physics flash

news and events from ASU Physics vol.2 | no.5

COLLEGE of LIBERAL ARTS & SCIENCES
ARIZONA STATE UNIVERSITY

In the news…

Regents' Professor Stuart Lindsay was recently invited to the White House for the release of the Recovery Act Innovation Report by Vice President Joe Biden. The invitation was recognition for Lindsay's work on DNA sequencing, funded in part by the American Recovery and Reinvestment Act.

Stuart Lindsay

"This is a wonderful recognition," noted ASU Physics chair Robert Nemanich. "Stuart Lindsay's work is truly creative."

Lindsay attributes the honor to his multidisciplinary research group in the Center for Single Molecule Biophysics in the Biodesign Institute.

"In truth, it is the great physics and chemistry graduate students who have made the group stand out," Lindsay said.

—

ASU Physics manager Margaret Stuart has been elected president of the ASU Staff Council (ASUSC), Tempe. ASUSC's mission is to serve as a voice for university staff, to advise the president of ASU, and to raise issues of concern to university staff.

Margaret Stuart

"As partners in the mission of the university, staff are a valuable tool for identifying ways to advance teaching and research," said Stuart. "I look forward to working with my colleagues and with university leadership to explore these opportunities."

(cont'd on page 5)

Department welcomes new students

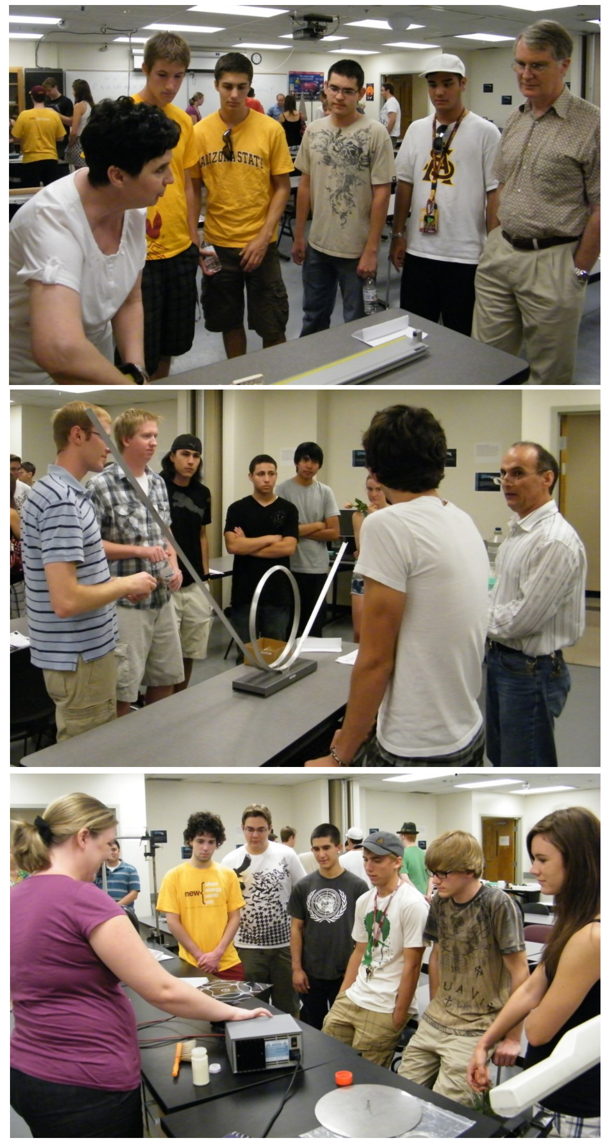
Two key events signal the beginning of a new academic year in ASU Physics: Fall Welcome and Graduate Orientation. Fall Welcome is a time for new first-year undergraduates to learn about people, organizations, and activities that will help in their transition into and succeed in collegiate life. As part of the Fall Welcome, new ASU Physics students visited the department on August 18 where they had an opportunity to meet department chair Robert Nemanich and undergraduate program director Michael Treacy before touring the department. Nemanich and Treacy both talked about the special nature of the undergraduate experience and the lasting impression it left on both of them. Students were also given a tour of department facilities including the laboratories used for physics majors coursework.

The ASU Physics event was organized by academic advisor and undergraduate program coordinator Jessica Pauls.

"Fall Welcome went incredibly well this year. The students thoroughly enjoyed the visit—especially the physics demonstrations" noted Pauls. "[They] are eager to learn and be challenged."

