

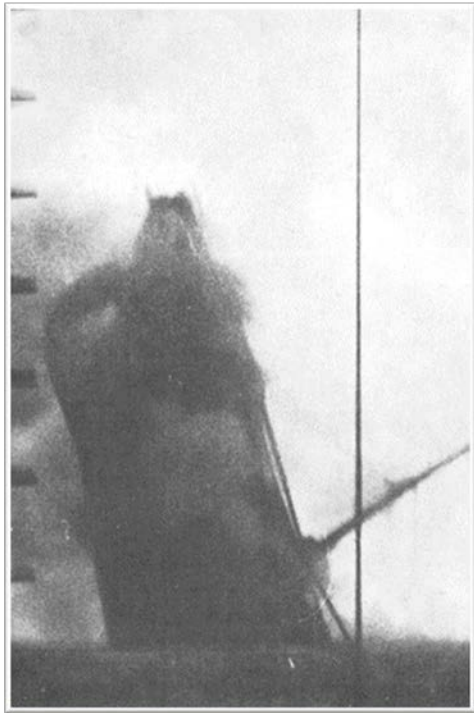


Building Partnerships and Enabling Discovery

***Scott A. Walper, PhD
Science Director for Synthetic Biology***

ACCELERATING TO THE NAVY & MARINE CORPS AFTER NEXT

A Storied History



“...plan, foster and encourage scientific research in recognition of its paramount importance as related to... future naval power, and the preservation of national security...to obtain, coordinate and make available...world-wide scientific information”





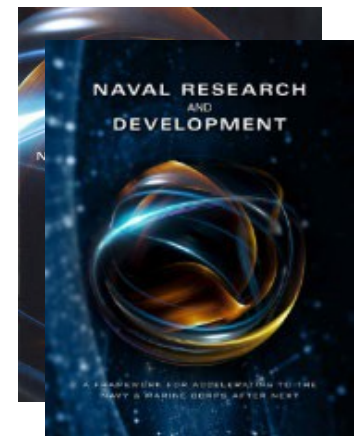
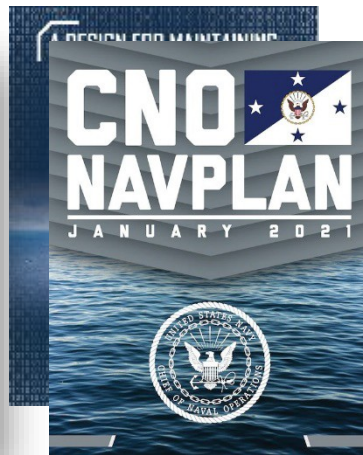
Mission and Vision

ONR Global Mission

To obtain, coordinate, and make available world-wide scientific information.

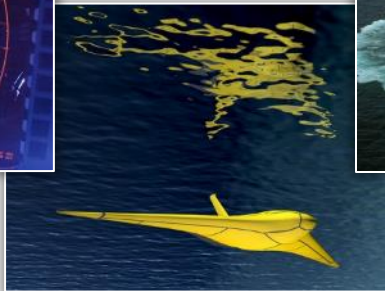
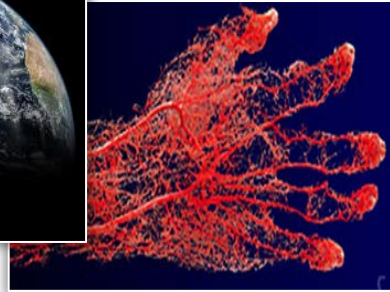
ONR Global Vision

To be the partner of choice for science and technology leaders.





The Naval Research Enterprise



U.S. NAVAL
RESEARCH
LABORATORY



4,000+ People
23 Locations
\$2.1B / year
>1,000 Partners



ONR Global Connections

ONR Global is 6 technical departments connecting: international research and technology, capability development, international military partners, and the US Navy and Marine Corps.



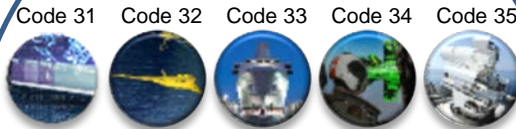
Fleet and Force

Science Advisors

TechSolutions

NRE

Integrated Research Portfolios



Code 31	Code 32	Code 33	Code 34	Code 35
Information, Cyber & Spectrum Superiority	Undersea Battlespace & Maritime Domain Access	Mission Capable, Persistent & Survivable Sea Platforms	Warfighter Supremacy	Aviation, Force Projection & Integrated Defense



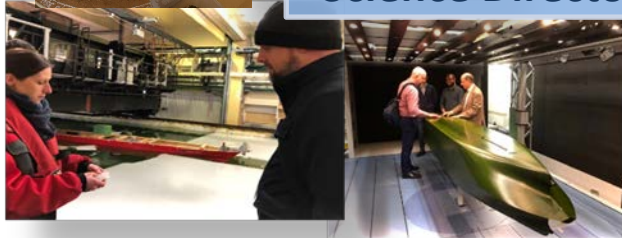
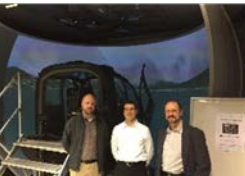
Experimentation/Analysis

