**A. SYSTEMS DIRECTORATE**

**53-19-01 - HIGH FREQUENCY RADAR**

**53-19-01C - HIGH FREQUENCY RADAR (CLASSIFIED)**

**53-19-02 - LOW-COST WIDEBAND ANTENNA ARRAY TECHNOLOGIES**

**53-19-03 - ADVANCED COMPUTATIONAL ELECTROMAGNETICS**

**55-19-01 - INFORMATION MANAGEMENT AND DECISION ARCHITECTURES**

**55-19-02 - MATHEMATICAL FOUNDATIONS OF HIGH ASSURANCE COMPUTING**

**55-19-04 - ADVANCED NAVAL NETWORK SOLUTIONS**

**55-19-05 - FEDERATED, DISTRIBUTED COMPUTING/NETWORK INFRASTRUCTURE**

**56-19-01 - OPTICAL SCIENCES R&D**

**57-19-01 - INNOVATIVE ANTI-SHIP MISSILE - ELECTRONIC WARFARE SIMULATION TECHNOLOGY**

**57-19-02 - ELECTROMAGNETIC TECHNIQUES AND TECHNOLOGY RESEARCH AND DEVELOPMENT**

**57-19-03 - OFFBOARD COUNTERMEASURE TECHNIQUES AND TECHNOLOGY RESEARCH AND DEVELOPMENT**

**57-19-04 – ADVANCED MACHINE LEARNING METHODS FOR THE RADIO FREQUENCY SPECTRUM**

**57-19-05 - SHIPBOARD ELECTRONIC WARFARE**

**B. MATERIALS SCIENCE AND COMPONENT TECHNOLOGY DIRECTORATE CODE 6000**

**60-19-01 - HIGH PERFORMANCE COMPUTING ON MASSIVELY PARALLEL ARCHITECTURES**

**61-19-01 - POWER/ENERGY SOURCE MATERIALS AND SYSTEMS**

The Alternative Energy Section (Code 6113) of the Chemical Dynamics and Diagnostics Branch of the Naval Research Laboratory (NRL) is interested in receiving proposals for the improvement of power/energy sources for U.S. military missions, with a focus on electrochemical power systems such as batteries and fuel cells. Proposals will be considered for characterization tools for fuel cell and battery materials and approaches to improve the effectiveness of cell electrodes. Systems, systems analysis, or systems components for improving the weight and/or volume of a power/energy system are of interest, particularly for complete systems. Advanced fueling solutions and storage concepts for hydrogen and oxygen will be considered when applicable.

Address White Papers (WP) to PowerEnergyBAA@nrl.navy.mil. Allow one month before requesting confirmation of receipt of WP, if confirmation is desired. Substantive contact should not take place prior to evaluation of a WP by NRL. If necessary, NRL will initiate substantive contact.

**61-19-02 - CORROSION PROCESSES, CONTROL, MITIGATION, AND TECHNOLOGY**

The Naval Research Laboratory (NRL) is interested in receiving proposals for research and development in materials performance, environmental effects, corrosion processes, corrosion control and marine coatings technology. These efforts may include studies from basic corrosion mechanistic studies through

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applied technology and corrosion control initiatives. The areas of research and development activities of interest to NRL include, but are not limited to the following:

1) Develop computational modeling techniques for the development of predictive equations of state for materials, mechanistic prediction and prognostics, which could greatly reduce costs, techniques, methodology and processes for developing new materials with improved corrosion resistance and structural performance attributes. These may include fundamental composition modification, forming processes, treatments, processing and augmentation that permit optimization of properties, including corrosion resistance, cathodic protection requirements, reduction in localized effects, stress corrosion cracking resistance, reduced hydrogen embrittlement, etc.

2) Improved properties of materials, inhibitors, surface modification and passivation, property enhancement related to materials physical property improvements, improved galvanic compatibility, minimize microbial influenced corrosion (MIC), electrochemical enhancement, plating, hardening, carburization and low temperature carburization, surface coatings, welding techniques, annealing, reduced susceptibility to stress corrosion cracking and hydrogen effects, novel methods for metal extraction, ionic liquids, rapid prototyping methods, oxidation/reduction effects. Materials efforts may contribute toward Navy vessels and may include but are not limited to: steels, HSLA steels, stainless steels, nickel alloys, aluminum alloys, titanium, copper/bronze, magnesium alloys, composites, polymers, anode materials, and novel materials, such as nano-based, amorphous, implanted, flame/plasma spray, novel microstructure and unique technology.

3) Design of marine coatings technology that contribute to improved corrosion performance, new resin/formulation properties, coatings durability, reduced total life cycle cost, dual-use, improved inspection capability, reduced/marginal surface preparation requirements, advanced application technology, rapid cure/single coat cure, self-inspecting, radar adsorption, acoustic damping, improved special hull treatment/mold in place, antifoulant technology, cavitation/erosion resistance, reduced maintenance and condition based maintenance (CBM). These efforts may pertain to all ship and submarine platform technologies and includes applications for aircraft, remotely operated vehicles, autonomous vehicles, Marine Corps vehicles, component parts and developing technology.

4) Development of: sensor technology, corrosion control systems, cathodic protection technology, electrochemical techniques, integrated components, biological materials, novel electronic circuits, smart materials and structures, dual-use systems, control algorithms, computational techniques, physical scale modeling, devices, components, bioremediation techniques, chlorination/dechlorination methods/equipment, descaling/fouling removal applications, electrical isolation, improved grounding, power systems, fuel cell technology, catalysts, membrane technology, materials extraction, novel manufacturing processes – including interstitial hardening and other surface modification processes that improve the corrosion resistance of materials, diamond materials, surface enhancements/detection methods, improved concrete processes/durability, and diver safety technology.

5) Development of materials, coatings, devices, components, product and systems that address

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crucial Naval and DoD requirements for corrosion prevention, control, remediation, maintenance, life-cycle extension, cost reduction, platform sustainment, sea basing, technical insertion, advanced ship design, propulsion systems, equipment design/specification, system engineering and unique naval applications.

Address White Papers (WP) to 6130BAA@nrl.navy.mil. Allow one month before requesting confirmation of receipt of WP, if confirmation is desired. Substantive contact should not take place prior to evaluation of a WP by NRL. If necessary, NRL will initiate substantive contact.

**61-19-03 - DEVELOPMENT OF MICROSENSORS AND MICROSYSTEMS FOR PHYSICAL, CHEMICAL, AND BIOCHEMICAL APPLICATIONS**

The Naval Research Laboratory (NRL) is interested in receiving proposals for research and development of new microsensors and microsystems to detect a variety of physical phenomena and chemical and biochemical species. The Surface Nanoscience and Sensor Technology Section of the Chemistry Division addresses a variety of DoD problems, from drug analysis to chemical and biological threat agent detection. NRL is interested in receiving proposals related to the development of new microsensors and microsystems for the following applications: (1) measuring physical phenomena such as magnetic and electric fields, pressure, electromagnetic radiation, temperature, humidity, and other meteorological parameters; (2) detecting chemical species with high sensitivity and specificity; and (3) detecting biochemical species with high sensitivity and specificity.

Address White Papers to 6170BAA@nrl.navy.mil. Allow one month before requesting confirmation of receipt of White Paper, if confirmation is desired. Substantive contact should not take place prior to evaluation of a White Paper by NRL. If necessary, NRL will initiate substantive contact.

