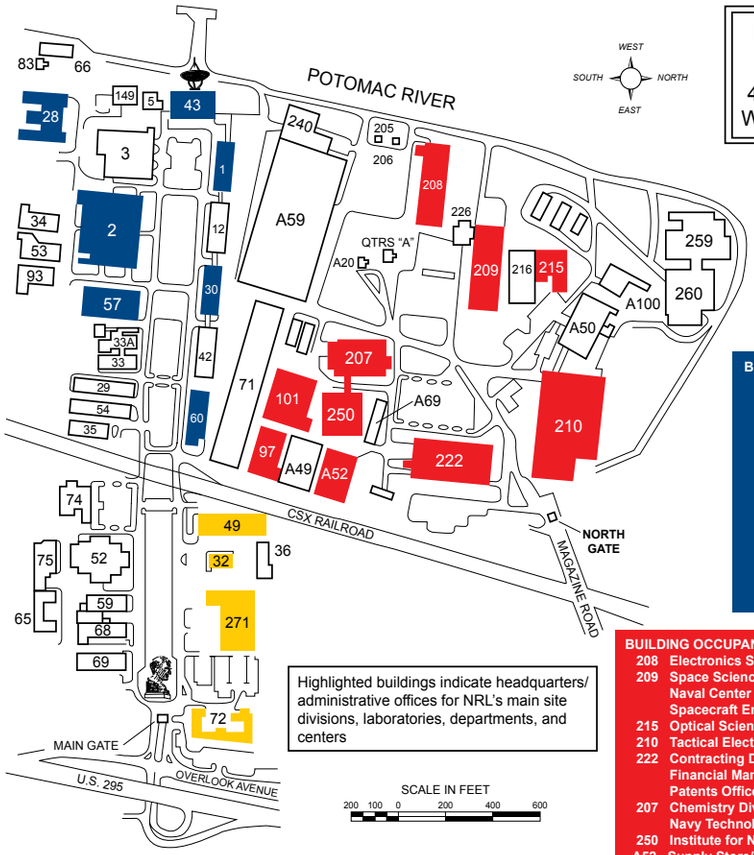


NAVAL RESEARCH LABORATORY

4555 Overlook Avenue, SW
Washington, DC 20375-5320

BUILDING OCCUPANTS
- 49/32 Supply and Information Services Division
- 72 Incoming Visitor Section
  Human Resources Office
- 271 Laboratory for Autonomous Systems Research

BUILDING OCCUPANTS
- 57 R&D Services Division
- 2 Acoustics Division
  Remote Sensing Division
- 28 Cafeteria
- 28 Materials Sci and Tech Division
- 43 Executive Directorate
  Command Support Division
  Management and Admin
  Head of Security
  Counsel/Legal
  Research Library
- 1 Information Technology Division
- 30 Center for Bio/Molecular Sci & Eng
- 60 Radar Division

BUILDING OCCUPANTS
- 208 Electronics Science and Technology Division
- 209 Space Science Division
  Naval Center for Space Technology
  Spacecraft Eng Dept/Space System Dev Dept
- 215 Optical Sciences Division
- 210 Tactical Electronic Warfare Division
- 222 Contracting Division
  Financial Management Division
  Patents Office
- 207 Chemistry Division
  Navy Technology Center for Safety & Survivability
- 250 Institute for Nanoscience
- A52 Supply Store/Technical Information Services Branch
- 101 Plasma Physics Division
- 97 Lab for Computational Physics & Fluid Dynamics

Highlighted buildings indicate headquarters/ administrative offices for NRL's main site divisions, laboratories, departments, and centers

The following publications are available from the Technical Information Services Branch, Code 3430, (202) 404-4963, and online at www.nrl.navy.mil/media/publications.

- The *NRL Fact Book* provides details about the Laboratory and its operations.
- The *NRL Review* presents annual highlights of the unclassified research and development programs.
- *NRL Major Facilities* describes the major laboratories and equipment in each research division.
- *SPECTRA* magazine highlights current research and news at the Laboratory.

Information on CRADAs and licensing of NRL-developed technology is available from the Technology Transfer Office, Code 1004, (202) 767-7230.

General information about NRL may be obtained from Public Affairs, Code 1030, (202) 767-2541.

The NRL Human Resources Office, Code 1800, may be reached at (202) 767-3031.

