatings; highly integrated propulsion inlets and exhausts and dust ingestion research, including modeling, separating, deposition, coatings and sensing. - Continue to improve jet engine material durability and temperature rate capabilities in both benign and corrosive environments. - Continue to develop advanced radio-frequency based sensors to provide ingestion and foreign object damage sensing, as well as overall prognostics. - Continue research of fundamental modeling of distributed combustion in the turbine. - Initiate Hierarchical nonlinear Control of Integrated Propulsion, Power, and Thermal Management Systems for Naval Aircraft - Initiate Inter-Turbine burning for enhanced performance - Initiate Enhancing Jet Breakup via High-Frequency Ultrasound Platform Design and Engineering Research efforts regarding platform performance, platform survivability in support of future platform-building programs, platform autonomy, autonomous systems, and control for naval systems. Research efforts include the following:					

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
- Continue research related to Naval Engineering and Platform Design (a National Naval Responsibility area), Basic Surface Ship Dynamics, Propulsion Hydromechanics, Basic Subsurface Hydromechanics, Basic Surface Ship Hydrodynamics, Adaptive Control and Centers for Innovative Naval Technology. - Continue research efforts associated with Digital Data Science including Autonomous Systems (Machinery/ Platform), Digital Threads, Digital Twins, Condition Based Maintenance, and Digital Engineering. - Continue research regarding Structural Reliability and Resiliency focusing efforts on Alternative Hull/Structural Materials, Composite Structures and engineered Metamaterials. - Continue research in Platform Signature Related Sciences to include: Structural Acoustics, Underwater Electromagnetic Signatures, Electromagnetic Signatures, Submarine Detectability, and Undersea Platform Susceptibility. - Initiate research efforts related to System Complexity and Resiliency for Naval Platforms and Systems. - Initiate research in Non-Acoustic Signatures Science for Advanced Naval Platforms. - Initiate research efforts regarding Digital Decision Metrics for Naval Platform Design and Engineering. Power, Energy & Propulsion Research relevant to the power, energy & propulsion of naval systems. Research efforts include the following: - Continue climate research to improve understanding of the environmental impacts on future platforms and reduce the impact of platforms on the environment. - Initiate fundamental electrical power, energy and propulsion research. - Initiate research in heat transfer and thermal management science and materials to enable effective cooling of future directed energy systems, power electronics, personnel, etc. - Initiate power generation research to improve operational endurance, energy storage, distribution, power management and control. - Initiate power electronics research for improved energy conversion efficiency, and electromagnetic materials research to achieve compatibility with high frequency power electronics. - Initiate to advance material science for electrochemical energy storage, alternative fuels, fuel cells, dielectrics, and photovoltaics. - Initiate physics-based modeling efforts, and the development of digital twins for power and energy materials, components, and systems. Materials Research relevant to enabling enhanced performance and resiliency of naval systems and platforms. Research efforts include the following:					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
- Continue research efforts regarding Corrosion Control Science (for conventionally and additive manufactured materials) for enhanced resiliency and sustainability of naval platforms and systems. - Continue research investigations of Nano-Engineered Materials for extended performance and sustainability of legacy systems and platforms and emerging opportunities for structural and functional (optical, electro-active, etc.) properties that will enable new system designs. - Continue research of Electrochemical Materials and Functional Polymeric and Organic Materials to understand phenomenology that can be applied to more efficient energy capture and power storage and distribution for a wide distribution of naval emerging requirements. - Continue research investigations of Computer-Aided Material Design to accelerate research in all areas described here. ***FY 2025 Base Plans:*** N/A ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The funding decrease from FY 2024 to FY 2025 is due to the transfer of Defense Research Sciences (DRS) Air, Ground and Sea Vehicles S&T investment from Project 0000 to new Project 1093 (Sea Warfare and Weapons) and Project 1095 (Naval Air Warfare and Weapons) within the same PE (0601153N).					
Title: Atmosphere and Space Sciences ***Description:*** Effective Naval operations depend upon accurately understanding the maritime and littoral operating environment and predicting its characteristics at high spatial and temporal resolution in areas that may be inaccessible. Understanding atmospheric phenomena and their impact on the electromagnetic spectrum from the sea surface to space provides a significant warfighting advantage. Efforts include: Battlespace Environments, Marine Meteorology and Prediction and Space Research. These efforts support basic research on physical process studies, fundamental observations, data discovery, and modeling and forecasting of the atmosphere and space with the goal of improving the ability to predict the battlespace environment of the Navy and Marine Corps, anywhere on the globe. Emphasis is placed on the marine atmosphere, the tropics, polar regions, the upper atmosphere and ionosphere and other areas where new understanding is needed in order to overcome predictability barriers that limit the accuracy of current forecast models. Efforts are underway to understand the interactions of physics between the atmosphere, space, land, ocean and ice, represent these coupled processes in models, and extend them across scales from local to planetary, with the goal of extending the skill of predictions up to seasonal and interannual timescales. Recent efforts have also focused	27.438	30.462	0.000	0.000	0.000

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
on the processes that control tropical cyclone formation, structure and intensity changes and phenomena that affect electromagnetic and electro-optic signal propagation in the marine atmosphere and near space domains. Research results provide the foundation for improved global and regional forecasts of the operational environment and for development of next-generation, fully coupled, high resolution prediction systems. Research areas evolve in response to priorities of the Oceanographer of the Navy. ***FY 2024 Plans:*** Battlespace Environments - Continue research investigations to improve the quality of the environmental analysis and prediction provided in support of warfighters, including the assessment of the impact of the atmosphere and ionosphere-thermosphere-magnetosphere on the performance of sensors, platforms and weapon systems, and the advancement of our basic understanding of atmospheric processes across spatial scales and the interactions of the atmosphere with the land, sea, wave, ice, and thermosphere. - Continue research efforts to exploit environmental observations and to characterize environmental processes more accurately, thus providing improved forecast models for the Navy and Marine Corps in regions where operations take place, including: the littoral zone, where complex topography and air-sea-land contrasts impact the environment on very short time and space scales; the tropics and sub-tropics; and the Arctic, where longer time scale atmospheric changes affect short-term weather events. - Continue research on the coupled processes in the high atmosphere, between the troposphere and stratosphere and the stratosphere/mesosphere and ionosphere and their effect on weather and space weather prediction. - Continue research efforts regarding atmospheric or Earth system coupled processes that are not well understood (cloud and aerosol interactions, etc.), marine boundary layer and coastal prediction, and diurnal and mesoscale variability to improve their representation in forecast models. Marine Meteorology and Prediction - Continue research efforts regarding marine atmospheric boundary layer gradients and processes important for low and mid-cloud evolution and structure. - Continue research investigations regarding key physical processes (marine atmospheric clouds, moisture and aerosol phenomena, etc.) to improve their representation in weather prediction models. - Continue research investigations of new and non-conventional observational data sources and novel methodologies for their assimilation into operational predictive models.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
- Continue efforts regarding the deployment of observing systems in the upper troposphere, middle and upper atmosphere and the near-space environment to allow extension of prediction systems into the middle and upper atmosphere and provide longer and higher fidelity forecasts. - Continue research investigations regarding the distribution, transport and time evolution of aerosols in the atmosphere and their impact on atmospheric visibility and laser propagation. - Complete observing experiments to understand the processes that contribute to the poorly predicted rapid intensification of tropical cyclones. - Complete field and modeling initiatives that focus on the origin, evolution and effects of Arctic cyclones believed to have a strong influence on Arctic sea ice motion and extent. - Initiate new research in satellite-based environmental remote sensing algorithms and techniques tailored to improved retrievals for phenomena and regions of particular Naval interest. Space Research Continue research efforts on innovative sensor development, physics-based modeling and forecasting efforts integrated across three environmental space areas: geospace, heliospace, and high-energy space. Research efforts include: Geospace: - Continue research into affordable small-sat sensors to investigate and specify the three dimensional structure and evolution of the electromagnetic signal propagation environment in the ionosphere, including ionospheric bubbles. Employ stereo imaging and tomographic reconstruction to access the three dimensional structure and evolution of the upper atmosphere and ionosphere, relevant to Naval communications, intelligence, surveillance and reconnaissance, and geolocation. - Continue development of our understanding and computational representation of upper atmospheric, ionospheric relevant plasma processes and their coupling to the lower atmosphere and solar inputs, towards a future physics-based ionospheric prediction capability. - Complete a small-sat investigation into improved ionospheric observation and understanding through use of new signal processing approaches, based on anomalous refraction of Global Navigation System transmissions. - Initiate development of new imaging techniques to examine the structure and avolution of additional airglow chemical species in the ionosphere for dayside and nightside processes. - Initiate the development of new neutral density atmospheric observations for the mesosphere. - Initiate observational research in polar ionospheric processes for improved regional prediction of the ionosphere at high latitudes.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
- Initiate efforts into understanding basic plasma processes in the near-earth space to protect and understanding the effects on Naval C4IRS capabilities. Heliospace: - Continue efforts to advance the understanding, and advance the forecastability of solar radiation and particle fluxes and their interaction with magnetic fields. Investigate how they influence the near-Earth environment and the relevant Naval systems that rely on that environment. - Continue to investigate efforts to improve solar event warning times, using newly available observations. - Continue efforts to understand particle acceleration mechanisms in high energy solar flares by studying gamma-ray and neutron emissions that are measured in space. - Continue efforts to leverage millisecond pulsars as stabile timing sources for precision navigation and timing applications. - Continue research efforts to improve solar event warning times, using newly available observations. - Initiate efforts into forecasting physically-derived solar irradiance variability and the ionosphere-thermosphere-mesosphere (ITM) response. High-Energy Space: - Continue research investigations of new high-energy radiation and neutron detector materials for space-based observations. ***FY 2025 Base Plans:*** N/A ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The funding decrease from FY 2024 to FY 2025 is due to the transfer of Defense Research Sciences (DRS) Atmosphere and Space Sciences S&T investments from Project 0000 to new Project 1092 (Ocean Battlespace Sensing) and Project 1096 (Naval Research Laboratory - Base) within the same PE (0601153N).					
Title: Science Addressing Hybrid Threats ***Description:*** Naval expeditionary forces increasingly face hybrid adversaries using conventional weapons combined with terror, crime, cyber, information operations, etc. A hybrid adversary is flexible and adapts quickly to synchronize advanced state weapons systems, disruptive commercial technologies, cheap expedient homemade weapons, and a variety of novel tactics. The Sciences Addressing Hybrid Threats (SAHT) (formerly	24.248	21.129	0.000	0.000	0.000

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
Counter Improvised Explosive Device (IED)) activity seeks to establish and nurture science to counter these growing challenges, while collaborating with and leveraging results from more traditional Naval research portfolios. The SAHT Sciences program provides research for Naval Forces to fight hybrid threats and adversaries in expeditionary operations. Naval Expeditionary Forces need science advances to address a range of research challenges that result from physical and operational environmental limitations so harsh that solutions push basic discovery and invention. Naval Forces able to operate amphibiously and in the littoral will have all of their capabilities exposed to degrading sea and land physical effects. Expeditionary forces must be agile and lethal but will be constrained by size, weight, and power requirements and must be sustained across large areas. Research efforts include: machine perception, reasoning and collaborative behavior; artificial intelligence enabling future intelligent systems; optics, electronics, and photonics research to enable revolutionary spectral awareness in small low power sensors; computer and network science to enable expeditionary computing; fundamental chemistry and materials science research to advance technologies to support sustainment; materials research to explore and improve armor and structural materials; electrochemical energy conversion and storage research to sustain the force; chemistry and physics to provide disruptive energetics for expeditionary fires; and biology, physiology, and cognitive sciences addressing Naval Expeditionary warfighter capabilities. ***FY 2024 Plans:*** Mathematics, Electronics, and Quantum Fundamental Research - Continue a focused research effort for discovery research on multi-class, multi-objective deep reinforced learning algorithms with automated training. - Complete research into reconstructing human physiological features from audio samples based upon brain science to pair vocal tract features with identifiable facial characteristics. Mine & Expeditionary Warfare - Continue research efforts in sensors and sensing technologies to enable stand-off detection and rapid neutralization of explosive hazards in multiple expeditionary mission environments while maintaining operational tempo. - Initiate research into rethinking data security in a speculative, hammerable, and heterogeneous world. - Initiate research into third generation network intrusion detection and prevention systems.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
Platform Design and Engineering - Continue research of ultra-low size, weight, and power communications in a contested environment. - Complete a focused research effort on investigation on security aspect of non-volatile main memory usage for future computing systems. - Complete research to provide fundamental understanding of biological olfactory sensing and processing of relevant odor representation in order to apply toward chemical sensor design and processing principles. - Complete research investigations into enabling secure and efficient sharing of computer hardware accelerators in systems restricted by size, weight, area and power. - Initiate efforts to study the complex energy-supply problem with deployed vehicles in contested environments en route to developing a novel decision-support framework for planning and managing adaptive transportation systems for naval logistics. - Initiate research to study, characterize, understand, and exploit anionic redox phenomena in lithium-ion and sodium-ion batteries and solve fundamental challenges en route to improving and designing new materials that could increase the cathode capacity of these battery chemistries by exploiting the anionic redox processes. Human-Level AI and Autonomy - Continue research investigations regarding learning theories to enable complex, collaborative, human-robot interactions. - Continue research for modeling autonomy, for the purpose of creating systems that operate in complex undersea/surface/land/air/space domains. - Continue research methods that model how diverse autonomous systems interact with each other in complex environments. - Continue research efforts on means and methods for evaluating the reliability and effectiveness of collective decision making by autonomous systems and humans. - Continue research investigations regarding the creation of Artificial Intelligence (AI) hybrid learning theories for the purpose of creating heterogeneous multi-agent collaborative autonomy. - Continue research to create theories for multi-agent collaborative autonomy that mimic the organizational principles found in social insects/birds/fishes. - Continue a follow-on and focused research effort for the machine learning investigation of multifactorial information environment parameters in order to automate the process of detecting, identifying and distinguishing intent. - Complete research into methods to identify coherent courses of action with effective outcomes using Artificial Intelligence (AI) agents.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
- Complete research to explore robotic behaviors for locating and mitigating threats from hazards in building clearing. - Initiate research to study novel collaborative methods for swarming autonomous entities to reliably determine true/relative position in GPS-denied operations. Training and Education for Naval Readiness - Continue work in immersive sciences for automated methods for generating content and behaviors, and conduct research studies to examine questions, such as usability and training effectiveness, to increase understanding and use of Extended Reality (XR) technologies for naval applications. ***FY 2025 Base Plans:*** N/A ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The funding decrease from FY 2024 to FY 2025 is due to the transfer of Defense Research Sciences (DRS) Science Addressing Hybrid Threats S&T investment from Project 0000 to new Project 1091 (Information, Cyber and Spectrum Superiority), 1092 (Ocean Battlespace Sensing), 1093 (Sea Warfare and Weapons) and Project 1094 (Warfighter Performance) within the same PE (0601153N).					
Title: Human Systems ***Description:*** Sailors and Marines operate across multiple domains: under, on and above the seas. This Activity focuses on understanding the human aspects of Naval operations with the objective of planning and execution for mission success. The long-term goal of this research is to increase total system performance by maximizing the effectiveness of human-machine systems to ensure mission effectiveness. Research areas include: attention and decision making in goal-directed behaviors, computational and neural foundations of cognitive skills and underlying processes, information exchange processes in human-human and human-machine teaming tasks, human interactions with autonomous systems, preparation and adaptation to novel challenge, new approaches to training and training assessment, personnel assessment, information conflicts, and humanitarian assistance/disaster relief. ***FY 2024 Plans:*** Command Decision Making	20.310	22.251	0.000	0.000	0.000

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
- Continue research application of artificial intelligence analytic methods for enabling decision support in military team decision making. - Complete decision making research for game-based mission planning and execution tasks. - Complete research to investigate methods that enable learning algorithms for task procedures and task context derived from human explanations. - Initiate research in artificial intelligence to create bidirectional collaboration in human-machine teaming and decision making. Cognitive Science for Human-Machine Teaming - Continue research to understand the foundation of human intelligence that enables cognitive functions, such as communication, social interaction, and context understanding. - Continue research regarding natural language processing and computational modeling to support the framework and architectures necessary to develop higher-level intelligence in robotic and autonomous systems. Schoolhouse Training - Continue research to create novel models for learning aimed at producing durable learning. - Continue research investigations regarding the creation of skill-decay models that can be used to predict when refresher training is needed for maintenance procedures. - Continue research to understand how individual differences impact training effectiveness and how to tailor training for each individual. - Continue research efforts to understand the underlying mechanisms by which generalized problem-solving skills are acquired. - Continue research in systematically studying complex skill learning (e.g., second language, computer programming, machine troubleshooting) to understand neurological and cognitive predictors of gaining these skills. - Continue research investigations of neuro-imaging analytical techniques to assess learning from written passages. - Continue research efforts regarding training techniques for spatial ability which facilitates learning STEM skills. Computational Neuroscience - Continue research to identify and understand neural circuits and pathways that will be used to develop models of sensorimotor control. The long-term goal is to understand the neural foundation of intrinsic cognitive skills, such as attention, memory formation, perception, and problem solving in order to develop novel intelligent systems.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
- Continue exploring the neural basis of the control of reaching, grasping and manipulation to inform robotics. - Initiate research exploring the combination of robot mobility with dexterous manipulation in assisting humans on Naval relevant tasks, such as shipboard maintenance and building clearing of hazards. Human Interaction with Autonomous Systems - Continue research investigations regarding principles of warfighter collaboration with autonomous and mission-capable robotic systems. - Continue research efforts to explore training of robots to perform complex manipulation skills using machine learning and human demonstration. The long-term goal is to provide better interfaces with autonomous systems, as well as provide transfer of control of autonomous platforms and payloads amongst operators. - Continue research exploring the combination of robot mobility with dexterous manipulation in assisting humans on Naval relevant tasks, such as shipboard maintenance and building clearing of hazards. Attention in Sensory Processing and Intelligent Sensing - Continue research of attention in intelligent sensing with a focus on radiated acoustic signals in noisy environments. - Continue research regarding the understanding of Artificial Intelligence-based approaches for adaptive training, tailored to the individual learner. - Complete research efforts aimed at characterizing the fundamental aspects of how humans understand reflected acoustic signals on underwater targets. - Initiate research efforts to systematically study the neuro-cognitive processes of attention and its control. Social, Cultural, and Behavioral Modeling - Continue research of emerging and novel threats in cyberspace and in key military operations to include humanitarian assistance/disaster relief, civil stability, and countering influence operations. - Continue research of understanding the anthropological, sociological and socio-psychological factors that alter the effects of influence operations against US interests abroad. - Continue research to improve current methods (e.g., algorithms, models) for detecting adversarial information maneuvers across social media platforms. - Initiate research investigations of country-centric, descriptive and computational models of national resource and security issues to lay the foundation for forecast models relevant to military missions. Social Networks and Computational Social Science					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
- Continue research efforts to develop models on the impact of spreading false information and geo-political shifts on the future of conflict in the next decade. - Continue research investigations to understand effective communications strategies in the face of information conflict, modeling human behavior, and the perception of information and cyber warfare. - Continue research efforts exploring social science methods and techniques to detect, mitigate, blunt, and defeat influence campaigns. - Initiate research to develop understanding of how influence campaigns in digital and social media affect decision making. Manpower, Personnel, Training and Education for Future Warfighting - Continue research efforts to increase our understanding of psychometric properties of selection/assessment for high performance in military settings. - Continue research to improve analytical approaches to understand human behavior based on real world (unstructured, interdependent, and complex) data. - Continue research exploring innovative technologies for real-time sensing and observation of individual behavioral responses to social and operational stressors. - Continue research on the theories of destructive social behaviors (e.g., attempting suicide, compulsive activities, risky behavior, overusing alcohol, toxic leadership). - Continue research to understand fundamentals of unit behavioral health. - Complete research efforts regarding the understanding of underlying mechanisms that optimize an individual's intellectual readiness and adaptability to military-relevant emerging technologies (e.g., Artificial Intelligence, autonomous systems) or novel operational challenges. Minerva Research Initiative - Initiate research efforts to address novel conflict problems such as water security, malware, information warfare, ransomware, and basic research in social shifts relevant to national security issues, hybrid warfare and other novel conflict problems. - Initiate research investigations regarding mechanisms of crowd manipulation, social hysteria, rumor and propaganda in online and offline audiences. - Initiate multidisciplinary basic research efforts regarding national security issues, hybrid warfare, and related issues to address information advantage relevant to US military missions.					
FY 2025 Base Plans:					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
N/A ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The funding decrease from FY 2024 to FY 2025 is due to the transfer of Defense Research Sciences (DRS) Human Systems S&T investment from Project 0000 to new Project 1094 (Warfighter Performance) within the same PE (0601153N).					
Title: Mathematics, Computer, and Information Sciences ***Description:*** This activity includes basic research efforts directed toward increasing scientific, mathematical, and computational foundations for integrated command, control, communications, cyber intelligence, surveillance, reconnaissance and targeting. The purpose is to sustain U.S. Naval Science and Technology (S&T) superiority, provide new technological concepts for the maintenance of naval power and national security, and help avoid scientific surprise. Efforts include: Scientific foundations and understanding for robust communications and networking; foundations for novel computing hardware, including nanoscale materials, emerging devices and circuits, emerging computational architecture and nanofabrication; basic research on novel techniques for controlling quantum states; algorithms for analyzing massive datasets in real time and heterogeneous information integration; science base and computational methods for building versatile intelligent agents; theory, algorithms and tools for decision support; mathematical optimization for resource allocation and usage; modeling and computation of complex physical phenomena; computation and information foundations for cyber defense; secure and reliable information infrastructure for command and control; information assurance; and research to extend state-of-the-science in artificial intelligence for the unique challenges of the Naval domain. ***FY 2024 Plans:*** Communications and Networks - Continue research to develop the scientific foundation and understanding of wireless communications and networking technologies to enable the naval warfighter to maintain access to mission critical information in contested environments. Research thrusts in this area includes Tactical Communications and Tactical Networks. Tactical Communications	59.808	63.334	0.000	0.000	0.000

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
- Continue research efforts to develop new techniques for wireless distributed computing and device-to-device communication. - Continue investigations regarding novel software coding and modulation techniques to improve the efficiency, capacity and/or resilience of wireless communication systems. Tactical Networks - Continue research efforts to develop feedback control models for determining the limit of fast adaptive traffic engineering. - Continue research investigations of algorithms, protocols and middleware regarding dynamic and scalable multi-hop ad hoc wireless networking in contested environments. - Continue research efforts regarding Artificial Intelligence/Machine Learning techniques relevant to multi-dimensional Quality-of-Service optimization issues. - Continue research efforts on the development of cognitive methods and algorithms to maintain network resiliency when experiencing communications link disruptions without adding excess overhead resources. Spectrum Superiority / Networked Sensing - Continue research investigations regarding fundamental implications of classical entanglement on imaging and metrology. - Continue research efforts regarding the exploration of highly sensitive, multi-spectral detector materials and active sensing modalities for imaging through clouds, fog, haze and dust. - Continue research efforts to explore novel optical processing architectures to significantly increase signal-processing bandwidth and to enable novel, real-time, distributed sensing applications. - Continue research investigations into the direct measurement of current and phase at optical and infrared light frequencies to enable wider flexibility in signal extraction and waveforms. - Complete research efforts exploring advanced photonics techniques to maximize information extraction from individual photons and through tailored optical beams with the goal of being able to image at long-ranges and in degraded conditions. Nanoscale Computing Devices and Systems - Continue research efforts on ultra-low power nanoelectronic devices, circuits and systems. - Continue research investigations of experimental routes to topologically-protected quantum computation with non-abelian quasiparticles in solid-state devices. - Continue research efforts regarding device physics enabling probabilistic computing in stochastic networks. - Complete research combining molecular quantum science and synthetic electronics.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
- Complete research investigations of spin-based electronics, focusing on single atom and single molecule level control. Quantum Information Sciences Research of quantum states, devices, phenomena relative to the simulation, information processing and computing performance needs of naval systems. Research efforts include the following: - Continue research on novel techniques for controlling quantum states to improve performance of information processors, sensors and clocks. - Continue research on demonstrations of systems having a quantum advantage in the solution of optimization problems and quantum simulation of complex physical systems. - Continue research on the utilization of photonic and phononic devices for high performance quantum information processing. - Continue research exploring the distribution of entanglement in a quantum network and applications thereof. Mathematical Data Science - Continue basic research in mathematics, probability, statistics, signal processing, machine learning, data engineering, and information theory. - Continue efforts to develop advanced algorithms for analyzing massive datasets in real time, identify real patterns and avoid false positives. - Continue investigations regarding the development of advanced methods to integrate and extract common features from large heterogeneous domains. - Continue research investigations of privacy in complex networks. - Continue research efforts regarding the development of scalable reinforcement learning. - Complete research efforts in approximate dynamic programming. - Initiate research investigations of causal dependences in complex networks. Machine Reasoning and Intelligence - Continue developing the science base and computational methods for building versatile intelligent agents, which can function autonomously in uncertain, unstructured, uncontrolled, open-world environments, and can collaborate seamlessly with humans and other agents. - Continue basic research in developing new mathematical methods for principled design of deep learning architectures and analysis of their behavior. This program is expected to develop techniques for predicting performance of learning-based systems, to improve their generalization abilities, and to reduce the need for empirical verification.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
- Continue basic research for developing robust computer vision systems, based on human vision, for automated understanding of surveillance imagery, perception for autonomous agents, and managing image/video libraries for after-action analysis and planning. - Continue basic research in machine self-learning for intelligent agents, inspired by human learning, for understanding real-world environments. - Initiate basic research in learning and decision-making in multi-agent systems in dynamic, uncertain settings where there are many competitive and cooperative agents and information about intentions and rewards are not fully known. This research area has a wide range of applications in tactical and strategic planning, economic planning, etc. Optimization and Discrete Mathematics - Continue to identify exploitable mathematical structures within specific decision problems for the purpose of devising superior solution algorithms. - Continue investigation into methods for strategically formulating and solving optimization problems that arise in resource allocation, logistics, and system planning. - Continue investigations into new techniques that utilize convex optimization and duality theory to solve non-convex optimization problems. - Continue research on integrating machine-learning techniques with algorithms for stochastic and combinatorial optimization. - Continue research on developing novel first-order methods for solving general classes of problems that include saddle point problems, problems with a large number of constraints, and machine learning problems. - Continue investigations into applying topological data analysis to combinatorial optimization problems. - Initiate investigations into finding solutions to various forms of multiagent, multiround games. Applied and Computational Mathematics - Continue basic research in developing analytical and computational tools for models of physical phenomena of critical interest to the Navy in waves, flows, materials, structures and information processing. - Continue to develop robust, reliable and near-real-time computational models for predicting environmental behavior in atmospheric and oceanic processes. - Continue to develop theoretical and computational tools to predict the onset of extreme events, whether in materials, such as formation of shocks, cracks and other discontinuities. - Continue to develop reduced models to enable speed up of computational models in acoustics, electromagnetics and optics, in regimes of special interest to the Navy.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
- Continue research to develop mathematically rigorous algorithms for employing variable-precision computations in very large-scale multi-physics problems. Complex Software Systems and Cybersecurity - Continue to investigate and explore novel computing concepts that lead toward robust, resilient, and dependable cyber systems. - Continue to explore novel application of ONR's concept of hybrid, formal-statistical machine learning in cyber security and software systems environment. - Continue to explore physics-based approaches to various security aspect of cyber-physical systems, including authentication, vulnerability testing, and exploit resilience. - Continue critical emphasis on improving scalability and capability of bottom-up formal analysis that would enable users to prove security properties about binaries directly. - Continue research on novel methods for attack surface maneuver for cyber physical systems and systems with complex apertures and sophisticated sensing apparatus, to include lightweight decoy synchronization and other resilience techniques. - Continue research on autonomous cyber operations to explore what facets of cyber activities can be done fully autonomously or semi autonomously with human input. - Initiate Exploration of new alternatives for computing devices and architectures. Science of Artificial Intelligence - Continue research exploring principled frameworks for integrating domain knowledge and machine learning for fast, robust learning of diverse complex concepts and tasks with light supervision. - Continue research efforts regarding the use of artificial intelligence to advance the scientific understanding of collaborative, complex decision-making that is typical of naval command decision making. - Continue research of formal verification and validation methods for artificial intelligence in the naval domain to enhance trust. - Continue research investigations exploring explainable artificial intelligence to enhance human-machine collaboration. - Continue research regarding decentralized perception and planning in dynamic environments to develop a unified framework perception and planning for resources distributed across multiple platforms, autonomous systems and agents. - Continue research exploring new brain-inspired artificial intelligence algorithms and architecture that provide richer computational capabilities than current deep learning networks, with an emphasis on memory systems and higher vision.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
- Continue research investigations of neuromorphic spiking neuron hardware designs based on brain models that are suitable for future edge computing and signal processing in small naval platforms. - Continue research efforts regarding autonomous problem solving and curiosity driven search for robust performance under unexpected conditions. - Continue research efforts to identify, characterize and model adversarial AI. - Continue research exploring theory and algorithms for learning and decision making in multi-agent systems, particularly in adversarial situations. - Initiate research efforts exploring computational models of vision-language interactions for intelligent agents that can learn and reason bout the real world with high levels of complexity. Information Technology - Continue development of improved methods for producing, analyzing, and securing Naval software systems. - Continue to design new concepts for future Naval tactical communication systems and networks. - Continue research in intelligent autonomy and improved interaction with autonomous systems, and improved methods for information analysis, fusion, and presentation. ***FY 2025 Base Plans:*** N/A ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The funding decrease from FY 2024 to FY 2025 is due to the transfer of Defense Research Sciences (DRS) Mathematics, Computer, & Information Sciences S&T investments from Project 0000 to new Project 1091 (Information, Cyber and Spectrum Superiority), Project 1094 (Warfighter Performance) and Project 1096 (Naval Research Laboratory - Base) within this same PE (0601153N).					
Title: Materials/Processes ***Description:*** Lighter, faster, stronger is a winning combination. Naval materials research produces quieter submarines, fuel-efficient ships/vehicles and systems capable of operating under extreme temperature and chemical environments. New materials will result in warfighting advantages, as well as, systems that ensure environmental compliance, improved system reliability/resilience, stealthier materials, reduced manufacturing/ maintenance and lower total ownership costs.	57.938	68.964	0.000	0.000	0.000

