the Photon online

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HASSAN JAWAHERY NAMED DISTINGUISHED UNIVERSITY PROFESSOR

Dr. Hassan Jawahery, the Gus T. Zorn Professor of Physics, has been named a Distinguished University Professor. This designation is the campus' highest academic honor, reserved for those whose scholarly achievements "have brought distinction to the University of Maryland." It recognizes Jawahery's efforts in precision measurements of the properties and interactions of subatomic particles, part of the quest to solve fundamental puzzles such as the matter/anti-matter asymmetry in the Universe.

After graduating from Tehran University in 1976, Jawahery moved to Tufts University and received his Ph.D. in 1981. He accepted postdoctoral and research assistant professor appointments at Syracuse University and was named the physics coordinator of the CLEO particle experiment (1987-1988) based at Cornell. In 1987, he joined the University of Maryland, and worked on the Omni-Purpose Apparatus (OPAL) experiment at CERN's Large Electron-Positron collider (LEP).

Jawahery was one of the founding members of the celebrated BaBar particle physics experiment, designed, built and operated by an international collaboration of over 600 physicists from 10 countries at the Stanford Linear Accelerator (SLAC). He served as the physics analysis coordinator of the experiment (2001-2002), and for two years (2006-2008) served as BaBar "spokesperson," a role combining the functions of chief scientist and CEO. BaBar observed a process that violates matter/anti-matter symmetry (and consequently time-reversal symmetry), and the effect was substantial: in 2008, the Nobel Prize in Physics was awarded to Kobayashi and Maskawa, whose 1973 prediction of broken symmetry in the framework of the Standard Model initiated the thirty-year experimental verification effort finally achieved by BaBar and a competing experiment in Japan.

Recently, Jawahery has been playing a leading role in the development of future experiments, such as the Super-B experiment at the Frascati Lab near Rome. The aim is to increase the production of bottom/anti-bottom quarks by several orders of magnitude over that produced at SLAC, which will allow for precision measurements that may reveal evidence for new physics, in synergy with the current efforts at CERN'S LHC supercollider.

Jawahery is the Associate Editor of the Annual Review of Nuclear and Particle Science, the field's most prestigious journal for summary publications. He was elected a Fellow of the American Physical Society in 2004 and the American Association for the Advancement of Science in 2010.

Jawahery will be recognized at the University of Maryland's 29th Annual Faculty and Staff Convocation on Tuesday, October 9 at 3:00 p.m. in the Memorial Chapel.

INSIDE

NEWS

Johnpierre Paglione has received the 2012 Richard A. Ferrell Distinguished Faculty Fellowship, which recognizes outstanding personal effort and expertise in physics as well as dedicated service to the UMD Department of Physics. The Fellowship, established in 2001, honors **Dr. Richard A. Ferrell**, a deeply-respected physicist who joined the University in 1953, served 40 years, and remained active in the department even after his retirement. Dr. Ferrell died in 2005 at his nearby University Park home.

PHOTO: N.S. Hammer

Jacob Taylor, an Adjunct Assistant Professor, was named one of nine winners of this year's Samuel J. Heyman Service to America Medals, also called "Sammies." The medals, sometimes referred to as the "Oscars" of government service, was presented by the non-profit Partnership for Public Service at a ceremony in Washington, DC on September 13. Taylor received the Call to Service Medal. His citation mentions that he "has made pioneering scientific discoveries that in time could lead to significant advances in health care, communications, computing and technology."

Yu-Hsin Chen was awarded a Marshall N. Rosenbluth Doctoral Thesis Award, which recognizes exceptional young scientists who have performed original doctoral thesis research of outstanding scientific quality and achievement in the area of plasma physics. Chen is Professor **Howard Milchberg's** third Ph.D. student to receive the award. His other two students, **Ki-Yong Kim** and **Thomas Clark,** received the award in 2004 and 1999, respectively.

Sankar Das Sarma was mentioned extensively in *Neue Zurcher Zeitung* (New Zurich Times) on August 8. The article, on Majorana fermions, referred to his plenary speech at the ICPS 2012 - 31st International Conference on the Physics of Semiconductors.

