Department welcomes new students

Incoming undergraduate and graduate students were welcomed to the department through two ASU Physics events in August. Undergraduates had the opportunity to meet with ASU Physics Chair and Professor Robert Nemanich and Professor Michael Treacy, Director of the Undergraduate Program, during the campus-wide Fall Welcome held on August 22nd. Nemanich talked about the overall structure of the department and the importance of exploring different research areas while an undergraduate. Treacy discussed the opportunities and challenges that lie ahead for a first-year physics major in terms of coursework. Students were also introduced to representatives from the Society for Physics Students. The event was organized and facilitated by Sabrina Mathues, Academic Advisor for ASU Physics.

Graduate students participated in a week-long new graduate student orientation between August 18-22. During the week, graduate students received important...
state NASPA members at the Prescott Resort in Prescott, AZ. NASPA is an organization dedicated to student affairs administration in higher education. With co-presenter, Doug Spencer, Academic Advisor for the School of International Letters & Cultures, Mathues defined the “Escalantean” technique for motivating students towards success. The technique is based on the efforts of ground-breaking high school math instructor Jaime Escalante who developed the philosophy in the 1970/80s. Mathues and Spencer guided break-out sessions focused on relevant theory, engaged in methods discussion, and encouraged participants of diverse backgrounds and positions in student affairs to consider how they too can impact the success of high-risk students.

teaching assistant training from General Studies Program Director, Dr. Carl Covatto. Students also discussed strategies for balancing workload and academic commitments, and met with advisors in the many different research areas within physics in preparation for choosing an area on which to focus. The week culminated in a welcome reception at the home of ASU Physics Chair Robert Nemanich.

Special thanks to Sabrina Mathues, Michael Treacy, SPS officers, Karen Burrington, Carl Covatto, David Smith, and Timothy Cook for help in organizing new student events. We welcome all students - new and returning - to ASU Physics and wish you a productive and memorable academic year!

Keep in touch and MAKE A DIFFERENCE with ASU Physics!

Please consider supporting ASU Physics students, research, and programs.

Distinguished Lecturer Series

Noted biophysicist to give two public talks

ASU Physics is proud to host Professor Carlos Bustamante as the 2008 ASU Physics Distinguished Lecturer. Bustamante is a member of the National Academy of Sciences and was named one of America's best scientists in 2001 by Time Magazine. He is a Howard Hughes Medical Institute Investigator as well as a Professor of Physics, Chemistry, and Molecular & Cellular Biology at University of California, Berkeley.
The Next Big Thing

by Jeff Drucker

Nano is supposed to be the next big thing. But for nano to have its predicted impact, we need to understand how to make nanostructures atom-by-atom. This is exactly what we do in the Drucker research group. We try to answer the question, "Why do the atoms go where they go when we grow a nanocrystal?" Gaining such a fundamental understanding of nanocrystal synthesis provides crucial guidance for engineering next generation technologies. Essentially, this fundamental knowledge lets us know what we can get away with when designing nanocrystals for a particular application.

Currently, our interests are focused on nanocrystal self-assembly. Self-assembly is exactly what it dissolves causing a crystal to grow at the solid/liquid interface. This process continues with the liquid metal droplet floating at the tip of a single-crystal Si NW. The diameter of the NW is controlled by the size of the Au seed and the length is controlled by the growth time. Aspect ratios of greater than 1000:1 can be readily achieved. This is the basic idea behind VLS as initially discovered in the...
sounds like. We magically grow nanocrystals by letting Nature do all of the work for us in this "bottom up" process. This contrasts sharply with the "top-down" processes used in manufacturing microprocessors for today's computers. Rather than using lithography to pattern materials for a particular function, self-assembly exploits the thermodynamics and kinetics of the growth process to produce nanocrystals with well-defined size, shape and composition.

1960s, but the physics of the process is not well understood.

As an example, we would always like to grow NWs that look like those in fig. 1, but slightly different growth conditions lead to NWs that look like those in fig. 2. The small dimensions of the NWs pose real challenges for investigating their growth. Fortunately, ASU has unique capabilities that make that job much easier. We just make movies of the NWs growing in the Tecnai F20 environmental transmission electron microscope (ETEM). Fig. 3 is a frame grabbed from the end of such a movie. The entire movie can be viewed online HERE.