**61-19-04 - APPLICATIONS OF MOLECULAR BIOLOGY, BIOCHEMISTRY, ANALYTICAL CHEMISTRY AND ADVANCED LASER TECHNIQUES**

The Naval Research Laboratory (NRL) Chemistry Division conducts research in a number of areas related to detection of biological, chemical and other hazardous materials or conditions. In addition, the Division conducts research in developing tools and methods to transfer, preserve and characterize and optimize the performance of chemical and biological based materials.

Areas of primary interest include:

1) Characterization of environmental processes and their application to remediation and restoration technologies;

2) Detection, sampling and characterization of chemical and biological agents, toxic metal ions and explosives;

3) Unique analytical chemistry tools for more efficient and cost effective sample processing;

4) Genetic- and molecular biological-based tools; (4a) techniques for the preservation and characterization of cells, tissue and biomaterials; (4b) methods for printing environmental biological and chemical material;

5) Improved and alternative fuel sources that include hydrogen fuel cells, solid oxide fuel cells and

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microbial fuel cells;

6) Atmospheric propagation of femtosecond pulses;

7) Electromagnetic induction sensors and analysis for detection and classification of unexploded ordinance;

8) Advanced laser and optical techniques, including novel plasmonic systems, optical diagnostics, remote sensing, and materials-based optical signatures;

9) Microfluidic structures with application to microchip separations, sampling, detection and pumping;

10)Chemometrics;

11)Volume sensing through image analysis and machine vision; 12) Reactive multi-functional coatings;

12)High throughput culturing of unculturable and/or environmentally derived microorganisms;

13) Lithium ion battery safety diagnostics; and

14)Advanced power system analysis and optimization

Key words describing these research interests include, but are not limited to: chemical sensors, biosensors, biosurfactants, gene probe technology, biofilms, freeze-drying, lyophilization, cryopreservation, contaminated sediments, corrosion and biofouling, remote sensing, methane hydrates, carbon cycling, laser pressure, optical techniques, biocollector, MTADS, capillary electrophoresis, microchip, laboratory-on-a-chip microfabrication, microfluidics, video-based detection, machine vision, workspace monitoring, damage control, multivariate analysis, mobility fuels, thermal stability, antioxidants, and metal catalysis. NRL is interested in receiving proposals which address innovative technologies or fundamental approaches related to these research areas.

Address White Papers to code6110@nrl.navy.mil. Allow one month before requesting confirmation of receipt of White Paper, if confirmation is desired. Substantive contact should not take place prior to evaluation of a White Paper by NRL. If necessary, NRL will initiate substantive contact.

**61-19-05 - MULTIECHELON DIAGNOSTICS (MEDx) TECHNOLOGY DEVELOPMENT AND TIERED EVALUATION**

Recent advances in diagnostic technologies are blurring the standard definitions of Echelons of Care *[see below for definitions]*. As smaller, faster, more sensitive, and easier to perform become superlatives of emerging technologies, those technologies may now be applicable to more than one Echelon of Care. For example, complex genomic analysis for alleles, SNPs, or other unique genomic markers may have started out as an Echelon 4 activity, but can now be performed on a portable thermocycler device that has the operational characteristics to be successfully deployed at Echelons 1 or 2. Therefore, the community has never been more empowered to introduce new technologies across the battlespace, specifically the same technology with multiple concepts of operation.

The Naval Research Laboratory (NRL) is seeking Research & Development partners to advance technology developed for *in vitro* diagnostic devices that are amenable to military hardening and integration with communication capabilities to support the medical diagnostic and epidemiological detection and biosurveillance needs of the US military across multiple Echelons of Care and specifically for field deployment at Echelons 1 or 2.

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**Desired Design and Performance Capabilities:** The Government is interested in proposals offering innovative, high functioning approaches for *in vitro* diagnostic devices that can operate at Echelon 1; however, superlative diagnostic technologies that operate at Echelon 2 will be considered. Offered technologies must be mature enough to enter into the Tiered Evaluation Model described in a later section of this call.

Proposals for both genomic and immuno-analysis technologies are sought. Desired performance capabilities for the two use cases are:

**Genomic Analysis Platforms**: Devices capable of detecting specific nucleic acid targets and/or examining molecular sequences at clinically relevant concentrations in complex clinical sample matrices, to include whole blood, serum/plasma, urine, and nasal swabs. An integrated or very simple method to nucleic acid sample preparation/purification is needed to operate without any complex external sample manipulation. Specifically DNA and/or RNA pathogen genomic signatures and/or host response biomarker targets must be measured, to provide positive identification of the causative agent of illness on a hand-held or man portable diagnostics system. Analysis should be multiplexed (minimum of four; preferred more than 5, including internal positive controls. Sample adequacy/processing controls and negative template controls are also encouraged) to provide a syndromic approach to disease identification; including sub-typing for diseases as appropriate (*e.g.,* dengue virus serotypes 1, 2, 3, and 4, phylogenetic differentiation of Ebola strains, et cetera).

**High Performance Non-Nucleic Acid Analysis Platforms**: Devices capable of identification of affinity ligand binding antigen capture (*e.g.,* immunoassay target platforms that promote identification of the causative agent of illness. Analysis should be multiplexed (minimum of three, preferred more than 4) to provide a syndromic approach to disease identification; including sub-classification for diseases as appropriate. Assays for immunological targets that indicate acute infections are preferred, particularly for deployment in endemic areas.

**In either use case, the Device and Assay must have the following characteristics**: The device must be a low-complexity diagnostic device usable by personnel following minimal training. A total sample to answer timeframe of one hour or less is preferred. The final technology package should be for use in field forward, often austere environments with limited resources. Important assumptions for these environments include that they have no surgical and limited patient holding capability, are manned by a Physician, Physician Assistant (PA), or Medic, with the mission of providing triage, and treatment to return military personnel to duty, or stabilizing them for evacuation to the next level care facility. The device must have communications ability or can be easily integrated with a communication capability. The base requirement is that the communication of the resulting analytical data is possible via electronic means (*e.g.,* text message, email, image, PDF, et cetera). The device should have battery capability that assures no disruption in assay completion should field conditions change abruptly. Full battery operation with periodic battery charging is preferred. It is not required that the device is handheld, but the physical parameters of weight and footprint will be evaluated.

Devices should demonstrate sufficient analytical sensitivity, specificity and total (positive and negative) predictive value for infectious disease diagnostic applications. The Devices and Assays should be designed to diagnosis diseases whose origin is an infectious agent, pathogen, or toxin (organized as panels by syndromic presentation or pathogen class), and/or biomarkers of exposure to said agents. Analytes of interest include both pathogen and host-related exposure class-differential diagnostic

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markers. The ability to differentiate between pathogens that cause non-specific febrile systemic disease that needs to be differentially ruled in (and preferably ruled out) such as Malaria (specifically *P. falciparum*), Arboviral diseases (e.g. dengue, chikungunya, etc.), Typhoid, Arenaviral diseases, Rickettsial diseases, Viral hemorrhagic fevers (specifically Lassa fever and Ebola), Plague, Tularemia (*Francisella tularensis*), and melioidosis (*Burkholderia pseudomallei*) is desirable. The government is also highly interested in capabilities for the rapid analysis of Antimicrobial/Multi-drug resistance (AMR/MDR) sensitivity. Detection should be possible out of the appropriate sample matrix (*e.g.,* whole blood, serum, urine, saliva) with sample collection occurring at similar environmental conditions to the device operation. Sample preparation should be minimal or preferably automated. It is not a requirement that the device technology fulfilling the requirements outlined above be specifically designed for these pathogens/diseases, but the technology must be easily adaptable to such pathogens/diseases. A full use scenario from sample collection, through sample preparation, to answer must be offered with preference given to fully automated and user-friendly solutions.