Sarah Eno was noted in the September 2012 *Washingtonian* magazine, in a column called "Guest List - A monthly roundup of people we'd like to have over for drinks, food and conversation." Eno was first on the list, ahead of Robert Griffin III, the Redskins' new quarterback. Eno was described as "part of a team of University of Maryland scientist working on the complicated machinery that recently discovered the Higgs boson."

Dennis Drew is currently serving as a Divisional Associate Editor for *Physical Review Letters (PRL)*. *PRL* is the world's foremost physics letters journal, providing rapid publication of short reports of significant fundamental research in all fields of physics. International in scope, the journal provides its diverse readership with weekly coverage of major advances in physics and cross disciplinary developments.

Aziza Baccouche '02 was in *Science*, "Spotlight on Diversity," on August 31. Baccouche founded a production company called AZIZA Productions a few years before graduating and began making films and short documentaries for science nonprofit organizations. Her first large-scale public documentary series focused on underrepresented minorities in science, including both ethnic minorities and people with disabilities. Baccouche's series debuted August 30, with a pilot episode, titled *Over the Hurricane,* showcasing the work of African - American atmospheric physicist Gregory S. Jenkins.

Nonlinear Time-Reversal Mirror

Researchers at the Center for Nanophysics and Advanced Materials, Electrical and Computer Engineering, and Physics departments of the University of Maryland have developed a new means to communicate using the time-reversal and nonlinear properties of electromagnetic waves. Their nonlinear time-reversal mirror has many unique potential applications, including secure communication, wireless power transfer, electronic device disruption, and precision hyperthermia treatment of tumors.

The UMD researchers, led by Postdoctoral Research Fellows **Matthew Frazier** and **Biniyam Taddese**, and Professors **Steven Anlage** and **Thomas Antonsen**, developed the nonlinear time-reversal mirror starting with a linear time-reversal mirror. The (linear) time reversal mirror works by sending a brief microwave pulse into an enclosed, complex (wave-chaotic) scattering environment and recording the reverberations (referred to as a 'sona' signal). These signals are at the same frequency as a microwave oven, or common cell-phone frequencies. By retransmitting a time-reversed copy of the sona signal, a copy of the original pulse is reconstructed. Amazingly, the effects of the time-forward scattering are undone by the time-reversed scattering, and the more complex the scattering environment, the better the time-reversal mirror works!

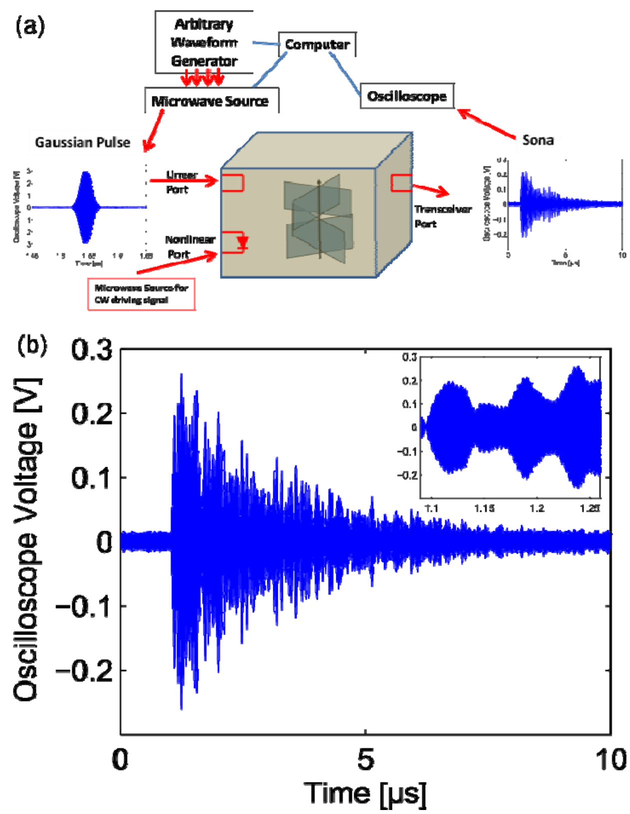

FIG. 1. (a) Schematic of the experimental setup. A Gaussian-shaped pulse (fpulse = 3.8 GHz, t = 50 ns) is transmitted into the ray-chaotic enclosure through the linear port, and reverberates through the scattering environment, interacting with the nonlinear element. (b) An example of a full Sona signal measured by the oscilloscope at the transceiver port, including the 3.8 GHz carrier tone and modulation envelope. (Inset) shows a short segment (150 ns) of the sona in detail.

