THE NATIONAL ACADEMIES

RESEARCH ASSOCIATESHIP PROGRAMS

NEWSLETTER

Autumn 2008

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NATIONAL RESEARCH COUNCIL
OF THE NATIONAL ACADEMIES

NIH (NIBIB) /NIST

The National Research Council administers applications for the Joint Postdoctoral Program for the National Institutes of Health (NIH) National Institute of Biomedical Imaging and Engineering (NIBIB) and the National Institute of Standards and Technology (NIST). The goal is to cultivate a scientific work force competent in both the biological and the physical sciences. The research opportunities will emphasize interdisciplinary research at the interface of the biological and physical sciences including, but not limited to, structural and computational biology, medical and bioinformatics, genomics and proteomics, tissue engineering, single molecule detection, nanotechnology, and imaging techniques. Each Postdoctoral Associate will have two Advisers, one at the NIH and one at NIST, and the Associate is expected to spend time at both the NIH and the NIST laboratories during the course of the two-year award. The NIH laboratories are located in Bethesda, Rockville, Frederick, and Baltimore, in Maryland; and in Research Triangle Park, North Carolina. The NIST laboratories are in Gaithersburg, Maryland, and in Boulder, Colorado.

The competition is open to both U.S. and non-U.S. citizens. The application deadline date is August 1 and awards will be made in late September. Ph.D. recipients within five years of the doctorate at the time of application are eligible to apply. The award offers an annual stipend of $55,000 plus relocation expenses, health insurance coverage, and limited professional travel

See article on page 3: ***"Gradient Nanofiber Scaffold Libraries for Tissue Regeneration by Electrospinning"*** by Dr. Murugan Ramalingam, **NRC Associate, NIH (NIBIB) /NIST**

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Ray Gamble, Ph.D., Director, Research Associateship Programs
Suzanne White, Manager, Newsletter

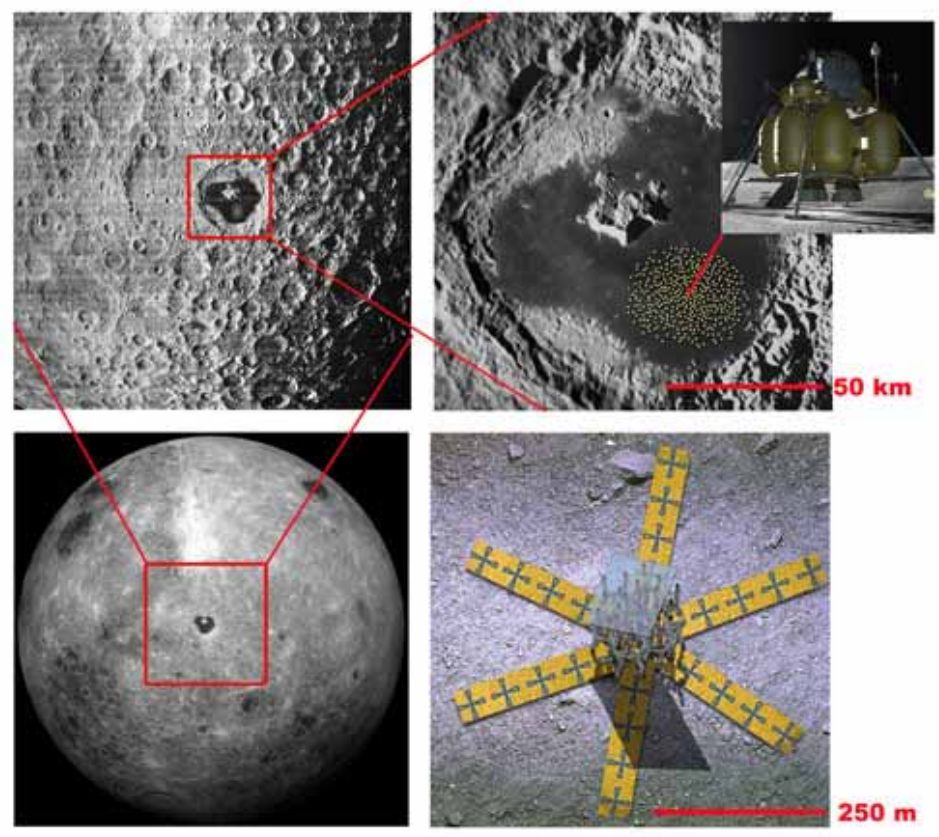
The NRC Research Associateship Programs *Newsletter* is published semi-annually (spring and autumn) to highlight research and activities of NRC Associates and Advisers who participate in the programs in our many agencies and laboratories. It is posted on this web page in full-color PDF. In addition, the monochrome version is printed by the National Academy Press (NAP), and bulk orders of 10 or more are available from our office for bulk distribution at agencies/laboratories, scientific meetings, NRC meetings, staff visits, site visits, etc. March 1 and September 1 are the tentative deadlines for submission of articles to the respective spring and autumn issues. However, we accept articles throughout the year-- press releases, profiles, 1 – 2 page articles already written and/or submitted to other publications, images, photos, notices, awards, honors, etc.

Send all submissions to Suzanne White (swhite@nas.edu)

NRL to design telescope to see into the Dark Ages

A team of scientists and engineers led by the Naval Research Laboratory (NRL) will study how to design a telescope on the Moon for peering into the last unexplored epoch in the Universe's history. NASA has announced that it will sponsor a series of studies focusing on next-generation space missions for astronomy. These studies will contribute to the Decadal Survey, an effort undertaken every 10 years by astronomers and physicists to help establish priorities for future research directions in astronomy and astrophysics. The upcoming Decadal Survey occurs over the next two years.

Among the missions to be studied is the Dark Ages Lunar Interferometer (DALI), the NRL-led concept for a telescope based on the Moon and studying an era of the young Universe, during the first 100 million years of its existence. Although the night sky is filled with stars, these stars did not form instantaneously after the Big Bang. There was an interval, now called the "Dark Ages," in which the Universe was unlit by any star. The most abundant element in the Universe, and the raw material from which stars, planets, and people are formed, is hydrogen. Fortunately, the hydrogen atom can produce a signal in the radio-wavelength part of the spectrum, at 21 cm; a wavelength far longer than what the human eye can detect. If these first signals from hydrogen atoms in the Dark Ages can be detected, astronomers can essentially probe how the first stars, the first galaxies, and ultimately the modern Universe evolved.



An artist's conception of the Dark Ages Lunar Interferometer. The crater Tsiolkovsky is a relatively level region on the far side of the Moon. A lander would deposit a series of rovers, which would then move out and unroll a set of arms containing individual antennas. The astronomical signals picked up by the antennas would be transmitted to back to the central lander for processing.