NRL will work cooperatively with the Offeror to test and verify performance of the devices and to assist in the integration of the diagnostic devices with communication and device hardening for Echelon 1 application. The offeror must demonstrate manufacturing capability, or partnerships for manufacturing, that assure prototype Devices and Assays will be available for field deployment and testing at the end of the performance period.

Any potential International Traffic in Arms Regulations (ITAR) restrictions, including any anticipated restrictions likely to be generated by the proposed work plan, must be listed.

**Tiered evaluation model:** It is anticipated that the MEDx program will provide up to two years of funding for research and development through competitive prototyping. The timeline will be divided into three Tiers. The first Tier will be no more than 5 months and include time for NRL to independently benchmark the performance of the offerors technology with the current assay that best matches the stated diagnostic needs; note that not every need must be met by the technology at the time of proposal, but a clear path towards meeting those needs within the overall span of the program options must be described. Technologies of sufficient merit will be advanced to an optional second Tier that engages the offeror in research and development of the technology to meet all needs outlined with a performance period up to 12 months. Following the performance period, the developed technology will be again be independently benchmarked by NRL. Finally, an optional third Tier of 3-9 months can be activated for the field deployment of the developed technology. The offeror will need to manufacture enough devices to supply the field study. Exact number of devices will depend on the offered technology, but anticipated requirements are for 500-5000 devices. These three Tiers include device development, testing and demonstration, evaluation, reporting, and selection activities. Selection of device candidates to be advanced into Tier 2 and Tier 3 will be based on specific parameters and metrics being successfully met in demonstration exercises. The government shall provide technical data and support for demonstrations, as well as facilitate interaction with relevant DoD and Interagency stakeholders.

Address White Papers (WP) to medx@nrl.navy.mil . Allow one month before requesting confirmation of receipt of WP, if confirmation is desired. Substantive contact should not take place prior to evaluation of a White Paper by NRL. If necessary, NRL will initiate substantive contact.

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**61-19-05 Supplemental Information:** Echelons of Care Definitions taken from:

Cubano, M.A,; Lenhart, M.K. *Emergency War Surgery*; US Army, Office of the Surgeon General; eBook; 2014; pp 410; ISBN: 016092197X.

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**63-19-01 - MATERIALS PERFORMANCE, PROCESSING, AND MODELING**

The Materials Science & Technology Division (MSTD) of the Naval Research Laboratory (NRL) is interested in receiving proposals for research and development in materials, their joining, and their processing, including modeling of materials performance and joining and forming processes to achieve cost- effectiveness. The areas of research and development activities of interest to NRL include, but are not limited to the following:

1) Modeling - Microstructural/continuum modeling for the development of predictive equations of state for materials which could greatly reduce costs of developing new alloys and forming processes as well as permit optimization of properties and plant weldable aluminum and iron alloys of high strength, toughness, stress corrosion cracking resistance, reduced hydrogen embrittlement, etc.

2) Forming/Machining - Forming and machining of hard-to-form and/or machine alloys by the application of high fields. This may include the application, singly or in combination, of electric, magnetic, ultrasonic, and microwave fields and address the casting and/or forming to near-net-shape by rolling, drawing, or forging and the machining by point cutting or grinding of any low ductility materials such as tungsten alloys, aluminides, etc.

3) Processes for Lower Life Cycle Costs/Simulations - Design of manufacturing processes that achieve desired product attributes at lowest total life cycle cost. This may include the integration of several unit forming processes and the simulation of such processes to account for geometric effects and the effects of evolving material microstructure and temperature and stress fields. Total life cycle spans issues from the initial material synthesis to the final disposition of components including all costs of acquisition and ownership.

4) Smart Materials - Demonstrate the application of "smart materials and structures" (SM&S), in military and dual-use systems. Generically, SM&S should have the capability to sense environmental stimuli, process the acquired data, and actively respond in a controlled manner to achieve a desired goal. This includes a wide range of materials (e.g., shape memory alloys, electrostrictive ceramics, ionic/conductive polymers, and polymer fibers and films, etc.), control algorithms and signal processors, and their assembly into devices that can be made to perform battle-related actions robotically (e.g., swim, fly, walk, etc.).

5) Superconductivity - Development of superconducting materials, devices, components, and systems that address crucial Naval and DoD requirements. Although the principal area of interest is in superconductors with transition temperatures above 30K, unusually sound proposals for research and development devices, components, and circuits fabricated from materials with superconducting transition temperatures below 30K will be considered if deemed suitable for potential Naval applications.

Address White Papers (WP) to Code 6300, by email to mstdbaa@nrl.navy.mil. Allow one month before requesting confirmation of receipt of WP, if confirmation is desired. Substantive contact should not take place prior to evaluation of a WP by NRL. If necessary, NRL will initiate substantive contact.

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**67-19-01 - BASIC AND APPLIED RESEARCH IN HIGH TEMPERATURE PLASMAS**

The Naval Research Laboratory (NRL) is interested in receiving proposals that address basic and applied experimental, theoretical and computational research to advance fundamental knowledge in high temperature plasmas.

Specific areas of interest include:

1) Theoretical and experimental studies of krypton-fluoride and argon-fluoride laser systems, both single pulse and repetitively pulsed, includes pulsed power, optics and electron beam generation, propagation and transport. Study of laser-matter interactions and strongly-coupled plasmas for conditions relevant to direct drive laser fusion. Theory and experimental studies of laser-plasma instability at high intensity that are relevant to laser fusion.

2) High energy pulsed power systems employing capacitive and inductive energy storage. Production of pulsed plasma and intense high-power, charged particle beams including single pulse and high average (rep-rated) power systems. Modeling and simulation of pulsed power devices and applications. Pulsed-power-driven radiation and acoustic shock generation sources. Primary energy storage and thermal management for pulsed power systems.

3) Theoretical and large-scale computational modeling of ionospheric, magnetospheric, solar and space plasmas.

4) Theoretical studies and computer simulations of nonlinear dynamic phenomena and novel nonlinear algorithms for use in applications such as nonlinear time series analysis, analysis of complex data sets, study of adaptive networks, analysis and control of coupled systems, and emergent structures in stochastic dynamics.

5) Theoretical and experimental research in the areas of coherent radiation sources, systems, and propagation, including microwave and millimeter-wave sources, high energy lasers, ultrashort pulse lasers, and free-electron lasers. Theoretical and experimental research in beam transport, intense laser-plasma interactions, laser-plasma accelerators, and intense laser-electron beam interactions.

6) Diagnostic and data handling/analysis techniques applicable to pulsed or dc measurements for remote sensing and laser-matter interactions, including real time diagnostics and post-interaction analysis.

7) Theoretical and experimental research into the production of plasmas in neutral gas backgrounds using RF excitation, plasma discharges, beam ionization, or other techniques. Development, testing, and analysis of advanced plasma diagnostics for partially ionized gas distributions. Investigations of the interaction of plasmas with gas distributions, surfaces, or coatings on surfaces. Development or utilization of specialized diagnostics to analyze plasma effects. Analysis of experimental results and comparison with theoretical predictions.

