

# ABSTRACTS

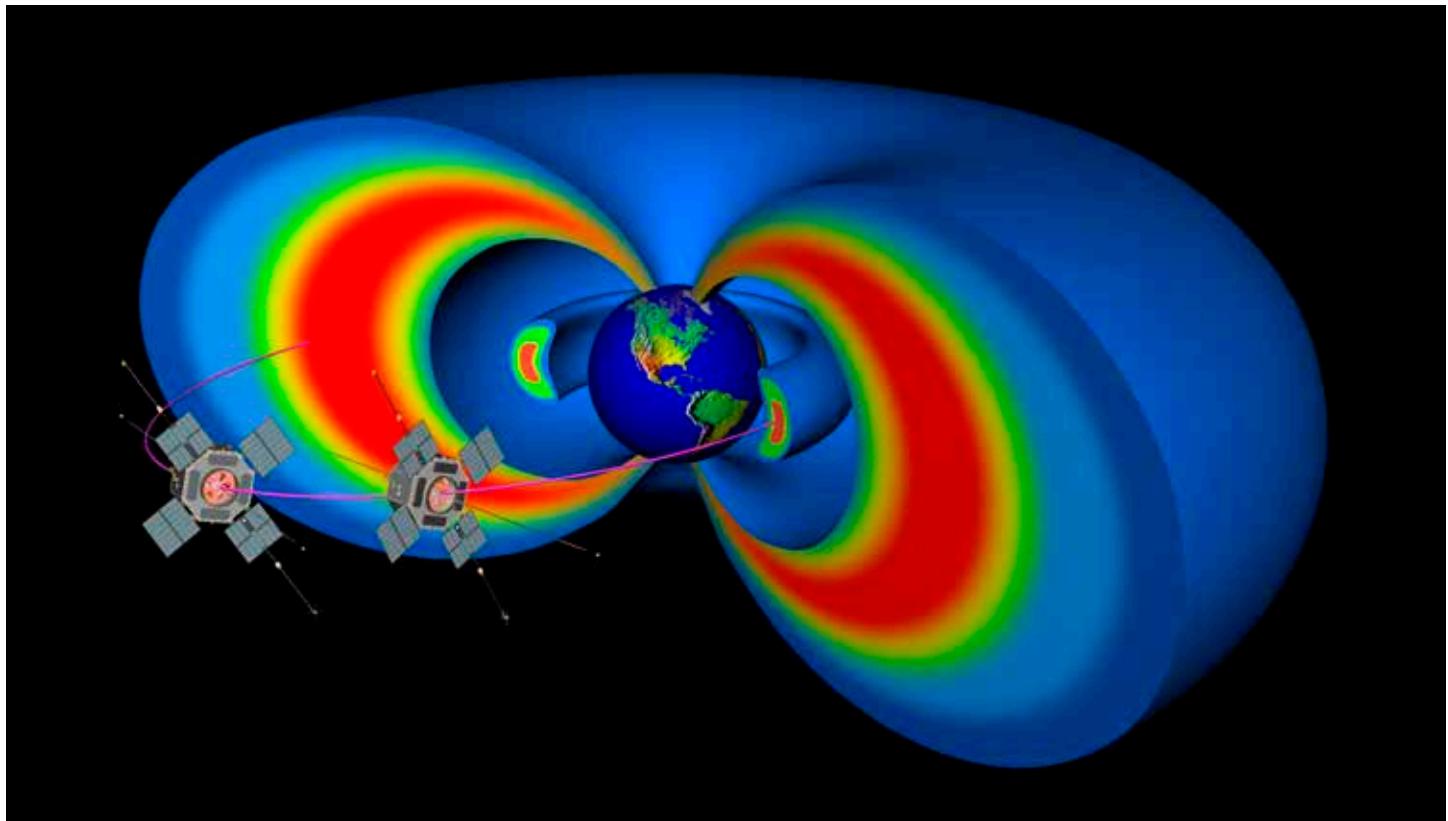


IMAGE COURTESY OF JHU/APL/NASA

## A FORCE IS WITH US

NJIT instruments aboard NASA's Van Allen Space Probes traveling through the magnetosphere have detected an invisible force field thousands of miles from Earth that blocks high-energy "killer electrons" emitted by the Sun from damaging orbiting spacecraft and preventing dangerous radiation from reaching the planet's surface.

