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PENN STATE RESEARCHERS NEAR COMPLETION OF PROJECT FOR ARECIBO OBSERVATORY

The Arecibo Observatory, the world's largest single-dish radio telescope, is located near the town of Arecibo, Puerto Rico. Operated by Cornell University under a cooperative agreement with the National Science Foundation, the observatory is used for research in radio astronomy, planetary radar and terrestrial aeronomy. The enormous structure has a reflecting surface with a diameter of 305 meters (1,000 feet) and covers an area of about 200 acres. The antennas above the reflecting surface allow the telescope to inspect our atmosphere as far as several thousand kilometers and beyond where it can study the properties of planets, comets, asteroids and other celestial objects.

Researchers at the Penn State Department of Electrical Engineering have been contracted by the National Science Foundation and Cornell University to construct a new and enhanced high frequency (HF) ionospheric heating instrument at the Arecibo Observatory. The HF heating facility will be used to study the interaction between HF radio waves and ionospheric plasma.



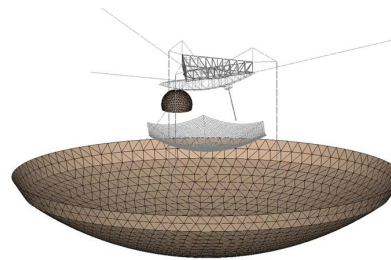
HF heating is accomplished by using a high power, high frequency radio wave which spreads through the partially ionized ionospheric plasma. As the wave propagates, some energy is absorbed which then alters the properties of the plasma. Studying these interactions between the HF waves and the ionospheric plasma provides a great deal of information about the upper atmosphere and ionospheric plasma, according to **Jim Breakall**, professor of electrical engineering.

In the 1980s, Breakall and **Tony Ferraro**, professor emeritus of electrical engineering, led the team which designed a huge array of 32 log periodic antennas for the observatory that was used to develop the high power needed for HF heating. This facility, located about 10 km from the main

Arecibo dish, was completely destroyed by Hurricane Georges in 1998. The new HF heating facility will replace this earlier version while providing updated technology.

Under the direction of Breakall, researchers have been working on the final electrical and mechanical design of the new HF ionospheric heating instrument. The mechanical design of the project has been subcontracted to Star-H Corporation which has offices in State College and Lancaster, PA.

The antenna for the new HF instrument consists of a cassegrain system with a three element phased array of crossed dipoles operating at 5.1 and 8.175 MHz.



The 98 meter, hexagonal subreflector for the cassegrain system will be constructed of a mesh net of cable that will be suspended from the upper platform of the observatory and will assume a catenary

shape. The cable net will have gaps no larger than 1.5 meters which is small enough to electrically simulate a surface. The size, focal depth, and height of the subreflector above the main dish were all determined through optimization. The height of the subreflector can be changed for each operating frequency by raising and lowering it with a system of winches attached to the three huge concrete towers that support the upper platform.

The 305-meter main dish that already exists at the observatory will serve as the primary reflector in the cassegrain system.

The cassegrain system will be fed with a phased array of three crossed dipoles located above the main dish or primary reflector. The crossed dipoles are oriented in a way such that the elements are not parallel to each other. Each element is rotated 30 degrees from the other two elements in order to minimize the mutual coupling between any two elements. The height of the array above the main dish has been optimized for maximum gain. Due to different element lengths and optimized parameter values, the 5.1 and 8.175 MHz systems will require different phased arrays. The length of the 5.1 MHz dipole is 25.5 meters while the length of the 8.175 MHz dipole is 14.5 meters.

Breakall and his research team including the following past and present members **Mike Jacobs**, **Al Moyle**, **Lincoln Carpenter**, **James Turner**, **Jon Arent**, **Ellwood Brem**, **William Glessner**, **Brad Parola**, and **Kyle Labowski** are in the final stages of design on this HF ionospheric heating instrument which should be completed in 2010. Breakall comments, "My students and I are so very fortunate to work on such an exciting project and to continue our special long and lasting Penn State relationship with the Arecibo Observatory."

FACULTY SPOTLIGHT

Yanxi Liu, associate professor of electrical engineering, has a lot of irons in the fire. Liu received her bachelor's degree in physics and electrical engineering from Beijing Normal University in Beijing, China. After receiving her doctoral degree in computer science from the University of Massachusetts at Amherst, she spent a year of postdoctoral training in Grenoble, France at the Laboratory of Fundamental Informatics and Artificial Intelligence of the Institute of Informatics and Applied Mathematics of Grenoble. She also spent one year at the Center for Discrete Mathematics and Theoretical Computer Science with a National Science Foundation research-education fellowship award.

