FY2016 ANNUAL REPORT

AFOSR INTERNATIONAL BASIC SCIENCE OFFICE

Table of Contents

AFOSR says Goodbye to Dr. Mark Maurice

March 29, 1961 - February 26, 2016

With the publication of this 2016 International Office Annual report, we are now a year removed from the death of Mark Maurice, Director of the Arlington-based International Office since 2001. Mark was then the longest-serving director in the Air Force Office of Scientific Research (AFOSR). His leadership spanned a remarkable period in the growth and influence of the Air Force Research Laboratory (AFRL)/AFOSR international enterprise.

Mark began his international career with a three-year assignment in the European Office of Aerospace Research and Development (EOARD) from 1993 to 1997. His coverage included much of the former Soviet Union. A significant part of his job was gathering information that had until recently been inaccessible and to build mutually beneficial relationships. Many of those productive relationships were to last the rest of his life. Mark played an essential role in launching the first International Initiative, the Russian Hypersonics Initiative, from which AFRL acquired insights and technology from the Russian invention of plasma actuation. The success of this long-running initiative led to other, remarkably successful ones, including the Taiwan Nanoscience Initiative, the Korean Nano-Info-Bio Initiative, the Siberian Materials Initiative, and the Mexican Initiative. Mark co-led the establishment of these initiatives and a change in the model of many of them from AF-provided financial support and AFRL harvesting of results to shared planning and funding between the countries, with strong collaborations and technology transition as integral features of each project. Such an approach was revolutionary at the time. The benefits from it have been profound and they continue to today.

Mark participated in and often led the new programs that now define AFOSR's international enterprise. It went in 1993 from two overseas offices largely tasked with monitoring their regions and supporting AFRL technology to three overseas offices handling that mission and engaging in a wide range of programs in direct support of basic research. The Southern Office of Aerospace Research and Development (SOARD) was established in 1998 under Mark's leadership. The number of projects and their dollar value across AFOSR's international enterprise grew nearly tenfold during Mark's time directing the Arlington International Office. His many duties included managing the Window-on-the-World exchange program, which he rebranded and increased in size and scope; managing the Engineer and Scientist Exchange Program, which he shepherded successfully through a series of substantive changes; and creating, organizing, and editing the International Notes and a number of international annual reports and strategy documents. Mark thought

strategically and was often ahead of his time. He started AFOSR's data-mining effort 15 years ago, helping to explain the value of international investing in research to colleagues and leaders and to shape portfolio investments. All of these duties were fulfilled with care, revealing a sense of pride in the programs and what they contributed the AFRL.

Mark was a consistent and compelling voice for international engagement, briefing programs to high levels of the Air Force, the Department of Defense, U.S. government agencies, and many foreign science and technology offices. He managed and often led AFOSR's participation in a number of international fora (his choice of word), such as NATO's Research and Technology Organisation, the annual bilateral Technology Working Groups, the annual Air Senior National Representatives meeting, and The Technology Cooperation Program. He saw his duty as leading discovery of world-class research, identifying and capitalizing on emerging trends, leveraging foreign resources, bringing knowledge and collaborators to the AFRL, and building and growing productive relationships around the world.

During this quest, Mark visited more than 170 countries and territories. His knowledge, understanding, and appreciation of foreign cultures formed the foundation of his work and provided a repository from which his colleagues could draw. He was a wise, patient, utterly trustworthy advisor to generations of international program managers. He was perfectly suited to the role and his love of it was clear. In his job, he was an example of the poet's definition of work as love made visible. We were fortunate to have him as a leader and colleague for nearly two decades. He will be missed, but through what he created and nurtured, his influence remains.

The Maurice Family
from left) Mark Steware Maurice, Charles Francis Maurice , Gail Scheible Maurice, Annie Ogden Maurice, Louise Krusemark Maurice

30 January 2017
London, U.K.

Dear International Stakeholders and Partners,

It's been another incredibly busy and productive year for the AFOSR International Office (IO). In addition to having the opportunity to show off IO's steady stream of accomplishments to a number of distinguished visitors, we've advanced our leveraging of international science funding and improved our capabilities for assessing and reporting the science and technology we find.

IO members in both London and Tokyo got to welcome and brief Major General McMurry this year. MG McMurry visited EOARD in October and AOARD in August, hearing the latest on international S&T and making excursions to hear directly from leading Principle Investigators. EOARD also was host to Mr. Ebersole in London for the US-UK TWIG in September. In addition, Mr. Frank Kendall, Under Secretary of Defense for Acquisition, Technology and Logistics, met with EOARD'ers during his trip to the Farnborough Air Show in July. Dr. Dave Walker visited in October and went to Oxford as well to view hypersonics, network security, and quantum computing. He also kicked off the workshop on quantum biology. IO members at EOARD were happy to host visitors from AFMC's Inspector General Office in November and got a great report—well done!

We are continuing to expand the horizons of scientific knowledge through our Global Initiative Program. The focus of the initiative program is the exchange of researchers, information, and jointly funding specific technical area of mutual interest. Each IO office was successfully able to leverage $2M of collaborative funds to support AFRL tech focus areas and technical areas listed in the FY19 Commander's Investment Strategy. We currently have partnered with 5 nations: Korea (Nanosciences and Cyber); Taiwan (Nanosciences); Australia (Autonomous Systems); Israel (Quantum Sciences); and Mexico (Basic Sciences). We are also actively pursuing to add hypersonics effort with Australia and autonomy with Argentina in FY17.

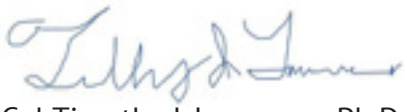
A Technology Assessment (TA) tool was developed and implemented this year to capture, track, and manage research assessments performed during our many engagements, such as site visits, conferences, workshops, and other technical events across the globe. The TA tool lays a foundation for better reporting products without ambiguity or misrepresentation. It has a user friendly input

via a single page web survey driven by drop down selections. The collected information includes program updates on the current research collaboration and accomplishments, as well as assessment of researchers, groups, labs, or tech trends. This tool also tracks transitions, program alignment to priorities, investments, regions/countries, and other items of interest to the Air Force. This will be a legacy tool helping new IO program officers to trace the technical trajectories of their international programs. In FY16, IPOs visited 195 unique sites in 38 countries, consisting of 184 institutions, and performed 293 assessments.

This year we said good bye to Jeremy Jordan, John Gonglewski, Vic Putz and Matt Snyder from the London office, as well as Brian Lutz and Ingrid Wysong from the Tokyo office. We also said farewell to Dennis Butcher and Jim Fillerup at the Arlington office. We welcomed Jason Foley, Chris McClernon, Jesse Peterson, Dave Garner, Shad Reed, and Kristine Martin to London and Jermont Chen, Jeremy Knopp, and Akira Namatame to Tokyo. Also, Brett Pokines moved from Santiago to the Arlington office, joining new ION member Barrett Flake.

The excitement continues across IO for the new FY and I look forward to discovering new areas of international S&T that benefit our Air Force research mission. Thanks for reading this report, and if you have any questions, please get in touch!

Diana and I would like to say thanks to Dr Christian. It was awesome working with you and we really enjoyed your company and best of luck in your new job in SAF/AQ. We both really look forward to working with Dr. Darema as she meets all of the AFOSR/IO team this year!



Col Timothy J. Lawrence, Ph.D.
Director, AFOSR/IO

EXECUTIVE SUMMARY AND HISTORY

AFOSR International Basic Science Office

The Air Force Office of Scientific Research (AFOSR), a directorate within the Air Force Research Laboratory (AFRL), is responsible for managing all Air Force basic research investment. The AFOSR mission is to discover, shape, and champion basic science that profoundly impacts the future Air Force. As the global R&D community outside the US accounts for approximately 70% of the investment, 80% of the researchers, and over 80% of the technical publications, it is critical to AFOSR's mission to proactively engage the international community.

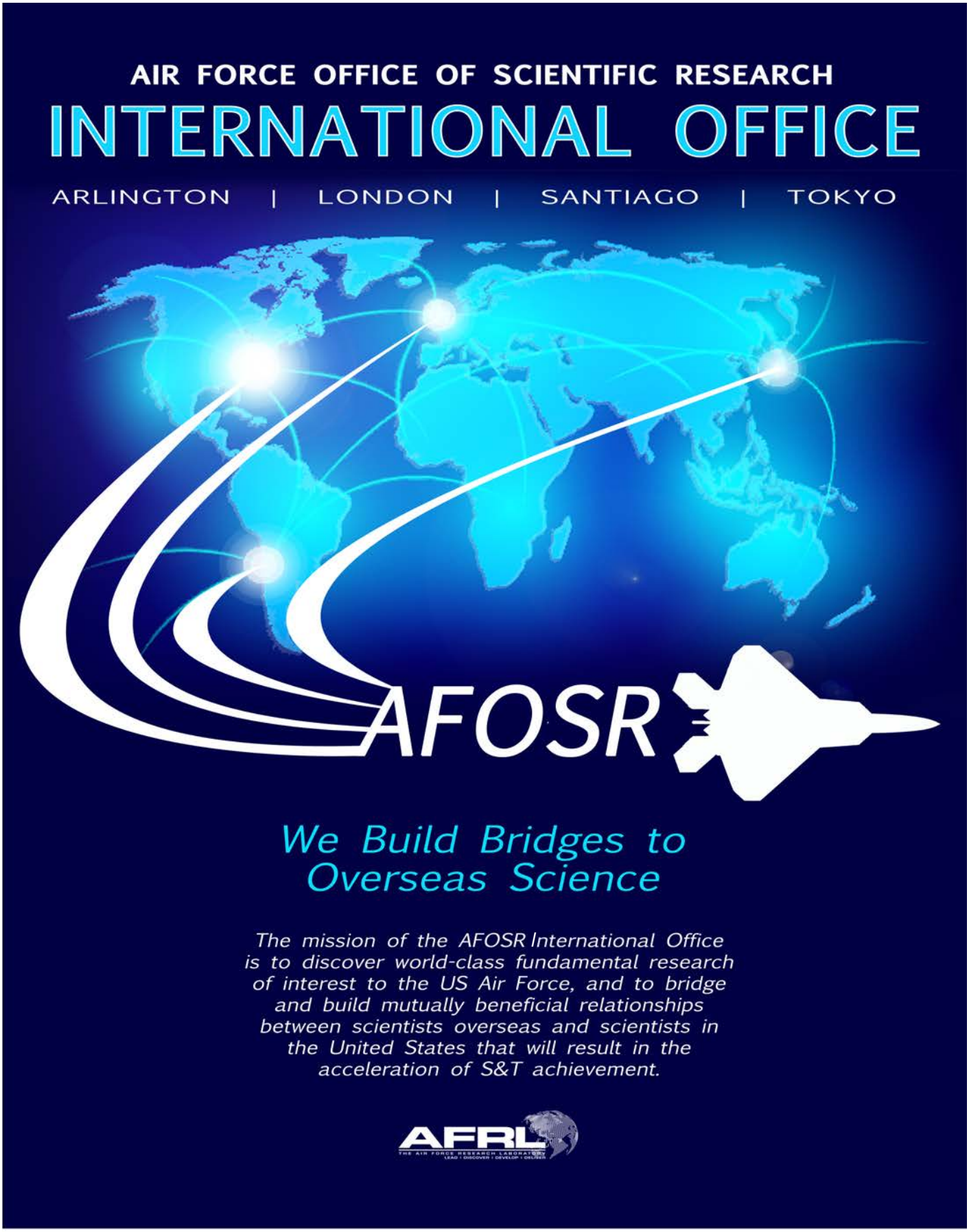
AFOSR's international enterprise consists of four offices: AFOSR/IOE, the European Office of Aerospace Research and Development (EOARD) in London; AFOSR/IOA, the Asian Office of Aerospace Research and Development (AOARD) in Tokyo; AFOSR/IOS, the Southern Office of Aerospace Research and Development (SOARD) in Santiago; and a support division (AFOSR/ION) in Arlington, Virginia, to facilitate integration, communication, and outreach.

These four international offices constitute a single International Basic Science Office, realizing significant efficiencies in both business operations and technical strategy. The mission of this consolidated office is: Provide the US Air Force awareness, engagement, and relationships to overseas basic research.

In FY2016, AFOSR's International Basic Science Office supported 393 research efforts (primarily grants) performed at foreign universities and institutes from 43 different countries. In addition to funding research projects, we build relationships between foreign researchers and US scientists and engineers through a variety of programs. This last year, we supported 17 international conferences and workshops, 171 visits of foreign researchers to present their research to AF audiences, and 29 AF scientists and engineers to conduct research in foreign laboratories.

The pursuit of cutting-edge science of AF relevance—both within the US and overseas—remains the singular focus of the AFOSR. The international element of this organization is well poised to shape, leverage, and transition exciting breakthroughs in the years ahead.

www.afosr.af.mil


AIR FORCE OFFICE OF SCIENTIFIC RESEARCH
INTERNATIONAL OFFICE
ARLINGTON | LONDON | SANTIAGO | TOKYO
AFOSR
We Build Bridges to Overseas Science
The mission of the AFOSR International Office is to discover world-class fundamental research of interest to the US Air Force, and to bridge and build mutually beneficial relationships between scientists overseas and scientists in the United States that will result in the acceleration of S&T achievement.
AFRL

International Offices & Programs

The AFOSR International Basic Science Office (AFOSR/IO) consists of four subordinate offices, realigned together under AFOSR/IO starting in FY2013.

AFOSR Office Locations.

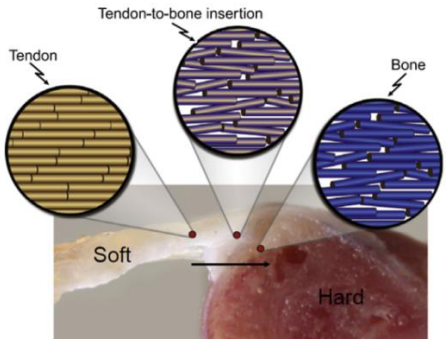
AFOSR/IOE - European Office of Aerospace Research & Development

The oldest of AFRL's overseas offices, EOARD (AFOSR/IOE) was originally established in Brussels in 1952 under the now defunct Air Research and Development Command, moved to London in 1970, and then realigned under AFOSR in 1974. Throughout its 62-year history, it has maintained the primary mission of engaging the European scientific community to support and leverage emerging basic research of interest to the US Air Force. EOARD's geographic area of responsibility includes Europe, the Middle East, former Soviet states, and Africa. EOARD is a partner organization to the Civilian Research and Development Foundation (CRDF Global), International Science and Technology Center (ISTC), and the Science and Technology Center in Ukraine (STCU) to facilitate projects in former Soviet states. Based in Greater London, EOARD is co-located with other DoD scientific outreach offices, including those of the Office of Naval Research Global, US Army International Technology Center-Atlantic, Defense Logistics Agency (DLA), and the US Army Corps of Engineers.

Commander: Col Timothy Lawrence | Contact: eoard.orgbox@us.af.mil

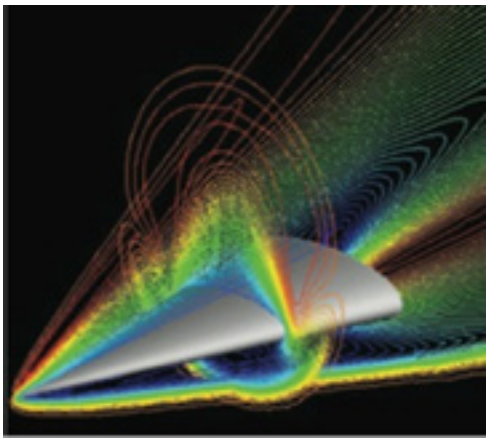
AFOSR/IOE - (EOARD) Basic Research Programs

Advanced Aerospace Materials and Structures. The Advanced Aerospace Materials and Structures portfolio seeks revolutionary basic science in the disciplines of physics, mathematics, materials science, structural mechanics and aeronautical sciences to enable new technologies for aerospace structures with United States Air Force relevance. This portfolio has two central pillars: energy efficient structures and extreme environment structures. Energy efficient structures are those which reduce operational costs through innovative means; examples include reconfigurable and/or novel flight structures. Fundamental research in this area is supported by many disciplines including structural mechanics, aeroelasticity, and materials science. This portfolio defines extreme environment structures as those subject to loads from high temperature, frequency and/or high strain rates with special emphasis on combined loadings. As such this portfolio supports research which drives towards material characterization under high strain rate or research which acts as an enabler for hypersonic flight. Supporting these two pillars are two foundational areas of study, including computational modeling and methods, focused on multi-scale and multi-physics simulations as well as optimization techniques, all designed to enable efficient and extreme environment aerospace structures. The second foundation is materials development where the focus is on next generation composites, optical materials, and new materials development. Further information about the goals, aims, and activities of this portfolio can be obtained by emailing the Program Officer, Lt Col David Garner, at david.garner.2@us.af.mil.



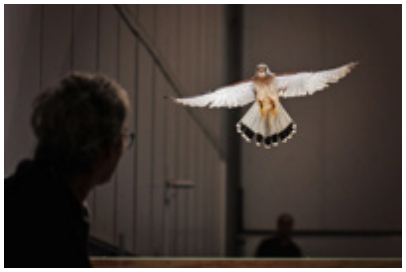
New materials mimic natur by blurring the interface between material types and providing a single material solution to replace a complex device.

Aeronautical Sciences. This portfolio covers a wide range of fundamental science problems under the heading of Aeronautical Sciences. Aeronautical Sciences covers any and all technology associated with enabling flight in air or that leads to a greater understanding of sciences therein. There are three main sub-areas of research focus within this program: 1) Aerodynamics, which covers fundamental science associated with the motion of air (or fluid), particularly when interacting with a body, and for which the relevant challenges in this area include hypersonics, flow physics for control, unsteady and low Reynolds number aerodynamics, boundary layer physics (especially transition), and fluid-structure interaction; 2) Air Vehicle Sciences, which deals with sciences associated with the air vehicle configuration, operation, and/or structures which can lead to increases in performance or agility; and 3) Air Breathing Propulsion, which covers fundamental research associated with all aspects of air-breathing propulsion, including improved performance of conventional engines and enabling capabilities for supersonic combustion engines. Further information about the goals, aims, and activities for this portfolio can be obtained by contacting the EOARD Program Officer, Dr. Russ Cummings, at russell.cummings@us.af.mil.

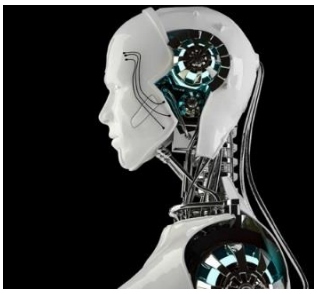


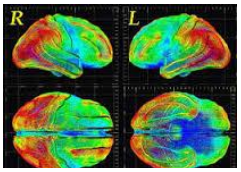
Autonomous Vehicles. This newly assembled portfolio was created to focus attention specifically on basic science and technology related to the realization of Autonomous Vehicles. While this topic is admittedly broad and could encompass dozens of areas, the portfolio will be centered on three sub-areas: 1) Control Sciences to include autonomous guidance & control algorithms, decentralized/cooperative

control, distributed real-time optimal control; 2) Air Vehicle Sciences which investigates the aerodynamic and structural challenges and opportunities associated with traditional and non-traditional air vehicle configurations unsuitable for, or unencumbered by, manned operation; and 3) Biologically Inspired Autonomy which covers science and technology inspired by natural flyers that will help us understand and apply biological principles to the design of UAS in order to derive step change increases in mission capability through highly innovative research. Further information about the goals, aims, and activities for this portfolio can be obtained by contacting the EOARD Program Officer, Lt Col Shad Reed, at shad.reed@us.af.mil.



Autonomy, Cognitive Sciences, and Human Factors. The Research in Europe on Autonomy, Cognitive sciences & Human factors (REACH) program was established in 2016 to address the most pressing Air Force behavioral science topics related to human interactions with other humans and machines. The program's autonomy research includes human-machine teaming, human trust in automated systems, supervisory control of highly automated systems, and other interactions with intelligent machine agents. The REACH sub-program on cognitive sciences explores theoretical cognitive research related to human information processing, biomarkers of stress & workload, socio/cultural topics, and applied neurosciences. The final Human Factors Engineering sub-area supports military research topics related to man-machine interfaces to include direct brain-machine interactions (neuroengineering), neuroergonomics, and display symbology and optimization involving all of the human senses. The REACH program is specifically designed to tie critical European, African, and Middle Eastern Behavioral Science research to AFRL's 711th Human Performance Wing, Human Effectiveness Directorate, and the Air Force Office of Scientific Research, as well as to the US Air Force Academy's Department of Behavioral Sciences and Leadership. For more information about the REACH portfolio, or to help identify critical research areas/gaps, please contact the EOARD Program Officer, Lt Col Chris McClernon, at christopher.mcclernon@us.af.mil.

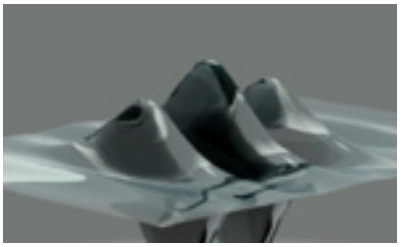




Cyber and C4ISR. This program supports international research in all aspects of technology related to cyber capabilities and Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR). The program draws from international communities of communications and network theory, provable security, information assurance, mathematics, and signal processing. In 2016, the program funded research into: proof assistants and tools for algorithms and protocols; the tensions between data provenance and data security; the tradeoffs between complexity, degeneracy and robustness in network functionality; new medium access control mechanisms for radar-comm hybrids, molecular devices, and multi-receiver channels; and new metrics for understanding and identifying emergent behaviors. In 2017, the program will start new work in: formally investigating and quantifying the human component of cyber security; understanding the information capacity of hidden malware command and control channels; and behavior-based access control paradigms. Further information can be obtained by contacting the Program Officer, Lt Col Ryan Thomas, at ryan.thomas@us.af.mil

Life Sciences & Human Performance. The Life Sciences & Human Performance portfolio covers a broad range of human performance technology areas associated with sensing, monitoring, modeling, augmenting, and training the human. Advancing human performance requires fundamental basic research in new technologies aimed at optimizing and protecting the men and women that operate on the ground, in the air, and in space. This portfolio focuses on human-centric sensing and sensor systems including research aimed to: 1) better understand and interrogate the fundamental physiological and biochemical signatures of performance and health; 2) investigate novel human sensing materials or technologies; 3) test new methods for integrating or merging complex multisensory data streams to extract meaningful measures of performance; and 4) better understand/model the biological effects (physiology and toxicology) of military-relevant stressors (lasers, radiofrequency radiation, microwave radiation, etc.). Further information about the goals, aims, and activities for this portfolio can be found by contacting the EOARD Program Officer, Mr Lee Poeppelman, at lee.poeppelman.1@us.af.mil.

Mathematics and Operations Research. The Mathematics and Operations Research portfolio supports basic science in a broad range of mathematical domains aimed at developing innovative, fast, and reliable methods for creating and/or analyzing large and complex models relevant to US Air Force applications. Modern technologies have made data collection more ubiquitous in the Air Force than ever before; this includes everything from medical care databases to outputs of an individual radio frequency sensor. As the amount and complexity of data increases, new techniques are required to better extract meaningful information from underlying structure in data. Specifically, the portfolio advances this effort via three primary research foci: signal processing, machine learning, and uncertainty quantification. Collectively, these focus areas drive toward novel approaches for modeling and data analysis, along with theoretical performance guarantees. This portfolio also seeks to tie in with current research efforts of the Information Directorate and AFOSR. For further information about the goals, aims, and activities of this portfolio, please contact the EOARD Program Officer, Maj Jesse Peterson, at jesse.peterson.1@us.af.mil.



Materials, Nanotechnology, Optics, and Physics. The materials, nanotechnology, and physics portfolio provides basic research across an incredibly wide range of technical domains. This portfolio is the result of merging the physics portfolio with the materials and nanotechnology portfolio. The materials portfolio carried two primary themes: Computational Materials Science, which focuses on developing models for predicting electronic, magnetic, thermal, optical, mechanical, and/or other properties of materials as well as the complementary materials characterization experiments for validation; and Functional Materials, which involves the development of novel materials for devices and systems with an emphasis on developing systems with desired operability in the extreme environments of aerospace applications. Similarly, the physics portfolio has focused on three main pillars in recent years: Advanced Carbon continues to be a major investment area, with new projects examining in situ characterization of nanotube growth processes and bonding dynamics; Sub-Wavelength Physics (formerly metamaterials) focuses on the design and implementation of material systems and devices which manipulate energy propagation for both electromagnetic and mechanical waves; new projects on multifunctional acoustic metamaterials, topological insulators, and tunable plasmonic devices for optoelectronic systems are just a few examples in this very active and exciting research area. Finally, significant global investments saw quantum computing attract a growing level of attention. Correspondingly, EOARD maintains a significant number of projects in Quantum Technologies, including

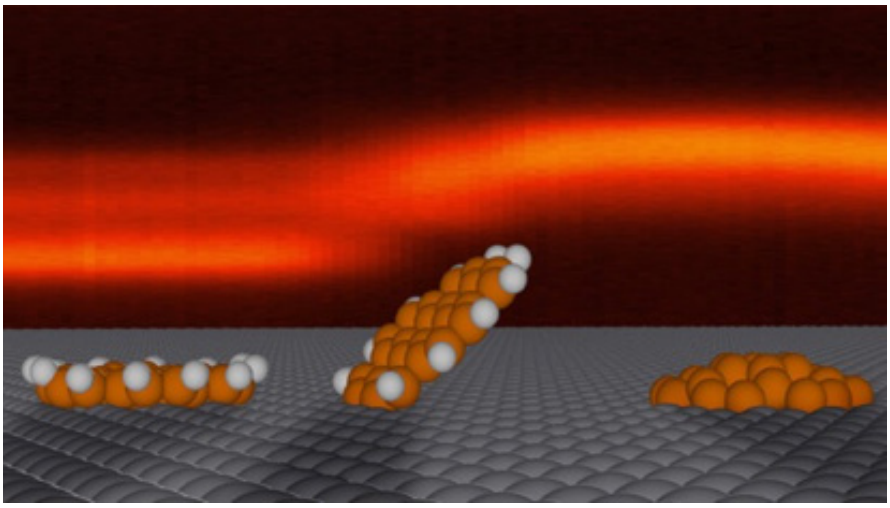
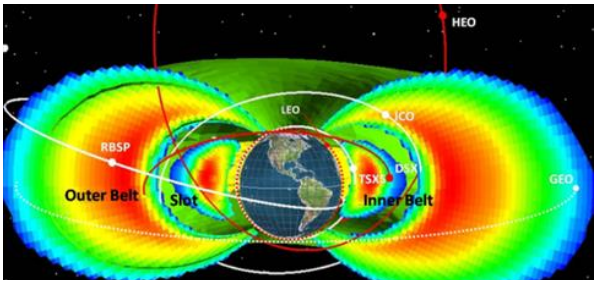
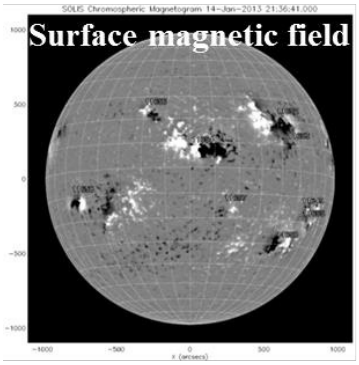


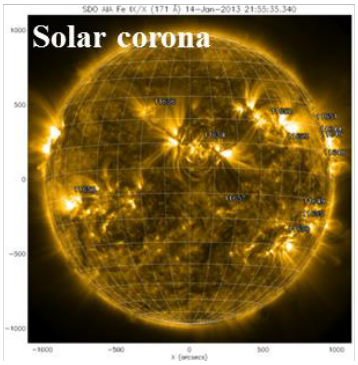
Figure taken from "Molecular Lifting, Twisting, and Curling during Metal-Assisted Polycyclic Hydrocarbon Dehydrogenation": J. Am. Chem. Soc., 2016, 138 (10), pp 3395-3402

grants focused on entanglement via optoelectronics/photonics devices as well as projects in cold atoms, ion traps, photonic chip production, and precision clocks for position/timing/navigation, gravitational sensors, and more. Other minor initiatives in this portfolio are driven by strong AFRL Technical Directorate interactions, including steels and alloys, optics and photonics, and plasma and electro-energetic physics. Further information about the goals, aims, and activities for this portfolio can be found by contacting the Program Officer, Dr Jason Foley, at jason.foley.1@us.af.mil.

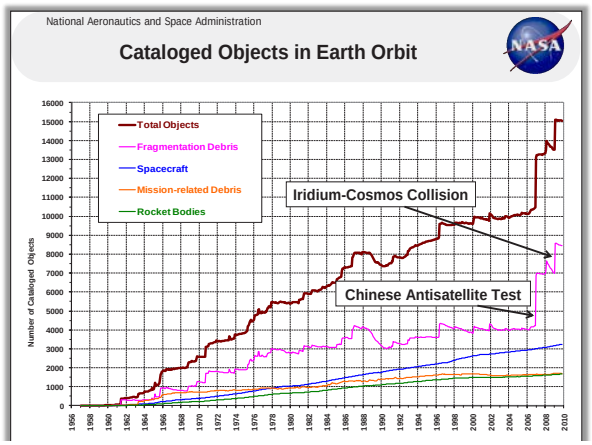
Space Sciences. This program's goal is to advance the understanding of the space environment to improve space situational awareness (SSA). The space environment affects all orbiting objects and has impact on communication, navigation, and other programs of relevance to the Air Force. Focus areas for this program include solar storm prediction and transport through the inner heliosphere; radiation and energetic particle distributions occurring in quiet conditions or from storm events; bottom-side structure of the ionosphere and its impact on radar propagation; prediction and trigger mechanisms of ionospheric scintillation and associated plasma instabilities; thermospheric dynamics (energy deposition, neutral winds, etc.) and its effects on atmospheric drag on satellites; and the atmospheric physics which impact satellite communications at various frequencies. Current instruments and models have advanced the state of the art over the past decade, but more accurate predictive modeling and simulation is needed. New instruments and models, particularly coupled models, are needed to understand and forecast significant space weather events. There is significant space weather research capability across Europe responding to, and understanding of, risk to national assets. Research institutions in Africa provide an opportunity to explore atmospheric physics in a unique region. Because of the potential global implications, interest in space science research is growing worldwide, providing an excellent opportunity to leverage the research investment across the community. Further information about the goals, aims, and activities can be found by contacting the EOARD Program Officer, Dr. Kent Miller, at kent.miller.2@us.af.mil.

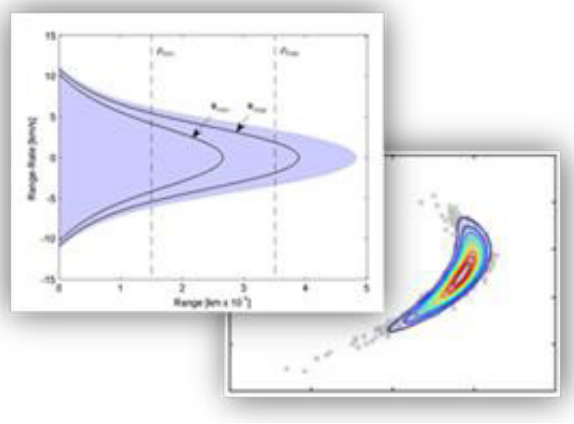






Space Technology. This research program sponsors basic research in space situational awareness, space object tracking and identification, and novel space vehicle technology. Covering a broad range of fundamental science and technology problems, the space technology portfolio focuses on the following multi-disciplinary sub-areas: 1) Remote Sensing and Imaging, including detection, tracking, identification, and object characterization methodologies, adaptive/multi-modal sensing, multi-object tracking and estimation, multi-sensor data fusion techniques, and real-time signal processing; 2) Astrodynamics, including orbit determination/prediction methodologies, orbit evolution uncertainty quantification, and spacecraft-environment coupled nonlinear dynamics modeling techniques; 3) Vehicle Technologies, including such topics as novel mission concepts and non-traditional spacecraft configurations, high-precision sensor/actuator techniques, nanoelectronics fundamentals, electric propulsion fundamentals, and advanced attitude determination and control techniques; 4) Space Robotics and Autonomy, including autonomous guidance & control algorithms, path planning/ trajectory optimization, and novel multi-agent distributed coordination methodologies; and 5) Responsive Space, including reconfigurable sensors and modular/adaptive architecture methodologies. Overall, it is through international discovery, engagement, and building relationships that this program aims to make substantial contributions to the scientific community while providing revolutionary ideas and transformational solutions that will ultimately lead to new space capabilities and enhanced autonomous systems in the timeframe of 5 to 20 years. Further information about this program can be found by contacting the EOARD Program Officer, Dr. Kent Miller, at kent.miller.2@us.af.mil.





AFOSR/IOA - Asian Office of Aerospace Research & Development

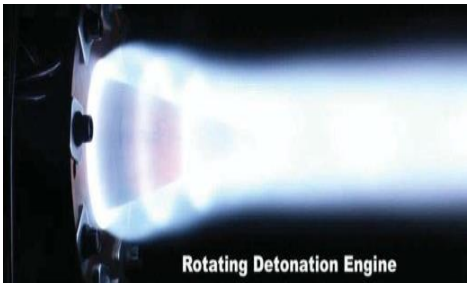
AOARD was established under AFOSR in 1992. For the last two decades, it has promoted basic science and scientific interchanges of interest to the US Air Force through the combined efforts of multinational top researchers within the region. AOARD's geographic area of responsibility is the Asia-Pacific region. The region has been rapidly rising in importance within the scientific community, and publishes more scientific papers compared to other regions globally. One reason behind this rapid growth is the innovative approach utilizing a convergence of key emerging and enabling technologies, such as nanotechnology, biotechnology, information and cognitive science. AOARD is the AF focal point for awareness, engagement and building relationships with the scientific leaders of the region. Located in Tokyo, AOARD shares offices with the Army's US Army RDECOM Forward Element-Pacific and the Office of Naval Research Global-Asia, and works indirectly with the U.S. Pacific Command through the Mutual Defense Assistance Office (MDAO) at the embassy in Tokyo.

Chief: Dr. Misoon Mah | Contact: afosr.aoard@us.af.mil

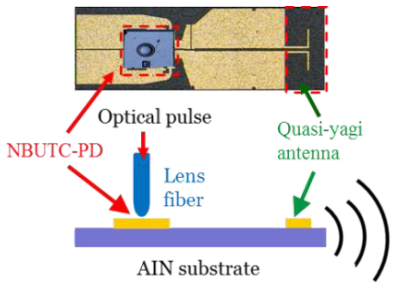
AFOSR/IOA - (AOARD) Basic Research Programs

Space and Hypersonics. This program seeks revolutionary science on all fundamental research relating to space weather: solar storm physics and predictions; solar wind and magnetosphere interactions; ionospheric physics, measurements, dynamics, and coupling to the atmosphere and the magnetosphere. Another particular focus area is nonequilibrium flows, including high-temperature hypersonic flows and advanced measurements for these flows, shocks, plasma-materials interactions, and rarefied flows. Another is research relating to novel spacecraft propulsion and research relating to space situational awareness (orbital debris dynamics, generation, removal and tracking, optical tracking methods, etc). Program Officer: Lt Col Sheena Winder | Sheena.winder@us.af.mil.

Combustion and Aero. This program explores fundamental research opportunities for enabling future propulsion systems with game-changing efficiency and operability, with a particular emphasis on science and engineering leading to novel combustion, energy conversion, and energy-saving approaches. In addition it looks for unique expertise or facilities in the fields of aerodynamics, structural mechanics.
Program Officer: Lt Col Sheena Winder | Sheena.winder@us.af.mil



Physics and Mathematics. The AOARD Physics and Mathematics portfolio maintains many projects across a number of domains supporting a variety of research and organizations. While open to a wide scope of projects which may in some manner use Physics and Mathematics the core focus of the program falls into two primary categories. BioPhysics looks for mathematical laws in nature in order to understand, describe, predict, and control the forces that drive biological systems.