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8) Theoretical and experimental research on microwave, millimeter-wave, low temperature plasma or pulsed electron beam processing or synthesis of materials, including ceramics, metals, liquids, or gas mixtures.

9) Experimental research in high-velocity electromagnetic launchers. Design of launcher barrels and armatures. Diagnostics of launcher performance. Pulsed power systems for electromagnetic launch. Novel applications of electromagnetic launchers, including laboratory studies of shock generation in materials.

10) Theoretical and experimental research on high-energy-density plasma (HEDP) physics, including atomic processes and advanced plasma diagnostics. Physics and simulation of high-energy-density plasmas produced by electron beams, lasers, or Z-pinches. Computational tools to understand the coupling of ionization, radiation transport, and plasma dynamics in HEDP environments.

11)Development of novel and robust detection systems suitable for high-power pulsed environments, consisting of temporally-, spatially-, and/or spectrally-resolved detectors for x-ray, high-energy gamma, or neutron (both fast and thermal) emissions and mode-differentiating data acquisition electronics.

12) Theoretical and experimental research on the generation and diagnosis of space plasmas. Developmental research of advanced plasma diagnostics for space plasmas using ground-based simulation chambers or space-based platforms. Integration of advanced diagnostics into space platforms. Interfacing of experimental hardware with space craft. Acquisition of data, analysis, and comparison with theoretical models or other data.

Address White Papers (WP) to nrl6701@nrl.navy.mil. Allow one month before requesting confirmation of receipt of WP, if confirmation is desired. Substantive contact should not take place prior to evaluation of a WP by NRL. If necessary, NRL will initiate substantive contact.

**68-19-01 – RF VACUUM ELECTRONICS**

The Electromagnetics Technology Branch of the Naval Research Laboratory (NRL) is seeking proposals for innovative technology base development in the broad area of vacuum electronics. Areas of interest include, but are not limited to: (1) advanced high power microwave and millimeter-wave amplifiers and oscillators suitable for applications in radar, electronic warfare, high data rate communications, imaging, remote sensing, and directed energy warfare; (2) microwave or millimeter-wave power modules (MPM) consisting of a solid-state driver, a vacuum electronics power booster, and integrated power conditioning; (3) manufacturing technologies and techniques to enable the high yield fabrication of precision vacuum electronic components and assemblies suitable for operation above 20 GHz while reducing life cycle costs and improving overall device reliability; (4) theory and design tool development to support an advanced computational environment for the computer-aided design of vacuum electronic devices operating from microwave to terahertz frequencies; (5) supporting technology to advance RF vacuum electronics; (6) advanced emitter technology; and (7) amplifiers or oscillators driven by spatially-distributed electron beams . Each area is briefly described below:

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1) High power microwave, millimeter-wave, and sub-millimeter-wave amplifiers and oscillators. The overall goal of this program area is to develop the technology base required for advanced high performance microwave, millimeter-wave, and sub-millimeter-wave amplifiers suitable for radar, communications, electronic warfare, imaging, remote sensing applications, and directed energy warfare. Proposals are encouraged detailing device concepts relating to the development of compact, efficient vacuum electronic amplifiers operating in the microwave (1-30 GHz), millimeter-wave (30-300 GHz) and sub-millimeter-wave (300 GHz – 1 THz) bands, with peak power levels ranging from milliwatts to megawatts, and average power levels of milliwatts to tens of kilowatts or higher, depending on the operating frequency and application. Amplifiers should be capable of operation with instantaneous fractional bandwidths of 1% to 20% or higher. Topics of interest include, but are not limited to innovative high power device concepts using both slow-wave and fast-wave approaches and advanced high-power electron optics and component technology.

2) Microwave and millimeter-wave power modules, consisting of a solid-state driver, a vacuum electronics power booster, and integrated power conditioning, will find applications in many military and civil systems, including electronic decoys, phased arrays, and high-data-rate communications. Proposals are encouraged under this solicitation that address topics such as (a) improved magnetics to provide high-quality high-perveance electron beams within module cross-section and weight constraints; (b) improved beam-wave interactions and depressed-collector designs to enhance power booster efficiencies; (c) innovative waste heat removal designs for a dimensionally-constrained MPM; (d) improved solid-state amplifier performance at high junction temperatures; (e) novel power conditioning schemes to provide spectral purity for radar applications; (f) development of low-loss passive components and devices to minimize overall system losses; (g) improved power conditioning components such as high voltage diodes and capacitors suitable for high-density power conversion; (h) three-dimensional fully-electromagnetic computer modeling; (i) innovative approaches to developing MPM architectures leading to low unit acquisition costs; and (j) innovative power extraction schemes capable of providing small cross-sectional power modules for m x n array applications.

3) The advanced manufacturing technology program area includes but is not limited to the development of innovative fabrication techniques such as microfabrication, 3D printing, and other additive manufacturing concepts that can improve the performance and fabrication yield of vacuum electronic devices, particularly in the millimeter-wave to sub-millimeter-wave operating regimes. This program area also seeks innovative concepts for fabrication in which critical design elements are identified and novel solutions are offered in order to minimize cost, supported with manufacturing analysis as evidence. DoD microwave power tube procurements have traditionally been low volume runs of limited duration; production of power tubes for certain high-volume applications, such as decoys, is currently too costly. Proposals detailing concepts consistent with these area objectives that are aimed at decoupling unit cost from production volume are encouraged under this solicitation.

4) The physics-based computer-aided design (CAD) program area is focused on the development of advanced theory, design, and simulation capabilities related to vacuum electronic devices. This task seeks the development of accurate physics-based models that can be implemented in computationally-efficient algorithms and integrated into state-of-the-art computational design

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codes. The numerical tools should address electromagnetic, electron beam–electromagnetic wave interaction, and thermal and mechanical issues associated with vacuum electronic devices. The development of both general electromagnetic and device-specific vacuum electronic computational tools is sought. The design tools can use steady state or time-dependent models focusing on one-dimensional, two-dimensional or three-dimensional aspects of the problem. In concert, within the design methodology framework, the design tools should be capable of optimizing the performance of the device by maximizing, for example, the efficiency, gain, linearity, and bandwidth and minimizing the noise. Code validation through comparison with experiment and/or the predictions of other computational tools is desired. Theory and computational tools to study the propagation of electromagnetic waves in free space and to investigate the interaction of electromagnetic fields with other materials and/or three-dimensional structures are also of interest.

5) The supporting technology program area encompasses the development of materials and technologies that can potentially benefit broad classes of vacuum power amplifiers and oscillators. Proposals that detail innovations and breakthroughs in any one of a variety of technical areas in this context are encouraged. Technical areas include, but are not limited to: (a) innovative cooling techniques for both vacuum and solid state devices; (b) innovative materials research for vacuum power devices, including mechanical and electromagnetic characterization, modeling, and development of materials, such as high thermal conductivity insulators, BeO replacement materials, and materials with tailored electromagnetic losses; (c) metamaterials; (d) passive components such as filters, combiners, quasi-optical components, isolators, circulators, and control components such as phase shifters; (e) novel compact sources to provide power and power conditioning for vacuum electronic devices; and (f) mass- and volume-efficient magnetic materials and magnetic structures to support compact, fieldable systems.