The shield, located just below the Van Allen radiation belts – layers of charged protons and electrons held in place by Earth's magnetic field – prevents those highly energized particles from penetrating below altitudes of 7,200 miles from Earth.

"In one region of the belts you detect electrons and in another,

you don't. It's like a hard wall," says Andrew Gerrard, professor of physics and director of NJIT's Center for Solar Terrestrial Research (CSTR). "Though indications of the barrier had existed in the literature previously, we were the first to show conclusively how strong and how spatially sharp it is."

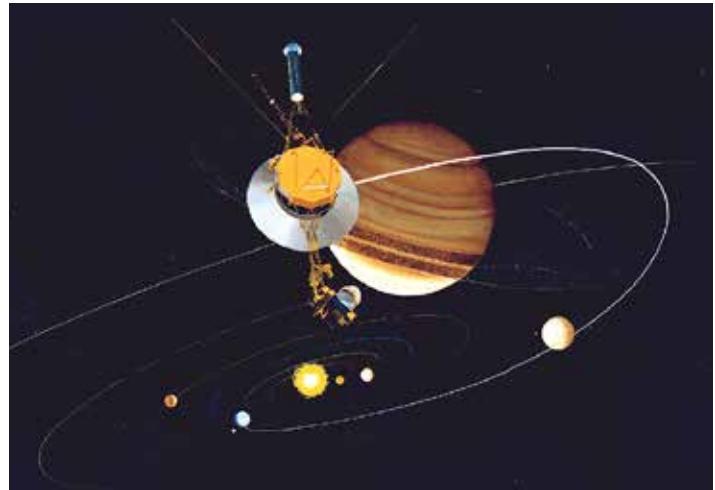


IMAGE COURTESY OF NASA

Gerrard and Louis Lanzerotti, distinguished research professor of physics at the CSTR, co-authored a recent article on the shield in the journal *Nature* along with a team of scientists from the University of Colorado and UCLA who had also observed it using different instruments. The NJIT scientists noticed the

TOP: An artist's rendering of NASA's Van Allen probes and Earth's radiation belts.

ABOVE: Conceptual interpretation of Voyager 1's immense journey.

force field in data collected by an environmental radiation monitor attached to their instruments aboard the twin Van Allen probes as they traveled through the

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*– Michel Boufadel, director of NJIT's Center for Natural Resources Development and Protection*

radiation belts surrounding Earth to measure their composition and shed new light on a hazardous, little-understood region of the planet's outermost atmosphere.

#### HONORED FOR LEAVING THE SOLAR SYSTEM

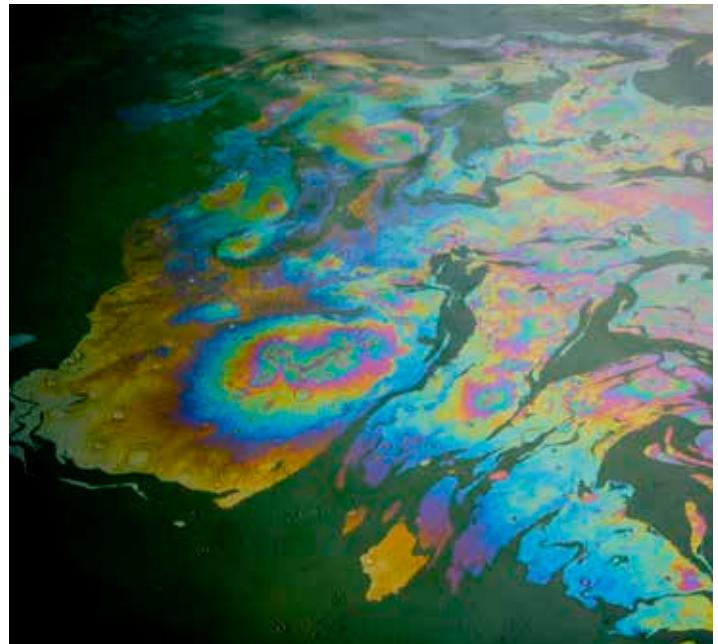
Recently, Lanzerotti was honored for his role on the team that created and launched Voyager 1, the first spacecraft to leave the solar system and enter interstellar space. He was recognized with one of NASA's highest awards, the Silver Achievement Medal.