Because the Universe is expanding, the signals from these distant hydrogen atoms will be stretched (or redshifted) to much longer wavelengths, as large as several meters. While astronomical observations at radio wavelengths have a long history, this portion of the electromagnetic spectrum is now heavily used for various civil and military transmissions, all of which are millions of times brighter than the hydrogen signal that astronomers seek to detect. Additionally, the upper layers of the Earth's atmosphere are ionized (the ionosphere), which introduce distortions into astronomical signals as they pass through on their way to telescopes on the ground.

With no atmosphere and shielding from the Earth, the far side of the Moon presents a nearly ideal environment for a sensitive Dark Ages telescope. In NRL's DALI concept, scientists and engineers will investigate novel antenna constructions, methods to deploy the antennas, electronics that can survive in the harsh lunar environment, and related technology in preparation for developing a roadmap for research and development of a lunar telescope over the next decade. The team will also build on their experience in developing the Radio Observatory for Lunar Sortie Science, a NASA-funded study of a pathfinding array that would be located on the near side of the Moon.

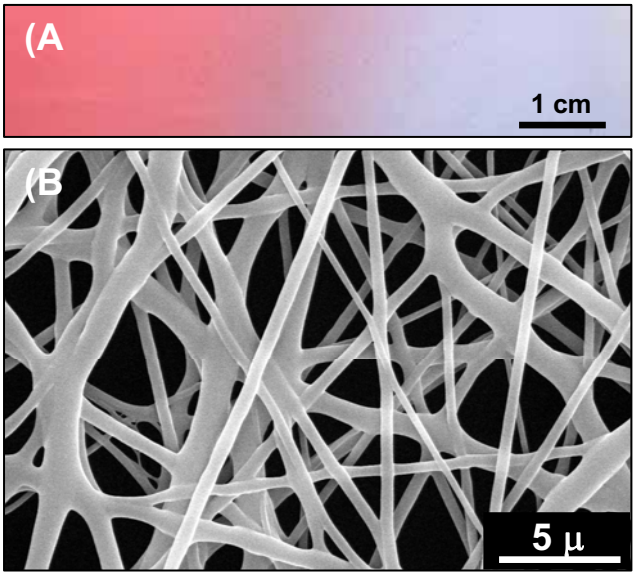
The project leader at NRL, Dr. Joseph Lazio, NRC Adviser, pointed out that DALI will be one of the most powerful telescope ever built and will bring us closer than we have ever been to understanding where our Universe came from and where it is going. **"*Probing the Dark Ages presents the opportunity to watch the young Universe evolve*," Dr. Lazio said. "*Just as current cosmological studies have both fascinated and surprised us, I anticipate that DALI will lead both to increased understanding of the Universe and unexpected discoveries.*"**

When asked about the program, NRL Senior Astronomer Dr. Kurt Weiler remarked "***Building telescopes on the Moon is clearly a long-term project, but I am very excited about us getting started on this proposal.***" Scientists and engineers from institutions and NASA centers around the country are participating in the Dark Ages Lunar Interferometer study, including NASA/Goddard Space Flight Center, Caltech/Jet Propulsion Laboratory, the University of Colorado, the Smithsonian Astrophysical Observatory, the National Radio Astronomy Observatory, University of California-Los Angeles, University of California-Berkeley, the University of New Mexico, and Virginia Polytechnic Institute.

Gradient Nanofiber Scaffold Libraries for Tissue Regeneration by Electrospinning†

Functional tissue engineering is a rapidly emerging biomedical field that holds great potential for healthcare in addressing the gap between need and availability of donor tissues and organs. The goal in the field of tissue engineering is to harvest a biopsy of cells from a patient, seed them on a scaffold to culture a replacement tissue and transplant the cultured tissue into the defective site. One approach for fabricating tissue scaffolds is electrospinning.

Electrospinning employs electrostatic forces to produce well-defined polymer fibers, ranging in diameter from a few micrometers down to tens of nanometers, which can be used as scaffolds for tissue generation. The merit of nanofiber scaffolds for tissue engineering is that they mimic the structural morphology of native extracellular matrix (ECM). Cells *in vivo* exist within an ECM which is composed of nanoscale fibers made of proteins such as collagen. Cell behavior is more physiological during culture in electrospun scaffolds because the scaffolds mimic this nanofibrous structure of native ECM.



Figures: Gradient nanofiber scaffold library fabrication (A) and structure (B)

Electrospinning consists of three major components: the spinneret, the fiber collector and the power source. For the spinneret, a polymer solution is pumped from a syringe through a metal needle. The fiber collector is a conductive surface (aluminum foil). Finally, a voltage is applied across the spinneret and the fiber collector for the conversion of polymer solution into a charged jet as it is pumped from the spinneret. The charged jet is very thin which allows the solvent to rapidly evaporate resulting in the formation of a very thin polymer nanofiber. The polymer nanofibers deposit on the collector into a non-woven mat. This non-woven mat serves as a scaffold substrate for tissue generation.

For many tissue engineering applications, in particular bone tissue engineering, multiphase scaffolds made of multiple biomaterials are typically required. Properties from the different material components are combined to yield more effective scaffolds. Thus, we have developed an approach for applying the "multiphase" principle to electrospun nanofiber scaffolds. Two spinnerets are employed for simultaneous deposition of two different polymer solutions into a non-woven mat composed of a mix of the two nanofiber types (patent pending). In addition, the co-deposition yields a nanofiber scaffold containing a gradient in nanofiber composition which can be used as a "library" for high-throughput screening of cellular response of the multiphase nanofiber scaffolds (Fig. A).

Fig. A is a photograph of a nanofiber library made from the biocompatible polymer poly(caprolactone) (PCL). The two spinnerets both pump PCL solutions but one syringe contains a PCL solution with a red dye and the other syringe contains a PCL solution with a blue dye. The addition of the red and blue dyes makes the gradient in nanofiber composition visible to the eye. As can be seen in Fig. A the scaffold library has three different color regions produced as a result of the two different dyes being used in the experiment: (i) a red nanofiber region on left, (ii) a purple region in the middle composed of a mix of red and blue nanofibers and (iii) a blue nanofiber region on the right. The structural morphology of the electrospun scaffolds is shown in Fig. B, which confirmed nanofiber formation. We will use this new fabrication method to make scaffold libraries where the chemical composition of the nanofibers is varied (not just dye color). We will culture cells on the compositional libraries and characterize their response to demonstrate that the libraries can be used to identify optimal nanofiber scaffold compositions for supporting cell responses such as adhesion, proliferation and differentiation.