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
The Materials/Processes activity generates fundamental scientific understanding for new, advanced and improved materials, and to accelerate materials-driven concepts essential to Naval superiority. The research is conducted in a cross-cutting and interdisciplinary manner covering Structural Materials, Functional Materials, Manufacturing, Chemistry and Undersea Materials to ensure future Naval power and maritime superiority. Fundamental challenges include understanding atomic-scale to meso-scale phenomena; developing robust, accurate and validated computational modeling and simulation capabilities; and translating this understanding into materials composition, synthesis, processing, properties and performance design principals for engineered devices, components and systems. This activity also includes peer-review basic research to develop innovative solutions and enhance the science and engineering base. Research directions in the Focus Area are selected to generate new, advanced and improved materials that enable innovative new technologies or can close critical technology gaps. Successes provide breakthroughs for higher performing, cost effective and/or timely technologies supporting Navy and Marine Corps acquisitions, operations and sustainment. Accomplishments and plans described below are examples for each effort category. ***FY 2024 Plans:*** Structural Materials - Continue foundational research that provides the underpinnings for robust systems and platforms, exploring and understanding phenomenology of structural properties as functions of with the aim to improve performance and predict and mitigate component degradation, captured in quantitative data and physics-driven models. Research domains include Basic Materials Research, Structural Metals, Polymer Composite Materials, Propulsion Materials, Materials for Additive Manufacturing, Sensors & NDE Prognostics, and Alternative Hull Materials & Structures. Functional Materials - Continue research to explore opportunities for controlling material composition and atomic structure through characterization and modeling to enhance electro-mechanical coupling for next generation Acoustic Transduction and Sensor Materials; better understand the chemical and mechanical properties of Material Science for Environment Quality; and accelerate research efforts through Computer Aided-Material Design. Materials and Chemistry					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
Continued research in Materials and Chemistry is essential to develop the scientific foundations required for a molecular-level understanding of materials synthesis, processing, and physical properties aimed at propelling, equipping and sustaining the US Navy and Marine Corps with tactical and strategic advantage. Research efforts include the following: - Continue efforts into nanoparticle surface chemistry for plasmonic mediated reactions, photocatalysis, hydrogen storage, energetic materials, and fuel additives which will enable new high power and energy density generation, storage, release and harvesting materials and technologies. These fuel generation, energetic, fuel cell and battery material will enable next generation Navy autonomous undersea and air vehicles. - Continued research efforts on combustion and reacting transport, coupled with advanced mutiphysics computational simulation, will advance fire suppression for damage control as well as liquid and solid-fueled power and energy for hypersonics. Combinatorial and multivariate chemical approaches inform sensor system designs for aviation fuel surety and complex shipboard atmosphere environment monitoring. - Continue advancements into quantum computing simulations of quantum systems which1 model aqueous chemistries to allow design of anti-corrosion additives. Understanding fundamental electrochemistry, (tribo)corrosion, and biofouling will guide materials solutions for fleet sustainment through manpower and life-cycle cost reductions. - Initiate efforts into how to understand and predict oleophobic and synergistic mechanisms thru machine learning to design/develop more effective surfactant molecules for fire suppression. Undersea Materials - Continue laboratory and theoretical/numerical research efforts focusing on creation of new techniques for understanding, predicting, and controlling the interactions between acoustic and elastic waves and the processing routes for associated new materials; high performance source transducer materials that achieve high powered performance with reduced cost and complexity; and high efficiency silicon-based thin film thermoelectric modules for undersea warfare applications. - Continue research into high performance source transducer materials, such as textured ferroelectric ceramics, that should achieve high power receiver performance at reduced cost and complexity. This would enable high throughput production of high performace tranducer ceramics, providing alternatives to current costly and difficult to produce single crystal technology. - Continue the creation of high efficiency silicon-based thin film thermoelectric modules for undersea warfare applications by exploiting nanocrystallization and multilayering to control thermal conductivity.					
FY 2025 Base Plans:					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
N/A ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The funding decrease from FY 2024 to FY 2025 is due to the transfer of Defense Research Sciences (DRS) Materials/Processes S&T investments from Project 0000 to new Project 1093 (Sea Warfare and Weapons) and Project 1096 (Naval Research Laboratory - Base) within the same PE (0601153N).					
Title: Medical and Biological Sciences ***Description:*** The health and performance of Sailors and Marines is a top priority. Extensive research in the medical and biological sciences discover and leverage breakthroughs to improve Naval warfighter performance, so they can fight, win and come home safe. Sailors and Marines operate in the harshest working environments at sea and around the world. Conducting research to gain a better understanding of the biologic challenges of warfighters in their operating environments will ensure optimal performance, prevent injury, and equip the DON to provide the best care for its warfighters. Research areas include: bio-inspired autonomous systems; bioengineering; biophysics; microbial synthetic biology; microelectronics; microbial electrophysiology; microbiome research; bio-inspired multi-spectral camouflage and sensing; sensory neuroscience and physiology; Naval force health protection; undersea medicine; stress responses, health monitoring and modeling research; and health and welfare of the Navy's marine mammals. ***FY 2024 Plans:*** Bio-Inspired Autonomous Systems and Soft Robotics - Continue research to explore novel bio-inspired sensing, control, and fluid dynamics of underwater propulsion and control systems to expand capabilities of underwater autonomous and unmanned systems. This research will include: (i) Exploration of experimental sensing capabilities and modeling for bio-sensing to enable sensorimotor control including fish schooling for passive swarm coordination in underwater vehicles; (ii) Exploration of bio-inspired locomotion from amphibious animals to enable technologies for amphibious and cross-domain vehicles; (iii) Investigation of bio-inspired design principles of distributed sensing, actuation, and control in soft biological structures for underwater propulsion and manipulation; and (iv) Design bio-inspired soft robots (e.g., worm-like robots) to characterize and measure geotechnical properties of the ocean floor. The long-	15.675	15.306	0.000	0.000	0.000

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
term result will be bio-inspired propulsion and control systems to enable high-lift, stealthy propulsion without propellers and achieve high maneuverability for underwater vehicles. - Continue research investigations exploring multi-fin control, propulsion and maneuver with robotic fish prototypes. Bioengineering and Life Sciences - Continue research investigations using synthetic biology to establish new biomanufacturing pathways/ strategies for complex and living materials. - Continue exploration of building and characterizing DNA nanostructures for use in optical computing, data storage, materials, and cell synthesis. - Complete basic research on computational tools for producing materials with targeted properties from the molecular level (nanometers) to the macroscopic level (meters) for Naval applications. - Complete research investigation of bioinspired and biomimetic adhesives and reversible adhesives that cure in seawater for underwater applications. Naval Biosciences and Synthetic Biology for Naval Applications - Continue research investigations into bio-inspired mechanisms for multi-spectral camouflage. - Continue basic research efforts regarding the use of bioengineering bacteria for sensing and materials synthesis. - Continue investigations of the use of novel materials and electroactive bacteria to improve energy generation from microbial powered devices. - Continue research efforts to understand electroactive bacteria and their components for use in synthetic biology/bioelectronics applications. - Complete research investigations of bacterially synthesized biomaterials for capturing and enriching rare earth elements to establish a secure source of these critical materials. Auditory Science for the Naval Domain - Continue research investigations regarding biological systems' use of acoustic camouflage and design of bio-inspired acoustic dampening metamaterials. Physiological Sciences and Monitoring - Continue research investigations to characterize novel physiologic signal monitoring capabilities. - Continue research efforts into innovative technologies for real-time sensing and observation of individual responses to environmental and operational stressors.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
- Continue Physiological Monitoring and Modeling research efforts regarding the use of nucleic acid cleavage in creation of detection systems for the Warfighter. This will enable easily adapted nucleic acid detection with orders of magnitude lower sensitivity and specificity. - Complete research efforts regarding the use of nucleic acid cleavage in the creation of detection systems for the Warfighter. - Initiate research efforts regarding concepts for passive or semi-passive location and identification of people lost at sea. - Initiate research into the development of functional bio/nanohybrid materials that will enable the ability to reprogram cellular behavior without the manipulation of the cell's genetic material. Naval Force Health Protection - Continue research into methods for modeling and simulation approaches to improve Warfighter protection, injury treatment, and safer platforms. - Continue investigations into nanotechnologies, microelectronics, artificial intelligence and autonomy that will inform future applications for estimation of combat casualty injury severity, improve care and facilitate casualty evacuation. - Continue research regarding the understanding of fundamental principles of composite materials, additive manufacturing, and microelectronics to enhance warfighter protection, health and situational awareness. - Continue research regarding the understanding of fundamental principles of physics to determine material properties of biological tissues to allow for physics based prediction and modeling of tissue damage resulting from insult or injury. - Complete research efforts regarding computational cellular biology investigations of blast effects to allow physics-based prediction and modeling of cavitation damage of tissues. - Initiate research regarding microelectronic detection of warfighter brain health to guide transcranial stimulation research into attentiveness, sleep, and mission focus. Undersea Medicine - Continue studies to enhance our understanding of human physiology (and leverage insights from comparative physiology studies of marine mammals) in the undersea environment. - Continue work to create synthetic biology approaches for thermal protection during dive operations. - Continue research to identify novel technologies to support underwater breathing apparatus to include utilizing resources naturally present in the ocean for gas management (e.g., oxygen supply and carbon dioxide disposal). - Continue fundamental research to understand the pulmonary physiology of exposure to altered levels of oxygen and carbon dioxide.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
-Initiate studies to explore use of porous liquids as novel gas management for biomedical applications to include Nitrogen capture for DCS mitigation. Stress Response - Continue research investigations regarding neurobiological and genetic factors that predict differences in stress reactivity for constructing a multi-modal predictor of stress responsiveness, and for identifying targets for intervention. - Continue research efforts to examine the impact of an acutely stressful environment on the function of the stress response system. - Continue research efforts to explore the feasibility of continuous and unobtrusive stress detection, tracking, and mitigation for a wearable closed-loop system capable of monitoring stress and providing bioelectronic therapy. - Complete research efforts regarding clinical factors that predict differences in stress reactivity for constructing a multi-modal predictor of stress responsiveness, and for identifying targets for intervention. - Complete research investigations regarding impact of changes in light/dark periods on the function of the stress response system. - Initiate comprehensive investigation of physiological and cognitive stress response following acute exposure to high stress operational or emergency scenarios/environments (i.e. extreme heat/cold, smoke/fire, unexpected water immersion), which will inform future development of countermeasures against these exposures. ***FY 2025 Base Plans:*** N/A ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The funding decrease from FY 2024 to FY 2025 is due to the transfer of Defense Research Sciences (DRS) Medical and Biological Sciences S&T investment from Project 0000 to new Project 1094 (Warfighter Performance) within this same PE (0601153N).					
Title: Ocean Sciences ***Description:*** Understanding and predicting oceanographic and acoustical phenomena provides significant warfighting advantages to naval forces. Ocean Sciences research addresses the full spectrum of acoustics and oceanography to enable observation, modeling, and prediction of the maritime environment. Efforts include: studying common operating areas for naval forces in the open oceans, the Arctic, the littorals, and nearshore and river mouths and inlet environments; elucidating the coupling between oceanographic, geophysical and	80.256	89.591	0.000	0.000	0.000

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
acoustical phenomena relevant to such mission areas such as Anti-Submarine Warfare and Mine Warfare; development of global, regional and local predictive models that fully couple the ocean-atmosphere-wave-ice domains; development and use of autonomous systems and sampling technologies for the collection of environmental observations and continuing support to research vessels of the U.S. Academic Research Fleet to enable at-sea oceanographic science. Research within the Ocean Sciences subactivity responds to mission needs of the Navy and Marine Corps as guided by the Oceanographer of the Navy. At-sea research involves ancillary studies to ensure full compliance with environmental requirements. ***FY 2024 Plans:*** Littoral Geosciences and Optics Research efforts regarding nonlinear coupling between atmospheric phenomena and surface/waves, sediment transport dynamics, and the study of bathymetric environments using field observations, modeling, and remote sensing data. Research efforts include the following: - Continue studies of surface gravity waves, currents, tides and internal wave processes along rocky coastlines. - Continue autonomous, scalable, hydrographic charting and coastal parameter sampling studies with concomitant remote sensing for data-assimilative coastal models. - Continue research using airborne and satellite active and passive microwave sensors, overhead optical sensors, and ship or shore-based radars to observe coastal and nearshore phenomena. - Continue studies of the dynamics of shallow coastal inlets; specific areas include their formation and maintenance processes by tides, waves, currents, discharge and sediment type and supply. - Continue research to predict physical, geological, geochemical, geo-acoustic and geotechnical properties of the seafloor in shallow-water coastal environments. - Complete field studies of coastal oceanographic phenomena using sonar-equipped autonomous underwater vehicles in conjunction with ground-based, airborne and satellite remote sensing. - Initiate research to investigate sub-seabed geophysical properties. Physical Oceanography and Prediction Research of ocean circulation, thermodynamics and mixing, and the dynamics of surface gravity waves, nonlinear internal waves and the interaction of waves with sea ice in order to understand the sub-mesoscale physical oceanography parameters from the tropics to the poles. Sub-mesoscale understanding of the ocean is					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
necessary to support the required fidelity and accuracy of ocean feature inputs to Naval warfighting applications. Research efforts include the following: - Continue research efforts exploring novel expeditionary ocean instrumentation to support targeted observing. - Continue research regarding the study of ocean fronts, eddies and turbulence; ocean thermodynamics including mixing and acoustic impacts; and ocean boundary layer processes and surface gravity waves. - Continue research investigations of the rapid evolution of the upper ocean in the high North Atlantic between Iceland and the European continent to understand the physical processes that control vertical and horizontal density structures in the upper ocean. - Continue research efforts to explore the cascade of energy in the sub-mesoscale ocean, including the physics and dynamics of ocean features such as current meanders, vortices, and filaments, with a field program in the Western Pacific, to expand the knowledge of the lifecycle of these features and enable improved predictions. - Complete research investigations of three-dimensional Lagrangian ocean circulation and the prediction of vertical pathways in field experiments in the Mediterranean Sea. - Complete research regarding the seasonal variability of processes that control sea surface temperature in the Arabian Sea to understand the relevant space and time scales that enable improved ocean and weather forecasts through the reduction of ocean temperature biases in coupled models. - Initiate research investigations of air-sea interaction in the Arabian Sea to understand the origin of monsoon moisture and precipitation biases that exist in all coupled climate models (including the Navy's forecasting system) at subseasonal and shorter timescales. Program will leverage new observations of the ocean and atmosphere collected with regional partners. Arctic Sciences Research of complex processes governing the interaction of the arctic atmosphere, ocean, and sea ice, including formation, deformation, and melting. The physical processes in the arctic are inherently different from those in non-polar regions. Research efforts include: - Continue research efforts to characterize the behavior of sea ice, including melt and reformation, ice rheology and motion, and interactions with ocean stratification, surface waves and the atmosphere. - Continue research investigations regarding the development of Arctic System models and data assimilation techniques for improved prediction of the Arctic region and development of new sensors and unmanned platforms to collect observations of the Arctic environment. - Continue research development of algorithms enabling the space-based remote sensing of bulk properties of Arctic sea-ice that previously could be sampled only by localized in-situ methods. - Continue research efforts into studies of the circulation of the Arctic Ocean to explore the fate of heat flowing in through the Bering Strait and the impact on the upper ocean density structure of the Beaufort Sea.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
Ocean Acoustics Ocean Acoustics research continues as one of five National Naval Responsibilities (NNR) S&T investment areas. Research and education supported under this PE contributes to a vigorous science and technology base to ensure continuing U.S. leadership in the critically important discipline of Ocean Acoustics. Research in these areas contribute to improved basic understanding of the physical, seafloor and biological parameters that impact acoustic propagation in the ocean. Accurate acoustic predictions are required to keep our undersea assets undetected as well as to enable the detection and tracking of adversary assets. Research efforts include the following: - Continue research efforts to understand propagation and scattering of acoustic energy in shallow-water ocean environments. Specific efforts include shallow-water scattering mechanisms related to reverberation and clutter; seabed acoustic measurements supporting geoacoustic inversion; acoustic propagation through internal waves and coastal ocean processes and the development of unified ocean/seabed/acoustic models, including scattering from rough surfaces, biologics and bubbles; and penetration/propagation within the porous seafloor. - Continue research investigations regarding optimal representations information contained in acoustic data. Specific efforts will include the investigation summary statistics and sparse encoding of underwater acoustic data. The objective is to enable efficient analysis and compact representations of acoustic scenes. - Continue research investigations regarding naturalization applicable to the ocean battlespace. Specific efforts will include investigations into source separation, characterization, and recombination along with physical, biological, and anthropogenic sound generating mechanisms. The objective is to model and simulate acoustic phenomena in undersea environments to be rendered as virtual sound-fields. - Continue research into the effects of environmental variability induced by ocean internal waves, internal tides and mesoscale processes, and by bathymetric features including seamounts and ridges, on the stability, statistics, spatial distribution, and predictability of broadband acoustic signals, as well as the coherence and depth dependence of deep-water ambient noise. - Continue research investigations into the effects of Arctic conditions on acoustic propagation and ambient noise, particularly in under-ice environments. - Continue research efforts regarding joint physical oceanography and acoustic field studies to investigate propagation and scattering in regions characterized by complex bathymetry and/or meteorological and oceanographic forcing. Specific efforts will include processes studies with the objective of linking observed ocean and acoustic phenomena. An objective is to characterize oceanographic phenomena and the effects on acoustic propagation and scattering at different frequencies. - Continue research efforts regarding characterizing and forecasting sediment acoustic properties. Specific efforts will include investigations aimed at linking local physical and biological processes to acoustic					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
observables. Continue analysis efforts related to acoustic seabed characterization experiment. Specific efforts will include development and verification of geoacoustic models and inference techniques for soft sediments based on experimental evidence. - Continue research efforts regarding the analysis of data from a previous trans-arctic basin collection effort to extend studies of under-ice environments. Marine Mammals and Biology - Continue research efforts regarding the development and testing of new and existing technologies to detect, classify, localize and potentially track marine mammals. - Continue multidisciplinary ecosystem research including tagging, visual surveys, and passive acoustics to collect baseline measures of marine mammal behaviors and distributions relative to environmental features and marine mammal prey fields. - Continue research investigations of sound reception mechanisms in large whales. - Continue research efforts regarding the effects of sound include behavioral, physiological and population-level consequences of sound exposure on marine life. - Continue research investigations to characterize and quantify the cumulative effects of multiple stressors on marine mammal populations. - Continue research to develop framework for understanding the ecology of eDNA, including the origin, state, transport, and fate of extra-organismal genetic material. - Continue studies to design appropriate primers and bioinformatics workflows to effectively and efficiently detect and identify target biological communities and ecosystems, and advance our understanding of the relationships between eDNA and the abundance of marine megafauna. Battlespace Environments - Continue research efforts to improve basic understanding of physical, seafloor and biological oceanographic processes on space and time scales of naval interest. Research emphasis is on improved measurements, laboratory and model based experiments to quantify and understand important oceanographic processes that lead to the development of ocean dynamic/thermodynamic models from global to sub-mesoscale scales, and to couple these oceanographic models with atmospheric, ice, biological, sediment response, and optical models. While today's numerical analysis and prediction systems are more capable of resolving and predicting highly variable phenomena than were the systems of 10-20 years ago, there are still oceanographic processes that are not well understood and must be studied including aspects of ocean circulation (fronts, eddies and turbulence), thermodynamics (mixing and acoustic impacts), waves (including their impact on sea ice and rogue waves), sea ice (including landfast ice) as well as ocean boundary layer processes. Navy and Marine Corps requirements					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
also include: a) an improved use of overhead (airborne and satellite) active and passive microwave sensors, overhead optical sensors, surface-based (ships and ground-based) grazing angle microwave sensor, b) use of remote sensing of bulk properties of Arctic sea-ice over broad two-dimensional areas that previously could be sampled only at spot locations by in-situ sampling, and c) use of newly available higher resolution (sub-mesoscale) oceanographic data. ***FY 2025 Base Plans:*** N/A ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The funding decrease from FY 2024 to FY 2025 is due to the transfer of Defense Research Sciences (DRS) Ocean Sciences S&T investments from Project 0000 to new Project 1092 (Ocean Battlespace Sensing) and Project 1096 (Naval Research Laboratory - Base) within this same PE (0601153N).					
Title: Science and Engineering Education, Career Development and Outreach	47.405	65.196	0.000	0.000	0.000
Description: The Science and Engineering Education, Career Development and Outreach activity addresses the critical need to grow and maintain a highly skilled technical naval workforce. These efforts inspire, engage, educate and attract participants to pursue naval careers and build the extramural performer base. DON Science, Technology, Engineering and Math (STEM) education and outreach is designed to increase the number of students and naval civilians with naval-relevant skills and degrees, expand capabilities of the current and future workforce by developing curricula and augmenting education, and augment awareness of Naval opportunities through localized education and outreach initiatives that foster the talent pipeline. This activity supports both the Naval Research Enterprise Intern Program (NREIP) for college students and the Science and Engineering Apprenticeship Program (SEAP) for high school students to encourage participants to pursue science and engineering careers. The objective is to further education via mentoring by laboratory personnel and their participation in research, and to make them aware of Department of the Navy (DON) research and technology efforts. This program serves as a recruitment tool for employment within the DON. Participating students at 45 DON laboratories will spend eight to ten weeks during the summer conducting research. The separately-managed Department of the Navy's (DON) Historically Black Colleges and Universities/Minority Institutions (HBCU/MI) program oversees the Navy's efforts to engage and support research in our nation's					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
HBCU/MIs and is responsible for developing and managing efforts that strengthen and support the capabilities of HBCU/MIs to participate in basic, applied, and advanced development research programs within the Naval Research Enterprise. The ONR Young Investigator Program (YIP) attracts outstanding faculty members to the Department of Navy's basic research program by identifying individuals that show exceptional promise for doing creative research and encourage their teaching and research careers through long term support. Young Investigator awards are for a period of three years. Proposals are solicited annually via a funding opportunity announcement open to tenure-track faculty in science, engineering, and mathematics. YIP awardees are competitively selected based on faculty achievements, technical proposal, benefit to the Navy and Marine Corps, and university endorsement. The Naval Research Institution was established through a Memorandum of Understanding between the United States Naval Academy (USNA) and the Office of Naval Research. This effort contributes to the technical education of midshipmen by providing a research experience in STEM and its impact on fleet and forces capabilities. This activity also supports the Office of Naval Research Global mission to serve as the enduring Navy and Marine Corps global presence in technical and operational communities, investing in trusted partnerships to discover and connect science and technology leaders for sustained maritime security. This is accomplished by establishing quality, relevant connections between the international research and development community, Naval fleet/forces, Department of Defense, other US Government agencies and international partners. The direct impact of this investment is to leverage international basic research during increasingly dynamic global interdependence and improve the ability to solve DON Science & Technology challenges through shared knowledge with partners. ***FY 2024 Plans:*** Science, Technology, Education and Mathematics (STEM) - Continue existing successful efforts, like the Navy and Marine Corps Junior Reserve Officers' Training Corps (JROTC) Flight Academy, while examining approaches to further scale up these efforts to achieve greater impact across the DON. - Continue the development of highly scalable pilot efforts, like Naval Horizons, to expand STEM education and outreach, with a focus on reaching underrepresented students, through the development of new virtual and in-person curricula as well as virtual and in-person experiential learning activities.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
- Continue activities targeting regional efforts to augment awareness of naval opportunities, like SeaPerch, and increase diverse workforce opportunity for the naval science and technology community. - Continue to support the Naval Research Institution efforts that provide hands-on and virtual research experiences in STEM fields for United States Naval Academy (USNA) midshipmen and faculty members to enhance the midshipmen's educational environment at the USNA. - Continue Naval Research Enterprise Internship Program (NREIP) and Science and Engineering Apprenticeship Program (SEAP) opportunities for students to participate in Navy and Marine Corps-relevant research at Naval Warfare Centers and Laboratories by expanding the number of participating sites, mentors, and interns. - Continue NREIP and SEAP internship opportunities for students to participate in Navy and Marine Corps-relevant research at Naval Warfare Centers and Laboratories. Continue to increase the number of participating sites resulting in additional mentors and interns. - Initiate new STEM efforts to address Naval skilled technical workforce needs. Historically Black Colleges and Universities/Minority Institutions (HBCU/MI) - Continue with increasing the number of internships at SYSCOMs: NRL, NAVSUP, NAVAIR, NAVFAC, BUMED and NAVWAR for students at HBCU/MIs. - Continue to provide faculty fellowships for HBCU/MI faculty to conduct naval relevant research at all Naval Warfare Centers and Labs working naval scientist and engineers. - Continue new outreach initiatives to increase the number of HBCU/MI white paper and grant proposal submissions - to include making more grant awards. - Continue to increase the number of science fairs at HBCU/MI that have partnerships with local junior and high schools to include providing more CNR scholarships. - Expand the DoN HBCU/MI Post-doctoral program that impacts the number of HBCU/MI PhD candidates working within the Navy STEM related fields. Young Investigator Program (YIP) - Continue FY2022 & FY2023 YIP awards to assistant professors that have demonstrated exceptional promise for performing creative research. Recent YIP topics include innovative technical approaches to a broad range of naval-relevant research topics, including improved ocean wave forecasting; bio-inspired wings for unmanned systems; hypersonic aerodynamics; bio-degradable polymers; and advanced metal alloys for improved thermal management. These and other research topics will benefit today's and the next generation warfighter by improving lethality, survivability, and communications. Additionally, many of these investigators will provide long-term support and knowledge in solving Naval related S&T challenges.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
- Complete Young Investigator Program topics initiated in previous fiscal years. - Initiate Young Investigator Program topics selected in fiscal year 2024. ONR Global - Continue international outreach efforts to foster collaboration through doctoral-level scientists located in Europe, South America, Asia and Australia, providing coverage in these regions by awarding grants in innovative basic research to discover, access and assess revolutionary, high-payoff technologies for future Naval missions and capabilities. ***FY 2025 Base Plans:*** N/A ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The funding decrease from FY 2024 to FY 2025 is due to the transfer of Defense Research Sciences (DRS) Science and Engineering Education, Career Development and Outreach S&T investments from Project 0000 to new Project 1091 (Information, Cyber and Spectrum Superiority), Project 1092 (Ocean Battlespace Sensing), 1093 (Sea Warfare and Weapons), Project 1094 (Warfighter Performance), Project 1095 (Naval Air Warfare and Weapons) and Project 1099 (ONR Global) within this same PE (0601153N).					
Title: Sensors, Electronics and Electronic Warfare (EW) ***Description:*** Basic research efforts directed toward increasing knowledge, components and algorithmic advances for electronics, sensing and EW ensuring the Navy can counter current and future threats. These efforts are applicable to sensing and EW on individual Naval platforms, as well as, efforts that aggregate capabilities in a Distributed Maritime Operation. The efforts research focus include: sensing, diagnostics, and detectors; navigation and timekeeping; nanoelectronics; wide band gap power devices; real-time targeting; Electro-Optical/Infra-Red (EO/IR) electronics; EO/IR electronic warfare; EO/IR sensors for surface/aerospace surveillance; Radio Frequency (RF) sensors for surface/aerospace surveillance; solid state electronics; vacuum electronics; and RF electronic warfare. ***FY 2024 Plans:*** Electronics Technology	54.108	61.328	0.000	0.000	0.000

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
- Continue research efforts in nitrogen-polar GaN materials and device development. - Continue research investigations in superconducting GaN materials and device development. - Continue research efforts in plasmonic photomixer devices and circuits. - Continue research efforts regarding device reliability studies of nitrogen-polar GaN devices. - Continue studies on superconducting GaN functional circuits. - Continue research investigations into p-type and n-type crystalline metal nitride materials, transport properties and heterostructures. - Continue research to improve full spectrum, real time, fully adaptive reception of many simultaneous signals-of-interest by exploiting the unique quantum properties of superconductor microelectronics and photonics. - Continue research investigations regarding methods to realize increased receiver dynamic range over entire DC to 200 GHz spectrum and enhance functional density to produce lighter and smaller receivers. - Continue architectural studies correlating the type of superconducting logic used to the expected performance and circuit SWaP when performing in the cryogenic environment specific digital signal processing tasks highly relevant to the naval environment. Such systems will be applicable to all RF applications while being most important to Surveillance, Electronic Warfare (EW), signal intelligence (SIGINT). - Complete research efforts regarding squeezed lasers and optical cooling of solids. - Complete research investigations regarding the use of generative neural networks to design topology-optimized metasurfaces and apply results to generate dual-level short-wave infrared antireflective coatings. - Complete research efforts developing novel materials for linear, low-power, broadband switches, including phase-change materials such as GeTe, as well as two-dimensional hexagonal boron nitride. - Complete research efforts on quantum entanglement and measurement as applied to RF signal analysis. - Complete research efforts to create new knowledge and understanding for quantum computing algorithms and their use to create new understanding of materials by design, process optimization, and quantum simulation. - Continue research efforts to create new knowledge and understanding and explore new concepts, components, techniques and methods, for the design, growth, and characterization of electronic, electromagnetic, quantum phenomenology, and electro-optical materials, fabrication processes, electronic and electro-optic components, including novel electromagnetic concepts and techniques, and plasma phenomena and theory. - Initiate research exploring new classes of analog superconducting devices including dynamically tunable resonators for analog processing and 3D stacks of predeposited YBCO as low loss interconnects. - Initiate research efforts to create new knowledge and understanding for quantum computing algorithms and their use to create new understanding of materials by design, process optimization, and quantum simulation. - Initiate research investigations into the use of molecular excitonics as a platform for quantum technologies such as quantum computing and quantum communications					

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
- Initiate research investigations into integrated mm-wave plasmonic photomixer receivers. - Initiate research efforts to evaluate RF properties of low Vpi electro-optical modulators made of thin film LiNbO3 deposits for airborne analog data links, including when hybridized with III-V, Si and SiN photonic devices. Quantum Measurement Architectural Devices - Continue research efforts regarding the development of protocols for sensing and timekeeping devices based on quantum systems, including clocks with improved short and long-term performance and electromagnetic field sensors. - Continue research into the development of inertial and gravity sensors based on light-atom interferometry. - Continue research efforts on the capabilities of non-equilibrium many-body systems for novel metrology. Electromagnetic Warfare - Continue research efforts with the overarching objective of establishing the mathematical constructs, techniques, computational procedures, and scientific foundations for analysis/design of signal, image, control, and data generating systems for use in Navy, other DoD, dual-use, or commercial development programs. Each project has defined objectives within the contexts of the Naval Research Enterprise Research and Development Strategic Framework and Marine Corps S&T Strategic Plan. - Continue research investigation into novel approaches to deep-generative machine learning-based algorithms and architectures for multi-static radar imaging to enable better noise robustness and resolution performance. - Complete research efforts regarding the development of ultrafast, efficient, and accurate time domain (TD) algorithms to predict the ultra-wideband radar cross-section (RCS) of complex naval platforms by solving the long-standing late-time instability problem. - Complete research efforts to enable the imaging of self-illuminating thermal objects occluded by walls by sensing non-specular reflections from rough surfaces such as open doors and around corners, to allow for asymmetric warfare through image recovery in previously denied conditions. Materials and Chemistry - Continue the design and fabrication of single-monolayer or low-dimensional materials with unique and useful fundamental properties, e.g. ferromagnets and semiconductors, distinct from bulk materials and capable of being functionalized for high performing sensors, computer memory elements and electronic components. - Continue the use of precision molecular placement and orientation to design and create bio-inspired materials exploiting quantum phenomena to perform functions such as ultrasensitive photon detectors and energy generation.					