And challenged they will

(cont'd on page 2)



New students participate in hands-on physics demonstrations facilitated by faculty, staff, and members of the Society of Physics Students (SPS) including (top) laboratory coordinator Iwonna Rzanek and Professor Michael Treacy; (center) Dr. Armen Hakhoyan (far right) and SPS secretary Michael Christensen (far left); (bottom) SPS president Rachel Ramirez (left).

New students…(cont'd from Page 1)

be. The ASU Physics program of study is among the most rigorous on campus.

"When you leave ASU Physics, you will have achieved a physics education that is on par with that of Harvard or Princeton," explained Treacy who leads the development of undergraduate studies in the department. "This program is among the best in the country—in the world, in fact."

The department also welcomed a new class of graduate students during a week-long orientation. Students met first with department chair Robert Nemanich who gave them an overview of the importance of transdisciplinary nature of ASU Physics research efforts. Program co-director and Regents' professor Otto Sankey and co-director Ralph Chamberlin shared their perspective on the graduate program and its newest students.

Otto Sankey

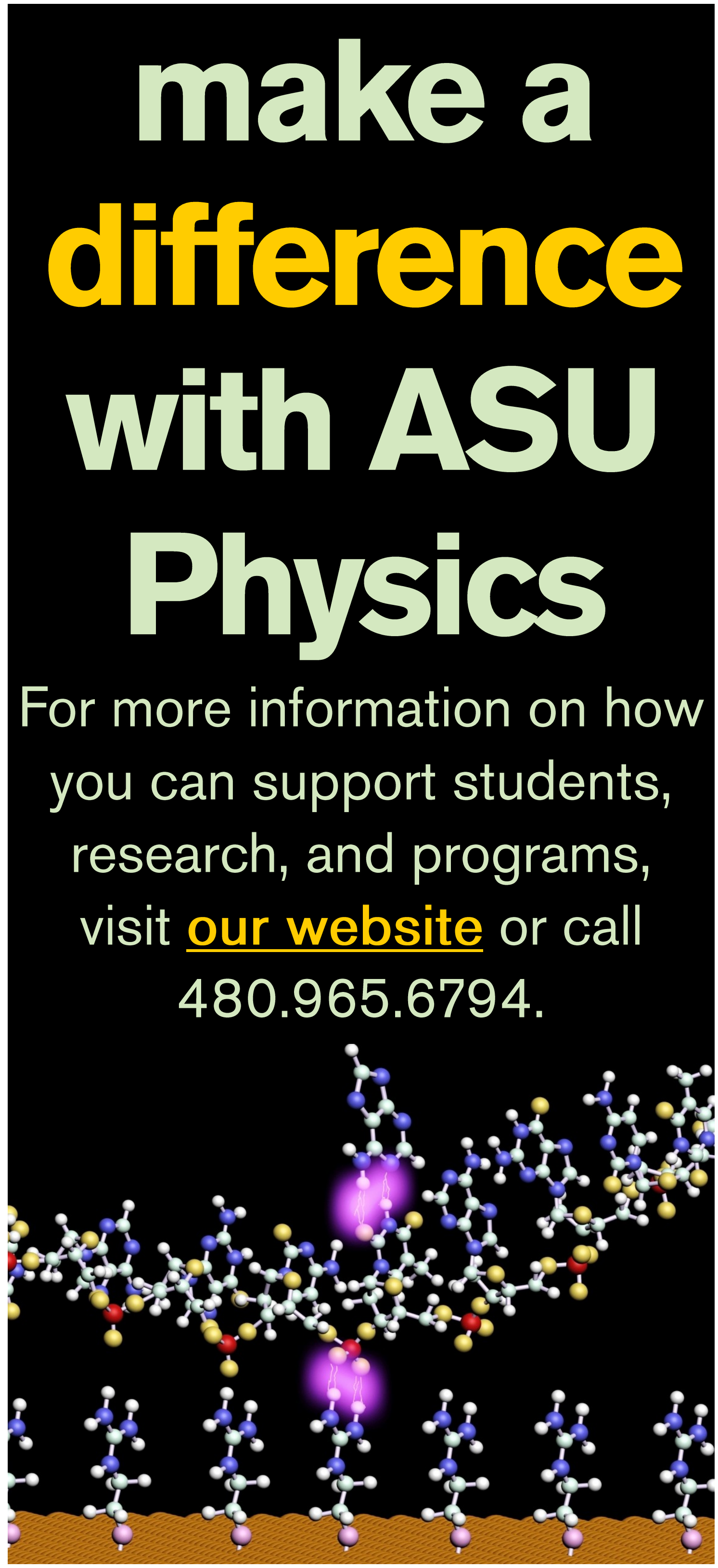
"This class of students among the highest caliber students we have ever had" said Sankey. "What that means is that even though each of you have a high undergraduate GPA, the person sitting next to you could very have an even higher one. Expect the discussion in graduate courses to be at a high level with your fellow students probing deep in to the material."