In summary, we have developed a new electrospinning technique that is capable of producing nanofiber scaffold libraries containing gradients in nanofiber composition. The gradient nanofiber scaffold libraries will be utilized in screening for nanofiber scaffold compositions that optimize tissue regeneration.

left: Dr. Carl G. Simon and right: Dr. Murugan Ramalingam, NRC Associate, NIH (Nibib)/NIST, team members, with their gradient scaffold

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Murugan Ramalingam[1,*], Marian F. Young[2], Vinoy Thomas[3,4,*] and Carl G. Simon, Jr.[1]

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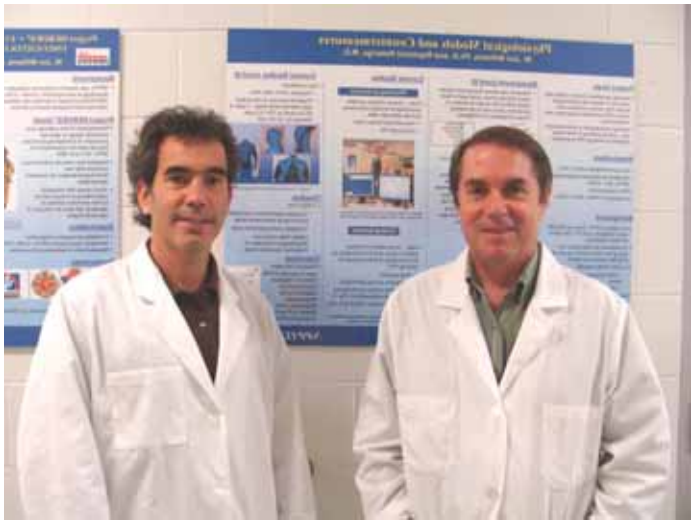
*Both MR and VT participated in this work under the NRC NIH (Nibib)/NIST Research Associateship Program.

Cooling Strategies for Firefighters

Firefighters and emergency responders are the Nation's first line of response for events involving fires, emergency medical operations, search and rescue tasks, hazardous materials incidents, and terrorist attacks. There are approximately one million firefighters in the United States and according to the United States Fire Administration an average of 115 firefighter fatalities per year occurred between 1977 and 2002, not including the 343 who died at the World Trade Center on September 11, 2001. About half of all firefighter injuries and fatalities occurred on the fire scene. Given the wide range of environments and conditions in which firefighters must operate, exposure to an extensive array of hazards is possible. Furthermore, the challenges facing firefighters today are increasingly due to the threat of terrorism (e.g., chemical, biological, radiological, and nuclear (CBRN) hazards). Firefighters rely on personal protective equipment (PPE) to reduce the risk of injury or death that may occur in the line of duty. However, the firefighter protective ensemble can impose hazards to the user (i.e., thermal injury, increased physical/cardiovascular stress).

above right: Dr Aitor Coca, NRC Associate, National Personal Protective Technology Lab. — (NPPTL/NIOSH) — measures physiological parameters while firefighter performs a dummy drag test.

Dr. Coca is testing new/emerging technologies that represent advances in the technology for physiological monitoring and advances in thermal cooling garments/technologies as countermeasures to physiological stress. Dr. Coca's project, with his advisor Dr. Jon Williams of NPPTL/NIOSH, has the goal of identifying changes in the physiological (thermoregulatory, respiratory, cardiovascular, fluid/electrolyte, musculoskeletal) responses to ensemble use and study the effects of countermeasure (cooling garment technologies) to these physiological responses. The project evaluates a cooling garment (conductive) technology that cool areas of the body known for maximal heat transfer.



left: Dr. Aitor Coca, NRC Associate, NPPTL/NIOSH
right: Dr. Jon Williams, NRC Adviser, NPPTL/NIOSH

The potential impact for this project cannot be overstated given the sheer number of professional and volunteer firefighters in the United States. The ultimate success of the project will result in enhanced protection against the hazards imposed by the safety equipment itself by incorporating physiological countermeasure technologies (i.e. cooling garments) into the ensembles used by the nation's firefighters. Through these efforts, firefighters of the future will enjoy the incorporation of a broad range of advanced physiological and cooling technologies integrated directly into their equipment.

Dr. Williams, NRC adviser and Dr. Ron Shaffer, NIOSH Laboratory Program Representative were interviewed by Ivanhoe Broadcast news for two video segments related to Dr. Coca's research for the "Discoveries and Breakthroughs inside Science (DBIS)" series. The videos "Physiologists Design Advanced Suit to Cool Firefighters" and "Physiologists Create Undergarment to Measure Vital Signs of Firefighters" were posted on the DBIS website (http://www.aip.org/dbis/stories/2008/18017.html & http://www.aip.org/dbis/stories/2008/18019.html) and played during local television newscasts. Dr. Coca can also be seen in the videos donning and doffing the firefighter PPE.

NIOSH

Dr. Coca simulating a laboratory test wearing a firefighter ensemble

Reefs may "unglue" in oceans with high carbon dioxide

Cements that bind individual coral skeletons and larger coral reef structures are predominantly absent in waters with naturally high levels of carbon dioxide (CO_2), making these reefs highly susceptible to a wearing down of their physical framework, say scientists with NOAA's Atlantic Oceanographic and Meteorological Laboratory in Miami, Florida and other institutions.

The study, released in the July 28, 2008 issue of the *Proceedings of the National Academy of Sciences* (NAS) found that the coral reefs of the eastern tropical Pacific provide a real-world example of the challenges all coral reefs will face under high-CO_2 conditions resulting in ocean acidification.

This is the first attempt to characterize the impacts of ocean acidification on coral reef ecosystems by examining naturally occurring, high-CO_2 reef environments. **Lead author, Derek Manzello, coral reef ecologist and NAS National Research Council (NRC) Associate at AOML,** and his colleagues analyzed the abundance of cements within reef framework structures from the eastern tropical Pacific, which is an entire region exposed to naturally higher levels of carbon dioxide, and compared them to reefs from the Bahamas, an ecosystem exposed to comparatively lower levels of carbon dioxide.

The impact of ocean acidification seems to be a drastic reduction in the production of the cements that allow coral reefs to grow into large, structurally-strong formations that can withstand high wave action.

"***Reefs are constantly degraded by mechanical, biological, and chemical erosion***," said Manzello. "***This study indicates that poorly cemented reefs that develop in an acidic ocean will be much less likely to withstand this persistent erosion. These results imply that coral reefs of the future may be eroded faster than they can grow.***"

A coral reef in a naturally high carbon dioxide (CO2) environment

Coral reefs that form in environments that are naturally high in carbon dioxide (CO2) are poorly formed and not as stable as those in lower CO2 areas.

Ocean acidification occurs as much of the new carbon dioxide being placed into the atmosphere is dissolved into the ocean's surface waters. This increase in the amount of carbon dioxide in ocean waters leads to a decrease in the amount of carbonate available to organisms like corals, which make calcium carbonate to build the stony structure they inhabit. Calcium carbonate is also the basis of the cement that binds one coral to another and to sand that fills spaces between them.