Liu began her academic career at the Robotics Institute of Carnegie Mellon where she spent ten years in research in computational symmetry and machine learning with projects in brain asymmetry, facial asymmetry, near-regular texture analysis and manipulation, repeated pattern perception using crystallographic groups, and gait analysis using frieze groups.

Liu joined Penn State in a joint appointment as associate professor of electrical engineering and computer science and engineering in 2006. She is also currently an adjunct associate professor in the Radiology Department of the University of Pittsburgh and a guest professor at Huazhong University of Science and Technology in China. Liu stated, "It might appear that I work with collaborators from completely unrelated disciplines on multiple projects that go in totally different directions. The truth is, I am only focused on answering one short question computationally: 'Does A look like B?'"

Liu is the co-director of the Laboratory for Perception, Action, and Cognition at Penn State (<http://vision.cse.psu.edu/index.html>). Her research interests span a wide range of applications in computer vision and pattern recognition; computer graphics; medical image analysis; and robotics; with two main themes: computational (a)symmetry and discriminative subspace learning. Computational symmetry addresses issues of robust representation, detection, analysis, and synthesis of real world (a)symmetries and regularities. Discriminative subspace learning focuses on discovering low-dimensional discriminative subspaces from very large (multi-million), multi-modality feature spaces for biomedical image database and computer aided diagnosis (e.g. Alzheimer's Disease) applications, in particular. Her past and current research projects have been funded generously by National Institute of Standards and Technology, National Science Foundation, National Institutes of Health, National Cancer Institute, National Institute of Biomedical Imaging and Bioengineering, Defense Advanced Research Projects Agency, Pennsylvania health department, Microsoft Research, Northrop Grumman, and more recently Google Research, Grace Woodward Grants for Collaborative Research in Engineering and Medicine, and Penn State's Clinical and Translational Science Award.

One of her recent research highlights in computer graphics includes the introduction of a novel image segmentation algorithm that uses translational symmetry as the primary foreground/ background separation cue. Understanding the different see-through layers allows researchers to perform powerful



image manipulations, such as recovering a mesh-occluded background (as much as 53% occluded area) to achieve the effect of image and photo de-fencing (Image De-fencing, CVPR 2008, project website: <http://vision.cse.psu.edu/defencing.html>).

In addition to her busy academic life, Liu is one of the founders of and the faculty adviser for the Penn State Taiji Club. She has practiced and taught Taiji for many years. At the 2009 World Karate Federation national championships, she won four medals: two gold medals in the 24-form and 42-form Taiji Quan; and a gold and a silver medal for the 32-form Taiji Jian (sword) and 42-form Taiji Jian (sword) respectively.

STUDENT SPOTLIGHT

Supratim Ghosh, graduate student in electrical engineering, really enjoys the challenges of math.

Originally from India, Ghosh came to Penn State to begin work on his Ph.D. in 2008. Ghosh chose Penn State for graduate school because of the enormous history and diversity of the electrical engineering



department. In addition, Ghosh was very interested in working with Professor **Ji-Woong Lee**. Ghosh commented, "Professor Lee's interests are quite close to mine and his mathematical knowledge really fascinated me."

Ghosh earned his bachelor of technology degree from the National Institute of

Technology in Jalandhar, India, majoring in instrumentation and control engineering. Ghosh was consistently ranked at the top of his class throughout his education as well as placing in the top 0.1 percent of students in the country in chemistry. After receiving his bachelor's degree in 2006, Ghosh worked at Wipro Technologies in India on a number of projects including "Functional Verification of the Data Movement Engine of the Maplewood Chip using EmbeddedC and SystemC." For his work on this project, Ghosh earned the "feather-in-my-cap" award which is similar to a best employee in the team award.

Ghosh is currently working on research in the Control Systems Research Area under the direction of his adviser, Ji-Woong Lee. His research involves the theoretical aspects of control using hybrid and switched systems theory. This includes working with a system of agents/objects moving in a plane in different directions trying to reach a consensus in the final direction or location. "My work deals with the theoretical aspect of controlling and coordinating these systems so that they can achieve the final goal," stated Ghosh. "This work has potentially vast applications in autonomous vehicles, robots used for exploration purposes and most importantly in the control of flight of unmanned air vehicles."

His love of mathematics fuels his energy to the extent that Ghosh has decided to pursue a graduate degree in mathematics in addition to obtaining his Ph.D. in electrical engineering.

In addition to the demands of his course work and research, Ghosh was the teaching assistant for EE212 in the fall semester under the direction of electrical engineering instructor, **Andrew Mayers**. The juggling of these activities and responsibilities have solidified Ghosh's time management skills.

"Supratim has exceptional mathematical skills compared to his peers. It is not surprising he received top marks in all the math-intensive graduate courses in control systems that he has taken," stated Lee. "By pursuing a dual degree in electrical engineering and mathematics, he will expand his knowledge to advanced topics such as functional analysis and algebraic geometry, which modern systems and control problems increasingly demand."