Foreign Comparative Test

Capability Development

International Engagement

Science Directors



International Research



International Naval Partnerships

The partner of choice for science and technology leaders



Investing in Trusted Partnerships

Washington, D.C. Region / ONR HQ

ONR Global Arlington

Executive Officer
FCC/C10F ★★ ★

ONR Global Headquarters London

Commanding Officer
Technical Director
Science Directors

Pyeongtaek

USFK ★★ ★

San Diego

C3F ★★ ★
AIRFOR ★★ ★
SURFOR ★★ ★
I MEF ★★ ★
UWDC ★
SMWDC ★

Camp Lejeune

II MEF ★★ ★

Fallon

NAWDC ★

Groton

UWDC ★★

Norfolk

FLTFOR ★★ ★
SUBFOR ★★ ★
MARFORCOM ★★ ★
NAVIFOR ★★ ★
SPECWAR ★★ ★
NECC ★
NWDC ★

Prague

Science Director

Naples

NAVEUR/NAVAF ★★ ★
C6F ★★ ★

Bahrain

NAVCENT/C5F ★★ ★

ONR Global Tokyo

Science Directors

Yokosuka

C7F ★★ ★

Okinawa

III MEF ★★ ★

Hawaii

PACOM ★★ ★
PACFLT ★★ ★
MARFORPAC ★★ ★

Santiago

Science Director

São Paulo

Science Directors

Singapore

Science Directors

Melbourne

Science Director

Science Advisors

- ★ Joint Command
- ★ Navy Command
- ★ Marine Corps Command

Locations

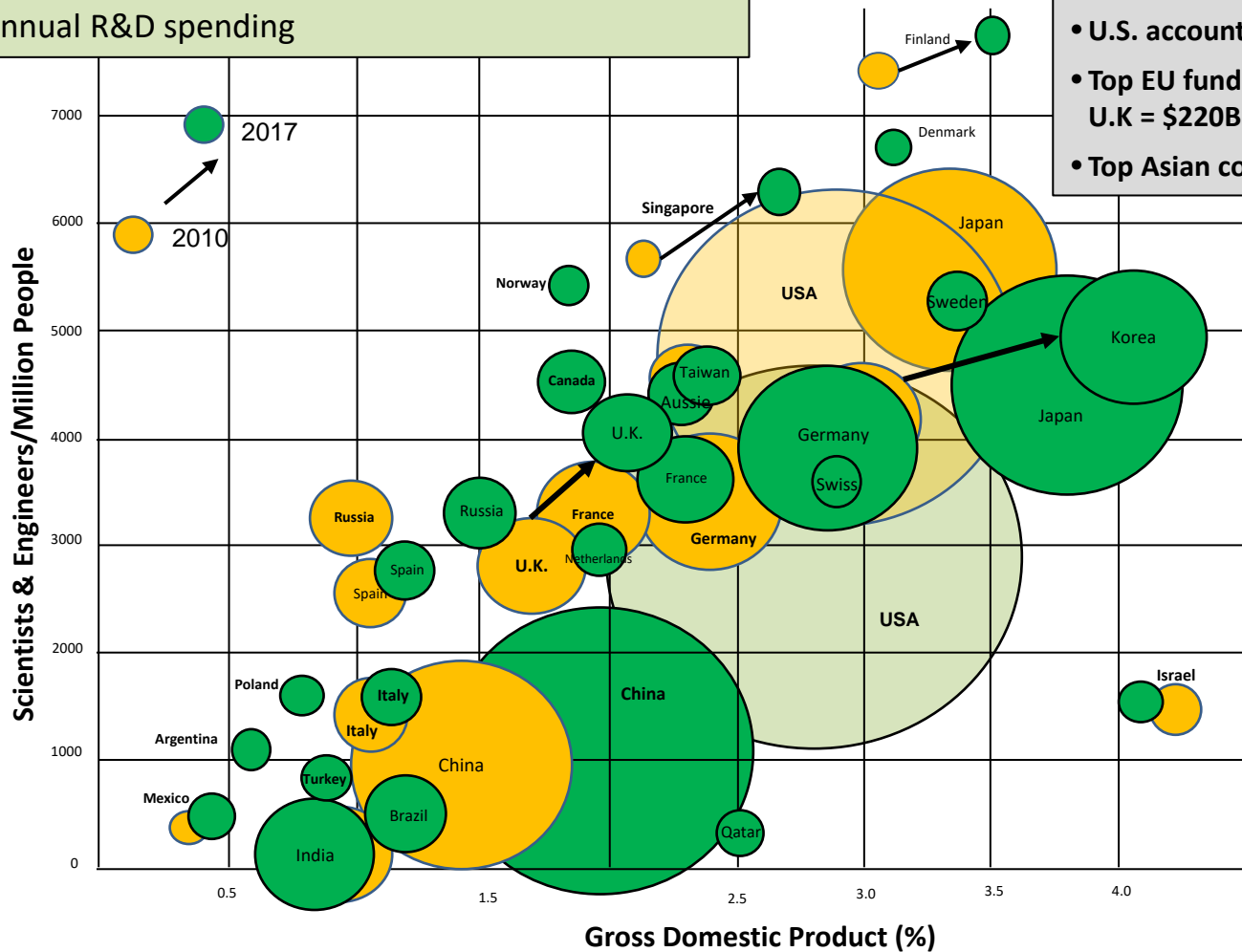
- Headquarters
- Office
- Deployment site

Focus: international research & partnerships, connecting S&T to fleet/force, global technical awareness

Why International Science?

International S&T is Outpacing the US

Size of the circles reflects the relative amount of annual R&D spending



- **80% of world's researchers are outside of the U.S**
- **U.S. accounts for \$497B (25.5%) in R&D funding**
- **Top EU funding countries Germany, France and U.K = \$220B**
- **Top Asian countries China, Japan, Korea = \$613B**





Why ONR Global?

ONR Global has partnered with **18** of the top **23** international universities (excluding China and Hong Kong) in the last 3 years.