Co-authors of the paper are Joan Kleypas, National Center for Atmospheric Research, Boulder, Colorado; David Budd, University of Colorado, Boulder, Colorado; C. Mark Eakin, NOAA Coral Reef Watch, Silver Spring, Maryland; and Peter Glynn and Chris Langdon, University of Miami, Miami, Florida. NOAA understands and predicts changes in the Earth's environment, from the depths of the ocean to the surface of the sun, and conserves and manages our coastal and marine resources.

Dr. Derek Manzello
NRC Associate, NOAA

Research at NOAA

The National Research Council Associateship Programs Web site contains abstracts, or opportunities for research that describe areas of research in which Associateships may be awarded at NOAA. NOAA provides the funds for this program and furnishes all necessary support services, facilities, and equipment for the approved research program of each Associate. While every effort has been made by NOAA to provide opportunities of ample scope and relevance, the publication of any opportunity in this website does not guarantee that it will be available at the time awards are offered. Changes and/or deletions may occur because of temporary lack of equipment, laboratory renovation, staffing already sufficient to meet research goals, or a lack of funding.

Publication

Since an Associate's later scientific and technical career will be judged by others, publication in the accepted open technical literature is highly encouraged. Publications should include a statement indicating that the research was conducted while the author held a National Research Council Research Associateship.

Research Adviser

Shown with each opportunity for research are the names of one or more Research Advisers who conduct or direct the work described in the opportunity. An Adviser is a scientist or engineer at NOAA with whom a Postdoctoral Research Associate works most closely. An Adviser acts as a surrogate of the National Research Council in monitoring an Associate, and all matters related to an Associate's research program fall under his or her purview. For a Senior Research Associate, an Adviser functions in a more collegial relationship and assists as needed in securing technical support and resources.

The NOAA NRC Program Representative is:
Ms. Sharon A. MacLean (smaclean@mola.na.nmfs.gov)

Scientists detect lowest frequency radar echo from the Moon

A team of scientists from the Naval Research Laboratory, the Air Force Research Laboratory's (AFRL's) Research Vehicles Directorate, Kirtland Air Force Base, N.M., and the University of New Mexico (UNM) has detected the lowest frequency radar echo from the moon ever seen with earth-based receivers. In the lunar echo experiment (more properly called a lunar bistatic radar experiment), the Air Force/Navy High Frequency Active Auroral Research Program (HAARP) high power transmitter, located near Gakona, Alaska, launched high power radio waves toward the moon. The reflected signal, weakened because of the long distance to the moon and back, was detected by receiving antennas in New Mexico.

NRL consultant scientist Dr. Paul Rodriguez, of NRL's Information Technology Division, who conceived and proposed the experiment explains, "Analysis of the echo gives information on the properties of the lunar sub-surface topography, because the low frequency radar waves propagate to varying depths below the visible surface of the moon. It is somewhat like sonar, except that we are using electromagnetic waves rather than sound waves. The experiment also allows us to study the interaction of the echo signal with the earth's ionosphere along its return path, because the ionosphere is only partially transparent at low frequencies."

During the experiment, which was carried out on Oct. 28 and 29, 2007, the radar signals from HAARP were at 7.4075 MHz and 9.4075 MHz. Both the transmitted signal and the echo from the moon were detected by NRL Remote Sensing Division scientist, Dr. Kenneth Stewart, and NRL engineer Brian Hicks with antennas built for the Long Wavelength Array (LWA). LWA is a radio interferometer being built in the desert west of Socorro, N.M., by UNM, NRL, the Applied Research Laboratories at the University of Texas at Austin, Virginia Tech, and Los Alamos National Laboratory, for studies of space physics and astrophysics.

The LWA is intended to work below the 88 MHz edge of the FM band, but to get down to the HAARP signal frequencies, the antennas were equipped with digital receivers and specially designed matching networks developed by Stewart, Hicks, and engineer Nagini Paravastu at NRL.

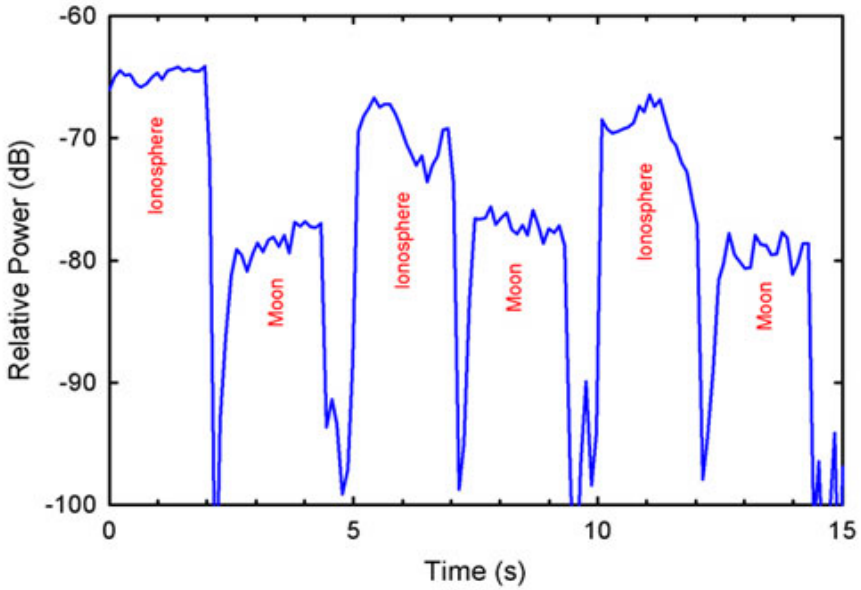
"***Detecting the very weak radio signals after their round trip to the moon and back was challenging and required careful modification of the LWA antennas to improve their performance at these frequencies,***" says Stewart. In addition, **NRL LWA Project Scientist Dr. Namir Kassim, NRC Adviser, and former NRC Associate, notes, "*One of the successful goals of this experiment was to demonstrate that the LWA can work with instruments like HAARP at lower frequencies than its nominal design.*".**

The HAARP radar antenna array was "phased" to point about 45 degrees away from the zenith, in order to track and directly illuminate the moon. Its full total power capability, about 3.6 MW, was used to transmit pulses two seconds in length every five seconds over a period of two hours each day, one hour at each frequency. Using such a pulse pattern makes the echo, which arrives back from the moon 2.4 seconds later, immediately recognizable, allowing the scientists to distinguish the moon's echo signal from the HAARP signal. The HAARP signal reached the receiving antennas in New Mexico by reflecting off the underside of the ionosphere, the region of the Earth's atmosphere from 50 to 400 km in altitude that is partially ionized by solar radiation.