Orientation ended with a graduate student reception

Later in the week through a series of workshops, Dr. Carl Covatto helped prepare students for their role as teaching assistants. Most new graduate students receive an appointment as a teaching assistant during their first year in the program.

The orientation was organized by graduate program coordinator Araceli Vizcarra who put all the pieces together - including group discussions on research opportunities, a campus tour, lab safety training, and a University Club reception on Friday.

ASU Physics programs have received national and international recognition for excellence. The graduate program tied for 48th in the country in a recent US News & World Report ranking and the department tied for 76th in the Academic Rankings of World Universities. Both reports underscore the quality education physics majors receive through ASU Physics.



New faculty join ASU Physics community

The department welcomes Tanmay Vachaspati and Tingyong Chen as the newest additions to the ASU Physics faculty. As a member of the cosmology and particle astrophysics research effort within the department, Vachaspati is also an affiliate member of ASU's Cosmology Initiative. Through his work on spintronics, Chen joins the nanoscale science and materials physics research effort at ASU. Both faculty members provide some insight into their current and future research plans as they join the ASU Physics community.

Professor Tanmay Vachaspati

It is a great pleasure for me to be joining the Physics department faculty at ASU. I am very excited by the diversity of interests in the department and the focus of the Cosmology initiative.

Tanmay Vachaspati

This is an exciting time to be working in cosmology with ever more sophisticated observational tools at our disposal. Probably the only comparably exciting time was back in the early 80's when I was a graduate student at Tufts University, working with Alexander Vilenkin. At that point in time, a crisis of cosmological proportions had hit particle physics. Guided by the success of Maxwell's theory at unifying electricity and magnetism, and the triumph of electroweak theory with its unified framework describing the weak interactions and electromagnetism, the ideas of unification of all forces had taken hold of particle physicists. Yet there was a theorem -- a grand unified model must contain magnetic monopoles. And simple yet powerful arguments of the type first proposed by Zeldovich showed that any grand unified theory with magnetic monopoles predicts too many cosmological monopoles, causing trepidation that the whole idea of unification may be in trouble. Good things were to emerge from this crisis. Inflationary cosmology was discovered as a solution to the cosmic monopole overabundance problem, and it became evident that particle physics ideas had to be taken seriously to obtain a deeper understanding of our universe. In this heady period, I did my thesis work on cosmic strings and got my Ph.D. in 1985.

My two postdoc years at the Bartol Research Institute at the University of Delaware, and another two at the Department of Applied Mathematics and Theoretical Physics at the University of Cambridge saw the rapid development of the cosmic string scenario. The research was largely driven by the possibility that the large-scale structure of the universe was seeded by grand unified strings. When I returned to Tufts University in 1989 on a faculty position, I continued to work on the particle physics-cosmology interface. At this time I proposed that primordial magnetic fields could also emerge as remnants from the early universe.

By now, there were several experiments looking at the cosmic microwave background fluctuations. Once the WMAP data came in, beautiful oscillations (``acoustic peaks'') were seen in the spectrum of fluctuations, which implied that whatever caused the fluctuations, laid them out at the big bang itself. This was different from how cosmic strings cause fluctuations -- they would continually generate new fluctuations all the time. The active nature of cosmic strings meant that there should be no acoustic peaks. It was clear that cosmic strings could not be the main source for the formation of large scale structure. A lot of the astronomy community lost interest in cosmic strings at this point. Only the true diehards, who are convinced that an invaluable tool to study the early universe and particle physics is through the search for remnants such as cosmic strings, have labored on, whether or not those remnants are responsible for cosmic structure. It is no surprise that I am one of these diehards.

In 1994 I went back to the UK as Rosenbaum Fellow at the Isaac Newton Institute in Cambridge. Cambridge had a program on Topological Defects that brought home a very important point about the unity of physics. In this program, roughly half of the participants were condensed matter physicists. They were interested in topological defects because they are known to be present in condensed matter systems and are responsible for many crucial properties. Materials from liquid crystals to superfluids have analogs of cosmic strings. Thus I was exposed to superfluid He-3 and the ingenuity of experimentalists. In the coming years, I worked on several problems that had overlap with cosmology and condensed matter.