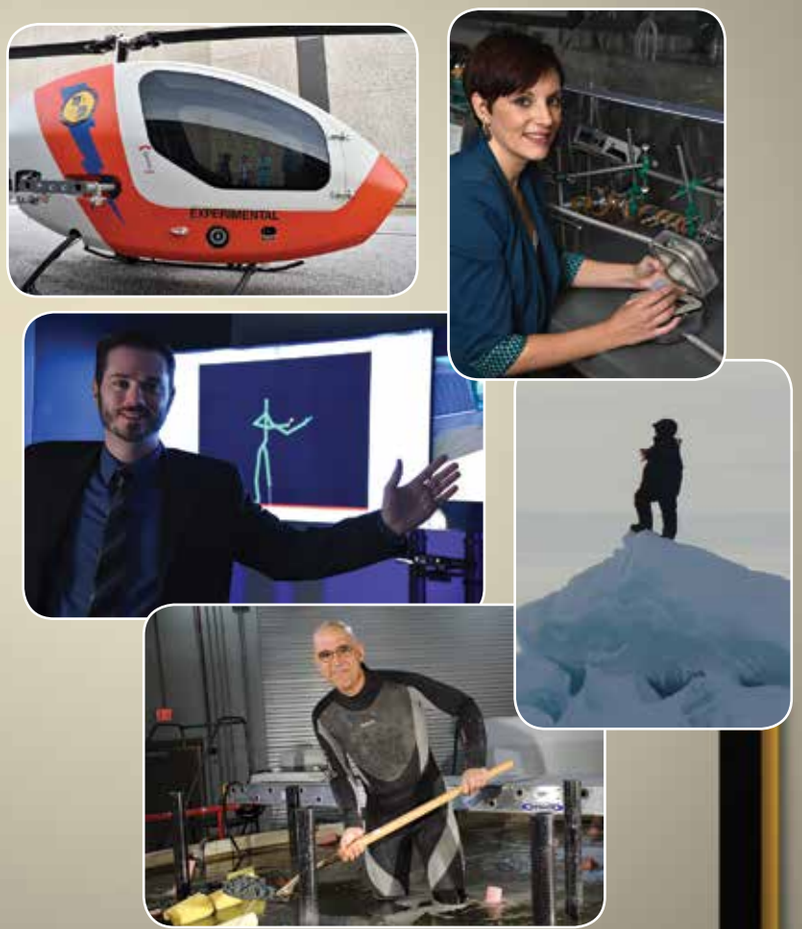
REVIEWED AND APPROVED
NRL/PU/1000--15-601
RN: 15-1231-1064
April 2015

CAPT Mark C. Bruington, USN
Commanding Officer

Welcome Aboard

Naval Research Laboratory

WASHINGTON, DC



http://www.nrl.navy.mil

CAPT Mark C. Bruington is the 38th Commanding Officer of the Naval Research Laboratory. He directs the activities of more than 2500 scientists, engineers, and support personnel in their mission to conduct leading-edge research and provide new technological capabilities to the U.S. Navy and Marine Corps.

Capt. Bruington holds a B.S. in physics, an M.S. in systems engineering, and an M.S. in national resource strategy. He received his commission through the Aviation Officer Candidate School program, received his Wings of Gold in 1992, and is a 2000 graduate of the United States Naval Test Pilot School (USNTPS).

Capt. Bruington's sea tours include an assignment in the A-6 Intruders with "The Boomers" (VA-165) aboard USS *Nimitz* (CVN 68) in support of Operation Southern Watch. Following decommissioning of the A-6E, Capt. Bruington transitioned to the F-14 Tomcat. He reported to "The Red Rippers" (VF-11) aboard USS *John C. Stennis* (CVN 74), again in support of Operation Southern Watch, and joined "The Fighting Checkmates" (VF-211), again aboard USS *John C. Stennis,* in the initial phases of Operation Enduring Freedom, where he led numerous strikes in support of coalition troops in Afghanistan.

His shore tours include Safety Officer and F-14 Project Officer with VX-23; senior fixed wing instructor at USNTPS; Vehicle Systems Integrated Product Team (IPT) lead in the F-35 Lightning II Joint Strike Fighter program office; "Deputy CAG" as part of the OPNAV N88 staff; Deputy Program Manager for the F/A-18 E/F and EA-18G air vehicle and RAAF F/A-18F programs as part of PMA 265 at NAS Patuxent River; and Principal Director, Programs at the Defense Security Cooperation Agency.