ONR Global awarded **70%** of all **ONR International grants** in FY19

ONR Global manages **18 formal international bilateral agreements**

ONR Global TechSolutions transitioned **9 prototypes** to the fleet/force in 2019

ONR Global conducted **11 Experiments** to inform FNC/INP/TC decisions

Partnerships include research grants and collaborative science projects FY17-19



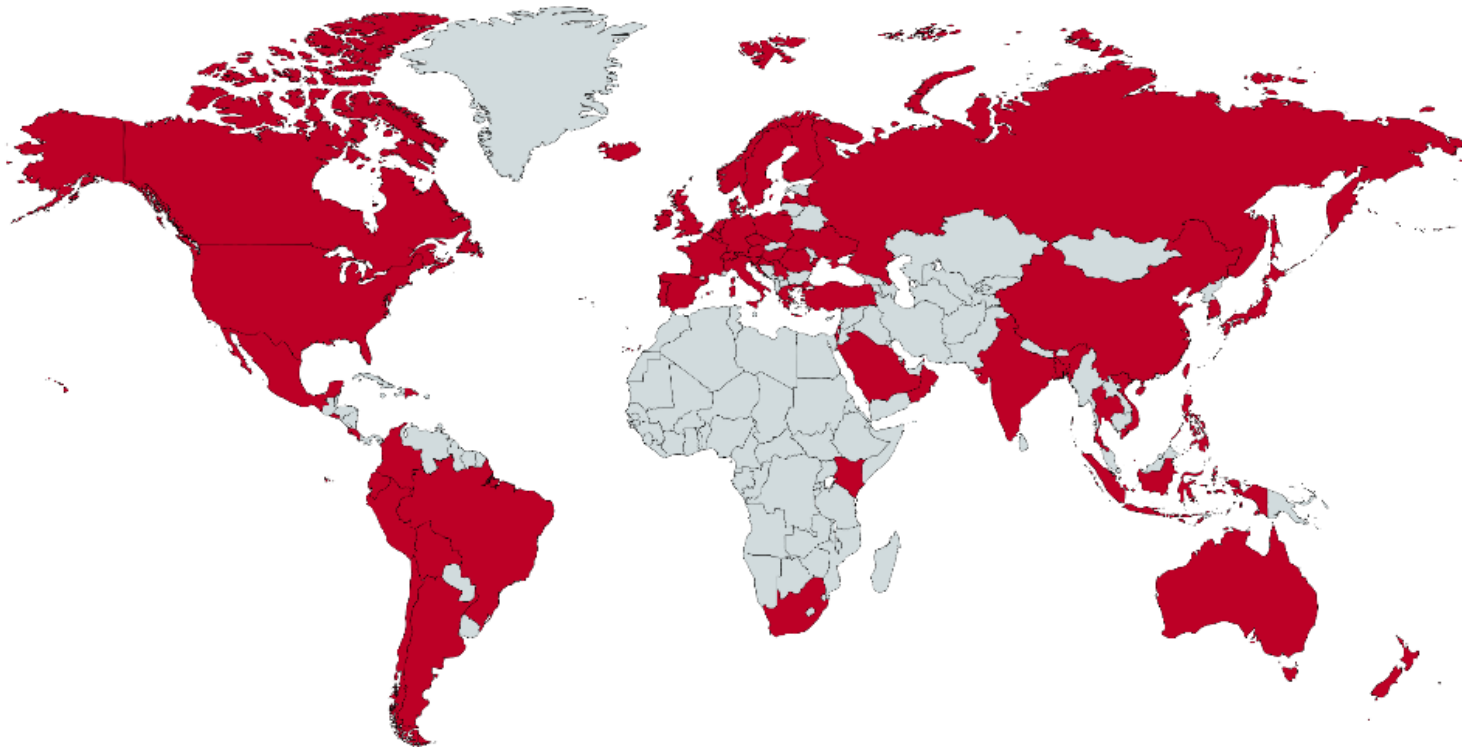
ONR Global is focused on international research and partnerships connecting S&T to the fleet and force global technical awareness.



ONR Global Presence in FY19

24 Science Directors Deployed Globally

- 130 liaison visits across 47 countries
- Submitted 161 Global Technical Awareness Reports (including 10 China / 1 Russia)
- 40 Visiting Scientist engagements across 23 countries
- 58 Collaborative Science Engagements across 28 countries
- 74 new International Research Grants
31 Countries / 60 Institutions / 20 Technology areas










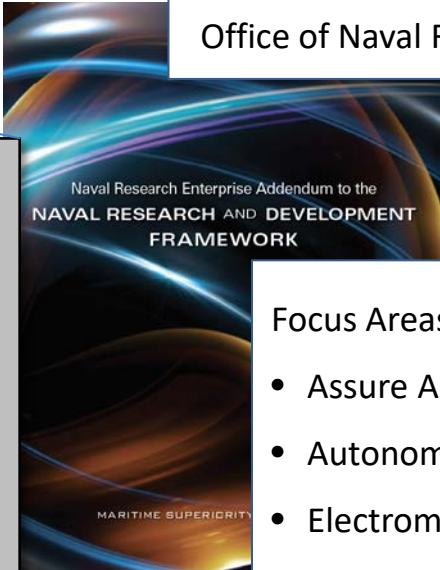
ONR Focus Areas

★
★
Chief of Naval Research

ONR HQ

Office of Naval Research Global (ONRG)

- Code 31 Information, Cyber and Spectrum Superiority 
- Code 32 Ocean Battlespace and Expeditionary Access 
- Code 33 Mission Capable, Persistent and Survivable Naval Platforms 
- Code 34 Warfighter Performance 
- Code 35 Aviation, Force Projection and Integrated Defense 
- Code 36 Naval X



Focus Areas:

- Assure Access to Maritime Battlespace
- Autonomy and Unmanned Systems
- Electromagnetic Maneuver Warfare
- Expeditionary and Irregular Warfare
- Information Dominance - Cyber
- Platform Design and Survivability
- Power and Energy
- Power Projection and Integrated Defense
- Warfighter Performance