6) The advanced emitter technology program area covers both established and evolving electron sources relevant to RF vacuum electronic devices. In most cases high current density, long lifetime, and superior robustness are desired. In specific situations cathodes compatible with insertion into meso-scale and micro-scale electron devices are required. Cathodes suitable for multiple beam and sheet beam devices are of particular interest. Proposals include but are not limited to the following areas: (a) thermionic sources including improved work function-reducing mechanisms allowing longer lifetime and improved uniformity; (b) field emitter arrays including means of regulating the emission at individual sites, means of scaling the total emission current with area, and having moderate to high current density; (c) explosive emission cathodes; (d) plasma cathodes and beam-plasma interaction; (e) semiconductor materials having properties suitable for creating sources requiring low or negative electron affinity; (f) materials and systems required for photoemitters; (g) cathodes and secondary emitter materials; (h) improved collector design and materials, including methods to suppress secondary electron emission; and (i) related theory and computational modeling. Proposals that detail breakthroughs and innovations in the materials development and/or cathode design in any of the above areas are encouraged.

7) Amplifiers driven by spatially-distributed electron beams. The overall goal of this activity is to develop the technology base required for spatially-distributed electron beam high-performance amplifiers suitable for DON/DoD applications. Proposals detailing device concepts relating to

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the development of compact, lightweight, low noise, efficient vacuum electronic amplifiers operating in the range of frequencies from 1 GHz to 1 terahertz at peak power levels from milliwatts to hundreds of kilowatts, and average power levels of milliwatts to tens of kilowatts. Devices should be capable of operation with fractional instantaneous bandwidths of 1% to 20% or higher. Topics of interest include, but are not limited to, (a) innovative high power device concepts; (b) advanced high-power electron optics for the electron guns and/or multistage depressed collectors; (c) innovative high current density cathodes for long life; (d) design methodology for low manufacturing cost; (e) multi-stage depressed collector design; and (f) novel concepts for electron beam confinement and transport.

Address White Papers (WP) to VE\_NRL\_BAA@nrl.navy.mil. Allow one month before requesting confirmation of receipt of WP, if confirmation is desired. Substantive contact should not take place prior to evaluation of a WP by NRL. If necessary, NRL will initiate substantive contact.

**68-19-02 - RADIATION EFFECTS RESEARCH**

The Solid State Devices Branch of the Electronics Science and Technology Division of the Naval Research Laboratory (NRL) is interested in receiving proposals to investigate the effects of radiation on advanced solid state devices, developing methods to mitigate these effects, and detecting radiation. The radiation of interest includes the natural radiation environment of space (trapped particles, cosmic ray ions, solar protons, etc.) and non-natural sources (gamma rays, neutrons, pulses of energy, etc.). The effects include total dose and displacement damage and single event effects including upset, latchup, gate rupture, etc. The devices of interest include, but are not limited to, advanced technology memory devices, gate arrays, microprocessors, imagers, solar arrays and energy storage devices such as batteries. Mitigation effects include hardening by processing or design or shielding techniques especially using novel and innovative ideas not previously investigated.

Address White Papers (WP) to nrl\_pv\_research@nrl.navy.mil. Allow one month before requesting confirmation of receipt of WP, if confirmation is desired. Substantive contact should not take place prior to evaluation of a WP by NRL. If necessary, NRL will initiate substantive contact.

**68-19-03 - PHOTOVOLTAICS FOR PORTABLE POWER**

The Optoelectronics and Radiation Effects Branch of the Electronics Science and Technology Division of the Naval Research Laboratory (NRL) is interested in receiving proposals to investigate photovoltaic (PV) technologies that enable portable power sources. These power sources are intended for man-portable applications as wells as powering unattended, remote systems. PV devices that provide high photon to electric conversion efficiency and can be produced on flexible substrates are of particular interest for forming flexible PV blankets. PV devices that can be directly integrated into a system for remote powering are also of interest. Proposals ranging from basic device development to system demonstration are encouraged.

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Address White Papers (WP) to nrl\_pv\_research@nrl.navy.mil. Allow one month before requesting confirmation of receipt of WP, if confirmation is desired. Substantive contact should not take place prior to evaluation of a WP by NRL. If necessary, NRL will initiate substantive contact.

**68-19-04 - ANALOG AND MIXED SIGNAL INTEGRATED CIRCUIT DESIGN AND CHARACTERIZATION**

The Electromagnetics Technology Branch of the Naval Research Laboratory (NRL) is seeking proposals for innovative technology base development in the broad area of analog and mixed signal integrated circuit design and characterization. The circuits may operate in the 0.3-300 GHz range and specifically designed to process signals with either fixed or variable bandwidths, known or unknown modulation. The areas of interest include but are not limited to novel and innovative design and characterization of:

1) highly linear, broad band system on chip transceivers;

2) on-chip subsystems including but not limited to integrated antennas, integrated passive components, low noise amplifiers, mixers, filters, phase locked loops, voltage control oscillators, analog-to-digital and digital-to-analog converters, bias circuits;

3) power amplifier topologies that can address needs for high power, high linearity and high efficiency under defined or undefined signal drives;

4) low noise amplifier topologies and techniques that can substantially enhance the overall noise capabilities of a system within a wide range of operating temperatures;

5) heterogeneous integration of diverse semiconductors technologies and multi-chip modules;

6) boards able to interface a novel or existing integrated circuit in the frequency range of interest to external circuits for further signal processing.

Address White Papers (WP) to baa681305@nrl.navy.mil. If confirmation of request is desired, please allow one month before submitting your request. Substantive contact should not take place prior to evaluation of a WP by NRL. If necessary, NRL will initiate contact.

**69-19-01 - RESEARCH IN BIO/MOLECULAR SCIENCE AND ENGINEERING**

The Center for Bio-Molecular Science and Engineering of the Naval Research Laboratory (NRL) conducts multidisciplinary research in biotechnology using the techniques of modern molecular biology, microbiology, synthetic biology, biophysics, chemistry, microelectronics, and engineering to fabricate biosensors/sensors, biomaterials, and advanced systems. Current research areas include:

1) Biophysical chemistry of membranes, proteins, DNA, and RNA.

2) Research into biosensors/sensors including development, testing and evaluation of novel devices, accessories for automated reagent delivery, production of biomolecular recognition elements or

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configuration of bioassays for integration into the sensor. Targets of detection include explosives, pollutants, pathogens, toxic agents, and hazardous chemicals in a variety of matrices.

3) Systems and synthetic biology, such as genomics, transcriptomics, proteomics, and metabolomics measurements of isolate microorganisms, microbiomes, and/or environmental consortia. Areas of specific interest include bioinformatics and database development for ‘-omics’ data analyses.

4) Synthesis, fabrication, and physical characterization of self-assembled thin films and surfaces for material development.

5) Microwave devices, ultramicroelectrodes and electron emitters based on metallized composites. Microwave materials based on nanodimension powders and metallized composites.

6) Self-assembly of microstructures for advanced materials and the assessment of potential applications including: controlled release, advanced composites for electronic, structural, and thermal applications, and environmental applications.

7) Fabrication and integration of microfluidic components for sample processing and analysis.

8) Design, development, and characterization of multifunctional, multilayered assemblies for advanced applications in the areas of environmental protection and general purpose detection, and in the development of non-conventional bioreactors for performing multistep chemistries in single operation.

9) Development of novel lithographic, patterning for fabrication or advanced biosensors processes for high resolution imaging, fabrication of advanced microelectronic or nanoelectronic devices, displays, biosensors, multilayers, or three dimensionally structured materials.