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 0000 / *Defense Research Sciences*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
- Continue highly sensitive measurement and modeling techniques to design, detect, diagnose and/or quantify physical, chemical and biological processes and properties affected by trace impurities, subtle composition changes and chemical species with high spatial resolution, sensitivity, and precision. Undersea Warfare - Continue to conduct laboratory, field, and theoretical/numerical studies to investigate physical phenomena related to acoustic propagation and scattering in oceanic environments such as: prediction of the scattering signature of a structure using noise sources of opportunity; fundamental physical phenomena of wave propagation in ocean environments; approaches to separate an acoustical field from turbulent flow on an acoustic array; new structural acoustics theory for scattering from large, complex undersea objects; and creation of new approaches to monitoring the acoustic signature and structural state of undersea vessels. ***FY 2025 Base Plans:*** N/A ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The funding decrease from FY 2024 to FY 2025 is due to the transfer of Defense Research Sciences (DRS) Sensors, Electronics and Electronic Warfare (EW) S&T investments from Project 0000 to new Project 1091 (Information, Cyber and Spectrum Superiority) and Project 1096 (Naval Research Laboratory - Base) within the same PE (0601153N).					
Title: Weapons ***Description:*** The Weapons activity focuses on a number of fundamental scientific areas aimed at expanding the underlying understanding of disciplines that are broadly useful for a wide range of naval weapon applications, including undersea weaponry; air weaponry; energetic materials and solid rocket propulsion; both laser and high power microwave directed energy systems; counter directed energy phenomena; and hypersonic aerodynamics and materials to address the unique challenges of extreme temperatures and air flow. ***FY 2024 Plans:*** Undersea Weaponry - Continue research investigations of Undersea Warheads with respect to the characterization and modeling of explosive formulations.	26.324	26.255	0.000	0.000	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
- Continue research efforts regarding Advanced Concepts for Sea Warfare and Weapons regarding unconventional power and energy technologies. - Continue research investigations of Cooperative Autonomous Swarm Technology. - Continue research efforts relevant to the Naval Undersea Research graduate-level STEM program to support the development of the Navy laboratory workforce. Air Weaponry - Continue efforts in the areas of solid and hybrid rocket propulsion, advanced structural and aperture materials, navigation, aerodynamics, single and multi-missile control, and power management. - Continue research on multifunctional material structures include making missile skins with embedded (woven-in) antennas, sensors, power sources, computational resources, and energetic materials. These efforts will enable missiles with greatly increased speed, range and lethality to meet future naval warfare needs. - Continue research to develop models and tools to provide robust bearings without oil. Energetic Materials and Rocket Propulsion - Continue research investigating advanced energetic materials, which provide reactive, explosive, and propulsive phenomena including high-energy ingredient synthesis, modeling, characterization, and the fundamentals of initiation, decomposition, combustion and shock. - Continue and expand research in advanced synthetic methodologies and motifs for energetic material ingredients and material concepts with superior specific energy / energy density, brisance, and insensitivity for useful warhead fills and tactical propulsion, including new metal-based fuel particle designs and other inorganic and hybrid energetic material concepts. - Continue and expand research in novel diagnostic method development for improved understanding of energetic material decomposition, pyrolysis, combustion, shock response, and related dynamic phenomena. - Continue and expand efforts in advanced modeling and simulations on energetic materials to further understand and predict energetic material properties, response to shock, thermal and other stimuli, and performance. - Continue and expand research into fundamental understanding of material interfacial physics/chemistry relevant to energetic formulation development and advanced manufacturing. - Continue research focused on novel synthetic methodology development for carbon/hydrogen/nitrogen/oxygen-based energetic ingredients in addition to new metal based fuel particle design and other inorganic and hybrid energetic material concept Hypersonics					

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
- Continue research to address technologies needed for long-range weapon components that are able to survive high temperature exposure for several minutes and defeat anti-access / area denial countermeasures. - Continue investigating the hypersonic boundary-layers and shock-wave / boundary-layer interactions, prediction of hypersonic weapon flight performance and control, environment-material interactions, exploration of ultrahigh temperature materials, and technologies needed for high-speed propulsion. Directed Energy and Counter Directed Energy Directed energy weapons are defined as electromagnetic systems capable of converting chemical and/or electrical energy to radiated energy and focusing it on a target, resulting in damage that degrades, neutralizes, defeats, or destroys an adversarial capability. Directed Energy Weapons efforts include High Energy Lasers that emit photons and High Power Microwaves that release radiofrequency waves. The ability to focus the radiated energy reliably and repeatedly at range, with precision and controllable effects, while producing measured physical damage, is the measure of effectiveness - requiring understanding of the basic sciences in high energy physics, optics, quantum mechanics and material sciences. The U.S. Navy applies the basic research knowledge through follow-on applied technology programs for power projection and integrated defense missions. High Energy Lasers - Continue the exploration of the physics of photonic creation, materials interaction, energy release and interactions with optical materials via computational and mathematical modeling methods, including machine learning. - Continue research on next-generation photon waveform and mode shaping interactions with materials, including metamaterials, examining high efficiency energy conversion designs within unique nanostructured materials with goal of increasing efficiency from source to release. - Continue examination of high energy laser-launched collimated photon interactions with the atmosphere, which are unique in propagation within the maritime domain, examining unique physical and optical interactions related to absorption, reflectance, scatter and turbulence often seen in expeditionary and at-sea conditions. - Continue research that will contribute to identifying new nanostructured materials, metamaterials and optical coatings processing for naval applications and investigate unique interactions of high energy photons with materials and coatings. High Power Microwaves (HPM) - Continue research into solid-state and vacuum electronic based sources and amplifiers, antennas, high voltage storage/switching components and power supplies, novel high power capable materials, radio-frequency					

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
coupling and electronic device interaction physics, predictive effects and modeling tools along with novel sensors and instrumentation. Planned research efforts include the following: - research investigations in HPM technologies including not only consideration of sources, but also the supporting pulsed power, antennas, and other subsystems. - research efforts in Solid-state and vacuum electronic based HPM sources capable of flexible waveforms. - research in Distributed array sources for agile beamforming. - research in Wide-bandwidth high-power frequency agile amplifiers. - research investigations of Low profile steerable antennas; high energy density capacitors, solid-state high voltage switches; high voltage power supplies, power electronics switches, hardened controls. - research in Novel materials - dielectric insulators, 3D printed materials, improved radome materials. - research efforts in RF coupling, device interaction physics and component level effects. - research in Prediction of effects on electronics with improved techniques for HPM lethality testing and analysis from L band to X band and above. - research in Novel HPM sensors including electronic battle damage indication (eBDI) instrumentation. Ultra Short Pulse Laser - Continue research on interaction of intense laser pulses with nanostructured surfaces, the role of disorder in promoting synchronization in technological systems of relevance to the Navy, hybrid quantum devices with the greatest technological impact to photonics and solid-state laser components, and extension of mode-locked laser and optical frequency comb technologies from the traditional near-infrared regime to new spectral regions. - Continue research on generation of high-average power ultra-broadband radio frequency and mid-infrared radiation in dielectrics and plasmas, effects of atmospheric turbulence on the propagation of laser beams having orbital angular momentum, demonstration of a compact solid-state laser source, demonstration of highly efficient frequency conversion of ultrashort pulse laser sources, and demonstration of ultrahigh peak power compact ultrashort sources in specific spectral ranges via advanced mode locking and chirped pulse amplification techniques. - Initiate research investigation of improved AI deep learning approaches for beaconless atmospheric turbulence prediction and compensation for deep turbulence. - Initiate research into the evaluation of wavefront sensing, reconstruction, and control methods for deep turbulence in the laboratory.					
FY 2025 Base Plans:					

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
N/A ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The funding decrease from FY 2024 to FY 2025 is due to the transfer of Defense Research Sciences (DRS) Weapons S&T investments from Project 0000 to new Project 1093 (Sea Warfare and Weapons) and Project 1095 (Naval Air Warfare and Weapons) within the same PE (0601153N).					
Accomplishments/Planned Programs Subtotals	469.411	520.984	0.000	0.000	0.000

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable.

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy											Date: March 2024	
Appropriation/Budget Activity 1319 / 1					R-1 Program Element (Number/Name) PE 0601153N / *Defense Research Sciences*				Project (Number/Name) 1099 / *Experimentation and Analysis*			
COST ($ in Millions)	**Prior Years**	**FY 2023**	**FY 2024**	**FY 2025 Base**	**FY 2025 OCO**	**FY 2025 Total**	**FY 2026**	**FY 2027**	**FY 2028**	**FY 2029**	**Cost To Complete**	**Total Cost**
1099: *Experimentation and Analysis*	0.000	0.000	0.000	6.478	-	6.478	6.391	6.977	7.131	8.440	Continuing	Continuing

Note

Investments in Project 1099 were previously funded in this same Program Element (PE) 0601153N under 'Science and Engineering Education, Career Development and Outreach' Planned Program of Project 0000. This new Project was created to promote greater transparency and execution oversight for ONR Global investments in Defense Research Science (DRS) in the Department of the Navy's annual budget request. This is not a new start.

A. Mission Description and Budget Item Justification

Office of Naval Research Global (ONR Global) supports the basic research portion of the Department of the Navy (DON) science and technology (S&T) portfolio, by exploring science and technology research activities being conducted by scientists and universities outside of the United States. These basic research concepts have gone forward to become the foundation for new innovative technologies and future capabilities for naval warfighters. ONR Global's mission is to obtain, coordinate, and make available world-wide scientific information, to provide Global Technology Awareness; serve as an avenue for experimentation and analysis in support of transitioning basic research; provide rapid-prototyping solutions to problems submitted by Sailors and Marines world-wide; and to work closely with our unparalleled network of allies and partners to support the strategy of integrated deterrence across the globe.

This project unit supports higher guidance defined by the National Defense Strategy and responds to requirements identified by the Secretary of the Navy through research priorities set by the Chief of Naval Research, coordinated across the Naval Research Enterprise (NRE), and outlined in the Naval R&D Framework. Research activities support long-term investments as outlined in an S&T Strategic Plan. The basic research conducted within this project activity supports areas of traditional, unique and emerging naval need to help ensure naval operational readiness and unsurpassed warfighting capabilities in the maritime domain.

The basic research conducted within this project unit is expected to be at Technology Readiness Level (TRL) 1 (basic principles observed and reported) up to TRL 2 (technology concept and/or application formulation). DRS basic research (BA1) results provide the foundation for later applied research (BA2) and advanced technology development (BA3) solution options for the Navy and Marine Corps.

ONR Global S&T research follows the trend of other DRS activities by advancing aspects of applied research and technology development that are developed into solutions for Navy and Marine Corps technical challenges via the Future Naval Capabilities (FNCs) pipeline, and new capability options for the future via the Innovative Naval Prototypes (INPs) portfolio. Just as today's Sailors and Marines are enabled by past naval S&T investments, current investments hedge against uncertainty, providing the scientific basis for near-term solutions to commanders today and options for an unknown future.

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2023**	**FY 2024**	**FY 2025 Base**	**FY 2025 OCO**	**FY 2025 Total**
Title: Global Technology Awareness	0.000	0.000	6.478	0.000	6.478

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
Description: Global Technology Awareness focus area addresses the critical need to grow and maintain relationships with both domestic and international scientists and engineers in the pursuit of supporting the US Navy as the partner of choice around the world. These efforts inspire, engage and educate top researchers around the world via the use of exchange visits, conferences and workshops, grant research funding that evolve to address the needs of the Navy and Marine Corps and enhance the S&T priorities of ONR, the NRE and our partnerships. - Research Grants provide direct research support to international scientists to help address naval S&T challenges. These grants support the insertion of innovative, international S&T into core ONR and NRE portfolios. ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** - Continue international outreach efforts to foster collaboration through doctoral-level scientists located in Europe, South America, Asia and Australia, providing coverage in these regions by awarding grants in innovative basic research to discover, access and assess revolutionary, high-payoff technologies for future Naval missions and capabilities. ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding changes from FY 2024 to FY 2025 are due to the new project structure where realignment of Defense Research Sciences (DRS) PE 0601153N Project 0000 planned program 'Science and Engineering Education, Career Development and Outreach' research area have been aligned starting in FY 2025 to new Project 1099 under the 'Global Technology Awareness' research area. There is no significant change to research activities in FY 2025 under the alignment to new Project 1099.					
Accomplishments/Planned Programs Subtotals	0.000	0.000	6.478	0.000	6.478

C. Other Program Funding Summary ($ in Millions)

N/A

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Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1099 / *Experimentation and Analysis*

C. Other Program Funding Summary ($ in Millions)

Remarks

D. Acquisition Strategy

Not required

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy			Date: March 2024
Appropriation/Budget Activity 1319 / 1	R-1 Program Element (Number/Name) PE 0601153N / *Defense Research Sciences*	Project (Number/Name) 1385 / *Aerospace Sciences*	

COST ($ in Millions)	Prior Years	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total	FY 2026	FY 2027	FY 2028	FY 2029	Cost To Complete	Total Cost
1385: *Aerospace Sciences*	0.000	0.000	0.000	24.636	-	24.636	26.623	35.237	40.492	41.844	Continuing	Continuing

Note

Investments in Project 1385 Aerospace Sciences were previously funded in this same Program Element (PE) 0601153N under Project 0000. This new Project was created to promote greater transparency and execution oversight for Aerospace science investments in Defense Research Science (DRS) in the Department of the Navy's annual budget request. This is not a new start.

A. Mission Description and Budget Item Justification

The Aerospace Sciences activity develops technologies for the science and engineering of flight from the land and sea surfaces to the edge of the atmosphere, and as applicable to the utilization of flight for aircraft, missiles, rockets, munitions, and unmanned systems (UxS) employed by the Navy and Marine Corps forces operating from naval platforms or land locations.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
Title: Aerodynamics	0.000	0.000	3.608	0.000	3.608
FY 2024 Plans: N/A					
FY 2025 Base Plans: Aerodynamics Research efforts focused on enhancing our understanding of Naval-unique aerodynamic challenges by developing advanced computational and experimental methods. Research efforts include the following: Continue: -Researching the fully coupled aerodynamic interface between ships and aircraft. -Investigating novel state-of-the-art in-situ diagnostics and reduced-order modeling of complex flow fields. -Researching innovative technologies enabling increased range and/or maneuverability suitable for aircraft operating from the maritime environment and attritable systems such as unmanned aerial systems and high-speed weapons. -Research of the interactional and transitional aerodynamics of multi-rotor systems in complex fluid dynamic environments involving multi-body relative motion. Initiate:					

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
-Research into effects of dynamic ground effect on lifting body aerodynamics, including coupling to active flow control schemes. -Investigation of novel active flow control schemes via innovative surface materials. -Understanding bluff body fluid dynamics and the effects of co-flow on wake evolution. ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The funding change FY 2024 to FY 2025 is due to the new project structure which realigned funding within the same PE 0601153N from Defense Research Sciences (DRS) Project 0000 under the Air, Ground and Sea Vehicles research planned program to Aerospace Sciences Project 1385 under the Aerodymanics research planned program.					
Title: Flight Dynamics & Controls ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** Flight Dynamics & Control Research to advance fundamental knowledge of the phenomena that drive air vehicle dynamics in the marine environment. Multi-disciplinary research efforts in this area enable greater operability in adverse conditions, higher precision flight control, agile multi-agent control, and greater human/machine performance. Research efforts include the following: "Air, Ground and Sea Vehicles" activities: Initiate: - Research control synthesis methods to enable both agile and guaranteed performance of non-linear systems with coupled control axes. - Research fundamental interactions between cyber, physical and physiological dynamics in coupled human/machine systems Continue: - Research investigations to increase the operational envelop for air vehicles, tailor airframe dynamics with novel control effectors, improve threat engagement performance, develop fundamentals for coupled human/machine dynamics, adapt to variable airframe conditions. - Research regarding multibody control systems and the ability to demonstrate guaranteed performance relative to a desired end-state.	0.000	0.000	5.214	0.000	5.214

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
- Research efforts to achieve robust and precise control in the presence of highly turbulent flow fields. - Research efforts to develop software algorithms that enable precise ship-relative navigation in GPS-denied environments. "Materials/Processes" research activities - Initiate research efforts into Computational Physics and Fluid Dynamics. The goal of this research is to develop state-of-the-art computational physics and data-driven algorithms, numerical models, and related high-performance computing capabilities that solve fundamental science and engineering roadblock problems, and to extend these capabilities systematically to leverage emerging computational architectures and physical models. (NRL) ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The change from FY 2024 to FY 2025 is due to the new project structure where funding was realigned within the same PE 0601153N from Defense Research Sciences (DRS) Project 0000 under the "Air, Ground and Sea Vehicles" and "Materials/Processes" research planned program to Aerospace Sciences Project 1385 under the "Flight Control & Dynamics" research planned program.					
Title: Aerospace Structures and Materials ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** Aerospace Structures and Materials Research is focused on basic research for developing lightweight, reliable, survivable, sustainable, and affordable airframes for naval and marine corps aircraft and weapons. Continue: -Research on galvanic corrosion and mitigation strategies for airframes in naval environment. -Efforts on multiaxial loading, environmental degradation and damage of hybrid airframes. -Work on novel out of autoclave and out of oven curing technologies. -Research on short fiber-thermoplastic composite forming and joining. -Investigating lightweight material solutions for multifunctional structures for airframes and weapons. -Investigating lightweight material solutions for multifunctional structures for airframes and weapons	0.000	0.000	3.596	0.000	3.596

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
Complete: -Work on high strain rate characterization of materials -High fidelity composite prediction methods that span multiple length scales -Computer assisted iterative material development for armor applications Initiate: -Research of non-traditional layups and curing methods -Research of Metallic alloys - MPEA's / CS-AFSD optimized compositions -Research on new polymeric M&P, thermoplastic and alternative resins -Processing methods and chemistries for novel M&P technologies ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The change from FY 2024 to FY 2025 is due to the new project structure where funding was realigned within the same PE 0601153N from Defense Research Sciences (DRS) Project 0000 under the Air, Ground and Sea Vehicles research planned program to Aerospace Sciences Project 1385 under the Aerospace Structures and Materials research planned program.					
Title: Science of Autonomy ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** Science of Autonomy and Control of Unmanned Systems Research investigations regarding critical multidisciplinary autonomy challenges that cut across areas/domains, including air, sea, undersea and ground. Research efforts include the following: Continue: -Investigating the scalable and robust distributed collaboration among autonomous systems. -Research on human/unmanned system collaboration. -Work on perception-based adaptation across uncertain naval environments. -Investigating embodied and situated intelligence and architectures.	0.000	0.000	8.362	0.000	8.362

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
-Developing theory-based tools and methods for safe, assured, robust, verifiable, and trustable autonomy ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The change from FY 2024 to FY 2025 is due to the new project structure where funding was realigned within the same PE 0601153N from Defense Research Sciences (DRS) Project 0000 under the Air, Ground and Sea Vehicles and Weapons research planned program to Aerospace Sciences Project 1385 under the Science of Autonomy research planned program.					
Title: STEM ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** Science, Technology, Education and Mathematics (STEM) - Continue existing successful efforts, like the Navy and Marine Corps Junior Reserve Officers' Training Corps (JROTC) Flight Academy, while examining approaches to further scale up these efforts to achieve greater impact across the DON. - Continue the development of highly scalable pilot efforts, like Naval Horizons, to expand STEM education and outreach, with a focus on reaching underrepresented students, through the development of new virtual and in-person curricula as well as virtual and in-person experiential learning activities. - Continue activities targeting regional efforts to augment awareness of naval opportunities, like SeaPerch, and increase diverse workforce opportunity for the naval science and technology community. - Continue to support the Naval Research Institution efforts that provide hands-on and virtual research experiences in STEM fields for United States Naval Academy (USNA) midshipmen and faculty members to enhance the midshipmen's educational environment at the USNA. Young Investigator Program (YIP) - Continue FY2023 & FY2024 YIP awards to assistant professors that have demonstrated exceptional promise for performing creative research. Recent YIP topics include innovative technical approaches to a broad range of naval aerospace science-relevant research topics, including bio-inspired wings for unmanned systems; hypersonic aerodynamics and advanced metal alloys for improved thermal management. These and other research topics will benefit today's and the next generation warfighter by improving lethality, survivability, and sustainability. Additionally, many of these investigators will provide long-	0.000	0.000	3.084	0.000	3.084

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Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1385 / *Aerospace Sciences*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
term support and knowledge in solving Naval related S&T challenges. - Complete Young Investigator Program topics initiated in previous fiscal years. - Initiate Young Investigator Program topics selected in fiscal year 2025. ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The change from FY 2024 to FY 2025 is due to the new project structure where funding was realigned within the same PE 0601153N from Defense Research Sciences (DRS) Project 0000 under the SCIENCE AND ENGINEERING EDUCATION, CAREER DEVELOPMENT AND OUTREACH research planned program to Aerospace Sciences Project 1385 under the STEM research planned program.					
Title: Expeditionary Aerospace Sciences ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** -Initiate research into mitigation of unsteady surface impacts on lifting bodies operating in-ground effect. (Expeditionary Warfare) ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The change from FY 2024 to FY 2025 is due to the new project structure where funding was realigned from the same PE 0601153N under the Science Addressing Hybrid Threats planned program of Project 0000 Defense Research Science to project 1385 under the expeditionary aerospace sciences planned program.	0.000	0.000	0.772	0.000	0.772
Accomplishments/Planned Programs Subtotals	0.000	0.000	24.636	0.000	24.636

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy			Date: March 2024
Appropriation/Budget Activity 1319 / 1	R-1 Program Element (Number/Name) PE 0601153N / *Defense Research Sciences*	Project (Number/Name) 1386 / *Biomedical*	

COST ($ in Millions)	Prior Years	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total	FY 2026	FY 2027	FY 2028	FY 2029	Cost To Complete	Total Cost
1386: *Biomedical*	0.000	0.000	0.000	4.794	-	4.794	4.864	5.150	5.183	5.643	Continuing	Continuing

Note

Investments in Project 1386 Biomedical were previously funded in this same PE 0601153N under the Medical and Biological Sciences planned programs in Project 0000. This new Project was created to promote greater transparency and execution for basic research investments in biomedical research in the Department of the Navy's annual budget request. this is not a new start.

A. Mission Description and Budget Item Justification

The health and performance of Sailors and Marines is a top priority. Research in the biomedical sciences allow us to discover and leverage breakthroughs that will improve Naval warfighter performance so they can fight, win and come home safe. Conducting research to gain a better understanding of the biomedical challenges of warfighters in their operating environments will ensure optimal performance, prevent injury, and equip the DON to provide the best care for its warfighters.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
Title: Expeditionary Biomedical	0.000	0.000	0.305	0.000	0.305
Description: Addresses the fundamental basic research and phenomenological studies into the science of health, survivability, and recovery of naval expeditionary forces operating in austere, distributed, and isolated maritime environments and to enable fundamentally new biomedical applications in the future operating environment.					
FY 2024 Plans: N/A					
FY 2025 Base Plans: -Initiate new fundamental research towards autonomous casualty care for severe trauma in austere conditions.					
FY 2025 OCO Plans: N/A					
FY 2024 to FY 2025 Increase/Decrease Statement: The change from FY 2024 to FY 2025 is due to the new project structure realigning funding and associated requirements from the Science Addressing Hybrid Threats planned program in PE 0601153N Defense Research Sciences (DRS) Project 0000 to Project 1386 Biomedical under the Expeditionary Biomedical planned program.					

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1386 / *Biomedical*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
This realignment will promote greater transparency for basic research investments in biomedical research in the Department of the Navy's annual budget request.					
Title: Naval Force Health Protection and Human Performance	0.000	0.000	3.224	0.000	3.224
Description: The Naval Force Health Protection and Human Performance planned program investigates research that will enhance the health, survivability, and recovery of Sailors and Marines operating in austere, distributed, and isolated maritime environments. The objectives are to enable naval forces to bring their biomedical capacity forward, create it on-demand, support prolonged field care, enable casualty evacuation, and provide en route care. This activity also addresses unique naval medical challenges associated with hypothermal and hyperbaric exposure. The research areas described in this planned program were previously represented under the Medical and Biological Sciences planned program in PE 0601153N Defense Research Sciences Project 0000. Research topics include Naval Force Health Protection, Physiological Monitoring and Modeling, Stress Response, and Undersea Medicine. ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** - Complete physiological monitoring and modeling research efforts regarding the use of nucleic acid cleavage in creation of detection systems for the Warfighter. This will enable easily adapted nucleic acid detection with orders of magnitude lower sensitivity and specificity. - Complete research into the development of functional bio/nanohybrid materials that will enable the ability to reprogram cellular behavior without the manipulation of the cell's genetic material. - Complete research investigations regarding neurobiological and genetic factors that predict differences in stress reactivity for constructing a multi-modal predictor of stress responsiveness, and for identifying targets for intervention. - Complete research efforts to explore the feasibility of continuous and unobtrusive stress detection, tracking, and mitigation for a wearable closed-loop system capable of monitoring stress and providing bioelectronic therapy. - Complete work to create synthetic biology approaches for thermal protection during dive operations.					