Louis Lanzerotti, interstellar honoree

Voyager 1 reached interstellar space in 2012, about 35 years after blast off at Cape Canaveral. "The two Voyagers launched were designed to reach Jupiter and Saturn, with the hope that at least one might be able to go on to explore Uranus and Neptune. Voyager 2 did gather data from all four planets, and it is now also en route to crossing into the interstellar medium," says Lanzerotti.

The Voyager instrument Lanzerotti helped develop while a scientist at Bell Labs measured the density and speed of particles in the solar wind and around the outer planets. Now that Voyager 1 has reached the local interstellar medium, its instruments are making measurements of the interstellar magnetic fields, charged particles, and plasma waves unaffected by the Sun and its solar wind. ■



and Protection and a founder of the partnership.

"There are also water implications for energy policy, as water plays an important part in the production, storage and transportation of energy," says Moshe Kam, dean of Newark College of Engineering. Kam also points out that water-energy solutions require multidisciplinary approaches that involve experts outside of the realm of science and engineering. Engineers who work on solutions to water-related challenges are likely to collaborate with other engineers, but also with economists, political scientists, sociologists and legal experts, he says.

A memorandum of understanding (MOU) concluded by the three schools calls in the near-term for the organization of seminars on water, the joint offering of short courses on water that draw on expertise at the institutions, and the creation of a Web portal to facilitate communication between

faculty and students. The MOU also addresses methods for spurring economic growth through collaboration with industry, and the development of a skilled workforce in water technologies.

The universities' research and technology will be "exportable, with relatively minor adjustments" to other regions of the U.S. and the world, says Boufadel, a specialist in water contamination, who provided technical analyses and remedial strategies in response to the two largest oil spills in U.S. history, the Deepwater Horizon and Exxon Valdez spills.

Boufadel adds that researchers' work with industrial partners will be facilitated by the New Jersey Innovation Institute (NJII), an NJIT corporation created in 2014 to spur innovation and growth in a range of economic sectors by leveraging the resources of industry, government and higher education. ■

## CONFRONTING REGIONAL WATER PROBLEMS

Water experts at NJIT, Drexel University and Rowan University are joining forces to tackle the increasingly complex challenges affecting water resources in the region, from shrinking supplies, to industrial contamination, to climate change.

The three universities have agreed to coordinate their resources and expertise in order to respond swiftly and effectively to problems presented by

water utilities, energy companies, environmental firms, and public advocacy groups. Many of these challenges stem from the persistence of industrial contaminants in the sediments of major waterways in the Northeast.

"Our objective is to offer turnkey solutions to industry, to become a one-stop shop for solving problems. Contact one of us and we will be able to tell you who the experts are among our faculty, from flooding specialists to public health researchers. We will connect you with the right advisers on the spot," says Michel Boufadel, the director of NJIT's Center for Natural Resources Development



Associate Professor  
Cristian Borcea

## MOBILE CONNECTION IN THE CLOUD

A team of computer scientists at NJIT has won a multi-year grant from the National Science Foundation to come up with a platform that would allow mobile devices to interact with each other with help from the cloud. The technology they are developing is designed to support collaborative applications in areas such as healthcare, safety and social interaction, potentially benefiting millions of users.