The lunar echo measurements at 7.4075 MHZ are believed to be the lowest frequency (longest wavelength) at which bistatic radar measurements have been conducted. "***Even though lunar echoes have been detected before at higher frequencies, it was really exciting to see them arrive in real time out under the full moon in the New Mexico desert,***" says NRL's Hicks.

The team members involved in the HAARP-LWA lunar radar experiment are: Dr.Paul Rodriguez, Dr. Kenneth Stewart, Brian Hicks, Dr. Nagini Paravastu; and Edward Kennedy of NRL; Dr. Paul Kossey of AFRL's Research Vehicles Directorate; and Dr. Lee J Rickard of UNM.

Significant help in conducting the experiment was provided by HAARP Program Managers Paul Kossey (Air Force) and Edward Kennedy (Navy); Mike McCarrick of BAE Systems-Advanced Technologies, which operates the HAARP facility, and by Clinton Janes (UNM); Gerald O'Connell (National Radio Astronomy Observatory); and Patrick Crane (NRL).



7.4075 Mhz signals from HAARP received by LWA on October 28, 2007, 09:00 UTC. This figure shows the ionospheric reflections and the lunar echos of three of the more than 1400 HAARP pulses received by one of the LWA antennas in New Mexico.

NRL scientists produce carbon nanotubes using commercially available polymeric resins

Scientists at the Naval Research Laboratory have successfully produced carbon nanotubes (CNTs) in high yields in bulk solid compositions using commercially available aromatic containing resins. The concentration of multi-walled carbon nanotubes (MWNTs) and metal nanoparticles can be easily varied within the shaped carbonaceous solid. Carbon nanotube containing fibers and films have also been formulated from the precursor compositions. The potential range of applications is huge, including structure, energy, sensors, separation/filtration, battery, electronic displays, and nanoelectronic devices.

Using this method, carbon nanotubes (CNTs) are formed in a bulk carbonaceous solid from thermal decomposition of melt-processable precursor compositions formulated from organometallic compounds or metal salts in the presence of an excess amount of selected highly aromatic compounds. The CNTs obtained by this patented method are not formed from gaseous components, as is common with the current CNT production based on chemical vapor deposition (CVD) methods, but rather evolve from metal and carbon nanoparticles that form within the carbonaceous solid during the carbonization process above 500 oC. Only a small amount of the organometallic compound or metal salt is needed to achieve the formation of CNTs in high yield, but large quantities of the metal source can be used, depending on the application, if desired.

The solid-state method enables the large-scale production of MWNTs in moldable solid forms, films, and fibers using low-cost precursors and equipment, thereby reducing economic barriers that are inherent with carbon nanotube materials produced by more conventional methods, such as CVD. Following carbonization, the shaped carbon solids are composed of varying amounts of nanotubes and amorphous carbon, depending on such synthetic parameters as the metal catalyst concentration, carbonization temperature, and the specific organic precursors used. The amorphous carbon phase is readily removed via selective combustion at temperatures from 300-500$_0$C, producing highly porous, purified CNT solids with specific surface areas up to 500 m2 g-1. This highly flexible synthetic method also offers the ability to incorporate heteroatoms, for example nitrogen, oxygen, and/or boron, into the carbon nanotube solid via the initial carbon precursors.

The NRL scientists use standard resin melt processing techniques to produce various shaped CNT-containing carbonaceous configurations. Their research is the first example of using high temperature thermosetting resins as a carbon source for the formation of CNTs. Any commercially available resins, including phthalonitriles resins, polyimides, epoxy resins, phenolics, and petroleum pitches, that have good thermal properties and show superior structural integrity, are attractive sources of carbon for CNT formation by the novel method.

The use of commercially available resins is a potentially inexpensive route to CNTs. Using this simple, potentially cost-effective method could result in the production of CNTs in large quantities and various shapes. Scientists are evaluating them for possible use in numerous aerospace, marine, and electronic applications.

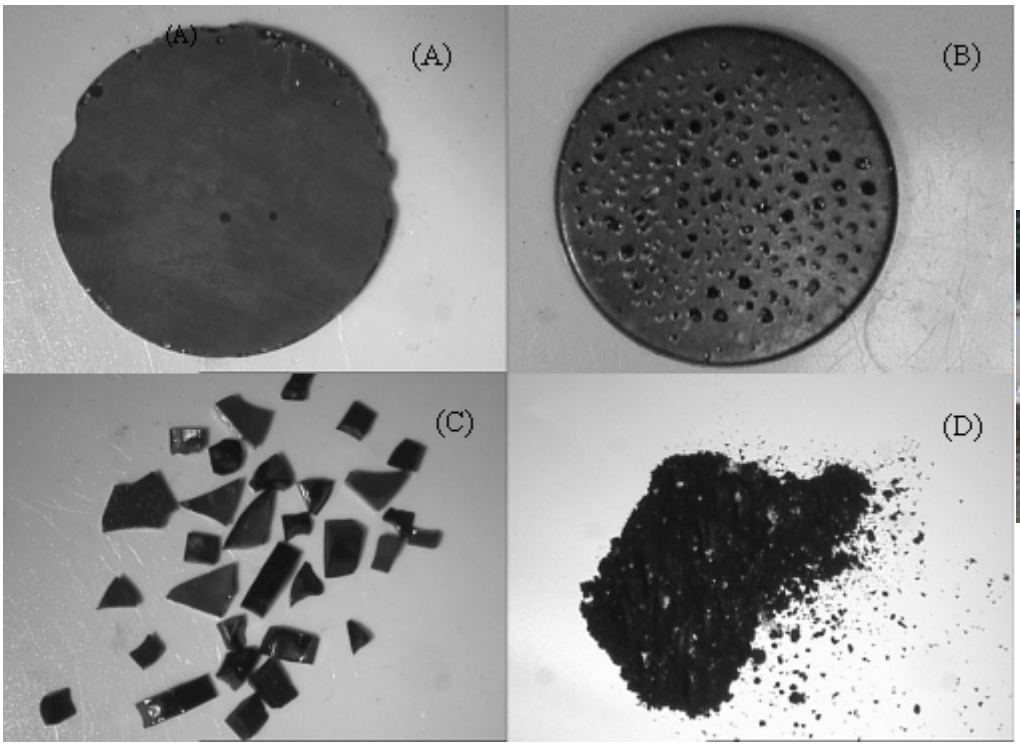
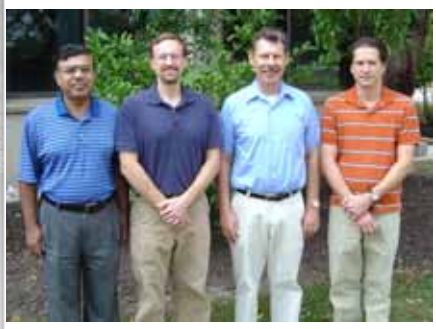