Enduring Research Responsibilities

Amphibious Expeditionary Maneuver

- Expeditionary fires and lethality
- Expeditionary C4ISR
- Hybrid threat defeat
- Human performance and protection
- Amphibious mobility
- Logistics, sustainment and maintenance
- Expeditionary power and energy
- Lightening the load
- Accelerated learning/decision making
- Information environment operations

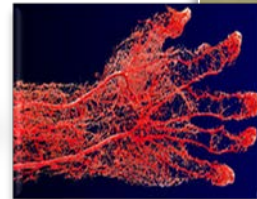


Warfighter Supremacy

- Undersea medicine
- Biological sciences
- Biorobotics
- Capable manpower
- Command decision making
- Force health protection
- Human-robot interaction
- Noise-induced hearing loss
- Training and simulation

Aviation, Force Projection & Integrated Defense

- Directed Energy (DE) & Counter DE
- Aerodynamics
- Flight dynamics & control
- Propulsion
- Structures and materials
- Energetic materials
- Hypersonics
- Autonomy



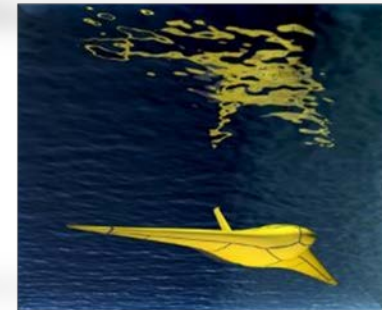
Information Cyber and Spectrum Superiority

- Advanced RF electronics & materials
- Communications and networking
- Computational methods for decision making
- Data science and analytics
- Electronic warfare
- Sensors and sensor processing
- Machine learning, reasoning and intelligence
- Resource optimization
- Precision navigation & timekeeping



Undersea Battlespace and Maritime Domain Access

- Arctic and global prediction
- Littoral geosciences and optics
- Marine mammals and biology
- Marine meteorology
- Maritime sensing
- Ocean acoustics
- Ocean engineering & marine systems
- Physical oceanography
- Research facilities
- Space environment
- Undersea signal processing

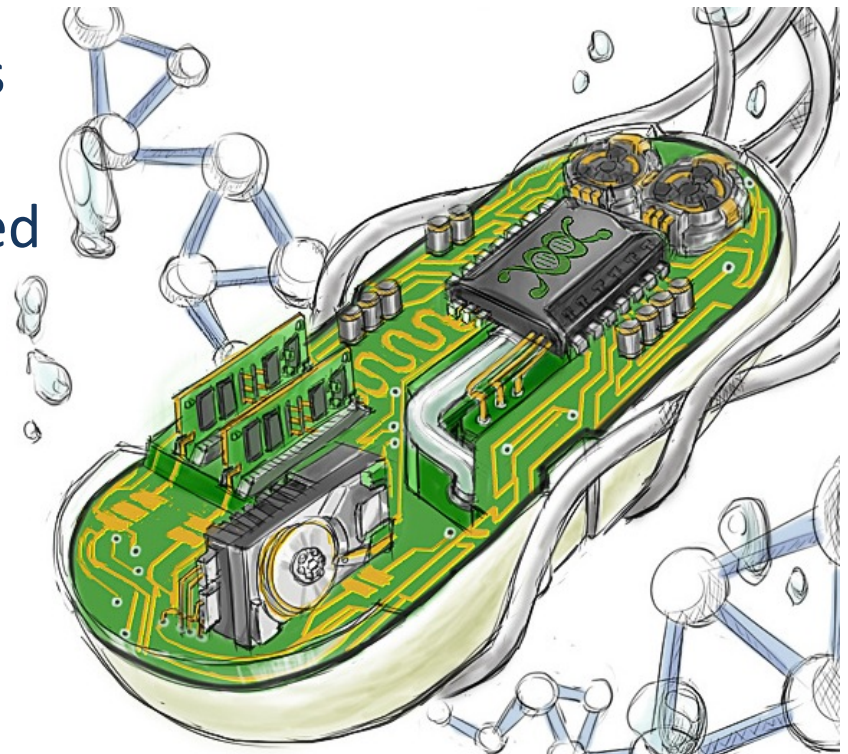




ONR Global Areas of Interest

- Sense-and-Respond Systems
- Tunable Materials
- Bio-hybrid Autonomous Systems
- Secure And Sustainable Bio-based Production
- *Fundamental information processing/tool development*

SynBio offers new routes to optimize SWaP for sensors, and reduced cost/logistics for materiel





ONR Global Funded Research

Distribution A. Approved for public release, distribution is unlimited.

Affordable, sustainable, secure & distributed biomanufacture in *Halomonas* with optogenetic control

Grantee: N. Scrutton



Co-funded:



Optically transparent armor reinforced with microbially synthesized cellulose nanofibers with self-repair capability

Grantee: K-Y. Lee



Co-funded:



Fundamentals of canoed biofilm electro-metabolism

Grantee: U. Schröder



Co-funded:



Cryptochrome-based magnetic sensors

Grantee: P. Hore



Co-funded:



Genetic Determinants for Formate Metabolism in *Methanothermobacter thermautotrophicus*