The proposed mobile cloud computing platform would not only stimulate the creation of groundbreaking applications, it would also leverage the cloud to expand the processing power, network bandwidth, storage space, and battery life of individual devices.

"Our goal is to make smart phones smarter," says Cristian Borcea, associate professor and associate chair of the Department of Computer Science, who is the grant's principal investigator.

By networking mobile devices, a parent looking for a child lost in a crowd could conduct real-time searches of cell phone photos taken by people in the area, which are tagged with GPS location and time.

The parent could send a query to find the location and time of the photos that include the lost child. To hasten the search and save battery power on individual phones, the image recognition processing would be done in the cloud.

With the expansion of sensing power contained in mobile devices, health officials could also use cloud-enabled networking to detect disease outbreaks in real time, allowing them to move quickly and precisely to contain the spread of an epidemic.

Over the next three years, Borcea and colleagues from the Department of Computer Science will create a mobile phone avatar, a software surrogate of the phone that would live in the cloud and synchronize with the phone, write a program that permits devices to interact, and figure out ways to improve application functionality and performance in the cloud.

Sustainability and reliability are also key concerns as the number of mobile computing devices proliferates. Calling battery capacity "the main limitation of a cell phone," Borcea notes that programs running in the cloud run faster and use less energy. Additionally, avatars are available at all times, even when their mobile devices are offline because of poor connectivity or simply turned off. ■

## HIGHLANDER HACKERS TAKE TOP PRIZE

A team of four NJIT students took top honors for their mobile gateway app at the United Athletes Foundation (UAF)-Microsoft Hackathon held in November at Microsoft headquarters in Redmond, Wash. The team achieved perfect scores in all three judging categories: innovation, revenue model, and demonstrable functionality.

Matthew Cooper '16, a computer science graduate student; Jackie Patel '15, a business and information systems major; Nikhil Kaushal '16, a biology major; and Pitambar Dayal '16, a biomedical engineering major, shared a \$40,000 prize for their app that converts a cellphone into a video transmitter.



Teams were required to create a mobile app, including a prototype and business plan. For their demo, the NJIT students installed their app on a cellphone to convert it into the mobile gateway, and then used it to broadcast videos directly to the judges' cellphones. Healthcare institutions can use this app to broadcast public-service announcements in regions of the world lacking Internet access.

"The judges were impressed that students did this live and with no safety net," says Cesar Bandera, an assistant professor of entrepreneurship in NJIT's School of Management who has two companies in the NJIT Enterprise Development Center specializing in mobile learning services. Bandera, the team's faculty advisor, says that the students went beyond conventional consumer apps to develop an enterprise app with societal impact.

In August, UAF Chief of Staff James Gaumond reached out to President Joel S. Bloom, inviting NJIT to participate in the Hackathon (participation is by invitation only). Bloom then reached out to Albert Dorman Honors College Dean Katia Passerini and charged her with putting a team together. Due to the Hackathon's emphasis on entrepreneurship, Passerini contacted Bandera, and they decided to build upon the recent healthcare work by Albert Dorman Honors College students in the Dominican Republic by assembling a team comprised of two of these students (Kaushal and Dayal) as well as two students from other NJIT schools (Cooper and Patel). ■

See "Tech Warriors" on page 10 for more about innovative mobile communications technology and health in the Dominican Republic.

**"Our students are doing translational research that will have a direct impact on their fellow citizens. This is engineering that will affect the lives of people with chronic limitations."**

— Richard Foulds, associate professor of biomedical engineering

## FOCUSED ON REHABILITATION

In an impressive showing for a single university, NJIT students recently presented eight separate research papers at the annual conference of the IEEE Engineering in Medicine and Biology Society, the largest biomedical engineering conference in the world. Their research included novel approaches to exoskeleton design and technology to assess the grasping capability of people recovering from strokes, among other areas.