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1386 / *Biomedical*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
- Continue investigations into autonomous control systems using nanotechnologies, microelectronics, and artificial intelligence to inform future applications for estimation of combat casualty injury severity and treatment needs to facilitate casualty care and evacuation. - Continue research into composite materials properties, additive manufacturing, and microelectronics to enhance warfighter protection, health and situational awareness. - Continue research regarding the understanding of fundamental principles of physics to determine material properties of biological tissues to allow for physics-based prediction and modeling of tissue damage resulting from insult or injury. - Continue research efforts regarding concepts for passive or semi-passive location and identification of people lost at sea. - Continue research efforts into innovative technologies for real-time sensing and observation of individual responses to environmental and operational stressors. - Continue research efforts to examine the impact of an acutely stressful environment on the function of the stress response system. - Continue studies to enhance our understanding of human physiology (and leverage insights from comparative physiology studies of marine mammals) in the undersea environment. - Continue research to identify novel technologies to support underwater breathing apparatus to include utilizing resources naturally present in the ocean for gas management (e.g., oxygen supply and carbon dioxide disposal). - Continue fundamental research to understand the pulmonary physiology of exposure to altered levels of oxygen and carbon dioxide. - Continue studies to explore use of porous liquids as novel gas management for biomedical applications to include Nitrogen capture for Decompression Sickness mitigation. - Initiate the development of computational models of the bioenergetic and metabolic dynamics in high oxygen and carbon dioxide conditions and thermal imbalances.					
FY 2025 OCO Plans: N/A					
FY 2024 to FY 2025 Increase/Decrease Statement: The change from FY 2024 to FY 2025 is due to the new project structure where funding and associated requirements were realigned from the Medical and Biological Sciences planned program in PE 0601153N Defense Research Sciences Project 0000 to Project 1386 Biomedical under the Naval Force Health Protection and Human Performance planned program. Research areas include Naval Force Health Protection, Physiological Monitoring and Modeling, Stress Response, and Undersea Medicine. This realignment promotes					

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1386 / *Biomedical*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
greater transparency for basic research investments in biomedical research in the Department of the Navy's annual budget request.					
Title: NREIP/SEAP	0.000	0.000	0.748	0.000	0.748
Description: This program supports both the Naval Research Enterprise Intern Program (NREIP) for college students and the Science and Engineering Apprenticeship Program (SEAP) for high school students to encourage participants to pursue science and engineering careers. The objective is to further education via mentoring by laboratory personnel and their participation in research, and to make them aware of Department of the Navy (DON) research and technology efforts. This program serves as a recruitment tool for employment within the DON. Participating students at 45 DON laboratories will spend eight to ten weeks during the summer conducting research. The research described in this planned program was previously represented under the Science and Engineering Education, Career Development and Outreach planned program in PE 0601153N Defense Research Sciences Project 0000. ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** - Continue Naval Research Enterprise Internship Program (NREIP) and Science and Engineering Apprenticeship Program (SEAP) opportunities for students to participate in Navy and Marine Corps-relevant research at Naval Warfare Centers and Laboratories by expanding the number of participating sites, mentors, and interns. - Continue NREIP and SEAP internship opportunities for students to participate in Navy and Marine Corps-relevant research at Naval Warfare Centers and Laboratories. Continue to increase the number of participating sites resulting in additional mentors and interns. ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The change from FY 2024 to FY 2025 is due to the new project structure realigning funding and associated requirements from the Science and Engineering Education, Career Development and Outreach planned program in PE 0601153N Defense Research Sciences Project 0000 to Project 1386 Biomedical under the Naval					

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1386 / *Biomedical*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
Research Enterprise Intern Program (NREIP) and Science and Engineering Apprenticeship Program (SEAP) planned program.					
Title: Young Investigator Program	0.000	0.000	0.517	0.000	0.517
Description: The Young Investigator Program (YIP) seeks to identify and support academic scientists and engineers who are early in their careers and show exceptional promise for performing creative research. The objectives of this program are to attract outstanding faculty members of U.S. Institutions of Higher Education to the Department of the Navy's Science and Technology research program, to support their research, and to encourage their teaching and research careers. This program was previously represented under the Science and Engineering Education, Career Development and Outreach planned program in PE 0601153N Defense Research Sciences Project 0000. ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** - Continue FY2023 & FY2024 YIP awards to assistant professors that have demonstrated exceptional promise for performing creative research. Recent YIP topics include innovative technical approaches to a broad range of naval-relevant research topics, including quantum computing; improved ocean wave forecasting; bio-inspired robotic sensing; hypersonic aerodynamics; advanced polymers; high temperature alloys; and energetic materials. These and other research topics will benefit today's and the next generation warfighter by improving lethality, survivability, and communications. Additionally, many of these investigators will provide long-term support and knowledge in solving Naval related S&T challenges. - Complete Young Investigator Program topics initiated in previous fiscal years. - Initiate Young Investigator Program topics selected in fiscal year 2025. ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The change from FY 2024 to FY 2025 is due to the new project structure realigning funding and associated requirements from the Science and Engineering Education, Career Development and Outreach planned program					

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1386 / *Biomedical*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
in PE 0601153N Defense Research Sciences Project 0000 to Project 1386 Biomedical under the Young Investigator Program (YIP).					
Accomplishments/Planned Programs Subtotals	0.000	0.000	4.794	0.000	4.794

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy			Date: March 2024
Appropriation/Budget Activity 1319 / 1	R-1 Program Element (Number/Name) PE 0601153N / *Defense Research Sciences*	Project (Number/Name) 1387 / *Biotechnology*	

COST ($ in Millions)	Prior Years	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total	FY 2026	FY 2027	FY 2028	FY 2029	Cost To Complete	Total Cost
1387: *Biotechnology*	0.000	0.000	0.000	27.215	-	27.215	28.553	32.399	32.866	35.704	Continuing	Continuing

Note

Investments in Project 1387 Biotechnology were previously funded in this same PE 0601153N under the Medical and Biological Sciences planned programs in Project 0000. This new Project was created to promote greater transparency and execution oversight for basic research investments in biotechnology research in the Department of the Navy's annual budget request. This is not a new start.

A. Mission Description and Budget Item Justification

Shortages of domestically sourced raw materials and power and energy challenges demand alternative approaches to protect military capabilities from scarcity vulnerabilities. These biology-based solutions introduce new opportunities to reduce logistics and resource risk and improve technology-enabled military capabilities. The objective of this research area is to identify and use nature's biological principles in materials, biomechanics, bioenergy, bioelectronics, propulsion, and control to solve critical naval challenges. The resultant technologies provide solutions that are superior to those based on physical sciences and materials engineering approaches.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
Title: Bio-Inspired Systems and Soft Robotics	0.000	0.000	2.754	0.000	2.754
Description: The Bio-Inspired Systems and Soft Robotics planned program investigates research that will expand the operational envelope of Navy underwater and amphibious vehicles and enable enhanced underwater manipulation. The research investments in this program extract principles of sensorimotor control, biomechanics and fluid dynamics of underwater propulsion and control in aquatic and amphibious animals that underlie the agility, stealth, efficiency and sensory adaptations of these animals. The research efforts described in this planned program were previously represented under the Medical and Biological Sciences planned program in PE 0601153N Defense Research Sciences Project 0000. Research topics include Bioinspired Autonomous Systems and Soft Robotics. ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** - Continue research to explore novel bio-inspired sensing, control, and fluid dynamics of underwater propulsion and control systems to expand capabilities of underwater autonomous and unmanned systems. - Continue exploration of experimental sensing capabilities and modeling for bio-sensing to enable sensorimotor control including fish schooling for passive swarm coordination in underwater vehicles.					

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1387 / *Biotechnology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
- Continue exploration of bio-inspired locomotion from amphibious animals to enable technologies for amphibious and cross-domain vehicles. - Continue investigation of bio-inspired design principles of distributed sensing, actuation, and control in soft biological structures for underwater propulsion and manipulation. - Continue design bio-inspired soft robots (e.g., worm-like robots) to characterize and measure geotechnical properties of the ocean floor. - Continue research investigations exploring multi-fin control, propulsion and maneuver with robotic fish prototypes. ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The change from FY 2024 to FY 2025 is due to the new project structure realigning funding and associated requirements from the Medical and Biological Sciences planned program in PE 0601153N Defense Research Sciences Project 0000, to Project 1387 Biotechnology. Research areas include Bioinspired Autonomous Systems and Soft Robotics. This realignment promotes greater transparency for basic research investments in biotechnology research in the Department of the Navy's annual budget request.					
Title: Biosciences, Bioengineering, and Synthetic Biology for Future Naval Applications ***Description:*** The aim of the Biosciences, Bioengineering, and Synthetic Biology for Future Naval Applications planned program is to discover and develop biological/biologically-inspired and bioengineered solutions to expand current Warfighter capabilities in the domains of materials, manufacturing, energy, electronics, sensors and devices. The research efforts described in this planned program were previously represented under the Medical and Biological Sciences planned program in PE 0601153N Defense Research Sciences Project 0000. Research topics include Bioengineering and Life Sciences, Naval Biosciences, and Synthetic Biology for Naval Applications ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** - Complete investigations of the use of novel materials and electroactive bacteria to understand and improve energy generation.	0.000	0.000	5.658	0.000	5.658

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1387 / *Biotechnology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
- Complete basic research efforts to understand electroactive bacteria and their components for use in synthetic biology and bioelectronics. - Complete exploration of DNA nanotechnology for use in computing, data storage, and materials. - Complete research investigations into bio-inspired mechanisms for multi-spectral camouflage. - Continue basic research efforts bioengineering bacteria for sensing and materials synthesis. - Continue investigations using synthetic biology to establish new biomanufacturing pathways and strategies for DoD-relevant materials. - Continue research into methods for modeling approaches to improve engineering of Warfighter protection and safer platforms. - Initiate investigations into bioengineering properties of soft biological tissues. ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The change from FY 2024 to FY 2025 is due to the new project structure realigning funding and associated requirements from the Medical and Biological Sciences planned program in PE 0601153N Defense Research Sciences Project 0000, to Project 1387 Biotechnology. Research areas include Bioengineering and Life Sciences, Naval Biosciences, and Synthetic Biology for Naval Applications. This realignment promotes greater transparency for basic research investments in biotechnology research in the Department of the Navy's annual budget request.					
Title: Historically Black Colleges and Universities / Minority Institutions (HBCU/MI)	0.000	0.000	7.771	0.000	7.771
Description: The Department of the Navy's (DON) Historically Black Colleges and Universities/Minority Institutions (HBCU/MI) program oversees the Navy's efforts to engage and support research in our nation's HBCU/MIs and is responsible for developing and managing efforts that strengthen and support the capabilities of HBCU/MIs to participate in basic, applied, and advanced development research programs within the Naval Research Enterprise. This program was previously represented under the Science and Engineering Education, Career Development and Outreach planned program in PE 0601153N Defense Research Sciences Project 0000. ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:***					

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1387 / *Biotechnology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
- Continue with increasing the number of internships at SYSCOMs: NRL, NAVSUP, NAVAIR, NAVFAC, BUMED and NAVWAR for students at HBCU/MIs. - Continue to provide faculty fellowships for HBCU/MI faculty to conduct naval relevant research at all Naval Warfare Centers and Labs working naval scientist and engineers. - Continue new outreach initiatives to increase the number of HBCU/MI white paper and grant proposal submissions - to include making more grant awards. - Continue to increase the number of science fairs at HBCU/MI that have partnerships with local junior and high schools to include providing more CNR scholarships. - Expand the DoN HBCU/MI Post-doctoral program that impacts the number of HBCU/MI PhD candidates working within the Navy STEM related fields. ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The change from FY 2024 to FY 2025 is due to the new project structure realigning funding and associated requirements from the Science and Engineering Education, Career Development and Outreach planned program in PE 0601153N Defense Research Sciences Project 0000 to Project 1387 Biotechnology under the Historically Black Colleges and Universities/Minority Institutions (HBCU/MI) planned program.					
Title: Naval Research Enterprise Intern Program (NREIP)/Science and Engineering Apprenticeship Program (SEAP) ***Description:*** This program supports both the Naval Research Enterprise Intern Program (NREIP) for college students and the Science and Engineering Apprenticeship Program (SEAP) for high school students to encourage participants to pursue science and engineering careers. The objective is to further education via mentoring by laboratory personnel and their participation in research, and to make them aware of Department of the Navy (DON) research and technology efforts. This program serves as a recruitment tool for employment within the DON. Participating students at 45 DON laboratories will spend eight to ten weeks during the summer conducting research. The research described in this planned program was previously represented under the Science and Engineering Education, Career Development and Outreach planned program in PE 0601153N Defense Research Sciences Project 0000. ***FY 2024 Plans:***	0.000	0.000	0.778	0.000	0.778

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1387 / *Biotechnology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
N/A ***FY 2025 Base Plans:*** - Continue Naval Research Enterprise Internship Program (NREIP) and Science and Engineering Apprenticeship Program (SEAP) opportunities for students to participate in Navy and Marine Corps-relevant research at Naval Warfare Centers and Laboratories by expanding the number of participating sites, mentors, and interns. - Continue NREIP and SEAP internship opportunities for students to participate in Navy and Marine Corps-relevant research at Naval Warfare Centers and Laboratories. Continue to increase the number of participating sites resulting in additional mentors and interns. ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The change from FY 2024 to FY 2025 is due to the new project structure realigning funding and associated requirements from the Science and Engineering Education, Career Development and Outreach planned program in PE 0601153N Defense Research Sciences Project 0000 to Project 1387 Biotechnology under the Naval Research Enterprise Intern Program (NREIP) and Science and Engineering Apprenticeship Program (SEAP) planned program.					
Title: Young Investigator Program (YIP) ***Description:*** The Young Investigator Program (YIP) seeks to identify and support academic scientists and engineers who are early in their careers and show exceptional promise for performing creative research. The objectives of this program are to attract outstanding faculty members of U.S. Institutions of Higher Education to the Department of the Navy's Science and Technology research program, to support their research, and to encourage their teaching and research careers. This program was previously represented under the Science and Engineering Education, Career Development and Outreach planned program in PE 0601153N Defense Research Sciences Project 0000. ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** - Continue FY2023 & FY2024 YIP awards to assistant professors that have demonstrated exceptional promise for performing creative research. Recent YIP topics include innovative technical approaches to a broad range of naval-relevant research topics, including quantum computing; improved ocean wave forecasting; bio-	0.000	0.000	0.537	0.000	0.537

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1387 / *Biotechnology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
inspired robotic sensing; hypersonic aerodynamics; advanced polymers; high temperature alloys; and energetic materials. These and other research topics will benefit today's and the next generation warfighter by improving lethality, survivability, and communications. Additionally, many of these investigators will provide long-term support and knowledge in solving Naval related S&T challenges. - Complete Young Investigator Program topics initiated in previous fiscal years. - Initiate Young Investigator Program topics selected in fiscal year 2025. ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The change from FY 2024 to FY 2025 is due to the new project structure realigning funding and associated requirements from the Science and Engineering Education, Career Development and Outreach planned program in PE 0601153N Defense Research Sciences Project 0000 to Project 1387 Biotechnology under the Young Investigator Program (YIP).					
Title: Physiological Monitoring and Modeling ***Description:*** The Physiological Monitoring and Modeling activity explores the Biomanufacturing Sciences and Biology, Materials and Warfighter Interfaces. Biomanufacturing research activities addresses biological processes required for the synthesis of materials, including harnessing existing cellular production, isolation and utilization of cellular components or pathways, and modification of cellular systems to develop and optimize novel pathways or products. Biotechnology and bioinspired process research explores the potential of components, biological and otherwise, to activate processes for on-demand control, delivery of a product or package, interrogation of a response, stimulation of a behavior change, and similar actions that may require interfacing across a large range of scales (via organism, organ, cell, protein, etc.). ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** Physiological Monitoring and Modeling: - Initiate research into Biomanufacturing Science. Biomanufacturing utilizes biological processes for the synthesis of materials, including harnessing existing cellular production, isolation and utilization of cellular	0.000	0.000	9.717	0.000	9.717

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1387 / *Biotechnology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
components or pathways, and modification of cellular systems to develop and optimize novel pathways or products. (NRL) - Initiate research efforts into Biology, Materials and Warfighter Interfaces to develop an understanding of the essential components and approaches needed for control of biomaterial properties as well as function, enabling novel sensing and signaling, cellular reprogramming, and design of biomimetic materials. (NRL) ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The change from FY 2024 to FY 2025 is due to a new project structure realigning funding and requirements within the same PE 0601153N from Defense Research Sciences (DRS) Project 0000 under the "Materials/ Processes" research activity to the "Physiological Monitoring and Modeling" research activity within Biotechnology, Project 1387.					
Accomplishments/Planned Programs Subtotals	0.000	0.000	27.215	0.000	27.215

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy			Date: March 2024
Appropriation/Budget Activity 1319 / 1	R-1 Program Element (Number/Name) PE 0601153N / *Defense Research Sciences*	Project (Number/Name) 1388 / *Directed Energy*	

COST ($ in Millions)	Prior Years	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total	FY 2026	FY 2027	FY 2028	FY 2029	Cost To Complete	Total Cost
1388: *Directed Energy*	0.000	0.000	0.000	8.326	-	8.326	5.015	6.052	6.779	8.245	Continuing	Continuing

Note

Investments in Project 1388 Directed Energy were previously funded in this same PE 0601153N and realigned from Project 0000 under the Weapons research planned program to project 1388 starting in FY2025. This Project was created to promote greater transparency and execution oversight for basic research investments in directed energy in the Department of the Navy's annual budget request. This is not a new start.

A. Mission Description and Budget Item Justification

The Directed Energy (DE) activity develops technologies that enable laser and high-power microwave (HPM) weapon systems, within Navy and Marine Corps size, weight, and power (SWAP) constraints, to strike enemy targets and to defend naval platforms and land bases from threats. Additionally, the DE activity develops technologies that enable defense against adversary DE systems.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
Title: Ultra Short Pulse Laser	0.000	0.000	3.082	0.000	3.082
FY 2024 Plans: N/A					
FY 2025 Base Plans: Continue: -Research investigation of improved AI deep learning approaches for beaconless atmospheric turbulence prediction and compensation for deep turbulence. -Research into the evaluation of wavefront sensing, reconstruction, and control methods for deep turbulence in the laboratory. -Research on interaction of intense laser pulses with nanostructured surfaces, the role of disorder in promoting synchronization in technological systems of relevance to the Navy, hybrid quantum devices with the greatest technological impact to photonics and solid-state laser components, and extension of mode-locked laser and optical frequency comb technologies from the traditional near-infrared regime to new spectral regions. -Research on generation of high-average power ultra-broadband radio frequency and mid-infrared radiation in dielectrics and plasmas, effects of atmospheric turbulence on the propagation of laser beams having orbital angular momentum, demonstration of a compact solid-state laser source, demonstration of highly efficient frequency conversion of ultrashort pulse laser sources, and demonstration of ultrahigh peak power compact					

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1388 / *Directed Energy*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
ultrashort sources in specific spectral ranges via advanced mode locking and chirped pulse amplification techniques. ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The funding increase from FY 2024 to FY 2025 is due to the new project structure realigning funding and requirements within the same PE 0601153N from Defense Research Sciences (DRS) Project 0000 under the Weapons research planned program to Directed Energy Project 1388 under the Ultra Short Pulse Laser research planned program.					
Title: High Power Microwaves ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** Continue: -Research into solid-state and vacuum electronic based sources and amplifiers, antennas, high voltage storage switching components and power supplies, novel high power capable materials, radio-frequency coupling and electronic device interaction physics, predictive effects and modeling tools along with novel sensors and instrumentation at X-band and higher. -Research investigations in HPM technologies including not only consideration of sources, but also the supporting pulsed power, antennas, and other subsystems. -Research efforts in Solid-state and vacuum electronic based HPM sources capable of flexible waveforms. -Research in Distributed array sources for agile beamforming. -Research investigations of Low profile steerable antennas; high energy density capacitors, solid-state high voltage switches; high voltage power supplies, power electronics switches, hardened controls. -Research in Novel materials - dielectric insulators, 3D printed materials, improved radome materials. -Research efforts in RF coupling, device interaction physics and component level effects. -Research in Wide-bandwidth high-power frequency agile amplifiers. -Research in Prediction of effects on electronics with improved techniques for HPM lethality testing and analysis from L band to X band and above. -Research in Novel HPM sensors including electronic battle damage indication (eBDI) instrumentation. ***FY 2025 OCO Plans:***	0.000	0.000	1.119	0.000	1.119

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1388 / *Directed Energy*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The funding increase from FY 2024 to FY 2025 is due to the new project structure realigning funding and requirements within the same PE 0601153N from Defense Research Sciences (DRS) Project 0000 under the Weapons research planned program to Directed Energy Project 1388 under the High Power Microwaves research planned program.					
Title: High Energy Laser & Counter Directed Energy Weapons	0.000	0.000	3.082	0.000	3.082
FY 2024 Plans: N/A ***FY 2025 Base Plans:*** Initiate: -Examination of science and technologies for vertical cavity surface emitting laser diodes, as well as edge and surface emitting diodes, as well as other compact high power photon emitters and as high energy laser sources [CHPLST] Continue: -Exploration of the underlying physics of photonic creation, materials interaction, energy release and subsequent interactions with optical materials via computational and mathematical modeling, including machine learning to enable higher power and higher energy levels, -Research into next-generation photon waveform and mode shaping devices and interactions with materials, including metamaterials, to enable higher efficiency energy conversion designs within unique nanostructured materials with goal of increasing efficiency from source to release. -Examination of high energy laser-launched collimated photon interactions with the atmosphere, which are unique in propagation within the maritime domain, examining unique physical and optical interactions related to absorption, reflectance, scatter and turbulence often seen in expeditionary and at-sea conditions. -Research that will contribute to identifying new nanostructured materials, metamaterials and optical coatings processing for naval applications and investigate unique interactions of high energy photons with materials and coatings. Complete:					

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1388 / *Directed Energy*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
-Industrial base manufacturing technologies study and identification of scientific based metrics and potential shortfalls in the production of next-generation photon emitters and laser based light emitting diodes, which exhibit higher power and coherent beam combining potentials. ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The funding increase from FY 2024 to FY 2025 is due to the new project structure realigning funding and requirements within the same PE 0601153N from Defense Research Sciences (DRS) Project 0000 under the Weapons research planned program to Directed Energy Project 1388 under the High Energy Laser & Counter Directed Energy Weapons research planned program.					
Title: Expeditionary Directed Energy ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** - Initiate basic research to conduct phenomenological studies involving the interaction of directed energy with matter. (Expeditionary Warfare) ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The funding increase from FY 2024 to FY 2025 is due to the new project structure realigning funding and requirements within the same PE 0601153N from Defense Research Sciences (DRS) Project 0000 under the Science Addressing Hybrid Threats planned program to Project 1388 under the Expeditionary Directed Energy planned program.	0.000	0.000	1.043	0.000	1.043
Accomplishments/Planned Programs Subtotals	0.000	0.000	8.326	0.000	8.326

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1388 / *Directed Energy*

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy											Date: March 2024	
Appropriation/Budget Activity 1319 / 1					R-1 Program Element (Number/Name) PE 0601153N / *Defense Research Sciences*				Project (Number/Name) 1389 / *Electromagnetic Spectrum*			
COST ($ in Millions)	**Prior Years**	**FY 2023**	**FY 2024**	**FY 2025 Base**	**FY 2025 OCO**	**FY 2025 Total**	**FY 2026**	**FY 2027**	**FY 2028**	**FY 2029**	**Cost To Complete**	**Total Cost**
1389: *Electromagnetic Spectrum*	0.000	0.000	0.000	9.097	-	9.097	9.344	14.294	18.035	17.710	Continuing	Continuing

Note

Investments in Project 1389 Electromagnetic Spectrum were previously funded in this same PE 0601153N and realigned from Project 0000 to project 1389 starting in FY2025. This Project was created to promote greater transparency and execution oversight for basic research investments in electromagnetic spectrum research in the Department of the Navy's annual budget request. This is not a new start.

A. Mission Description and Budget Item Justification

The Electromagnetic Spectrum research area conducts fundamental research in areas that utilize the electromagnetic spectrum to deliver operational capability to the warfighter. This research area focuses on new concepts that increase knowledge and develops advanced capabilities regarding sensing, atmospheric considerations, networking, quantum phenomena, electromagnetic warfare, and the innovative use of the electromagnetic spectrum to provide a significant warfighting advantage. Research efforts include: Research Platforms, Networking Sensing, Quantum Measurement Architectural Devices, Expeditionary Electromagnetic Spectrum and Electromagnetic Warfare.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
Title: Research Platforms	0.000	0.000	0.918	0.000	0.918
Description: The primary focus of the Research Platforms activity is to provide airborne research assets for collection of phenomenology data in real world environments in order to test new C5ISRT and Counter C5ISRT technologies and techniques. Data collection of this type is required to develop algorithms, train machine learning and test sensor capabilities to improve C5ISRT capabilities for Naval forces in complex electro-magnetic environments.					
FY 2024 Plans: N/A					
FY 2025 Base Plans: Research Platforms: - Initiate airborne collection of multi-modal signature and phenomenology for fundamental modelling and machine learning research.					
FY 2025 OCO Plans: N/A					
FY 2024 to FY 2025 Increase/Decrease Statement:					

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1389 / *Electromagnetic Spectrum*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
The change from FY 2024 to FY 2025 is due to the new project structure realigning funding and requirements within the same PE 0601153N from Defense Research Sciences (DRS) Project 0000 under the Sensors, Electronics and Electronic Warfare (EW) research planned program to Electromagnetic Spectrum Project 1389 under the Research Platforms planned program.					
Title: Networked Sensing ***Description:*** The primary focus of the Networked Sensing program is to conduct basic research in optical components and infrared technologies to enable significant leap-ahead capabilities for the survivability and lethality of Naval forces in complex environments. ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** Networked Sensing: - Continue research investigations regarding fundamental implications of classical entanglement on imaging and metrology. - Continue research efforts regarding the exploration of highly sensitive, multi-spectral detector materials and active sensing modalities for imaging through clouds, fog, haze and dust. - Continue research efforts to explore novel optical processing architectures to significantly increase signal-processing bandwidth and to enable novel, real-time, distributed sensing applications. - Continue research investigations into the direct measurement of current and phase at optical and infrared light frequencies to enable wider flexibility in signal extraction and waveforms. - Initiate research into physical and quantum limitations of photon detection to enhance understanding of light-matter interactions, beam control, and detection. ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The change from FY 2024 to FY 2025 is due to the new project structure realigning funding and requirements within the same PE 0601153N from Defense Research Sciences (DRS) Project 0000 under the Mathematics, Computer, and Information Sciences research planned program to Electromagnetic Spectrum Project 1389 under the Networked Sensing planned program.	0.000	0.000	0.793	0.000	0.793
Title: Quantum Measurement Architectural Devices	0.000	0.000	2.985	0.000	2.985

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1389 / *Electromagnetic Spectrum*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
Description: The primary focus of the Quantum Measurement Architectural Devices activity is to conduct basic research in atomic, molecular and quantum systems to enable improved sensing and timekeeping capabilities for Naval forces in a contested environment. ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** Quantum Measurement Architectural Devices: - Continue research efforts regarding the development of protocols for sensing and timekeeping devices based on quantum systems, including clocks with improved short and long-term performance and electromagnetic field sensors. - Continue research into the development of inertial and gravity sensors based on light-atom interferometry. - Continue research efforts on the capabilities of non-equilibrium many-body systems for novel metrology. - Initiate research on cooling and trapping of molecules for quantum sensing. ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The change from FY 2024 to FY 2025 is due to the new project structure realigning funding and requirements within the same PE 0601153N from Defense Research Sciences (DRS) Project 0000 under the Sensors, Electronics and Electronic Warfare (EW) research planned program to Electromagnetic Spectrum Project 1389 under the Quantum Measurement Architectural Devices planned program.					
Title: Expeditionary Electromagnetic Spectrum ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** Expeditionary Electromagnetic Spectrum: - Continue research of ultra-low size, weight, and power communications in a contested environment (Expeditionary Warfare) ***FY 2025 OCO Plans:***	0.000	0.000	0.857	0.000	0.857

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1389 / *Electromagnetic Spectrum*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding changes from FY 2024 to FY 2025 is due to the new project structure realigning funding and requirements within the same PE 0601153N from Defense Research Sciences (DRS) Project 0000 under the Science Addressing Hybrid Threats research planned program to Electromagnetic Spectrum Project 1389 under the Expeditionary Electromagnetic Spectrum planned program.					
Title: Electromagnetic Warfare ***Description:*** The Electromagnetic Warfare (EmW) research area explores advanced concepts and knowledge required to develop new and advanced capabilities in electromagnetic warfare and its supporting technologies. Research activities will explore advances in radar systems, advanced signal processing, electronic warfare, Electro Optic/Infrared (EO/IR) sensor technologies, decision making algorithms utilizing artificial intelligence (AI) concepts for signal processing and other emerging effectors across the entire electromagnetic spectrum (EmS). ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** Electromagnetic Warfare: - Continue investigations into novel approaches to deep-generative machine learning-based algorithms and architectures for multi-static radar imaging to enable better noise robustness and resolution performance. (NRL) - Continue research efforts with the overarching objective of establishing the mathematical constructs, techniques, computational procedures, and scientific foundations for analysis/design of signal, image, control, and data generating systems for use in Navy, other DoD, dual-use, or commercial development programs. Each project has defined objectives within the contexts of the Naval Research Enterprise Research and Development Strategic Framework and Marine Corps S&T Strategic Plan. (NRL) ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The change from FY 2024 to FY 2025 is due to the new project structure realigning funding and requirements within this same PE 0601153N from Defense Research Sciences (DRS) Project 0000 under the Sensors,	0.000	0.000	3.544	0.000	3.544

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1389 / *Electromagnetic Spectrum*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
Electronics and Electronic Warfare (EW) research planned program to Electromagnetic Spectrum Project 1389 under the Electromagnetic Warfare planned program.					
Accomplishments/Planned Programs Subtotals	0.000	0.000	9.097	0.000	9.097

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy											Date: March 2024	
Appropriation/Budget Activity 1319 / 1					R-1 Program Element (Number/Name) PE 0601153N / *Defense Research Sciences*				Project (Number/Name) 1390 / *Electronics*			
COST ($ in Millions)	**Prior Years**	**FY 2023**	**FY 2024**	**FY 2025 Base**	**FY 2025 OCO**	**FY 2025 Total**	**FY 2026**	**FY 2027**	**FY 2028**	**FY 2029**	**Cost To Complete**	**Total Cost**
1390: *Electronics*	0.000	0.000	0.000	50.277	-	50.277	51.892	61.093	63.147	68.848	Continuing	Continuing

Note

Investments in Project 1390 Electronics were previously funded in this same PE 0601153N and realigned from Project 0000 to project 1390 starting in FY2025. This new Project was created to promote greater transparency and execution oversight for basic research investments in electronics research in the Department of the Navy's annual budget request. This is not a new start.

A. Mission Description and Budget Item Justification

The Electronics research area conducts basic research focused on increasing knowledge, developing advanced components and materials for electronics, communication systems, sensing devices, etc., to ensure the Naval warfighter can counter current and future threats. The research activities will focus on the following areas:

- Nanoscale Computing Devices and Systems
- Electronics and Sensors Technology
- Expeditionary Electronics
- Electronic Materials and Processes

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
Title: Nanoscale Computing Devices and Systems	0.000	0.000	5.126	0.000	5.126
Description: The Nanoscale Computing Devices and Systems activity invests in innovative research and breakthrough scientific discoveries that will inform the development of future computing technologies at all levels, from materials and devices to circuits and architectures.					
FY 2024 Plans: N/A					
FY 2025 Base Plans: Nanoscale Computing Devices and Systems: - Continue research efforts on post-CMOS, ultra-low power nanoelectronic materials, devices, and architectures. - Continue research explorations of topological quantum computing in solid-state devices. - Continue research efforts exploring new platforms for probabilistic computing in stochastic networks. - Initiate investigation of novel physical phenomena in quantum materials.					