❖ W-band Photonic Transmitter

This study happens at every level from atoms to environments from protein machines to neurological biomarkers. Mathematical Modeling is a description of a technical arrangement of mathematical concepts and language. Mathematical models are used in the natural sciences as well as in the social sciences. Mathematical models may take many forms, including but not limited to dynamical systems, statistical models, differential equations, game theoretic models, or models which combine and overlap other forms. Close interaction with AFRL Technical Directorates (RH, RX, RW, RQ) as well as Army, Navy and DARPA colleagues helps to drive the direction of this program. Program Officer: Lt Col Kristopher Ahlers | Kristopher.ahlers@us.af.mil

Quantum Engineering and Cyber-Security Foundations. This program is a new and growing focus area for AFOSR. In 2016, AFOSR opened a new Quantum Information Science portfolio. The AOARD program largely supports this transition. The topics are broadly described as quantum sensing, quantum communications, and quantum enabled calculations. In each of these areas, the use of non-classical quantum-mechanical phenomena enables one to beat the classical physics limits once assumed to limit system performance. The domain of quantum sensing includes superconducting, BEC, and atomic interferometric to sense motion and electromagnetic fields. The field of quantum communication enables guaranteed eavesdrop-free communication channels built by using entangled states. The domain of quantum calculations include both quantum simulations and new algorithms and hardware needed to manipulate quantum states to execute quantum-specific algorithms that can perform tasks not easily possible on a classical computer. Program Officer: Lt Col Mario A Serna | Mario.serna@us.af.mil

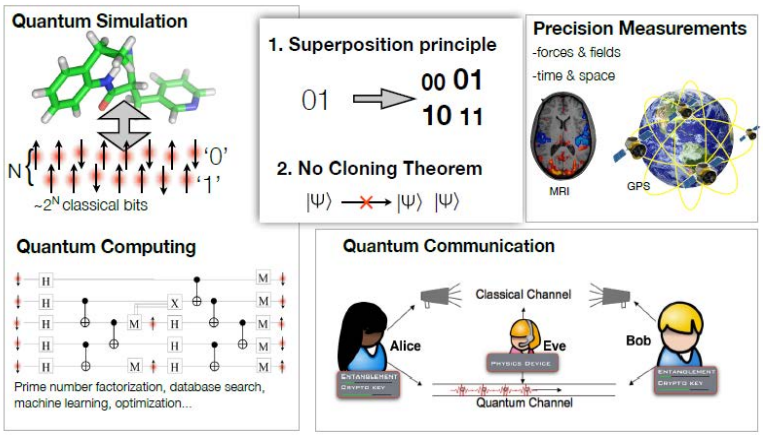
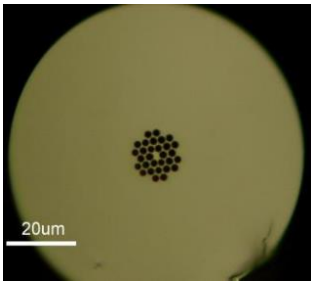
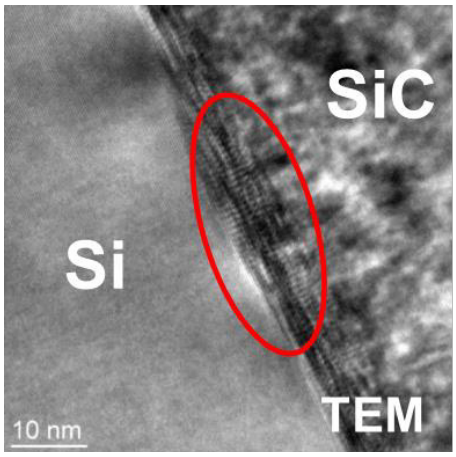


Figure from BRICC summary of the AFOSR "Future Directions of Quantum Information Workshop"which took place on 25-26 August 2016.

Lasers & Optics. This program is focused on Optical Sciences. Focus areas center on Laser materials for high power lasers – transparent ceramics, sesquioxide materials and fiber lasers. Close interaction with AFRL Technical Directorates (RY, RD and RV) guides the focus and ensures relevance of this portfolio to the Air Force. There is also great interest, participation and funding with DoD partners from the Navy, Army and HEL/JTO. Program Officer: Lt Col Scott Robertson | Scott.robertson@us.af.mil



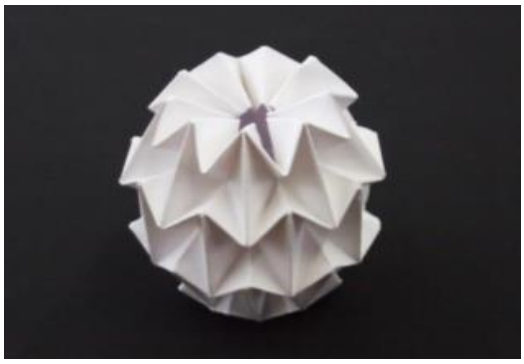
Materials, Chemistry, Nanoscience. This program broadly covers hard and soft materials, organic/polymer chemistry, and catalysis. We seek basic research projects that lead to creation of new (nano)structures or enhancement of existing capabilities and functionalities through precise control of material (nano)structure and morphology at specific length scales, and ultimately understanding how to use material processing to control (nano)structures and properties across multiple length scales (i.e., atomic/molecular to micron). Some representative application areas of interest include electro-optic and -active materials; light-weight, high strength structural materials; and processes that lead to on-demand chemicals, materials, and properties. Novel catalytic processes are of particular interest.

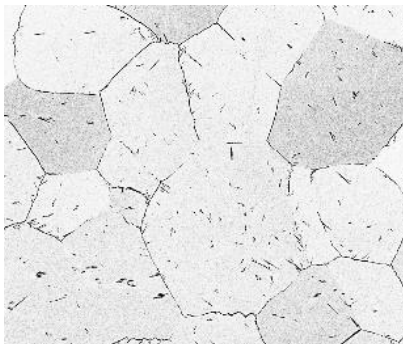


Program Officer: Dr. Ken Caster | AOARD.Materials.Chemistry@us.af.mil.

Sensors and Devices Physics. This program explores fundamental concepts in RF sensors, MEMS, microelectronics, photonics, electro-mechanical, and bio-inspired optical devices to advance current and future Air Force capabilities. The basic research areas are: a) Computational electromagnetic (EM) and clutter modeling, b) Scalable low power density phased antenna array, c) Nanostructured metamaterials and phenomenological material media parameters, d) Distributed secured networks and sensor electronics, e) Semiconductor spintronics and quantum computation. Program Officer: Dr. Seng Hong | seng.hong@us.af.mil

Structural Materials. This program is focused on Materials Science as applied to load-bearing structures. Focus areas include metals, ceramics, composites, as well as compliant materials and structural health monitoring. Close interaction with AFRL Technical Directorates (RX and RQ) guides the focus and ensures the relevance of this portfolio to the Air Force. There is also great interest, participation and funding with DoD partners from the Navy, and Army. Program Officer: Lt Col Scott Robertson | Scott.robertson@us.af.mil



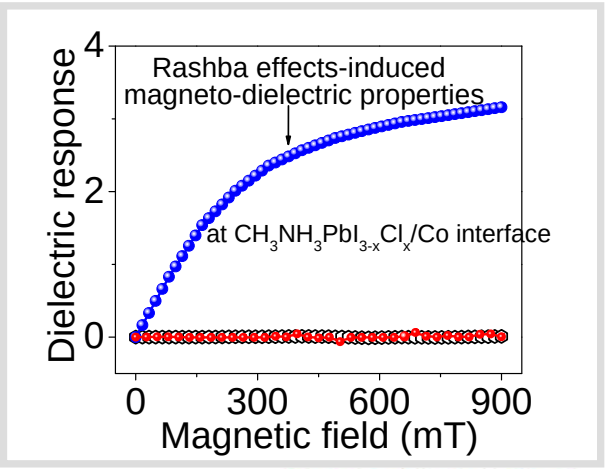


Materials Discovery and Manufacturing Science. This program broadly covers the exploration of new material systems and the use of autonomous experimentation for materials discovery and manufacturing optimization. New materials systems of interest include high-entropy alloys, magnetic materials, programmable materials, flexible electronics, materials for extreme environments, multifunctional materials, and nanoscale materials and structures. Currently, automated processes are used in additive manufacturing, laser annealing, automated fiber placement, device pick and place, and other material processes. Leveraging parallel research in autonomy where appropriate, this program is seeking to provide the foundational science of control algorithms based on advances in machine learning and novel reliable sensing techniques necessary for future suites of tools that will ensure decisions can be made to optimize key product life-cycle

objectives such as manufacturability, reliability, and cost (including sustainment). In addition, uncertainty quantification (UQ) techniques and verification and validation necessary for design of material systems for additive manufacturing is of interest. Close interaction with AFRL Technical Directorates (RX, RQ, and RH) guides the focus and ensures the relevance of this program to the Air Force. Program Officer: Dr. Jeremy Knopp | Jeremy.knopp@us.af.mil

Novel Nano-Magnetic Materials and Multifunctional Materials (NNMM).

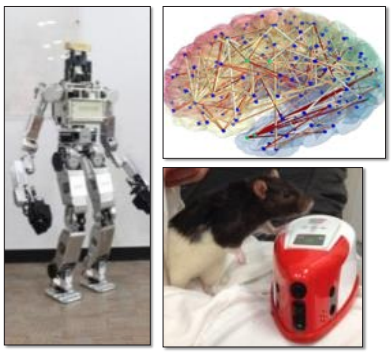
This program investigates magnetic material systems at the nano level. Traditional magnetic properties have been obtained by using spins in ground states through molecular, morphological, and dimensional controls. However, integrating magnetic properties with optics and electronics have become an emerging area necessary for developing spin-controllable optics and electronics to advance sensing, detection, and renewable-energy applications. The possibility of synergistic interactions between magnetic, electronic, and optic effects may provide new properties and application potential. The approach for developing novel nano-magnetic materials will use significant spin coupling in nanomaterials or in molecular excited states under optical or electrical excitation to generate strong magnetic properties and magnetically controllable multiple functions. This research effort presents a unique research area to generate superior magnetic properties for application to Air Force technologies. The US, Japan, China, France, Germany, Brazil and Korea, etc. have been investing in the areas of novel magnetic materials, nano-magnetic materials synthesis, molecular spin physics, and magnetic structure-property characterizations in both ground and excited states. Clearly, nano-magnetic and multi-functional materials are expected to become a critical component in next-generation detection, sensing, and renewable-energy technologies. The recent international collaborations have made significant progress on optically controllable magnetic properties, coupling between magnetic and optic properties, coupling between magnetic and electric properties, and magnetic properties in renewable-energy technologies.



Rashba effects induced magnetically controllable electric properties: magneto-dielectric functions, experimentally obtained at perovskite/Co interface

Program Officers: Dr. Misoon Mah and Dr. Jeremy Knopp | Jeremy.knopp@us.af.mil

Information Sciences.



This program is broadly focused in three main areas: Autonomy, Cognitive/Brain Science, and Computational Intelligence. Exploring leading-edge, fundamental research which is unique or complementary to work in the United States, addressing the critical questions in these areas. Leveraging limited resources on high-risk, but fundamentally sound, leading research labs throughout Asia/Pacific and bringing that research back to the AF through collaboration established through AFRL TDs (specifically: RI, 711HPW/RH, RY, RQ and RW). Key areas currently under investigation are human-machine teaming research, machine learning techniques, autonomous planning and learning techniques. Program Officers: Dr. Hiroshi Motoda | hiroshi.motoda.1.jp@us.af.mil

AFOSR/IOS - Southern Office of Aerospace Research & Development

SOARD, the smallest of AFOSR's international offices, was established in 2007 to engage the rapidly emerging Latin American scientific community. Located in Santiago, Chile, SOARD promotes scientific advancements of interest to the US Air Force by coordinating research with the leading scientists of Mexico, Central, and South America in partnership with AFRL investigators. In FY16, SOARD managed a total of 34 scientific projects with 28 research institutions in Latin America. Because of its unique location within a US Embassy, SOARD also leverages the Dept of State mission by promoting S&T cooperation with government funding agencies, and supporting DoD bi-lateral S&T efforts in the region. Similar to its sister offices of AOARD and EOARD, SOARD is co-located with the Army's Research, Development & Engineering Command (RDECOM) - Americas and the Office of Naval Research - Global (ONRG).

Chief: Lt Col Michael Martinez | Contact: theamericas@us.af.mil

AFOSR/IOS - (SOARD) Basic Research Programs

SOARD is assigned three International Program Officers (IPO). Consequently, each IPO covers a broad range of scientific disciplines. Its overall strategy is to form research collaborations between technical expertise at AFRL and scientists throughout Latin American. Chief – Lt Col Michael Martinez.
Please email theamericas@us.af.mil to contact a SOARD Program Officer.

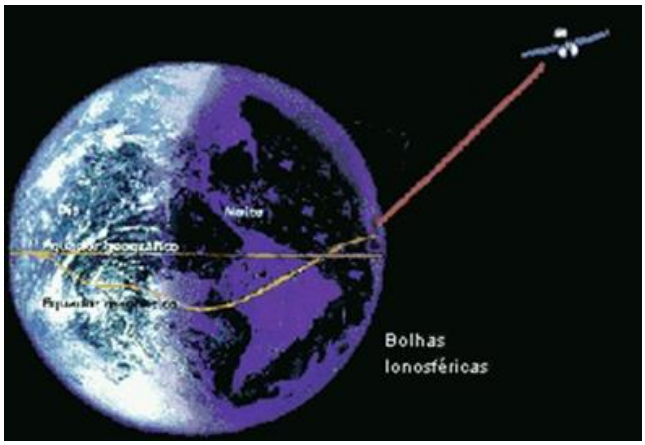
Latin America – Physics & Nanoscience. This portfolio links the Air Force Research Laboratory into the global science community. The portfolio objectives are integrating innovative science outside the US vocabulary into the Department of Defense science and technology acquisition chain, matching US Air Force requirements with unique Latin American science resources, and building collaborative, leveraged programs. US Air Force longer-term science goals are being realized through a teaming strategy with the US State Department, Army Research, Development, and Engineering Command, along with other national and international science investors.

Innovative programs in organic materials chemistry, natural materials and systems, and quantum electronic solids drawing on Latin America's unique biodiversity and infrastructure investments are broadening US Air Force technology capabilities through the portfolio. Globally-integrated teams aligned with the US Air Force Research Laboratory's Advanced Components for Electronic Warfare Consortium roadmaps are researching integrated silicon photonics and metamaterials. The portfolio has programs anchored in Argentina, Chile,

Brazil, Mexico, and cross-discipline collaboration partnering with US, Thailand, Taiwan, and Sweden-based science leaders. Funded projects support the current Broad Agency Announcement (BAA) topics of (i.) Dynamics & Control, (ii.) Atomic & Molecular Physics, (iii.) Science of Information, Computation & Fusion, (iv.) Dynamic Materials & Interactions, and (v.) Energy & Combustion Science.
Program Officer: Dr Brett Pokines | Brett.pokines.1@us.af.mil

Latin America – Space Science & Space Situational Awareness (SSA).

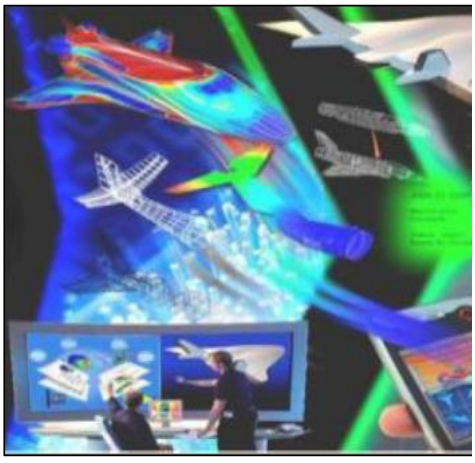
Due in part to the singular infrastructure and the geophysical space environment found in the southern hemisphere, key research areas in this SOARD portfolio are Space Science and Remote Sensing—all to enhance Space Situational Awareness. Unique features include the magnetic equator, which passes through the heart of South America, monitored by a network of scintillation stations located throughout the region to study ionosphere perturbations that affect GPS and communications. Similarly, the SAMBA magnetometer network, running north and south down the length of Chile and into Antarctica, studies the earth's magnetic fluxes and monitors magnetic storm effects. These stations are supported by NSF, NASA and the AFRL Space Vehicles (RV) Directorate. Finally, some of the world's largest and most advanced astronomical observatories are located in the dry regions in the Andes of Argentina, Chile and Peru, taking advantage of what is considered by many as the darkest and clearest skies on the planet, to enhance methodologies in Space Situational Awareness. Leveraging these unique resources, SOARD has formed research collaborations with several institutions in Latin America for the purpose of forecasting the geospace environment of Earth. This research is necessary for predicting satellite drag and radiation belt perturbations used in maintaining space situational awareness and for protecting AF space assets used in communications, navigation, and surveillance.



Program Officer: Lt Col Michael Martinez | michael.martinez.2@us.af.mil

Latin America – Structural Mechanics & Aerodynamics.

SOARD seeks new physics-based models that quantitatively predict material performance and durability of metallic and composite flight structures. These include the control of aerodynamic responses of extremely flexible, nonlinear structures resulting from the use of newer, more flexible, lightweight materials. In addition, novel and revolutionary on-board health monitoring concepts are being explored to increase the safety and structural integrity of air vehicles. Recent accomplishments include implementation of a computational model of viscoplasticity with kinematic hardening in COMSOL Multiphysics software in order to compute stresses in adhesive joints more accurately, and the development of a nanomembrane-based sensor for damage identification.



Program Officer: Lt Col Michael Martinez | michael.martinez.2@us.af.mil

AFOSR/ION - International Division - Arlington

AFOSR's International Division in Arlington, Virginia, (AFOSR/ION) provides critical links between the overseas offices and customers and colleagues based stateside. It is responsible for a range of activities and programs that either must be run or are most efficiently run from AFOSR's headquarters. Responsibilities include technology security assurance and training; data mining; personnel exchanges to and from AFRL and affiliated sites; liaison with other DoD federal agencies and Washington-based foreign S&T offices; assistance in developing collaborative international programs; and representing the international community in drafting of AF and DoD plans and strategies. ION's work is a mixture of specific programs and the development of new activities.

Chief: Dr. Barrett Flake | Contact: barrett.flake@us.af.mil

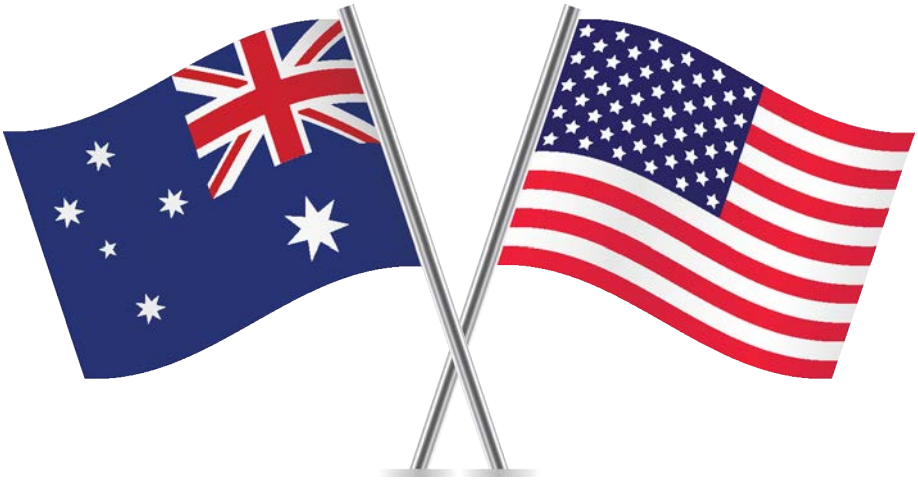
AFOSR/ION - Programs and Services

S&E Exchange Programs. ION manages the Engineer and Scientist Exchange Program (ESEP) and the Windows-on-the-World (WOW) Program. The ESEP places Air Force researchers into research laboratories of foreign militaries and foreign military researchers into AFRL, the Air Force Academy, or the Air Force Institute of Technology. The program began in 1963 with a bilateral agreement with Germany. There are now 16 countries that exchange researchers with AFRL (Australia, Canada, Czech Republic, Chile, France, Germany, Israel, Italy, Japan, Korea, Norway, Poland, Singapore, Spain, the Netherlands, and the United Kingdom).
The WOW Program places AFRL researchers into nongovernment foreign laboratories. Participants in FY16 are shown on page 41. Program Officer: Mr. Phil Gibber | phil.gibber.1@us.af.mil

US-German ESEP/APEP Program Review held in December at AFOSR

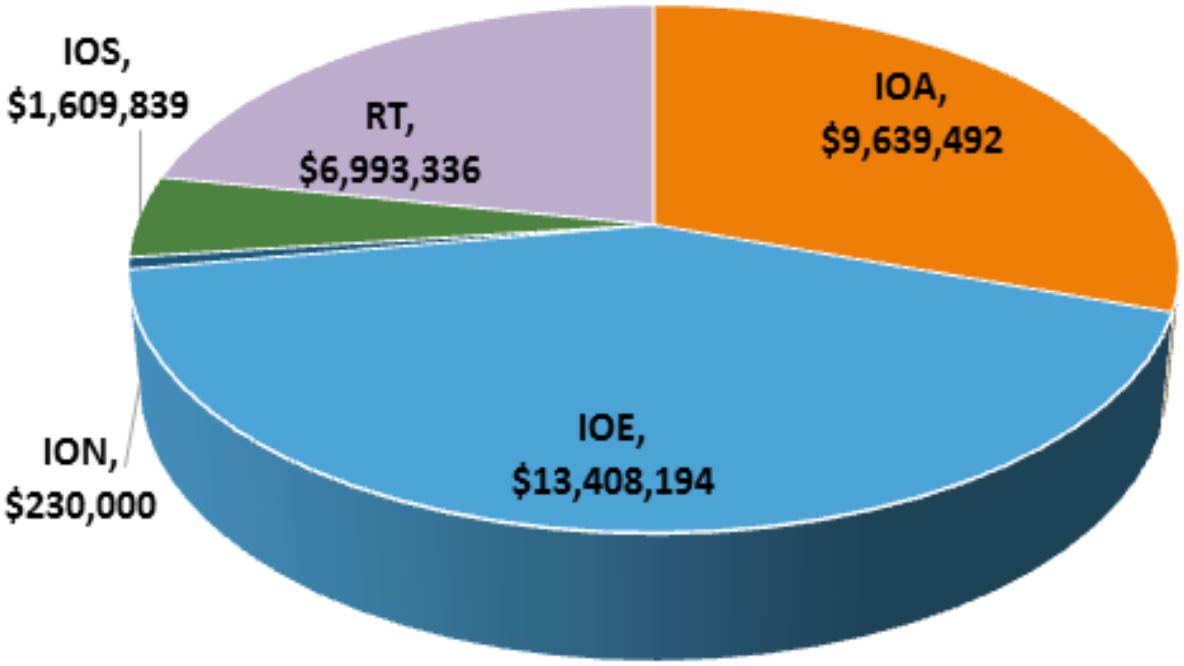
Interagency Collaborations. IO collaborates directly with the Army's International Technology Centers and the Office of Naval Research Global. Its IPOs work with and often represent colleagues in AFOSR and the other Technology Directorates in AFRL. In addition, our office has much in common with international offices in other federal agencies, almost all of which are located in the Washington, DC, area. International research offices within DoD met quarterly to provide updates and discuss challenges and opportunities. These meetings, now chaired by the office of the Assistant Secretary of Defense for Research and Engineering (ASD(R&E)), focus considerable attention on systematic sharing of information. We now have access to the international agreements database, https://www.dtic.mil/IA, a comprehensive list of international R&D agreements across DoD. ION also meets regularly with international program managers in the Department of State, the National Science Foundation (NSF), and NASA. Program Officers: Dr. Brett Pokines | brett.pokines.1@us.af.mil and Ms. Joanne Maurice | joanne.maurice@us.af.mil

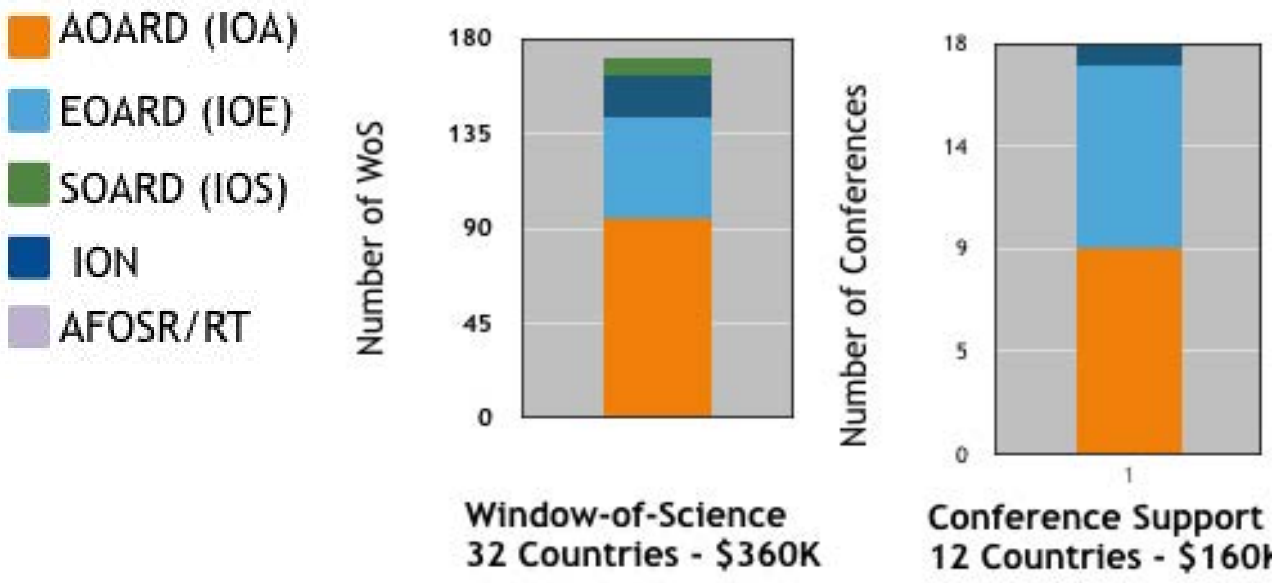
International Initiatives. Bilateral programs with specific countries and regions have benefited AFOSR immensely. In addition to earlier initiatives with Korea and Taiwan on nanotechnology and nanoscience, and Mexico on materials sciences, ION works with AFOSR's overseas and domestic Program Officers, colleagues in other agencies, local embassy officials, and a range of foreign research leaders to develop new initiatives or other opportunities for coordinated programs. In FY16, a new coordinated program with South Korea on information science and cyber security was initiated. Also, a US-Australia program was begun to advance basic research in autonomy. International initiatives and country programs are listed and described on page 55. ION International Initiatives
POC: Dr. Brett Pokines | brett.pokines.1@us.af.mil



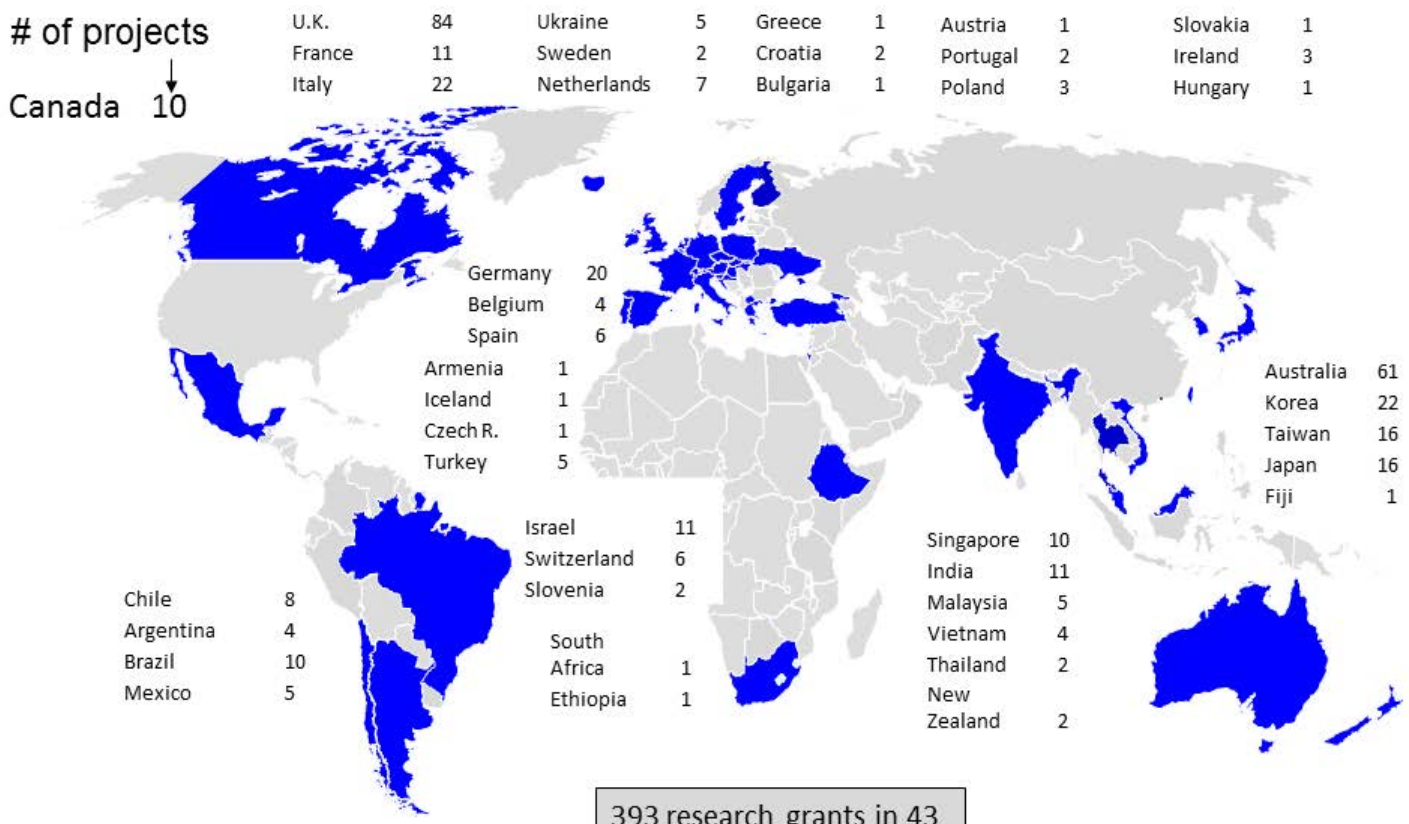
FY16 ACTIVITY SUMMARY

This section summarizes AFOSR international activity over FY16 (1 Oct 2015 through 30 Sep 2016).