The nonlinear version of the time reversal mirror adds a discrete nonlinear element – the nonlinear port in Fig. 1. This element could be a diode, a cell phone, or even a rusty contact between two pieces of metal. The nonlinear port acts as a new signal source; as the initial pulse interacts with the nonlinear element, new signals are generated at additional frequencies. The new signals appear as a 'nonlinear' sona which is distinguishable from the original 'linear' sona, and can be recorded and time-reversed in the same manner. Furthermore, the generation and time-reversal of the nonlinear sona will not depend upon the location of the object, which may be unknown. The nonlinear time-reversal mirror thus creates a special communication link to the nonlinear object alone, and other eavesdroppers in the environment cannot 'hear' the signals being transmitted to the nonlinear object. This allows creation of an exclusive communication channel with the nonlinear object, and the ability to direct energy onto it without interfering with nearby objects. *Continued on page 4...*

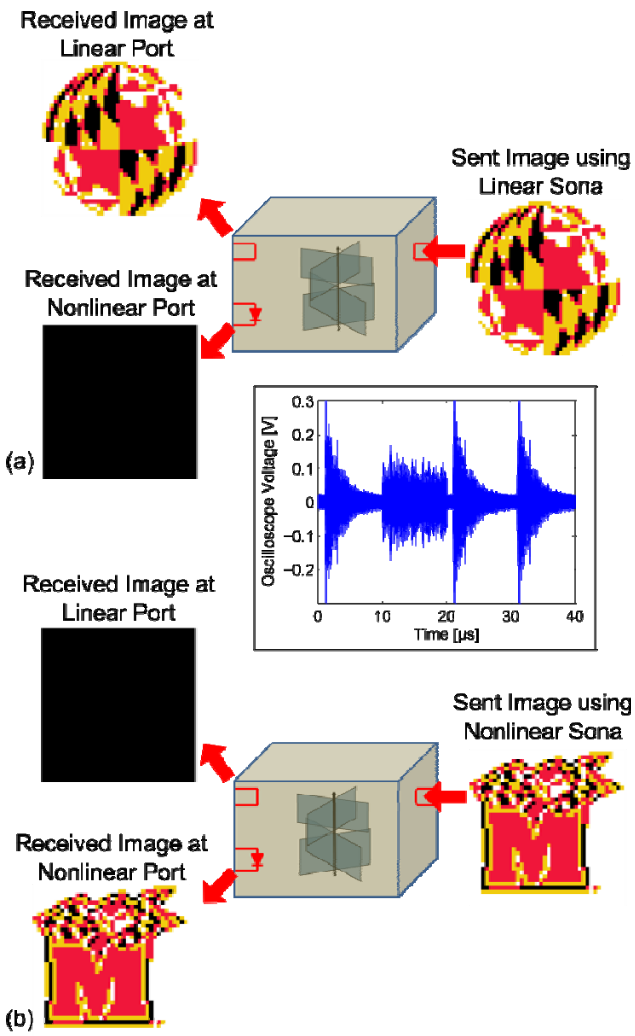

Fig. 2 (a) Transmission of a four-color (two bits per pixel) image using the time-reversed linear *sona*, which is reconstructed only at the linear port. The lack of reconstructed pulses at the nonlinear port corresponds to the transmission of '00' which decodes as a black pixel. (inset) An example constructed sona, displaying the combination of '1' and '0' component sonas, to generate a reconstruction representing '1101'. (b) Transmission of a different four-color image using the time-reversed nonlinear *sona*, which is reconstructed only at the nonlinear port.