Capt. Bruington has flown more than 70 combat missions above Iraq and Afghanistan and flown 41 different types of aircraft, amassing 3200 flight hours and over 500 carrier arrested landings. His decorations include the Defense Meritorious Service Medal, Meritorious Service Medal, four Air Medals (Strike/Flight), and numerous campaign and unit awards.

Dr. John A. Montgomery is the Director of Research of the Naval Research Laboratory, where he oversees research and development programs with expenditures of approximately $1 billion per year.

Dr. Montgomery holds B.S., M.S., and Ph.D. degrees in physics. He joined NRL in 1968 as a research physicist in the Advanced Techniques Branch of the Electronic Warfare Division. In 1980, he was selected to head the Off-Board Countermeasures Branch. In 1985, he was appointed to the Senior Executive Service (SES) and was selected as Superintendent of the Tactical Electronic Warfare Division. He led that division until he was appointed Director of Research in 2002. Throughout his career, Dr. Montgomery has been responsible for numerous electronic warfare systems that have been developed/approved for operational use by the Navy and other services, and has had great impact through the application of advanced technologies to solve unusual or severe operational deficiencies noted during world crises.

Dr. Montgomery was awarded the Presidential Rank of Meritorious Executive in 2007, as well as in 1988 and 1999. He was also awarded the Presidential Rank of Distinguished Executive in 1991 and 2002. He received the DoD Distinguished Civilian Service Award in 2001, the DON Distinguished Civilian Service Award in 1999, and the DON Meritorious Civilian Service Award in 1986. He also received the Roger W. Jones Award for Executive Leadership from American University's School of Public Affairs in 2011; the Laboratory Director of the Year Award from the Federal Laboratory Consortium for Technology Transfer in 2006; the 1997 Dr. Arthur E. Bisson Prize for Naval Technology Achievement, awarded by the Chief of Naval Research in 1998; and the Association of Old Crows (Electronic Defense Association) Joint Services Award in 1993. He was an NRL Edison Scholar and is a member of Sigma Xi. He served as the U.S. National Leader of The Technical Cooperation Program's multinational Group on Electronic Warfare from 1987 to 2002, and served a five-year term as its Executive Chairman.

Welcome

Welcome to the Naval Research Laboratory, a vital and innovative research institution with a proud, 92-year history of discovery and invention. As the Department of the Navy's corporate laboratory, NRL performs a wide range of basic and applied research leading to future naval materials, components, sensors, systems, and capabilities. Since its establishment in 1923, NRL has been involved in nearly every area of science and technology needed to help the Navy attain the advantage over potential adversaries. Our efforts push beyond current technology boundaries to make our Navy and Marine Corps the most advanced in the world.

NRL's most important asset is its people. We are a motivated, inquiring, and diverse community of scientists, engineers, and support personnel. We work in a campus-like atmosphere that fosters creative thought and encourages interdisciplinary studies and projects. Our collaborations are NRL-wide and extend to other professionals in government, academia, and industry. We attract and retain highly qualified staff by providing a flexible research environment and significant opportunities for educational and career development. Our passion for our work means we excel at our primary mission: support of Fleet and Marine Corps operations with the fruits of first principles research and cutting-edge technology.

For people who place a high value on scientific and technical contributions, NRL is a superb place to work. Our goal is to continue to create a stimulating climate for inventiveness and productivity that supports the needs of the Naval services and our nation.

*Current as of September 30, 2014.

Mission

As the Navy's full-spectrum corporate laboratory, NRL conducts a broadly based, multidisciplinary program of scientific research and advanced technological development directed toward maritime applications of new and improved materials; techniques; equipment; systems; ocean, atmospheric, and space sciences; and related technologies. Specific leadership responsibilities and expertise are maintained in the following areas:

- primary in-house research in the physical, engineering, space, and environmental sciences;
- broadly based exploratory and advanced development programs in response to identified and anticipated Navy needs;
- broad multidisciplinary support to the Naval Warfare Centers;
- space systems technology, development, and support.