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1390 / *Electronics*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
- Initiate research on coherent manipulation and interrogation of atomic and molecular spin qubits. ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The change from FY 2024 to FY 2025 is due to the new project structure realigning funding and requirements within the same PE 0601153N from Defense Research Sciences (DRS) Project 0000 under the Mathematics, Computer, and Information Sciences research activity to Electronics Project 1390 under the Nanoscale Computing Devices and Systems research activity.					
Title: Electronics and Sensors Technology ***Description:*** This activity includes basic research efforts directed toward increasing knowledge, components and algorithmic advances for electronics and sensing ensuring the Navy can counter current and future threats. These efforts are applicable to electronics and sensing on individual Naval platforms, as well as efforts that aggregate capabilities in a Distributed Maritime Operation. Research efforts include: sensing, diagnostics, and detectors; nanoelectronics; wide band gap power devices; real-time targeting; Electro-Optical/Infra-Red (EO/IR) electronics; EO/IR sensors for surface/aerospace surveillance; Radio Frequency (RF) sensors for surface/aerospace surveillance; and solid-state electronics. ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** Electronics and Sensors Technology: - Continue research investigations in nitrogen-polar GaN materials and device physics. - Continue research investigations in superconducting GaN materials and device development. - Continue research efforts in plasmonic photomixer devices and circuits. - Continue research efforts investigating defects and material stability of nitrogen-polar GaN materials and devices. - Continue studies on superconducting GaN functional circuits. - Continue research investigations into p-type and n-type crystalline metal nitride materials, transport properties and heterostructures. - Continue research efforts to create new knowledge and understanding and explore new concepts, components, techniques and methods, for the design, growth, and characterization of electronic,	0.000	0.000	6.571	0.000	6.571

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1390 / *Electronics*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
electromagnetic, quantum phenomenology, and electro-optical materials, fabrication processes, electronic and electro-optic components, including novel electromagnetic concepts and techniques, and plasma phenomena and theory. - Continue experimenting with ways superconductor microelectronics and RF photonics may uniquely enable ideal ultra-wideband receivers (full spectrum, real time, fully adaptive reception of all simultaneous signals-of-interest and functional in the presence of significant uncooperative interference). - Continue research exploring feasibility of 3D stacked superconducting devices for SWaP reduction. - Continue investigation of properties of low Vpi electro-optical modulators for unamplified analog RF data links, eg. when made from new versions of thin film LiNbO3 deposits. - Complete architectural studies correlating the type of superconducting logic used to the expected performance and circuit SWaP when performing specific digital signal processing tasks. - Initiate research in porous III-Nitride materials. - Initiate research to explore how to reconcile conflicting requirements for ultra-wideband, high sensitivity receivers, including the use of machine learning based adaptive DSP in a cueing architecture. - Initiate research on non-linear/quantum phenomena that can lead to auto-adaptive interference excision. - Initiate studies of physics of phonon/photon interactions in devices built via microelectronic techniques. - Initiate studies of the materials science of device hybridizion in Photonic Integrated Chips containing III-V, Chalcogenide, Si, and SiN photonic devices. ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The change from FY 2024 to FY 2025 is due to the new project structure realigning funding and requirements within the same PE 0601153N from Defense Research Sciences (DRS) Project 0000 under the Sensors, Electronics and Electronic Warfare (EW) research activity to Electronics Project 1390 under the Electronics and Sensors Technology research activity.					
Title: Expeditionary Electronics ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** -Initiate research into understanding the fundamental limit of infrared detection beyond the electron-photon interactions of photoelectric and thermal photon-based detections. (Expeditionary Warfare)	0.000	0.000	0.318	0.000	0.318

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1390 / *Electronics*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
-Initiate research into ultra-wide bandgap power electronics for ultrahigh frequency and medium voltage operation in extreme environments. (Expeditionary Warfare) ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The change from FY 2024 to FY 2025 is due to the new project structure realigning funding and requirements from PE 0601153N under the Science Addressing Hybrid Threats Activity of Project 0000 Defense Research Science.					
Title: Electronics Materials and Processes ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** Electronics Materials and Processes - Initiate research investigations of electronic materials essential to the sensors, electronics, and electronic warfare systems needed for future US naval dominance. (NRL) - Initiate theoretical, numerical, and experimental research in Power Electronics Science to create an improved understanding and realization of power electronic materials, device physics, and methods and techniques. This effort will inform power electronic devices and components regarding applicability for power conversion, power distribution, and protection with reduced Size, Weight and Power (SWaP) and improve performance of military systems. (NRL) - Initiate research efforts regarding the invention and understanding of new phenomena, concepts and materials for the creation, transmission, modulation and detection of electromagnetic waves throughout the ultraviolet, visible and infrared spectral regions in Optical Sciences. (NRL) - Initiate research into Plasma Science to provide revolutionary advances in the fundamental understanding of the underlying physical processes necessary to control the interaction of electromagnetic energy and charged particles. These efforts are applicable to a variety of applications, including sensors, communications, novel compact accelerators, and materials processing, and improve the Navy's ability to operate in a range of extreme environments and conditions. (NRL) - Initiate research into Electric Weapons Science regarding the development of a next-generation of electric weapons. Research efforts will include, but are not limited to, high-power lasers, microwaves, directed energy systems and electromagnetic launchers. (NRL)	0.000	0.000	38.262	0.000	38.262

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1390 / *Electronics*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
- Initiate research of Electronic, Magnetic and Optical Materials. Research investigations include the exploration of novel experimental methods, as well as theoretical and computational models to elucidate materials behavior spanning the range of physical properties of materials including electronic, magnetic, optical, thermal, mechanical, and quantum behaviors. (NRL) - Continue research in Electric Sciences to perform basic theoretical, numerical, and experimental research to develop an improved understanding and realization of electronic devices with potential applicability to computation, radar, electronic warfare, communications, navigation, and sensing systems. (NRL) - Continue research efforts to create new knowledge and understanding and explore new concepts, components, techniques and methods, for the design, growth, and characterization of electronic, electromagnetic, quantum phenomenology, and electro-optical materials, fabrication processes, electronic and electro-optic components, including novel electromagnetic concepts and techniques, and plasma phenomena and theory. (NRL) - Continue basic research in Quantum Information Science regarding experimental and theoretical research to harness the properties of quantum superposition, entanglement and non-classical correlation for Navy applications in sensing, secure communications and networking, and information processing. (NRL) - Continue research efforts to understand quantum computing algorithms and their use to create new understanding of materials by design, process optimization, and quantum simulation. (NRL) - Complete the design and fabrication of single-monolayer or low-dimensional materials with unique and useful fundamental properties, e.g. ferromagnets and semiconductors, distinct from bulk materials and capable of being functionalized for high performing sensors, computer memory elements and electronic components. (NRL) - Complete research efforts on the use of precision molecular placement and orientation to design and create bio-inspired materials exploiting quantum phenomena to perform functions such as ultrasensitive photon detectors and energy generation. (NRL) - Complete research efforts regarding highly sensitive measurements and modeling techniques to design, detect, diagnose and/or quantify physical, chemical and biological processes and properties affected by trace impurities, subtle composition changes and chemical species with high spatial resolution, sensitivity, and precision. (NRL)					
FY 2025 OCO Plans: N/A					
FY 2024 to FY 2025 Increase/Decrease Statement: The change from FY 2024 to FY 2025 is due to the new project structure realigning funding and requirements within the same PE 0601153N from Defense Research Sciences (DRS) Project 0000 under the "Materials/					

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1390 / *Electronics*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
Processes" and the "Sensors, Electronics and Electronic Warfare (EW)" research activities to the "Electronics Materials and Processes" research activity within Electronics, Project 1390.					
Accomplishments/Planned Programs Subtotals	0.000	0.000	50.277	0.000	50.277

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy			Date: March 2024
Appropriation/Budget Activity 1319 / 1	R-1 Program Element (Number/Name) PE 0601153N / *Defense Research Sciences*	Project (Number/Name) 1391 / *Full Spectrum Cyber*	

COST ($ in Millions)	Prior Years	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total	FY 2026	FY 2027	FY 2028	FY 2029	Cost To Complete	Total Cost
1391: *Full Spectrum Cyber*	0.000	0.000	0.000	10.817	-	10.817	10.744	11.502	11.635	12.665	Continuing	Continuing

Note

Investments in Project 1391 Full Spectrum Cyber were previously funded in this same PE 0601153N and realigned from Project 0000 to project 1391 starting in FY2025. This Project was created to promote greater transparency and execution oversight for basic research investments in full spectrum cyber research in the Department of the Navy's annual budget request. This is not a new start.

A. Mission Description and Budget Item Justification

The Full Spectrum Cyber research area addresses a number of research topics to include, but not limited to, advanced/emerging and theoretical implications of advanced networking architectures, neural networks, artificial intelligence (AI), machine learning (ML), secure software algorithms, autonomous operating agents/ systems, vulnerability analysis, use of intelligent agents, cryptographic computing, defenses against cyber-attacks, threat modeling, privacy-enhancing technologies, covert and encrypted communications, reconfigurable system design, quantum sensors, etc.

Basic research activities within this area include:
- Complex Software Systems and Cybersecurity
- Expeditionary Cyber
- Networks and Communications
- Science of Artificial Intelligence

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
Title: Complex Software Systems and Cybersecurity	0.000	0.000	8.123	0.000	8.123
Description: This activity focuses on developing the fundamental principles and models for the design and construction of complex software and hardware systems that meet required assurances for security, safety, reliability and performance. It builds upon foundations of mathematical logic and computational complexity but takes into account the uncertainties and constraints of the Naval operational environment which is very different from commercial and home cyber environments. The overall goal is to measurably improve the ability of complex computing systems to meet the information-processing challenges of future naval systems. The Cyber Security sub-program investigates wide-ranging principles and techniques for continuously maintaining integrity, availability and confidentiality of information and information infrastructures, focusing on the software, the hardware and the network. The program heavily emphasizes automation and autonomy in the cyber environment, preferring the human-on-the-loop paradigm over the human-in-the-loop, whenever possible. The program seeks to establish an autonomic, secure and dependable informational infrastructure toward ensuring Navy's mission successes. The Complex Software sub-program: Investigates principles, algorithms					

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1391 / *Full Spectrum Cyber*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
and methods; explores software and hardware engineering proof-of-concept tools for achieving efficient, timely, robust and secure software executables; focuses on science for software construction, correctness and efficiency by revisiting software development and deployment methodology. Efficient, timely, robust and secure cyber systems are required for secure computing infrastructure toward ensuring Navy's mission successes. ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** Complex Software Systems and Cybersecurity: - Continue to investigate and explore novel computing concepts that lead toward robust, resilient, and dependable cyber systems. - Continue to explore novel application of ONR's concept of hybrid, formal-statistical machine learning in cyber security and software systems environment. - Continue to explore physics-based approaches to various security aspect of cyber-physical systems, including authentication, vulnerability testing, and exploit resilience. - Continue critical emphasis on improving scalability and capability of bottom-up formal analysis that would enable users to prove security properties about binaries directly. - Continue research on novel methods for attack surface maneuver for cyber physical systems and systems with complex apertures and sophisticated sensing apparatus, to include lightweight decoy synchronization and other resilience techniques. - Continue research on autonomous cyber operations to explore what facets of cyber activities can be done fully autonomously or semi autonomously with human input. - Continue Exploration of new alternatives for computing devices and architectures to include chip level security both in design and analysis. ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The change from FY 2024 to FY 2025 is due to the new project structure realigning funding and requirements within the same PE 0601153N from Defense Research Sciences (DRS) Project 0000 under the Mathematics, Computer, and Information Sciences research activity to Full Spectrum Cyber Project 1391 under the Complex Software Systems and Cybersecurity research activity.					
Title: Expeditionary Cyber	0.000	0.000	1.247	0.000	1.247

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1391 / *Full Spectrum Cyber*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
FY 2024 Plans: N/A ***FY 2025 Base Plans:*** Expeditionary Cyber: - Continue research into rethinking data security in a speculative, hammerable, and heterogeneous world. - Continue research into third generation network intrusion detection and prevention systems. - Initiate research into secure embedded federated learning in the cybersecurity domain on resource constrained, sporadically connected systems. ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The change from FY 2024 to FY 2025 is due to the new project structure realigning funding and requirements within the same PE 0601153N from Defense Research Sciences (DRS) Project 0000 under the Science Addressing Hybrid Threats research activity to Full Spectrum Cyber Project 1391 under the Expeditionary Cyber research activity.					
Title: Networks and Communications ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** - Initiate efforts into Networks and Communication; devoted to the broad field of the foundational basic science behind information theory, network and transport layer theory, and wireless, networked communications, to include waveforms, heterogeneous communications networks, tactical data links, tactical edge networks, and operational reachback communications link theory. Efforts in this area are in the information layer stack from the physical layer to transport/network layer and to the edge of application layer, and includes software defined radios/networks, and Command-Control-Communications-Cyber-Computers-Intelligence-Surveillance-Reconaissance-Targeting (CC5ISRT) and Counter C5ISRT efforts as they relate to Command, Control, Communications, Targeting, and Information Operations. Theoretical studies underpinning physical and network/ transport layer efforts in spectrum agility/efficiency, assured communications, resilient networks, network efficiency, low observability/low power transmission, and dynamic spectrum access. The information theory governing networked communications between nodes in heterogeneous networks, as well as the aspects of	0.000	0.000	1.111	0.000	1.111

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1391 / *Full Spectrum Cyber*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
information operations that rely on everything aforementioned, and theoretical underpinnings of distributed, autonomous systems communications networks are also covered in this research. ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The change from FY 2024 to FY 2025 is due to the new project structure that realigned funding and requirements within the same PE 0601153N from Defense Research Sciences (DRS) Project 0000 under the 'Mathematics, Computer & Information Sciences' research activity to the 'Networks and Communications' research activity within Full Spectrum Cyber, Project 1391.					
Title: Science of Artificial Intelligence ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** - Initiate efforts into High Assurance Computing aimed at the theoretical underpinnings of assurance of deep neural networks, autonomous software-defined networking (SDN) orchestration, automation for reverse engineering and vulnerability analysis, Game-theoretic AI for defenses against cyber-attacks, adversarial threat modeling, privacy-enhancing technologies, covert and encrypted communications, field-programmable gate array (FPGA) based hardware assurance, automatic generation of Correct-by-Construction code. This endeavor also includes ground breaking basic S&T in intelligent agents for autonomic cyber maneuver, scaling and automation of algorithms for vulnerability discovery, mitigation, and weaponization, techniques for rapid verification of customized and/or reprogrammed versions of software/hardware as well as scalable cryptographic computing, cyber-ISR capabilities for an increasingly balkanized Internet, minimalism and composability in systems engineering and design, and integrated cyber-physical vulnerability analysis. ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The change from FY 2024 to FY 2025 is due to the new project structure that realigned funding and requirements within the same PE 0601153N from Defense Research Sciences (DRS) Project 0000 under	0.000	0.000	0.336	0.000	0.336

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
the 'Mathematics, Computer & Information Sciences' research activity to the 'Science of Artificial Intelligence' research activity within Full Spectrum Cyber, Project 1391.					
Accomplishments/Planned Programs Subtotals	0.000	0.000	10.817	0.000	10.817

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy			Date: March 2024
Appropriation/Budget Activity 1319 / 1	R-1 Program Element (Number/Name) PE 0601153N / *Defense Research Sciences*	Project (Number/Name) 1392 / *Human Systems*	

COST ($ in Millions)	Prior Years	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total	FY 2026	FY 2027	FY 2028	FY 2029	Cost To Complete	Total Cost
1392: *Human Systems*	0.000	0.000	0.000	38.644	-	38.644	38.930	41.392	41.980	45.714	Continuing	Continuing

Note

Investments in Project 1392 Human Systems were previously funded in this same PE 0601153N under the Human Systems planned program in Project 0000. This Project was created to promote greater transparency and execution oversight for basic research investments in biomedical research in the Department of the Navy's annual budget request. This is not a new start.

A. Mission Description and Budget Item Justification

Humans are at the core of every current and foreseeable Naval mission, whether they are assessing, coordinating and communicating decisions and actions across and within command echelons, planning and directing missions, controlling, managing or supervising systems in support of a mission, or directly executing the mission. The ability to select, train, sustain, maintain, and improve innate human competencies extends the warfighter's ability to meet current and anticipated needs. Creating synergies between warfighters and their technologies positions naval forces to quickly pivot to meet and dominate future challenges.

The basic research in this project will lead to the development of future capabilities for maintaining, sustaining, and enhancing a warfighter's performance across a range of missions and operational environments throughout their career. The science and resulting technologies enable streamlined talent management, enhance cognitive and physical performance, and augment warfighter-machine teaming for greater operational effectiveness.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
Title: Expeditionary Human Systems	0.000	0.000	6.095	0.000	6.095
Description: Addresses the fundamental basic research to support new science advancements that enhance cognitive and physical performance, and augment warfighter-machine teaming for greater operational effectiveness in the future operating environment.					
FY 2024 Plans: N/A					
FY 2025 Base Plans: - Continue research investigations regarding learning theories to enable complex, collaborative, human-robot interactions. - Continue research efforts on means and methods for evaluating the reliability and effectiveness of collective decision making by autonomous systems and humans.					

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1392 / *Human Systems*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
- Continue work in immersive sciences for automated methods for generating content and behaviors, and conduct research studies to examine questions, such as usability and training effectiveness, to increase understanding and use of Extended Reality (XR) technologies for naval applications. ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The change from FY 2024 to FY 2025 is due to the new project structure realigning funding and associated requirements from the Science Addressing Hybrid Threats planned program in PE 0601153N Defense Research Sciences (DRS) Project 0000 to Project 1392 Human Systems. This realignment will promote greater transparency for basic research investments in the Department of the Navy's annual budget request.					
Title: Human-Level Artificial Intelligence and Autonomy	0.000	0.000	8.946	0.000	8.946
Description: Mission sets and operational threats continue to evolve, and weapons platform technologies continue to advance. As a result, the manner in which warfighters will be employed must adapt in new and to-be-determined ways, making continued human systems science and technology efforts crucial to maintaining a decisive advantage of our warfighters over those of our adversaries. The Human-Level Artificial Intelligence and Autonomy planned program will help us gain a deeper understanding of how Warfighters sense, process, and use information to make decisions, and on providing the understanding needed for future technologies that can leverage cognition to enable humans to make better decisions. The research areas described in this planned program were previously represented under the Human Systems planned program in PE 0601153N Defense Research Sciences Project 0000. Research topics include Command Decision Making, Cognitive Science for Human-Machine Teaming, Computational Neuroscience, and Human Interaction with Autonomous Systems. ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** - Continue research to understand the foundation of human intelligence that enables cognitive functions, such as communication, social interaction, and context understanding. - Continue research regarding natural language processing and computational modeling to support the framework and architectures necessary to develop higher-level intelligence in robotic and autonomous systems.					

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
- Continue research application of artificial intelligence analytic methods for enabling decision support in military team decision making. - Continue research in artificial intelligence to create bidirectional collaboration in human-machine teaming and decision making. - Continue research to identify and understand neural circuits and pathways that will be used to develop models of sensorimotor control. The long-term goal is to understand the neural foundation of intrinsic cognitive skills, such as attention, memory formation, perception, and problem solving in order to develop novel intelligent systems. - Continue exploring the neural basis of the control of reaching, grasping and manipulation to inform robotics. - Continue research exploring the combination of robot mobility with dexterous manipulation in assisting humans on Naval relevant tasks, such as shipboard maintenance and building clearing of hazards. - Continue research investigations regarding principles of warfighter collaboration with autonomous and mission-capable robotic systems. - Continue research efforts to explore training of robots to perform complex manipulation skills using machine learning and human demonstration. The long-term goal is to provide better interfaces with autonomous systems, as well as provide transfer of control of autonomous platforms and payloads amongst operators. - Continue research exploring the combination of robot mobility with dexterous manipulation in assisting humans on Naval relevant tasks, such as shipboard maintenance and building clearing of hazards. ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The funding change from FY 2024 to FY 2025 is due to the realignment of funding and associated requirements from the Human Systems planned program in PE 0601153N Defense Research Sciences Project 0000, to Project 1392 Human Systems. Research areas in this new planned program include Command Decision Making, Cognitive Science for Human-Machine Teaming, Computational Neuroscience, and Human Interaction with Autonomous Systems. This realignment promotes greater transparency for basic research investments in the Department of the Navy's annual budget request.					
Title: NREIP/SEAP ***Description:*** This program supports both the Naval Research Enterprise Intern Program (NREIP) for college students and the Science and Engineering Apprenticeship Program (SEAP) for high school students to encourage participants to pursue science and engineering careers. The objective is to further education via mentoring by laboratory personnel and their participation in research, and to make them aware of Department	0.000	0.000	0.748	0.000	0.748

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
of the Navy (DON) research and technology efforts. This program serves as a recruitment tool for employment within the DON. Participating students at 45 DON laboratories will spend eight to ten weeks during the summer conducting research. The research described in this planned program was previously represented under the Science and Engineering Education, Career Development and Outreach planned program in PE 0601153N Defense Research Sciences Project 0000. ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** - Continue Naval Research Enterprise Internship Program (NREIP) and Science and Engineering Apprenticeship Program (SEAP) opportunities for students to participate in Navy and Marine Corps-relevant research at Naval Warfare Centers and Laboratories by expanding the number of participating sites, mentors, and interns. - Continue NREIP and SEAP internship opportunities for students to participate in Navy and Marine Corps-relevant research at Naval Warfare Centers and Laboratories. Continue to increase the number of participating sites resulting in additional mentors and interns. ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The funding change from FY 2024 to FY 2025 is due to the realignment of funding and associated requirements from the Science and Engineering Education, Career Development and Outreach planned program in PE 0601153N Defense Research Sciences Project 0000 to Project 1392 Human Systems under the Naval Research Enterprise Intern Program (NREIP) and Science and Engineering Apprenticeship Program (SEAP) planned program.					
Title: Science of Artificial Intelligence ***Description:*** Artificial Intelligence (AI) will be a necessary component in a future multi-domain, battle-capable, force. However, the Naval operational environment is considerably more complex and unstructured than that experienced in the commercial sector, with unique constraints. The Science of AI planned program focuses on basic research that will create efficient computational methods for building versatile intelligent agents (physical and cyber) that can perform a variety of tasks in uncertain, unstructured and open-world environments and aid	0.000	0.000	7.946	0.000	7.946

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1392 / *Human Systems*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
in command decision making. Research areas include human-inspired computational models of vision-language interactions for agents, mission-focused AI, and collaborative AI. The research areas described in this planned program were previously represented under the Mathematics, Computer, and Information Sciences planned program in PE 0601153N Defense Research Sciences Project 0000. ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** - Complete research regarding decentralized perception and planning in dynamic environments to develop a unified framework perception and planning for resources distributed across multiple platforms, autonomous systems and agents. - Complete research exploring theory and algorithms for learning and decision making in multi-agent systems, particularly in adversarial situations. Note: Funding continued under Multidisciplinary University Research Initiative. - Continue research exploring principled frameworks for integrating domain knowledge and machine learning for fast, robust learning of diverse complex concepts and tasks with light supervision. - Continue research efforts regarding the use of artificial intelligence to advance the scientific understanding of collaborative, complex decision-making that is typical of naval command decision making. - Continue research of formal verification and validation methods for artificial intelligence in the naval domain to enhance trust. - Continue research investigations exploring explainable artificial intelligence to enhance human-machine collaboration. - Continue research exploring new brain-inspired artificial intelligence algorithms and architecture that provide richer computational capabilities than current deep learning networks, with an emphasis on memory systems and higher vision. - Continue research investigations of neuromorphic spiking neuron hardware designs based on brain models that are suitable for future edge computing and signal processing in small naval platforms. - Continue research efforts regarding autonomous problem solving and curiosity driven search for robust performance under unexpected conditions. - Continue research efforts to identify, characterize and model adversarial AI.					

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
- Continue research efforts exploring computational models of vision-language interactions for intelligent agents that can learn and reason bout the real world with high levels of complexity. ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The funding change from FY 2024 to FY 2025 is due to the realignment of funding and associated requirements from the Mathematics, Computer, and Information Sciences planned program in PE 0601153N Defense Research Sciences Project 0000, to Project 1392 Human Systems. Research areas in this new planned program include Science of Artificial Intelligence. This realignment promotes greater transparency for basic research investments in the Department of the Navy's annual budget request.					
Title: Social Networks and Computational Social Science	0.000	0.000	5.832	0.000	5.832
Description: Social Networks and Computational Social Science supports research in social science (anthropology, sociology, social psychology, etc.) for the study of social dynamics, human geography and human behavior relevant to Navy and Marine Corps missions. This program is pursuing research in big social changes that affect mission execution and success. Research in understanding important phenomena such as cyber-influence campaigns, the impact of climate change on human migration and human security concerns relevant to crisis response and humanitarian assistance are central thrusts in this program. The research areas described in this planned program were previously represented under the Human Systems planned program in PE 0601153N Defense Research Sciences Project 0000. Research topics include Social, Cultural, and Behavioral Modeling, Social Networks and Computational Social Science, and Minerva Research Initiative. ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** - Complete research efforts on malware and ransomware. - Complete humanitarian assistance/disaster relief research. - Continue research efforts to address novel conflict problems such as water security, information warfare, and basic research in social shifts relevant to national security issues, hybrid warfare and other novel conflict problems.					