Grantee: L. Angenent



ONR Global Motivation

DEFINE

accelerate
realize



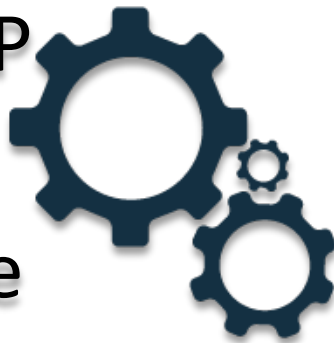
DISCOVER

innovate
disrupt

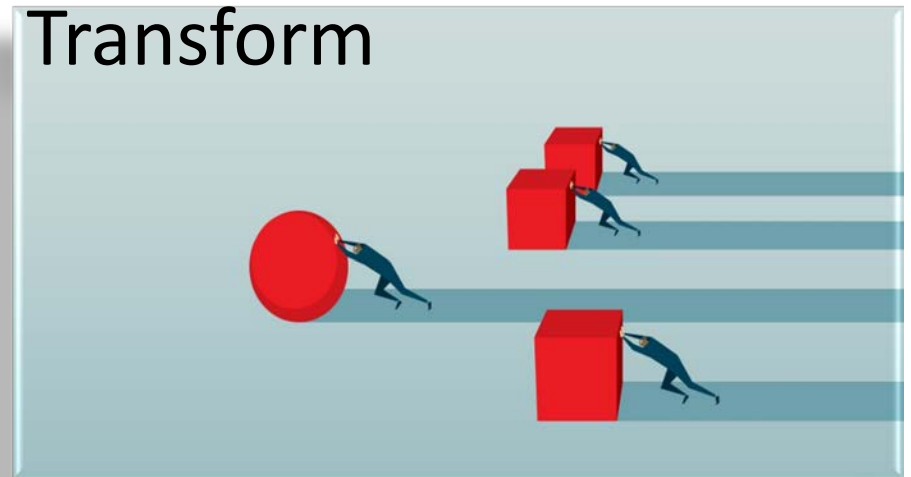


DEVELOP

exploit
enhance



Transform





International Science Tools

Liaison Visits

- ONRG technical staff attend international events and visit international institutions to develop access and discover cutting edge S&T

Grant tools

Visiting Scientist Program (VSP)

- Support travel of foreign scientists to the US to socialize new S&T ideas or findings with the Naval Research Enterprise

Collaborative Science Program (CSP)

- Support foreign or international workshops and conferences of Naval interest

Research Grants

- Support connection of innovative, international S&T to ONR programs and US PIs



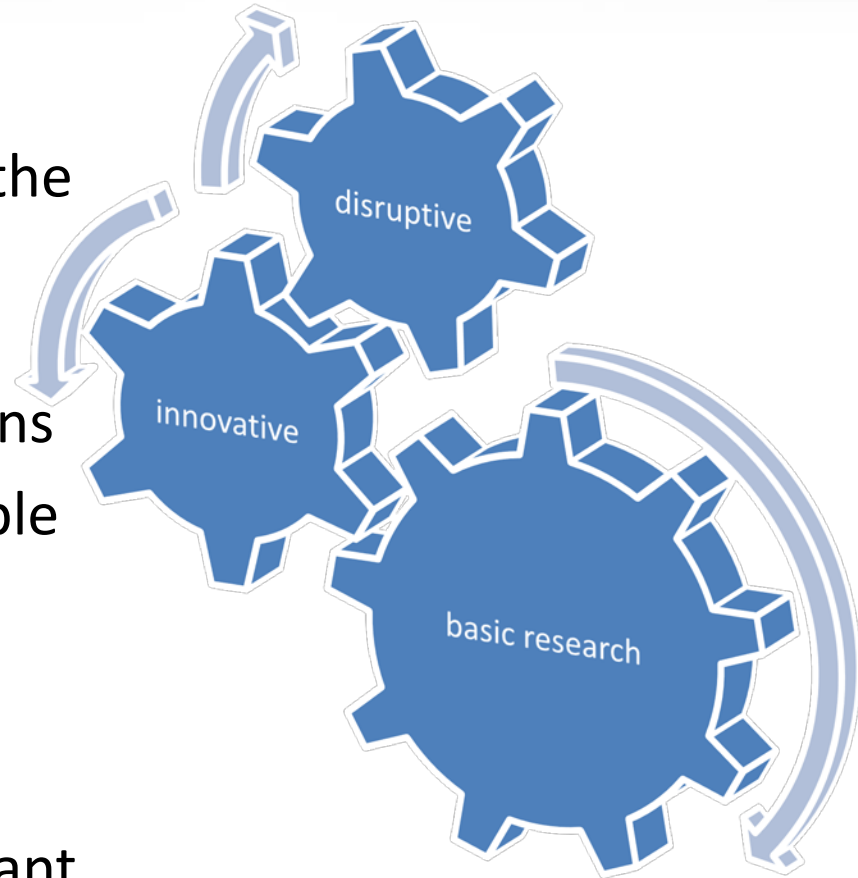
Small early investments can lead to significant results



Engagement Opportunities

- **Intellectual property remains** with the Principal Investigator
- Funding goes to **non-U.S. based** Principal Investigators and institutions
- Government organizations not eligible
- We **encourage openly** publishing results/outcomes

Email me white papers with your relevant concepts





Proposal Submission Guidance

- Most current BAA can be found on www.onr.navy.mil
- Submit proposal using <http://grants.gov>
 - Offeror shall use the Grants.gov form Standard Form SF424(r & R), the Research And Related Other Project Information, the Research & Related Budget, and Project Abstract forms from the application package template associated with the BAA on the Grants.gov web site. Assume that performance will start no earlier than three (3) months after the date the cost proposal is submitted.

Grant proposals submitted to ONRG should be in response to Broad Agency Announcement (BAA) of long-range ONR scientific projects



Register on Grants.gov

- Acquire DUNS (Data Universal Numbering System) number
<http://fedgov.dnb.com/webform>
- Acquire NCAGE Code (NATO Commercial and Government Entity Code)
<https://eportal.nspa.nato.int/AC135Public/default.aspx>
- Register in SAM (System for Award Management)
<https://www.sam.gov>

Proposals must be submitted through the Grants.gov



90 Years of Naval Research

Distribution A. Approved for public release, distribution is unlimited (43-6601-20).