10) Advanced materials using liquid crystals and ordered polymers, relation between molecular structure and material properties, assessment of their properties for potential applications in the areas of real time holography, ferroelectric phenomena, high resolution display, pyroelectric sensors, and piezoelectric materials, electro-optic materials, non-linear optics, and optical wave guiding.

11) Bio-based energy harvesting and production for marine, underwater, and naval applications.

12) Development, testing, and evaluation of bioprotocols and subsequent bioinformatic analysis of detection and diagnostic platforms.

13) Natural marine adhesion for use in promoting or resisting adhesion.

The Center for Bio/molecular Science and Engineering Branch is interested in White Papers (WP) for research related to the above research interests.

Address White Papers (WP) to baa6900@nrl.navy.mil. Allow one month before requesting confirmation of receipt of WP, if confirmation is desired. Substantive contact should not take place prior to evaluation of a WP by NRL. If necessary, NRL will initiate substantive contact.

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**C. OCEAN AND ATMOSPHERIC SCIENCE AND TECHNOLOGY DIRECTORATE**

**CODE 7000**

**71-19-01 - ACOUSTIC SIMULATION, MEASUREMENTS AND TACTICS**

The Naval Research Laboratory (NRL) conducts broad-based research in ocean acoustics to better understand the effects of the ocean environment on underwater acoustics, and to assess and predict how these environmental effects will impact the performance of naval systems, operations, and missions. The "ocean environment" includes three-dimensional, time-evolving features such as rough air-sea interfaces, sub-surface bubbles and plumes, volume effects (e.g., internal waves, solitons, fluctuating media, biologics, pollutants, fronts, eddies), rough sea-floor interfaces, and ocean bottom and sub-bottom regions. "Underwater acoustics" includes all acoustic processes and interactions that can occur within the ocean environment (e.g., propagation, scatter, attenuation, dispersion, mode conversion, coherence, ambient noise and sediment penetration). "Naval systems, operations, and missions" include, but are not limited to, sonar systems, Anti-Submarine Warfare (ASW), Mine Counter Measures (MCM), warfare effectiveness, and strategy and tactics optimization. Numerical techniques and computer codes are developed as required to support the Navy's need for improved ocean acoustics models and data bases and to provide supporting analysis for operational and tactical application of computer models.

Current major areas of research interest include:

1) Acoustic Simulation and Modeling (e.g., theoretical formulations, computational acoustics, numerical modeling, inverse methods, stochastic methods, visualization, and scalable computer and supercomputer code development);

2) Warfare Effectiveness (i.e., research in advanced methods of assessing environmental impact on Naval missions and strategy optimization);

3) Mid to High-Frequency Acoustics efforts related to the effect of the environment on the performance of Navy sonar systems, including the effects of the medium coherence, bottom roughness, sediment composition, clutter and their effects on advanced imaging techniques;

4) Coastal Acoustics, as related to the application of sophisticated signal processing methodologies (e.g., matched field processing and high-order spectral techniques), to determine the limits and variability of harsh environments on the performance of Navy sonar systems; and,

5) Novel optimization, clustering, network techniques for acoustic applications.

6) Other research interests include:

7) The combination of acoustics with other sensing techniques, such as optics, magnetics, electromagnetics, hydrodynamics, geophysics and others for both ASW and MCM applications;

a. Acoustic environmental characterizations, data base modeling, and analysis of those aspects of the marine environment relevant to acoustic propagation; and

b. Coupled target-waveguide modeling and target recognition, classification, and discrimination.

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Proposals for evolutionary improvements are inappropriate under BAA authority and are not desired.

Address White Papers (WP) to Code7180BAA@nrlssc.navy.mil Allow one month before requesting confirmation of receipt of WP, if confirmation is desired. Substantive contact should not take place prior to evaluation of a WP by NRL. If necessary, NRL will initiate substantive contact.

**71-19-02 - ELASTO-ACOUSTIC (META) MATERIALS**

The Acoustic Signal Processing and Systems Branch of the Naval Research Laboratory conducts basic and applied research in concepts in acoustic materials and metamaterials with the goal of constructing novel devices for use in aqueous, air, and elastic environments. This work seeks to both understand and develop the underlying physics of acoustic and elastic solid wave propagation in engineered and/or patterned materials from the micro constituent level in order to accurately predict the physical properties and geometries of constituent components required to create a desired wave propagation behavior in the bulk material. The work naturally seeks to explore the fabrication of devices using new and exotic materials as possible constituents to provide control over the bulk elasto-acoustic properties of a given material. Additional work involves the study of phonons in nanoscale materials, as well as novel uses of MEMS devices.

Address White Papers (WP) to Code 7160, by email to NRL7160\_BAA@nrl.navy.mil. Allow one month before requesting confirmation of receipt of WP, if confirmation is desired. Substantive contact should not take place prior to evaluation of a WP by NRL. If necessary, NRL will initiate substantive contact.

**72-19-01 - LOW FREQUENCY RADIO INTERFEROMETRY**

The Remote Sensing Division of the Naval Research Laboratory is developing and deploying imaging HF/VHF radio interferometers for use in developing, demonstrating, and exploiting interferometric imaging through the ionosphere at low frequencies. NRL is interested in proposals for innovative basic and applied research leading to the development of new capabilities and applications for these instruments; the development of new techniques for wide-field interferometric imaging, ionospheric phase correction, or interference excision; or for other innovative science or technical development related to long wavelength radio interferometry.

Proposers may respond to one or more areas of interest or may propose clearly related investigations; however, each area requires an individual and complete proposal which will be separately evaluated.

Research may be conducted at the unclassified level and proposals must be unclassified.

Address White Papers (WP) to RemoteSensingBAA@nrl.navy.mil. Allow one month before requesting confirmation of receipt of WP, if confirmation is desired. Substantive contact should not take place prior to evaluation of a WP by NRL. If necessary, NRL will initiate substantive contact.

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**72-19-02 - OPTICAL REMOTE SENSING OF THE COASTAL REGIME**

The Remote Sensing Division of the Naval Research Laboratory (NRL) is developing methods and instrumentation for the remote sensing of coastal waters, near shore areas and adjacent lands, and other coastal regions by means of optical sensors working throughout the electromagnetic spectrum – both active and passive – and the algorithms associated with sensor data. NRL is interested in innovative proposals for basic and applied research which will lead to improved retrieval of environmental parameters be that from novel or improved instrumentation or algorithms. Additionally, the ability to model the performance of instruments and methods in various situations is desirable.

Proposers may respond to one or more areas of interest or may propose clearly related investigations; however, each area requires an individual and complete proposal which will be separately evaluated.

Address White Papers (WP) to RemoteSensingBAA@nrl.navy.mil. Allow one month before requesting confirmation of receipt of WP, if confirmation is desired. Substantive contact should not take place prior to evaluation of a WP by NRL. If necessary, NRL will initiate substantive contact.