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
- Continue research investigations regarding mechanisms of crowd manipulation, social hysteria, rumor and propaganda in online and offline audiences. - Continue multidisciplinary basic research efforts regarding national security issues, hybrid warfare, and related issues to address information advantage relevant to US military missions. - Continue research efforts to develop models on the impact of spreading false information and geo-political shifts on the future of conflict in the next decade. - Continue research investigations to understand effective communications strategies in the face of information conflict, modeling human behavior, and the perception of information and cyber warfare. - Continue research efforts exploring social science methods and techniques to detect, mitigate, blunt, and defeat influence campaigns. - Continue research to develop understanding of how influence campaigns in digital and social media affect decision making. - Continue research of emerging and novel threats in cyberspace and in key military operations to include civil stability, and countering influence operations. - Continue research of understanding the anthropological, sociological and socio-psychological factors that alter the effects of influence operations against US interests abroad. - Continue research to improve current methods (e.g., algorithms, models) for detecting adversarial information maneuvers across social media platforms. - Continue research investigations of country-centric, descriptive and computational models of national resource and security issues to lay the foundation for forecast models relevant to military missions. - Initiate modeling and case study research to develop models on human behavior that leverage new and emerging artificial intelligence techniques to improve model forecast capabilities and US military mission execution. - Initiate research on environmental influences on migration and security, to include social and cultural factors. - Initiate research on novel socio-computational techniques to model audience resilience to persuasion, propaganda, and influence campaigns. - Initiate research on military leadership decision making.					
FY 2025 OCO Plans: N/A					
FY 2024 to FY 2025 Increase/Decrease Statement: The funding change from FY 2024 to FY 2025 is due to the realignment of funding and associated requirements from the Human Systems planned program in PE 0601153N Defense Research Sciences Project 0000, to					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
Project 1392 Human Systems. Research areas in this new planned program include Social, Cultural, and Behavioral Modeling, Social Networks and Computational Social Science, and Minerva Research Initiative. This realignment promotes greater transparency for basic research investments in the Department of the Navy's annual budget request.					
Title: STEM for Warfighter Performance ***Description:*** The Science, Technology, Engineering, and Mathematics (STEM) for Warfighter Performance planned program addresses the critical need to grow and maintain a highly skilled technical naval workforce in research domains that will enhance warfighter effectiveness and efficiencies. These efforts inspire, engage, educate and attract participants to pursue naval careers and build the future extramural performer base. ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** - Continue SEAL to Seal workshops, youth diving programs, and drone building competitions to engage and inspire k-12 students to pursue future naval careers in undersea medicine, diving, unmanned systems, and artificial intelligence. - Continue the longitudinal analysis of early interventional approaches to science erudition to expand STEM education and outreach, with a focus on reaching underrepresented students in a variety of STEM fields. - Initiate new STEM efforts to address Naval skilled technical workforce needs. ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The funding change from FY 2024 to FY 2025 is due to the realignment of funding and associated requirements from the Science and Engineering Education, Career Development and Outreach planned program in PE 0601153N Defense Research Sciences Project 0000, to Project 1392 Human Systems. Research areas in this new planned program include Science, Technology, Engineering, and Mathematics (STEM) for Warfighter Performance. This realignment promotes greater transparency for basic research investments in the Department of the Navy's annual budget request.	0.000	0.000	1.629	0.000	1.629
Title: Training and Education for Naval Readiness ***Description:*** Humans are at the core of every current and foreseeable Naval mission, whether they are assessing, coordinating and communicating decisions and actions across and within command echelons,	0.000	0.000	3.942	0.000	3.942

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
planning and directing missions, controlling, managing or supervising systems in support of a mission, or directly executing the mission. The ability to select, train, sustain, maintain, and improve innate human competencies extends the warfighter's ability to meet current and anticipated needs. Creating synergies between warfighters and their technologies positions naval forces to quickly pivot to meet and dominate future challenges. The science and resulting technologies enable streamlined talent management, enhance cognitive and physical performance, and augment warfighter-machine teaming for greater operational effectiveness. The research areas described in this planned program were previously represented under the Human Systems planned program in PE 0601153N Defense Research Sciences Project 0000. Research topics include Schoolhouse Training, Attention in Sensory Processing and Intelligent Sensing, Manpower, Personnel, Training, and Education for Future Warfighting. ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** - Complete research to create novel models for learning aimed at producing durable learning. - Complete research investigations regarding the creation of skill-decay models that can be used to predict when refresher training is needed for maintenance procedures. - Complete research to understand how individual differences impact training effectiveness and how to tailor training for each individual. - Complete research efforts to understand the underlying mechanisms by which generalized problem-solving skills are acquired. - Complete research in systematically studying complex skill learning (e.g., second language, computer programming, machine troubleshooting) to understand neurological and cognitive predictors of gaining these skills. - Complete research investigations of neuro-imaging analytical techniques to assess learning from written passages. - Complete research efforts regarding training techniques for spatial ability which facilitates learning STEM skills. - Continue to explore the role of attention in intelligent sensing with a focus on radiated acoustic signals in noisy environments. - Continue to investigate the use of Artificial Intelligence-based approaches for adaptive training, tailored to the individual learner. - Continue to systematically study the neuro-cognitive processes of attention and its control.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
- Continue research efforts to increase understanding of psychometric properties of selection/assessment for high performance in military settings. - Continue research to improve analytical approaches to understand human behavior based on real world (unstructured, interdependent, and complex) data. - Continue research on the theories of destructive social behaviors (e.g., attempting suicide, compulsive activities, risky behavior, overusing alcohol, toxic leadership). - Continue research to understand fundamentals of unit behavioral health. - Continue research exploring innovative technologies for real-time sensing and observation of individual behavioral responses to social and operational stressors. - Initiate studies to uncover attention control techniques to enhance task focus and content mastery during training and operations. - Initiate studies to explore techniques to increase training effectiveness that are unique to Live, Virtual, and Constructive environments. ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The funding change from FY 2024 to FY 2025 is due to the realignment of funding and associated requirements from the Human Systems planned program in PE 0601153N Defense Research Sciences Project 0000, to Project 1392 Human Systems. Research areas in this new planned program include Schoolhouse Training, Attention in Sensory Processing, Intelligent Sensing, Manpower, Personnel, Training, and Education for Future Warfighting. This realignment promotes greater transparency for basic research investments in the Department of the Navy's annual budget request.					
Title: Warfighter Lethality and Survivability ***Description:*** In operational environments with limited communications and extensive use of autonomous and unmanned systems, commanders will rely even more on decentralized control enabled by cohesive human-machine teams. Physical and cognitive enhancement capabilities will ensure warfighters are ready to meet a wide range of unanticipated, complex, and dynamic challenges. The Warfighter Lethality and Survivability planned program focuses on basic research that will enhance warfighter performance attributes needed to execute distributed maritime operations. The research areas described in this planned program were previously represented under the Medical and Biological Sciences planned program in PE 0601153N Defense Research Sciences Project 0000. Research	0.000	0.000	2.989	0.000	2.989

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
topics include Naval Force Health Protection, Physiological Monitoring and Modeling, Stress Response, and Undersea Medicine. ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** - Complete efforts on acoustic camouflage and design of bio-inspired acoustic dampening metamaterials. - Complete research regarding microelectronic detection of warfighter brain health to guide transcranial stimulation research into attentiveness, sleep, and mission focus. - Complete comprehensive investigation of physiological and cognitive stress response following acute exposure to high stress operational or emergency scenarios/environments (i.e., extreme heat/cold, smoke/fire, unexpected water immersion), which will inform future development of countermeasures against these exposures. - Continue research investigations to characterize novel physiologic signal monitoring capabilities. - Initiate studies to investigate high stress environments and ways to optimally perform in spaces not researched previously. - Initiate research to enhance and quantify warfighters performance for improved capabilities across military operations especially on shipboard. - Initiate research wearable materials either on skin or clothing to meet current and future naval needs in different settings. - Initiate development of algorithms to detect fatigue and loss of attention using a limited array of physiological sensors and brainwave monitoring. ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The funding change from FY 2024 to FY 2025 is due to the realignment of funding and associated requirements from the Medical and Biological Sciences planned program in PE 0601153N Defense Research Sciences Project 0000, to Project 1392 Human Systems. Research areas in this new planned program include Auditory Science for the Naval Domain, Naval Force Health Protection, Physiological Monitoring and Modeling, and Stress Response. This realignment promotes greater transparency for basic research investments in the Department of the Navy's annual budget request.					
Title: Young Investigator Program	0.000	0.000	0.517	0.000	0.517

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Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1392 / *Human Systems*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
Description: The Young Investigator Program (YIP) seeks to identify and support academic scientists and engineers who are early in their careers and show exceptional promise for performing creative research. The objectives of this program are to attract outstanding faculty members of U.S. Institutions of Higher Education to the Department of the Navy's Science and Technology research program, to support their research, and to encourage their teaching and research careers. This program was previously represented under the Science and Engineering Education, Career Development and Outreach planned program in PE 0601153N Defense Research Sciences Project 0000. ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** - Continue FY2023 & FY2024 YIP awards to assistant professors that have demonstrated exceptional promise for performing creative research. Recent YIP topics include innovative technical approaches to a broad range of naval-relevant research topics, including quantum computing; improved ocean wave forecasting; bio-inspired robotic sensing; hypersonic aerodynamics; advanced polymers; high temperature alloys; and energetic materials. These and other research topics will benefit today's and the next generation warfighter by improving lethality, survivability, and communications. Additionally, many of these investigators will provide long-term support and knowledge in solving Naval related S&T challenges. - Complete Young Investigator Program topics initiated in previous fiscal years. - Initiate Young Investigator Program topics selected in fiscal year 2025. ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The funding change from FY 2024 to FY 2025 is due to the realignment of funding and associated requirements from the Science and Engineering Education, Career Development and Outreach planned program in PE 0601153N Defense Research Sciences Project 0000 to Project 1392 Human Systems under the Young Investigator Program (YIP).					
Accomplishments/Planned Programs Subtotals	0.000	0.000	38.644	0.000	38.644

C. Other Program Funding Summary ($ in Millions)

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1392 / *Human Systems*

C. Other Program Funding Summary ($ in Millions)

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy			Date: March 2024
Appropriation/Budget Activity 1319 / 1	R-1 Program Element (Number/Name) PE 0601153N / *Defense Research Sciences*	Project (Number/Name) 1393 / *Kinetic Weapons*	

COST ($ in Millions)	Prior Years	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total	FY 2026	FY 2027	FY 2028	FY 2029	Cost To Complete	Total Cost
1393: *Kinetic Weapons*	0.000	0.000	0.000	6.937	-	6.937	10.164	11.356	11.867	12.918	Continuing	Continuing

Note

Investments in Project 1393 Kinetic Weapons were previously funded in this same PE 0601153N in Project 0000. This Project was created to promote greater transparency and execution oversight for basic research investments in kinetic weapons research in the Department of the Navy's annual budget request. This is not a new start.

A. Mission Description and Budget Item Justification

The Kinetic Weapons activity develops technologies to address the Navy and Marine Corps fires requirements for extended range, increased precision, decreased weapons fly-out times, greater destructive power, novel weapons effects, autonomy, human-machine teaming, reduced weapons costs, mission planning, and mass-producible swarming munitions.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
Title: Advanced Energetic Materials	0.000	0.000	3.638	0.000	3.638
FY 2024 Plans: N/A					
FY 2025 Base Plans: Energetic Materials and Rocket Propulsion Initiate: -Research focused on advanced modeling pertaining to air-breathing combustion to further understand complex pyrolysis and combustion mechanisms. -Research into dynamic flow control driven by energetic material gas-producing reactions. Continue: -Research investigating advanced energetic materials, which provide reactive, explosive, and propulsive phenomena including high-energy ingredient synthesis, modeling, characterization, and the fundamentals of initiation, decomposition, combustion and shock. -Research in advanced synthetic methodologies and motifs for energetic material ingredients and material concepts, specifically carbon/hydrogen/nitrogen/oxygen-based energetic ingredients, new metal-based fuel particle designs and other inorganic and hybrid energetic material concepts.					

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1393 / *Kinetic Weapons*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
-Research in novel diagnostic method development for improved understanding of energetic material decomposition, pyrolysis, combustion, shock response, and related dynamic phenomena. -Efforts in advanced modeling and simulations on energetic materials to further understand and predict energetic material properties, response to shock, thermal and other stimuli, and performance. -Research into fundamental understanding of material interfacial physics/chemistry relevant to energetic formulation development and advanced manufacturing. Complete: -Particular modeling efforts pertaining to quantifying pressure effects on the decomposition kinetics of energetic materials. -Research efforts in exploring Hydroxy Terminated Polycyclobutanes as prepolymers for propellant applications. ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The funding change from FY 2024 to FY 2025 is due to a realignment that moved funding within the same PE 0601153N from Defense Research Sciences (DRS) Project 0000 under the Weapons research activity to Kinetic Weapons Project 1393 under the Advanced Energetic Materials research activity.					
Title: Hypersonics ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** Continue: -Research to address technologies needed for long-range weapon components that are able to survive high temperature exposure for several minutes and defeat anti-access / area denial countermeasures. -Continue investigating the hypersonic boundary-layers and shock-wave / boundary-layer interactions, prediction of hypersonic weapon flight performance and control, environment-material interactions, exploration of ultrahigh temperature materials, and technologies needed for high-speed propulsion. ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:***	0.000	0.000	3.299	0.000	3.299

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1393 / *Kinetic Weapons*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
The funding change from FY 2024 to FY 2025 is due to a realignment that moved funding within the same PE 0601153N from Defense Research Sciences (DRS) Project 0000 under the Weapons research activity to Kinetic Weapons Project 1393 under the Hypersonics research activity.					
Accomplishments/Planned Programs Subtotals	0.000	0.000	6.937	0.000	6.937

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy											Date: March 2024	
Appropriation/Budget Activity 1319 / 1					R-1 Program Element (Number/Name) PE 0601153N / *Defense Research Sciences*				Project (Number/Name) 1394 / *Manufacturing*			
COST ($ in Millions)	**Prior Years**	**FY 2023**	**FY 2024**	**FY 2025 Base**	**FY 2025 OCO**	**FY 2025 Total**	**FY 2026**	**FY 2027**	**FY 2028**	**FY 2029**	**Cost To Complete**	**Total Cost**
1394: *Manufacturing*	0.000	0.000	0.000	0.391	-	0.391	0.408	1.343	2.077	2.601	Continuing	Continuing

Note

Investments in Project 1394 Manufacturing were previously funded in this same PE 0601153N in Project 0000. This Project was created to promote greater transparency and execution oversight for basic research investments in manufacturing research in the Department of the Navy's annual budget request. This is not a new start.

A. Mission Description and Budget Item Justification

This Focus Area (FA) develops processes technologies that acquisition programs need to make the design, fabrication, construction, repair, and sustainment of naval platforms more affordable. This FA also supports manufacturing S&T that accelerates the delivery of capabilities to the fleet and force. Advanced manufacturing technologies include additive manufacturing, repair and sustainment technologies, and coupling computational tools from design to sustainment.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
Title: Sea Warfare and Weapons STEM	0.000	0.000	0.391	0.000	0.391
FY 2024 Plans: N/A					
FY 2025 Base Plans: - Continue activities targeting efforts to augment awareness of naval opportunities and increase diverse workforce opportunity for the naval science and technology community. - Continue efforts to address Naval skilled technical workforce needs. - Continue FY2023 & FY2024 YIP awards to assistant professors that have demonstrated exceptional promise for performing creative research. - Complete Young Investigator Program topics initiated in previous fiscal years. - Initiate Young Investigator Program topics selected in fiscal year 2025.					
FY 2025 OCO Plans: N/A					
FY 2024 to FY 2025 Increase/Decrease Statement: Funding change for this Activity was moved from the same PE 0601153N Project 0000 Defense Research Science under the Science and Engineering Education, Career Development and Outreach Activity.					
Accomplishments/Planned Programs Subtotals	0.000	0.000	0.391	0.000	0.391

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1394 / *Manufacturing*

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy											Date: March 2024	
Appropriation/Budget Activity 1319 / 1					R-1 Program Element (Number/Name) PE 0601153N / *Defense Research Sciences*				Project (Number/Name) 1395 / *Materials*			
COST ($ in Millions)	**Prior Years**	**FY 2023**	**FY 2024**	**FY 2025 Base**	**FY 2025 OCO**	**FY 2025 Total**	**FY 2026**	**FY 2027**	**FY 2028**	**FY 2029**	**Cost To Complete**	**Total Cost**
1395: *Materials*	0.000	0.000	0.000	55.448	-	55.448	56.641	64.745	66.776	72.687	Continuing	Continuing

Note

Investments in Project 1395 Materials were previously funded in this same PE 0601153N in Project 0000. This Project was created to promote greater transparency and execution oversight for basic research investments in materials research in the Department of the Navy's annual budget request. This is not a new start

A. Mission Description and Budget Item Justification

This Focus Area (FA) enhances the performance, affordability, survivability, and reliability of the future fleet and force by developing materials with novel or enhanced properties suited to the unique needs of Navy and Marine Corps platforms and systems. Research relevant to enabling enhanced performance and resiliency of naval systems and platforms are included in this R-2 Activity

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
Title: Materials	0.000	0.000	7.625	0.000	7.625
FY 2024 Plans: N/A					
FY 2025 Base Plans: Research relevant to enabling enhanced performance and resiliency of naval systems and platforms. Research efforts include the following: - Continue research efforts regarding Corrosion Control Science (for conventionally and additive manufactured materials) including galvanic and microbially influenced corrosion for enhanced resiliency and sustainability of naval platforms and systems. - Complete research investigations of Nano-Engineered Materials for extended performance and sustainability of legacy systems and platforms and emerging opportunities for structural and functional (optical, electro-active, etc.) properties that will enable new system designs. - Continue research of Electrochemical Materials and Functional Organic Materials and Composites to understand phenomenology that can be applied to more efficient energy capture and power storage and distribution for a wide distribution of naval emerging requirements, - Continue research investigations of Computer-Aided Material Design to accelerate research in all areas described here.					
FY 2025 OCO Plans:					

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1395 / *Materials*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding change for this Activity was moved from the same PE 0601153N Project 0000 Defense Research Science under the Air, Ground and Sea Vehicles Activity.					
Title: Sea Warfare and Weapons STEM ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** N/A ***FY 2025 OCO Plans:*** - Continue activities targeting efforts to augment awareness of naval opportunities and increase diverse workforce opportunity for the naval science and technology community. - Continue efforts to address Naval skilled technical workforce needs. - Continue FY2023 & FY2024 YIP awards to assistant professors that have demonstrated exceptional promise for performing creative research. - Complete Young Investigator Program topics initiated in previous fiscal years. - Initiate Young Investigator Program topics selected in fiscal year 2025. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding change for this Activity was moved from the same PE 0601153N Project 0000 Defense Research Science under the Science and Engineering Education, Career Development and Outreach Activity.	0.000	0.000	1.783	0.000	1.783
Title: Expeditionary Materials ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** - Initiate research into developing a multi-physics understanding of multiferroic materials to enable future new expeditionary applications. (Expeditionary Warfare) - Initiate research into quantum couplings to control phonon relaxation or transport processes in a material system. (Expeditionary Warfare)	0.000	0.000	0.812	0.000	0.812

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1395 / *Materials*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
- Initiate research on enhancing/optimizing the magnetoelectric coupling efficiency among electric, magnetic, mechanical, and optical (properties) states to explore fundamental light-matter interaction in heterostructured multiferroic materials. (Expeditionary Warfare) - Initiate the effort in Materials Control through Quantum Coupling for Enhanced Sensing and Transduction. (Expeditionary Warfare) ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funds for this Activity were moved from the same PE 0601153N under the Science Addressing Hybrid Threats Activity of Project 0000 Defense Research Science.					
Title: Materials and Chemistry ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** - Continue work into Corrosion and Interfacial Chemistry. Efforts in this area of research target an understanding of corrosion and interfacial chemistries/processes to develop new materials technologies and control measures to ensure Fleet readiness, critical operations, and survivability. (NRL) - Continue efforts into Materials Chemistry and Diagnostics. The focus of these efforts are on the chemical synthesis, structure/property relationships and processing of inorganic, organic, organometallic, biochemical, polymeric, ceramic and nanoparticle materials. Synthesis and advanced processing efforts address Materials for Extreme Environments - polymer and ceramic matrix composites, thermal protection, camouflage, obscurants, directed energy protection, especially for hypersonic applications; Soft Materials - functional and bio-inspired polymers, catalytic polymers, fire suppressant molecules, soft robotics, self-reporting materials, smart materials. (NRL) - Continue efforts into Materials Processes and Performance. Efforts focus on the discovery and advancement of new and improved structural and functional high performance materials including advances and discovery of new fabrication methods associated understanding of these methods for the consistent production of these new materials. (NRL)	0.000	0.000	29.834	0.000	29.834

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1395 / *Materials*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
- Complete to research the use of nucleic acid cleavage in creation of detection systems for the Warfighter. This will enable easily adapted nucleic acid detection with orders of magnitude lower sensitivity and specificity. (NRL) - Complete research into the development of functional bio/nanohybrid materials that will enable the ability to reprogram cellular behavior without the manipulation of the cell's genetic material. (NRL) - Initiate in Materials for Advanced Sensor Science. Research in this area focuses on the physical properties of materials for the discovery of new functionality with direct application to sensing and advanced electronic devices. The work performed in this area utilizes novel experimental methods, as well as theoretical and computational models to identify and understand materials behavior spanning the range of physical properties of materials including electronic, magnetic, optical, and quantum behaviors. A primary technical objective is to identify new functional materials or new methods to control the functionality of materials to enhance current or enable new sensing capabilities. Evaluation of properties is performed across scales and conditions pertinent to naval applications. Specific areas of research include investigations into enhancing performance of sensing materials through engineering properties of 2D heterostructures, control of optoelectronics properties of halide perovkites, and ferroelectric materials to enable revolutionary advances in sonar device sensitivity. (NRL) - Initiate Materials Modeling, Simulation and Analytics. This research focuses on use of computational methodologies and manipulation of data to discover, identify, and interpret new and innovative insights into material performance and processing methodologies. Efforts aim to investigate the behavior of materials, materials synthesis, processing and characterization, modification of surfaces and plasma processing and engineered materials. Specific areas of research include first principle understanding of material response, advanced modeling and simulation techniques which can address performance of a variety of material systems, design tools for active materials for sensors and actuators, and advances in the algorithmic processes for rapid trace explosives detection. (NRL) - Initiate work into Biologically Enabled Materials. Here, the fundamental properties of the materials are investigated to provide the basis for sensing and actuation approaches, bioelectronics, organizational and structural mechanisms, and protective strategies, driving the underlying concepts and modeling necessary to the application of these novel products to Navy relevant systems and environments. Novel, new, and emerging biomaterials have been touted as the heart of regenerative medicine and the fabric of the medical devices market; however, bio, bioinspired, and bioderived materials offer a wider spectrum of applications than this attention would tend to indicate. From thermal and corrosion protection to waveguide technologies, attritable formulations, and energy transfer, these materials offer novel capabilities that can be harnessed to meet Navy					

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1395 / *Materials*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
needs. Realization of these applications requires a fundamental understanding of how the materials function and how that function can be adapted to non-native environments and use scenarios. (NRL) ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The change from FY 2024 to FY 2025 is due to a realignment that moved funding within the same PE 0601153N from Defense Research Sciences (DRS) Project 0000 under the 'Materials/Processes' and the 'Sensors, Electronics and Electronic Warfare (EW)' research activities to the 'Materials and Chemistry' research activity within Materials, Project 1395.					
Title: Undersea Materials ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** - Complete the creation of high efficiency silicon-based thin film thermoelectric modules for undersea warfare applications by exploiting nanocrystallization and multilayering to control thermal conductivity. (NRL) - Complete research into high performance source transducer materials, such as textured ferroelectric ceramics, that should achieve high power receiver performance at reduced cost and complexity. This would enable high throughput production of high performace tranducer ceramics, providing alternatives to current costly and difficult to produce single crystal technology. (NRL) - Complete efforts into how to understand and predict oleophobic and synergistic mechanisms thru machine learning to design/develop more effective surfactant molecules for fire suppression. (NRL) ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The change from FY 2024 to FY 2025 is due to a realignment that moved funding within the same PE 0601153N from Defense Research Sciences (DRS) Project 0000 under the 'Materials/Processes' and the 'Sensors,	0.000	0.000	0.216	0.000	0.216

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1395 / *Materials*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
Electronics and Electronic Warfare (EW)' research activities to the 'Undersea Materials' research activity within Materials, Project 1395.					
Title: Functional Materials ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** - Continue research to explore opportunities for controlling material composition and atomic structure through characterization and modeling to enhance electro-mechanical coupling for next generation Acoustic Transduction and Sensor Materials. - Continue research to better understand the chemical and mechanical properties of Materials for Environment Quality. ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding change for this Activity was moved from the same PE 0601153N Project 0000 Defense Research Science under the Materials/Processes Activity.	0.000	0.000	7.588	0.000	7.588
Title: Structural Materials ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** - Continue foundational research that provides the underpinnings for robust systems and platforms, exploring and understanding phenomenology of structural properties as functions of with the aim to improve performance and predict and mitigate component degradation, captured in quantitative data and physics-driven models that utilize an Integrated Computational Materials Engineering (ICME) approach and support machine learning. Research domains include Basic Materials Research, Structural Metals, Polymer Composite Materials, Propulsion Materials, Materials for Additive Manufacturing, Sensors & NDE Prognostics, and Alternative Hull Materials & Structures. - Initiate research effort in the physics and chemistry of extreme material behavior. - Initiate research effort in materials for new sensor modalities.	0.000	0.000	7.590	0.000	7.590

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1395 / *Materials*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
- Initiate material development for multifunctional capabilities such as energy storage systems that are structural, or coatings that both protect a substrate and harvest energy, function as a sensor or limit platform signatures. - Complete efforts in Structural Cellular Materials and Solid Mechanics, as technology areas have matured and attention turns to other emerging research areas. ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding change for this Activity was moved from the same PE 0601153N Project 0000 Defense Research Science under the Materials/Processes Activity.					
Accomplishments/Planned Programs Subtotals	0.000	0.000	55.448	0.000	55.448

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy											Date: March 2024	
Appropriation/Budget Activity 1319 / 1					R-1 Program Element (Number/Name) PE 0601153N / *Defense Research Sciences*				Project (Number/Name) 1396 / *Naval Engineering*			
COST ($ in Millions)	**Prior Years**	**FY 2023**	**FY 2024**	**FY 2025 Base**	**FY 2025 OCO**	**FY 2025 Total**	**FY 2026**	**FY 2027**	**FY 2028**	**FY 2029**	**Cost To Complete**	**Total Cost**
1396: *Naval Engineering*	0.000	0.000	0.000	25.922	-	25.922	25.960	28.849	28.428	31.304	Continuing	Continuing

Note

Investments in Project 1396 Naval Engineering were previously funded in this same PE 0601153N in Project 0000. This Project was created to promote greater transparency and execution oversight for basic research investments in Naval Engineering research in the Department of the Navy's annual budget request. This is not a new start.

A. Mission Description and Budget Item Justification

This Focus Area (FA) addresses the design, fabrication, integration, and operation of ground and sea naval warfare platforms, sensors, weapons, networks, and countermeasures to maximize their operational availability and effectiveness. Research efforts regarding all aspects of platform performance, platform survivability in support of future platform-building programs, platform autonomy, autonomous systems, and control for naval systems are included in this R-2 Activity.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
Title: Platform Design and Engineering	0.000	0.000	19.669	0.000	19.669
FY 2024 Plans: N/A					
FY 2025 Base Plans: - Continue research related to Naval Engineering (a National Naval Responsibility area) and Platform Design, Basic Surface Ship Dynamics, Propulsion Hydromechanics, Basic Subsurface Hydromechanics, Basic Surface Ship Hydrodynamics, Adaptive Control and Centers for Innovative Naval Technology. - Continue research efforts associated with Digital Data Science including Autonomous Systems (Machinery/ Platform), Digital Threads, Digital Twins, and Digital Engineering. - Continue research regarding Structural Reliability and Resiliency focusing efforts on Alternative Hull/Structural Materials, Composite Structures, and Engineered Materials (Metamaterials). - Continue research in Platform Signature Related Sciences to include: Structural Acoustics, Underwater Electromagnetic Signatures, Electromagnetic Signatures, Submarine Detectability, and Undersea Platform Susceptibility. - Continue research efforts related to System Complexity and Resiliency for Naval Platforms and Systems. - Continue research in Non-Acoustic Signatures Science for Advanced Naval Platforms. - Continue research efforts regarding Digital Decision Metrics for Naval Platform Design and Engineering.					
FY 2025 OCO Plans:					

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1396 / *Naval Engineering*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding change for this Activity was moved from the same PE 0601153N Project 0000 Defense Research Science under the Air, Ground and Sea Vehicles Activity.					
Title: Sea Warfare and Weapons STEM ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** - Continue activities targeting efforts to increase awareness of naval research opportunities and increase diverse workforce participation opportunities in the naval science and technology community. - Continue STEM efforts to address Naval skilled technical workforce needs. - Continue FY2023 & FY2024 YIP awards to assistant professors that have demonstrated exceptional promise for performing creative research. - Continue to fund efforts in support of the National Naval Responsibility in Naval Engineering. - Complete Young Investigator Program topics initiated in previous fiscal years. - Initiate Young Investigator Program topics selected in fiscal year 2025. ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding change for this Activity was moved from the same PE 0601153N Project 0000 Defense Research Science under the Science and Engineering Education, Career Development and Outreach Activity.	0.000	0.000	3.519	0.000	3.519
Title: Expeditionary Naval Engineering ***Description:*** Addresses the basic research to enable new, fundamental advancements for naval expeditionary platforms, sensors, weapons, networks, and countermeasures in the future operating environment. ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** Research activity as aligned from prior 'Science Addressing Hyrid Threats':	0.000	0.000	2.734	0.000	2.734

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1396 / *Naval Engineering*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
- Continue efforts to study the complex energy-supply problem with deployed vehicles in contested environments en-route to developing a novel decision-support framework for planning and managing adaptive transportation systems for naval logistics. (Expeditionary Warfare) - Continue research for modeling autonomy, for the purpose of creating systems that operate in complex undersea/surface/ land/air/space domains. (Expeditionary Warfare) - Continue research methods that model how diverse autonomous systems interact with each other in complex environments. (Expeditionary Warfare) - Continue research investigations regarding the creation of Artificial Intelligence (AI) hybrid learning theories for the purpose of creating heterogeneous multi-agent collaborative autonomy. (Expeditionary Warfare) - Continue research to create theories for multi-agent collaborative autonomy that mimic the organizational principles found in social insects/birds/fishes. (Expeditionary Warfare) - Continue a follow-on and focused research effort for the machine learning investigation of multifactorial information environment parameters in order to automate the process of detecting, identifying and distinguishing intent. (Expeditionary Warfare) - Continue research to study novel collaborative methods for swarming autonomous entities to reliably determine true/relative position in GPS-denied operations. (Expeditionary Warfare) - Complete research into methods to identify coherent courses of action with effective outcomes using Artificial Intelligence (AI) agents. (Expeditionary Warfare) ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The funding change from FY 2024 to FY 2025 is due to a realignment that moved funding within the same PE 0601153N from Defense Research Sciences (DRS) Project 0000 under the 'Science Addressing Hybrid Threats' research activity to the 'Expeditionary Naval Engineering' research activity within Naval Engineering, Project 1396.					
Accomplishments/Planned Programs Subtotals	0.000	0.000	25.922	0.000	25.922

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1396 / *Naval Engineering*

D. Acquisition Strategy

N/A

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Appropriation/Budget Activity 1319 / 1	R-1 Program Element (Number/Name) PE 0601153N / *Defense Research Sciences*	Project (Number/Name) 1398 / *Ocean Atmosphere and Space Sciences*	

COST ($ in Millions)	Prior Years	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total	FY 2026	FY 2027	FY 2028	FY 2029	Cost To Complete	Total Cost
1398: *Ocean Atmosphere and Space Sciences*	0.000	0.000	0.000	118.935	-	118.935	120.602	137.247	139.539	151.897	Continuing	Continuing

Note

Investments in Project 1398 Ocean Atmosphere and Space Sciences were previously funded in this same PE 0601153N in Project 0000. This Project was created to promote greater transparency and execution oversight for basic research investments in ocean atmosphere and space sciences research in the Department of the Navy's annual budget request. This is not a new start.

A. Mission Description and Budget Item Justification

The Office of Naval Research (ONR) was established by Congress in 1946 to plan, foster and encourage scientific research in recognition of its paramount importance to the maintenance of future naval power and national security; to provide within the Department of the Navy a single office, which, by contract and otherwise, shall be able to obtain, coordinate, and make available to all bureaus and activities of the Department of the Navy, world-wide scientific information and the necessary services for conducting specialized and imaginative research; to establish a Naval Research Advisory Committee consisting of persons preeminent in the fields of research, to consult with and advise the Chief of such Office in matters pertaining to research The Office of Naval Research shall perform such duties as the Secretary of the Navy prescribes relating to the execution of, and management responsibility for, programs for which funds are provided in the basic and applied research and advanced technology categories of the Department of the Navy research, development, test, and evaluation budget in such a manner that will foster the transition of science and technology to higher levels of research, development, test, and evaluation.

This Program Element (PE) supports the Basic Research portion of the Department of the Navy (DON) science and technology (S&T) portfolio, laying the foundation for new innovative technologies and future capabilities for Naval warfighters. Efforts within this PE address Ocean Atmosphere and Space Sciences.

Ocean Battlespace Sensing research activities span a number of disciplines in support of Navy and Marine Corp operational missions. This research area supports theoretical and experimental investigations directed toward increasing knowledge and understanding of the physical, chemical, engineering, environmental and life sciences fundamental to naval operations, including expeditionary operations. Naval Operations research areas will include mine warfare, mine countermeasures, ocean acoustics, naval special warfare (governed by Littoral Geosciences), the reliable use of unmanned/robotic systems, autonomous operations, remote sensing, anti-submarine warfare, ocean engineering, artic operations, marine mammals/biology, physical oceanography, metrology/METOC and emerging undersea warfare capabilities.