In 1995 I joined Case Western Reserve University where I was to stay for 15 years. In 2007 I became a Member of the Institute for Advanced Study (IAS) in Princeton where I spent a sabbatical year. This was a unique opportunity to meet many different people and I enjoyed my (cont'd on page 4)

New faculty (cont'd from Page 3)...

interactions with the Physics and Astrophysics groups. From 2008-2010, I remained a visitor at the IAS and arrived at ASU a month ago. While at ASU, I hope to continue to feed my diverse interests, stay connected with different groups, press on with my research interests, and most of all to enjoy studying the diverse manifestations in Nature of fundamental Physics.

Away from work, my family and I enjoy meeting people, exploring good vegetarian food and restaurants. We like to go for long walks , modest hikes and bike rides. I have a passion for racket sports -- though age is taking its toll -- and also like classical Hindustani music and theater.

Assistant Professor Tingyong Chen

I am very happy to join the faculty at ASU. I look forward to teaching, collaborating, and continuing my research on spintronics. Besides the bright Arizona sunshine, the excellence in electron microcopy and the efficient management of ASU are the strong magnets that attracted me here from Johns Hopkins.

While electronics is extensively utilized in daily life, only the charge of an electron is utilized. An electron has another degree of freedom—the spin angular momentum or spin. Taking advantage of both spin and charge of electrons, the new generation electronics called spintronics has the advantage of non-volatility, low power consumption, higher integration density, and higher processing speed.

One example of a spintronic device is the spin valve, based on the giant magnetoresistance (GMR) effect that garnered the 2007 Nobel Prize in Physics. Since its discovery, the spin valve GMR has drastically enhanced magnetic memory density thus enabling the iPod and many other mobile devices. In ordinary electronics, the spin orientations of conduction electrons are random so its effect is averaged out. My research is to explore and engineer nanodevices that exploit the spin of conduction electrons. The goal is to discover new, more efficient spintronic devices or materials that have lower energy consumption.

In electronics, a significant amount of energy is dissipated via Joule heating, which stems from electron scattering from impurities and defects. This is the reason that our laptops and cell phones are hot when in use. This is also the reason why most electronics have annoying and sometimes noisy fans. Joule heating not only wastes energy, it is also a central limitation on the performance of our electronics. Part of my research is to explore ballistic transport, where not only spin information is preserved for spintronics but there is no scattering, thus much less Joule heating.

To save energy, the best way is to transport electric current without energy loss which can be achieved using a superconductor. Part of my research is to explore the mechanism of superconductivity. In fact, superconductivity is intimately related to the spin of electrons. In a superconductor, the spins of the two electrons are strongly paired to form a Cooper pair. The most essential property of a superconductor is the pairing mechanism, which can be revealed by the nature of the superconducting gap. Understanding the superconducting mechanism can provide a guide to discover or engineer new superconductors that operate at manageable temperatures. The newly discovered Fe-based superconductors operate above 50 K, but without the CuO2 planes that are essential for the superconductivity in cuprates. The crucial question for the oxypnictides is the mechanism of its superconductivity. There are many theoretical predictions (and in some cases experimental results) of a nodal gap similar to that in cuprates. In my postdoc work, I was fortunate to be part of a research group that was the first to have determined the gap value, its structure and temperature dependence in the newly discovered Fe-based superconductors. We showed that the gap is fully gapped in a manner altogether different from those in the cuprates but close to that of a BCS superconductor.

Tingyong Chen

The impressive facilities in the ASU Center for Solid State Electronics Research (CSSER) will be very helpful in my research. In spin transport, spin polarization is often lost across an interface. Thus it is crucial to engineer an appropriate interface that can preserve or even enhance spin current. Electron microscopy is a powerful tool to characterize interfaces while the spintronic nanostructures can be fabricated by the facilities in CSSER. I am very excited to see the outcome of the incorporation of spin into microelectronics, bio or molecular electronics and even opto-electronics.

Robert Nemanich

From the Chair…

New students, new semester, renewed excitement

Faculty and staff of ASU Physics have focused all of their attention on welcoming our students to the new academic year. All of our programs (Majors, General Studies, and Graduate) have shown substantial growth, and we have welcomed an excellent group of new faculty who will be devoted to our students learning and who will develop research programs that both advance the forefronts of knowledge and provide the basis for the innovations and applications that will impact our lives.