Fig.1:Images of (A,B) shaped CNT solids monoliths, (C) shards, and (D) powders derived from said monoliths



Left to right, from Mats Sci & Tech Div: Dr. Syed Qadri, NRC Adviser; from Chem Div: Dr. Matthew Laskoski, former NRC Associate, Dr. Teddy Keller, NRC Adviser, and Dr. Jeff Long, current NRC Adviser and former NRC Associate

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CARBON NANOTUBES using POLYMERIC RESINS

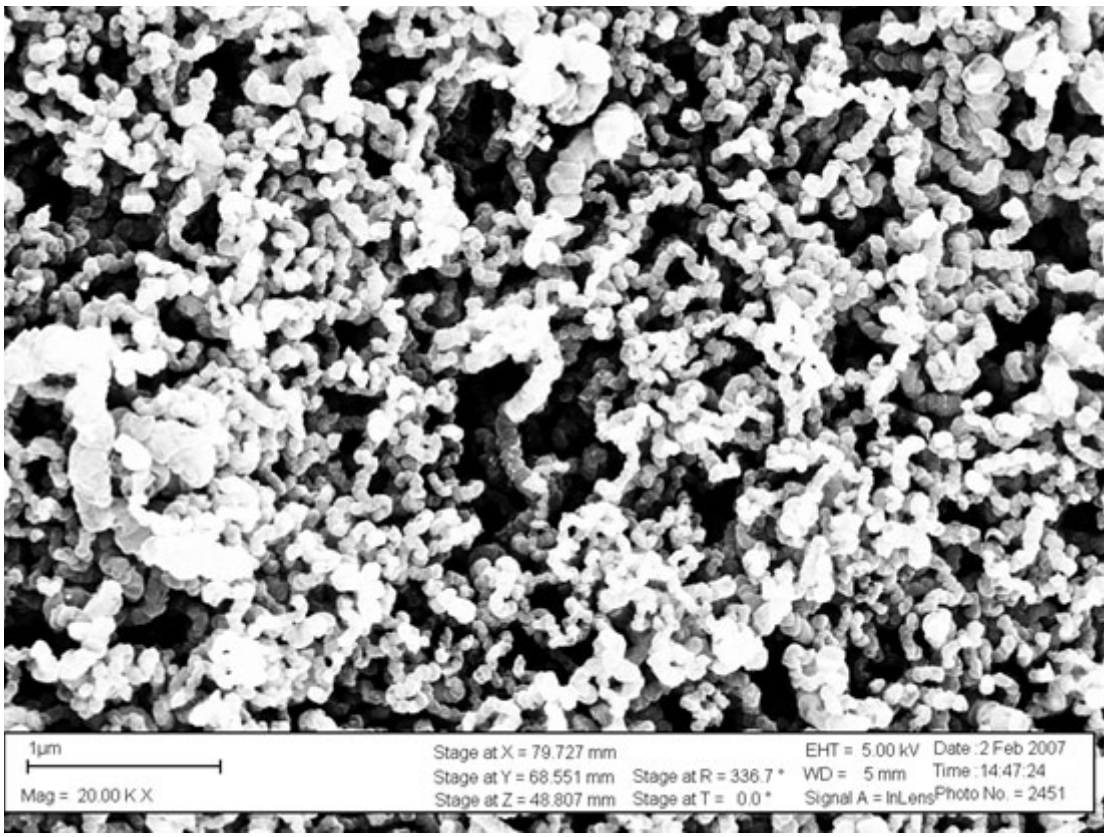


Figure 2. Scanning electron micrograph (SEM) of the surface of a purified, Ni-catalyzed MWNT solid.

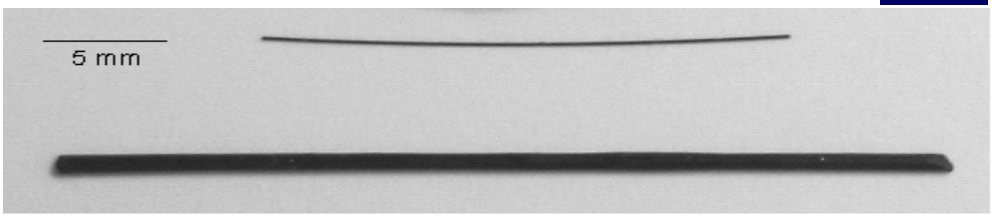


Figure 3. Images of a carbonized CNT fiber and rod fabricated from phthalonitrile resin pulled from melt and heated to 1000° C.

NRL Inventors 7 out of 10 Navy Nanotech Patents

A study by researchers at the University of Arizona reports that the U.S. Navy ranks third, behind IBM and the University of California system, in the number of nanotechnology patents granted by the U.S. Patent and Trademark Office (USPTO) in 1976-2006. Nanotechnology patents were identified by searching for certain keywords in the title or abstracts of published patents.

The Navy received 99 out of a total of 7,406 nanotechnology patents granted by the USPTO and NRL researchers were inventors on 70 of those patents. The researchers also identified the Navy, along with IBM and Eastman Kodak, as having been among the most active in patenting nanotechnology as far back as the 1970's.

The study, published in *Nature Nanotechnology* and funded by the National Science Foundation, found that the USPTO granted two times as many nanotechnology patents as the European Patent Office and over six times as many as the Japanese Patent Office during the same period. There is little overlap in the lists of institutions that received the most nanotechnology patents from the three offices.

(Link to study published in *Nature Nanotechnology* is: http://www.nature.com/nnano/journal/v3/n3/pdf/nnano.2008.51.pdf)

Tagging Green Turtles

Dr. Helen Bailey, NRC Associate, NOAA, with a green turtle in Hawaii.