History

The Naval Research Laboratory began operations in 1923, seven years after inventor Thomas Edison suggested that the Government establish "a great research laboratory." The new institution on the Potomac River boasted two research divisions, Radio and Sound. Divisions in Heat and Light (later Optics), Physical Metallurgy, Chemistry, and Mechanics and Electricity soon followed. Early research achievements included the explanation of the radio "skip distance effect"; the development of the fathometer and early sonar; and the development of the first operational American radar, in time for use in World War II.

NRL demonstrated XAF radar on the battleship USS *New York*, 1938–1939.

The period after World War II was a time of great expansion for NRL. The Laboratory continued to develop its programs in radio, radar, underwater sound, chemistry, metallurgy, and optics. It also added new research areas in nuclear science and cosmic rays; upper atmosphere research, using V-2 and successor rockets; radio astronomy; electron and X-ray diffraction analysis of molecular structures; and enhanced programs in antisubmarine warfare, electronic countermeasures, surface chemistry, solar physics, and more.

The Laboratory's Vanguard satellite project was possibly its most famous postwar R&D program. Less well known was its development and launch of America's first operational intelligence satellite in 1960, an achievement not declassified until 1998. Laboratory scientists have designed, built, and launched 100 satellites since the late 1950s, including prototypes for the Global Positioning System (GPS). In the oceans, NRL's Ocean Engineering Branch, working with the Navy's Deep Submergence Project Office, acquired a worldwide reputation for searching the oceans' abyssal depths. On the molecular scale, NRL's Dr. Jerome Karle in the Laboratory for Structure of Matter pioneered work that led to his receiving the Nobel Prize for Chemistry in 1985.

NRL research scientist from the Marine Geosciences Division takes LIDAR measurements off the coast of Barrow, Alaska.

NRL scientists set off an explosive charge near GelMan surrogate brain models to test how helmets can provide better protection.

The Laboratory's current research program spans the scientific spectrum, including studies in biomolecular engineering, remote sensing, virtual reality, superconductivity, nanoscience, and solar corona monitoring. Indeed, NRL is the Navy's lead laboratory in space systems research, fire research, tactical electronic warfare, microelectronic devices, artificial intelligence, and research in ocean and atmospheric sciences. With 92 years of growth and development, NRL shines as the Navy's corporate laboratory and as one of the Federal Government's leading in-house centers for innovative research in the national interest.

Facilities

In support of its diverse programs, NRL has an impressive array of modern tools for research, many of which are unique. A sampling is listed below.

- Affiliated Resource Center for High Perfomance Computing
- Large Data Research Laboratory
- Laboratory for Autonomous Systems Research
- Visual Analytics Laboratory
- Immersive Simulation Laboratory
- Cyber Defense Development Laboratory
- Mobile and Dynamic Network Laboratory
- Central Target Simulator Facility
- Versatile facilities for high magnetic field and cryogenics research
- Variety of GaAs and solid-state lasers, including devices of very high power and brightness
- Institute for Nanoscience
- Nike krypton fluoride 5-kilojoule laser
- Spacecraft fabrication, assembly, test, shock and vibration facilities
  - – Radio frequency anechoic chambers and controls
  - – Dual 6 D.O.F. robotic lab
  - – Thermal vacuum and acoustic reverberation chambers
- Satellite telemetry, tracking, and control facilities
- Advanced purification and growth facilities for optical ceramics
- Advanced Multifunction RF Concept (AMRFC) Test Bed
- High-power 94 GHz tracking radar system (WARLOC)
- Optical Fiber Fabrication Facility
- Missile Seeker Evaluation Facility
- Large-volume space chamber
- Laboratory for Advanced Materials Synthesis
- Center for Corrosion Science and Engineering
- Molecular Beam Epitaxy Center for advanced electronic devices
- Advanced microscopy and spectrometry facilities
- Matrix assisted pulsed laser evaporation system
- Microwave processing facility
- Railgun Materials Testing Facility
- Laboratory for Structural Acoustics
  - – Acoustic Holography Pool Facility
  - – In-Air Acoustic Laboratory
- Naval Prototype Optical Interferometer
- Ocean Dynamics and Prediction Network
- Environmental Microscopy Facility
- Satellite Receiving and Processing Center
- Space Instrument Test Facility
- Ocean Optics Facility
- Seagoing Measurement Systems Facility
- WindSat Spaceborne Sensor
- Sediment Dynamics Laboratory
- Marine Biogeochemistry Laboratory

NRL–Stennis Space Center (Bay St. Louis, Mississippi) and NRL–Monterey (California) perform R&D in marine geology and geophysics, oceanography, ocean acoustics, and atmospheric sciences. Other NRL locations include the Chesapeake Bay Detachment in Chesapeake Beach, Maryland; two smaller Maryland sites, Pomonkey and Tilghman Island; and the Marine Corrosion Facility in Key West, Florida.