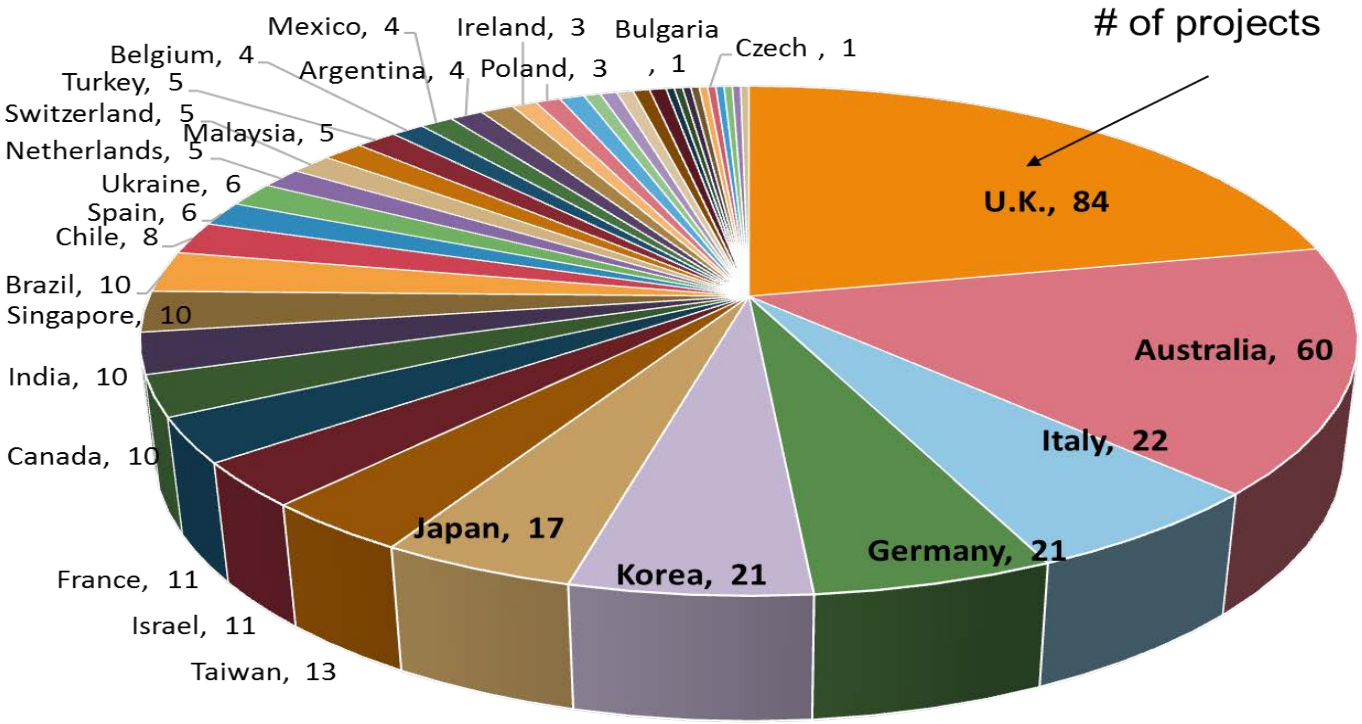


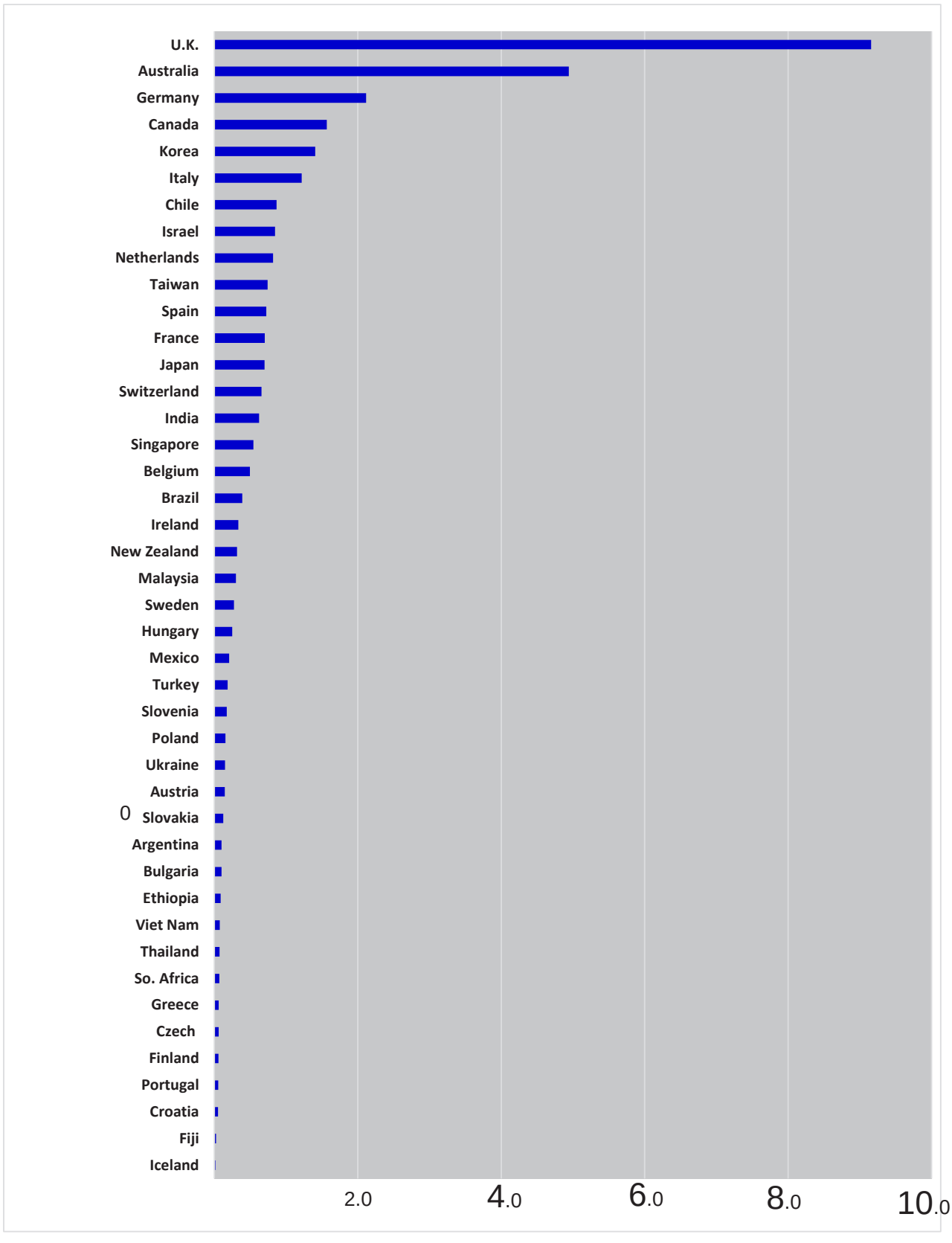
FY16 AFOSR/IO Research Projects



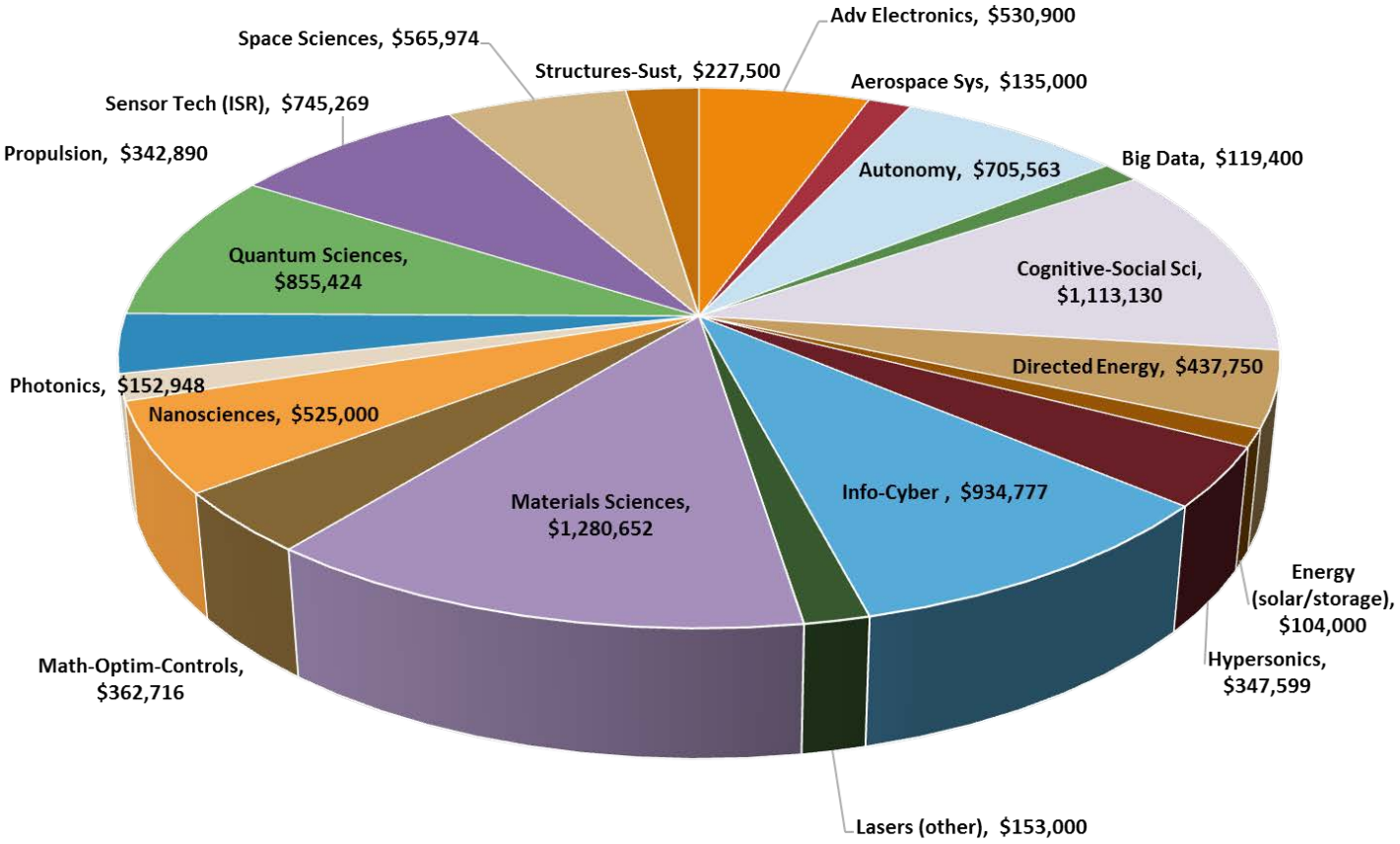
393 research grants in 43 countries totaling $31.9M

FY16 Countries Funded by AFOSR/IO

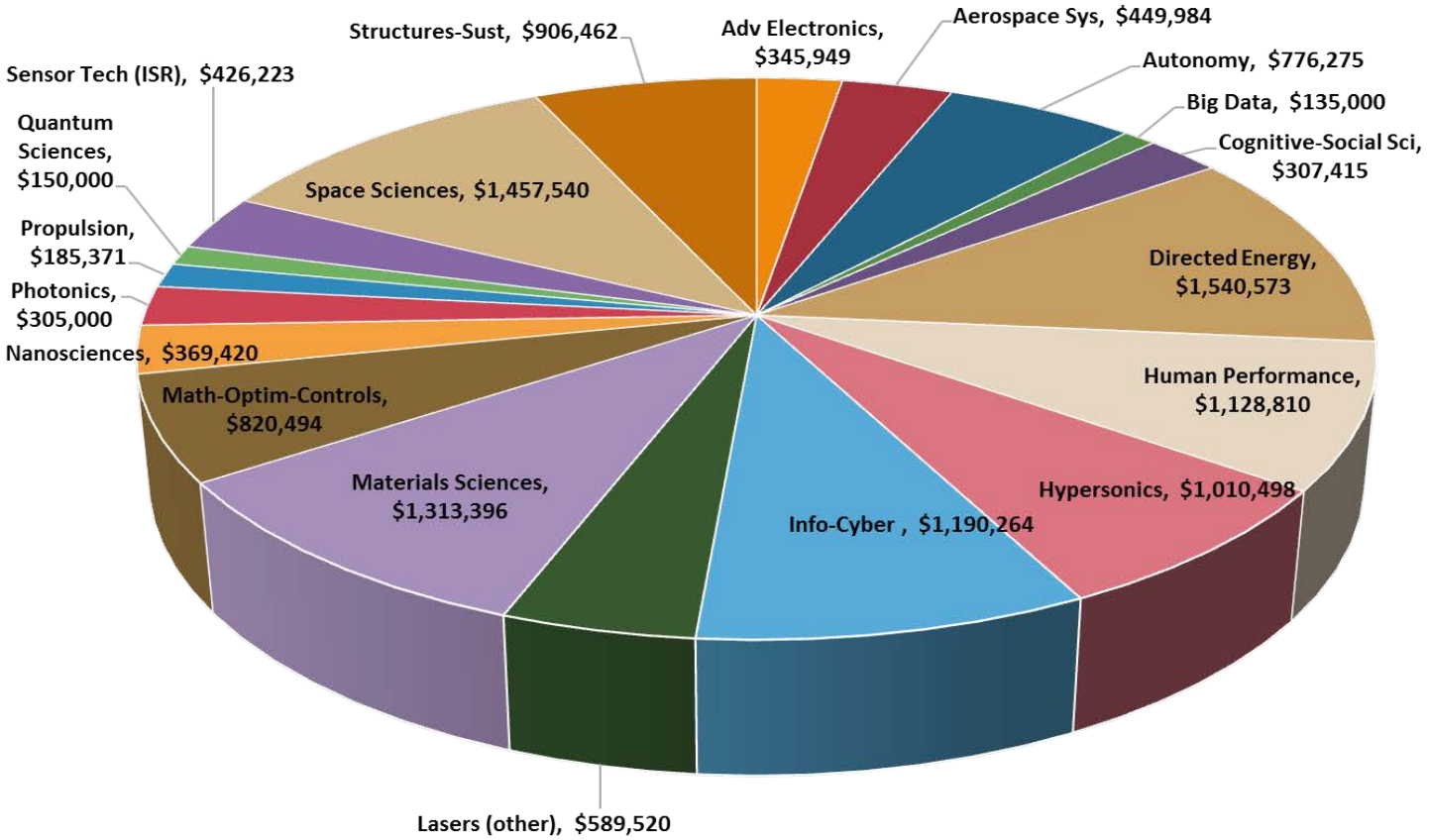



U.K.
Australia
Germany
Canada
Korea
Italy
Chile
Israel
Netherlands
Taiwan
Spain
France
Japan
Switzerland
India
Singapore
Belgium
Brazil
Ireland
New Zealand
Malaysia
Sweden
Hungary
Mexico
Turkey
Slovenia
Poland
Ukraine
Austria
0
Slovakia
Argentina
Bulgaria
Ethiopia
Viet Nam
Thailand
So. Africa
Greece
Czech
Finland
Portugal
Croatia
Fiji
Iceland
2.0
4.0
6.0
8.0
10.0
FY16 Funded Amount ($M)

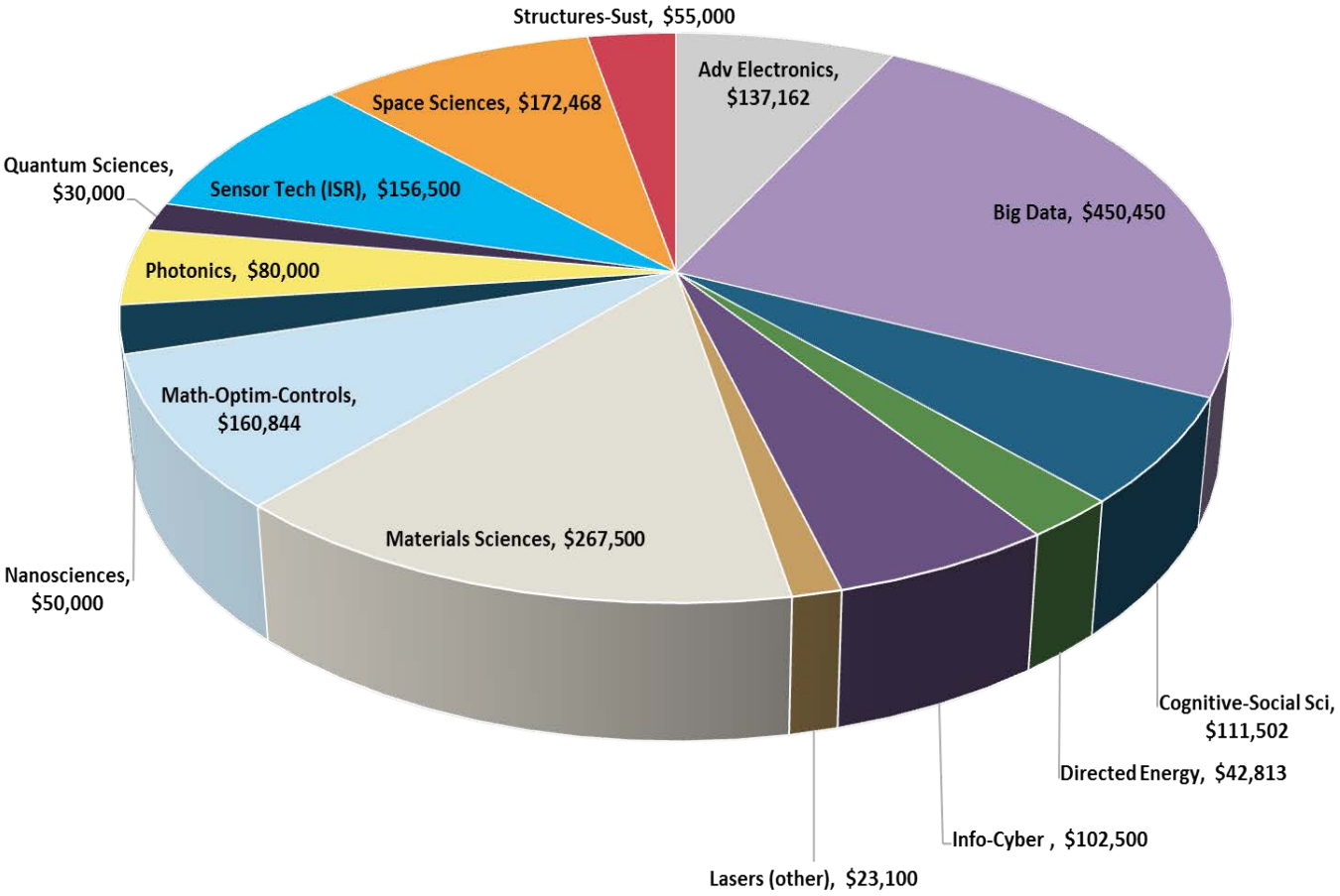
FY16 Research Areas Funded by IOA



FY16 Research Areas Funded by IOE

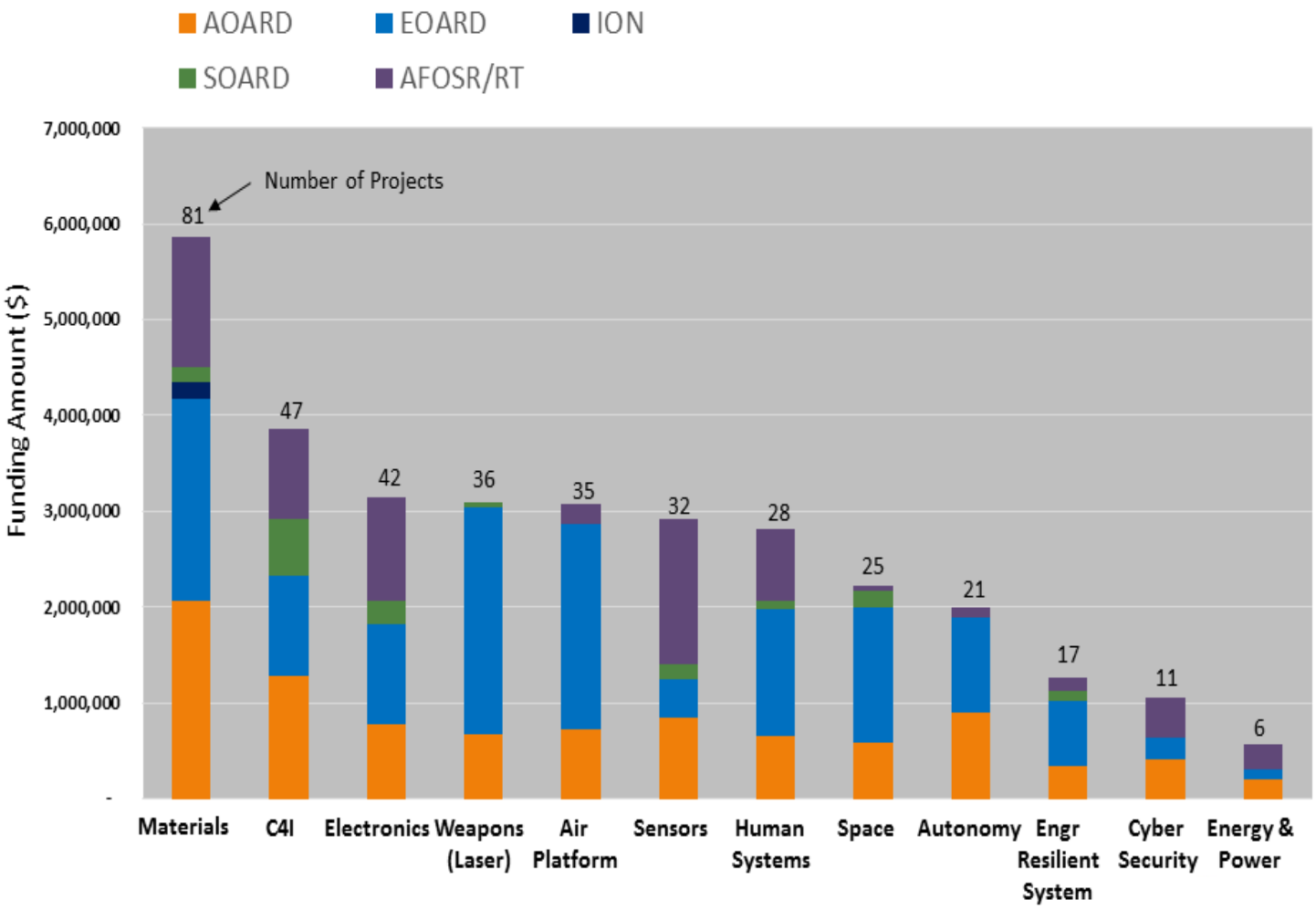


FY16 Research Areas Funded by IOS/ION



Communities of Interest (COI)

Under Reliance 21, the Science and Technology Executive Committee has divided the DoD R&E Portfolio into 17 Communities of Interest (COIs) that reach across all components. These technical communities are reviewing and assessing the alignment of current and planned R&E programs, identifying gaps, and helping to prioritize R&E funding efforts to meet the technical challenges of the DoD in their respective focus area. Each COI represents specific cross-domain technology areas where there is substantial investment across multiple components. The COIs are collecting, coordinating and aligning the technical capabilities, requirements, gaps, opportunities and priorities for their respective technology areas or portfolios. The COI may help leadership identify and understand areas of over- (or under-) investment, unproductive duplication and any technology gaps that need to be addressed. This graph highlights research efforts funded by AFOSR/IO in COIs of AF interest, leveraging global science and technology.



DoD Community of Interest (COI) Areas Supported by AFOSR/IO

Conference & Workshop Support Program

AFOSR provides limited support for selected international technical exchanges to further scientific collaborations and advancement in support of AFOSR basic research objectives. Proceedings and/or presentations (if produced) from these events are available to DoD scientists and engineers. Contact an AFOSR/IO Program Officer for more information.

AFOSR supported 19 international technical exchanges with FY16 funds.

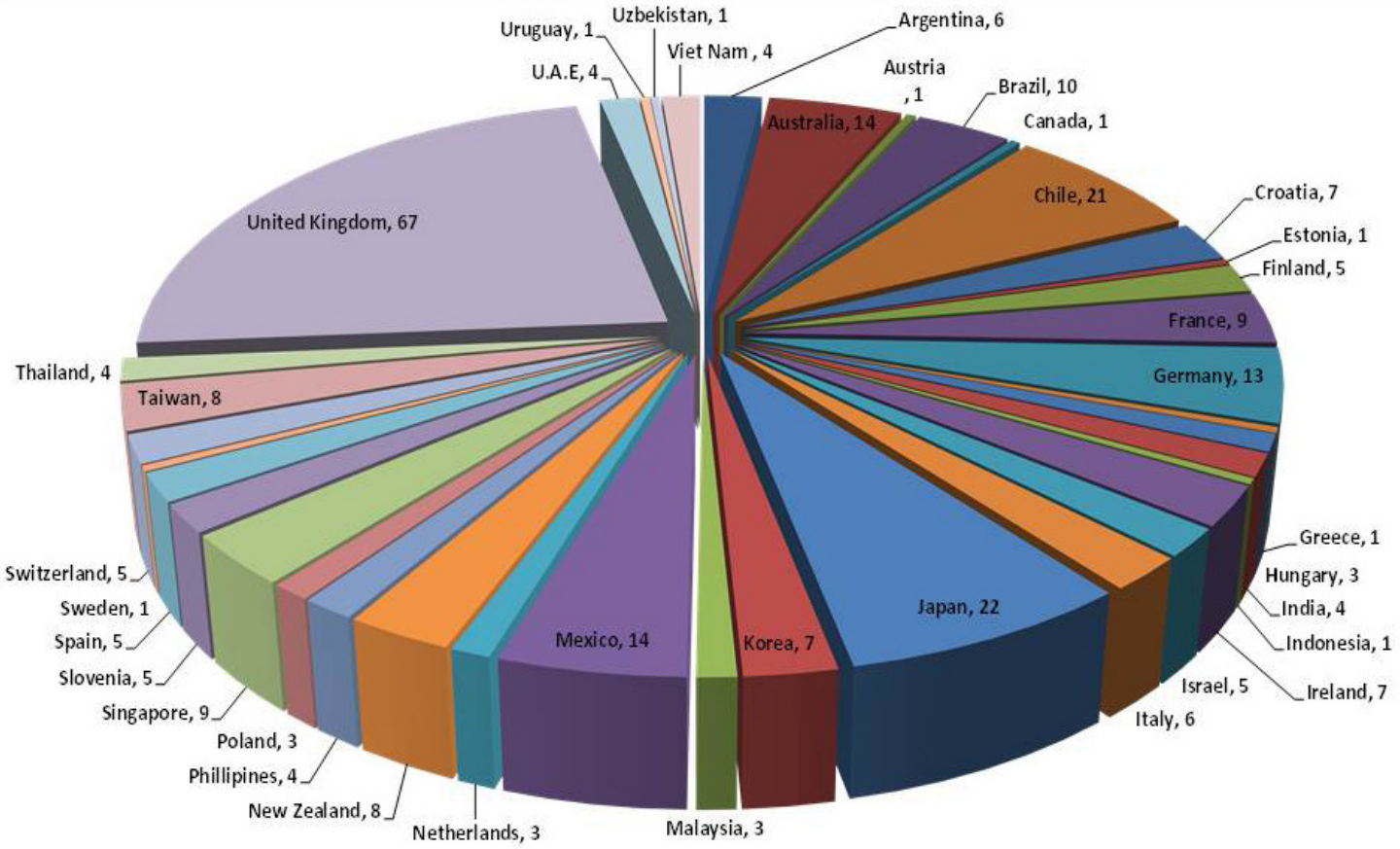
Conferences Supported by IO in FY16

Conference Title	Institution	Country	PI/Organizer
21st International Symposium High Power Laser Systems & Applications	Vienna University of Technology	Austria	Schuoecker, Dieter
Space Climate 6 Symposium	OULUN YLIOPISTO	Finland	Asikainen, Timo
SUPPORT FOR LES HOUCHES SUMMER SCHOOL: CURRENT TRENDS IN ATOMIC PHYSICS	UNIVERSITE GRENOBLE ALPES	France	Browaeys, Antoine
Dynamic Sun: MHD Waves and Confined Transients in the Magnetized Atmosphere	Indian Institute of Technology BHU	India	Srivastava, Abhishek
ECML-PKDD 2016	University of Trento	Italy	Passerini, Andrea
2nd Florentine Symposium on Emotional Intelligence	UNIVERSITA DEGLI STUDI DI FIRENZE	Italy	Burr, DAVID
IROS 2016	Korea University Research and Business Foundation	Korea	Song, Jae-Bok
ISPSA 2016 Conference	KOREA RESEARCH INSTITUTE OF STANDARDS AND SCIENCE (KRISS)	Korea	Noh, Sam Kyu
Programmable Materials and Manufacturing Science	KOREA NANO TECHNOLOGY RESEARCH SOCIETY	Korea	Lee, Haiwon
Support for EAAP-16 Conference	EUROPESE VERENIGING VOOR LUCHTVAARTPSYCHOLOGIE - E.A.A.P.	Netherlands	Droog, Andre
ACML 2016	University of Waikato	New Zealand	Holmes, Geoff
DSEC V	UNIWERSYTET WARSZAWSKI	Poland	Pawlak, Dorota
International Workshop on Detonations for Propulsion 2016	NATIONAL UNIVERSITY OF SINGAPORE	Singapore	Li, Jiun-Ming
International Symposium on Physics and Applications of Laser Dynamics (IS-PALD)	NATIONAL TSING HUA UNIVERSITY	Taiwan	Lin, Fan-Yi
PRICAI 2016	ARTIFICIAL INTELLIGENCE ASSOC OF THAILAND	Thailand	Theeramunkong, Thanaruk
RIN 16 Animal Navigation Conference	ROYAL INSTITUTE OF NAVIGATION	United Kingdom	Chapman-Andrews, Peter
2016 Trust and Influence Workshop	Universita degli Studi di Palermo	United Kingdom	Chella, Antonio
ICECCS16	ASTON UNIVERSITY	United Kingdom	Wang, Hai
12th International Congress of Neuroethology	University of the Republic	Uruguay	Silva, Ana

Technical Assessments

A Technology Assessment (TA) tool was developed and implemented this year to capture, track, and manage research assessments performed during our many engagements, such as site visits, conferences, workshops, and other technical events across the globe. The collected information includes program updates on the current research collaboration and accomplishments, as well as assessment of researchers, groups, labs, and tech trends. In FY16, IPOs visited 195 unique sites in 38 countries, consisting of 184 institutions, and performed 293 assessments.

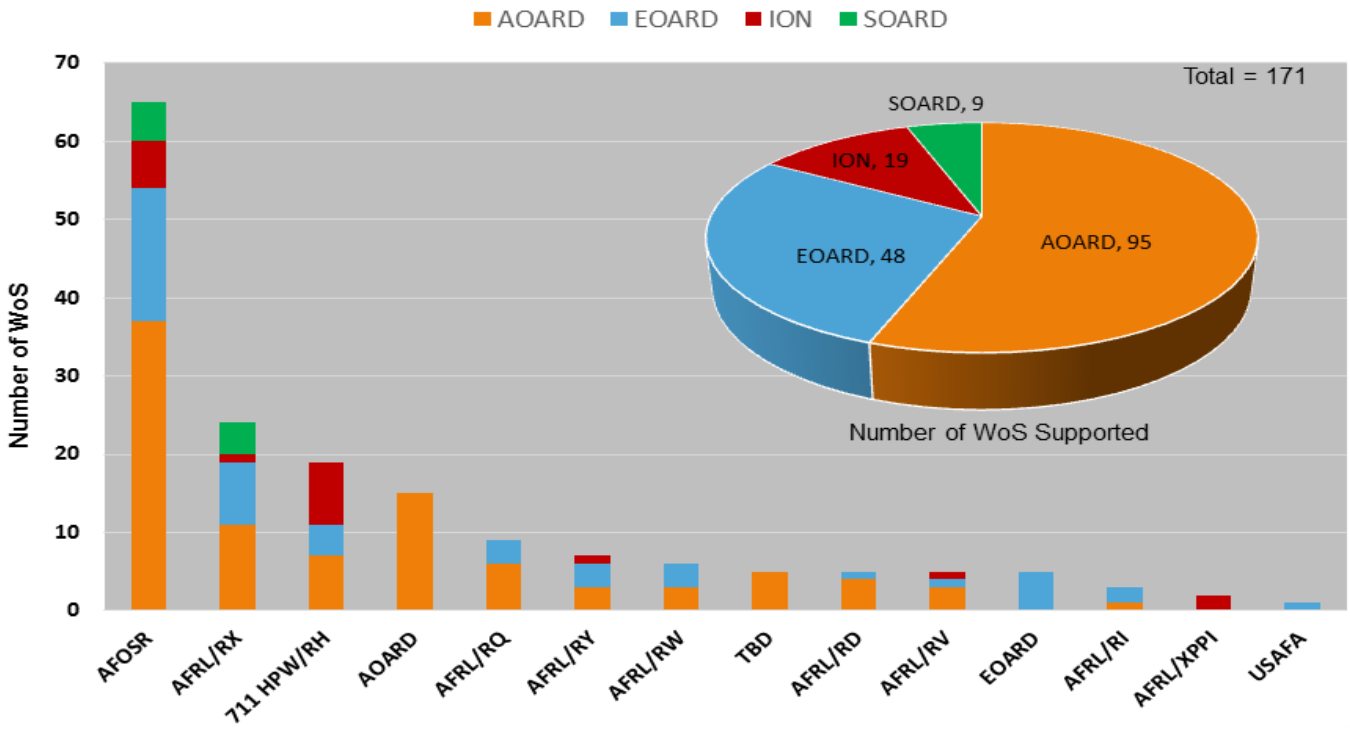
Countries and number of Technology Assessments accomplished in FY16



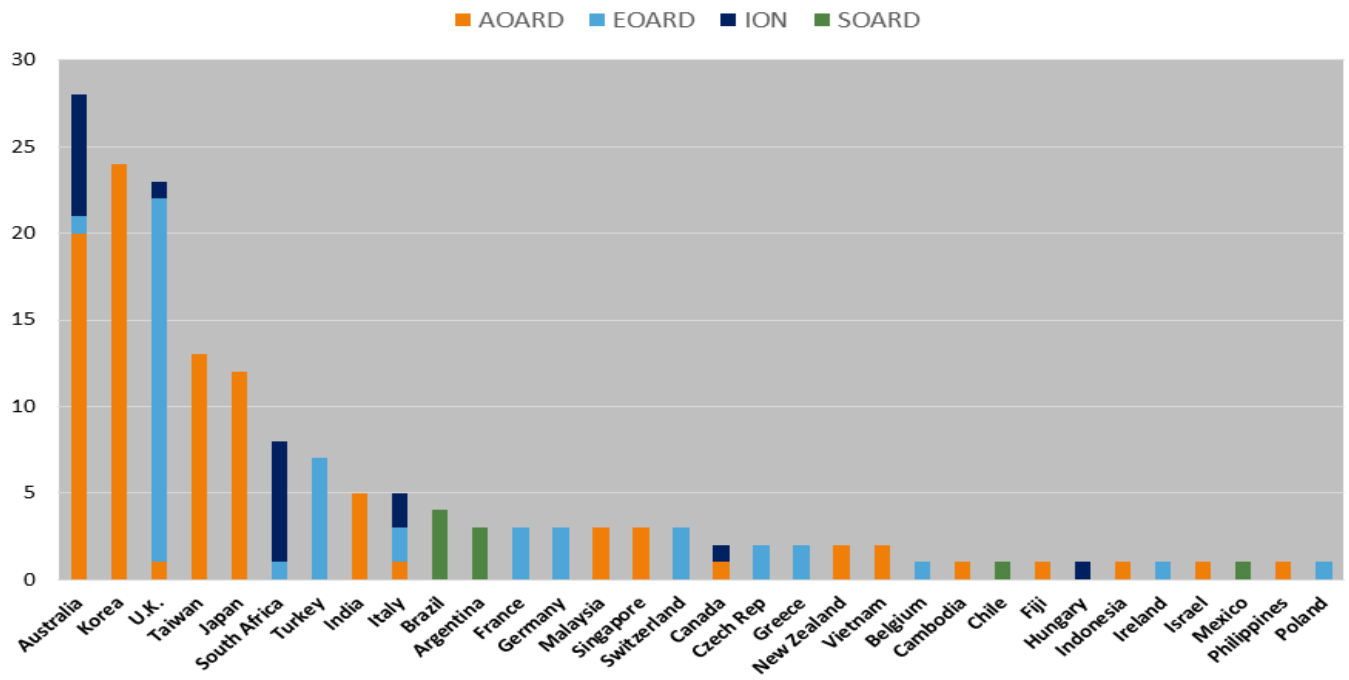
Window on Science Visits

AFOSR supported 171 visits by foreign researchers during FY16 under the Windows on Science (WOS) program, enabling foreign researchers to share and discuss their activity with AFRL and DoD audiences.

FY16 Window-on-Science (WOS) by location

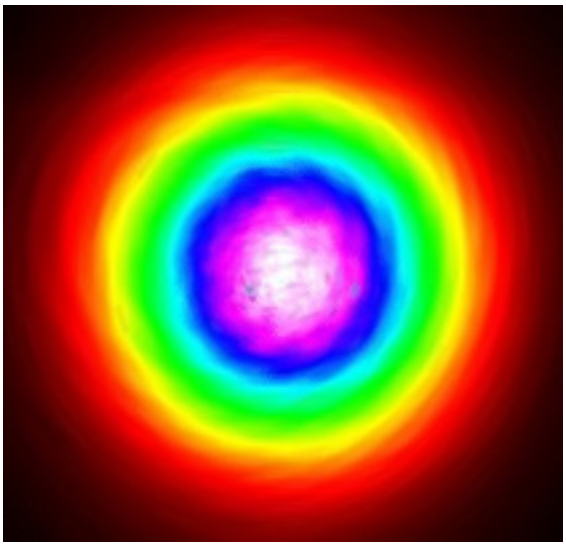


FY16 Window-on-Science (WOS) by PI Country of Origin



FY16 Windows on Science (WOS) Visitor Highlights

Diode-pumped Alkali Lasers WOS Highlight.



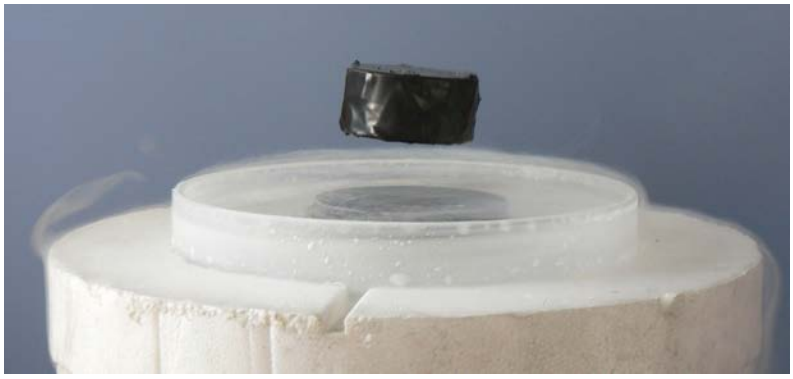
At the invitation of Maj. Scott Robertson (AOARD) and Dr. Greg Pitz (AFRL/RD), Dr. Masamori Endo, Tokai University, and Dr. Fumio Wani, Kawasaki Heavy Industries Ltd. (KHI), Japan, visited AFRL/RD on 4 May 2016 to discuss numerical simulation methods for diode-pumped alkali lasers (DPAL). Dr. Greg Pitz and Mr. Ben Oliker hosted their visit and expressed interest in Dr. Endo's wave-optics simulation code. Dr. Endo and Dr. Wani kindly shared their experience and expertise in the implementation of wave optics to the numerical simulation of laser oscillation. As a direct result of this excellent visit, Dr. Endo and Dr. Wani are in the process of applying for a research grant with joint funding from Dr. Pitz's group at AFRL/RD, from AOARD, and from ONR-Global. This research grant will enable Dr. Endo and Dr. Wani to work on specific areas of science needed to improve current AFRL DPAL modeling and analysis techniques and will include collaboration with Dr. Pitz's group throughout the life of the grant. Arrangements are also underway for Dr. Pitz to visit Dr. Endo's facility at Tokai University under a Windows on the World grant. Program Officer: Lt Col Scott Robertson | Scott.robertson@us.af.mil

Dynamic Behavior of Materials.