"Eight papers across three labs is a very strong showing. What our students also made clear is that their work is on par with the very best work presented at that meeting," says Richard Foulds, associate professor of biomedical engineering, who also attended the conference in Chicago.

Kiran Karunakaran, a Ph.D. candidate working with Foulds, presented a new approach to controlling exoskeletons, wearable robots used by people who have lost movement in their limbs. Rather than pre-programming the device to walk, she

has proposed basing its stride – the length and height of steps – on hand or finger movements.

Altogether, six Ph.D. students, two post-doctoral researchers who recently earned degrees at NJIT, and three faculty members attended the conference. Much of the NJIT research presented there, including devices to measure joint mobility, grasping function, and muscle control, among others, focused on improving the quality of life for people with sensory and motor impairments resulting from disease or accidents.

Helping people improve their lives is at the heart of NJIT's research, Foulds says. "Our students are doing translational research that will have a direct impact on their fellow citizens. This is engineering that will affect the lives of people with chronic limitations, that is designed to either restore them or accommodate their disabilities to help them lead meaningful lives." ■

*Ph.D. candidate Kiran Karunakaran was among the NJIT students presenting work at IEEE's annual conference on engineering in medicine and biology.*



Distinguished Professor Emeritus Yeheskel Bar-Ness



Distinguished Professor Somenath Mitra

## OVERSEERS HONOR PIONEERING RESEARCH

At NJIT's seventh annual celebration of research excellence in October, NJIT's Board of Overseers honored two eminent NJIT faculty members, Distinguished Professor Emeritus Yeheskel Bar-Ness and Distinguished Professor Somenath Mitra, for foundational contributions to their respective fields of wireless communications and nanotechnology.

Bar-Ness received the 2014 Excellence in Research Lifetime Achievement Award for his groundbreaking work in electrical and computer engineering. Mitra was awarded the Overseers Excellence in Research Prize for his pioneering work in chemistry and environmental science.

"The two individuals we recognize today are not only distinguished among their colleagues at NJIT. They are held in high esteem nationally and internationally by all of their peers. Each has made

very substantial contributions to basic knowledge in their areas of expertise, and their work has influenced the quality of daily life in significant and positive ways," said NJIT President Joel S. Bloom in opening remarks at the awards ceremony. He called Bar-Ness and Mitra "representative of a commitment to pioneering research shared by every NJIT faculty member."

Bar-Ness is the founder of The Elisha Yegal Bar-Ness Center for Wireless Communications and Signal Processing Research at NJIT, which has long been at the forefront of wireless technology. Since it was established in 1985, the Center has contributed key technological advances in communications, including a set of algorithms that facilitate code division multiple access, a digital cellphone technology that eliminates interference caused by high cellphone usage.

Bar-Ness and his colleagues have developed breakthrough technologies for industry, including a technology known as multiple input/multiple output, which uses antenna arrays to increase the bit rate of wireless communications.

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In other critical work, he led a collaborative project with Samsung to improve the capability of Worldwide Interoperability for Microwave Access (WiMAX), a certification mark for products that pass conformance tests established by the Institute of Electrical and Electronics Engineers.

Mitra has achieved global prominence for his work in several areas, including nanotechnology trace measurement and diverse applications ranging from solar-cell technology to seawater desalination. His work in real-time trace measurement plays a central role in environmental monitoring. He has, for example, developed a variety of air-monitoring techniques for parts-per-billion-level measurements in ambient air and industrial emissions.

Mitra's recent work with microwave-induced carbon-nanotube purification and functionalization has wide-ranging applications in areas from polymer composites to thin films and nanoelectronics. A related development for which he received significant recognition was the development of solar cells using carbon-nanotube composites. The resulting solar cells can be painted on flexible substrates, even by using an inkjet process.