Mobile research platforms contribute greatly to NRL's research. These include three uniquely configured NP-3D Orion and two RC-12 aircraft at Scientific Development Squadron One (VXS-1) located at Patuxent River Naval Air Station, Maryland; and one ship, the ex-USS *Shadwell* (LSD 15), berthed in Mobile Bay, Alabama.

Organization and Administration

The Naval Research Laboratory is a field command under the Chief of Naval Research, who reports to the Secretary of the Navy via the Assistant Secretary of the Navy for Research, Development, and Acquisition.

Heading the Laboratory with joint responsibilities are CAPT Mark C. Bruington, USN, Commanding Officer, and Dr. John A. Montgomery, Director of Research. Line authority passes from the Commanding Officer and the Director of Research through the Associate Directors to the research divisions. Research is performed in the following organizational units: Systems Directorate, Materials Science and Component Technology Directorate, Ocean and Atmospheric Science and Technology Directorate, and Naval Center for Space Technology.

NRL operates as a Navy Working Capital Fund (NWCF) activity. As an NWCF activity, all costs, including overhead, are paid by benefiting customers. Funding in FY2015 comes from the Chief of Naval Research, the Naval Systems Commands, and other Navy sources; government agencies, such as the U.S. Air Force, the Defense Advanced Research Projects Agency, the Department of Energy, and the National Aeronautics and Space Administration; and several nongovernment activities.

The Flimmer (Flying Swimmer) program at NRL is merging two research areas to provide a novel airborne delivery method for unmanned underwater vehicles (UUVs).

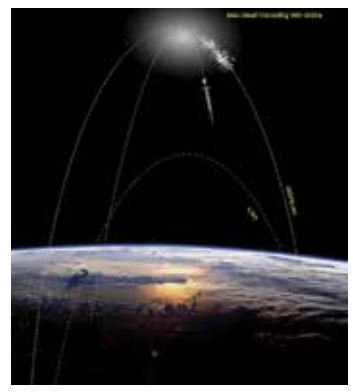
NRL People

NRL today* employs 2610 personnel — 32 military officers, 55 enlisted men and women, and 2523 civilians. In the research staff, there are 867 people with doctoral degrees, 359 with master's degrees, and 394 with bachelor's degrees. The support staff assists the research staff by providing administrative help, computer-aided design, machining, fabrication, technical information services, exhibit services, personnel development, information retrieval, computer support, contracting, and supply management services.

* As of September 30, 2014.

SCIENTISTS/ENGINEERS:	1596
Physicists	380
Chemists	93
General Physical Scientists	49
Mathematicians	33
Astronomers	38
Metallurgists	7
Computer Scientists	135
Electronics Engineers	347
Mechanical Engineers	77
Aerospace Engineers	73
Oceanographers	63
Meteorologists	55
Other	246

Technology Transfer



NRL has developed a concept for releasing micron-scale dust in space to remove small orbital debris from low Earth orbit. The cost-effective method can reduce collision hazards to space assets.

Many of NRL's research efforts have spun off commercial applications in addition to the defense-oriented objectives for which they were originally developed. NRL developments in areas such as radar, radio, satellite navigation, fiber optics, chemical and biological sensors, and a wide variety of materials and coatings have made significant contributions to the safety and welfare of the civilian community.

The transfer of NRL's dual-use technologies to the private sector for commercialization is facilitated by NRL's Technology Transfer Office. This office implements the Technology Transfer Act by which Congress authorized Federal Laboratories such as NRL to participate in Cooperative Research and Development Agreements (CRADAs) and patent licensing agreements. NRL has entered into more than 490 CRADAs with industry, universities, nonprofit organizations, and other government organizations. In addition, NRL has executed over 145 licenses to its inventions. These licenses authorize the licensees to manufacture and sell a product based on NRL's technology in exchange for royalty payments that are shared by the Laboratory and the inventors.