Dr. Juan P. Escobedo (University of New South Wales, Australia) visited AFRL/RW and AFRL/RX and provided a seminar on the dynamic behavior of materials and the research and testing capabilities that exist at UNSW. Dr. Christopher (Kit) Neel (RW) and Dr. Manny Gonzalez (RX) served as hosts for Dr. Escobedo's visit, arranging lab tours and discussions with several researchers. This visit led four AFRL researchers to seek continued collaboration with Dr. Escobedo, and efforts are underway to begin those collaborations with an AFOSR grant. One collaboration is focused on investigating the mechanical response under shock conditions of 3D printed materials and structures. Dr. Jonathan Spowart (RX) and Dr. Philip Flater (RW) will work with Dr. Escobedo on this project. A second project is on the investigation of dynamic/shock response of multiphase materials. Dr. Neel (RW) and Dr. Gonzalez (RX) will collaborate with Dr. Escobedo on this project.
Program Officer: Lt Col Scott Robertson | Scott.robertson@us.af.mil

Superconductivity Program Review.

Three-day (November 09-11, 2016) visit to AFOSR by Dr. Yakov Kopelevich, Professor at the State University of Campinas (UNICAMP), Brazil – coordinated by Dr Brett Pokines, SOARD. As a SOARD PI, Dr Kopelevich contributed to the 2016 Superconductivity Program Review, hosted by Dr Harold Weinstock, AFOSR/RTB. Along with 18 other researchers, Dr. Kopelevich presented his recent work in possible high-temperature superconductivity in Copper Chloride (CuCl). During the scientific discussion, Dr Kopelevich shared original experimental results which suggest superconductive and Kondo-like behavior of



CuCl at certain temperatures in an applied electric field. This discovery may lead to breakthroughs in CMOS-compatible electronics that can perform without dissipation. As such, it can open up the major bottleneck in modern electronics towards new generation of high-performance devices with ultimate energy efficiency. Program Officer: Dr Brett Pokines | Brett.pokines.1@us.af.mil

Dynamics & Control, Computational Mathematics Program Reviews.

Visit to two AFOSR Program Reviews by three Argentine PIs, 1-12 August 2016 – coordinated by Lt Col Michael Martinez, SOARD. Prof. Diana Rubio from the National University of San Martin and Dr. Ruben Spies from the Argentine Science and Technology Ministry, attended the Computational Mathematics Program Review, hosted by Dr Jean-Luc Cambier. In addition to attending Dr Cambier's Program Review, Professor Domingo Tarzia from Austral University also attended the Dynamics & Control Program Review, hosted by Dr Frederick Leve. These three researchers hold current AFOSR grants in mathematical disciplines, primarily working on inverse problems, uncertainty quantification, optimal control theory. Besides direct interaction with other AFOSR PIs, they explored a new collaboration with a scientist from the Materials Directorate (RX). Their research has potential applications in a wide variety of Air Force issues, such as autonomy, material properties, and imagery analysis. Program Officer: Lt Col Michael Martinez | michael.martinez.2@us.af.mil

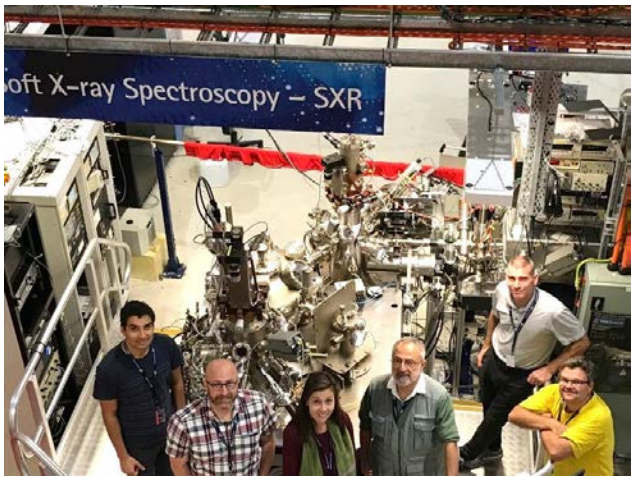
Trust & Influence Program Review.

Visit to AFOSR by Dr. Tomas Perez-Acle, Researcher at the Science & Life Foundation, Chile – coordinated by Lt Col Michael Martinez, SOARD.
As a SOARD PI, Dr Perez contributed to the 2016 Trust & Influence Program Review, hosted by Dr Benjamin Knott, AFOSR/RTA. At the Program Review, Dr Perez interacted with more than 50 other sponsored researchers, exploring concepts such as religion, culture, trust and influences on society and effects on human behavior. Using mathematical simulations, Dr Perez conducts investigation on the impact of panic in social unrest situations. The Trust & Influence portfolio supports the human-machine interaction, a key component of OSD's 3rd Offset strategy. As a result of the visit, Dr Perez is exploring a specific collaboration with a PI located in Australia, as well as inviting some of his Chilean colleagues to submit research proposals to AFOSR.
Program Officer: Lt Col Michael Martinez | michael.martinez.2@us.af.mil

Australian Synchrotron Facility.

Dr. Patrick Soukiassian completed an AOARD funded Windows-on-Science (WOS) to provide his synchrotron expertise at the Soft-X-ray Spectroscopy (SXR) beamline at the Australian Synchrotron Facility in Melbourne for experiments undertaken to understand hydrogen intercalation of graphene grown on 3C-SiC epi-layers on Si substrates

(G-SiC-Si). Dr. Soukiassian has extensive experience in understanding the 3C-SiC crystal structure using various synchrotron based end-stations and was indispensable in assisting with setup for the studies at the current beamtime. The experiments support an ongoing AOARD funded effort between Dr. Francesca Iacopi at the University of Technology in Sydney (UTS) and Dr. John Boeckl at AFRL/RX who have been studying the G-SiC-Si system for the past 5 years. Use of the SXR offered a unique capability, not available at UTS or AFRL, and with the high energy resolution at the beamline, results were able to conclusively identify the existence of the buffer layer of graphene on the 3C-SiC, which was known for graphene grown on bulk hexagonal poly-types of SiC but until now unconfirmed on the cubic poly-type. Future work in this area is focused on complex low-loss plasmonic structures based on G-SiC-Si and is funded through an ICR&D grant with collaborations between Drs. Iacopi, Boeckl and Joshua Caldwell at the US Naval Research Laboratory.



In addition to the graphene samples, the beamtime allowed for the preliminary examination of eutectic samples of LaB6 and ZrB2 studied for their thermionic emission properties aimed at ion propulsion applications, this work is supported under an AFOSR LRIR (POs: Drs. Ali Sayir and Jason Marshall). These initial SXR data are being used to submit a follow-on proposal for additional beamtime in Q2 of 2017. Furthermore, an ongoing collaboration with Dr. Paul Pigram at La Trobe University, Melbourne (initiated during Dr. Boeckl's WOW visits in 2014 and 2015) facilitated another unique characterization opportunity for this material system using a mapping Auger system. This technique, again not available at AFRL, will be instrumental to complete the theory on the emission properties of the eutectic. Coming full circle, Dr. Boeckl will be on a working visit to Dr. Soukiassian's laboratory at the French Atomic Energy Department (CEA-Saclay, France) to perform Low-Energy Electron Microscopy (LEEM) studies on these eutectic materials in Q1 2017. We are also collaborating with Dr. Soukiassian on beamtime at the Taiwan Synchrotron, as he was awarded the prestigious 2010 Taiwan-France Science and Technology Award which qualifies the awardee with a week of beamtime. Our proposal will focus on the eutectic materials using synchrotron based LEEM which represents the highest resolution for this technique, complimentary to the lab-based LEEM in France. Program Officer: Dr. Ken Caster | AOARD.Materials.Chemistry@us.af.mil.

Cold Atom Navigation. In early Oct 2016, Prof John Close from the Australian National University (ANU), Canberra, Australia traveled under the Windows-on-Science program to visit the cold atom research groups at AFRL/RVBYE at Kirtland AFB, NM and the USAF Academy near Colorado Springs, CO. Prof Close was the first WOS supported visitor to have their presentation shared across all of AFRL via teleconference as a part of the AFRL-wide Quantum Information Science community bi-monthly VTC seminars. Prof Close explained their atom interferometry approach and compared, contrasted their efforts to those at Kirtland AFB. After the talk questions were asked from Maui, from AFOSR headquarters in Arlington, from AFRL/RI in Rome, NY and from AFRL/RX in Dayton, OH. The visit illuminated many synergies including the possible future basic research grants and possible government to government arrangements as his current work in Australia is sponsored by the Australian Defense Science Technology Group (DSTG) and was found to have parallels to the applied work at AFRL. Program Officer: Lt Col Mario A Serna | Mario.serna@us.af.mil

Windows on Science Enables US-Europe Materials Science Workshop… and Much More.

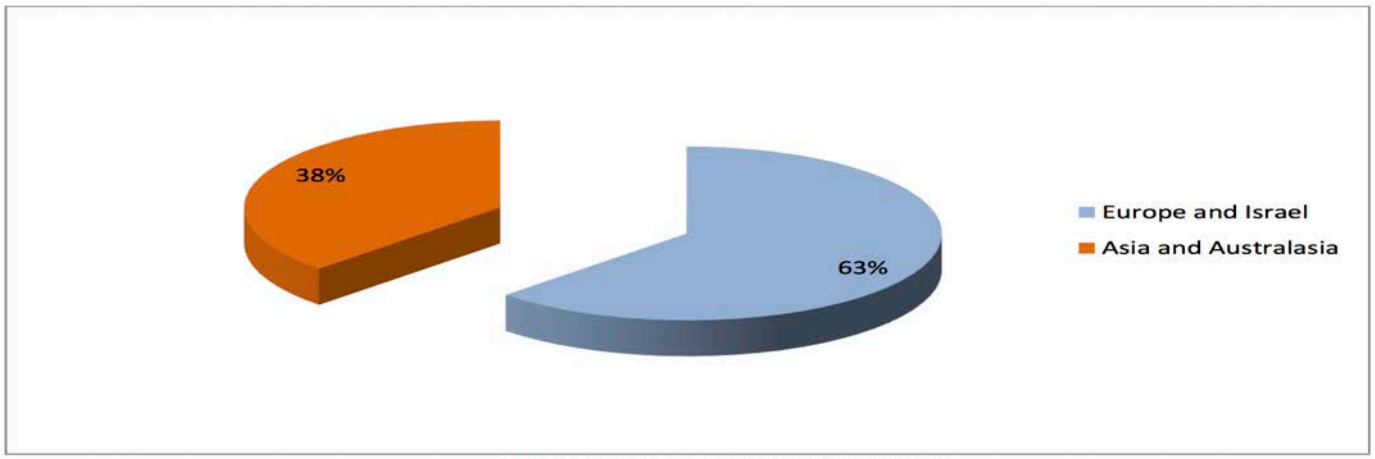
Materials are quite literally the building blocks of defense. Indeed, many Air Force capabilities are enabled by breakthroughs in materials science and manufacturing. These include high temperature alloys for hypersonic flight, next-generation RF and optoelectronic sensors for ISR, wide bandgap semiconductors for more efficient electronics… the list goes on and on. It is therefore appropriate to periodically assemble experts from across the globe to critically evaluate the state of the art and also identify new research frontiers. To address this need, the "Workshop on Enhancing International Collaborations on Emerging Materials for Defense Applications via Innovative Theory, Simulation, and Experiment" was hosted by the Thomas Young Centre, University College London (London, United Kingdom) in collaboration with AFRL researchers. Participants included U.S. and U.K. government researchers (from AFRL and DSTL, respectively) as well as academic leaders in materials research from across the globe, including British, Turkish, Swiss, and other European researchers on topics of mutual interest for critical defense applications. Topics included computational materials science development and application (including associated theory and/or experiment) for materials ranging from functional electronic, magnetic, and optical materials (including low-dimensional materials) to structural materials (including for extreme environments).

The Windows on Science (WOS) program played a critical role in enabling this workshop. Several of the researchers from Turkey had no means to travel to the workshop; the WOS program provided both the technical justification and financial support to secure their participation. This in turn created the "critical mass" of researchers to develop new ideas, connections, and collaborations. Regarded by attendees as wildly successful in this context, several bilateral and multilateral research collaboration opportunities were identified over the course of the two days of meetings. For example, five joint research grants have already been proposed to EOARD as a direct result of the workshop (and more are expected!). Additionally, three follow-up WOS visits to Wright-Patterson AFB, OH, by participants have already occurred in FY17 and more are being requested and coordinated with AFRL workshop participants. These visits are focused on defining, refining, and converging to specific research tasks that address Air Force needs. By cross-linking these WOS visits at both the start and refinement phases of research collaborations, the relationships that arise from personal, face-to-face interactions are strengthened and the technical products that ultimately result become more relevant to Air Force interests. So although it takes time for these processes to occur, utilizing WOS strategically to catalyze international collaboration is worth the wait.

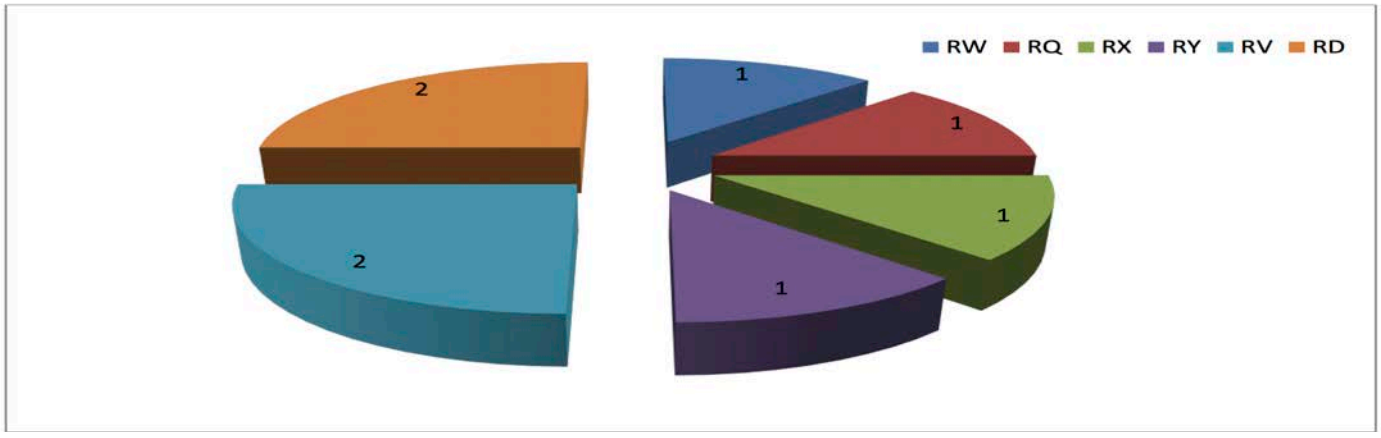
For further information about these specific WOS activities, please contact Dr Jason Foley (EOARD) at jason.foley.1@us.af.mil. General WOS inquiries or questions should be directed through the appropriate IO office: Dr Tom Kim (EOARD), Lt Col Mike Martinez (SOARD), or Dr Ken Caster (AOARD).

Windows on the World (WOW) Program

AFOSR usually supports 5-7 AF researchers per year, to perform short-term research projects (3 weeks to 6 months) in foreign non-government laboratories under the Windows on the World (WOW) program. In FY16, 8 WOW visits were approved (UK, Germany, France, Japan and Australia).

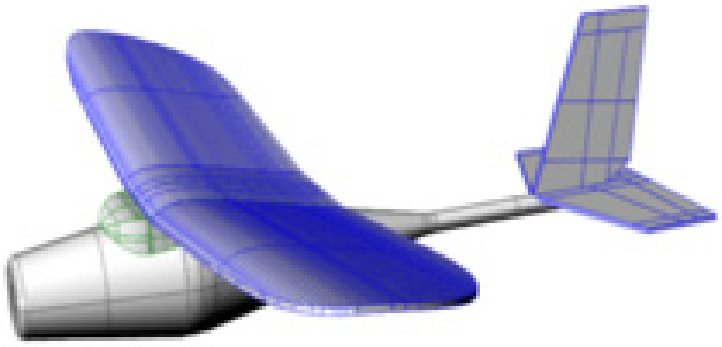


WOW Research Activity by Region.



FY16 Windows on the World (WOW) Highlights

Research Visit at the University of Oxford: From February 27th to April 28th, 2016, Dr. Benjamin Dickinson at the Munitions Directorate (RW) of the Air Force Research Laboratory, conducted basic research at the University of Oxford with Professor of Mathematical Biology, Dr. Graham Taylor. His research, inspired by innervated head hair on the locust, sought to understand how feedback from engineered distributed and embedded air flow sensor arrays may contribute to enhanced flight control performance and robustness properties in comparison to flight controllers developed with modern aerodynamic measurement technology. Through mathematical analysis, physical reasoning, and simulation, Dr Dickinson and Prof Taylor developed a rationale for distributed flow sensor based flight control. Tests were performed via computer simulation and to their knowledge, the first successful example of angle of attack command tracking control via artificial hair sensor array output feedback was demonstrated. As a result of this two month exchange, Dr Dickinson and Prof Taylor began planning joint or independent complementary research proposals on mechanosensing (e.g. distributed air flow sensing) for flight control. Additionally, a conference paper was prepared based on the results and ideas developed during the WoW program. This work was also subsequently presented at AFRL/RW workshops organized through the Nature Inspired Center of Excellence. Ben Dickinson, AFRL/RWWN, DSN: 875-2645, benjamin.dickinson.1@us.af.mil



CAD drawing of GENMAV platform, 23.7 inch wing span with 5 inch wing chord.

Research Visit at Télécom ParisTech in Paris France: The AFRL/RDLT semiconductor group pursues infrared quantum cascade lasers (QCL) for applications including chemical sensing (e.g. explosives, narcotics and hydrocarbons), infrared surveillance and tracking (IRST) and infrared countermeasures (e.g. missile jamming). Their roadmap includes the development of these lasers with more than 10W power simultaneously with a very high beam quality. Thus they are investigating "broad-area" quantum cascade lasers looking at various techniques to improve the beam quality. Dr. Newell's one month long Windows on the World (WoW) program was motivated by their interest in investigating temporal and mode stability in QCL devices. They desired to determine the effect of external cavity feedback on the modal quality of their lasers.

The visit took place by collaborating with Prof. Frederic Grillot and his group at Télécom ParisTech in Paris France. They are well established in investigations of nonlinear dynamics and instabilities in quantum cascade lasers, and they have an experimental base established to test QCL devices in the time and frequency domain. For Prof. Grillot, it was a new opportunity for him to see experiments with "broad-area" lasers.

The results of this collaboration showed them that they can perform simple beam steering of the laser and that the phase-front of the near-field can be controlled in order to change the far-field pattern. It revealed that the transverse mode structure in quantum cascade lasers is robust with respect to feedback but that mode competition and external cavity nonlinear oscillations can be triggered. Furthermore, the knowledge gained will be applied to Dr. Newell's AFOSR LRIR program to investigate passive phase-locking in arrays of quantum cascade laser emitters. They presented their work at the International Symposium on Physics and Applications of Laser Dynamics 2016 (IS-PALD) in September 2016. Dr. Timothy Newell, AFRL/RDLT DSN: 863-5651, Timothy.newell.1@us.af.mil

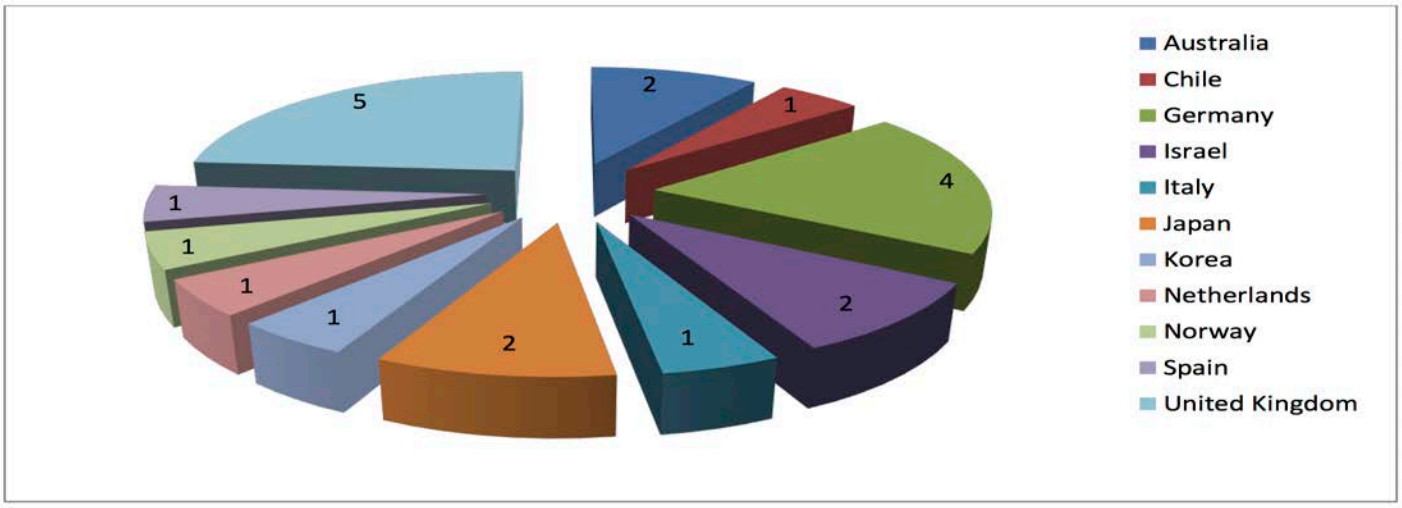
Research Visits at Imperial College London and the University of Cambridge: This effort sought to develop methods that better define, assess, and communicate the potential system-level impact of emerging multifunctional composites on future applications by working with world leaders in multifunctional composites and material selection methods. Primarily, Dr. Jeffery Baur worked with Prof. Emile Greenhalgh and Prof. Milo Shaffer at Imperial College London to understand and optimize the methods used to create supercapacitor structural composites – some of which have already been demonstrated in automotive components. Secondarily, he worked with Prof. Michael Ashby of the University of Cambridge and Granta Design to apply his graphical material and processing selection methods to aerospace multifunctional composites designs. Thirdly, Dr. Baur leveraged the substantial amount of composite research within the United Kingdom by engaging Lt Col Matt Snyder and Dr. Jason Foley (AFRL/IOE) relative

to their EOARD-sponsored research, Dstl Multifunctional Materials Lead Dr. Laura Jones and Dr. John Pearson relative to their UK Ministry of Defense-sponsored research, and approximately 50 professors who were working on multifunctional composite across 10 different premier universities. In addition to the enhanced knowledge, improved situational awareness for future Air Force investments, strengthened professional connections and journal manuscripts in preparation, this WoW also directly contributed to the successful award of a $5M AFRL Commanders Research and Development Funded (CRDF) for FY17-19. The AFRL/RX portion of this joint AFRL/RW, RX, & RQ effort will use the developed methods to evaluate multifunctional composite concepts for use in a shape changing (morphing) limited use air vehicles. Dr. Jeffery W. Baur, AFRL/RXCCM, 937-255-6510, jeffery.baur@us.af.mil

Engineer & Scientist Exchange Program (ESEP)

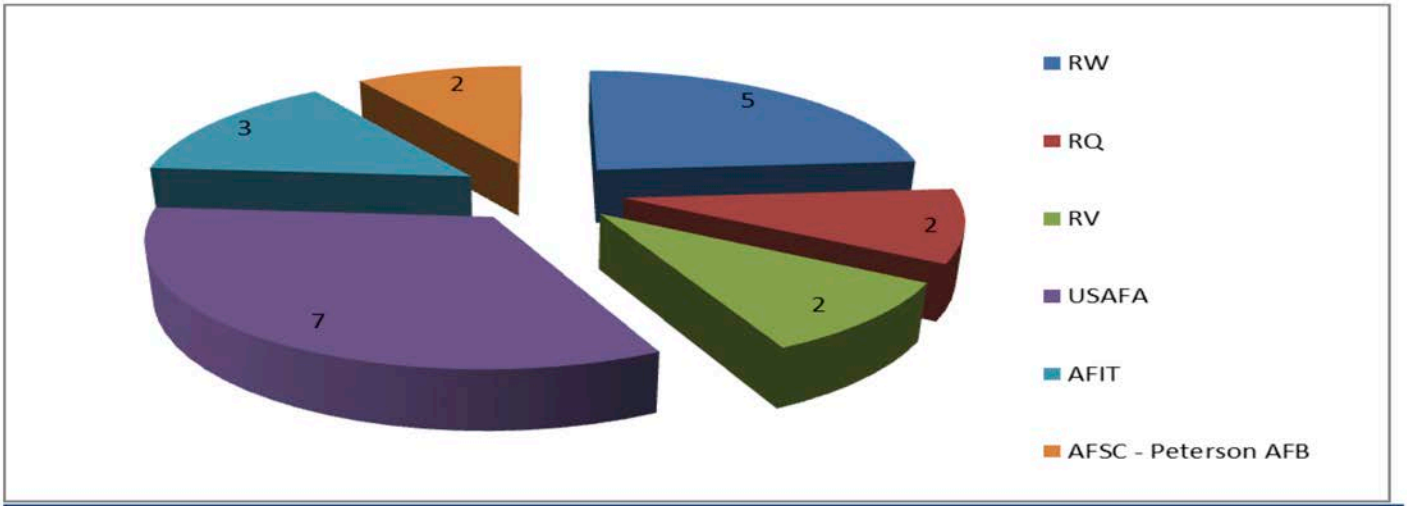
AFOSR facilitated 21 AF scientists and engineers to perform long-term research (i.e., overseas tour) in foreign defense research facilities during FY16 under the DoD Engineer and Scientist Exchange Program (ESEP).

USAF personnel were at the following countries for ESEP tours during FY16:



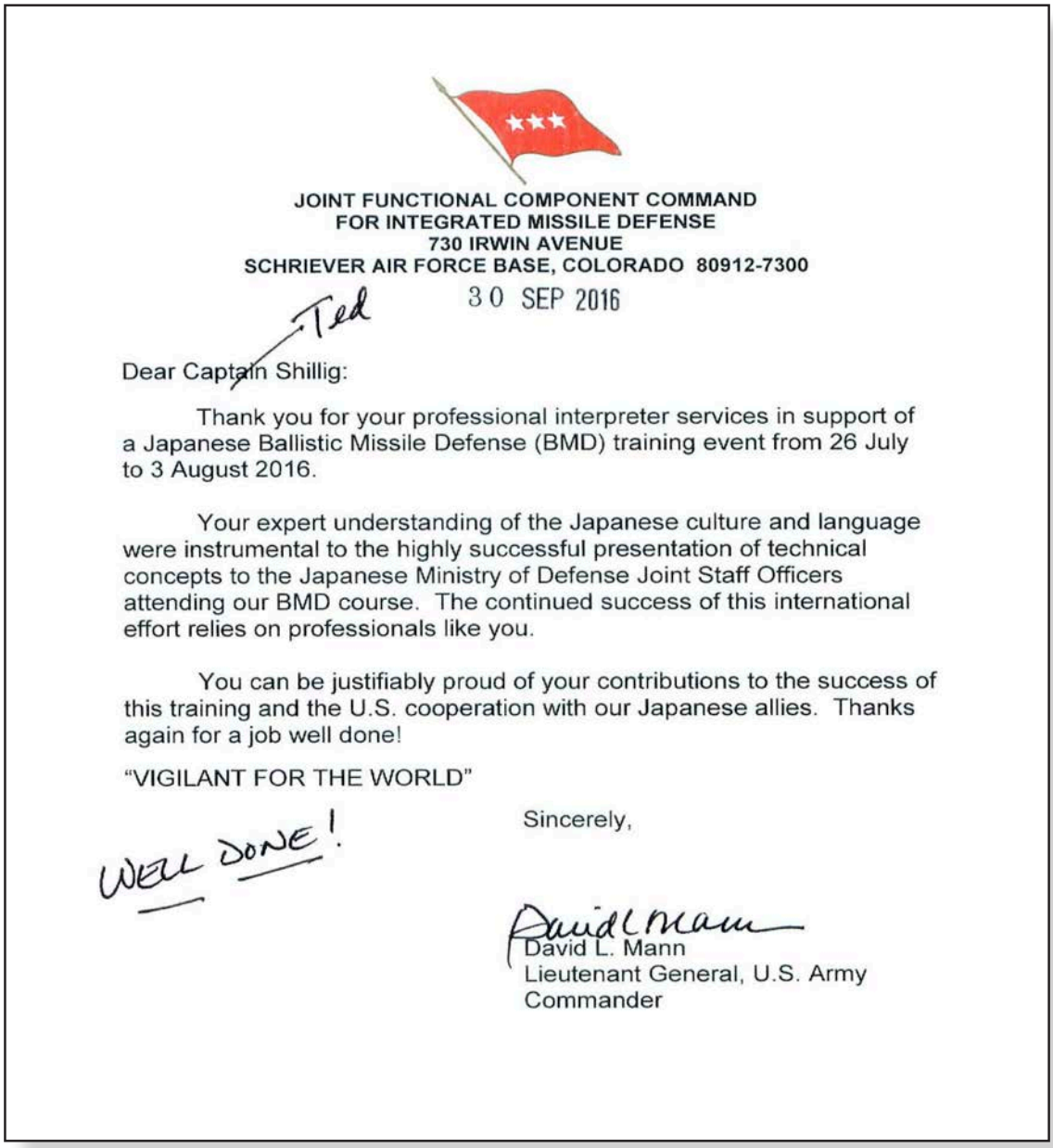
AFOSR facilitated 21 foreign scientists and engineers to perform long-term research in USAF research facilities during FY16 under the DoD Engineer and Scientist Exchange Program (ESEP)

Foreign Defense Dept. personnel were located at the following USAF sites for ESEP tours during FY16:



FY16 Engineer & Scientist Exchange Program (ESEP) Highlights

In FY16, Captain Theodore Shillig Received a letter of appreciation from LtGen David L. Mann, US Army Commander, Joint Functional Component Command for Integrated Missile Defense, for his professional interpreter services during his ESEP tour at Shriever AFB, CO.



JOINT FUNCTIONAL COMPONENT COMMAND
FOR INTEGRATED MISSILE DEFENSE
730 IRWIN AVENUE
SCHRIEVER AIR FORCE BASE, COLORADO 80912-7300

30 SEP 2016

Ted

Dear Captain Shillig:

Thank you for your professional interpreter services in support of a Japanese Ballistic Missile Defense (BMD) training event from 26 July to 3 August 2016.

Your expert understanding of the Japanese culture and language were instrumental to the highly successful presentation of technical concepts to the Japanese Ministry of Defense Joint Staff Officers attending our BMD course. The continued success of this international effort relies on professionals like you.

You can be justifiably proud of your contributions to the success of this training and the U.S. cooperation with our Japanese allies. Thanks again for a job well done!

"VIGILANT FOR THE WORLD"

WELL DONE!

Sincerely,

David L. Mann
Lieutenant General, U.S. Army
Commander

Research visits approved in FY16 for AF S&Es under the WOW program are listed below.

AF Organization	Institute, Country	Research Topic
AFRL/RDLTS (Henry)	The University of Adelaide, AU	Investigation of bismuth doped germanate glasses prepared by the melt-quench Technique
AFRL/RQHF (Carter)	German Aerospace Center, DLR, Stuttgart, GE	KHz Imaging Diagnostics for the Study of High-Pressure Swirl-Stabilized Flames
AFRL/RWWN (Dickinson)	University of Oxford, UK	Robust Flight Control from Flow Patterns
AFRL/RVBXR (Hoffmanl)	Universite Paul Sabatier, Toulouse, FR	Internal Charge Distribution of Electron Irradiated Insulating Materials Using Pulsed Electro-Acoustics
AFRL/RDLT (Newell)	Télécom ParisTech, FR	Dynamical Behavior of Quantum Cascade Lasers
AFRL/RYAT(Taylor)	University of Sydney, AU	Obtaining Accurate Uncertainty Estimates for Navigation in Distributed Estimation Scenarios
AFRL/RVBXS(White)	Nagoya University, JA	High–Resolution Synoptic Radio Maps of the Sun
AFRL/RXCC(Baur)	Imperial College, London, UK	Methods for Linking Multifunctional Composite Concepts to System Level

USAF overseas ESEP tours active in FY16 are listed below.

AF Org	Tour	Institute, Location
AFRL/RQQE	7/13 – 7/16	DSTL, Porton Down, UK
AFRL/RQQE	7/14 – 7/16	DSTL, Porton Down, ,UK
AFRL/RDL	7/14 – 7/16	DLR, Goettingen, Germany
AFLCMC	7/14 – 7/16	AWE Aldermaston, UK
AFRL/RVES	8/14 – 8/16	Norwegian Defence Research Establishment (NDRE)(FFI),Norway)
2SOPS/DOK	9/14 – 9/16	Tel Aviv Univ ((Meadow Aerodynamics Lab), Israel
USAFA	9/14 – 9/16	Center of R&D in Aerospace Sciences, (CIDCA) Santiago, Chile
AFNWC/NIES	7/15 – 7/17	WIWEB, Munich, Germany
AFRL/RQHV	7/15 – 7/17	DSTL, Portsdown West, Fareham, UK
AFRL/RX	7/15 – 7/17	SGD/DNA, Rome, Italy
AMC/A9	7/15 – 7/17	SGP, Madrid, Spain
AFRL/RXCC	7/15 – 7/17	TRDI, Tokyo, Japan
AFRL/RDST	9/15 – 9/17	DSTO, Edinburgh, Australia
AFRL/RQQA	7/16 –7/18	Technion Israel Institute of Technology, Haifa, Israel
45 LCSS/LSM	7/16 –7/18	TNO, The Hague, The Netherlands
AFLCMC/WWUM	7/16 –7/18	Bundeswehr Tech Center for Weapons & Ammunition, WTD91, Meppen, Germany
AFRL/RWWV	7/16 –7/18	DSTG Queensland, Australia
AFLCMC/EBMS	7/16 –7/18	DSTL Portsdown West, Fareham, UK
AFRL/RYAP	7/16 –7/18	DSTL Porton Down, Salisbury, UK
AFRL/RVBYE	7/16 –7/18	DLR, Oberpfaftenhofen, Wessling, Germany
AFRL/RQTC	7/16 –7/18	Acquisition, Technology & Logistics Agency, Tokyo Japan
DTRA/J9CXW	7/16 –7/18	ADD, Daejon (Taejon), Republic of Korea

Foreign ESEP personnel at USAF locations are listed below.