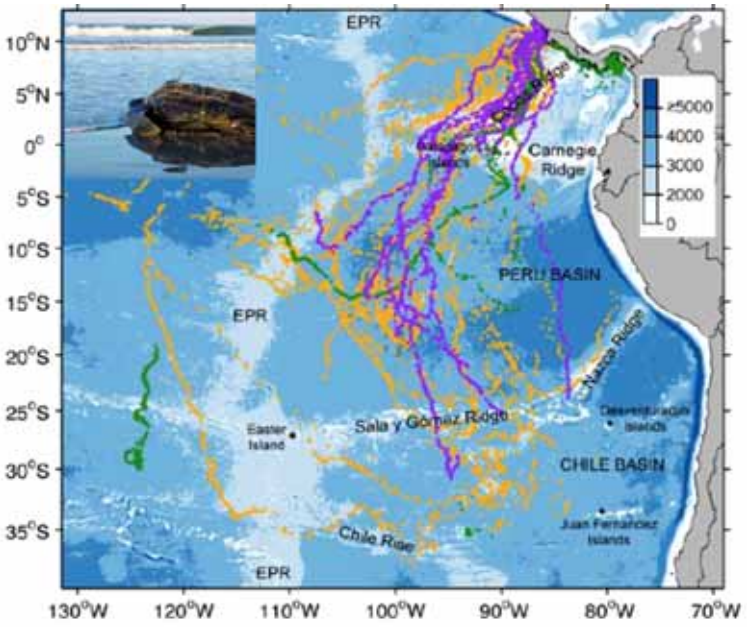
Over the last couple of decades, tagging technology has improved dramatically, revolutionizing our understanding of animal migrations. Nowhere has this development been more pronounced than in our oceans, the final frontier. Many animals that we see close to our shores, such as elephant seals and sea turtles, are now known to travel thousands of miles to reach offshore feeding areas. Our understanding of critical habitat for these large marine animals is being totally redefined.

Although national parks have existed for more than a century, the designation of marine protected parks is relatively recent. However, many species are highly mobile requiring not only an understanding of where they are, but how they move in response to their dynamic ocean environment. Consequently, the future of marine conservation may involve boundaries being set based on environmental factors, such as sea surface temperature, that are biologically important, rather than fixed locations.

Identifying areas that are important to marine species and the factors that influence their movements has been the focus of **Dr. Helen Bailey's NRC Post-doctoral Research Associateship at the National Oceanic and Atmospheric Administration (NOAA) in Pacific Grove, California**. Helen received her PhD in Biology from the University of Aberdeen, Scotland in 2006. Since then, in collaboration with **Dr. Steven Bograd, her NRC Adviser**, she has been analyzing marine animal tracking data from the multi-institutional Tagging of Pacific Predators (TOPP) program.

TOPP has deployed tags on more than 20 marine species since 2002 resulting in over 100,000 tracking days. These tags provide information on the animal's location, but positions are only received when the animal surfacing and a satellite passing overhead coincides. This means that positions are recorded sporadically and are prone to errors that may be of the order of tens to hundreds of kilometers. Helen has been applying complex statistical models that can take these errors into account and estimate the most likely true location at regular time intervals. They also enable the behavior of the animal to be discerned based on how fast they are moving and turning.

This work has identified the nesting, migration and feeding phases of critically endangered eastern Pacific leatherback turtles. These turtles migrate through a complex series of strong currents that deflect them eastward and westward resulting in a zig-zag pattern. The turtles swim faster southward to get out of these currents as fast as they can. They then reach the South Pacific to feed, an area once believed to be an ocean desert. In contrast, analysis of blue whale tracks has shown that they move from patch to patch feeding northwards along the California coast during the summer and moving more offshore in the winter. The dense concentrations of food these animals require to maintain their large size, mean upwelling of cold, nutrient rich water may play a key role in determining where the whales congregate each summer. Combining animal movements and oceanographic data will provide managers with the ability to predict changes in critical areas and take effective conservation action.



Map of eastern Pacific leatherback turtle positions from 2004 (yellow), 2005 (green) and 2007 (purple) overlaid on water depth (meters). EPR=East Pacific Rise

Dr. Helen Bailey visits Dr. Donald Kobayashi at the NOAA Pacific Islands Fisheries Science Center where they have been tagging green turtles.

National Science Bowl
energized by NRL / NRC postdoc volunteers

Each year, shortly after the spring cherry blossoms, another group comes to town to show their stuff, high school science geeks, over 300 strong. They come from schools around the country and are brought in at government expense to compete in the National Science Bowl for high school students organized by the Department of Energy. Each team of 4 -5 students qualifies for the all-expenses-paid trip by winning one of the over 60 regional Science Bowl held the previous winter.

Last year's 18th annual competition involved 12,000 high school students from 1,800 schools in 41 states, Puerto Rico, the U.S. Virgin Islands, and the District of Columbia. At stake were honors for their school, personal honors, medals, international science-oriented trips, grand trophies, a Congressional reception, and college-application bragging rights.

High school science competitors in the National Science Bowl stand for group photograph while there are many volunteers behind the scenes. (Picture courtesy of Dr. Bill Kennedy)

The regional winners and their coaches are in town for several days of science-oriented activities including monument and museum tours, science lectures, and demonstrations, all leading up to a weekend of national-level competition. The competition includes team efforts on laboratory tasks on the Saturday and head-to-head game-show like competition on Sunday with finals in front of TV cameras on Monday.

The competition consists of eight students from two schools sitting side by side at two tables facing a judges' table. Each student, with buzzer ready, is striving to be the first to buzz in and accurately answer a toss-up science question read by the moderator. The questions cover all science topics and could include questions like what three things does the Krebs Cycle convert into energy (answer: sugars, fats, and proteins), what is the name of the first dinosaur to be named (Megalosaurus), and what discovery by Galileo Galilei in 1609 proved to him that Copernicus, not Ptolemy, was right on whether the sun moved around the earth or the earth moved around the sun. (He observed moons orbiting Jupiter.)

Students do not have to wait for the full reading of a toss-up question, they can interrupt to answer first, but if they interrupt and their answer is incorrect, the other team gets points, gets to hear the full question, and gets a leisurely 5 seconds to answer. Winning the toss-up question allows the whole team to collaborate in answering the associated, more thoughtful, bonus question that is worth much more than the toss up. The questioning, buzzing in, and answering continues for a 24 minutes. Then scores are totaled, a winner identified, and it's off to the next match in another room. The competitions, in two dozen rooms of the 4-H Center in Bethesda, start before noon and end at 9 pm to begin again the next morning. Besides a moderator, who reads the questions, a scientific judge, timer, score-keeper, and a rules judge play specific roles in making the competition work and they are rotated frequently throughout the day.

Annually, the Department of Energy draws, organizes, and trains around 5,000 volunteers to conduct various levels of Science Bowls nationwide. For the national-level competition held in Washington, DC, there were 215 volunteers — from DOE, NASA, NOAA, DoD, FAA, US Forest Service, IBM, area teachers and professors, and alumni . Many came with family members to help. In the mix of volunteers were **NRC Associates**: **Dr. Bill Kennedy (now at GMU), Dr. Leah Chock (now at William & Mary), and Dr. Melissa Hornstein (now an NRL employee in Code 6795)**. In addition to the national competition, volunteers are also needed in the DC area for regional competitions, which are a good place for volunteers to get their feet wet.