**72-19-03 - REMOTE SENSORS AND IMAGING SYSTEMS**

The Remote Sensing Division conducts a program of basic research, science, and applications aimed at the development of new concepts for sensors and imaging systems for objects and targets on the Earth and in the near-Earth environment, as well as deep space. The research focuses on the discovery and understanding of the basic physical principles and mechanisms that give rise to the background environmental emission and targets of interest and to absorption and emission mechanisms of the intervening medium. The development effort includes active and passive sensor systems to be used for the study and analysis of the physical characteristics of phenomena that give rise to naturally occurring background radiation, such as that due to the Earth's atmosphere and oceans, as well as man-made or induced phenomena such as ship/submarine hydrographic effects. The research includes theoretical, laboratory, and field experiments leading to ground based, airborne and space systems for use in such areas as remote sensing, astrometry, astrophysics, surveillance, environment and improved operational support systems for the Navy. Areas of interest include all levels of the atmosphere (lower, middle, and upper) and space environment, air/sea interface and oceanography. Special emphasis is given to developing space-based sensors and improving the exploitation of existing space systems. Innovative research is desired in areas of interest including, but not limited to, the following:

1) The impact of the physics of atmosphere and ocean interaction on physical and biological sea surface characteristics, from the viewpoint of global surveillance systems.

2) Research attempting breakthrough advancements in imaging data compression methodology, scene classification, and coherent/non-coherent sensor exploitation.

3) Atmospheric gases and aerosol measurements. Research in this area is wide ranging: propagation effects, pollutant monitoring, global climate change, and cloud physics.

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4) Development of instruments, models, and retrieval algorithms for passive remote sensing of the oceans, atmosphere, and land.

Address White Papers (WP) RemoteSensingBAA@nrl.navy.mil. Allow one month before requesting confirmation of receipt of WP, if confirmation is desired. Substantive contact should not take place prior to evaluation of a WP by NRL. If necessary, NRL will initiate substantive contact.

**72-19-04 - AIRBORNE, SHIPBOARD, AND OVERHEAD DATA ACQUISITION AND ANALYSIS**

The Marine Physics Branch of the Naval Research Laboratory (NRL) is interested in receiving proposals for research and development in the areas of sensor technology, data acquisition, and data analysis in the field of fixed sensor, airborne and shipboard remote sensing.

The primary areas of interest are synthetic aperture radar, GPS navigation, multi- and hyper-spectral imaging, and radar/laser profilometry. The proposed research would address methods and techniques in data acquisition, analysis, and modeling for all of these sensors, with particular interest in ultra-wide-band SAR and hyperspectral sensors. The research may address issues in surveying and analysis of natural materials - i.e. sediment, water, snow and ice - surface and sub-surface layers, vegetation, including multi-layered canopies, as well as man-made object and materials property evaluation using all remote sensing modalities from the entire electro-magnetic spectrum range.

The research may involve new and innovative research in long-range kinematic differential GPS navigation with a goal of producing decimeter level positioning of aircraft for baseline lengths of up to 1,000 kilometers. The research may also involve new methods of acoustic and non-acoustic modeling combining the water column with bottom and sub-bottom acoustic and non-acoustic characteristics in both shallow and deep-water regions. The research may also address issues in seafloor sediment characterization using novel contact and non-contact methods and instruments as well as modeling of sediment behavior in the wide range of deformation and rates-of-deformation regimes – both in situ and in laboratory environments.

The Coastal and Ocean Remote Sensing Branch particularly desires proposals on innovative techniques for:

1) Real-time acquisition and storage of data at high rates from numerous sensor channels;

2) Real-time high-speed data analysis and display; and

3) Optimal combined processing of multi-sensor data.

Address White Papers (WP) to RemoteSensingBAA@nrl.navy.mil. Allow one month before requesting confirmation of receipt of WP, if confirmation is desired. Substantive contact should not take place prior to evaluation of a WP by NRL. If necessary, NRL will initiate substantive contact.

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**73-19-01 - OCEAN DYNAMICS AND PREDICTION OCEANOGRAPHY**

The Oceanography Division of the Naval Research Laboratory (NRL) is interested in proposals of basic and applied research in its mission areas of ocean dynamics and prediction, and of ocean feature and process analysis using remote and in situ data. Ocean dynamics and prediction includes basic and applied research in computer modeling of ocean hydro/thermodynamics (i.e., ocean circulation and density structure), modeling of ice dynamics, coupled ocean/acoustic, ocean/atmosphere, ocean/sediment, and ocean/biological model development, computational numerical techniques, visualization of ocean features and dynamical processes, data assimilation and the analysis of satellite oceanographic data as related to the development of modeling and data assimilation capabilities. Deep ocean basins, marginal and semi-enclosed seas, coastal regions harbors and rivers are of interest. Expanded ocean physics included in such systems and areas for future research and development include ocean tide and wave and surf modeling as well as upper ocean processes. Research in computational techniques includes the study of efficient solutions to partial differential equations arising in oceanography with a special focus on efficient utilization of massive parallel processing technology. Ocean feature and process analysis includes development of sensor systems that acquire the in-situ spatial and temporal properties of oceanographic environmental parameters including wave height, wave direction, currents, temperature, salinity, wind speed, and wind direction. Innovative ideas, trawl resistant designs, real-time data access, and covert operations are of high interest. Development of algorithms and techniques for processing remotely sensed ocean data, with special application to determining ocean features and properties from multispectral, hyperspectral, and optical data is of high interest. Application of ocean data and analysis to systems performance models for emerging and operational Navy sensors and systems is also of interest. The ocean nowcast/forecast and simulation systems have broad and direct application to issues related to Naval operations (ASW, Search & Rescue, Amphibious landing, Mine and Special Warfare, Mission Planning, etc.). These systems also are directly applicable to the simulation and design of global, regional and coastal observing systems.

Address White Papers (WP) to nrl7302@nrlssc.navy.mil. Allow one month before requesting confirmation of receipt of WP, if confirmation is desired. Substantive contact should not take place prior to evaluation of a WP by NRL. If necessary, NRL will initiate substantive contact.

**74-19-01 - SEAFLOOR SCIENCES**

The Naval Research Laboratory’s (NRL) Seafloor Sciences Branch conducts biogeochemical, geophysical, geoacoustic and geotechnical research of marine sediments, which advances the development, and/or performance of naval sensors and systems. Research conducted includes investigation and modeling of the fundamental micro to macro-structural processes which control sediment behavior and seafloor properties. This includes biological, geological, geochemical, historical, and subsequent diagenetic processes that control the distribution, range, and variability of sediment physical properties including bathymetry, roughness, and subseafloor morphology. NRL is responsible for developing, assessing, and improving models and databases for all seafloor properties of interest to the Navy and utilizes state-of-the-art laboratory, in situ, and remote sensing techniques.

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Address White Papers (WP) to BAACode7430@nrlssc.navy.mil. Allow one month before requesting confirmation of receipt of WP, if confirmation is desired. Substantive contact should not take place prior to evaluation of a WP by NRL. If necessary, NRL will initiate substantive contact.

**74-19-02 - GEOSPATIAL SCIENCES AND TECHNOLOGY**

The research focus is on development and exploitation of new technology and techniques to support all aspects of geospatial sciences and technology. Current research interest areas are:

1) Geospatial Enterprise Solutions. Web service approaches to service oriented architecture enterprise solutions that promote interoperability and leveraging of community-of-interest content and services for optimized inter agency solutions.

2) Automated Reasoning for Distributed Surveillance and Data Fusion. Approaches to allow advanced reasoning based on multiple, disparate sensor inputs.

3) Open Source Content Exploitation. Techniques to leverage and harness the rapidly expanding structured and unstructured content on open networks.

4) Uncertainty Management. Approaches to allow improved fusion of various sensors with accommodation for propagated uncertainty.

5) Precise Positioning. Techniques for more precisely positioning undersea sensors in the absence of GPS.