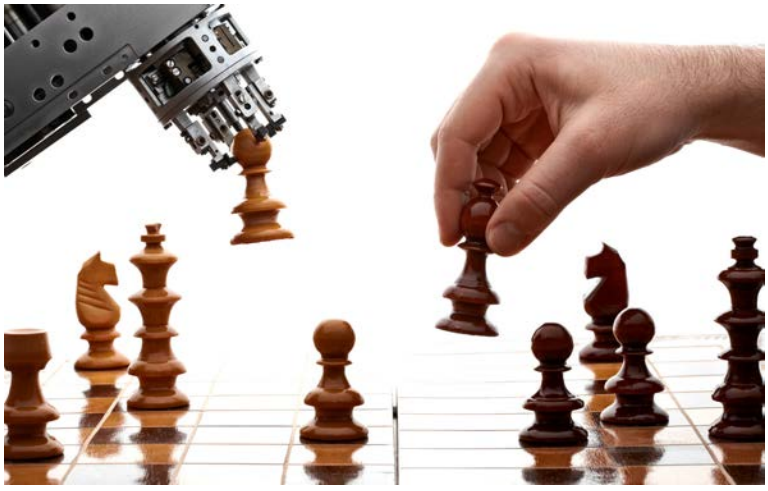
Country	Tour	USAF Location
Germany	1/15 – 1/16	AFSC (Peterson AFB)
Germany	1/15 – 1/16	AFRL/RWWN (Eglin AFB)
Germany	1/15 – 1/16	AFRL/RWWN (Eglin AFB)
Germany	1/15 – 1/16	USAFA (Colorado Springs)
Germany	8/15 – 8/16	USAFA (Colorado Springs)
Australia	9/15 – 9/16	AFRL/RV(Kirtland AFB)
Australia	10/15 – 10/16	AFRL/RV(Kirtland AFB)
Poland	10/15 – 6/16	AFIT (WPAFB)
Korea	12/15 – 12/16	AFIT (WPAFB)
Germany	1/16 – 1/17	AFIT (WPAFB)
Germany	1/16 – 1/17	AFRL/RW (Eglin AFB)
Germany	1/16 – 1/17	AFRL/RW (Eglin AFB)
Germany	1/16 – 1/17	USAFA (Colorado Springs)
Germany	1/16 – 1/17	USAFA (Colorado Springs)
Australia	3/16 – 3/17	AFRL/RQ (WPAFB)
Australia	3/16 – 3/17	AFRL/RQ (WPAFB)
Germany	8/16 – 8/17	USAFA (Colorado Springs)
Germany	8/16 – 8/17	AFRL/RW (Eglin AFB)
Germany	8/16 – 8/17	AFSC (Peterson AFB)
Germany	8/16 – 8/17	USAFA (Colorado Springs)
Korea	12/16 – 12/17	USAFA (Colorado Springs)

3RD OFFSET FOCUS AREAS

For FY16, our Focus Areas section lists basic research projects and programs supporting a range of topics that underpin a long-term competitive or "off-set" strategy to generate strategic advantage. This has become known as the "3rd Offset Strategy." AFOSR/IO international program officers support this strategy, funding research that contributes to enabling technologies. Research that advances in artificial intelligence and autonomy will allow the DoD to develop and operate advanced joint, collaborative human-machine battle networks that synchronize simultaneous operations in space, air, sea, undersea, ground, and cyber domains. In FY16, IO has funded 110 research projects ($11.2M) related to the 3rd Offset Strategy. Several of those projects are highlighted here.

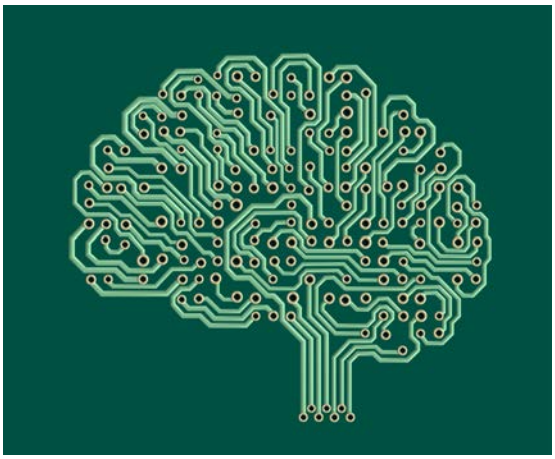
3RD OFFSET FOCUS AREA: Human-Machine Teaming

Autonomous Learning Systems. Contextual Models of Information Fusion, Dr. Jerome Busemeyer (Indiana University) and Dr. Peter Bruza (Queensland University of Technology)
The core research objective is to determine how observations with different types of associated uncertainty can be combined such that uncertainty is suitably assigned numerically to evidence and such that the level of trust in or reliance on a given data source or piece of data is adequately represented. This project will diagnose and analyze the prevalence of contextuality in information fusion with regard to decisions of trust and develop models of contextually sensitive information fusion and express them as probabilistic programs (P-programs). This project directly supports the 3rd Offset concept of Autonomous Learning Systems because it will provide essential capability to autonomous systems to enable them to process contextually complex information and combine it in a way that provides a high level of confidence in the correctness of decisions based on this information. This capability will result in autonomous systems that can be delegated decision-making authority because they can correctly understand contextual information. Program Officer: Lt Col Scott Robertson | Scott.robertson@us.af.mil



Human-Machine Collaboration. Fostering Positive Team Behaviors in Human-Machine Teams through Emotion Processing: Adapting to the Operator's State, Dr. April Rose Fallon (AFRL/711HPW) and Dr. Margaret Lech (Royal Melbourne Institute of Technology). The aim of the proposed project is to research an entirely new concept of training and behavioral augmentation methodology for human-machine teams. The project will develop multi-modal audio-visual emotion recognition and conversation analysis algorithms that can simultaneously recognize in real-time multiple classes of categorical emotions and detect intra- and inter-partner emotional influence trends. The project will also design and conduct experiments aiming to collect audio-visual recordings of dyadic teams conducting problem solving tasks under different trust conditions. The recordings will be labeled with emotional states of team members as well as perceived trust in team partners. The research team will adapt the automatic audio-visual emotive classification system developed to estimate trustworthiness. Then, the team will apply the automatic paralinguistic audio-visual classification system developed to analyze conversational behavior and trustworthiness of human-machine teams and determine optimal interaction patterns for human-machine dyads. The key objectives will be to maximize human trust in autonomous machine partners. This project directly supports the 3rd Offset concept of Human-Machine Collaboration by investigating and maximizing human trust in autonomous machine partners. Humans must trust machine partners in order for the collaboration to be effective. Program Officer: Lt Col Scott Robertson | Scott.robertson@us.af.mil

Discovering Patterns in Human-Robot Interaction. Discovering Patterns in Human-Robot Interaction: New Tools for Complex Adaptive Social Systems, Dr. Andrea Chiba (UC San Diego) and Dr. Janet Wiles (University of Queensland). This project aims to develop algorithms for characterizing individual behaviors in team tasks, uncover principles of effective human-robot teams and use them to construct robots that function as cooperative team members. This project will start by developing an Interactive Systems Toolkit as a comprehensive qualitative and quantitative toolkit for the study of interaction. First, the research team develop the topological data analysis for interaction data as a qualitative approach that enables high fidelity modelling of the manifold derived from time series data. Next, the team will extend the Interactive Systems Toolkit to recurrence analysis, building on the multi-participant recurrence metrics developed by the Wiles group for conceptual recurrence in conversations. The team will then test the principles discovered to develop robots with cooperative behaviors.
This project directly supports the 3rd Offset concept of Human-Machine Collaboration by characterizing and quantifying behaviors that aid team coordination and reveal when an individual member (human or robot) does or does not adapt. The project will use this knowledge to develop principles of effective interaction and to develop robots that are socially effective team members that can adapt to the team's unique composition. Program Officer: Lt Col Scott Robertson | Scott.robertson@us.af.mil



International Human Sensing Project to Launch in 2017.

At the forefront of human-machine cooperation and collaboration is the ability to sense the human operator's state. A unique team of international and AFRL researchers are teaming to better understand the future of sensing technologies for assessing human workload, situation awareness, performance, decision making, etc., and how these technologies might be implemented. The research team represents laboratories and universities from Germany, The Netherlands, Italy, and the UK, and they are combining their efforts to augment existing AFRL capabilities.

While the proposed project is in its infancy, the first formal exchange will take place at AFRL in Summer 2017. Hand-selected European researchers in the area of human sensing will learn about existing AFRL research, present their own research, and work together to shape the future of this quickly expanding field. In addition, ARL researchers are invited and excited about the possibility of cross-service research in this important area.

The ultimate goal of the planned human sensing project is to gain insight into operator capabilities and real-time status, feeding into complex human-machine teaming concepts. Specific applications may include real-time dynamic function allocation, fatigue and awareness assessment, military commander decision aids, and, more broadly, a more effective and efficient human-machine teaming approach. Program Officer: Lt Col Christopher McClernon | christopher.mcclernon@us.af.mil

International Unmanned Systems Research.

The new Research in Europe on Autonomy, Cognitive Sciences, and Human Factors (REACH) program at EOARD is aggressively looking to accelerate USAF, US Navy, and international research collaborations focusing on unmanned systems. Leveraging existing partnerships, this new program is focused on the underpinning research questions that are paramount to effective human-machine teaming. Specific topics include trust in automated systems, human aiding, human sensing, automation design and interfaces, among others.

Existing partners at AFRL, SPAWAR, ONR-G, and European laboratories are the focus of this new EOARD research area. Mechanisms in place to support future research include Windows on Science, tradition grants, and workshops. Program Officer: Lt Col Christopher McClernon | christopher.mcclernon@us.af.mil

Exploring Quantum Biology.

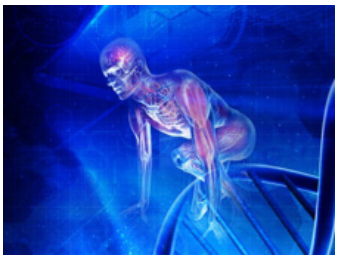
EOARD and the United Kingdom's Defense Science and Technology Laboratory (Dstl) have a history of supporting research programs that explore nature's designs in information processing, energy transfer, sensing, navigation, and flight to produce novel approaches which cannot be practically realized using current technology. In recent years, the field of quantum biology has begun to emerge as an area of potential interest for basic research funding, which led to AFOSR and Dstl's first joint international workshop on the subject in 2016. The aim was to gain a deeper understanding of potential technologies (in energy, sensing, navigation, etc.) that might one day be possible with focused research in quantum biology. By taking a deeper dive with subject matter experts from both the U.S. and Europe, workshop participants identified areas of quantum biology that require investment today in order to understand future design rules for quantum biological systems, as well as research gaps that must be filled in order to apply and adapt these design principles for future technology.

The workshop was held at EOARD in London, UK, and featured eight premier speakers from North American and Europe, as well as the USAF's Deputy Assistant Secretary of the Air Force for Science, Technology, and Engineering.

Special topics of focus included talks on the quantum effects observed in avian magnetoreception (organic spintronics), quantum coherence in photosynthetic systems, and quantum tunneling in biology.
Program Officer: Mr. Lee Poeppelman | lee.poeppelman.1@us.af.mil.

The Microbiome and the Brain, Untangling Bacteria, Behavior, and Biochemistry.

AFRL is interested in better understanding the human microbiome, in effort to further develop its comprehensive sense-assess-augment paradigm for the future of human performance. This becomes especially important in today's highly dynamic and constantly changing mission theater, which is finding new ways to push the physical and emotional boundaries of endurance among warfighters. The gut microbiome is a plastic entity, meaning that it can be affected by the choices an individual makes, and the stressors endured. Probiotics (actively ingesting beneficial bacteria) can modify the microbiome, and may have the potential to increase cognition and reduce anxiety. In 2016, EOARD and the 711th Human Performance Wing began co-funding their first research effort focused on the microbiome with Processor John Cryan at University College Cork, Ireland. This novel effort focuses on what is referred to as the gut-brain axis, whereby two-way communication between gut microbiota and the brain influences health, development, and behavior. Specifically, the collaboration between the Cryan laboratory and AFRL will focus on understanding and validating microbial and host interfaces, and unique metabolite signatures of stressors. Elucidating exactly how these conversations between the microbiome and host occur, through what conduits, especially under stressful conditions, represents an important and new area of basic research for AFRL. Program Officer: Mr. Lee Poeppelman | lee.poeppelman.1@us.af.mil.



Aidy SE, Dinan TG, Cryan JF. "Gut Microbiota: The Conductor in the Orchestra of Immune-Neuroendocrine Communication." Clinical Therapeutics. 2015 May 1;37(5):954-67

Effects of Human Behavior in Stressful Situations.

To provide a foundation for Manned-Unmanned Combat Teaming, understanding human-population behavior and their adaptations are essential. When behavioral adaptations occur, people react with apparent patterns, making erratic decisions influenced by the actions of the masses. According to sociological theories, panic-triggering situations arise whenever social unrest leads to collective emotion and a social contagion. The approach develops a mathematical framework to address behavioral adaptations of a human population induced by stressful situations. By expanding the kinetic Monte Carlo algorithm, known as Gillespie's stochastic simulation algorithm, spatially explicit environments are modeled dynamically. In doing so, parallel compartments are treated such that agents may interact with others and/or transport themselves. The model also introduces an approximation to measure the effect of panic in the population as a function of the individual situational awareness, correlated to the amount of information captured from the environment and social interaction. By coding the rules and rates that generate the stochastic dynamics in a formal language, the research addresses the specificity and heterogeneity of the system by treating each individual as a single entity. The use of patterns allow for dealing efficiently with the combinatorial explosion arising from the social interaction of individuals. The work potentially offers a better comprehension of human behavior in situations such as economic collapse, political uncertainty, disease epidemics, natural disasters, terrorism, and war. Program Officer: Lt Col Michael Martinez | michael.martinez.2@us.af.mil

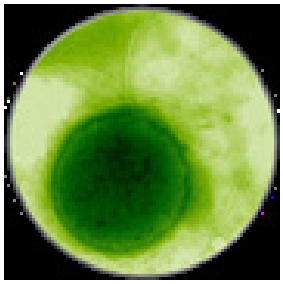
$$X(t) = X(0) + \sum_{k=1}^{K} Y_k \left(\int_0^t \lambda_k(X(s))\mathrm{d}s \right) \zeta_k$$

"Predictive Stochastic Rule-Based Models to Evaluate the Effect of Panic in Human Populations under Stressful Situations", FA9550-16-1-0111, Prof. Tomas Perez-Acle (PI), Ciencia y Vida Foundation, Chile.

Neuromorphic Computing. The results of this particular grant have direct applications in enhancing autonomy through analysis of Big Data. The objectives of this project are to advance neuromorphic computing, which utilizes bio-nano materials to mimic brain functions for analysis and decision-making. This effort involves a cross-discipline approach, incorporating six Chilean universities and seven basic research teams. The background for this project is astro-informatics, the analysis of Big Data for astronomy—leveraging the fact that Chile will soon be home to the Large Synoptic Survey Telescope (LSST), an observatory sensor with a 3-billion pixel camera that may generate up to 30 TB of data per night. To date, computer architecture is approaching the theoretical limits of size, speed, and power—so a new computational framework will likely replace it. Thus, this grant offers an open template for researchers to address these challenges in the areas of neuroscience, computer science, material science, and computational mathematics. This effort seeks to exploit bio-nano systems that offer a wider horizon of performance, potentially revolutionizing the US Air Force technology areas of Command & Control, Communications, Computers (C4), Electronic Warfare / Electronic Protection (EW/EP), and Intelligence, Surveillance, & Reconnaissance (ISR). Autonomous and intelligent processing of real-time sensor inputs can provide the AF with asymmetric battlefield decision-making advantages. Program Officer: Lt Col Michael Martinez | michael.martinez.2@us.af.mil

"Neuromorphic-inspired Science to Maximize Big Data Dynamic Problem Solving for Future ISR Operations", FA9550-16-1-0384, Prof. Samuel Hevia (PI), Catholic University of Chile (PUC).

Bioengineering Extremophile Enzymes to Develop Smart Sensors. This research project investigates bio-enzyme properties to ultimately develop an application in versatile biosensor systems. The main objective is to research the thermostability properties of a thermophilic glutamate dehydrogenase (GDH), isolate a new RNA polymerase from a psychrophile and understand its low temperature stability and efficiency. RNA-based intracellular gene expression switches, known as riboswitches, offer a way to synthetically develop biosensors to any analyte of interest. However, cellular processes may affect the performance of the riboswitch in vivo. The most critical compounds in these types of sensor systems are enzymes that can retain their function under extreme environments, like high temperature and humidity, and different pH conditions, but still perform reactions to allow efficient optical analysis of the biosensors. Extremophiles and their enzymes have been studied to understand their physiology and adaptation to extreme environments, and for biotechnological purposes due to the growing need for robust biocatalysts which are stable under harsh operating conditions. Biosensor systems are gaining relevance due to their versatility in a broad spectrum of applications. They have revolutionized the field of medical diagnostics by providing fast and accurate sensors for different disease markers in diverse biofluids. This research effort has the potential to create rapid diagnostic tests for Airmen deployed in the field, away from medical infrastructure. Program Officer: Lt Col Michael Martinez | michael.martinez.2@us.af.mil



"Bioengineering Extremophile Enzymes to Develop a Rapid Diagnostic Test for Warfighters", FA9550-16-1-0356, Dr Jenny Blamey (PI), Biociencia Foundation, Chile.

3RD OFFSET FOCUS AREA:
Anti-access, Area Denial (A2/AD)

Frequency Agile Microwave Photonic Notch Filter in a Photonic Chip.

AOARD PI team, led by Prof. Ben Eggleton (Centre for Ultrahigh bandwidth Devices for Optical Systems, Univ. of Sydney, Australia), had demonstrated experimentally a highly selective stimulated Brillouin scattering (SBS) integrated microwave photonic bandstop filter in a centimeter-scale chalcogenide glass waveguide that operates with a low pump power (8 - 12 mW) and a low SBS gain (1 - 4 dB), while maintaining high, reconfigurable resolution (32 - 88 MHz) and high stopband rejection greater than 55 dB. PI team further has shown that the filter can be tuned over a wide frequency range of 0 - 30 GHz (Figure 1a), leading to a unique performance combination difficult to match with any existing filter technology, and demonstrated the first high resolution RF filtering experiment using the chip-based Microwave photonic (MWP) filter. The research team has conducted test scenario in which two RF signals, one of interest and the other an unwanted interferer separated in frequency by 20 MHz, were supplied to the input of the filter, and then compared the output RF spectra from a conventional single-sideband MWP filter. Figure 1b (upper) showing the unwanted tone power was reduced by 17 dB, but the signal attenuation was as high as 9 dB, which indicated that the conventional filter resolution was below 20 MHz.

This clearly demonstrated the limitation of the conventional approach, which cannot simultaneously achieve high resolution and high-suppression filtering. In contrast, this can be achieved using on-chip SBS filter, as shown in Figure 1b (lower). The measured interferer suppression in this case was 47 dB, limited by the noise floor of the measurements.

AOARD PI Team: Prof. Benjamin Eggleton, Dr. David Marpaung, Dr. Ravi Pant, Blair Morrison. Mattia Pagani (University of Sydney), Prof. Stephen Madden, Prof. Barry Luther Davies, Dr. Duk-Yong Choi (Australian National University). PI team is collaborating with Dr. Gernot Pomrenke (AFOSR), Dr. Rob Nelson (AFRL/RX), Dr. Nick Usechak (AFRL/RY), Dr. Weimin Zhou (ARL), and Dr. Craig Hoffman (NRL). The developed Microwave Photonic filter prototype is being characterized by AFRL/RY, AFRL/RX, and ARL. In addition, ARL is creating a CRADA with PI team (Univ. of Sydney). Program Officer: Dr. Seng Hong, PE

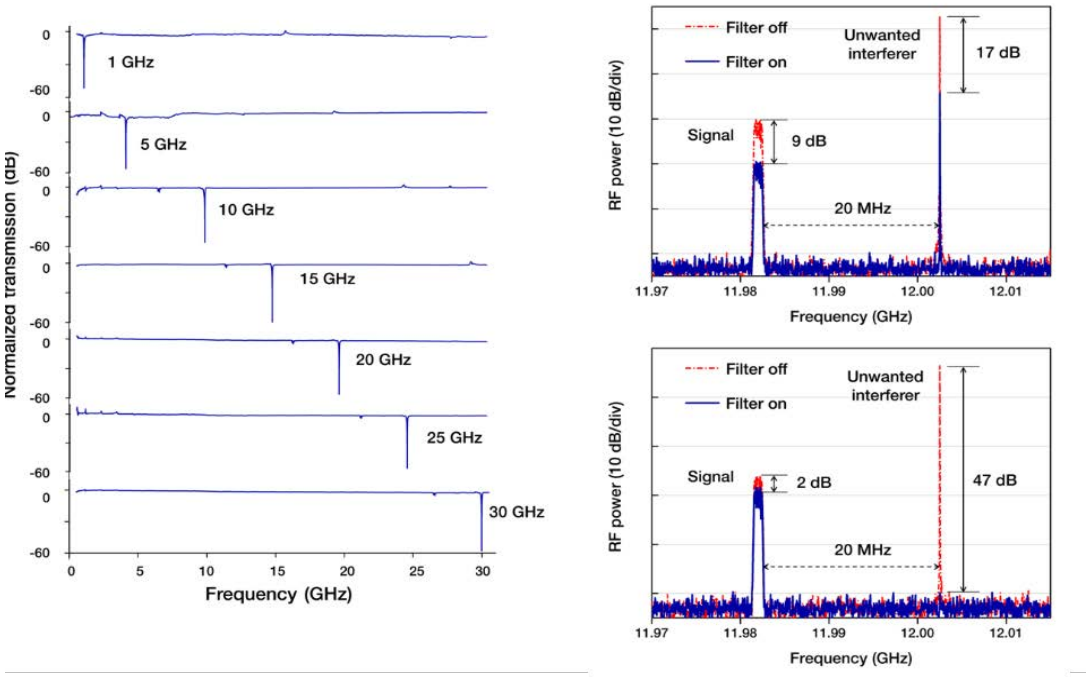


Figure 1. (a) 1-30 GHz frequency tuning of the on-chip SBS MWP filter. (b) High-resolution RF filtering experiment. Two RF signals with 20 MHz frequency separation were used at the filter input. (upper) Filtering with conventional single-sideband scheme with 17 dB SBS loss as optical filter. Peak attenuation at the unwanted interferer tone was 17 dB, and signal attenuation was 9 dB. (lower) Filtering with the cancellation filter using 4 dB of SBS gain. Complete reduction of unwanted interferer was observed with low attenuation of the desired signal (2 dB).

Synthesis of Large-Area 2D Layered Materials and Their Heterostacking Structures.

Transition metal dichalcogenides (TMDs) which have been recognized as a new class of semiconducting two-dimensional (2D) layered materials, has been opened up new opportunities in semiconductor technology for developing future 2D electronics and optoelectronics. Monolayer TMDs also feature their direct energy band gap, good carrier mobility and excellent ON/OFF current ratio when fabricated into field effect transistors, which are important properties for future low-power electronics and optoelectronics. For further applications in advanced circuits, the development of two-dimensional (2D) p-n junction is prerequisite. AOARD PI team, led by Prof. Lain Jong Li (Academia Sinica, Taiwan) has successfully shown the direct growth of atomically sharp p-n junction between WSe2 and MoS2 (Science, 349, 524 (2015)), and has demonstrated the state-of-the-art growth in this field. The heterostructural interface presents a nice p-n junction, which is a key component for monolayer electronics. Most critical components in modern electronics/ optoelectronics can be redesigned and produced based on this new class of 2D materials, where the great ability to tune the band gap, band offset, carrier density, carrier polarity and switching characteristics provide unparalleled control over device properties and possibly new physical phenomena. The new

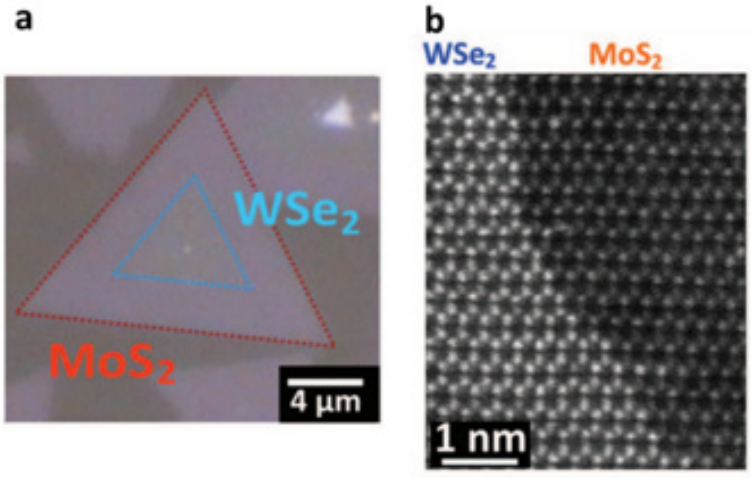


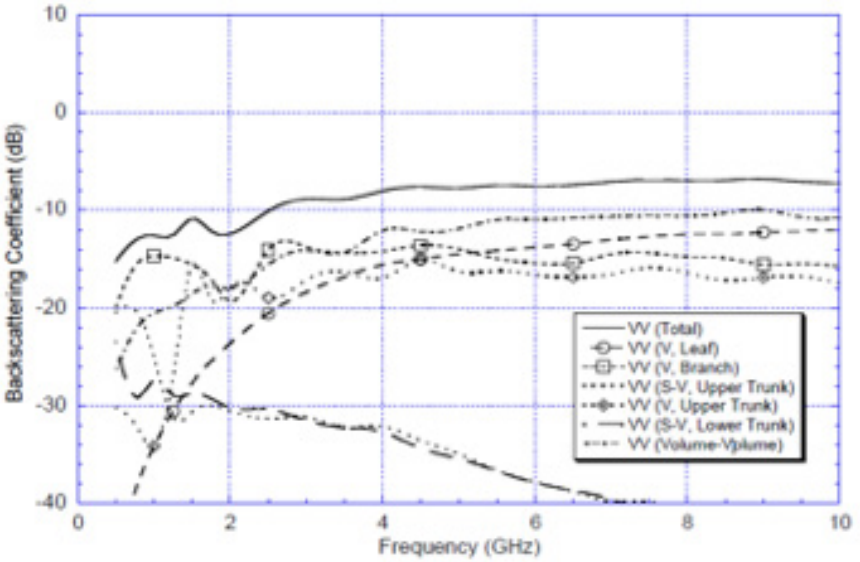
Figure 1: (a) The optical microscope image of the WSe2/MoS2 lateral heterojunction. (b) The High-resolution Scanning Transmission Electron Microscope (STEM) image taken at the interface.

electronics based on 2D layer materials, referred as "monolayer electronics". This research opens the path leading to future monolayer electronics. Furthermore, the atomically sharp interface offers an interesting platform for the study of fundamental material science.

AOARD PI, Prof. Li, is collaborating with Dr. Shin Mou (AFRL/RX) and Prof. James Hwang (Lehigh University). Dr. Program Officer: Dr. Seng Hong, PE

Multi-scale ECM for Phenomenology & Saliency Characterization in Remote Sensing.

Terrain modeling to understand and interpret the satellite SAR images, particularly for complex shape is of interest to USAF. The research in the area of computational electromagnetics in microwave remote sensing, is led by AOARD PI, Prof. Hean Teik Chuah (Universiti Tunku Abdul Rahman, Malaysia) who collaborates with Prof. Leung Tsang (Univ. of Michigan), Prof. Weng Cho Chew (Univ. of Illinois at Urbana Champaign), Prof. Tatsuo Itoh (UCLA), Prof. Li Jun Jiang (Univ. of Hong Kong), Dr. Albert Ruehli (T J Watson Research Center), and Dr. Jun Yi Koay (postdoc at Niels Bohr Institute, Univ. of Copenhagen, Denmark). The objectives are to further study and develop basic methods needed to apply computational electromagnetics in microwave remote sensing and also to construct a basic theoretical framework that will extend and integrate existing Equivalence Principle Algorithm (EPA) in Computational Electromagnetics (CEM) with the domain of Microwave Remote Sensing (MRS) for better interpretation of satellite Synthetic Aperture Radar (SAR) images, radar returns from the earth terrain and scattering mechanisms within the earth terrain. Under the domain of CEM, progress and achievements have been made in this project in extending the current Equivalence Principle Algorithm (EPA) that computes efficiently the radiation and interference of man-made objects and semiconductor components to the realm of microwave interaction in embedded scatterers in the earth terrain, as well as incorporation of such technique in better representing the embedded scatterers to its natural form in the computation of radar backscattering returns and scattering mechanisms involved in the interaction of incoming microwave and natural media (such as vegetation, forest, sea ice, snow, etc). The theoretical framework and model developed allows the solution of microwave remote sensing problem through iterative solution of Radiative Transfer Theory. In addition, dense medium improvement theories such as Dense Medium Phase and Array Correction Theory is also incorporated to allow the application of such solution in the electrically dense medium such as sea ice, snow and dense vegetation. Through the project, advancement has also been made in improving the techniques of EPA for wider application in larger range of problem areas. A novel relaxed hierarchical algorithm based on the surface equivalence principle for the volume integral equations (VIEs) has also been proposed and developed.



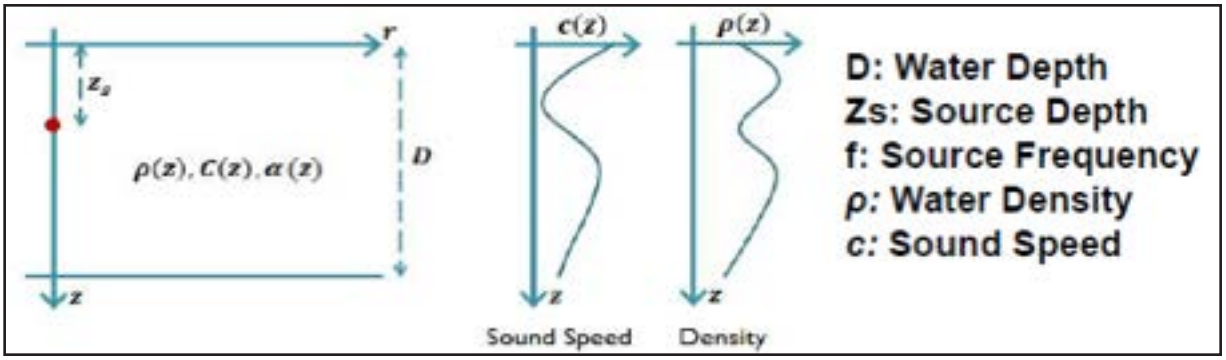
Models allow in-depth understanding of the scattering physics involved, providing feedback to studies of SAR image classification and other applications

Dr. Kung Hua Ding (AFRL/RY) is collaborating with PI team to speed up the electromagnetics full-wave solutions, and to increase the numerical accuracy for antenna integration and design tools. Program Officer: Dr. Seng Hong, PE

Wave Scattering in Heterogeneous Media using the Finite Element Method.

Increased use of UAVs required the needs for development of better electromagnetic (EM) environment models. AOARD PI team, led by Prof. C. P. Vendhan (IIT-Madras, India), is to study acoustic wave propagation in a heterogeneous anisotropic domain with embedded scatterers employing the finite element (FE) model. The goal is to improve the capability to handle deterministic heterogeneous waveguide properties and to develop numerical modeling with radiation boundary condition. The research aim is to develop a finite element model for wave propagation and scattering in a heterogeneous medium. Research in radar and lidar detection of targets in complex environment is problem of great importance to the DoD, specifically when target signal is much weaker than the background clutter. To enhance target detection and deduce false alarm rates one has to understand the characteristics of the complex environment which comprises of volumetric and surface inhomogeneities. Hence, developing a Rayleigh-Ritz approach to model the normal modes in the background inhomogeneous medium, is very useful for constructing the Green's functions of heterogeneous media, for simulations in ground target detection from airborne platforms. In addition, the model could be employed in wave propagation through atmosphere, ionosphere, and turbulent boundary layer of high-speed platforms.

Dr. Saba Mudaliar (AFRL/RY) is collaborating with PI team on compact EM wave model and waveguide acoustics with different heterogeneities. In 2015, AOARD PI, Prof. C.P. Vendhan, received the National Award in the field of Ocean Science and Technology from the Ministry of Earth Sciences, Government of India. Program Officer: Dr. Seng Hong, PE



Depth-dependent cylindrically symmetric ocean waveguide

3RD OFFSET FOCUS AREA:
Cyber & Electronic Warfare

Impact of Ionospheric Electrodynamics. This project utilizes the South-American B-field Array Magnetometer (SAMBA) network to study the effects of scintillation and fluxes in the radiation belt, which could impact space and satellite activities such as GPS and secure communications. During the last two decades, significant results have been obtained in the understanding of the solar wind magnetosphere-ionosphere-thermosphere interaction and its potential impacts. This has been made possible because of the increasing scientific cooperation of different countries and a global effort to increase and improve satellite and ground-based observations. The main scientific objectives of this work are: 1) monitoring the equatorial density and drifts to determine possible causal relationships with the occurrence of scintillation, 2) creating an empirical map of inner magnetosphere mass density distributions to reveal the electrodynamics during storms that affect radiation belt fluxes, and 3) exploring the effect of magnetosphere dynamics on the auroral electrojets and the energy input into the ionosphere-thermosphere system. The geographic location of Chile makes it possible to execute magnetosphere and ionosphere studies in a wide range of latitudes, including the equatorial and auroral phenomena. In particular, a SAMBA sensor located in northern Chile, near the geomagnetic equator, is perfectly suitable for monitoring electrodynamics and comparing it other stations around the globe. This region is located inside the South Atlantic Magnetic Anomaly, which is believed to be the primary reason the Americas experience strong vertical drift velocities, leading to the formation of ionospheric irregularities and scintillation. These irregularities affect the core of USAF operations, and offer significant improvements to our Electronic Warfare capabilities. Program Officer: Lt Col Michael Martinez | michael.martinez.2@us.af.mil

"Study of Ionospheric Electrodynamics and Potential Impact", FA9550-14-1-0139, Dr Marina Stepanova (PI), University of Santiago (USACH), Chile.

Automated Protocol Analysis. The complexity of many deployed security mechanisms makes it extremely hard for humans to assess their security, missing many possible venues of attack. One approach that has revealed many subtle attacks is the area of symbolic protocol analysis, which has been used for example to find attacks on several security protocol standards. Current approaches show promise, but need to be enhanced to cover state-of-the-art security protocol analysis tools to include stateful protocols.

EOARD Oxford University PI Prof Cas Cremers is working to

extend these tools by categorizing and generalizing existing, previously developed invariants (tools for proving or disproving properties of protocols), and then using these results to devise algorithms that automatically generate new invariants for newly analyzed protocols.

With the increased scope that will come from these mathematical breakthroughs, the analysis of many safety-critical systems that are currently out of scope of fully automated analysis, such as the upcoming TPM 2.0 standard and advanced secure messaging systems, will become possible. Program Officer: Lt Col Ryan Thomas | ryan.thomas@us.af.mil.

Radar Enhanced Wireless Access for Directional Networks. Directional antennas are becoming ubiquitous due to the shift to higher frequencies, particularly millimeter wave, and the availability of low-cost massive phased-array antennas. Directivity provides higher gain and reduced interference in wireless networks, as well as low probability of interception, as tight antenna beams are difficult to detect outside of the main radiation lobe. This leads to higher spatial reuse of spectrum and higher network throughput through smart elimination of interference.

EOARD RWTH Aachen PI Prof Marina Petrova is investigating the communication capacity gain or loss under joint radar and communications operation in a networked environment. Over the next two years, she will be defining and developing a general system and environmental model for joint radar-communications operation, leading to the formulation and estimation of the communication capacity problem. Program Officer: Lt Col Ryan Thomas | ryan.thomas@us.af.mil.

Robust Hypothesis Testing for Radar. In recent years, there has been great interest in robust methods for signal processing applications. Robust methods are useful in situations where a not perfect a-priori knowledge of the statistical behavior of the observed data leads to a significant degradation of the performance from the expected nominal one. Robust methods are applicable in a huge variety of signal processing areas, such as signal detection, estimation, and filtering.

Specifically, in radar applications, existing work tends to focus on deriving optimal algorithms to be used in a specific (and a priori known) signal and noise environment. However, in practice, a perfect match between the true signal and noise models and the assumed models cannot be achieved. This motivates the search for robust signal processing techniques in radar.

EOARD University of Pisa PI Prof Fulvio Gini is creating robust radar target detection algorithms regardless of the unknown return model, meaning that a full statistical characterization of returns will not be required. Specifically, his algorithm are to be robust in the min-max sense, meaning that it minimizes the maximum possible value of a given loss function or equivalently, if it optimizes the worst-case performance of the detector. Program Officer: Lt Col Ryan Thomas | ryan.thomas@us.af.mil.