Naval S&T Milestones

ACCOMPLISHMENTS ACROSS ALL DOMAINS



 MULTISTATIC RADAR TESTED AT NRL		 PLAN-POSITION INDICATOR		 MAGNETIC DRUM RADAR EQUIPMENT (MADRE)		 FIRST UNMANNED HELICOPTER		 OWENS VALLEY 40M RADIO TELESCOPE		 NTS-2 SATELLITE IN NAVSTAR GPS		 NOBEL PRIZE TO DR. JEROME KARLE, NRL		 NAVY AEROSOL ANALYSIS AND PREDICTION SYSTEM		 HIGH TEMPERATURE SUPERCONDUCTIVE DEGAUSSING		 NOBEL PRIZE TO ONR RESEARCHERS FOR GRAPHENE			
 FIRST UNMANNED AERIAL VEHICLE		 URANIUM 235 PRODUCTION		 PRINCIPLES OF MODERN FRACTURE MECHANICS		 PROJECT WHIRLWIND DIGITAL COMPUTER		 AQUEOUS FILM FORMING FOAMS (AFF)		 MOBILE ROBOTS		 CORONAL MASS EJECTION		 HIGH-ENERGY MAGNETS		 CLEMENTINE SPACECRAFT		 HYPERSPECTRAL IMAGER FOR COASTAL OCEANS		 FREE ELECTRON LASER	
 GAMMA-RAY RADIOGRAPHY		 FIRST CONCEPT FOR A NUCLEAR SUBMARINE		 SYNTHETIC LUBRICANTS		 PARTICLE ACCELERATORS		 SEALAB I AND II		 EXCIMER LASER TECHNOLOGY		 ONR-FUNDED TECH FINDS RMS TITANIC		 INTERACTIVE MULTISENSOR ANALYSIS TRAINING (IMAT)		 SHARP RECONNAISSANCE		 LARGE DISPLACEMENT UNMANNED UNDERWATER VEHICLE			
 NRL COMMISSIONED		 FIRST U.S. RADAR PATENTS		 ONR FOUNDED 1946		 VERTICAL TAKE-OFF AND LANDING		 BATHYSCAPHE TRIESTE REACHES 35,800 FT.		 FAR ULTRAVIOLET LUNAR CAMERA		 GLOBAL ATMOSPHERIC PREDICTION SYSTEM		 HIGH-STRENGTH LOW-ALLOY STEELS		 DRAGON EYE UAV		 INTEGRATED TOPSIDE (INTOP)			
 SOUND SURVEILLANCE SYSTEM (SOSUS)		 ACOUSTIC MICROSCOPY		 HULL ANTI-FOULING COATINGS		 REMOTE ENVIRONMENT MONITORING UNITS		 ANTI-TORPEDO TORPEDO		 LITHIUM BATTERIES		 CONTRIBUTED TO AEGIS COMBAT SYSTEM		 ULTRA-HIGH STRENGTH STEEL		 QUIKCLOT® COMBAT GAUZE		 WORLD-RECORD SETTING 33 MJ EMRG SHOT			
1920s		1930s		1940s		1950s		1960s		1970s		1980s		1990s		2000s		2010 & BEYOND			

Celebrating Success!

TUHH

Hamburg University of Technology

Understanding the Influence of Coherent Flow Vortices on Surface Ship Maneuvering

08.04.2020



Hauptgebäude der TU Hamburg. Foto: TUHH

Professor Moustafa Abdel-Maksoud of the Hamburg University of Technology in Germany provides details of this ONR Global funded project, which aims to understand the influence of coherent flow vortices on ship maneuvering.

Optimizing surface ship performance has been a goal of navies for millennia. Improving performance makes ships more efficient to run, less costly to operate, and most importantly, safer.

When a ship is moving through the water, vortices are created which interact with the boundary layer, the propulsion system, with other vortices, and hence influence the entire ship performance. Thanks to research funded by the Office of Naval Research Global (ONR Global), a group of scientists at the Hamburg University of Technology (TUHH) are tackling this problem. The group, led by Professor Moustafa Abdel-Maksoud, is analyzing vortices generated behind fixed and moving blunt bodies. The aim is to understand how these vortices affect ship maneuverability and to potentially decrease noise and vibrations.

ONR Global's small investment at TUHH not only led to critical insights into vortex structures and their effects on surface ships, the resultant data were also used to support a follow-on proposal to the German Federal Ministry for Economic Affairs and Energy. This successful proposal resulted in a €1.5 million award to TUHH for the purchase of a high speed Particle Image Velocimeter (PIV) system for more precise measurements.

Experimental Analysis of Coherent Vortical Structures Behind Fixed and Moving Blunt Bodies

Grantee: M. Abdel-Maksoud



Co-funded:



20 February 2020

MIB receives Queen's Anniversary Prize at Buckingham Palace ceremony

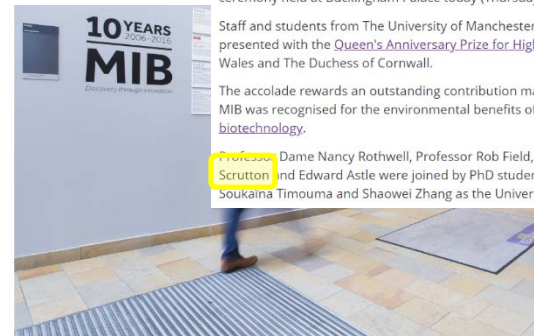


The Manchester Institute of Biotechnology (MIB) has collected a prestigious award ceremony held at Buckingham Palace today (Thursday, 20 February).