6) Acoustic Image Processing. Innovative approaches to exploit acoustic imagery given its complexities inherent in the ocean medium, especially in the area of feature detection and classification.

Address White Papers (WP) to NRL\_Geospatial\_BAA\_Technical\_POC@nrlssc.navy.mil. Allow one month before requesting confirmation of receipt of WP, if confirmation is desired. Substantive contact should not take place prior to evaluation of a WP by NRL. If necessary, NRL will initiate substantive contact.

**75-19-01 - ATMOSPHERIC EFFECTS, ANALYSIS, AND PREDICTION**

The Marine Meteorology Division of the Naval Research Laboratory (NRL) is interested in proposals for innovative basic and applied research in atmospheric sciences to increase our understanding of atmospheric processes and to advance the state-of-the-art in numerical analysis and prediction techniques, from short-term local-scales (microscale and mesoscale) to global-scale phenomena. Areas of active interest include numerical methods; parameterization and explicit prediction of physical processes; assimilation of remotely sensed and other non-conventional data including radar data and data collected by autonomous vehicles; dynamic initialization; variational assimilation and adjoint techniques; predictability, sensitivity, and targeted observation studies; ensemble data assimilation and prediction methods; data assimilation; middle-atmosphere prediction; tropical cyclone prediction; air-sea

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interaction; large eddy simulations; aerosol and cloud modeling and observations; urban and land surface parameterizations; coupled air-land-ocean-ice-hydrology-wave models; computationally efficient methods for environmental prediction on next-generation architectures; and stream processing and big data analytics for environmental information.

We are also interested in proposals that provide new and novel methods for providing environmental support directly to the warfighter especially using tactical through-the-sensor data. Areas of particular interest include exploitation of atmospheric information from observations and numerical models to derive tactical weather parameters (including the quality control of such information), and research that increases our knowledge of the effects of the atmospheric environment on ship and air platforms as well as on shipboard, airborne, and land-based communications, sensors and weapons systems. Examples of specific research topics include meteorological applications of remotely sensed and non-conventional data; satellite data interpretation and imagery analysis; atmospheric acoustic propagation prediction; tropical cyclone forecast aids; artificial intelligence techniques and expert system development; model post-processing techniques; nowcasting including combined model, satellite and radar data; weather impact on piloted aircraft and UAV operations; aerosol measurement, characterization, and electro-optical effects; ducting, refractivity, and electro-magnetic effects; and atmospheric dispersion of chemical and biological agents.

Address White Papers (WP) to baa@nrlmry.navy.mil. Allow one month before requesting confirmation of receipt of WP, if confirmation is desired. Substantive contact should not take place prior to evaluation of a WP by NRL. If necessary, NRL will initiate substantive contact.

**76-19-01 - RESEARCH INTO SPACE, BACKGROUNDS, IMAGING AND MODELING**

The Naval Research Laboratory (NRL) is interested in receiving proposals that address basic and applied experimental, theoretical and computational research to advance fundamental knowledge of high-energy space, heliospace, and geospace. The results are of importance to orbital tracking, radio communications, and navigation that affect the operation of ships and aircraft; utilization of the near-space and space environment of the earth; homeland defense; and, the fundamental understanding of natural radiation and geophysical phenomena.

The Space Science Division is interested in receiving proposals for research related to the above research interests.

Address White Papers (WP) to TPOC7600@nrl.navy.mil. Allow one month before requesting confirmation of receipt of WP, if confirmation is desired. Substantive contact should not take place prior to evaluation of a WP by NRL. If necessary, NRL will initiate substantive contact

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**D. NAVAL CENTER FOR SPACE TECHNOLOGY CODE 8000**

**81-19-01 - CYBER SECURE OPEN SOURCE INFORMATION AND ANALYTICS**

The Mission Development Branch of the Space Systems Development Department of the Naval Research Laboratory (NRL) conducts research and development in concepts and techniques for using service oriented system architectures that target technologies designed to increase the effectiveness of Open Source Intelligence (OSINT) information to meet U.S. Navy mission requirements. To provide maximum utility for the US Navy and Department of Defense (DoD), these systems are required to employ advanced cyber security features to limit access to the intended audience. The focus is on creating secure and efficient processes to collect information from available data sources and analyze collected data to produce actionable intelligence while limiting system complexity. The technologies may have utility within federal and state agencies outside of the DoD where open source information is used to monitor, identify, and respond to threats.

Address White Papers (WP) to 8110BAA@nrl.navy.mil. Allow one month before requesting confirmation of receipt of WP, if confirmation is desired. Substantive contact should not take place prior to evaluation of a WP by NRL. If necessary, NRL will initiate substantive contact.

**81-19-02 – OPTICAL CHANNEL TECHNOLOGIES**

The Advanced Systems Technology Branch of the Space Systems Development Department of the Naval Research Laboratory (NRL) conducts research and development in technologies and techniques that leverage the optical channel for communications and positioning, navigation, and timing. The focus is on modular system architectures, payload controllers, processors and signal processing, event timers, pointing/acquisition/tracking techniques, power efficient components and transceivers, compact gimbals and beam directors, compact optical systems, beam stabilization components and methods, novel atmospheric sensors and diagnostics, adaptive modems, and components and subsystems that enable communications and/or time and frequency transfer. Technology applications may include ground, maritime, airborne, and space. NRL’s Advanced Systems Technology Branch seeks a broad range of innovative techniques, subsystems, and tools to develop, integrate, and evaluate free space optical communications and optical time transfer systems.

The Advanced Systems Technology Branch is interested in receiving proposals for research related to the above research interests.

Address White Papers (WP) to 8120BAA@nrl.navy.mil. Allow one month before requesting confirmation of receipt of WP, if confirmation is desired. Substantive contact should not take place prior to evaluation of a WP by NRL. If necessary, NRL will initiate substantive contact.

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**82-19-01 - SPACECRAFT & SPACE SYSTEMS TECHNOLOGY**

The Spacecraft Engineering Department (SED) at the Naval Research Laboratory (NRL) performs research and development by applying advanced technologies and techniques to provide new space capabilities that address critical Navy, DoD, and national needs. The emphasis at the NRL’s SED is incubating critical technologies and assembling them into systems that provide relevant and often revolutionary new space capabilities. Past examples include first flight of solar cells, atomic precision clocks leading to the NAVSTAR Global Positioning System (GPS), and the first tactical downlink of space data and on-board processed products to Tactical Receive Equipment (TRE). Each of these systems radically improved operational capability and each was enabled by innovative, system application of new technologies. Therefore, NRL’s SED seeks a broad range of innovative space systems technologies included associated and enabling ground systems technologies.

NRL’s SED performs research and exploratory development in, but not limited to, the following areas: spacecraft payloads, spacecraft structures; spacecraft mechanisms; spacecraft guidance, navigation, and control; spacecraft robotics; spacecraft thermal control, spacecraft power systems, spacecraft propulsion systems, advanced materials for spaceflight use, on-orbit environment monitoring, ground and flight software, spacecraft electronics, spacecraft ground systems, integration and testing, operational user interfaces, and space integration into operational tiered systems. SED projects range from basic theory and component technology development to full space systems development and operations.

Address White Papers (WP) to code8200baa@nrl.navy.mil. Allow one month before requesting confirmation of receipt of WP, if confirmation is desired. Substantive contact should not take place prior to evaluation of a WP by NRL. If necessary, NRL will initiate substantive contact.