In order to ensure that increasingly ubiquitous carbon nanotubes do not themselves pose a threat to the environment, Mitra has been granted \$2.5 million from the National Institute of Environmental Health Sciences, part of the National Institutes of Health, to better understand their impact and the safety of their design. ■

## END NOTES

**Ali Akansu**, professor in the Department of Electrical and Computer Engineering, delivered the plenary talk “Eigen Subspaces: From Eigenfaces to Eigen Portfolios in Finance” at the 80th anniversary celebration of the Faculty of Electrical and Electronic Engineering of Istanbul Technical University (ITU) in Turkey. Recently, NJIT and ITU launched an undergraduate dual diploma program in electrical engineering (NJIT) and electronics and communications engineering (ITU).

**Gabrielle Esperdy**, associate professor of architecture, is a new featured columnist for *Places*, a leading journal of contemporary architecture, landscaping and urbanism. *Places* publishes essays, criticism, photography and narrative journalism, as well as peer-reviewed scholarship.

**Timothy Franklin**, associate vice president for business and economic development at NJIT, has been inducted into the Academy of Community Engagement Scholarship, an organization whose mission is to improve the physical, social, civic and economic well-being of communities by advancing scholarship based on collaborative discovery by communities and their partners in higher education.

**Glenn Goldman**, founding director of the School of Art + Design, has been named one of the nation's “most admired educators” by DesignIntelligence. Each year, DesignIntelligence honors excellence in education and education administration by naming 30 exemplary professionals in the fields

of architecture, industrial design, interior design, and landscape architecture. The 2015 class of education role models was selected by DesignIntelligence staff with input from thousands of design professionals, academic department heads, and students.

**Lou Kondic**, professor of mathematical sciences at NJIT, recently organized the Pan-American Study Institute's workshop “Frontiers in Particulate Media: From Fundamentals to Applications” in La Plata, Argentina. This advanced study workshop was sponsored by the National Science Foundation, the U.S. Department of Energy, the Society for Industrial and Applied Mathematics, the Latinoamerican Center for Physics, Argentinian funding agencies and YPF, a local oil company.

**Alison Lefkovitz**, assistant professor of history, recently wrote a key introductory essay for the newly launched Child Custody Project website ([www.childcustodyproject.org](http://www.childcustodyproject.org)). The site explores child custody issues nationwide within a broad historical and legal context with the goal of providing an impartial, interdisciplinary resource for scholars, practitioners and the public at large.

**Bernadette Longo**, associate professor in the Department of Humanities, has been elected to the Administrative Committee of the IEEE Professional Communication Society. Longo's election was announced at IEEE ProCom, held at Carnegie Mellon University, where she gave the closing plenary talk “From Disciplinary

Grounding to Interdisciplinary Understanding.” Longo is a senior member of IEEE.

**Siva Nadimpalli**, assistant professor in the Department of Mechanical and Industrial Engineering, was invited to give a seminar on the mechanics of energy storage materials at the Materials Science Engineering Department at Drexel University. She presented “Role of Mechanics in the Design of Durable Lithium-Ion Batteries,” which discussed how battery electrodes are subjected to mechanical stresses and what effect the stresses have on electrochemical processes.

**Daphne Soares**, assistant professor of biological sciences, is the recipient of a WINGS WorldQuest Women of Discovery Award. Established in 2003 by Milbry Polk and Leila Hadley Luce, the award honors achievement by women who combine scientific and geographical exploration. Soares was recognized for her investigation of the neurophysiological evolution of fish that have evolved to survive without eyes in subterranean environments, research that takes her to various remote locations in Asia and South America.

**Mengchu Zhou**, distinguished professor in the Department of Electrical and Computer Engineering, recently delivered a keynote speech, “Internet of Things: Architectural Evolution and Applications,” at the IEEE International Conference on Control, Decision and Information Technologies in Metz, France.