Staff and students from The University of Manchester attended the event in London, where they were presented with the Queen's Anniversary Prize for Higher and Further Education by TRH The Prince of Wales and The Duchess of Cornwall.

The accolade rewards an outstanding contribution made to the UK by an academic institution - and the MIB was recognised for the environmental benefits of its pioneering expertise in industrial biotechnology.

Dame Nancy Rothwell, Professor Rob Field, Professor Martin Schröder, Professor Nigel Scrutton and Edward Astle were joined by PhD students Emily Kempa, Ashley Matthey, Jeremy Ramsden, Soukaina Timouma and Shaowei Zhang as the University's representatives.



29 April 2020



Outstanding MIB scientists elected as Fellows of the Royal Society

Two prominent biotechnology scientists from The University of Manchester have been confirmed as Royal Society Fellows among more than 60 of their peers across the world.

Professor Nigel Scrutton and Professor Nicholas Turner from the Manchester Institute of Biotechnology have been awarded the prestigious Fellowships thanks to their pioneering contributions to scientific discovery in the field of industrial biotechnology - one of the key research beacons for The University of Manchester.

Affordable, sustainable, secure & distributed biomanufacture in Halomonas with optogenetic control

Grantee: N. Scrutton



Co-funded:





Naval Research Paying Off

The Chemical Evolution: ONR-Sponsored Researcher Wins Nobel Prize

Story Number: NNS181211-04 Release Date: 12/11/2018 9:17:00 AM



By Sierra Jones, Office of Naval Research Public Affairs

ARLINGTON, Va. (NNS) -- The Office of Naval Research (ONR) has a long record of placing winning bets on up-and-coming scientists.

In fact, it was 30 years ago that the ONR Young Investigator Program sponsored Dr. Frances H. Arnold, a professor from the California Institute of Technology, who was awarded the 2018 Nobel Prize in Chemistry.

Arnold, who still serves as a professor of chemical engineering at Caltech, was in Stockholm, Sweden, early Dec. 10 for the Nobel Prize Award Ceremonies, where she became only the fifth woman - and the first American woman - to take home the chemistry award.

"Doctor Arnold is the latest in a long line of Nobel Prize winners to have been sponsored through ONR basic research programs," said Dr. E. Anne Sandel, ONR executive director. "Like the others, her research has led to discoveries and breakthroughs with important implications for both the Navy and society at large."

ONR sponsored Arnold with a series of grants between 1988 and 2002.

"I received an ONR Young Investigator Award in the late 1980s, which introduced me to problems of interest to the Navy, but also problems of good intellectual content that overlapped with some of my interests in metal recognition and protein engineering," said Arnold.



Naval Research Stories

Distribution A. Approved for public release, distribution is unlimited (43-6601-20).

Noble efforts, Nobel Prizes...

1950



Felix Bloch (PHYSICS, 1952)
Linus Pauling (CHEMISTRY, 1954)
Severo Ochoa (MEDICINE, 1958)

NAVAL APPLICATIONS:

Naval medicine; nondestructive inspection; chemical engineering applications such as coatings; advanced materials

1990

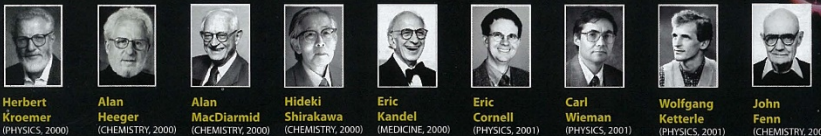


Rudolph Marcus (CHEMISTRY, 1992)
George Olah (CHEMISTRY, 1994)
Richard Smalley (CHEMISTRY, 1996)
William Phillips (PHYSICS, 1997)
Walter Kohn (CHEMISTRY, 1998)
Daniel Tsui (PHYSICS, 1998)
Horst Störmer (PHYSICS, 1998)
Ahmed Zewail (CHEMISTRY, 1999)

NAVAL APPLICATIONS:

Material science; corrosion resistance; chemical engineering; organic chemistry; fuel production; material science; precision timekeeping; navigation; quantum computing; materials by design

2000



Herbert Kroemer (PHYSICS, 2000)
Alan Heeger (CHEMISTRY, 2000)
Alan MacDiarmid (CHEMISTRY, 2000)
Hideki Shirakawa (CHEMISTRY, 2000)
Eric Kandel (MEDICINE, 2000)
Eric Cornell (PHYSICS, 2001)
Carl Wieman (PHYSICS, 2001)
Wolfgang Ketterle (PHYSICS, 2001)
John Fenn (CHEMISTRY, 2002)

NAVAL APPLICATIONS:

Advanced sensors; advanced autonomous systems; information storage and retrieval; information transmission; multifunctional electronics for intelligent naval sensors; decision support systems; nanoelectronics; biomimetics; signal processing; human-machine interface; precision timekeeping; highly precise geolocation; high bandwidth secure communication; chemical sensor technology; improved medical treatments; new medicines; new 'greener' materials



Paul Lauterbur (MEDICINE, 2003)
Richard Schrock (CHEMISTRY, 2005)
Robert Grubbs (CHEMISTRY, 2005)
Theodor Hansch (PHYSICS, 2005)
John Hall (PHYSICS, 2005)

1960



Donald Glaser (PHYSICS, 1960)
Robert Hofstadter (PHYSICS, 1961)
Melvin Calvin (CHEMISTRY, 1961)
Georg von Békésy (MEDICINE, 1961)
Charles Townes (PHYSICS, 1964)
Haldan Hartline (MEDICINE, 1967)
George Wald (MEDICINE, 1967)

NAVAL APPLICATIONS:

Hydrodynamic research; nuclear engineering; marine biology; hearing protection; communications; targeting; sensor applications; distance measuring; ballistic missile defense; data processing; nuclear engineering; human factors engineering; biomimetics; vision protection; naval medicine