Cole Valley Christian School Science Bowl Team between competitions. (Picture courtesy of Dr. Bill Kennedy)

For more information or to volunteer, visit the Web site http://www.scied.science.doe.gov/nsb

Trauma treatment in Army's top 10 2007 inventions

from ***Mercury***, August 2008
Army Medical Dept. publication:

Damage Control Resuscitation of Severely Injured Soldiers, an innovation by the Institute of Surgical Research, was named one of the Army's Top 10 Greatest Inventions of 2007. "***This new procedure saves severely injured Soldiers with non-compressible injuries, meaning internal injuries that cannot be compressed using a tourniquet or other device"***, said **Dr. Michael Dubick, NRC Adviser** and senior research pharmacologist for ISR.

An autopsy study showed that 79 percent of service members killed in combat died of hemorrhage, and 70 percent had an injury that couldn't be compressed. The standard method of fluid resuscitation is to administer IV salt solutions in an amount that is three times the patient's blood volume. If the patient is still bleeding, blood transfusions are given to restore lost blood. For some severely injured warriors, the massive volume of fluids and blood can dilute clotting factors, reducing the ability to slow or stop bleeding.

Under the new standard of care, fluid resuscitation with salt solutions is limited, which keeps the blood pressure from rising too high and "popping" newly formed blood clots. Blood volume is restored using plasma, along with packed red blood cells. Instead of the standard four times the amount of red blood cells to plasma. Dubick said ***"…we use a ratio of 1:1 of plasma to red blood cells".***

Early use of a clotting factor called rFVIIa has also been beneficial. Other blood products, such as platelets and cryoprecipitate, are used as needed. Use of this innovation decreased the mortality rate of patients who needed massive transfusions from 65 percent to 17 percent. [Dubick]:***"Some liken this standard of care to the first time someone applied antibiotics".***

Dr. Michael Dubick, NRC Adviser, AMRMC/ISR

U.S. AMRMC
(Arny Medical Research & Materiel Command)
Institute of Surgical Research

Nominated for the Langley Prize, the second-best paper is awarded £100 by Blackwell Publishing

from ***Veterinary Anaesthesia and Analgesia***, August 2008:

The sum of £100 is generously awarded by Blackwell Publishing, Ltd. to the author of the second best paper nominated for the Langley Prize. Professor Hunter considered that this year's award should go to Drs. **Andrey Yershov, former NRC Associate**, AMRMC/ISR; Bryan Jordan; James Fudge; and **Michael Dubick, NRC Adviser**, AMRMC/ISR, for their paper "Influence of the mode of ventilation on ketamine/xylazine requirements in rabbits". (May issue, pages 157 – 163). The editorial board congratulates Andrey and his team and acknowledges the kind assistance of Wiley-Blackwell for this support.

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USAMRMC Mission and Vision

Mission: Provide medical knowledge and materiel lifecycle management to protect, treat and optimize Warfighter health and performance across the full spectrum of operations.

Vision: We are the world's experts and leaders in the military relevant biomedical research and medical materiel communities, delivering the best medical solutions to enhance, protect, treat, and heal our Warfighters

The U.S. Army Institute of Surgical Research (USAISR) is part of the U.S. Army Medical Research and Materiel Command and is collocated with Brooke Army Medical Center. The USAISR is dedicated to both laboratory and clinical trauma research. Its mission is to provide requirements-driven combat casualty care medical solutions and products for injured soldiers, from self-aid through definitive care across the full spectrum of military operations; provide state-of-the-art trauma, burn, and critical care to Department of Defense beneficiaries around the world and civilians in our trauma region; and provide Burn Special Medical Augmentation Response Teams.

2008 SCHEDULE

February Review

Submission deadline - February 1
Transcripts and Reference Reports deadline - February 15.
The Board meets on March 21.
Agencies will be notified within two weeks.

August Review

Submission deadline - August 1.
Transcripts and Reference Reports deadline - August 15.
The Board meets on September 26.
Agencies will be notified within two weeks.

May Review

Submission deadline - May 1
Transcripts and Reference Reports deadline - May 15.
The Board meets on June 27.
Agencies will be notified within two weeks.

November Review

Submission deadline - November 1.
Transcripts and Reference Reports deadline - November 15.
The Board meets on January 9, 2009.
Agencies will be notified within two weeks.

William E. Collins Publication Award

In April 2008, Dr. Carla Hackworth received the Office of Aerospace Medicine William E. Collins Publication Award. She published three technical reports in 2007, which were all uniformly high quality and reflect the dedication and creativity she applies to each project she leads. These reports are important contributions to research literature and directly relate to FAA/AVS/AAM goals, in response to research requirements developed by operational organizations within the FAA.

Dr. Carla A. Hackworth, NRC Adviser, FAA

Dr. Hackworth reported results of a survey of personnel working in aviation maintenance around the world. The report documents how different countries and governing agencies are approaching human performance issues, involving mechanics and those with whom mechanics interface in accomplishing their duties. The report also provides information, aiding them in addressing the criticality of performance safety among maintenance personnel.

Dr. Hackworth also authored a report of survey results of pilots who recently completed their single-engine land rating. It provides a number of insights into how training and certification are being accomplished in general aviation operations and suggests issues that require further attention in both policy and oversight of designees.

As co-author with a team assessing Aviation Safety Inspectors (ASI) training, Dr. Hackworth reviewed a course which familiarizes ASIs with general aviation aircraft electronic displays, GPS and flight management systems. Initial feedback on the course was important, because most ASIs complete their qualifications prior to additional training on advanced aircraft topics.

Additionally, in May 2008, Dr. Hackworth was elected President-Elect of the Aerospace Human Factors Association. Currently Dr. Hackworth is serving as the acting manager for the Aerospace Human Factors laboratory in which she oversees: (1) advance and basic general aviation research conducted in CAMI's general aviation simulators, (2) research on aircrew performance and behavioral stressors, and (3) the assessment of the organizational effectiveness of the FAA and its customers.

NRL Semi-Annual All-Postdoc Poster Sessions

Autumn sessions are sponsored by Sigma Xi.. Spring sessions are sponsored by NRL-WISE.

This past spring,, 13 National Research Council (NRC), American Society for Engineering Education (ASEE) and university supported postdoctoral associates presented their research to the Naval Research Laboratory (NRL) community at a poster session sponsored by NRC and the NRL Women In Science and Engineering Network (WISE). The associates represented seven NRL Divisions (Optical Sciences, Chemistry, Materials Science and Technology, Electronics Science and Technology, Center for Biomolecular Sciences and Engineering, Remote Sensing, and Space Science) from three of the five NRL directorates and presented a broad range of topics from obital decay of a binary neutron star system to undersea aerobic environment fuel cells. The event was well attended with approximately 80 people viewing and discussing the posters including Dr. Basques, NRC Program Administrator, Suzanne White, Program Coordinator, and Captain Gahagan, then Commanding Officer of NRL.