Upon graduation, Ghosh would like to become a faculty member at a university, and ultimately sees himself contributing to the Indian Space Research Organization in space exploration missions.

FACULTY NEWS

Suman Datta, associate professor, served as a panelist at the Semiconductor Manufacturing Technology/Aixtron sponsored Workshop for Future III-V Complementary Metal-Oxide-Semiconductor (CMOS) Technology, Washington DC, on Dec. 6, 2009. The workshop called "High Mobility Channel MOSFETs," assembled panelists from corporations, researchers, and academicians to lead discussions on future non-silicon based CMOS transistor options. In addition, Datta, along with Vijay Narayanan, professor of computer science and engineering, will present a tutorial titled "Green Transistors to Green Architectures" at the 16th Institute of Electrical and Electronics Engineers International Symposium on High-Performance Computer Architecture in Bangalore, India on Jan. 9-14. The tutorial, designed for computer architects and circuit designers, provides information on emerging transistor architectures and introduces them to new challenges and opportunities for power-aware system design with these emerging devices.

Ken Jenkins, professor of electrical engineering and department head, served on a National Science Foundation panel in December 2009 to review the Research Experience for Undergraduates program proposals submitted for the 2010 competition.

Iam-Choon Khoo, William E. Leonhard Professor of Electrical Engineering, presented an invited paper at the Material Research Society fall meeting in Boston on Dec. 2, 2009. The topic of his talk was "Liquid Crystals for Tunable Optical Metamaterials," coauthored with members of the Liquid Crystals and Nonlinear Optics Research Laboratory: **Michael Stinger**, **Junbin Huang**, **Justin Liou**, **Yi Ma** and **Andres Diaz**.

In the December 2009 edition of "Cabling" magazine, Patrick McLaughlin, chief editor, writes an editorial discussing the research of **Mohsen Kavehrad**, W. L. Weiss Professor of Electrical Engineering. McLaughlin mentions the workshop, "Greater Than 10Gbps Copper Ethernet" organized by Kavehrad in summer 2009 that was convened at Penn State titled "Greater than 10Gbps Copper Ethernet workshop" and attended by "A-listers." This is some nice visibility for the work that Kavehrad has been doing in this area.

The paper titled "High-Speed Access over Copper: Rate Optimization and Signal Construction" authored by graduate students **Ali Enteshari** and **Jarir M. Fadlullah**, and W. L. Weiss Professor **Mohsen Kavehrad** won the "Paper of the Year" by the editors of Electronics and Telecommunications Research Institute Journal. They will be awarded an honorarium of one million won.

Raj Mitra, professor of electrical engineering, presented an invited talk titled "Square Kilometer Array-A Unique Instrument for Radio Astronomy to Explore the Mysteries of Cosmology" in Bangkok for the Oct. 20-23 International Symposium on Antennas and Propagation 2009 conference. In addition, he was invited to speak at the Nov. 3-6, 2009 International Conference on Microwave Technology and Computational Electromagnetics conference in Beijing. His paper was titled "New Directions in Computational Electromagnetics." Mitra was a keynote speaker at the Nov. 16-17, 2009 Loughborough Antennas and Propagation conference in the United Kingdom where he presented a paper titled "Performance Enhancements of Antennas Using Metamaterials: Challenges and Future Directions."

STUDENT RECOGNITION

Jarir Fadlullah, graduate student in electrical engineering, presented a paper titled "Joint Channel and Echo Impulse Response Shortening for High-Speed Data Transmission" and coauthored with **Ali Enteshari** and **Mohsen Kavehrad**, at the Institute of Electrical and Electronics Engineers Globecom in Hawaii on Dec. 3, 2009 (**while on his honeymoon - now that's dedication**).

Fadlullah, will attend the Photonics West Conference on Jan. 27 in San Francisco, CA and present two papers: "Wideband Optical Propagation Measurement System for Characterization of Indoor Optical Wireless Channels" coauthored with Mohsen Kavehrad; and "Efficiency of MIMO Configuration and Adaptive Optics Corrections in Free-Space Optical Fading Channels" coauthored with **Zeinab Hajjarian Kashani** and **Mohsen Kavehrad**.

Congratulations to the Fall 2009 electrical engineering M.S. and Ph.D. graduates:

Master's degree:
Siddharth Advani
Vinit Bhandari
Brett Bissinger
Wei-Liang Chen
Micah Gregory
Xin Jin
Jesal Kanani
Kushal Mukherjee
Joonho Park
Srijith Rajamohan
Sathya Rajasekaran
Aditi Rathi
Peyman Safabakhsh
Aseem Singh
Umamahesh Srinivas

Doctoral degree:
Min Chen
Mohammad Enteshari
Kashan Zei Hajjarian
In Soo Kim
Joel Van Sickle
Wenli Yang
Xin Zhou

STUDENT MARSHAL ANNOUNCED

Grant Marchewka was the student marshal for the College of Engineering at Penn State's fall commencement ceremony on Dec. 19, 2009. He received a bachelor of science degree in electrical engineering. He chose Jeffrey Mayer, associate professor of electrical engineering, to be his faculty escort.