In the last few weeks, I had an opportunity to meet with our freshman class and our first year graduate students. These students – graduate and undergraduate alike - are experiencing an important transition in their respective lives and academic careers. At both introductory meetings I had the chance to remind myself that physics is truly a core scientific discipline, and the concepts of physics begin with the relationship of mass and energy and space and time, and extend to studies of all natural or directed phenomena which inevitably span all fields of science, engineering and technology.

For many of us, the excitement of studying physics is that it seeks the most fundamental understanding of ever-new events including biological, cosmological and nanoscience phenomena. The beauty of physics is in its drive for simplicity, and the elegance is in the measurements that explore new classes of phenomena or seek to provide a basis of understanding for the newest (or oldest) theories.

This semester we welcome over 4,000 students to our classes. Ours is certainly one of the largest programs in the world. Our students recognize that learning the concepts of physics and our problem solving approaches are both difficult and complex. Still, the experience and skills gained in these travails provides the foundational knowledge of science and the ability to attack the multifaceted and intricate problems facing our society.

It is a pleasure to remember the satisfaction of solving complex physics problems. (It is also nice to forget the ones we could not solve!) As we progress through the year I am sure that our students too will experience tremendous satisfaction as they solve increasingly challenging problems, and our faculty and staff will share a similar satisfaction in their respective accomplishments.

Welcome to ASU Physics and best wishes for a productive and exciting 2010-2011 academic year!

let us hear from you!

Whether you're an ASU Physics alum or just love physics, we invite you to **keep in touch**!

Share ASU memories, career updates, or suggestions for the Physics Flash at phyflash@asu.edu.

New staff join department teams

The past months have seen several new additions to ASU Physics academic, business, and instructional support teams. **Drs. Darya Makarova** and **Armen Hakhoyan** join the Physics Instructional Resource Team (PIRT) . Makarova, who joined the department in July, will lead the PIRT team in their mission to support teaching laboratories and manage teaching assistants. Hakyohan joined the department in January after transferring over from the Polytechnic campus where he taught undergraduate physics courses.

Jane Laux joined the department in June to manage business operations. Laux is a veteran ASU employee with experience in grant management and business services on both the Tempe and Polytechnic campuses.

Diana Sesate joined the department in July after working on social media projects through the Office of the Provost. Sesate will coordinate the department's General Studies program and manage front office operations. She recently expanded her team to include two new student workers in the front office area—**Jarrod Lavine** and **Morgan Texeira**.

In the news (cont'd from Page 1)

ASUSC represents all service professional and classified employees with chapters on all four ASU campuses. The Tempe campus current employs over 5000 staff.

—

Regents' professor David Smith is part of a team of researchers at ASU who will explore the development of the next generations of lasers and infrared detectors. Smith, along with ASU colleagues Yong-Hang Zhang and Shane Johnson from Ira A. Fulton Schools of Engineering, were awarded $2.34 million of a $6.25 million Multidisciplinary University Research Initiative—or MURI—grant funded by the Army Research office. The project includes research teams from the University of Illinois at Urbana-Champaign, the Georgia Institute of Technology and the University of North Carolina. (Read more)

Professor Peter Rez was quoted in a USA Today article about radiation exposure during airport security screening s. The article focuses on concerns held by people with prosthetic limbs who feel the screening process puts them at increased risk of exposure. As part of the 2010-2011 ASU Physics Colloquia, Rez will give a free, public lecture on September 23 titled "The Physics of Airline Security". The talk will be held in the Bateman Physical Sciences, F-wing in Room 101 at 3:15pm. More information at 480.965.3561.

—

Congratulations to Professor Fernando Ponce who received an honorary doctorate in August from his undergraduate alma mater, the National University of Engineering (UNI) in Lima, Peru. The honor was in conjunction with a university celebration and conference marking 50 years of the faculty of sciences.

Snapshot Fall 2010: *White-washing the "A"*

During Fall Welcome, many new ASU Physics undergrads participated in one of the oldest traditions on campus: whitewashing the "A". Started in the 1930s, the tradition signifies the start of a new fall semester. On average, over 2000 students hike up "A" mountain each fall, pour a Dixie cup of water and white paint on the "A" and hand-paint a small section of the "A". The "A" remains whitewashed until the first ASU football home game.