*continued...*The UMD researchers demonstrated an exclusive communication scheme using the nonlinear time-reversal mirror. Binary data is encoded as a series of sona signals: the nonlinear sona representing a '1' and a scrambled (by random phase noise) nonlinear sona representing a '0'. At the nonlinear port, only the '1' sonas will reconstruct, allowing data to be decoded by the presence and absence of reconstructed pulses. Everywhere else, the '1' and '0' transmissions are indistinguishable, and no information can be determined. An equivalent process may be performed with the linear sona, to establish exclusive communication between the transceiver and linear ports.

Figure 2 (a, b) shows images encoded in this manner that were transmitted in an exclusive manner to either the linear port (Fig. 2a) or the nonlinear port (Fig. 2b). In Fig. 2a, an image encoded using the linear sona is received with no error at the linear port. At the nonlinear port, the lack of any reconstruction is decoded as zeros, appearing as a black image. In Fig. 2b, the converse holds: a different image encoded using the nonlinear sona is decoded without error using reconstructions at the nonlinear port; no reconstructions are measured at the linear port.

Other potential applications involve using the (possibly amplified) nonlinear sona to reconstruct high-energy pulses at a desired location. The target object may have a rectenna to harvest energy from the reconstructed pulse to power devices or charge batteries, forming a wireless power transmission system which avoids using a dangerously high-energy beam for power transmission. Alternatively, the reconstructed pulse could be used to disrupt, jam, or destroy electronic devices, by applying high-energy pulses to nonlinear components in the device. This can be done with minimal disruption to any other object in the scattering environment. Analogously, hyperthermic treatment of tumors could be possible by tagging a tumor with compounds containing nonlinear electromagnetic absorbers to focus highly localized pulses onto the tumor without damage to surrounding tissue. In addition to the precision of the highly localized pulse (both spatially and temporally), different nonlinear objects may be distinguishable by the spectrum of their nonlinear response, allowing for tailoring of nonlinear sonas to focus pulses on specific objects. A paper describing the work is available at http://arxiv.org/abs/1207.1667v2. An invention disclosure (PS-2011-116) for the nonlinear time-reversal mirror has been submitted to the UMD Office of Technology Commercialization.

EVENTS

Ted Jacobson spent the period from January to May, 2012 as a Simons Distinguished Visiting Scholar at the Kavli Institute for Theoretical Physics. The visit overlapped with the "Bits, Branes, Black Holes" research program, for which he served as a Scientific Advisor. He spoke on "Horizon Entropy, Higher Curvature, and Spacetime Equations of State" at the associated conference on Black Holes and Information.

On September 9, **Michael Fisher** gave the opening remarks, "Computing for the Simplest Model Electrolyte: Correlations, Sum Rules and Criticality in the RPM," at the Statistical Mechanics: Interplay of Theory and Computer Simulations workshop. The workshop, held at Johannes Gutenberg Universitat in Mainz, Rhineland Palatinate, Germany, honored Professor Kurt Binder.

Nobel Laureate Andre Geim, of the University of Manchester, UK, has been named the 2012 recipient of the **Richard E. Prange Prize and Lectureship in Condensed Matter Theory and Related Areas**. Dr. Geim will deliver a public presentation entitled "Random Walk to Graphene" on October 16, 2012. He was awarded the 2010 Nobel Prize in physics with Konstantin Novoselov "for groundbreaking experiments regarding the two-dimensional material graphene." Additionally, Dr. Geim will give a technical CMTC Distinguished Lecture entitled "Beyond Graphene: Electronic Properties of van Der Waals Heterostructures" on October 15.

The Prange Prize, established by the UMD Department of Physics and the Condensed Matter Theory Center, honors the late Professor Richard Prange, whose distinguished career at Maryland spanned four decades (1961 - 2000). It is made possible through the generosity of Dr. Prange's wife, Dr. Madeleine Joullié, a Professor of Chemistry at the University of Pennsylvania.

SAVE THE DATES

October 2 - Shih-I Pai Lecture

Michael Berry, University of Bristol UK

Hamilton's Diabolical Singularity

1412 Physics - 4:00PM

October 16 - Prange Prize Lecture

Andre Geim, University of Manchester

Random Walk to Graphene

1412 Physics - 4:00PM

November 13 - Distinguished Scholar-Teacher Lecture

Betsy Beise, University of Maryland

The Matter of Our Matter

1412 Physics - 4:00PM

CONTACT US:

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