Complex Systems Science for Modelling Wireless Networks. To create survivable, resilient networks, particularly, communications networks, the underlying structure needs to be robust.

Complex systems science research focusing on communication systems has been historically focused on applications and traffic modelling. It has lacked considerations of architecture, infrastructure, and technology. Furthermore, typical attributes used to characterize these networks (such as interference, coverage, throughput, robustness, and cost) fail to fully account for network reconfigurability and robustness.

EOARD Trinity College Dublin PI Dr. Nicola Marchetti is investigating the development of novel network monitoring techniques, drawing on concepts from complex systems science and computational biology, and using them to underpin a new approach to the design and management of wireless networks. In particular, he is interested in the effects of degeneracy, a ubiquitous characteristic of biological systems existing at all levels of biological organization that quantifies the ability of elements that are structurally different to perform the same function or yield the same output. Systems with degeneracy exhibit robustness (without compromising efficiency) and adaptability (based on providing multiple functional options).
This work is developing new complexity and degeneracy metrics will be developed from multi-scale abstractions of telecomm networks. These multi-scale abstractions will include device (physical and virtual elements of the network), interaction (information exchanged explicitly and implicitly within the network), and information (information external to then network) levels of the model.

These complexity and degeneracy metrics will be linked to traditional network performance indicators. In particular, the PIs will analyze the relationship between operators' decisions about the use of shared resources (i.e. infrastructure and/or spectrum) and the resulting network characteristics. They hypothesize that in this relationship, increased degeneracy will result increased stability under dynamic environments.
Program Officer: Lt Col Ryan Thomas | ryan.thomas@us.af.mil.

International Initiatives

International Office Country Programs. In addition to individual travel support, conference support, and R&D projects identified by the international program officers, the International Office also negotiates and champions programs which amplify the AFOSR BAA encouraging submission on scientific specialties of specific countries. The AFOSR country programs were highlighted by the chief-of-staff of the USAF as models for international scientific collaboration in the 2013 Global Horizons final report. These programs are often structured as team proposals consisting of a US partner and a foreign partner where the foreign country funds the foreign half of the team and AFOSR funds the US half of the team. The teams propose special synergy opportunities that building on strong national investments of each nation. The scientific experts of each nation propose collaborations where together the scientists are able to accomplish more than they could accomplish separately. These efforts have historically shown a very strong return on investment and are a growing fraction of the investment portfolio of the AFOSR International Office. There are many ways to judge success including patents, publications, transitions to applied R&D programs at AFRL, and the scientific citations of other scientists attesting the value of the published work. Using the latter most quantitative measure, we found that between 2011 and 2014, the papers published by the Korea and Taiwan nanotechnology country programs accounted for about 29% of the top AFOSR/IO supported published papers; whereas those country programs only represented about 10% of the AFOSR/IO executed budget. This success rate is thought to be from several complimentary factors: (a) building on strong national investments in a scientific areas, (b) working with the host nation to perform a joint call giving a more selective process, (c) the inclusion of joint reviews where the teams further cross-pollinate their interactions and begin to bridge towards AFRL, (d) the self-organized arrangement of the S&T community to form teams with win-win collaborations, and (e) the costs of the projects are shared with our foreign partners. In addition to the long-standing programs with Korea and Taiwan on nanotechnology, AFOSR has launched several new country programs including one on Autonomy with Australia, on Cybersecurity with Korea, and on Quantum Information with Israel.

US-Korea Nano-Bio-Information Technology (NBIT) Initiative. Both the US and Korea have made a substantial investment in nanotechnology over the past several years, and the same trend is expected to continue into the near future. In order to provide an opportunity for scientists and engineers in both countries to collaborate particularly in the areas of "nanostructured materials," "nanoelectronics" and "nano-biotechnology," AFOSR began supporting a series of US-Korea Workshops since 2002. As a result of these interactions, 17 exploratory research grants were arranged for a number of universities in Korea in 2005 under the AFOSR Nanoscience Initiative. Among them, 4 research grants were implemented with full matching support from Korea. In 2007, strong support from Korea and AFOSR led to the inauguration of a new Initiative for Nano-Bio- Information Technology (NBIT) Convergence with 1:1 matching support from two agencies. As a result, a total of 10 research projects was established for this Phase I (2007-2010) involving selected teams of researchers from premier

research universities in the US and Korea. Three of the Phase I projects were continued along with six new ones forming a total of nine collaborative research grants for Phase II (2010-2013), in which Korea National Research Foundation funded the Korean PIs and DoD (AFOSR and US Army International Technology Center - Pacific) funded the US PIs. In FY13 Phase III was initiated, with two projects from Phase II continuing and six new projects selected.

The truly collaborative program among US and Korean PIs, the Tri-Service, and Korean research institutions has led to many research accomplishments. As a result, in FY17, a special Phase III extension was initiated that will enable six projects to continue for one final year.

The Phase III NBIT, Year 3, Program Review was held 08-12 August 2016 in Xitou, Taiwan in conjunction with the US-Taiwan Nanoscience program review. Overall, the NBIT technical presentations were excellent, and the quality of science was high. Great collaborations between US and Korean teams through student and faculty exchanges, and sharing of samples and information were evident throughout the presentations. Program Officer: Dr. Jeremy Knopp | Jeremy.knopp@us.af.mil

NBIT Phase III Extension Teams: 2017 Program Officer: Dr. Jeremy Knopp

Title	Location	Country	Principal Investigator
Ultrafast and Precise Identifications of Waterborne Pathogens by Two-dimensional Nanoplasmonic Optical Antennas	*Univ of California, Berkeley*	US	Lee, Luke
	Sogang, Univ	Korea	Kang, Taewook
Hybrid plasmonic interaction: collective and spin-coupled plasmonic systems	*Northwestern Univ*	US	Mirkin, Chad
	Pukyong Nat'l Univ	Korea	Jang, Jae-Won
Three-dimensional Microstructured bioFETs based Two-dimensional Materials	*Univ of Illinois*	US	Nam, SungWoo
	Hanyang Univ	Korea	Park, Won Il
Integration of Tectonic Silicon Nanotip Probes onto Flexible Substrates	*Purdue Univ*	US	Lee, Chi Hwan
	Hanyang Univ	Korea	Kim, Dong Rip
New Application of Tunnel Junctions for Sensing Toxic and Explosive Gases	*Iowa State Univ*	US	Thuo, Martin
	Korea Univ	Korea	Hyo, Jae Yoon
Wearable Biosensing Platforms Using 2D Native Protein Fibers	Purdue Univ	US	Kim, Young
	Kyung Hee Univ	Korea	Byung, Kyung Min

USAF-Taiwan Nanoscience Initiative. The US Air Force-Taiwan Nanoscience Program is one of the Air Force Office of Scientific Research's (AFOSR) International Research Initiatives. This international program is focused on shaping the direction and advancing the state-of-the-art in nanoscience research. Starting in 2002, grants were provided to Taiwanese investigators to focus on basic research in specific nanoscience areas of interest as described by program managers at AFOSR or at the Air Force Research Lab (AFRL). In 2011, the program evolved to become a collaborative effort in research submission and funding where a US and Taiwanese investigator jointly submitted a research proposal for consideration, and each investigator is to be funded by their respective country's agency (Taiwan -- National Science Council, NSC; US – AFOSR). From

FY 2011 to FY 2013, $600K USD/year was provided to US team members and a total of 8 collaborative grants were awarded – 6 x three year and 2 x two year, with an additional 8 x one year grants. US extension projects which were funded because of the one year difference between the end of the US/ Taiwan Joint Projects and the Taiwan National Nanotechnology program. AFOSR funded 8 such projects during FY14-15 to allow teams to complete research objectives from Phase 1. The collaborative projects were reviewed during the 2015 Joint USAF-Korea NBIT-Taiwan Nanoscience Program Review and Technical Exchange that was held in Seoul, South Korea during 26-30Oct. Significant research progress and collaboration between Taiwan and US academic and AFRL researchers was evident from the excellent presentations. While the program review closed out the extension period for Phase 1, the Joint Review met one of its goals to bring key nanoscience researchers from US, Taiwan, and Korean academic communities.

With the success of Phase 1 of the USAF-Taiwan Nanoscience Program, the Taiwan Ministry of Science and Technology (MOST, formerly NSC) extended their National Nanoscience Program for an additional phase. In FY15, a joint collaborative research proposal "rider" was attached to the Taiwan Innovation and Application of Nanoscience Thematic Program (IANTP) General Call for research proposals. Taiwan researchers who's proposals successfully passed MOST's highly selective evaluation process were then encouraged to submit collaborative research proposals with US researchers, which formed the basis for Phase 2. Submitted joint proposals were evaluated by AFRL and DoD subject matter experts and resulted in the selection of 7 joint proposals. A Joint USAF-Korea NBIT-Taiwan Nanoscience Program Review and Technical Exchange was held in Xitou, Nantou County, Taiwan from 08-12 August 2016. Program Officer: Dr. Ken Caster | AOARD.Materials.Chemistry@us.af.mil.

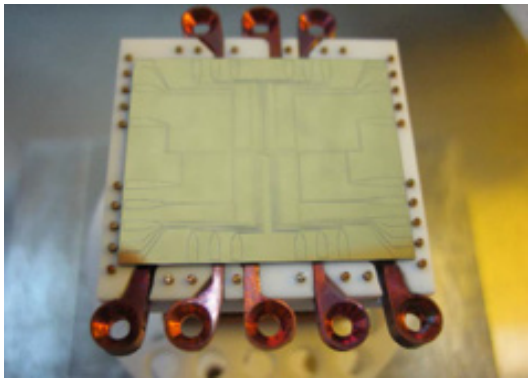
USAF -Taiwan Nanoscience Projects (Phase 2)

Title	Location	Country	Principal Investigator
Aptamer-Based Nano-Slit Platforms for Characterizing Human Performance Biomarkers	Univ of Virginia	US	Swami, Nathan
	Academia Sinica	Taiwan	Chou, Chia-Fu
Integrated Multifunctional Stretchable Nanofibers for Novel Energy Applications	Univ of Washington	US	Jen, Alex
	National Taiwan Univ	Taiwan	Chen, Wen-Chang
Development of Advanced Li rich xLi2MO3-(1-x)LiMO2 Composite Cathode for High Capacity Li Ion Batteries	UC San Diego	US	Ying, Shirley Meng
	National Cheng Kung Univ	Taiwan	Fung, Kuan-Zong
Toward High Performance Photovoltaic Cells based on Conjugated Polymers	UCLA	US	Yang, Yang
	National Chiao Tung Univ	Taiwan	Wei, Kung-Hwa
Chirality Transfer to Mesoscale Network Assemblies	Univ of Massachusetts	US	Grason, Gregory
	National Tsing Hua Univ	Taiwan	Ho, Rong-Ming
Graphene Infrared Transparent Electrode (GITE) and Thermal Enhancer for the Hybrid Energy Nanodevice	Air Force Research Lab	US	Mou, Shin
	National Dong Hwa Univ	Taiwan	Ma, Yuan-Ron
Ultrastrong Carbon Thin Films from Diamond to Graphene under Extreme Conditions: Probing Atomic-Scale Interfacial Mechanisms to Achieve Ultralow Friction and Wear	Univ of Pennsylvania	US	Carpick, Robert
	National Chung Cheng Univ	Taiwan	Jeng, Yeau-Ren

Phase II: 2015-2017 Program Officer: Dr. Ken Caster

USAF-Korea NBIT-Taiwan Nanoscience Program Review and Technical Exchange
08-12August2016, Xitou, Nantou County, Taiwan

Quantum Information US-Israel Program. Spring 2016 launched a basic research collaboration between AFRL and several Israeli universities being coordinated with the Israeli Ministry of Defense (IMOD). Two teams have formed and are jointly supported by AFOSR/IO and IMOD: AFRL/RI with Hebrew Univ of Jerusalem and Bar-Ilan Univ regarding novel uses for a Photonic Quantum Photonic Processor (QPP). A second team is being formed with AFRL/RV and Ben-Gurion University on High Gradient Atom Chip Magnetic Traps.



The figure shows the atom chip work being done at Ron Folman's lab at Ben Gurion University. As a part of the Quantum Israeli Basic research initiative, AFRL/RV is jointly advancing their joint approach on similar atom chip techniques and designs.

Intelligent Convergent Cyber Security (iC2S2) US-Korea Program. In September 2016, AFOSR signed a Terms of Reference with the Ministry of Science ICT and Future Planning (MSIP) of South Korea to jointly fund 5 collaborations between US & Korean Universities between 2017 and 2020. The two organizations will jointly select and fund join researchers totaling about $500k per side per year. In addition the US Navy will support Korean travel to program reviews and the US Army will help review proposals. The spring of 2017 will see the Korean call for proposals posted with the collaborations beginning work summer of 2017. The science pursued will focus on cyber-security foundations in practical homomorphic encryption, provable security, nanotech or quantum enabled security, and formal modeling. Together these hold promise to be transformative in the nature of cyber security. Today anti-virus software provides "patches" every week to each of our systems. If these basic research cyber foundations bear fruit, perhaps one day no patches will be needed.

Figure shows the signing of the Terms-of-Reference regarding iC2S2 between AFOSR and MSIP at the US State Department on 27 October 2016.

International Initiative - Australia. The Terms of Reference for the Australia-US Autonomy Program were signed on 27 May 2016 by Dr. Thomas Christian, Director of AFOSR, and Dr. Jason Scholz, DST Group – Director of Program Tyche. The first funding year is FY17 involves joint matchmaking by AFOSR & DST Group. AFOSR Program officers involved in the program are Dr. Ben Knott (Trust and Influence), Dr. James Lawton (Computational Cognition and Machine Intelligence), and Dr. Richard (Doug) Riecken (Science of Information, Computation, Learning, and Fusion). Dr. Peter Freeland is also involved as a technical consultant. As of the end of CY16, three collaborations have been identified, reviewed and approved for funding and the grant award process is underway.
Program Officer: Lt Col Scott Robertson | Scott.robertson@us.af.mil

Mexico - Cooperative Materials Science Innovation & Invention. The Air Force Office of Scientific Research (AFOSR) and the Mexican National Council for Science and Technology (CONACYT) recognize the importance of promoting scientific and technological cooperation programs that add value to shared science priorities. A Statement of Intent (SOI) was signed in 2015 to launch this collaborative research effort. In order to advance and extend networking and resource coordination, AFOSR and CONACYT are working together to align basic science research in the key technical field of material science through joint US-Mexico research teams.

Submitted proposals for research funding will be jointly evaluated and awarded, averaging $200K per project per year. Mexican researchers are primarily from the Advanced Materials Research Center (CIMAV). Grants will support the following AFOSR topics, identified as common areas of expertise and interest: Optoelectronics and Photonics, Mechanics of Multifunctional Materials and Microsystems, GHz-THz Electronics, Aerospace Materials for Extreme Environments, Multiscale Structural Mechanics and Prognosis, Low-Density Materials, and Organic Materials Chemistry. Program Officer: Dr Brett Pokines | Brett.pokines.1@us.af.mil

Chile & Thailand - Tri-lateral Pacific-Nation Military Defense Science. Over the past two years, the Southern Office of Aerospace Research & Development (SOARD) has worked to establish a tri-lateral Pacific-Nation Defense-Science partnership between the US, Chile, and Thailand.

Both of these countries are solid US allies, and our respective air forces each fly the F-16 fighter aircraft. To lay an R&D foundation for collaboration, the three nations have signed Terms of Reference (ToR) documents between each pair of countries. The initiative also leverages the Department of State (DoS) to add synergy to the relationship—DoS gains diplomatically, while DoD gains technical solutions. The US Ambassador to Chile has provided leadership and validation to the effort, strengthening the relationships and highlighting achievements with diplomatic cables.

With the tri-lateral foundation laid, research grants are currently in formulation in the areas of bio-nanotechnology, space science, and materials science. Additionally, a US-Thai Pacific S&T field experiment, called CRIMSON VIPER, was observed this past year by representatives from the Chilean Air Force (FACh). Going forward, the vision for 2017 is Chilean participation in CRIMSON VIPER by demonstrating a metal-corrosion technology. Finally, Thailand seeks to contribute to a space science research effort by locating a sensor at a Thai observatory.
Program Officer: Dr Brett Pokines | Brett.pokines.1@us.af.mil

Germany - Hypersonic Initiative.

A new relationship with Germany in the area of hypersonics research was started in Fall 2015. In collaboration with researchers at AFRL/RQ and Ivett Leyva at AFOSR, and based on ongoing activities within NATO Science & Technology Organization efforts on hypersonics, a set of related and important projects were solicited and funded through the EOARD Aeronautical Sciences portfolio and the AFOSR Director's Competitive Fund (DCF). Hypersonics is one of the AFRL Game Changers and the approximately $1M investment in these projects over the next three years will directly support AFRL/RQ in their advancement of hypersonic science and technology.

The projects include the following: a hypersonic transition study in the Mach 6 Ludwieg Tube at T.U. Braunschweig; this project will be done in collaboration with wind tunnel tests at the US Air Force Academy in their nearly identical Mach 6 Ludwieg Tube; experimental hypersonic Shock/Boundary Layer Interactions research at DLR Göttingen co-funded by Ivett Leyva at AFOSR; a passive hypersonic transition control research program at DLR Göttingen supported by DCF for the first year; and the development of miniature Atomic Layer Thermopile Sensors at Ingenieurbuero Roediger also supported by DCF for the first year.

While these programs are extremely timely and valuable, there are numerous other outstanding experimental and numerical research facilities and universities in Germany for hypersonic research, many of which could greatly benefit research taking place in AFRL/RQ. Further research project development will take place in the coming year to possibly expand and leverage the hypersonics research programs at German universities, coupled with the outstanding research capabilities of the German Aerospace Center (DLR).

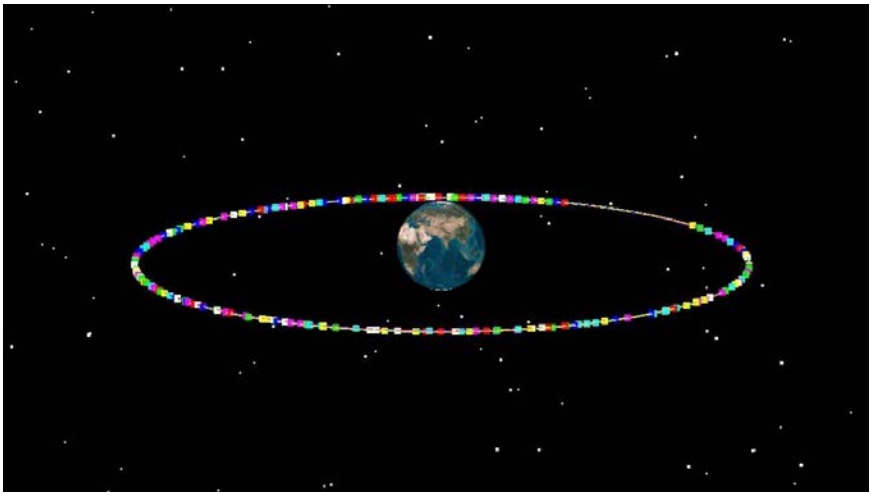
For more information about the German hypersonic program plans and progress contact Dr. Russell M. Cummings at russell.cummings@us.af.mil.

U.S. / U.K. Space Situational Awareness (SSA) Workshop. The European Office of Aerospace Research and Development (EOARD) and the UK Defense Science and Technology Laboratory (Dstl) convened a joint US/UK workshop on Expanding the Observational Data Base for GEO Objects, at the headquarters of EOARD in Ruislip, UK. A select group of experienced military, civil, industry and academic participants met for two days to address the challenges of developing a joint effort to expand and integrate data of resident space objects within the deep space environment. The principle goal was to identify members of the community that can contribute to international initiatives focused on Space Situational Awareness (SSA) of deep space and to generate actions to progress against this objective.

The participants were challenged to address the following:

1. Investigate optimal mix of sensors to support deep space SSA and advise on the utility of existing sensor assets within the wider community
2. Identify the current challenges of calibration and validation of unrelated, distributed sensors
3. Identify optimal methods of data exchange to enable an effective sensor network
4. Identify methods to improve the precision of orbit determination in the deep space domain, including association of measurements between observation periods and data fusion of a distributed sensor network
5. Produce a list of assets available to a joint US/UK non-military observation of GEO; including network solutions
6. Postulate objectives and advise on the design of experiments to assess possible contributions

The desired outcome of the workshop was to achieve a mutual understanding (across the community) of topic areas of relevance to UK and US communities. Then, by identifying capabilities and needs, to generate a strawman plan to deliver an experimental deep space SSA architecture available to explore potential solutions from the community.



There were 32 participants at the workshop representing government, industry, and academia. Of these, 20 gave invited or contributed presentations on topics relevant to deep space SSA. They included descriptions of sensor capabilities and networking, tracking methods, data management, and academic treatments of the astrodynamics of a GEO object. The presentations showed that deep space SSA remains a complex problem and is involving an increasingly large community. Some common themes emerged from the briefings. There is a need for community standards, both in terminology and in technology. User requirements are often lacking or unclear. There are many groups from differing communities that need information of objects at GEO, but there is no consensus of the way ahead. This is complicated by inconsistent interpretations of SSA products and capabilities and a lack of understanding of the domain population.

The second day of the workshop included a discussion to determine the topics most immediately relevant to deep space SSA. Smaller groups then discussed the way forward in sensor operations, satellite characterization, and requirements and data sharing. Each group was asked to identify and summarize a need in their area and to discuss approaches to address it.

The group considering sensor operations discussed the need for clear requirements and Con-Ops to guide development and optimization of sensor placement and networking. This is important in developing observation strategy, and also in creating trust and developing better communication between operators and users of SSA information. Persistent trackability, behaviors affecting track custody, and space object taxonomy are issues that require real time networking, standardization, and access to a common data base through data sharing.

The group considering satellite characterization addressed improvement of the understanding and implementation of space object behavior in the near-GEO regime. There is a need to improve classification, identification and track custody of operational space vehicles in this region. It was noted that, due to an increasing number of "dead" objects drifting from graveyard orbits, it is important to understand the behavior of decommissioned space vehicles placed in graveyard orbits at Super-GEO. This requires the development of high fidelity non-gravitational force models for a candidate GEO space vehicle. An ideal scenario would be to observe an object with higher area-to-mass ratio carrying a GPS receiver, together with a simulation of the likely space object behavior using space environment, astrodynamics, and sensor models.

The group considering requirements and data sharing considered the importance of developing a minimum set of data standards as a first step to build upon for the entire SSA community. This requires engagement with operators, government, and agencies to get agreement on the overall approach to generate requirements.

Action items for participants include the development of the required elements for classification, identification, and track custody of space objects, a webinar by the University of Arizona to brief the capabilities of the CyVerse data base, the development of a draft scenario to set an initial case study, and engagement with the UK Space Agency for a realistic list of requirements. Proposals were solicited for a basic research grant to begin this process.

The results of this workshop will influence policy discussions, data sharing arrangements and technology and infrastructure development. The findings will influence the current AFRL work to produce a catalog of the deep space domain using "off the shelf" sensors and data. There was a feeling among the participants that the discussions and sharing of ideas among the group should continue, and that specific opportunities should be sought for further collaboration. A workshop is recommended to be held in about six months to follow up on these suggestions.

Workshop organizers: Kent Miller, EOARD and Andy Ash, Dstl

Expanding the Observational Data Base for GEO Objects
A workshop held at EOARD, Ruislip, UK on 7-8 December 2016

APPENDIX I: FY16 Grants

Below is a listing of all international grants supported by AFOSR with FY16 funds.

Country	Institution	Principal Investigator	Project Title
Argentina	UBATEC S.A. - Universidad de Buenos Aires	Hnilo, Alejandro	Nonlinear dynamics of self-pulsing all-solid-state lasers.
Argentina	ASOCIACION CIVIL DE ESTUDIOS SUPERIORES (ACES)	Tarzia, Domingo	Problems Governed by Elliptic and Parabolic Variational Inequalities
Argentina	CENTRO CIENTIFICO TECNOLOGICO CONICET SANTA FE	Spies, Ruben	Mathematical methods for inverse ill-posed problems and applications
Argentina	UNIVERSIDAD NACIONAL DE SAN MARTIN	Rubio, Diana Aurora	APPLIED AND THEORETICAL ISSUES ON INVERSE PROBLEMS
Australia	MONASH UNIVERSITY	Jones, Cameron	144043 Transition Metal-Like Reactivity - Small Molecule Activation
Australia	THE UNIVERSITY OF QUEENSLAND	Bowen, Warwick	Quantum microrheology 144046
Australia	THE UNIVERSITY OF ADELAIDE	Medwell, Paul	144039 Towards the Application of MILD Combustion to Gas Turbines
Australia	CURTIN UNIVERSITY OF TECHNOLOGY	Tingay, Steven	144061 ICME Magnetic Field Orientations: Murchison Widefield Array
Australia	QUEENSLAND UNIVERSITY OF TECHNOLOGY	Motta, Nunzio	144014 Encapsulating Quantum Dots into ZnO Nanorods
Australia	MONASH UNIVERSITY	Zukerman, Ingrid	134132 A decision-theoretic model of interactions between people and devices
Australia	NATIONAL ICT AUSTRALIA LIMITED	Chen, Fang	134131 Trust Measurement using Multimodal Behavioral Analysis & Trust Calib.
Australia	THE UNIVERSITY OF QUEENSLAND	Wiles, Janet	134128 Human-robot interactions: Social micro-abilities
Australia	UNIVERSITY OF NEW SOUTH WALES	Hengst, Bernhard	134127 Autonomous Adaptation and Trust
Australia	NATIONAL ICT AUSTRALIA LIMITED	Andronick, June	Formal Model of a Multi-Core Kernel-based System
Australia	NATIONAL ICT AUSTRALIA LIMITED	Walsh, Toby	Meta-Optimization
Australia	FEDERATION UNIVERSITY AUSTRALIA	Gao, David	Unified Theory and Algorithm for Solving Challenging Problems with Applications
Australia	UNIVERSITY OF NEW SOUTH WALES	Pagnucco, Maurice	Eliciting Emotions from Tactile Surfaces and Kinetic Agents

Australia	ROYAL MELBOURNE INSTITUTE OF TECHNOLOGY	Watkins, Simon	Turbulence Mitigation for Aircraft in Urban Environments
Australia	UNIVERSITY OF MELBOURNE	Dower, Peter	Tractable Computational Methods for Optimal Control via Fast Dynamic Programming
Australia	FEDERATION UNIVERSITY AUSTRALIA	Gao, David	Canonical Duality Theory in Decision Science and Complex Systems
Australia	QUEENSLAND UNIVERSITY OF TECHNOLOGY	Milford, Michael	An Infinitely Scalable Learning and Recognition Network
Australia	NATIONAL ICT AUSTRALIA LIMITED	Thiebaux, Sylvie	154015 Negotiating Mission Plans under Risk Bounds
Australia	AUSTRALIAN NATIONAL UNIVERSITY RESEARCH OFFICE ACTON (AUSTRALIA)	Xie, Lexing	154002 The Anatomy of Social Media Popularity
Australia	AUSTRALIAN NATIONAL UNIVERSITY RESEARCH OFFICE ACTON (AUSTRALIA)	Kivshar, Yuri	Topologically nontrivial electromagnetic states 154029
Australia	UNIVERSITY OF MELBOURNE	Prawer, Steven	High temperature superconductivity in diamond
Australia	THE UNIVERSITY OF QUEENSLAND	Horvath, Ildiko	Sub-auroral polarization stream electric field in coupled MIT processes
Australia	UNIVERSITY OF TECHNOLOGY SYDNEY	Aharonovich, Igor	Novel single photon sources for new generation of quantum communications
Australia	GRIFFITH UNIVERSITY	Iacopi, Francesca	Graphene on SiC for Nanomaterial Applications
Australia	UNIVERSITY OF MELBOURNE	Tordesillas, Antoinette	DIRECTING TRANSMISSION PATTERNS IN GRANULAR MATERIALS FROM THE GRAIN SCALE
Australia	UNIVERSITY OF NEW SOUTH WALES	Hattori, Haroldo	Terahertz beam steering based on tunable nano-antennas 144003
Australia	ROYAL MELBOURNE INSTITUTE OF TECHNOLOGY	Moran, Bill	Radar Control | Optimal Resource Allocation
Australia	MACQUARIE UNIVERSITY	Mildren, Richard	Scaling diamond Raman lasers and beam combiners into the kilowatt
Australia	THE UNIVERSITY OF QUEENSLAND	Smart, Michael Kevin	Mach 6-8 Scramjet Combustion Experiments using Hydrocarbon Fuel
Australia	UNIVERSITY OF NEW SOUTH WALES	Tyo, J. SCOTT	Advanced Polarization and Coherence Sensors

Australia	University of New South Wales-NEW NCAGE Code	Gai, Sudhir	Effects of Wall Temperature in Hypersonic Separated Flow
Australia	ROYAL MELBOURNE INSTITUTE OF TECHNOLOGY	Menicucci, Nicolas	Quantum information theory of observers in analogue and emergent gravity
Australia	MONASH UNIVERSITY	Petitjean, Francois	Automatic analysis of satellite image time series
Australia	University of New South Wales-NEW NCAGE Code	Neely, Andrew	Characterisation and control of a flap undergoing hypersonic FSI
Australia	THE UNIVERSITY OF QUEENSLAND	Pounds, Paul	Bio-inspired peripersonal-space sensors for social interaction
Australia	University of New South Wales-NEW NCAGE Code	OByrne, Sean	Doppler-free velocimetry in hypersonic flow
Australia	UNIVERSITY OF SYDNEY	Hawkett, Brian	Properties of ionic liquid ferrofluids
Australia	MACQUARIE UNIVERSITY	Fuerbach, Alex	Ultrafast mid-infrared fiber laser systems
Australia	UNIVERSITY OF NEW SOUTH WALES	Canning, John	Spun, Doped Air-clad Photonic Crystal Fibers for High Power Laser Work
Australia	UNIVERSITY OF SYDNEY	Eggleton, Benjamin	Harnessing giant Brillouin gain for advanced integrated microwave
Australia	MACQUARIE UNIVERSITY	Fuerbach, Alex	Broadband integrated mid-infrared light sources as enabling technology
Australia	UNIVERSITY OF SOUTHERN QUEENSLAND	Epaarachchi, Jayantha	Development of fiber reinforced IR Light Activated Shape Memory Polymer Material
Australia	UNIVERSITY OF TASMANIA	Kang, Byeong Ho	Knowledge Acquisition for Autonomous System
Australia	DEAKIN UNIVERSITY	Lapovok, Rimma	Shear induced solid-state joining of dissimilar titanium alloys
Australia	DEAKIN UNIVERSITY	Walsh, Tiffany	Integration of Experiment and Modelling to Advance Biosensor Design
Australia	THE UNIVERSITY OF QUEENSLAND	Morgan, Richard	Rapidly Expanding Non Equilibrium Hypersonic Flow
Australia	AUSTRALIAN NATIONAL UNIVERSITY RESEARCH OFFICE ACTON (AUSTRALIA)	James, Matthew	Systems Theory Approach to Modeling and Robust Design of Quantum Devices
Australia	THE UNIVERSITY OF ADELAIDE	Ebendorff-Heidepriem, Heike	High power durability of soft glasses for laser applications

Australia	COMMONWEALTH SCIENTIFIC AND INUSTRIAL RESEARCH ORGANISATION	Cummins, Sharen	Thermo-Mechanical Modelling of Granular Materials With Non-spherical Particle Sh
Australia	AUSTRALIAN NATIONAL UNIVERSITY RESEARCH OFFICE ACTON (AUSTRALIA)	Fu, Lan	Sb-Based III–V Ternary Nanowire Materials for Infrared Photodectectors
Australia	University of New South Wales-NEW NCAGE Code	OByrne, Sean	Laser-spark and pulsed nanosecond ignition for hydrocarbon fuels
Australia	QUEENSLAND UNIVERSITY OF TECHNOLOGY	Fairfull-Smith, Kathryn	The Development of Nitroxide-Containing Anti-Biofilm Agents
Australia	THE UNIVERSITY OF ADELAIDE	Visintin, Philip	Ultra-high performance fibre-reinforced concrete for rapid low-cost mat. dev.
Australia	UNIVERSITY OF BALLARAT	Ting, Kai Ming	Algorithms that defy the gravity of learning curve
Australia	MONASH UNIVERSITY	Ningqun, Anthony Guo	Investigate Target reflection and illumination sensitivity in range gate
Australia	DEAKIN UNIVERSITY	Henderson, Luke	Small-Diameter PAN-based Carbon Fiber Research
Australia	UNIVERSITY OF NEW SOUTH WALES	Brown, Laurie	Rarefied plasma aerodynamics for LEO objects in the ionosphere
Australia	DEAKIN UNIVERSITY	Phung, Dinh	Bayesian Learning with Unbounded Capacity from Heterogeneous and Set-Valued Data
Australia	MONASH UNIVERSITY	Webb, Geoff	Learning in the context of distribution drift
Australia	CURTIN UNIVERSITY OF TECHNOLOGY	wang, song	Advanced Numerical Algorithms for Fractional Optimal Feedback Control Problems
Australia	THE UNIVERSITY OF ADELAIDE	Hutchinson, Mark	Shining light on the neuroimmune interface
Austria	ZENTRUM FUER NANOBIOTECHNOLOGIE	Pum, Dietmar	S-Layer Directed Nanoscale Fluid Mechanics
Belgium	KATHOLIEKE UNIVERSITEIT TE LEUVEN INST. OPENB. NUT	Poedts, Stefaan	Physics-based modeling of CMEs 140375
Belgium	INSTITUT VON KARMAN DE DYNAMIQUE DES FLUIDES VZW	Paniagua, Guillermo	cuBoundary Layer Establishment and Separation: Discovering the Dynamic Scales

Belgium	UNIVERSITEIT GENT VZW	Roelkens, Gunther	Innovative silicon and InP integrated photonic devices for RF downconversion
Belgium	UNIVERSITEIT GENT VZW	Shawkey, Matthew	Emergent properties of avian biophotonic nanostructures
Brazil	Fundaçao de Desenvolvimento da Pesquisa - Fundep.	Avila, Antonio	Piezoelectric Sensor/Actuator for Aeronautical Structures Based PVdF-CN 140377
Brazil	UNIVERSIDADE FEDERAL DO CEARA.	Bezerra Sombra, Antonio Sergio	EXPERIMENTAL AND NUMERICAL INVESTIGATION OF MICROSTRIP AND DIELECTRIC RESONATOR
Brazil	INSTITUTO DE QUIMICA UNIVERSIDADE DE SAO PAULO	Tita, Volnei	New Multi-Scale Based Damage Evolution and Failure Models for Prognosis of Compo
Brazil	UNIVERSIDADE FEDERAL DO RIO GRANDE DO SUL	Rizzato, Felipe Barbedo	Nonlinear Stability of Magnetically Focused Particle Beams
Brazil	INSTITUTO PRESBITERIANO MACKENZIE.	Kaufmann, Pierre	Solar Flare Emissions from GHz to THz Frequencies
Brazil	INSTITUTO DE FISICA DE SAO CARLOS	Mendonca, Cleber	Two-photon absorption with polarization control in chiral compounds
Brazil	Uniao Brasileira de Educacao e Assistencia	Azevedo, Dario	Urban Traffic patterns in Intermittently Sampled Airborne Wide-Area
Brazil	FACULDADES CATOLICAS	Costa, Emanoel	Statistical Analysis of Ion Density Fluctuations & Dynamics
Brazil	INSTITUTO DE FISICA DE SAO CARLOS	Marcassa, Luis	Cold Rydberg atoms: few body effects and high order interaction
Brazil	FUNDACAO COORDENACAO DE PROJETOS PESQUISAS E EEUDOS TECNOL	Savi, Marcelo	Nonlinear Dynamics of Shape Memory Alloy Origami Systems
Bulgaria	NEW BULGARIAN UNIVERSITY	Petkov, Georgi	Anticipating Future by Analogy-Making
Canada	UNIVERSITY OF BRITISH COUMBIA THE	Grant, Edward	Quantum and classical measures of molecular ultracold plasma dynamics
Canada	UNIVERSITY OF TORONTO	Brumer, Paul	Photoinduced electronic energy transfer
Canada	UNIVERSITY OF TORONTO	Thywissen, Joseph	Single-site imaging of fermions in two-dimensional optical lattices