College of Engineering student marshals are selected for their outstanding academic achievement and contributions to engineering student life.

Marchewka is the son of Larry and Tammy Marchewka of Connellsville, Pa. He is a 2005 graduate of Southmoreland High School in Alverton, Pa. He is a member of the Dawson Grange Community Fair Board. He serves as technical director and Web site manager for the Owensdale United Methodist Church and Web site designer for Upper Tyrone Township. While at Penn State, he received the Evan Pugh Scholar Award, the Devorris Scholarship, the Madden Memorial Scholarship and the Lockheed Martin Engineering Scholarship.

Following graduation, Marchewka will join Allegheny Power as an engineer.



DEPARTMENT MOURNS THE PASSING OF TWO FACULTY MEMBERS

Nirmal K. Bose, HRB-Systems Professor of Electrical Engineering died on Nov. 22, 2009, at the age of 69, while on sabbatical at the University of Wuppertal in Germany.

Bose was a member of the Penn State faculty since 1986. His research centered on the development of multidimensional systems theory and applied it to the processing and coding of degraded signals. Specifically, he investigated the restoration and high resolution reconstruction of blurred and noisy images and suggested a computationally efficient scheme for tracking multiple targets in clutter.

He was a fellow of the Institute of Electrical and Electronics Engineers (IEEE) and held memberships in the American Society of Engineering Education and the Sigma Xi scientific research society. Bose was the founding editor-in-chief of the International Journal on Multidimensional Systems and Signal Processing and an associate editor of IEEE's Transactions on Circuits and Systems.

Bose's awards include the IEEE Circuits and Systems Society Education Award, the IEEE Third Millennium Merit Award, the Alexander Von Humboldt Research Award and the Penn State Engineering Alumni Society's Outstanding Research Award.

He received his B.Tech. in electrical engineering from the Indian Institute of Technology in Kharagpur, India, his M.S. in electrical engineering from Cornell University and his Ph.D. in electrical engineering from Syracuse University.

He is survived by his wife, Chandra Bose; daughters, Meenekshi Bose and Enakshi Bose; and grandchildren, Lucy and Brian Barr.

Mukunda B. Das, professor emeritus, died on Nov. 25, 2009, at the age of 78.

Das joined the Penn State Department of Electrical Engineering in 1968. His research interests included high frequency limitations of devices; millimeter wave device design and performance evaluation, including low frequency and high frequency noise behavior of GaAs metal semiconductor field effect transistors; modulation-doped field effect transistors; heterojunction bipolar transistors; and thin oxide-gate silicon metal oxide semiconductor field effect transistors. He was also actively involved in characterization of material defects in devices through electrical measurements.

He was the associate director of the Electronic Materials and Processing Research Laboratory until his retirement in 1996.

Das, a native of India, received his B.S. in physics with honors and his M.S. in electronics from Dhaka University in East Pakistan. Das received his Ph.D. from the Imperial College in London, England, in 1960. Prior to joining Penn State, Das was a senior scientific officer for General Electric specializing in silicon technology and pioneering a new direction of integrated circuits.

Das authored and coauthored over 75 publications in refereed scientific journals. He was granted eight British and U.S. patents concerning field-effect device design and fabrication. He was a senior member of IEEE and a member of the Electron Device Society.

He is survived by his wife, Rama Kana Biswas; daughters, Lipika Selmar Larson and Poppy Das; and his granddaughter, Lilly Roy.

EPSILON CHAPTER OF ETA KAPPA NU CELEBRATES ITS CENTENNIAL



Eta Kappa Nu officers with Jack Mitchell, chapter adviser.

Epsilon Chapter of Eta Kappa Nu (HKN) Association, the electrical and computer engineering honor society, held a centennial celebration on Dec. 4, 2009. Students, faculty and alumni were present for the festivities which included some historical pictures and electrical engineering devices as well as cake and conversation. We're off to a good start for a successful next century.

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Our monthly electronic newsletter has a distribution of 5,000 alumni, friends, colleagues, and universities. In addition, we print a number of newsletters each month to send to electrical engineering departments in universities across the country. This has been a wonderful means to keep in touch with our alumni, and spread the word about the activities and events of the electrical engineering department.

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For more information, please contact Cathy at 814-863-0253 or cls118@psu.edu.

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Please submit news items to: Cathy McClellan at cls118@psu.edu

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