Hans Bethe (PHYSICS, 1967)
Har Gobind Khorana (MEDICINE, 1968)

1970



Kenneth Arrow (ECONOMICS, 1972)
Gerald Edelman (MEDICINE, 1972)
Leon Cooper (PHYSICS, 1972)
J. Robert Schrieffer (PHYSICS, 1972)
Christian Anfinsen (CHEMISTRY, 1972)
Paul Flory (CHEMISTRY, 1974)
William Lipscomb (CHEMISTRY, 1976)
Peter Mitchell (CHEMISTRY, 1978)
Herbert Simon (ECONOMICS, 1978)
Herbert Brown (CHEMISTRY, 1979)

NAVAL APPLICATIONS:

Management techniques; naval medicine; electrical engineering; computer science; advanced composite materials; chemical engineering; material science; organizational behavior; cybernetics

1980



Arthur Schawlow (PHYSICS, 1981)
Nicolaas Bloembergen (PHYSICS, 1981)
Rüdiger Hoffmann (CHEMISTRY, 1981)
David Hubel (MEDICINE, 1981)
Kenneth Wilson (PHYSICS, 1982)
William Fowler (PHYSICS, 1983)
Jerome Karle (CHEMISTRY, 1985)

NAVAL APPLICATIONS:

Spectroscopy; highly accurate timekeeping; biochemistry; chemical engineering; naval medicine; human factors engineering; oceanic and atmospheric science; hydrodynamics; nuclear chemistry; mechanical engineering; space communications; navigation



Yuan Lee (CHEMISTRY, 1986)
Dudley Herschbach (CHEMISTRY, 1986)
Hans Dehmelt (PHYSICS, 1989)
Norman Ramsey (PHYSICS, 1989)

2010



Andre Geim (PHYSICS, 2010)
Konstantin Novoselov (PHYSICS, 2010)
David Wineland (PHYSICS, 2012)
Arish Warshel (CHEMISTRY, 2013)

NAVAL APPLICATIONS:

Ultra-strong, lightweight materials; accelerated computing; precision timekeeping and measurements

Supporting the best minds in the world since 1946!

For more than six decades, the Office of Naval Research - ONR - has supported the world's greatest scientific thinkers to achieve research, invention, discovery and engineering breakthroughs for our Sailors and Marines. Thousands of scientists, including nearly 60 (and counting) Nobel Prize winners, have been supported by ONR; together, their research has literally changed the world - cell phones, the Global Positioning System (GPS), life-saving vaccines, the laser, fiber optics, radar, blood-clotting agents, semiconductors, nanotechnologies and more are among ONR-sponsored technologies that have benefitted the Navy, Marine Corps and the planet at large. ONR is proud to salute its Nobel Prize winners from the past, present and future, whose work has made such an impact.



ONR Global Driving Serendipity

- Interested in pursuing **blue sky/disruptive** approaches to challenge conventional thinking.
- Agnostic to the application, **focused on the mission**, remaining open to opportunity and driving **serendipity** to deliver **revolutionary** change.





Where to Find Us Online

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- Tales of Discovery >
- Records, Sources and Archives >
- Nobel Laureates >
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- Leadership >
- ONR Locations >
- Scientific Peer Review >
- Strategy >
- Visiting ONR >

All ONR-Sponsored Nobel Laureates

W.E. Moerner - (Chemistry, 2014)

For the development of super-resolved fluorescence microscopy.

Arieh Warshel - (Chemistry, 2013)

For the development of multi-scale models for complex chemical systems. ([More Warshel](#))

Andre Geim and Konstantin Novoselov - (Physics, 2010)

For groundbreaking experiments regarding the two-dimensional material graphene. ([More Geim, Novoselov](#))

John L. Hall - (Physics, 2005)

For contributions to the development of laser-based precision spectroscopy, including the so-called optical frequency comb technique.
General Applications: Precise measurements; determination of the quantum structure of matter with ever-increasing accuracy, and the ability to further test fundamental theories.
Navy application: Precision timekeeping and measurements.

Theodor W. Hansch - (Physics, 2005)

For contributions to the development of laser-based precision spectroscopy, including the so-called optical frequency comb technique.
General Applications: Precise measurements; determination of the quantum structure of matter with ever-increasing accuracy, and the ability to further test fundamental theories.
Navy application: Precision timekeeping and measurements.

Robert H. Grubbs - (Chemistry, 2005)

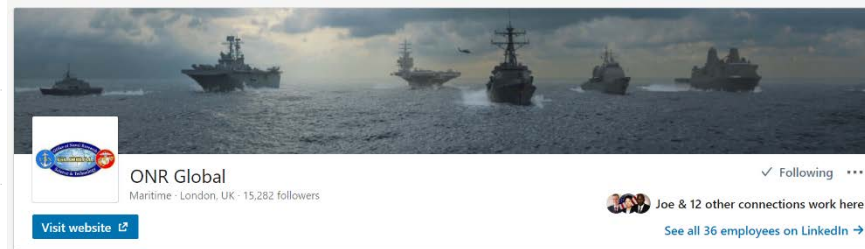
For development of the metathesis method in organic synthesis.
General Applications: The development of new drugs and other biologically active compounds, polymeric materials and industrial syntheses
Navy application: Improved medical treatments, new drugs, and new greener materials.

Richard R. Schrock - (Chemistry, 2005)

For development of the metathesis method in organic synthesis.
General Applications: The development of new drugs and other biologically active compounds, polymeric materials and industrial syntheses
Navy application: Improved medical treatments, new drugs, and new greener materials.

Paul Lauterbur - (Medicine, 2003)

For his discoveries concerning "magnetic resonance imaging"



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Thank You!

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