Canada	YORK UNIVERSITY	Tsotsos, John	A Neurocomputational Process for Visual Attention and Reasoning
Canada	DALHOUSIE UNIVERSITY	Selinger, Peter	Trusted Quantum Software
Canada	UNIVERSITY OF SASKATCHEWAN	smolyakov, andrei	Fluid modeling of instabilities and structures in Hall plasmas
Canada	NATIONAL RESEARCH COUNCIL OF CANADA	Corkum, Paul	Linking Attosecond Science in Solids and Gases
Canada	UNIVERSITY OF TORONTO	STEINBERG, ADAM	Turbulence Evolution Through Premixed Flames and its Relationship with Flame Str
Canada	UNIVERSITY OF OTTAWA	Broadbent, Anne	VERIFICATION OF QUANTUM COMPUTATIONS
Canada	UNIVERSITY OF WATERLOO	Eliasmith, Chris	Learning in large-scale models of biological cognition
Chile	Pontificia Universidad Catolica de Chile	Hevia, Samuel	Neuromorphic Inspired Science to Maximize Big Data Dynamic Problem Solving for F
Chile	UNIVERSIDAD DE SANTIAGO DE CHILE	Stepanova, Marina	The Study of Ionospheric Electrodynamics and Potential Impact 140139
Chile	Universidad de Chile	Adams, Martin	Space Object Detection & Tracking Within a Finite Set Statistics Framework150069
Chile	Universidad de La Serena	Ramirez, Amelia	Simultaneous Observations of Geosynchronous Satellites from Falcon Telescope
Chile	ACADEMIA POLITECNICA AERONAUTICA	Vejar, Nelson	MULTI-LATERAL DEFENSE SCIENCE PARTNERING TO INVESTIGATE FUNDAMENTAL BIO-ELECTRO-
Chile	UNIVERSIDAD DE CHILE	Kiwi, Miguel	Exchange Bias: from basic physics towards applications
Chile	FUNDACION CIENCIA PARA LA VIDA	Perez-Acle, Tomas	Predictive and stochastic rule-based models to evaluate the effect of panic in h
Chile	FUNDACION CIENTIFICA Y CULTURAL BIOCIENCIA	Blamey, Jenny	Biological Sensor Development
Croatia	FAKULTET ELEKTROTEHNIKE I RACUNARSTVA	Sipus, Zvonimir	Analysis and Design of Curved Metasurface Structures 150121
Croatia	FAKULTET ELEKTROTEHNIKE I RACUNARSTVA	Hrabar, Silvio	Non-Foster Source-load Networks and Metasurfaces 150120
Czech	University of West Bohemia	Straka, Ondrej	Nonlinear Estimation Framework for Optimized Target Tracking,and Self-assessment

Ethiopia	BAHIR DAR UNIVERSITY	Nigussie, Melessew	African ionospheric irregularity
Fiji	University of South Pacific	Kumar, Sushil	Ionosphere irregularities in South Pacific
Finland	University of Jyväskylä	Semenov, Alexander	Information spread in online social media
France	Institut Mines Telecom	GRILLOT, FREDERIC	Nonlinear Photonics in Nanostructured Lasers: Ultra-Broadband THz Comm 150104
France	Ass Recherche Devel Methode Proces Indus	Berger, Marie-Helene	Nanostructural Characterization of directionally solidified eutectic materials f
France	UNIVERSITE PARIS 6 PIERRE ET MARIE CURIE	Trelat, Emmanuel	Interplay Between Continuous-Time & Discrete-Time Optimal Control Problems
France	Fondat J J Laffont Tlse Sciences Eco	Bolte, Jerome	Majorization-minimization procedures and multi-objective optimization
France	ECOLE SUPERIEURE D'ELECTRICITE	Rontani, Damien	Scalable Photonic Machine for Neuromorphic Computation 150279
France	COMMISSARIAT L'ENERGIE ATOMIQUUSE	Mingo, Natalio	Predictive theoretical modeling of electro-thermal properties of SnGe graphane a
France	Ass Recherche Devel Methode Proces Indus	Willot, Francois	Stochastic Models for cold sprayed microstructures
France	École Supérieure d'Electricite	Rontani, Damien	Spatio-temporal photonic liquid state and extreme learning machines
France	CTRE NAT DE LA RECHERCHE SCIENTIFIQUE	Jourdain, Vincent	Chiral Selectivity of SWCNT growth
France	Comue Univ Bourgogne Franche Comte	Senet, Patrick	Design and Computer Simulations of 2D MeX2 (Me=transition metal) Nanopores for D
France	Fondat J J Laffont Tlse Sciences Eco	Bolte, Jerome	Forward-backward algorithms for nonconvex structured optimization problems
Germany	Philipps-Universität	Stoltz, Wolfgang	Experimental Semiconductor Lasers under Non-equilibrium Op Conditions 140159
Germany	RUHR-UNIVERSITAT BOCHUM	Hofmann, Martin	Mode-locked Diode Lasers from Microscopic Analysis to Femtosecond Pulses 140137

Germany	UNIVERSITAET DER BUNDESWEHR MUENCHEN	Gerdts, Matthias	Model-Predictive Control Strategies for Distributed Multi-Agent Systems
Germany	Technische Universität Bergakademie Freiberg	Bruecker, Christoph	Spatio-temporal response of sensory hair arrays 140315
Germany	Technische Universität Darmstadt	Klein, Andreas	Electrode Interfaces of Non-Linear Dielectrics
Germany	Technische Universität Kaiserslautern	Rahm, Marco	Compressed Sensing for Terahertz Imaging Spectroscopy - RW - Dr. Allen 150488
Germany	Universitat Paderborn	Lorenz, Alexander	Liquid crystal light valves driven by photovoltaic fields - RX Evans 150426
Germany	DEUTSCHES ZENTRUM FUR LUFT- UND RAUMFAHRT E.V.	Boxx, Isaac	Characterization of Flames Using High-speed Laser-Diagnostic Techniques 160044
Germany	Medizinisches Laserzentrum Lübeck GmbH	Miura, Yoko	Cell response determinants in laser-induced thermal impacts
Germany	Universität zu Lübeck	Vogel, Alfred	Experimental and theoretical investigation of the mechanisms
Germany	Rheinisch Westfalische Technische Hochschule Aachen	Petrova, Marina	RadMAC
Germany	TECHNISCHE UNIVERSITAT CAROLO-WILHELMINA ZU BRAUNSCHWEIG	Radespiel, Rolf	HypTraLT - Measure growth of boundary layer disturbances
Germany	Technische Universität Darmstadt	Haase, Wolfgang	Nanocomposites based on Ferroelectric Crystals and Solid State Ferroelectrics
Germany	DEUTSCHES ZENTRUM FUR LUFT- UND RAUMFAHRT E.V.	Wagner, Alexander	Experimental Hypersonic SWBLI
Germany	DEUTSCHES ZENTRUM FUR LUFT- UND RAUMFAHRT E.V.	Wagner, Alexander	Passive Hypersonic Transition Control
Germany	LASER-LABORATORIUM GOTTINGEN E.V.	Troe, Hans Jurgen	Elementary Reactions in Plasma Chemistry
Germany	Ingenieurbuero Roediger	Roediger, Tim	Atomic Layer Thermopile Sensor
Germany	Rheinisch Westfalische Technische Hochschule Aachen	Mahonen, Petri	Multi-receiver Medium Access Control
Germany	FRAUNHOFER-GESELLSCHAFT ZUR FORDERUNG DER ANGEWANDTEN FORSCHUNG E.V.	Gladysz, Szymon	Turbulence compensation

Germany	Max Planck Institute	Krausz, Ferenc	Advancing attosecond solid state physics towards petahertz electronics
Greece	ARISTOTLE UNIVERSITY OF THESSALONIKI	Michailidis, Nikolaos	Corrosion Resistance of High-Temperature SMAs Under Extreme Environments
Hungary	KOZEP-EUROPAI EGYETEM	Barabasi, Albert-Laszlo	Quantifying Scientific Performance and Success 150364
Hungary	EOTVOS LORAND TUDOMANYEGETEM	Vicsek, Tamas	Autonomous Mission Control of Drone Flocks
Iceland	Nyskopunarmidstod Islands	Leosson, Kristjan	Metasurface Polarimetry
India	JAWAHARLAL NEHRU CENTRE FOR ADVANCED SCIENTIFIC RESEARCH	Waghmare, Umesh	Tuning Coupled Dynamics of Electrons and Phonons in MoS2.
India	INDRAPRASTHA INSTITUTE OF INFORMATION TECHNOLOGY DELHI	Ram, Shobha Sundar	Frontal Radar Imaging of Humans Behind Walls 154018
India	University of Calcutta	Paul, Ashik	Space weather studies using SCINDA data
India	INDIAN INSTITUTE OF TECHNOLOGY MADRAS	Ramaprabhu, Sundara	Development of Li-S Battery With Improved Sulphur Utilization and Cyclic Stabili
India	INDIAN INSTITUTE OF TECHNOLOGY - KANPUR	Shukla, Sandeep	A Formal Approach against Code Replacement Attacks on Cyber Physical Systems
India	INDIAN INSTITUTE OF TECHNOLOGY MADRAS	Rajagopalan, Ambasamudram	Registration of Large Motion Blurred CMOS Images
India	INDIAN INSTITUTE OF SCIENCE	Banerjee, Dipankar	GRAIN BOUNDARY α IN TITANIUM ALLOYS
India	INDIAN INSTITUTE OF TECHNOLOGY DELHI	Gupta, Shalini	Rapid Preconcentration and Detection of Pathogens in Large Volumes via Dual-Nano
India	INDIAN INSTITUTE OF SCIENCE EDUCATION AND RESEARCH	Kumar, G.V. Pavan	Angle-Dependent Optics of Plasmonic Core-Shell Nanoparticles
India	INDIAN INSTITUTE OF TECHNOLOGY MADRAS	Srinivasan, Balaji	Study of orbital angular momentum mode fiber amplification of optical pulses
India	NATIONAL CENTRE FOR BIOLOGICAL SCIENCES	Sane, Sanjay	The Mechanisms of Behavioural Coordination in flying insects
Ireland	UNIVERSITY COLLEGE CORK	McInerney, John	Effective First Principles Modeling of Semiconductor Lasers 140204
Ireland	UNIVERSITY OF DUBLIN, TRINITY COLLEGE	Marchetti, Nicola	Complexity for Telecom

Ireland	UNIVERSITY COLLEGE CORK	Cryan, John	Multidirectional axes of communication between the gut microbiome and the brain
Israel	WEIZMANN INSTITUTE OF SCIENCE	Joselevich, Ernesto	Torsion of carbon and inorganic nanotubes
Israel	The Interdisciplinary Center (IDC) Herzliya	Boyle, Elette	New Directions in Secure Computation via Function Secret Sharing
Israel	TECHNION ISRAEL INSTITUTE OF TECHNOLOGY	Adler, Robert	SATA II - Stochastic Algebraic Topology and Applications
Israel	SOREQ - NAHAL SOREQ NUCLEAR RESEARCH CENTER	Gvishi, Raz	Development of Optical Materials based on Sol-gels
Israel	BEN GURION UNIVERSITY OF THE NEGEV	Rosenwaks, Salman	Advanced Diode Pumped Alkali Lasers: Theory Investigations and Modeling, 150489
Israel	TECHNION ISRAEL INSTITUTE OF TECHNOLOGY	Shima, Tal	Cooperative Evasion and Pursuit for Autonomous Vehicles
Israel	TECHNION ISRAEL INSTITUTE OF TECHNOLOGY	Segev, Mordechai	Curved Space Photonics Inspired by General Relativity Concepts
Israel	BEN GURION UNIVERSITY OF THE NEGEV	Shriki, Oren	NeuroFalcon-Neurotechnology for Fast Assessment of Loss-of-CONsciousness 160035
Israel	BEN GURION UNIVERSITY OF THE NEGEV	Rosenwaks, Salman	DPALS Lasers: Israel CFD theory and lab experiments
Israel	ARIEL UNIVERSITY	Bernstein, Joseph	Reliability Physics of Advanced Space Electronics
Israel	WEIZMANN INSTITUTE OF SCIENCE	Maron, Yitzhak	Investigation of the properties of imploding plasma magnetic-field distributions
Italy	UNIVERSITY DI PISA, DEPARTMENT DI INGEGNERIA	Greco, Maria	Waveform Diversity and Frequency Sharing Techniques for Radar Systems
Italy	POLITECNICO DI MILANO	Luini, Lorenzo	DEVELOPMENT OF A COMPREHENSIVE PROPAGATION MODEL FOR SATCOM SYS HIGH FREQ
Italy	CNR CONSIGLIO NAZIONALE DELLE RICERCHE - ISTITUTO DI NANOSCIENZE -	Affronte, Marco	Quantum Properties of Molecular Nanomagnets
Italy	Universita' di Genova	Lorenzo, Rosasco	TTESLA: Towards Tera-Scale Nonparametric Learning

Italy	UNIVERSIT DEGLI STUDI DI ROMA	Lacarbonara, Walter	Bridging High Strength and Dissipation in Carbon Nanotube Composites
Italy	UNIVERSIT DEGLI STUDI DI GENOVA	Alessandri, Angelo	Optimal Control of Level Set Dynamics Involved by PDE Systems
Italy	POLITECNICO DI MILANO	Di Lizia, Pierluigi	Initial Orbit Determination using Differential Algebra
Italy	ALMA MATER STUDIORUM UNIVERSITA' DI BOLOGNA SEDE	Zannoni, Claudio	Nanoparticles Effects in Liquid Crystals (NELC)
Italy	UNIVERSITA DEGLI STUDI DI FIRENZE	Burr, DAVID	The impact of Emotional intel on the Human Factor: a cross-cultural study
Italy	ALMA MATER STUDIORUM UNIVERSITA' DI BOLOGNA SEDE	Tortora, Paolo	Microfluidics of the Decomposition of Hydrogen Peroxide in MEMS Microthrusters
Italy	CONSIGLIO NAZIONALE DELLE RICERCHE	IANNACE, SALVATORE	In situ formation of 3D nanostructured lightweight polymer composites
Italy	UNIVERSITA' DEGLI STUDI DI ROMA LA SAPIENZA	Sarto, Maria Sabrina	Characterization of epoxy-based composites with nano-structures
Italy	UNIVERSITA DEGLI STUDI DI ROMA TRE	Lanzara, Giula	Phase-changing Morphing Metamaterial with Hieararchical Musco-Skeletal Structure
Italy	UNIVERSITY DI PISA, DEPARTMENT DI INGEGNERIA	Gini, Fulvio	Robust Hypothesis Testing for Radar Applications
Italy	ALMA MATER STUDIORUM UNIVERSITA' DI BOLOGNA SEDE	Montanari, Angela	Big Data Covariance estimation
Italy	UNIVERSITA' DEGLI STUDI ROMA 3	Marzano, Frank	HiMetCom
Italy	ALMA MATER STUDIORUM UNIVERSITA' DI BOLOGNA SEDE	Vigo, Daniele	Acceleration Techniques for Vehicle Routing Heuristics
Italy	ALMA MATER STUDIORUM UNIVERSITA' DI BOLOGNA SEDE	Cacchiani, Valentina	(A)symmetric Traveling Salesman Problem w/ order dependent contraints algorithms
Italy	ALMA MATER STUDIORUM UNIVERSITA' DI BOLOGNA SEDE	Martello, Silvano	Models and algorithms for large-size knapsack problems

Italy	ALMA MATER STUDIORUM UNIVERSITA' DI BOLOGNA SEDE	Roverato, Alberto	Path weights in undirected Markov random fields
Italy	CONSIGLIO NAZIONALE DELLE RICERCHE	Benfenati, Valentina	Advanced nano-structured material interface and devices for in vivo-like
Italy	CONSIGLIO NAZIONALE DELLE RICERCHE	Benfenati, Valentina	Shedding light on brain microdomains
Japan			134030 QUANTUM PROPERTIES OF MOLECULAR NANOMAGNETS
Japan			Study of Complex Plasmas with Magnetic Dipoles
Japan			144015 Artificial Leaf Based on Artificial Photosynthesis
Japan			Using biological rhythm inspired wireless electromagnetic communication 154036
Japan			Solar photospheric magnetic field
Japan			Electric Current Analysis for Damage Monitoring
Japan			Change Detection and Forecasting Methods for Predictive Maintenance
Japan			Theoretical Framework for Interaction Game Design
Japan			Network-Wide Security Effects in Quantum Repeater Network Operation
Japan			Quantum Information Transport on Chip-based Quantum Systems
Japan			Statistical Creep Failure Time of Unidirectional CFRP under Compression Loading
Japan			Measurements in Inside-injector Rotating Detonation Engines
Japan			Realization of high-temperature superconductivity in carbon-nanotubes
Japan			Dimensionality Reduction in Big Data w/ Nonnegative Matrix Factorization

Japan			Decomposing Huge Networks into Skeleton Graphs by Reachable Relations
Japan			Probabilistic Modeling
Korea	KOREA RESEARCH INSTITUTE OF STANDARDS AND SCIENCE (KRISS)	Lee, Sang Jun	Multi-functional Infrared Sensor
Korea	KOREA ASTRONOMY&SPACE SCIENCE INSTITUTE	Kwak, Youngsil	144004 Electron density irregularities in the mid-latitude E and F regions
Korea	INDUSTRY-UNIVERSITY COOPERATION FOUNDATION.SUNMOON UNIV.	Lee, Ho-Yong	144055 Development of "n- and p-type Doped" Perovskite Single Crystals
Korea	UNIVERSITY INDUSTRY LIAISON OF CHONNAM NATIONAL UN	Yang, Kap Seung	144011 Nanostructured catalytic hybrid materials
Korea	HANYANG UNIVERSITY SEOUL CAMPUS	Suh, Il Hong	134130 Autonomous Learning & Human Intention for Enhancing Trust
Korea	Korea Advanced Institute of Science and Technology	Lee, Soo-Young	144035 Impact of Human like Cues on Human Trust in Machines
Korea	Ulsan National Institute of Science and Technology	Ruoff, Rodney	144091 New Materials for Quantum Computing
Korea	Korea Advanced Institute of Science and Technology	Choi, Han-Lim	Distributed Cooperative Multi-Agent Planning over Information Space
Korea	YONSEI UNIVERSITY UNIVERSITY-INDUSTRY FOUNDATION	Kim, Kyoungsik	Metamaterials for optical and MW applications
Korea	Korea University Research and Business Foundation	Kim, Hackjin	Revealing Neurocircuitry for Prosociality in Human
Korea	SEOUL NATIONAL UNIVERSITY	Hwang, Nong-Moon	A Study of Material and Optical Properties of Nano Diamond Wires 154046
Korea	HANYANG INDUSTRY-UNIVERSITY COOPERATION	Lee, Haiwon	Template Effect on Guiding Biomolecular Growth by 3-D CNT Networks
Korea	SEOUL NATIONAL UNIVERSITY	Kang, U	Real-time Anomaly Detection in High-Speed Time-evolving Graphs
Korea	SEOUL NATIONAL UNIVERSITY	Cho, Kyu-Jin	Development of an Origami-Inspired Mechanism utilizing Soft Material

Korea	YONSEI UNIVERSITY UNIVERSITY-INDUSTRY FOUNDATION	Park, Cheolmin	Hierarchical Interaction of Polymer Crystals on 2D TM Dichalogenide Nanosheets
Korea	KOREA INSTITUTE OF SCIENCE AND TECHNOLOGY (KIST)	Kim, Seun Min	Investigation of Chirality Selection Mechanism of SWCNT-3
Korea	Kyungpook National University	Kim, Youngkyoo	Synthesis of Electrically Conducting Polyimides for Flexible Electronic Devices
Korea	SEOUL NATIONAL UNIVERSITY	Zhang, Byoung-Tak	Autonomous Learning in Mobile Cognitive Machines
Korea	Korea Advanced Institute of Science and Technology	Choi, Pyuck-Pa	Gamma' precipitation-strengthened W-free Co-base superalloys for gas turbines
Korea	Korea University Research and Business Foundation	Ko, Hanseok	Robust acoustics and speech perception of aerial robot
Korea	Korea Advanced Institute of Science and Technology	Kong, Hong Jin	Self-phase-controlled SBS-PCM cell for coherent beam combination of HP Lasers
Korea	Korea Advanced Institute of Science and Technology	Lee, Hansuek	On-chip high performance optical components based on a hybrid material system
Malaysia	DAMAI SCIENCES SDN BHD	Khalid, Halimahtun Mohd	Trusting Humanoid Robot Undertake Social Task THRUST
Malaysia	SUNWAY UNIVERSITY COLLEGE	Lin, Mei-Hua	A Multilevel Comparisons on the Antecedents of Trust Among
Malaysia	UNIVERSITI TUNKU ABDUL RAHMAN	Ewe, Hong Tat	Computational Electromagnetics in Scattering Interactions of Earth Terrain
Malaysia	University of Malaya	Chong, Wu Yi	Graphene oxide: A new functional material for optical waveguide devices
Malaysia	INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA	Azlan, Norsinnira	Development of a Stretchable Tactile Distribution Sensor
Mexico	CENTRO DE INVESTIGACION CIENTIFICA Y DE EDUCACION SUPERIOR DE ENSENADA, BAJA CAL	Camacho-Lopez, Santiago	Synthesis of Multiphase Metallic Oxides by Femtosecond Laser Irradiation 150142
Mexico	INSTITUTO DE FISICA UNAM	NOGUEZ, CECILIA	Assessment of Exchange-correlation Functionals for the Description and Predictio
Mexico	CIQA	Ziolo, Ronald	High Loading Semiconductor Quantum Dot Nonlinear Optical Nanocomposites

Mexico	Universidad Nacional Autónoma de México	U'Ren, Alfred	Spatio-temporal engineering of photon pairs generated through spontaneous four w
Mexico	Centro de Investigacione en Optica	Piazza, Valeria	Observation and manipulation of the sprouting of hair cell stereocilia
Netherlands	Nederlandse Organisatie voor Toegepast-natuurwetenschappelijk onderzoek TNO	Toet, Alexander	Multispectral image enhancement through adaptive wavelet fusion
Netherlands	Lumium	Heeg, Bauke	Radiative transport modeling of thermal barrier coatings
Netherlands	TECHNISCHE UNIVERSITEIT DELFT	Mooij, Erwin	Space-Debris Trajectories: Uncertainty Propagation and Reentry Impact 140344
Netherlands	RIJKSUNIVERSITEIT GRONINGEN	Stavenga, Doekele	Optics and information processes vision that underlie visual searching 150068
Netherlands	RIJKSUNIVERSITEIT GRONINGEN	van Rijn, D.H.	Sparse sampling-based estimation of the retention of rarely used knowledge160043
Netherlands	UNIVERSITEIT TWENTE	Nijhuis, Arend	Rare-earth barium-copper-oxide REBCO and MgB2 cable test and analysis for AFOSR/EOARD
Netherlands	TNO TECHNISCH MENSKUNDE	Toet, Alexander	Multispectral image enhancement and color fusion through steerable pyramids
New Zealand	VICTORIA PHYSIOTHERAPY CLINIC	Ward, Colleen	134117 Implicit and Explicit Attitudes towards America in Socio-Digital
New Zealand	THE UNIVERSITY OF AUCKLAND	Sridharan, Mohan	Learning Human Intent for Human-Robot Collaboration
Poland	INSTYTUT TECNOLOGII MATERIALOW ELEKTRONICZNYCH	Pawlak, Dorota	(BRI) NOE: Novel metamaterials and plasmonic materials properties enabled by dir
Poland	INSTYTUT LOTNICTWA	Wolanski, Piotr	Influence of sizing on rotating detonation combustor performance
Poland	Warsaw University of Technology	Kulpa, Krzysztof	Forward Scattering Effect Exploitation in Passive Radars
Portugal	UNIVERSIDADE DA BEIRA INTERIOR	Fernandes, Rui	Correlating Effects of Scintillation in Atmospheric Regions: Ionosphere And Troposphere

Portugal	UNIVERSIDADE DO MINHO	Alves, Jose Luis	Improved Understanding of Cementitious Materials 150486
Singapore	Singapore University of Technology and Design	Ang, Lay Kee	Modeling of Ultrafast Laser Induced Emission from TI and Graphene
Singapore	NATIONAL UNIVERSITY OF SINGAPORE	Ong, Chong Kim	Metamaterial-enhanced magnetic materials and their applications
Singapore	NATIONAL UNIVERSITY OF SINGAPORE	Lee, Wee Sun	Online POMDP Algorithms for Very Large Observation Spaces
Singapore	Singapore University of Technology and Design	Yang, Hui Ying	Magnetically Doped 2D MoS2: Towards High Performance Spintronics 154017
Singapore	NANYANG TECHNOLOGICAL UNIVERSITY	Gunawan, Erry	Multi-Band GNSS Radio Occultation for Troposphere Water Vapor Remote Sensing
Singapore	Singapore University of Technology and Design	Fitzsimons, Joseph	Quantum primitives for secure computing
Singapore	NANYANG TECHNOLOGICAL UNIVERSITY	Tan, Eng Leong	GNSS Ionospheric Scintillation Models
Singapore	NANYANG TECHNOLOGICAL UNIVERSITY	Zhang, Dao Hua	Plasmonic light-harvesting devices for biosensing and optoelectronic modulation
Singapore	Singapore University of Technology and Design	Poletti, Dario	Exploring the Design Space of Quantum Heat Engines
Singapore	NANYANG TECHNOLOGICAL UNIVERSITY	Tan, Howe-Siang	Development of ultrafast Electronic-Raman 2D spectroscopy
Slovakia	Univerzita Konstantina Filozofa v Nitre	Benus, Stefan	Relationship between trust and entrainment in speech 150055
Slovenia	UNIVERSITY OF LJUBLJANA	Bauer, Andrej	Computational Effects in Computable and Formalized Mathematics
Slovenia	UNIVERSITY OF LJUBLJANA	Ravnik, Miha	Nematic colloidal tilings as tunable soft metamaterials 150418
So. Africa	COUNCIL FOR SCIENTIFIC & INDUSTRIAL RESEARCH	Chikosha, Silethelwe	Development of TiPt-based HTSMA for actuator applications at 1000oC
Spain	UNIVERSIDAD DEL PAIS VASCO - EUSKAL HERRIKO UNIBERTSITTEA	Rubio, Angel	Del-Science & Emerging Technology of 2D Atomic Layered Materials and Devices

Spain	ICFO-THE INSTITUTE OF PHOTONIC SCIENCES	Ebrahim-Zadeh, Majid	Compact, High-power, Agile Laser Source for Mid-Infrared Science 140390
Spain	REAL ACADEMIA DE CIENCIAS Y ARTES DE BARCELONA	Gladysz, Szymon	Anisoplanatic Imaging through Turbulence 140244
Spain	DAS PHOTONICS SL	Marti, Javier	Integrated Photonic Science Device for Ultra-wideband RF Electromagnetic Agility
Spain	NUMERICAL MODELLING SL.	Theofilis, VASSILIOS	Global Transient Growth Mechanisms in High-Speed Flows 150387
Spain	NUMERICAL MODELLING SL.	Theofilis, Vassilios	Shock-Induced Separation Bubbles
Sweden	LUNDS UNIVERSITET	Warrant, Eric	The Magnetic Compass Sense
Sweden	KUNGLIGA TEKNISKA HOGSKOLAN	Norman, Patrick	Modeling of Chromophores for Optical Power Limiting Glass
Switzerland	Eidgenössische Technische Hochschule ETH	Ermanni, Paolo	Variable stiffness wing structures compliance for aeroelastic morphing 133057
Switzerland	Ecole Polytechnique Fédérale de Lausanne	Kippenberg, Tobias	Temporal solitons in nano-photonic microresonators
Switzerland	Eidgenössische Technische Hochschule ETH	Studart, Andre	Fast morphing multi-stable structures 16-0007
Switzerland	Eidgenössische Technische Hochschule ETH	Tiso, Paolo	Reduced Order Modeling for Hypersonic Aeroelasticity
Switzerland	UNIVERSITAT BASEL	Meuwly, Markus	Small-Molecule Reactions Relevant to the Hypersonic Flight Regime 160033
Switzerland	Eidgenössische Technische Hochschule ETH	Renner, Renato	Feasible Device-Independent Quantum Cryptography
Taiwan	NATIONAL TAIWAN UNIVERSITY	Chen, Kwang-Cheng	144053 Social Dynamics Modeling and Inference
Taiwan	NATIONAL CENTRAL UNIVERSITY	Liu, Chao-Han	134126 Equatorial Ionospheric Irregularities
Taiwan	NATIONAL CHENG KUNG UNIVERSITY	Guo, Tzung-Fang	Magnetic field effect in conjugated molecules-based devices 144012
Taiwan	NATIONAL TAIWAN UNIVERSITY	Yang, Chih-Chung	144105 Ga- and N-polar GaN Growths on SiC Substrate
Taiwan	National Chiao Tung University	Li, Pei-Wen	Innovative Ge Quantum Dot Functional Sensing and Metrology Devices 154033
Taiwan	NATIONAL TAIWAN UNIVERSITY	Wong, Ken-Tsung	Stretching Toward the Near Infrared in Small Molecule Photovoltaics - 154031

Taiwan	National Sun Yat-Sen University	Lin, Tsung-Hsien	Development of Large Blue-Phase Liquid Crystal in Single-Crystal Form
Taiwan	NATIONAL TSING HUA UNIVERSITY	Lee, Yi-Hsien	Near Infrared Photo-detection with Monolayer Heterostructures
Taiwan	NATIONAL CHENG KUNG UNIVERSITY	Hwang, Chi-Chuan	Applying Democratic Topology for Exascale HPC, to develop new set of rules for m
Taiwan	NATIONAL CENTRAL UNIVERSITY	Shi, Jin Wei	Photonic MMW monopulse radar with ultra-wide bandwidth chirped pulse
Taiwan	National Chiao Tung University	Chang, Wen-Hao	2D Materials Integrated with Surface Acoustic Wave
Taiwan	NATIONAL TAIWAN UNIVERSITY	Cheng, Hung Hsiang	GeSn Based Near and Mid Infrared Heterostructure Detectors
Taiwan	National Chiao Tung University	Wei, Kung-Hwa	Toward High Performance Photovoltaic Cells based on Conjugated Polymers II
Taiwan	NATIONAL CHENG KUNG UNIVERSITY	Fung, Kuan-Zong	Minimization of Capacity Fading in Li rich Composite Cathodes
Taiwan	NATIONAL TAIWAN UNIVERSITY	Lin, Shou-de	Towards a Better Distributed Framework for Learning Big Data
Taiwan	NATIONAL TAIWAN UNIVERSITY	Lin, Hsuan-Tien	Budgeted Interactive Learning
Thailand	CHULALONGKORN UNIVERSITY	Panyakeow, Somsak	Fundamental Study of Antimonide Nanostructures by Molecular Beam Epitaxy (Phase
Thailand	SURANAREE UNIVERSITY OF TECHNOLOGY	Widjaja, Joewono	HANDHELD SURFACE PLASMON RESONANCE
Turkey	ORTA DOGU TEKNIK UNIVERSITESI	Koksalan, Murat	BAAINTERACTIVE APPROACHES FOR BI-OBJECTIVE UAV ROUTE PLANNING IN CONTINUOUS SPAC
Turkey	ORTA DOGU TEKNIK UNIVERSITESI	KOKSALAN, MURAT	Real-Time Biobjective UAV Route Planning
Turkey	BOGAZICI UNIVERSITESI VAKFI	Baydogan, Mustafa	Modeling Unevenly Spaced Multivariate Time Series with Mixed Variable Types
Turkey	ORTA DOGU TEKNIK UNIVERSITESI	Kalay, Eren	The Local Structure and Chemistry in Marginal Glass Forming Alloys

Turkey	SABANCI UNIVERSITESI	Sendur, Kursat	Broadband Reflective Surfaces for Infrared Radiation
U.K.	UNIVERSITY OF OXFORD	Hooker, Simon	X-ray Free-electron Laser Driven by a Wakefield Plasma Accelerator 132141
U.K.	UNIVERSITY OF STRATHCLYDE	Phelps, Alan	High Power Microwave Low-Contrast Surface Artificial Materials 132132
U.K.	UNIVERSITY OF STRATHCLYDE	McKenna, Paul	Proton Acceleration by Extreme Laser Radiation 133008
U.K.	UNIVERSITY OF EDINBURGH	Arapinis, Myrto	Entrapping Machines (ENTMAT)
U.K.	UNIVERSITY COLLEGE LONDON	Thanh, Nguyen	Nanoscale Magnetism in Next Generation Magnetic Nanoparticles
U.K.	UNIVERSITY OF OXFORD	Coecke, Bob	Algorithmic and Logical Aspects when Composing Meanings
U.K.	UNIVERSITY OF LANCASTER	Young, Robert	ATOMICALLY UNIQUE PHYSICALLY UNCLONEABLE FUNCTIONS
U.K.	UNIVERSITY OF PLYMOUTH	Cangelosi, Angelo	THRIVE Trust in Human Robot Interaction Via Embodiment 150025
U.K.	QUEEN'S UNIVERSITY BELFAST	Sousa, Paulo	(BRI) Ritual Participation, Sacred Values, Violence & Intergroup Conflict 150057
U.K.	UNIVERSITY OF EDINBURGH	Cheney, James	Foundations of Language-Based Provenance Security
U.K.	IMPERIAL COLLEGE	Hess, Ortwin	Effective First Principles Modeling of Semiconductor Lasers 140181
U.K.	UNIVERSITY OF SOUTHAMPTON	Sharma, Atul	Understanding and Controlling Wall Turbulence 140042
U.K.	UNIVERSITY OF HERTFORDSHIRE	Dautenhahn, Kerstin	Investigating psychological and biological processes for human-robot interaction
U.K.	IMPERIAL COLLEGE	Wynn, Andrew	Aeroservoelastic Optimization of Aircraft Wings with Load Alleviation Sys 140055
U.K.	KING'S COLLEGE LONDON	Miles, Simon	Engineering Emergence in Large-Scale Simulations
U.K.	UNIVERISTY OF CAMBRIDGE	O'Neill, William	Laser Processing of Carbon Nanotube Fibres and Films 140070