The majority of research conducted within this PE is performed by academia and government labs, both of which play significant roles in developing the S&T workforce of tomorrow in addition to delivering new knowledge and scientific discoveries.

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
Title: Ocean Sciences	0.000	0.000	71.611	0.000	71.611
Description: The Ocean, Atmosphere & Space Science program advances our understanding of atmospheric and space phenomena/processes which, during naval operations, may range from the seabed, to surface sea-state conditions to high altitude space sensing. Highly dynamic conditions researched within this PE include artic conditions, ocean acoustics, coastal and seabed geoscience, meteorology, anti-submarine operations, mine counter measures, marine mammal biology and maritime sensing. Basic research advances improve the precision and reliability of ocean, atmospheric and space environmental products provided to the warfighter and allow for increasingly accurate assessments and predictions of the impact of space and atmospheric phenomena on the performance of naval weapon systems. Understanding and predicting oceanographic and acoustical phenomena provides significant warfighting advantages to naval forces. Ocean Sciences research addresses the full spectrum of acoustics and oceanography to enable observation, modeling, and prediction of the maritime environment. Efforts include: studying common operating areas for naval forces in the open oceans, the Arctic, the littorals, and nearshore and river mouths and inlet environments; elucidating the coupling between oceanographic, geophysical and acoustical phenomena relevant to mission areas such as Anti-Submarine Warfare and Mine Warfare; development of global, regional and local predictive models that fully couple the ocean-atmosphere-wave-ice domains; development and use of autonomous systems and sampling technologies for the collection of environmental observations and continuing support to research vessels of the U.S. Academic Research Fleet to enable at-sea oceanographic science. Naval Expeditionary Forces need science advances to address a range of research challenges that result from physical and operational environmental limitations so harsh that solutions push basic discovery and invention. Naval Expeditionary Forces operate amphibiously and in the littoral will have all of their capabilities exposed to degrading sea and land physical effects. Expeditionary forces must be agile and lethal but will be constrained by size, weight, and power requirements and must be sustained across large areas. Research efforts within this Project (previously aligned within the Sciences Addressing Hybrid Threats (SAHT) research area of Project 0000) include optics, electronics, and photonics research to enable revolutionary spectral awareness in small low power sensors. The Science and Engineering Education, Career Development and Outreach research activities address the critical need to grow and maintain a diverse and highly skilled technical naval workforce. These efforts inspire,					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
engage, educate and attract participants to pursue naval careers and build the extramural performer base. DON Science, Technology, Engineering and Math (STEM) education and outreach is designed to increase the number of students and naval civilians with naval-relevant skills and degrees, expand capabilities of the current and future workforce by augmenting education and increasing the awareness of Naval Ocean Battlespace Sensing research and career opportunities through localized education and outreach activities that foster the talent pipeline. ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** Aligned from prior 'Ocean Sciences' and 'Atmosphere and Space Sciences' research area: Research efforts addressing 'Battlespace Environments' include: - Continue research investigations to improve the quality of the environmental analysis and prediction provided in support of warfighters, including the assessment of the impact of the atmosphere and ionosphere-thermosphere-magnetosphere on the performance of sensors, platforms and weapon systems, and the advancement of our basic understanding of atmospheric processes across spatial scales and the interactions of the atmosphere with the land, sea, wave, ice, and thermosphere. - Continue research efforts to exploit environmental observations and to characterize environmental processes more accurately, thus providing improved forecast models for the Navy and Marine Corps in regions where operations take place, including: the littoral zone, where complex topography and air-sea-land contrasts impact the environment on very short time and space scales; the tropics and sub-tropics; and the Arctic, where longer time scale atmospheric changes affect short-term weather events. - Continue research on the coupled processes in the high atmosphere, between the troposphere and stratosphere and the stratosphere/mesosphere and ionosphere and their effect on weather and space weather prediction. (NRL) - Continue research efforts regarding atmospheric or Earth system coupled processes that are not well understood (cloud and aerosol interactions, etc.), marine boundary layer and coastal prediction, and diurnal and mesoscale variability to improve their representation in forecast models. Aligned from the prior 'Atmosphere and Space Sciences' research area: The 'Marine Meteorology Analysis and Prediction' research area includes the following:					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
- Continue research efforts regarding marine atmospheric boundary layer gradients and processes important for low and mid-cloud evolution and structure. - Continue research investigations regarding key physical processes (marine atmospheric clouds, moisture and aerosol phenomena, etc.) to improve their representation in weather prediction models. - Continue research investigations of new and non-conventional observational data sources and novel methodologies for their assimilation into operational predictive models. - Continue efforts regarding the deployment of observing systems in the upper troposphere, middle and upper atmosphere and the near-space environment to allow extension of prediction systems into the middle and upper atmosphere and provide longer and higher fidelity forecasts. - Continue research investigations regarding the distribution, transport and time evolution of aerosols in the atmosphere and their impact on atmospheric visibility and laser propagation. - Continue new research in satellite-based environmental remote sensing algorithms and techniques tailored to improved retrievals for phenomena and regions of particular Naval interest. - Continue new research in atmospheric river dynamics and interaction with global circulation and air-sea interaction for improved prediction of extreme events and error modes for extended range forecasts. - Continue new research in the use of signals of opportunity such as GNSS radio occultation, reflectometry, and other anomalous propagation modes as a means to provide insight into the structure of the atmosphere and ocean surface that they are propagating through. Aligned from prior 'Ocean Sciences' research area: Littoral Geosciences and Optics research efforts address nonlinear coupling between atmospheric phenomena and surface/waves, sediment transport dynamics, and the study of bathymetric environments using field observations, modeling, and remote sensing data. Research efforts aligned to this area include the following: - Continue studies of surface gravity waves, currents, tides and internal wave processes along rocky coastlines. - Continue autonomous, scalable, hydrographic charting and coastal parameter sampling studies with concomitant remote sensing for data-assimilative coastal models. - Continue research using airborne and satellite active and passive microwave sensors, overhead optical sensors, and ship or shore-based radars to observe coastal and nearshore phenomena. - Continue studies of the dynamics of shallow coastal inlets; specific areas include their formation and maintenance processes by tides, waves, currents, discharge and sediment type and supply. - Continue research to predict physical, geological, geochemical, geo-acoustic and geotechnical properties of the seafloor in shallow-water coastal environments. - Continue research investigations of sub-seabed geophysical properties.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
- Complete field studies of coastal oceanographic phenomena using sonar-equipped autonomous underwater vehicles in conjunction with ground-based, airborne and satellite remote sensing. Aligned from the prior 'Atmosphere and Space Sciences' research area: The 'Space Research' program explores innovative sensor development, physics-based modeling and forecasting efforts integrated across the geo-space environmental research areas. Geospace research efforts include: - Continue research into affordable small-sat sensors to investigate and specify the three dimensional structure and evolution of the electromagnetic signal propagation environment in the ionosphere, including ionospheric bubbles. Employ stereo imaging and tomographic reconstruction to access the three dimensional structure and evolution of the upper atmosphere and ionosphere, relevant to Naval communications, intelligence, surveillance and reconnaissance, and geolocation. - Continue development of our understanding and computational representation of upper atmospheric, ionospheric relevant plasma processes and their coupling to the lower atmosphere and solar inputs, towards a future physics-based ionospheric prediction capability. - Continue development of new imaging techniques to examine the structure and evolution of additional airglow chemical species in the ionosphere for dayside and nightside processes. - Continue the development of new neutral density atmospheric observations for the mesosphere. - Continue observational research in polar ionospheric processes for improved regional prediction of the ionosphere at high latitudes. - Continue efforts into understanding basic plasma processes in the near-earth space to protect and understanding the effects on Naval C4ISR capabilities. Aligned from prior 'Ocean Sciences' research area: The 'Physical Oceanography and Prediction' research area explores ocean circulation, thermodynamics and mixing, and the dynamics of surface gravity waves, nonlinear internal waves and the interaction of waves with sea ice in order to understand the sub-mesoscale physical oceanography parameters from the tropics to the poles. Sub-mesoscale understanding of the ocean is necessary to support the required fidelity and accuracy of ocean feature inputs to Naval warfighting applications. Research efforts include the following: - Continue research efforts exploring novel expeditionary ocean instrumentation to support targeted observing. - Continue research regarding the study of ocean fronts, eddies and turbulence; ocean thermodynamics including mixing and acoustic impacts; and ocean boundary layer processes and surface gravity waves.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
- Continue research investigations of the rapid evolution of the upper ocean in the high North Atlantic between Iceland and the European continent to understand the physical processes that control vertical and horizontal density structures in the upper ocean. - Continue research efforts to explore the cascade of energy in the sub-mesoscale ocean, including the physics and dynamics of ocean features such as current meanders, vortices, and filaments, with a field program in the Western Pacific, to expand the knowledge of the lifecycle of these features and enable improved predictions. - Complete research investigations of three-dimensional Lagrangian ocean circulation and the prediction of vertical pathways in field experiments in the Mediterranean Sea. - Complete research regarding the seasonal variability of processes that control sea surface temperature in the Arabian Sea to understand the relevant space and time scales that enable improved ocean and weather forecasts through the reduction of ocean temperature biases in coupled models. - Initiate research investigations of air-sea interaction in the Arabian Sea to understand the origin of monsoon moisture and precipitation biases that exist in all coupled climate models (including the Navy's forecasting system) at sub-seasonal and shorter timescales. Program will leverage new observations of the ocean and atmosphere collected with regional partners. Aligned from prior 'Ocean Sciences' research area: The 'Arctic Sciences' research area explores complex processes governing the interaction of the arctic atmosphere, ocean, and sea ice, including formation, deformation, and melting. The physical processes in the arctic are inherently different from those in non-polar regions. Research efforts include: - Continue research efforts to characterize the behavior of sea ice, including melt and reformation, ice rheology and motion, and interactions with ocean stratification, surface waves and the atmosphere. - Continue research investigations regarding the development of Arctic System models and data assimilation techniques for improved prediction of the Arctic region and development of new sensors and unmanned platforms to collect observations of the Arctic environment. - Continue research development of algorithms enabling the space-based remote sensing of bulk properties of Arctic sea-ice that previously could be sampled only by localized in-situ methods. - Continue research efforts into studies of the circulation of the Arctic Ocean to explore the fate of heat flowing in through the Bering Strait and the impact on the upper ocean density structure of the Beaufort Sea. Aligned from prior 'Ocean Sciences' research area: The Ocean Acoustics research area addresses a National Naval Responsibility (NNR) S&T investment area considered critical to the naval services where the Navy has historically taken the lead to ensure decisive					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
naval capability in the maritime domain. The Ocean Acoustics research program conducts basic research addressing the fundamental understanding of the physics, mathematics, and engineering principles related to the generation, propagation, scattering, reception, and processing of underwater sound. Investigations may involve passive or active acoustics, along with theoretical and/or experimental approaches and model development. OA is inherently multidisciplinary and highly intertwined with physical, biological, and chemical processes that comprise the field of oceanography. Core areas of research include the generation, propagation and scattering of acoustic (and elastic) waves in temporally and spatially-varying ocean environments; the temporal, spatial, and frequency dependence of ocean ambient sound and characteristics of source generating mechanisms that contribute to the overall sound field; extracting information from acoustic signals that reveal information about the ocean environment - including characteristics of, and biogeochemical processes occurring at, the air-sea interface or the seafloor and within the ocean volume. Knowledge and expertise generated by basic research in OA supports operationally motivated experimentation conducted under the Task Force Ocean (PE 0602435N), mine and obstacle detection (PE 0602782N) and provides the underpinning of operational models for planning and decision making. Ever increasing skill in underwater acoustic prediction capability is essential to keep our undersea assets undetected as well as to enable the detection and tracking of adversary assets. Research efforts planned in Ocean Acoustics under this PE include: - Continue research to understand propagation and scattering of acoustic energy in shallow-water ocean environments. Specific efforts include shallow-water acoustic measurements supporting geoacoustic inversion; acoustic propagation through internal waves and coastal ocean processes and the development of unified ocean/seabed/acoustic models, including scattering from rough surfaces, biologics and bubbles; penetration/ propagation within the porous seafloor; and scattering mechanisms within the ocean volume, or related to the seabed, as a cause of reverberation and clutter. - Continue research into the effects of environmental variability, stratification, and mixing induced by ocean internal waves, internal tides and mesoscale processes, and by bathymetric features including seamounts and ridges, on the stability, statistics, spatial distribution, and predictability of broadband acoustic signals, as well as the coherence and depth dependence of deep-water ambient noise. - Continue joint field studies combining physical oceanography and acoustics to investigate propagation and scattering in regions characterized by complex bathymetry and/or meteorological and oceanographic forcing. Specific efforts will include processes studies aimed at characterizing the relationship between different oceanographic phenomena and the effects on acoustic propagation and scattering at different frequencies. - Continue efforts in characterizing, parameterizing, and model development for sediment acoustic properties. Specific efforts will include analysis of data from the acoustic seabed characterization experiments conducted					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
between 2015 and 2023. Analysis will include development and verification of geoacoustic models and inference techniques for mud, clay, and other fine-grained sediments based on the experimental evidence. - Continue research efforts aimed at optimally representing information contained in acoustic data. Efforts will focus on novel methods of extraction and processing data including those inspired by cognitive processing. Specific efforts will include the investigation of summary statistics and sparse encoding of underwater acoustic data with the objective of enabling efficient analysis and compact representations of acoustic scenes. - Continue research efforts on auralization refocused on applicability to understanding the maritime acoustic environment for characterizing the ocean battlespace. Specific efforts will include investigations into source separation, characterization, and recombination along with physical, biological, and anthropogenic sound generating mechanisms. An objective is to parameterize and develop models for acoustic phenomena in undersea environments to enable a capability for predicting the acoustic environment. - Continue analysis of data from a previous trans-arctic basin collection effort and initiate additional studies to account for changing conditions on acoustic propagation and ambient noise, particularly in under-ice environments. Specific efforts will include field studies focused on collecting long-time series data in support of acoustic thermometry in the changing arctic. - Initiate investigations of biogeochemical processes occurring near and within the seabed that impact the acoustic properties of the seabed. Specific efforts will include investigations aimed at linking local physical and biological processes to geoacoustic properties of the seabed and which have an impact on acoustic propagation and scattering. - Initiate investigations on acoustical oceanography with the objective of extracting information related to earth-system processes, climate, and/or biologic or human activities from ocean sound. Specific activities will include feasibility studies to be conducted in the Gulf of Maine in partnership with the Northeastern Regional Association of Coastal Ocean Observing Systems. Other activities will investigate and seek to develop relationships between the sound generated by or associated with physical processes such as deglaciation and air-sea gas exchange. - Initiate research efforts aimed at developing approaches to entraining and educating a workforce capable of responding to future requirements and maintaining U.S. leadership in the critically important discipline of Ocean Acoustics. Specific efforts will include investigations into the feasibility and value of micro-credentials, specialized workshops or intensives, bootcamps, and other non-traditional educational approaches. Aligned from prior 'Ocean Sciences' research area: The 'Marine Mammals and Biology' research program conducts basic research to understand and characterize the effects of sound					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
exposure on marine mammals to enable Navy to meet operational training and testing objectives in an environmentally responsible and legal manner. Areas of research include monitoring and detection of marine mammals, integrated ecosystem research, hearing in large whales, and effects of sound on marine mammals. Research activity in this area includes: - Continue research efforts regarding the development and testing of new and existing technologies to detect, classify, localize and potentially track marine mammals. - Continue multidisciplinary ecosystem research including tagging, visual surveys, and passive acoustics to collect baseline measures of marine mammal behaviors and distributions relative to environmental features and marine mammal prey fields. - Continue research investigations of sound reception mechanisms in large whales. - Continue research efforts regarding the effects of sound include behavioral, physiological and population-level consequences of sound exposure on marine life. - Continue research investigations to characterize and quantify the cumulative effects of multiple stressors on marine mammal populations. - Continue research to develop framework for understanding the ecology of eDNA, including the origin, state, transport, and fate of extra-organismal genetic material. - Continue studies to design appropriate primers and bioinformatics workflows to effectively and efficiently detect and identify target biological communities and ecosystems, and advance our understanding of the relationships between eDNA and the abundance of marine megafauna. Aligned from the 'Science and Engineering Education, Career Development and Outreach' program. The research and outreach efforts include: - Continue opportunities for students to participate in Navy and Marine Corps-relevant Ocean Battlespace Sensing research within the Naval Research Enterprise (NRE), at Naval Warfare Centers and Laboratories, by expanding the number of participating sites, mentors, and interns. - Continue to provide innovative research opportunities, such as faculty fellowships and student internships, that address critical Naval Ocean Battlespace Sensing S&T challenges through collaborations between academic researchers and Naval scientists and engineers. - Continue advancing Naval Ocean Battlespace Sensing relevant research, by cultivating long-term HBCU/MI partnerships that leverage knowledge sharing and empower scientific global discovery.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
- Continue Naval Ocean Battlespace Sensing outreach initiatives to increase the number of HBCU/MI research opportunities and grant proposal submissions. - Continue efforts to increase HBCU/MI Post-doctoral program participation in the Ocean Battlespace Sensing research program - Continue Young Investigator Program (YIP) topics selected in fiscal year 2024. ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The funding change from FY 2024 to FY 2025 is due to a realignment that moved funding within the same PE 0601153N from Defense Research Sciences (DRS) Project 0000 under the 'Ocean Sciences', 'Atmosphere and Space Sciences', and 'Science and Engineering Education, Career Development and Outreach' research areas to the 'Ocean Sciences' research area within Ocean Atmosphere and Space Sciences, Project 1398.					
Title: Battlespace Environments ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** - Continue research into Atmospheric Processes. The objective of this effort is to improve our understanding of complex atmospheric processes involving multiple scales in time and space and explore new, innovative strategies for observing, representing, and predicting the atmosphere. Efforts in this area encompass processes in the atmosphere, processes in coupled environmental systems (e.g. land/wave/ocean/ice/atmosphere), aerosol processes, and processes related to accurately estimating forecast uncertainty. Furthermore; this thrust encompasses projects aimed at effectively utilizing novel computational platforms or techniques to enable improved understanding or heretofore unobtainable accuracy of atmospheric forecasts. (NRL) - Continue research into Environmental Sensing. The overall objective is to increase our understanding in the areas necessary to obtain remote sensing measurement capabilities for battlespace environment constituents and phenomena that are important for environmental situational awareness and for driving battlespace environment models, but heretofore have either not been measured by remote sensing or have not been measured to the required accuracy. This entails research in several areas, including: improved understanding of the specific phenomenology to be probed by remote sensing or that impacts what is being remotely sensed, the creation of new sensors, and the generation of models to map from what is observed to what is required by a	0.000	0.000	19.867	0.000	19.867

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
human or model. Efforts in this area will improve the understanding of physical processes and remotely sensed signatures of oceanographic, atmospheric, littoral, and inland domains to include - but not limited to - bare soil and vegetation-covered terrain, ocean wave and current dynamics, bio-optical characterization, and the air-sea interface. It will also explore improved understanding of environmentally impacted sensing related to tactical sensors and surveillance systems. (NRL) - Continue efforts into the improvement of the basic understanding of physical and biological oceanographic processes on space and time scales of Naval interest in Oceanographic Process. Emphasis is on improved measurement and numerical based prediction. The following are some of the objectives in this research area. First is to quantify and understand important oceanographic processes that lead to the development of ocean dynamic models from global to submesoscale scales, and to develop methods for evaluating and validating the accuracy of models at these various scales. (NRL) - Complete efforts into forecasting physically-Derived Solar Irradiance Variability and the ionosphere-thermosphere-mesosphere (ITM) Response. (NRL) - Complete efforts into understanding basic plasma processes in the near-earth space to protect and understanding the effects on Naval C4IRS capabilities. (NRL) - Complete efforts to investigate new high-energy radiation and neutron detector materials for space-based observations. (NRL) - Initiate research into Geosciences Processes to understand the processes that generate and modify the shape, structure, biogeochemical, physical, and mechanical properties of the fluid-sediment bottom boundary layer through all areas of Naval relevance from deep water to on the beach. Research efforts in this area address an understanding of predictive model approaches both in representing the physics of seabed material and representing the influences of uncertainty in the seabed physical properties. (NRL) - Initiate research into Data Assimilation Process to exploit environmental sensing data to make optimal estimates to enable numerical model predictions, estimate individual environmental parameters, and provide the rigorous uncertain in these. These efforts will enable environmental sensing to be transformed into forecasts for Navy application. Areas of investigation include characterizing errors in observations and in models, the exploration of novel data assimilation techniques for the battlespace environment, the incorporation of novel					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
means of sensing, and the theory required to make battlespace environment data assimilation computationally tractable. This area covers the seabed, littoral, ocean, waves, ice, land surface, atmosphere, and middle atmosphere, and interactions in coupled systems. (NRL) - Initiate research efforts into Middle Atmosphere Processes to support measurements and modeling in the middle atmosphere (stratosphere and mesosphere) with the goal of understanding predictability on scales from hours to multi-decadal. Further areas of research in stratospheric aerosols to understand its interaction with radiation and assess its importance for Navy missions shall be conducted. The final area covered in this area supports satellite measurements in this region, including temperature, aerosols, and chemical constituents for use in process studies and comparison with models. (NRL) ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding changes from FY 2024 to FY 2025 are due to a realignment that moved funding within the same Program Element (PE) 0601153N from Defense Research Sciences (DRS) Project 0000 under the 'Atmosphere and Space Sciences' and 'Ocean Sciences' research areas to the 'Battlespace Environments' research area within Ocean Atmosphere and Space Sciences, Project 1398.					
Title: Expeditionary Ocean Atmosphere and Space Sciences ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** Research activity aligned from prior 'Science Addressing Hybrid Threats': - Continue research efforts in sensors and sensing technologies to enable stand-off detection and rapid neutralization of explosive hazards in multiple expeditionary mission environments while maintaining operational tempo. (Expeditionary Warfare) - Initiate research to understand nearshore and littoral environmental effects on future multidomain expeditionary operations. (Expeditionary Warfare) ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:***	0.000	0.000	2.336	0.000	2.336

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
Funds for this Activity were moved from the same PE 0601153N under the Science Addressing Hybrid Threats Activity of Project 0000 Defense Research Science.					
Title: Space Research	0.000	0.000	17.919	0.000	17.919
FY 2024 Plans: N/A					
FY 2025 Base Plans: - Continue reserach investigations into the geospace, which extends from the mesosphere up to the thermosphere. This is the environment in which the ionosphere is embedded and in which many low-Earth orbit satellites are located. Thus the Extended Operational (Geospace) Environment research aims at developing a fundamental understanding of the relevant physical, chemical and dynamic processes in this altitude regime, and the development of innovative approaches to sense and monitor the relevant environment, as well as the impacts of the solar and lower atmospheric drivers and their respective impacts. Real time knowledge and the ability to forecast this environment are highly relevant to DON capabilities, such as over the horizon radar and high frequency (HF) communications. (NRL) - Continue research on atmospheric or Earth system coupled processes that are not well understood, including cloud and aerosol interaction, marine boundary layer and coastal prediction, and diurnal and mesoscale variability to improve their representation in forecast models. (NRL) - Continue research efforts in High-Energy Space Environments comprising electromagnetic and particle radiation, including x-rays, gamma rays, protons, and electrons. Sensing, understanding the physics of, and interpreting the high energy space environment can be exploited for a multitude of DON-relevant applications, including, but not limited to positioning, navigation and timing (PNT), C2ISR, and space domain awareness. The goals of this research include the fundamental understanding of the high-energy space environment, ranging from the physical processes that emit the radiation, to the measurement of the natural and man-made environment with innovative, more efficient instrumentation, to novel approaches for the extraction of information from the observations. (NRL) - Continue research on the coupled processes in the high atmosphere, between the troposphere and stratosphere and the stratosphere/mesosphere and ionosphere and their effect on weather and space weather prediction. (NRL)					

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1398 / *Ocean Atmosphere and Space Sciences*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
- Initiate research in Radio and Infrared Astronomy regarding Naval-relevant applications, ranging from ionospheric specification, to positioning, navigation and timing (PNT), to space domain awareness. Research efforts include the development of exquisite imaging capabilities in the radio and visible/near-infrared at unprecedented angular resolution and to conceive and advance astrophysics techniques for future transition to a variety of DON and national security applications. (NRL) - Initiate research regarding the interplanetary space of our solar system that is under the direct influence of the Sun via physical phenomena such as the solar wind and electromagnetic radiation spanning nearly the entire spectrum summarized as Heliospace Environment research. The long-term goal of this research is to specify, and, with observational data, forecast heliospace dynamics and the impact of the Sun's variability on the Earth, and develop predictive and real-time DON-capability-relevant threat warnings. (NRL) ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding changes from FY 2024 to FY 2025 are due to a realignment that moved funding within the same Program Element (PE) 0601153N from Defense Research Sciences (DRS) Project 0000 under the 'Atmosphere and Space Sciences' research area to 'Space Research' within Ocean Atmosphere and Space Sciences, Project 1398.					
Title: Physical Oceanography and Prediction ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** - Continue research efforts in physical oceanography, acoustics and prediction to understand the exploitation of structural/physical acoustic processes. Research efforts explore factors in the assessment and reduction of the threat posed by enemy submarines and mines, the determination of methods to reduce the vulnerability of U.S. submarines, the development of next generation sonar and sensor systems, and in the development of new micro-structure and nano-structure devices. The objective is to develop new and improved techniques for understanding, detecting, visualizing, exploiting, predicting, and controlling the interactions between acoustic and elastic waves, and structures. These research efforts are essential to structural acoustic-based hull designs,	0.000	0.000	4.734	0.000	4.734

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1398 / *Ocean Atmosphere and Space Sciences*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
which are naturally compatible with high-density, hull-mounted sensor systems for sonar arrays, performance monitors, active control, and stealth. (NRL) - Continue research efforts involving laboratory, field, and theoretical/numerical studies to investigate physical phenomena related to acoustic propagation and scattering in oceanic environments such as: prediction of the scattering signature of a structure using noise sources of opportunity; fundamental physical phenomena of wave propagation in ocean environments; approaches to separate an acoustical field from turbulent flow on an acoustic array; new structural acoustics theory for scattering from large, complex undersea objects; and creation of new approaches to monitoring the acoustic signature and structural state of undersea vessels. (NRL) ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding changes from FY 2024 to FY 2025 are due to a realignment that moved funding within the same Program Element (PE) 0601153N from Defense Research Sciences (DRS) Project 0000 under the 'Ocean Sciences' research area to 'Physical Oceanography and Prediction' research area within Ocean Atmosphere and Space Sciences, Project 1398.					
Title: Ocean Acoustics ***FY 2024 Plans:*** - Initiate research efforts in Ocean Acoustics to investigate physical phenomenon related to in oceanic environments. This program is focused on extending acoustic propagation simulation technology as a fundamental tool for understanding the environment through inversion methods and performance prediction. Efforts in this area of research are investigating acoustic propagation and interactions with the sea surface and seabed to improve system prediction performance, sonar processing, and to discover novel concepts for Anti-submarine Warfare (ASW). Research will include the ability to remotely determine the complete elastic properties of the ocean's sediment will address serious shortcomings in Navy databases that affect many acoustic performance prediction models as well as mine warfare planning assessments. Another specific area of research will be developing the understanding and being able to model the acoustic field in a three-dimensional environment - which will greatly increase the ability to detect and track submerged targets in environments with significant changes in environmental characteristics. An important goal in ASW is passive source localization in littoral regions. (NRL) ***FY 2025 Base Plans:***	0.000	0.000	2.468	0.000	2.468

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1398 / *Ocean Atmosphere and Space Sciences*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
N/A ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding changes from FY 2024 to FY 2025 are due to a realignment that moved funding within the same Program Element (PE) 0601153N from Defense Research Sciences (DRS) Project 0000 under the Ocean Sciences research area to Ocean Acoustics within Ocean Atmosphere and Space Sciences, Project 1398.					
Accomplishments/Planned Programs Subtotals	0.000	0.000	118.935	0.000	118.935

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not Required

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy			Date: March 2024
Appropriation/Budget Activity 1319 / 1	R-1 Program Element (Number/Name) PE 0601153N / *Defense Research Sciences*	Project (Number/Name) 1400 / *Power and Energy*	

COST ($ in Millions)	Prior Years	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total	FY 2026	FY 2027	FY 2028	FY 2029	Cost To Complete	Total Cost
1400: *Power and Energy*	0.000	0.000	0.000	21.014	-	21.014	21.203	23.865	24.391	27.417	Continuing	Continuing

Note

Investments in Project 1400 Power and Energy were previously funded in this same PE 0601153N under Project 0000. This Project was created to promote greater transparency and execution oversight for basic research investments in power and energy research in the Department of the Navy's annual budget request. This is not a new start.