This NW changes its growth morphology when we change the temperature by a small amount. Segments grown at 425°C are straight single crystals. Those grown at 400°C grow straight between localized kink sites and those grown at 380°C look 'wormy'. At this lowest growth temperature, the NW randomly changes growth direction. We're still thinking about the detailed mechanism for these drastic changes in growth
One of the projects that we are involved in uses a technique called vapor-liquid-solid (VLS) growth to form nanowires (NW). In VLS growth, we deposit 20-100 nanometer diameter gold (Au) 'seeds' directly onto silicon (Si) wafers. We heat the Si wafers to 400°C and some Si from the wafer dissolves into the Au seed to form a liquid metal droplet. We then introduce some disilane (Si$_2$H$_6$) vapor into the growth chamber. The disilane decomposes at the liquid/vapor interface and some additional Si morphology induced by relatively small growth temperature excursions.

The final model will likely encompass details of how the individual Si atoms incorporate into the growing NW at the planar growth front. To do so, they must locate single-atom-high steps at the liquid-solid interface after diffusing along the planar growth front. Understanding the details this process will be a challenge, but that's why we're in this business.

For more information on Professor Jeff Drucker's research, click HERE.

Drucker Group personnel (top left) Nick Jungwirth, Sutharvan Ketharanathan, (bottom left) Eric Deiley, and Prashanth Madras alongside the Molecular Beam Epitaxy (MBE) system.
It is a pleasure to extend the warmest welcome to all of our new and continuing students. In the first days of the semester the campus has been alive with excitement as students search for their classes, assemble their course materials and renew old friendships and make many new acquaintances. Just a few of my first impressions – there are more skateboards than last year, there are more bicycles than last year, there are more scooters than last year, and our students seem healthy and excited to be here. (Walking is, however, more complex.

The enrollments in all of our programs continue to grow. With about 4,000 registered students in our courses, this is again a record for ASU Physics. We have also seen significant growth in the new physics courses offered on the Polytechnic Campus as three new assistant professors have joined the Faculty of Physics in the College of Applied Sciences.

Our majors program on the Tempe campus has shown tremendous growth in the last few years and now including K-12 education, economic competitiveness, energy, security and an informed electorate…” (learn more at their HERE). Our majors are able to broadly apply the principles of physics to society’s most critical problems, and as noted by the APS this will be a critical need as our society is facing numerous challenges.

Our acclaimed graduate program welcomes a group of highly skilled students from over the US and around the world. These students will help guide our undergraduates in lectures and laboratories, and they will be the heart of our research program that pushes the frontiers of knowledge.

Welcome (back) to everyone! Good luck with solving your challenging homework problems and in your search for new knowledge.

Sincerely,

Robert J. Nemanich

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Popsicles, Pins, & Physics---

For a second summer, Brian Bingham and Fred Haeger, high school teachers at Deer Valley High School and Richard Runyon, a high school teacher at Agua Fria High School, worked together with ASU Physics’ Dr. Michael Thorpe to continue, and further develop, the Popsicle Stick Project.

One of the principal objectives in this program is the development of curriculum materials that provide a connection between researchers at the university level and the students and teachers in K-12 classroom. Last summer, the three teachers developed lessons related to the complex physics of protein folding. The math involved in this concept is useful in the fields of engineering, physics, and biological systems.
This summer, the group further developed the concept into a workable, ready to use set of materials for high school mathematics and science classes. The result is a remarkably effective and affordable way to model the concept of rigidity theory and is a powerful vehicle for introducing mathematical ideas and logical thinking.

The process begins by drilling tiny holes in each end of a popsicle stick. The popsicle sticks are then connected together with cotton pins to constructed a model to study flexible or rigid two dimensional structures. The plan is for classroom teachers and K-12 students to simulate the construction and study of these models in their classrooms.

Working with Richard Flubacher, from ASU Physics’ Mechanical and Electronics Instrument Shop, a jig was built to hold ten Popsicle sticks at a time which were then precisely drilled using an automated computer drill. Approximately 1000 Popsicle sticks can be drilled an hour using this high-tech machinery. Previously, the holes had been painstakingly drilled by hand.

Working with the CBP, the teachers have a plan to hold future workshops to train teachers in this and other lessons. Although funding is limited, the group continues to work toward a budgetary solution that will provide the means to hold these workshops and build “Popsicle Stick Kits” to distribute to teachers and students across the state.

If you are interested in supporting this or other efforts through ASU Physics, please visit http://physics.asu.edu/alumni/welcome.php for details on how to contribute.

For more information on the Center for Biological Physics, click HERE. For information on the Mechanical and Electronic Instrument Shops at ASU, click HERE.