U.K.	UNIVERSITY COLLEGE LONDON	Smith, Frank	Mathematical modelling stall suppression using dynamic roughness 140240
U.K.	I C CONSULTANTS LTD (ICON)	Zaki, Tamer	Effects of free-stream turbulence on wall-bounded turbulence 15C0050
U.K.	UNIVERSITY OF DURHAM	Yeates, Anthony	PHOTOSPHERIC DRIVING OF NON-POTENTIAL CORONAL MAGNETIC FIELD SIMULATIONS 140191
U.K.	KING'S COLLEGE LONDON	Booth, George	Stochastic Algorithms in Sparse Antisymmetrized Hilbert Spaces
U.K.	COVENTRY UNIVERSITY	Fitzpatrick, Michael	Optimization of Residual Stress Generation from Laser Shock Peening 140415
U.K.	ROYAL HOLLOWAY AND BEDFORD NEW COLLEGE	Pavlovic, Dusko	Semantic completions - unifying the wave and the particle views of info
U.K.	UNIVERSITY OF SOUTHAMPTON	Nilsson, Johan	Fibers and pulse combination for super-linear power scaling 140382
U.K.	UNIVERSITY OF OXFORD	Hore, Peter	(BRI) Cryptochrome-based Magnetic Sensing
U.K.	UNIVERSITY OF BATH	Gursul, Ismet	Control of afterbody vortices and wake
U.K.	UNIVERSITY OF WARWICK	Chapman, Sandra	Develop network science quantifying patterns with DDDAS space-based observations
U.K.	UNIVERSITY OF NOTTINGHAM	Altenkirch, Thorsten	Certified Programming with Dependent Types
U.K.	THE UNIVERSITY OF LIVERPOOL	Poole, Robert	Experiments in Hibernating Turbulence
U.K.	NPL MANAGEMENT LTD	Tzalenchuk, Alexander	First Graphene Landau Level Laser 15IOE008
U.K.	HERIOT-WATT UNIVERSITY	Kar, Ajoy	Short Pulse Mid IR Laser & Amplifier Device via Direct Inscription in ZnSe160080
U.K.	BRUNEL UNIVERSITY	Ray, Asim	Design of Novel All Organic Complementary Circuits for Wearable Electronic150123
U.K.	UNIVERSITY OF SHEFFIELD	Foreman, Joel	Intelligent Polymer Design using High Throughput Modelling
U.K.	Northumbria University	McLaughlin, James	Understanding solar wind acceleration 160032

U.K.	UNIVERSITY OF SHEFFIELD	Ricco, Pierre	Effect of porous surfaces on compressible boundary layers
U.K.	THE UNIVERSITY OF LEEDS	Kent, John	Finite Set Statistics on Manifolds for Space Surveillance 160099
U.K.	THE ROYAL VETERINARY COLLEGE	Bomphrey, Richard	Avian-Inspired Multifunctional Morphing Air Vehicles:Underpinning Bio Rsch160034
U.K.	UNIVERSITY OF OXFORD	McGilvray, Matthew	HiFire-1Post-Flight testing 150380
U.K.	UNIVERSITY OF WARWICK	Guo, Weisi	Fundamentals of Molecular Communications in Complex Environments
U.K.	THE UNIVERSITY OF GLASGOW	McInnes, Colin	Osculating Keplerian Elements for Highly Non-Keplerian Orbits
U.K.	SCIENCE AND TECHNOLOGY FACILITIES COUNCIL	Bisi, Mario	Interplanetary Scintillation and Faraday Rotation I
U.K.	THE MET OFFICE	Jackson, David	Interplanetary Scintillation and Faraday Rotation II
U.K.	UNIVERSITY OF STRATHCLYDE	Drikakis, Dimitris	Shock-Induced Turbulence and Acoustic Loading on Aerospace Structures 150501
U.K.	UNIVERSITY OF BIRMINGHAM	Binner, Jon	High Temperature Composites Using Microwave Enhanced Chemical Vapor 150465
U.K.	UNIVERSITY OF OXFORD	Siviour, Clive	Properties of particulate composites: time-temperature effects 150448
U.K.	GRAPHENE INDUSTRIES LTD	Blake, Peter	Single Layer Graphene for Chemically Resistant Optical Coating and Electron Emit
U.K.	THE UNIVERSITY OF LIVERPOOL	Patterson, Eann A.	Validation of multi-physics failure models in extreme environments 160091
U.K.	UNIVERSITY OF OXFORD	Vollrath, Fritz	SILK: RECONSTITUTION AND NOVEL 3D COMPOSITE
U.K.	UNIVERSITY OF OXFORD	Hesjedal, Thorsten	Growth, Doping, and Band Structure Determination of 2-D Dichalcogenides
U.K.	UNIVERISTY OF CAMBRIDGE	Gonzalez-Bellido, Paloma	Neural basis of target tracking in insects
U.K.	NOTTINGHAM TRENT UNIVERSITY	Perry, Carole	Probing Mechanisms of Biological-Material interaction; towards realizing biomime

U.K.	UNIVERSITY COLLEGE LONDON	Bouhana, Noemie	The Social Ecology of Radicalization
U.K.	UNIVERSITY OF WARWICK	Alpern, Steve	Security Games Involving Search and Patrolling
U.K.	University Of Huddersfield	Seviour, Rebecca-	Effective Meta-Materials for High-Power Microwave Applications
U.K.	IMPERIAL COLLEGE	Hess, Ortwin	Ultrafast Cavity-Free Dark-Light Laser Enabled by Stopped Light-14IOE124
U.K.	UNIVERSITY OF SURREY	Sweeney, Stephen	Study of defect levels in InAs/InAsSb superlattice mid-infrared photodetectors
U.K.	UNIVERSITY OF SOUTHAMPTON	Smith, Peter	Fabrication of Optical Components for next generation Quantum Technologies
U.K.	IMPERIAL COLLEGE	Lindstedt, Peter	Combustion Regime Transitions
U.K.	QUEEN'S UNIVERSITY BELFAST	Soban, Danielle	Technology Impact Forecasting for Multi-Functional Composites
U.K.	UNIVERSITY OF STRATHCLYDE	Phelps, Alan	Advanced surface artificial materials for high power microwave sources
U.K.	UNIVERSITY COLLEGE LONDON	Palma, Matteo	Single-molecule Bioelectronic Devices with Multi-Sensing Capability
U.K.	UNIVERISTY OF CAMBRIDGE	Babinsky, Holger	Supersonic Streamwise Corner Flows
U.K.	BANGOR UNIVERSITY	Campo, Eva	Experiment and theory to inform industrial graphene manufacturing
U.K.	UNIVERSITY OF SOUTHAMPTON	Nilsson, Johan	Study of orbital angular momentum mode fiber amplification of optical pulses
U.K.	UNIVERSITY OF BATH	Trask, Richard	4D Programmed Stimuli-Responsive Structural Reinforcement
U.K.	UNIVERSITY OF ULSTER	Papakonstantinou, Pagona	Novel Multifunctional Hierarchical Composite Aerostructures
U.K.	UNIVERSITY OF OXFORD	You, Zhong	Programmable Origami Metamaterials with Adaptive Stiffness
U.K.	UNIVERSITY OF SOUTHAMPTON	Ajaj, Rafic	Toward a Fully Autonomous Morphing UAV

U.K.	UNIVERSITY OF SOUTHAMPTON	Pierron, Fabrice	Intra- & Interlaminar Properties of Composites at High Rates
U.K.	UNIVERSITY OF SOUTHAMPTON	Nilsson, Johan	Directly diode-pumped ultra-high-power fiber lasers for directed energy
U.K.	UNIVERISTY OF CAMBRIDGE	O'Neill, William	Anode Materials for High Power Microwave Devices
U.K.	UNIVERISTY OF CAMBRIDGE	O'Neill, William	Ultrafast Machining of High Temperature Superconductor Nanostructures for Novel
U.K.	UNIVERSITY OF OXFORD	Watt, Andrew	Optimization of an Inorganic Scintillating Thermal Neutron Detector
U.K.	Northumbria University	Zharkova, Valentina	Energetic Particles in the Sun and Heliosphere
U.K.	UNIVERSITY OF OXFORD	Walmsley, Ian	Towards deterministic photonic entanglement using time-frequency control
U.K.	THE UNIVERSITY OF EDINBURGH	Linne, Mark	Supercritical Fuel Jets - Resolving Controversy
U.K.	UNIVERSITY OF NOTTINGHAM	Wildman, Ricky	EM structure fab using multiphoton absorption and holographic tweezers
U.K.	UNIVERSITY OF OXFORD	Petrinic, Nikica	Mesoscale binder-crystal interactions in energetic materials
U.K.	UNIVERISTY OF CAMBRIDGE	Stone, Howard	Nanostructured, Strong and Tough Steels
U.K.	Imperial College London	Bland, Simon	Plasma Driven Hypersonic Testing
U.K.	UNIVERSITY OF STRATHCLYDE	Arulselvan, Ashwin	Node Deletion and Edge Deletion Problems in Networks
U.K.	UNIVERISTY OF CAMBRIDGE	Keyser, Ulrich	Multifunctional Nanopores in 2D Materials for Efficient Particle Detection, Filt
U.K.	UNIVERISTY OF CAMBRIDGE	Jardine, Andrew	Characterising Group Interaction Modelling for Complex Composite Materials
U.K.	UNIVERSITY OF STRATHCLYDE	Akartunali, Kerem	Data Mining in Social Networks
U.K.	UNIVERSITY OF STRATHCLYDE	Akartunali, Kerem	Robust Vessel Crew Scheduling
Ukraine	SCIENCE AND TECHNOLOGY CENTER IN UKRAINE	Grabar, Oleksandr	Modification of chalcogenide photorefractive crystals by indiffusion

Ukraine	SCIENCE AND TECHNOLOGY CENTER IN UKRAINE	Shcherbin, Konstantin	Photorefractive two-beam coupling in the Infrared
Ukraine	SCIENCE AND TECHNOLOGY CENTER IN UKRAINE	Reshetnyak, Viktor Yuriyovych	Theoretical Modeling of Liquid Crystal Based Tunable Metamaterials 118007
Ukraine	SCIENCE AND TECHNOLOGY CENTER IN UKRAINE	Reshetnyak, Viktor Yuriyovych	Photorefractive effects in “soft” hybrid liquid crystals - 14IOE039
Ukraine	SCIENCE AND TECHNOLOGY CENTER IN UKRAINE	Zalizovsky, Andriy	Investigation into AGW/TID
Viet Nam	TON DUC THANG UNIVERSITY	Ta, Quoc Bao	Design and Optimization of Novel Passive Micromixers
Viet Nam	Vietnam National University	Nguyen, Thanh Hien	Spatiotemporal imaging exploiting structured sparsity
Viet Nam	INTERNATIONAL UNIVERSITY OF VIETNAM NATIONAL UNIVERSITY-HCM	Le, Ly	Building Vietnamese herbal database towards big data science
Viet Nam	Hanoi University of Science and Technology	Than, Khoat	Inferring the semantics hidden in big heterogeneous data

APPENDIX II: FY16 Conference Support

Below is a listing of all international technical exchanges supported by AFOSR with FY16 funds.

Conference Title	Institution	Country	PI/Organizer
21st International Symposium High Power Laser Systems & Applications	Vienna University of Technology	Austria	Schuoecker, Dieter
Space Climate 6 Symposium	OULUN YLIOPISTO	Finland	Asikainen, Timo
SUPPORT FOR LES HOUCHES SUMMER SCHOOL: CURRENT TRENDS IN ATOMIC PHYSICS	UNIVERSITE GRENOBLE ALPES	France	Browaeys, Antoine
Dynamic Sun: MHD Waves and Confined Transients in the Magnetized Atmosphere	Indian Institute of Technology BHU	India	Srivastava, Abhishek
ECML-PKDD 2016	University of Trento	Italy	Passerini, Andrea
2nd Florentine Symposium on Emotional Intelligence	UNIVERSITA DEGLI STUDI DI FIRENZE	Italy	Burr, DAVID
IROS 2016	Korea University Research and Business Foundation	Korea	Song, Jae-Bok
ISPSA 2016 Conference	KOREA RESEARCH INSTITUTE OF STANDARDS AND SCIENCE (KRISS)	Korea	Noh, Sam Kyu
Programmable Materials and Manufacturing Science	KOREA NANO TECHNOLOGY RESEARCH SOCIETY	Korea	Lee, Haiwon
Support for EAAP-16 Conference	EUROPESE VERENIGING VOOR LUCHTVAARTPSYCHOLOGIE - E.A.A.P.	Netherlands	Droog, Andre
ACML 2016	University of Waikato	New Zealand	Holmes, Geoff
DSEC V	UNIWERSYTET WARSZAWSKI	Poland	Pawlak, Dorota
International Workshop on Detonations for Propulsion 2016	NATIONAL UNIVERSITY OF SINGAPORE	Singapore	Li, Jiun-Ming
International Symposium on Physics and Applications of Laser Dynamics (IS-PALD)	NATIONAL TSING HUA UNIVERSITY	Taiwan	Lin, Fan-Yi
PRICAI 2016	ARTIFICIAL INTELLIGENCE ASSOC OF THAILAND	Thailand	Theeramunkong, Thanaruk
RIN 16 Animal Navigation Conference	ROYAL INSTITUTE OF NAVIGATION	United Kingdom	Chapman-Andrews, Peter
2016 Trust and Influence Workshop	Universita degli Studi di Palermo	United Kingdom	Chella, Antonio
ICECCS16	ASTON UNIVERSITY	United Kingdom	Wang, Hai
12th International Congress of Neuroethology	University of the Republic	Uruguay	Silva, Ana

APPENDIX III: FY16 W.O.S. visits

Visitor	Organization	Country	Host Office	Topic
Ruben Spies	Instituto de Matemática Aplicada del Litoral IMAL	Argentina	AFOSR/RT	Recent advances in regularization methods for inverse ill-posed problems and applications
Aurora Rubio	Universidad Nacional de General San Martin	Argentina	AFOSR/RT	Inverse Problems in a range of PDE and Integral Equations
Domingo Tarzia	Universidad Austral	Argentina	AFOSR/RT	Numerical Analysis of Optimal Control Problems Governed by Elliptic Variational Inequalities of an Obstacle Type with a Parameter
Marcelo G. Kovalsky	Instituto de Investigaciones Científicas y Tecnológicas para la Defensa (CITEDEF).	Argentina	AFRL/RS	Nonlinear dynamics of self-pulsing all-solid-state lasers.
Alejandro Hnilo		Argentina	AFRL/RS	Nonlinear dynamics of self-pulsing all-solid-state lasers
Andrew Neely	UNSW Canberra	Australia	AFOSR/RTA	Characterisation and control of a flap undergoing hypersonic FSI
Mari Velonaki	The University of New South Wales	Australia	AFOSR/RTA	Eliciting Emotions from Tactile Surfaces and Kinetic Agents
Michael Gratton	The University of New South Wales	Australia	AFOSR/RTA	Eliciting Emotions from Tactile Surfaces and Kinetic Agents
Haroldo Hattori	UNSW Canberra	Australia	AFRL/RWWS	Terahertz and infrared nano-antennas
Paul Punds	University of Queensland	Australia	711 HPW/RHCB	UQ Aerial Robotics Research
Simon Atkins	simon.watkins@rmit.edu.au	Australia	AFRL/RQ	Worst Case Gust Inputs for Micro Air Vehicles
Richard Mildren	Macquarie University	Australia	AFRL/RQQE	UV diamond Raman lasers
Paul Dastoor	University of Newcastle	Australia	AFOSR/ RTB	Organic Materials Chemistry
Rosie Hicks	Australian National Fabrication Facility	Australia	AFOSR/ RTB	ANFF's role in enabling advanced manufacturing research
Maurice Agnucco	UNSW Canberra	Australia		
Bernhard Hengst	University of New South Wales	Australia	AFOSR/RTA	Autonomous Adaptation and Trust
Fang Chen	CSIRO	Australia	AFOSR/RTA	Trust Measurement (Dr. Knott program)
Ingrid Zukerman	Monash University	Australia	AFOSR/RTA	A decision-theoretic model of interactions between people and devices (Dr. Knott program)
Jannet Wiles	University of Queensland	Australia	AFOSR/RTA, 711HPW RHCB	Human-robot interactions: Social micro-abilities to establish and manage social exchange

Richard Mildren	Macquarie University	Australia	AFRL/RDLTS	Diamond for high power lasers and beam combiner systems
Steven Wiederman	The University of Adelaide	Australia	AFRL/RWWI	Robot autonomy derived from neurobiology
Margaret Lech	RMIT University	Australia	AFRL/RHCB	Towards emotionally capable human-machine communications
Kathryn Fairfull-Smith	Queensland University of Technology	Australia	AFRL/RXAS	Nitroxide-containing scaffolds for biofilm remediation
Richard Morgan	The University of Queensland	Australia	AFOSR/RTA	Expansion tube studies of non-equilibrium nitrogen flows
Simon Watkins	RMIT University	Australia	AFRL/RQ	Gust Alleviation for Micro Air Vehicles
Paul Dastoor		Australia		
Valentina Benfenati	Consiglio Nazionale delle Ricerche	Australia	711HPW/RHDO	Combined Biophysics and Human Performance Program
Steve Prawer	University of Melbourne	Australia	711HPW/RHDO	Combined Biophysics and Human Performance Program
Alex Fuerbach	Macquarie University	Australia	AFRL/RYDH AFOSR/RTB	Femtosecond laser direct-written devices for sensin
Jim Piper	Macquarie University	Australia	711HPW/RHDO	Combined Biophysics and Human Performance Program
Sally McArthur	Swinburne University of Technology	Australia	711HPW/RHDO	Combined Biophysics and Human Performance Program
Gulay Mann	Defence Science and Technology Group	Australia	711HPW/RHDO	Combined Biophysics and Human Performance Program
Patrick Soukiassian	University of Leuven	Belgium	AFOSR/RTD2	Collaborative work on magneto optic polymers and magnetic sensors
Leonardo Alves	Fluminense Federal University	Brazil	AFRL/RS	Stability Analysis of Coaxial Free Jets in Liquid Rocket Engines
Volnei Tita	University of São Paulo	Brazil	AFRL/RXCCP	New Multi-Scale Based Damage Evolution and Failure Models for Prognosis of Composite Structures
Iakov Kopelevitch	Universidade Estadual de Campinas-UNICAMP	Brazil	AFOSR	Superconductivity Review Meeting
Kimsay Hoeung	Department of Techniques, Science and Technology	Cambodia	AOARD	Materials Research in Cambodia
Traver Penny	National University of Singapore	Canada	AFOSR/RTA2	Using Brain-State Information to Facilitate Conditioned Attitude Formation
Norm O'Neill	Université de Sherbrooke	Canada	AFRL/RVBYI	Overview of passive and active aerosol optical measurements in the high Arctic

Joseph Shapter		Canada	AFOSR/ RTB	
Tomas Perez-Acle	Fundacion Ciencia para la Vida	Chile	AFOSR/RT	Predictive Stochastic Rule-Based Models to Evaluate the Effects of Panic in Human Populations under Stressful Situations
Ondrej Straka	University of West Bohemia	Czech Rep	AFOSR/RIED	Nonlinearity Measures for State Estimation
Jindrich Dunik	University of West Bohemia	Czech Rep	AFOSR/RIED	Nonlinearity Measures for State Estimation
Ondrej Jindrich		Czech Rep	AFRL/RI	
Berhard Falk Runkel	ETH Zurich	Czech Republic	AFOSR/RT	Novel flight structures, adapitve materials
Paola Ermanni	ETH Zurich	Czech Republic	AFOSR/RT	Novel flight structures, adapitve materials
Sushil Kumar	The University of the South Pacific	Fiji	AFRL/RV	HF radar project
Gilles Coppin	TELECOM BRETAGNE	France	AFRL/RHCI	Management of UV swarms and Human Autonomy Dialog
Damien Rontani		France		
Miles Padgett	Commissariat à l'Energie Atomique et aux Energies Alternatives - CEA	France	AFRL/RX	Present results of PEEM/LEEM work on Lanthanum Hexaboride samples
Oleg Doubovik	CNRS/University of Lille 1	France	AFRL/RVBYI	Grasp-Versatile remote retrieval algorithm
Christoph Pfalaum	Friedrich-Alexander Universität Erlangen-Nürnberg	Germany	AFRL/RXAP	AFRL Meeting
Venkataram Prasad Shastri	University of Freiburg (Germany)	Germany	AFRL/RX	biopolymers
Georogios Froudakis	University of Crete	Greece	AFRL/RX	collaboration with Dr. A. Roy and invited talk
Nikolaos Michalilidis	Aristotle University of Thessaloniki	Greece	AFOSR/RT	2016 Aerospace Materials for Extreme Environment Program Review
Andras Kis	École Polytechnique Fédérale de Lausanne	Hungary	AFRL/RX	2D dichalcogenide electronic materials and devices
Mohan Sridharan	The University of Auckland	India	AFOSR/RTA	Trust and Influence
Shalini Gupta	Indian Institute of Technology Delhi	India	711HPW/RH	human performance
Balaji Srinivasan	Indian Institute of Technology Madras	India	AFRL/RDLTS	All-Fiber Fused Coupler for Vortex Mode Excitation

Sushil Kumar	The University of the South Pacific	India	AFRL/RVBX	VLF PERTURBATIONS ASSOCIATED WITH SOLAR ECLIPSES
Nookala Munichandraiah	Indian Institute of Science	India	AFRL/RQ	228th ECS Meeting
Toto Sudiro	Research Center for Physics	Indonesia	AOARD	Materials Research in Indonesia
John F Cryan	UNIVERSITY COLLEGE CORK	Ireland	711 HPW	THE MICROBIOME AS A KEY REGULATOR OF BRAIN & BEHAVIOR.
Igor Aharonovich	University of Technology Sydney	Israel	AFRL/RXAN	single photon emitters in diamond,FA2386-15-1-4044 R&D 15IOA044
Sauro Succi	National Research Council of Italy	Italy	AFRL/RQ	Lattice Boltzmann beyond Navier-Stokes
Marco Affronte	Università di Modena e Reggio Emilia	Italy	AFOSR/RTB	QUANTUM PROPERTIES OF MOLECULAR NANOMAGNETS
Claudio Grassi	Università Cattolica School of Medicine	Italy	711th HPW/RH	modulation of brain plasticity by physiological and pathophysiological Stimulation
Guglielmo Fortunato	Italian National Research Council (CNR)	Italy	711HPW/RHDO	Combined Biophysics and Human Performance Program
Stefano Toffanin	Consiglio Nazionale delle Ricerche	Italy	AFOSR/RTB	Plasma & Electro-energetic Physics Program Review/Laser & Optical Physics Program Review
		Japan	AFRL/RXAP	functional materials,liquid crystals
		Japan	AFRL/RXAF	Photonics and optics based on nano-structured liquid crystals (tentative)
		Japan	AFRL/RXAP	Technical Interchange Meeting
		Japan	AFRL/RXAP	Technical Interchange Meeting
		Japan	AFOSR/RTB	Electron-proton synchronized transfer of mixed valence Re(III,IV) dinuclear complexes in their single crystal
		Japan	AFRI/RX	Advanced computational methods for optimization of non-periodic inspection intervals for aging infrastructure
		Japan	AFRL/RDLTD	Technical Interchange Meeting(no cost)
		Japan	AFRL/RDLTD	Wave Optics Simulation of Diode Pumped Alkali Laser
		Japan	AFOSR/RTA1	Ga2O3 power devices
		Japan	AFRL/RQ	Shock Wave Structure in Polyatomic Gases: Numerical Analysis using a Model Boltzmann Equation

		Japan	AFOSR/RTA	
		Japan		AFOSR MURI Program Review: Quantum Transduction
Doe-Sook Kin	Hanyang University	Korea	HQ PACAF Science and Technology	Voronoi 3D Simulation
Kyujin Cho	SEOUL NATIONAL UNIVERSITY	Korea	AFOSR/IOS	Development of Component Mechanisms for Origami Inspired Designs
Joon Youong Park	Seoul National University	Korea	AOARD	Nano Electronics on Atomically Controlled van der Waals Quantum Heterostructures
Taewook Kang	Sogang University	Korea	AOARD	Bioinspired Engineering Synthesis Technology (BEST) for Active Photonic Devices
Sunkuk Kim		Korea		
Jae-Won Jang	PUKYONG NATIONAL UNIVERSITY	Korea	AOARD	Plasmonic Optoelectronic Interactions
Won Il Park	Hanyang University	Korea	AOARD	Nanotube-on-Graphene Heterostructures for Smart Nano/Bio-Interface
Yuanzhe (WONCHUL)Piao (PARK)	Seoul National University	Korea	AFOSR/RTB	Preparation of uniform nanoparticles through novel thermal treatment process
Intek Song	Pohang University of Science and Technology	Korea	AOARD	Layer-by- Layer Growth and Assembly of 2D Quantum Superlattices
Haiwon Lee	Hanyang University	Korea	AOARD	A Noble Platform Based on Hierarchically Ordered 3D Network of Carbon Nanotubes
Kwang-Sup Lee	Hannam University	Korea	711 HPW/RHXBC	Organic-Inorganic Hybrid Materials for Magnetic and Optoelectronic Applications
Deok-Soo Kim	Hanyang University	Korea	AFRL/RX	How the Voronoi Diagram of 3D Spheres Can be used for the Accurate and Efficient Analysis of Geometry and Topology of Metallic Glasses?
Ki Tae Nam	Seoul National University	Korea	AOARD	
Eunkyong Kim	Yonsei University	Korea	AFOSR/RTB	Conjugated Polymer thin films for photothermal conversion
Sang Ho Oh	Syungkyunkwan University	Korea	AOARD	Two-dimensional Electron Gas at Oxide Heterointerfaces
Seon Jeong Kim	Hanyang University	Korea	AOARD	Nanotechnology
Nongmoon Hwang	Seoul National University	Korea	AFRL/RXAN	Non-classical crystallization of thin films and nanostructures
Il Hong Suh	Hanyang University	Korea	AFOSR/RTA	

Soo Young Lee	Korea Advanced Institute of Science & Technology	Korea	AFOSR/RTA	Impact of Humanlike Cues on Human Trust in Machines (Dr. Knott program)
Kyujin Cho	Seoul National University	Korea	711th HPW/CL	Origami inspired designs and Human Machine Interaction
Changmin Son	Pusan National University	Korea	AFRL/RQTT	Improved profile loss models for compressor and turbine
Young-Sil Kwak	Korea Astronomy and Space Science Institute	Korea	AFRL/RY	KASI Activities for Upper atmosphere and Ionosphere research
Deok-Soo Kim	Hanyang University	Korea	AFOSR/RTA	Molecular Geometry and Its Operating System: A New Computational Paradigm for the Structure of Atomic Arrangements
Dongho Kim	Yonsei University	Korea		
Shafiz Affendi Mohd Mohd Yusof	Universiti Utara Malaysia	Malaysia	AFOSR/RTA2	Culture, Swift Trust and GVT: A model of teamwork
Ronald Ziolo	Centro de Investigacion en Quimica Aplicada	Mexico	AFRL/RXAP	Photorefractive Polymers and Nanocompsites
Mohamed Izat Mohd.Ezwan	Advanced Materials Research Centre	Mlaysia	AOARD	Materials Research in Malaysia
James Liu	Massey University	New Zealand	AFOSR/RTA2	Trust as a System of Interpersonal and Political Meaning vital to Democracy
William Helton	University of Canterbury	New Zealand	711th HPW, USAF Academy	Team Workload
Bkessue Ambata	Industrial Technology Development Institute	Philippines	AOARD	Materials Research in the Philippines
Szymon Gladysz	Fraunhofer Institute of Optronics, System Technologies and Image Exploitation	Poland	AFRL/RYMT	Extension of collaboration with Dr. LeMaster of AFRL and Prof. Hardie of Univ. of Dayton. Seminar at WPAFB and UofD. Planning of common experiments
Yeng Ming Lam	Nanyang Technological University	Singapore	AOARD	Material Reserarch in Singapore
Qihua Xiong	Nanyang Technological University	Singapore	AFRL/RVSS	Recent Progress of Laser Cooling in Semiconductors
Zongxiang Shen	Nanyang Technological University	Songapore	AFRL/RYMD	
Asimenye Kapito	MINTEK (Council for Mineral Technology)	South Africa	AFOSR/RTB	Materials for Extreme Environments Programmes at the Advanced Materials Division at Mintek
Shumane (Joseph) Moema	MINTEK (Council for Mineral Technology)	South Africa	AFOSR/ RTB	Exploration of collaboration R&D opportunities inn the AFSOR Aerospace Materials
David Greenblatt	Technion - Israel Institute of Technology	South Africa	AFRL/RQVA	AFRL-Israel working group meeting

Mkhulu Mathe		South Africa		
Devid Britton	PST Sensors (pty) Ltd	South Africa	XPPI	meeting with researchers at Wright Patterson Airforce Base
Lorinda Wu	CSIR	South Africa	AFOSR/RTB	Plasma & Electro-energetic Physics Program Review/Laser & Optical Physics Program Review
Amanda Skep	MINTEK (Council for Mineral Technology)	South Africa	711HPW/RHDO	Combined Biophysics and Human Performance Program
Jones Papo	MINTEK (Council for Mineral Technology)	South Africa	711HPW/RHDO	Combined Biophysics and Human Performance Program
Christine	Rhodes University	South Africa	711HPW/RHDO	Combined Biophysics and Human Performance Program
Javier Marti		Spain		
Oliver Guenat	University of Bern	Switzerland	711th HPW/RHDJ	Towards an In-Vivo-like Lung Alveolar Model for Toxicological Applications
Hery Chang	NTU	Taiwan		Collaborative team project with Greg Sun and RY
Tzung-Fang Guo	National Cheng Kung University	Taiwan	AFOSR/RT	Magnetic field effect in conjugated molecules-based devices
Ken Wong	National Taiwan University	Taiwan	AFOSR/RT	Stretching Toward the Near Infrared in Small Molecule Photovoltaics
Chia-Fu Chou		Taiwan	AOARD	Joint USAF-Korea NBIT-Taiwan Nanoscience Program
Kuei-Hsien Chen	Academia Sinica	Taiwan	AOARD	Joint USAF-Korea NBIT-Taiwan Nanoscience Program
Yeau-Ren Jeng	National Chung Cheng University	Taiwan	AOARD	Joint USAF-Korea NBIT-Taiwan Nanoscience Program
Kung-Hwa Wei	National Chiao Tung University	Taiwan	AOARD	Joint USAF-Korea NBIT-Taiwan Nanoscience Program
Hung Cheng	National Taiwan University	Taiwan	AOARD	Joint USAF-Korea NBIT-Taiwan Nanoscience Program
Pei-Wen Li	National Chiao Tung University	Taiwan	AOARD	Joint USAF-Korea NBIT-Taiwan Nanoscience Program
Chinh-Chung Yang	National Taiwan University	Taiwan	AOARD	Joint USAF-Korea NBIT-Taiwan Nanoscience Program
Minghwei Hong	National Taiwan University	Taiwan	AOARD	Joint USAF-Korea NBIT-Taiwan Nanoscience Program
Albert Chin	National Chiao Tung University	Taiwan	AOARD	Joint USAF-Korea NBIT-Taiwan Nanoscience Program

Yzung-Fang Guo	National Cheng Kung University	Taiwan	AOARD	Joint USAF-Korea NBIT-Taiwan Nanoscience Program
Tai-Chou Lee	National Central University	Taiwan	AOARD	Joint USAF-Korea NBIT-Taiwan Nanoscience Program
Wisanu Pecharapa	King Mongkut's Institute of Technology Ladkrabang	Thai	AOARD	Corrosion and Materials Research at KMIT
Taweechai Amornsakchai	Mahidol University	Thai	AOARD	Corrosion and Materials Research at Mahidol U
Bovornchok Poopat	King Mongkut's University of Technology Thonburi	Thai	AOARD	Corrosion and Materials Research at KMUT
Uraiwan Intatha	MAE FAH LUANG UNIVESITY	Thai	AOARD	Corrosion and Materials Research at MFLU
Sukum Eissayeam	CHIANG MAI UNIVESITY	Thai	AOARD	Corrosion and Materials Research at CMU
Sevik Cem	ANADOLU UNIVERSITY	Turkey	EOARD	SIMULATION OF 2D MATERIALS FOR DIFFERENT DEVICE APPLICATIONS
Buke Goknur	TOBB University of Economics and Technology	Turkey	EOARD	Few Layer Graphene Synthesis
Tugrul Senger	Izmir Institute of Technology	Turkey	EOARD	Exploring Two-Dimensional Materials for Novel Properties
Sevincli Haldun	Izmir Institute of Technology	Turkey	EOARD	Electrical and Thermal Transport Properties of Nano-Structured Materials
Ferridun Ay	Anadolu University	Turkey	EOARD	Novel Heterostructures of 2D Materials for Device Applications
Eren Kalay	Middle East Technical University	Turkey	AFOSR/RT	Aerospace Materials for Extreme Environments / Metallic Glass
Ibrahim Sendur	Sabanci University	Turkey	AFOSR/RT	Program Review
Amy MacLachlan	University of Strathclyde	U.K	AFOSR/RTB	Periodic Surface Lattices for Novel mm-wave and THz Frequency Sources
Amy MacLachlan	University of Strathclyde	U.K	AFOSR/RTB	Periodic Surface Lattices for Novel mm-wave and THz Frequency Sources
Rolf Baxter	Heriot-Watt University	U.K	AFRL/RY	Spatio-temporal anomaly detection from large streaming datasets of target trajectories
Holger Babinsky	University of Cambridge	U.K	USAFA	University of Cambridge
William O'Neill	University of Cambridge	U.K	AFRL/RXAP	Overview of the Centre for Industrial Photonics
Daniel Gortat	University of Cambridge	U.K	AFRL/RXAP	Anode Materials for High Power Microwave Devices

Eann Patterson	University of Liverpool	U.K	AFOSR/RT	A multi-physics approach to validation of failure modes in thermo-acoustic environments
Robert Murray	Imperial College London	U.K	AFRL/RXAP	fiber laser development at Imperial College
Zhoung You	University of Oxford	U.K	AFOSR/RT	Origami tubular structures
Holger Krapp	Imperial College London	U.K	AFOSR/RT	Sensor Fusion; Insect sensorimotor systems
Thanh Nguyen	University College London	U.K	AFOSR/RTB	Design, synthesis, functionalization and characterisation of different magnetic nanoparticle systems
Eva Zincone	University of Sheffield	U.K.	AFOSR/RTA	Klebanoff modes in Hiemenz boundary layer
Oierre Ricco	University of Sheffield	U.K.	AFRL/RTA	Klebanoff modes in Hiemenz boundary layer
Pedro Orozco Nieto	UNIVERSITY OF CAMBRIDGE	U.K.	AFRL/RXAP	Overview of the Centre for Industrial Photonics
John Bulmer	University of Cambridge	U.K.	AFRL/RXAP	Characteristic lengths in nanotube textiles
Christopher Sebastian	University of Liverpool	U.K.	AFOSR/RT	A multi-physics approach to validation of failure modes in thermo-acoustic environments
Matteo Palma	Queen Mary University of London	U.K.		Single-molecule Biosensing devices
Nicholas Durston	University of Bristol	U.K.	AFRL/RW	High Resolution 3D Reconstruction of Gliding Falconry Birds
Shane Windsor	University of Bristol	U.K.	AFOSR/RTB2	Bio-inspired flight dynamics and control
Richard Bomphrey	Royal Veterinary College, London	U.K.	AFOSR/RT	
Graham Taylor	University of Oxford	U.K.	AFOSR/RTB2	Sensor Fusion
Ian Cowling	Blue Bear Systems Research	U.K.	AFRL/RW	
Petter Biggins	Imperial College London	U.K.	AFRL/RW	
Phelps		U.K.	AFRL/RD	
Kerstin Dautenhahn	University of Hertfordshire	U.K.	AFOSR/RT	Bringing together psychological (top-down) and biological (bottom-up) processes for enhancing human-robot
Reshetnyak		Ukraine	AFRL/RX	

Halimahtun Mohd Khalid			AFOSR	
Quang Liem Nguyen	Institute of Materials	Viet Nam	AOARD	Materials Research in Vietnam
Phuc Naguyen	Institute of Materials Science, VAST	Vietnam	AFOSR/RTB	Some attempts to fabricate magnetite-based multifunctional nanomaterials
Norhayati	Universiti Utara Malaysia	Zakaria	AFOSR/RTA2	Culture, Swift Trust and GVTs: Developing a Model of Virtual Teamwork

FY2016 ANNUAL REPORT

Air Force Office of Scientific Research
875 North Randolph Sgtreet, Suite 325
Arlington, Virginia, USA 22203

www.afosr.af.mil