A. Mission Description and Budget Item Justification

This Focus Area (FA) enables increasingly efficient, reliable, resilient, and abundant energy for Navy and Marine Corps infrastructure, platforms, systems, and equipment. This FA seeks to optimize power and energy density, energy efficiency, service life, reliability, low maintenance operation, safety, climate resilience, and cost. Research relevant to the power, energy & propulsion of naval systems is included in this R-2 Activity.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
Title: Aerospace Propulsion, Power and Thermal Management	0.000	0.000	2.899	0.000	2.899
FY 2024 Plans: N/A					
FY 2025 Base Plans: Research efforts with focused emphasis regarding critical areas such as propulsion cycles, subsystems, propulsion integration, turbo machinery and drive systems, and high-temperature (hot section) materials and coatings. Research efforts include the following: Initiate: -Synergistic Effects in the Environmental Degradation of Ceramic Coatings in Gas-Turbine Engines and its Mitigation -Advanced Subgrid-Scale Models for Particle Transport and Deposition in Gas Turbines -Advancing Prediction Methods for Flows with Complex Curvature Relevant to Next-Generation Naval Aircraft Propulsion Continue: -Hierarchical nonlinear Control of Integrated Propulsion, Power, and Thermal Management Systems for Naval Aircraft					

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1400 / *Power and Energy*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
-Inter-Turbine burning for enhanced performance - Initiate Enhancing Jet Breakup via High-Frequency Ultrasound -Research to advance the technical superiority of Naval Aircraft - Propulsion, Power and Thermal management with emphasis on propulsion cycles, subsystems, propulsion integration, turbo machinery and drive systems, and hot section materials and coatings -Research to improve the power density, fuel efficiency, speed, range and operating reliability of future large, medium and small engines. -Studies with Rotating Detonation Engines and integration into platforms and weapon systems using thermodynamic models, Computational Fluid Dynamics and sub-scale experiments. -Research for high stage-loading and efficient turbomachinery including distortion tolerant fans, casing treatments and advanced methods in blade-disk aerodynamics; advanced cooling and thermal management for engines and auxiliary systems including new concepts of heat collection, distribution and rejection; advanced turbine engine materials and coatings; highly integrated propulsion inlets and exhausts and dust ingestion research, including modeling, separating, deposition, coatings and sensing. -Improve jet engine material durability and temperature rate capabilities in both benign and corrosive environments. -Develop advanced radio-frequency based sensors to provide ingestion and foreign object damage sensing, as well as overall prognostics. -Research of fundamental modeling of distributed combustion in the turbine. ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The funding change from FY 2024 to FY 2025 is due to a realignment that moved funding within the same PE 0601153N from Defense Research Sciences (DRS) Project 0000 under the Air, Ground and Sea Vehicles research activity to Power and Energy Project 1400 under the Aerospace Propulsion, Power and Thermal Management research activity.					
Title: Power, Energy and Propulsion ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** - Continue climate research to improve understanding of the environmental impacts on future platforms and reduce the impact of platforms on the environment.	0.000	0.000	9.722	0.000	9.722

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1400 / *Power and Energy*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
- Continue fundamental electrical power, energy and propulsion research. - Continue research in heat transfer and thermal management science and materials to enable effective cooling of future directed energy systems, power electronics, personnel, etc. - Continue power generation research to improve operational endurance, energy storage, distribution, power management and control. - Continue power electronics research for improved energy conversion efficiency, and electromagnetic materials research to achieve compatibility with high frequency power electronics. - Continue to advance material science for electrochemical energy storage, alternative fuels, fuel cells, dielectrics, and photovoltaics. - Continue physics-based modeling efforts, and the development of digital twins for power and energy materials, components, and systems. ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding change for this Activity was moved from the same PE 0601153N Project 0000 Defense Research Science under the Air, Ground and Sea Vehicles Activity.					
Title: Sea Warfare and Weapons STEM	0.000	0.000	1.065	0.000	1.065
FY 2024 Plans: N/A ***FY 2025 Base Plans:*** - Continue activities targeting efforts to augment awareness of naval opportunities and increase diverse workforce opportunity for the naval science and technology community. - Continue STEM efforts to address Naval skilled technical workforce needs. - Continue FY2023 & FY2024 YIP awards to assistant professors that have demonstrated exceptional promise for performing creative research. - Complete Young Investigator Program topics initiated in previous fiscal years. - Initiate Young Investigator Program topics selected in fiscal year 2025. ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:***					

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1400 / *Power and Energy*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
Funding change for this Activity was moved from the same PE 0601153N Project 0000 Defense Research Science under the Science and Engineering Education, Career Development and Outreach Activity.					
Title: Expeditionary Power and Energy ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** - Continue research to study, characterize, understand, and exploit anionic redox phenomena in lithium-ion and sodium- ion batteries and solve fundamental challenges en route to improving and designing new materials that could increase the cathode capacity of these battery chemistries by exploiting the anionic redox processes. (Expeditionary Warfare) ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding change for this Activity were moved from the same PE 0601153N under the Science Addressing Hybrid Threats Activity of Project 0000 Defense Research Science.	0.000	0.000	1.095	0.000	1.095
Title: Structural Materials ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** - Initiate research efforts into Power, Energy, and Propulsion topics to advance Navy / Marine Corps capabilities in power, energy, and propulsion. These research efforts will develop an understanding of new materials for on-demand (electro)chemical energy generation, harvesting, storage, and release. Research efforts will focus on energy storage materials, including energetic materials, reactive metal nanoparticle fuel additives, new - both nanoscale and mesoporous - materials and supercapacitors and safe rechargeable batteries. (NRL) ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:***	0.000	0.000	6.233	0.000	6.233

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1400 / *Power and Energy*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
The funding change from FY 2024 to FY 2025 is due to a realignment that moved funding within the same PE 0601153N from Defense Research Sciences (DRS) Project 0000 under the 'Materials/Processes' research activity to the 'Structural Materials' research activity within Power and Energy, Project 1400.					
Accomplishments/Planned Programs Subtotals	0.000	0.000	21.014	0.000	21.014

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy											Date: March 2024	
Appropriation/Budget Activity 1319 / 1					R-1 Program Element (Number/Name) PE 0601153N / *Defense Research Sciences*				Project (Number/Name) 1401 / *Undersea Systems Payloads and Weapons*			
COST ($ in Millions)	**Prior Years**	**FY 2023**	**FY 2024**	**FY 2025 Base**	**FY 2025 OCO**	**FY 2025 Total**	**FY 2026**	**FY 2027**	**FY 2028**	**FY 2029**	**Cost To Complete**	**Total Cost**
1401: *Undersea Systems Payloads and Weapons*	0.000	0.000	0.000	5.782	-	5.782	5.765	6.262	6.364	6.927	Continuing	Continuing

Note

Investments in Project 1401 Undersea Systems Payload and Weapons were previously funded in this same PE 0601153N in Project 0000. This Project was created to promote greater transparency and execution oversight for basic research investments in undersea systems payloads and weapons research in the Department of the Navy's annual budget request. This is not a new start.

A. Mission Description and Budget Item Justification

This Focus Area (FA) addresses innovative affordable, persistent, and stealthy undersea systems that leverage the asymmetric US Navy advantage afforded by subsurface operations.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
Title: Undersea Weaponry ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** - Continue research investigations of Undersea Warheads with respect to the characterization and modeling of explosive formulations. - Continue research efforts regarding Advanced Concepts for Sea Warfare and Weapons regarding unconventional power and energy technologies. - Continue research investigations of Cooperative Autonomous Swarm Technology. ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding change for this Activity was moved from the same PE 0601153N Project 0000 Defense Research Science under the Weapons Activity.	0.000	0.000	4.805	0.000	4.805
Title: Sea Warfare and Weapons STEM ***FY 2024 Plans:***	0.000	0.000	0.977	0.000	0.977

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1401 / *Undersea Systems Payloads and Weapons*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
N/A ***FY 2025 Base Plans:*** - Continue activities targeting efforts to augment awareness of naval opportunities and increase diverse workforce opportunity for the naval science and technology community. - Continue STEM efforts to address Naval skilled technical workforce needs. - Continue FY2023 & FY2024 YIP awards to assistant professors that have demonstrated exceptional promise for performing creative research. - Continue research efforts in support of the National Naval Responsibility for Undersea Weapons by performing efforts relevant to the Naval Undersea Research graduate-level STEM program to support the development of the Navy laboratory workforce. - Complete Young Investigator Program topics initiated in previous fiscal years. - Initiate Young Investigator Program topics selected in fiscal year 2025. ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding change for this Activity was moved from the same PE 0601153N Project 0000 Defense Research Science under the Science and Engineering Education, Career Development and Outreach Activity.					
Accomplishments/Planned Programs Subtotals	0.000	0.000	5.782	0.000	5.782

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy											Date: March 2024	
Appropriation/Budget Activity 1319 / 1					R-1 Program Element (Number/Name) PE 0601153N / *Defense Research Sciences*				Project (Number/Name) 1402 / *Naval STEM*			
COST ($ in Millions)	**Prior Years**	**FY 2023**	**FY 2024**	**FY 2025 Base**	**FY 2025 OCO**	**FY 2025 Total**	**FY 2026**	**FY 2027**	**FY 2028**	**FY 2029**	**Cost To Complete**	**Total Cost**
1402: *Naval STEM*	0.000	0.000	0.000	17.482	-	17.482	18.143	19.433	19.776	21.527	Continuing	Continuing

Note

Investments in Project 1402 Naval STEM were previously funded in this same PE 0601153N in Project 0000. This Project was created to promote greater transparency and execution oversight for basic research investments in Naval STEM in the Department of the Navy's annual budget request. This is not a new start.

A. Mission Description and Budget Item Justification

The Naval STEM (Science, Technology, Engineering, and Mathematics) research area proactively addresses a variety of naval, and national, security issues by fostering and cultivating a diverse, world-class workforce as necessary to maintain the U.S. Navy and Marine Corps technological superiority. The Naval STEM research area supports strategic opportunities that inspire, engage, educate, employ, develop, and retain the current and future workforce through a diverse portfolio of research and outreach initiatives. Naval STEM initiatives are coordinated across the Naval Research Enterprise (NRE) and executed locally to more effectively address local priority issues and leverage a much larger pool of diverse local expertise, infrastructure, community investments, and provide critical skills and career opportunity awareness/exposure to youth and communities throughout the nation.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
Title: Naval STEM	0.000	0.000	17.482	0.000	17.482
Description: The Naval Science, Technology, Engineering and Math (STEM) activity addresses the critical need to grow and maintain a highly skilled technical naval workforce. These efforts inspire, engage, educate and attract participants to pursue naval careers and build the extramural performer base. DON STEM education and outreach is designed to increase the number of students and naval civilians with naval-relevant skills and degrees, expand capabilities of the current and future workforce by developing curricula and augmenting education, and augment awareness of Naval opportunities through localized education and outreach initiatives that foster the talent pipeline.					
FY 2024 Plans: N/A					
FY 2025 Base Plans: Science, Technology, Education and Mathematics (STEM) - Continue existing successful efforts, like the Navy and Marine Corps Junior Reserve Officers' Training Corps (JROTC) Flight Academy, while examining approaches to further scale up these efforts to achieve greater impact across the DON.					

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 1402 / *Naval STEM*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
- Continue the development of highly scalable pilot efforts, like Naval Horizons, to expand STEM education and outreach, with a focus on reaching underrepresented students, through the development of new virtual and in-person curricula as well as virtual and in-person experiential learning activities. - Continue activities targeting regional efforts to augment awareness of naval opportunities, like SeaPerch and Summer Heroes Youth Program, and increase diverse workforce opportunity for the naval science and technology community. - Continue national efforts to encourage students to conduct original STEM research, such as the National Junior Science and Humanities Symposium which recognizes students with scholarships for outstanding achievements. - Continue to cultivate a diverse, world-class STEM workforce relevant to the needs of Department of Navy's current and future workforce through a competitive grants process open to academia, industry, and non-profits. - Continue efforts to expand STEM education through train-the-trainer efforts, like the US Naval Academy DoDEA Educator Training. - Continue new STEM efforts to address Naval skilled technical workforce needs. ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The funding change in FY 2025 is due to a realignment that moved funding within the same PE 0601153N from Defense Research Sciences (DRS) Project 0000 under the Engineering Education, Career Development and Outreach research activity to Naval STEM Project 1402 under the Naval STEM research activity.					
Accomplishments/Planned Programs Subtotals	0.000	0.000	17.482	0.000	17.482

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy			Date: March 2024
Appropriation/Budget Activity 1319 / 1	R-1 Program Element (Number/Name) PE 0601153N / *Defense Research Sciences*	Project (Number/Name) 3465 / *In-House Lab Independent Res*	

COST ($ in Millions)	Prior Years	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total	FY 2026	FY 2027	FY 2028	FY 2029	Cost To Complete	Total Cost
3465: *In-House Lab Independent Res*	0.000	18.947	19.924	17.939	-	17.939	18.259	21.619	22.494	23.519	Continuing	Continuing

A. Mission Description and Budget Item Justification

The In-house Laboratory Independent Research (ILIR) initiative seeks to improve the quality of defense research conducted predominantly through the Naval Warfare Centers/Laboratories. It also supports the development of technical intellect and education of engineers and scientists in disciplines critical to national defense needs through the development of new knowledge in a military laboratory environment. Initial research focus is often conducted in an unfettered environment since it is basic research, but many projects focus on applying recently developed theoretical knowledge to real world military problems with the intention of developing new capabilities and improving the performance of existing systems.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
Title: In-House Laboratory Independent Research (ILIR)	18.947	19.924	17.939	0.000	17.939
Description: The In-house Laboratory Independent Research program provides opportunities to strengthen the Naval Science and Engineering workforce through basic research conducted at the Naval Warfare Centers and Laboratories. These research efforts address high risk/high payoff warfighter science and technological needs, as well as attract the next generation of researchers to consider employment within the Department of the Navy. ILIR also provides opportunities for advanced degrees, technical publications, presentations, and patents. ***FY 2024 Plans:*** Continue: - Further develop and maintain the Science and Engineering workforce by providing funding to Naval Warfare Centers and Laboratories to foster high risk/ high reward basic research initiatives of Naval interest. Each Naval site conducts peer reviews for existing research projects, assess the quality of the research, and determine if projects should continue. Complete: - Research topics that initiated in FY 2022. Assess opportunities for technology transition through coordination with various resource sponsors. Transfer successful efforts to research, development, test, and evaluation-sponsored programs. Initiate: - The participating warfare centers or laboratories generate new three-year research topics where priority is given to warfighter needs, technology alignment, high quality research, and the recruitment and retention of					

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 3465 / *In-House Lab Independent Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
outstanding scientists and engineers. Topics cover a broad range of naval relevant research areas critical to the support of warfare center and laboratory missions. ***FY 2025 Base Plans:*** Continue: - The development of the naval Science and Engineering workforce at the Naval Warfare Centers and Laboratories via high-risk / high-reward basic research initiatives with direct naval relevance to the naval mission of the Command. Each participating naval site will conduct peer reviews for on-going research projects to assess the progress/quality of the research and to help determine if research investments should continue. Complete: - Research topics as planned. Assess opportunities for technology transition through coordination with naval resource sponsors. Transfer successful efforts to Navy research, development, test & evaluation (RDT&E) sponsored programs. Initiate: - Participating warfare centers / laboratories will generate new research topics with selection decision priority being given to warfighter needs, technology alignment, high quality research, and recruitment / retention needs as appropriate to attract outstanding scientists and engineers to the Department of the Navy. Approved topics will cover a broad range of naval relevant research areas critical to the naval missions of the participating warfare center and laboratories. ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The funding decrease from FY 2024 to FY 2025 is due to completion of research topics that initiated in FY 2023.					
Accomplishments/Planned Programs Subtotals	18.947	19.924	17.939	0.000	17.939

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy											Date: March 2024	
Appropriation/Budget Activity 1319 / 1					R-1 Program Element (Number/Name) PE 0601153N / *Defense Research Sciences*				Project (Number/Name) 5893 / *Decision Superiority*			
COST ($ in Millions)	**Prior Years**	**FY 2023**	**FY 2024**	**FY 2025 Base**	**FY 2025 OCO**	**FY 2025 Total**	**FY 2026**	**FY 2027**	**FY 2028**	**FY 2029**	**Cost To Complete**	**Total Cost**
5893: *Decision Superiority*	0.000	0.000	0.000	33.780	-	33.780	33.779	37.329	38.501	42.269	Continuing	Continuing

Note

Investments in Project 5893 Decision Superiority were previously funded in this same PE 0601153N in Project 0000. This Project was created to promote greater transparency and execution oversight for basic research investments in decision superiority research in the Department of the Navy's annual budget request. This is not a new start.

A. Mission Description and Budget Item Justification

The Decision Superiority research area explores and develops technology for the naval force to include information processing, understanding, analysis, decision-making, and execution to obtain decisive competitive advantage across the range of naval missions and levels of warfare. Advanced communications and networking and precision navigation and timing (PNT) technology will accelerate and expand the Navy and Marine Corps ability to access high quality information for the kill web and to use information for operational effects and advantage with incredible ubiquity, accuracy, precision, security, integrity, and speed.

Basic research efforts within this research area includes:
- Communications and Networks
- Artificial Intelligence, Data Sciences, and Quantum Information Sciences
- Young Investigator Program (YIP)
- Expeditionary Decision Superiority
- Information Technology

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
Title: Communications and Networks	0.000	0.000	0.887	0.000	0.887
Description: The Communications and Networking activity conducts basic research in information-theoretic capacity and wireless communications science to enable seamless, robust connectivity and networking in hostile tactical environments.					
FY 2024 Plans: N/A					
FY 2025 Base Plans: Communications and Networks: Research thrusts in this area include Tactical Communications and Tactical Networks. Tactical Communications:					

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
- Continue research efforts to develop new techniques for wireless distributed computing and device-to-device communication. - Continue investigations regarding novel software coding and modulation techniques to improve the efficiency, capacity and/or resilience of wireless communication systems. Tactical Networks: - Continue research efforts regarding Artificial Intelligence/Machine Learning techniques relevant to multi-dimensional Quality-of-Service optimization issues. - Continue research efforts on the development of cognitive methods and algorithms to maintain network resiliency when experiencing communications link disruptions without adding excess overhead resources. - Complete research efforts to develop feedback control models for determining the limit of fast adaptive traffic engineering. - Complete research investigations of algorithms, protocols and middleware regarding dynamic and scalable multi-hop ad hoc wireless networking in contested environments. - Complete research to develop the scientific foundation and understanding of wireless communications and networking technologies to enable the naval warfighter to maintain access to mission critical information in contested environments. - Initiate research on learned optimal software-defined network synchronization. ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The funding change in FY 2025 is due to a realignment that moved funding within the same PE 0601153N from Defense Research Sciences (DRS) Project 0000 under the Mathematics, Computer, and Information Sciences research activity to Decision Superiority Project 5893 under the Communications and Networks research activity.					
Title: Artificial Intelligence, Data Sciences, and Quantum Information Sciences ***Description:*** The AI, Data Sciences, and QIS activity includes basic research efforts directed toward scientific foundations and understanding of novel techniques for controlling quantum states; algorithms for analyzing massive datasets in real time and heterogeneous information integration; science base and computational methods for building versatile intelligent agents; theory, algorithms and tools for decision support; mathematical optimization for resource allocation and usage; and modeling and computation of complex physical phenomena for the unique challenges of the Naval domain. ***FY 2024 Plans:***	0.000	0.000	23.016	0.000	23.016

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
N/A					
FY 2025 Base Plans: Quantum Information Sciences: - Continue research of quantum states, devices, phenomena relative to the simulation, information processing and computing performance needs of naval systems. - Continue research on novel techniques for controlling quantum states to improve performance of information processors, sensors and clocks. - Continue research on demonstrations of systems having a quantum advantage in the solution of optimization problems and quantum simulation of complex physical systems. - Continue research on the utilization of photonic and phononic devices for high performance quantum information processing. - Continue research exploring the distribution of entanglement in a quantum network and applications thereof. - Initiate research on the use of single magnetic excitations for quantum information processing. Mathematical Data Science: - Continue basic research in mathematics, probability, statistics, signal processing, machine learning, data engineering, and information theory. - Continue efforts to develop advanced algorithms for analyzing massive datasets in real time, identify real patterns and avoid false positives. - Continue investigations regarding the development of advanced methods to integrate and extract common features from large heterogeneous domains. - Continue research investigations of privacy in complex networks. - Continue research efforts regarding the development of scalable reinforcement learning. - Continue research investigations of causal dependences in complex networks. - Initiate research investigation regarding large language models. Machine Reasoning and Intelligence: - Continue developing the science base and computational methods for building versatile intelligent agents, which can function autonomously in uncertain, unstructured, uncontrolled, open-world environments, and can collaborate seamlessly with humans and other agents. - Continue basic research in developing new mathematical methods for principled design of deep learning architectures and analysis of their behavior. This program is expected to develop techniques for predicting					

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
performance of learning-based systems, to improve their generalization abilities, and to reduce the need for empirical verification. - Continue basic research for developing robust computer vision systems, based on human vision, for automated understanding of surveillance imagery, perception for autonomous agents, and managing image/video libraries for after-action analysis and planning. - Continue basic research in machine self-learning for intelligent agents, inspired by human learning, for understanding real-world environments. - Continue basic research in learning and decision-making in multi-agent systems in dynamic, uncertain settings where there are many competitive and cooperative agents and information about intentions and rewards are not fully known. This research area has a wide range of applications in tactical and strategic planning, economic planning, etc. - Initiate basic research in exploiting generative models, such as auto-encoders and stable diffusion models, to solve inverse problems. This research area has a wide range of applications in robot perception and automated understanding of surveillance imagery. Optimization and Discrete Mathematics: - Continue to identify exploitable mathematical structures within specific decision problems for the purpose of devising superior solution algorithms. - Continue investigations into methods for strategically formulating and solving optimization problems that arise in resource allocation, logistics, and system planning. - Continue investigations into new techniques that utilize convex optimization and duality theory to solve non-convex optimization problems. - Continue research on integrating machine-learning techniques with algorithms for stochastic and combinatorial optimization. - Continue research on developing novel first-order methods for solving general classes of problems that include saddle point problems, problems with a large number of constraints, and machine learning problems. - Continue investigations into applying topological data analysis to combinatorial optimization problems. - Continue investigations into finding solutions to various forms of multi-agent, multi-round games. - Initiate investigations into optimization algorithms that leverage potential future computational advances including quantum and pseudo-quantum computers. Applied and Computational Mathematics: - Continue basic research in developing analytical and computational tools for models of physical phenomena of critical interest to the Navy in waves, flows, materials, structures and information processing.					

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy		Date: March 2024
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
- Continue to develop robust, reliable and near-real-time computational models for predicting environmental behavior in atmospheric and oceanic processes. - Continue to develop theoretical and computational tools to predict the onset of extreme events, whether in materials, such as formation of shocks, cracks and other discontinuities. - Continue to develop reduced models to enable speed up of computational models in acoustics, electromagnetics and optics, in regimes of special interest to the Navy. - Continue research to develop mathematically rigorous algorithms for employing variable-precision computations in very large-scale multi-physics problems. Naval Research Institution: - Continue to support the Naval Research Institution efforts that provide hands-on and virtual research experiences in STEM fields for United States Naval Academy (USNA) midshipmen and faculty members to enhance the midshipmen's educational environment at the USNA. ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The funding change in FY 2025 is due to a realignment that moved funding within the same PE 0601153N from Defense Research Sciences (DRS) Project 0000 under the Mathematics, Computer, and Information Sciences and Engineering Education, Career Development and Outreach research activities to Decision Superiority Project 5893 under the Artificial Intelligence, Data Sciences, and Quantum Information Sciences research activity.					
Title: Young Investigator Program (YIP) ***Description:*** The ONR Young Investigator Program (YIP) attracts outstanding faculty members to the Department of Navy's basic research program by identifying individuals that show exceptional promise for doing creative research and encourage their teaching and research careers through long term support. Young Investigator awards are for a period of three years. Proposals are solicited annually via a funding opportunity announcement open to tenure-track faculty in science, engineering, and mathematics. YIP awardees are competitively selected based on faculty achievements, technical proposal, benefit to the Navy and Marine Corps, and university endorsement. ***FY 2024 Plans:***	0.000	0.000	1.627	0.000	1.627

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
N/A ***FY 2025 Base Plans:*** Young Investigator Program (YIP): - Continue FY 2023 & FY 2024 YIP awards to assistant professors that have demonstrated exceptional promise for performing creative research. Recent YIP topics include innovative technical approaches to a broad range of naval-relevant research topics, including quantum computing, machine learning, polymorphic wireless computing, and cryogenically enabled systems. These and other research topics will benefit today's and the next generation warfighter by improving lethality, survivability, and communications. Additionally, many of these investigators will provide long-term support and knowledge in solving Naval related S&T challenges. - Complete YIP topics initiated in previous fiscal years. - Initiate YIP topics selected in FY 2025. ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The funding change in FY 2025 is due to a realignment that moved funding within the same PE 0601153N from Defense Research Sciences (DRS) Project 0000 under the Engineering Education, Career Development and Outreach research activity to Decision Superiority Project 5893 under the Young Investigator Program (YIP) research activity.					
Title: Expeditionary Decision Superiority ***Description:*** Supports the fundamental basic research and phenomenological studies into perceiving the future operational environment, processing information, and supporting decision-making to gain a future competitive advantage across the range of naval expeditionary missions. ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** Research activity aligned from prior 'Science Addressing Hybrid Threats': - Continue a focused research effort for discovery research on multi-class, multi-objective deep reinforced learning algorithms with automated training. (Expeditionary Warfare) - Initiate research into deception, degradation, and manipulation of artificial intelligence algorithms in perception/ action loops. (Expeditionary Warfare)	0.000	0.000	1.498	0.000	1.498

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
- Initiate research on understanding generalized theoretical foundations and limitations of predicting, deceiving, and disrupting artificial intelligence algorithms embedded in the perception/action loops of autonomous systems. (Expeditionary Warfare) ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funds change for this Activity were moved from the same PE 0601153N under the Science Addressing Hybrid Threats Activity of Project 0000 Defense Research Science.					
Title: Information Technology ***FY 2024 Plans:*** N/A ***FY 2025 Base Plans:*** - Initiate research efforts into the use of Artificial Intelligence (incorporating, but not limited to Intelligent Agents, Cognitive Science, Robotics, Autonomy, Machine Learning (ML), and Multi-agent control planes/protocols) to explore the viability of future distributed autonomous unmanned systems and swarms. These research efforts will include present and future theoretical endeavors in the Cognitive S&T for for the deployment of autonomous/ interactive intelligent agents compatible with Allies and mission partners. This research area will address foundational theory in computational cognitive modeling for warfighter collaboration, S&T supporting deployment of adaptive autonomy, instructable autonomous systems, resilient agent-control to maintain desired states for deployed distributed autonomous unmanned swarms - including counter/disrupt/combat enemy swarms, and integrated, multi-agent (heterogeneous, human in the loop) autonomous systems. (NRL) - Initiate research efforts in Environmentally-informed Decision Theory that focuses on the theory and understanding behind the information processing, analytics, optimization, information content, analysis, decision-making, and decision understanding needed to obtain decisive competitive advantage across the range of naval missions and levels of warfare that are significantly impacted by the environment and predictions of the environment. These efforts will focus on the creation and understanding of algorithms and software technologies that utilize environmental characterization or forecasts along with non-environmental information to support user-cognitive processes. Research efforts conducted in this area involves all elements of decision-relevant artificial intelligence, and places an emphasis on efforts that enable the ability to communicate the reasoning behind specific decision guidance. Recognizing the large amount of data required to generate decision guidance, the computationally difficult nature of optimizing large, complex problems, and the proliferation of disconnected and	0.000	0.000	6.752	0.000	6.752

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
independent decision guidance systems, these efforts includes theory, approximations, and advanced heuristics aimed at tackling these challenges. (NRL) - Initiate research efforts in information management and human-machine interactions, decision superiority, detection of cognitive biases in decision-making, and efficient computation amongst multi-agent systems and Service Oriented Architectures. Research activities within this area will explore the theoretical underpinnings of systems modeling warfighter abilities, cognitive state, neurophysiological markers and behavior, enabling expert agents to identify bias and suggest alternative courses of action to decision-makers, as well as machine-based efforts at the basic science level to ensure software accuracy and proper function. Long term goals include foundational research in maritime AI-based algorithms on deployed Naval/Joint platforms, operating at the micro-level, with super-human speed and accuracy, and human interaction with deployed Adaptable Artificial Intelligence. (NRL) ***FY 2025 OCO Plans:*** N/A ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The funding change in FY 2025 is due to a realignment that moved funding within the same PE 0601153N from Defense Research Sciences (DRS) Project 0000 under the 'Mathematics, Computer & Information Sciences' research activity to the 'Information Technology' research activity within Decision Superiority, Project 5893.					
Accomplishments/Planned Programs Subtotals	0.000	0.000	33.780	0.000	33.780

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Navy											Date: March 2024	
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COST ($ in Millions)	**Prior Years**	**FY 2023**	**FY 2024**	**FY 2025 Base**	**FY 2025 OCO**	**FY 2025 Total**	**FY 2026**	**FY 2027**	**FY 2028**	**FY 2029**	**Cost To Complete**	**Total Cost**
9999: *Congressional Adds*	0.000	41.027	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	41.027

A. Mission Description and Budget Item Justification

Congressional Interest Items not included in other Projects.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024
Congressional Add: Basic Research ***FY 2023 Accomplishments:*** Provide significant new opportunities for basic research across the spectrum of activities in the 0601153N Program Element performed in the five departments of the Office of Naval Research. ***FY 2024 Plans:*** N/A	24.134	0.000
Congressional Add: Multifunctional structural batteries ***FY 2023 Accomplishments:*** Objective to investigate the important basic engineering science challenges that can substantially advance the naval undersea systems technologies. ***FY 2024 Plans:*** N/A	2.896	0.000
Congressional Add: Silicon-germanium-tin alloy research ***FY 2023 Accomplishments:*** This project is to deliver breakthroughs in semiconductor science and technology for the fabrication of new and novel focal-plane array digital imaging systems. ***FY 2024 Plans:*** N/A	4.826	0.000
Congressional Add: Predictive modeling for next generation undersea vehicles ***FY 2023 Accomplishments:*** Conduct research in predictive modeling for next generation undersea vehicles. ***FY 2024 Plans:*** N/A	2.896	0.000
Congressional Add: Naval Research Laboratory S&T ***FY 2023 Accomplishments:*** Conduct Congressional Interest Science and Technology at the Naval Research Laboratory ***FY 2024 Plans:*** N/A	6.275	0.000
Congressional Adds Subtotals	41.027	0.000

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C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A