Current Research

The list below outlines broad fields of NRL research and some of the specific topics NRL is investigating for the benefit of the Naval services and other sponsoring organizations. Some details of this work are published in the annual *NRL Review*.

Autonomous Systems
- Cognitive robotics
- Test and evaluation of autonomous systems
- Human-system interaction
- Swarm behaviors
- Power and energy, sensors, and networking and communications for autonomous systems

Device Technology
- RF photonics
- Fiber sensor devices
- Quantum electronics
- Power electronic devices
- IR sensors
- Solid-state devices
- Radiation-hardened electronics
- Microwave and millimeter-wave components and techniques
- Hydrogen masers for GPS
- Aperture syntheses
- Vacuum electronics
- Signature technology

Directed Energy Technology
- Laser propagation
- High-power microwave sources
- Pulsed power
- High-energy and chemical lasers
- Pulse detonation engines
- RAM accelerators

Electronic Warfare
- Repeaters/jammers, EO/IR active countermeasures and decoys
- EW/C^3CM systems and technology
- Intercept receivers, signal processing, and identification systems
- Expendable autonomous vehicles/UAVs
- Effectiveness of Naval EW Systems (ENEWS)
- Threat and EW systems modeling and simulation
- Microwave photonics

Enhanced Maintainability, Reliability, and Survivability Technology
- Coatings
- Corrosion monitoring and control
- Lubricants and greases
- Water additives and cleaners
- Fire safety and fire suppression
- Laser hardening
- Satellite survivability
- Missile blast survivability

Environmental Effects on Naval Systems
- Meteorological effects on electro-optical system performance
- Air quality in confined spaces
- Solar and geomagnetic activity
- Oceanographic effects on acoustic system performance
- Magnetospheric and space plasma effects
- Contaminant transport
- Structure and variability of the middle atmosphere

Information Technology
- Free space photonics communications
- Adversarial modeling and exploitation
- Artificial intelligence and intelligent autonomy
- Communication and networking theory
- High assurance computer systems and information security
- Information transmission and reception technology
- Information management and decision architectures
- High performance computers and networking technologies

Marine Geosciences
- Geoacoustic and geomagnetic modeling
- Marine seismology
- Geotechnology/sediment dynamics
- Geospatial information systems

Materials
- Biocorrosion
- Biomolecular engineering
- Theory of materials
- Mobility fuels/explosives/propellants
- Materials processing
- Advanced alloy systems
- Rapid solidification technology
- High-temperature materials
- Laser fabrication and processing
- Ceramics and composite materials
- Superconductivity
- Thin films and coatings
- Structural characterization of materials

Meteorology
- Air/sea interaction effects on operations
- Data assimilation techniques
- Global/regional forecasting
- Tactical database development
- Meteorological tactical decision aids

Nanoelectronics and Microelectronics
- Novel, nanostructure-based sensors
- New materials and nano devices

Oceanography
- Open-ocean, littoral, polar, and nearshore oceanographic forecasting
- Shallow water tactical oceanography
- In situ oceanographic sensors and data fusion
- Bio-optical and fine-scale physical processes
- Waves, tides, and surf prediction
- Data assimilation techniques
- Remote sensing of in-water environmental parameters using hyperspectral imaging

Plasma Physics
- Radiation hydrodynamics
- Laser plasma interactions
- Pulsed power
- Large-area plasma processing
- Space plasma simulations

Space Research and Technology
- Advanced space systems
- Ionospheric studies
- Space sensing applications
- Sun–Earth interactions
- Space environment astrophysics
- Remote sensing of the Earth from space
- Satellite communications
- Spacecraft design, engineering, and integration
- Satellite ground station design
- Navigation technology
- Astrodynamics
- Mesospheric studies

Surveillance and Sensor Technology
- Imaging radars
- Target classification/identification
- Underwater acoustic propagation, reverberation, and noise
- Electromagnetic sensors, gamma ray to RF wavelengths
- SQUID for magnetic field detection
- Low observables technology

Undersea Technology
- Anechoic coatings
- Fiber-optic acoustic sensors
- Shallow water environmental acoustics and sensor systems
- Target reflection, diffraction, and scattering
- Unmanned undersea vehicle dynamics
- Weapons launch