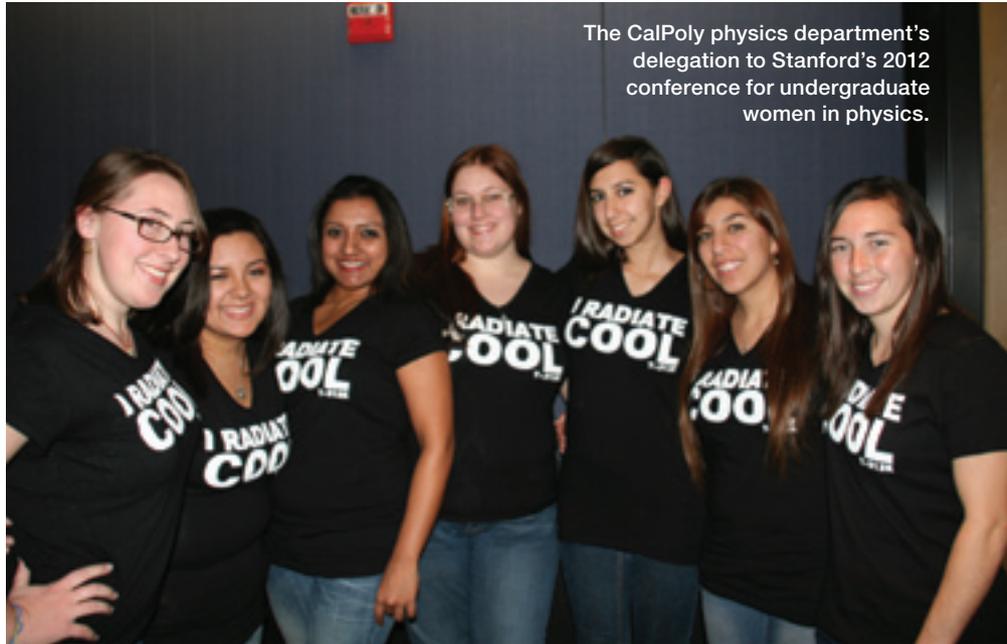


How to Build a Thriving Undergrad Physics Program

Ertan Salik and Alex Small



The CalPoly physics department's delegation to Stanford's 2012 conference for undergraduate women in physics.

California State Polytechnic University

Undergraduate physics programs introduce students to the wonderful world of optics. This case study from California provides insight into how to strengthen your department and improve recruitment strategies.

An undergraduate degree in physics is often the foundation for a career in optics. Yet in the wake of low participation and tight budgets, many institutions are cutting departments and reducing class offerings. In 2009, we led a group of junior and mid-career physics and astronomy faculty at California State Polytechnic University in Pomona (CPP) to develop a multifaceted strategy to build up our undergraduate physics program. Taking inspiration from the Strategic Programs for Innovations in Undergraduate Physics report (SPIN UP), a study of successful undergraduate physics programs from the American Association of Physics Teachers, we dedicated ourselves to actively recruiting new physics majors and minors. Here's how we did it.

Engage faculty in recruitment

Every quarter, about 1,500 engineering and science students take introductory physics courses at CPP. They are natural recruitment targets. If we persuade just a small percentage of them that physics aligns with their intellectual interests and professional goals, we can have a

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large, healthy program. To that end, the faculty set about persuading students taking introductory physics to consider a major or minor in the subject.

We developed a calendar of events outside the classroom. In the fall, the department hosts a welcome social for students, and there is a similar event before finals in spring. In the winter, we lead a group of SPIN UP members that arranges a research open house where students are invited to visit their professors' labs. Beyond recruitment and retention, associate professor Nina Abramzon and assistant professor

Barbara Hoeling promote the CPP physics program at community colleges in the area, often with assistance from alumni teaching at those institutions. Some strong undergraduates in our research groups have been transfer students from these schools, so this work is important for our program.

Alex Small is an officer in the Optical Society of Southern California (OSSC), the local OSA chapter. He brings undergrads to monthly OSSC meetings to introduce them to the different career paths available to physics majors. Exposing students to the professional side of physics sends the message that a major in this field is a practical choice that offers many employment opportunities.

Encourage student participation

Our department's active Society of Physics Students (SPS) chapter plays a key role in the undergraduate recruitment effort. The SPS chapter hosted a successful 2011 SPS zone meeting for all of California, Nevada, Hawaii and the

Philippines. Led by SPS Associate Zone Councilor and CPP student Courtney Lemon, the club invited Jill Tarter of the Search for Extraterrestrial Intelligence Institute (SETI) as a speaker. The event attracted over 250 participants. In January, the CPP physics and astronomy delegation to the 2012 Western Conference for Undergraduate Women in Physics won an award for being the largest student delegation.

Develop an inclusive “gateway” course

A gateway course is the first course that physics majors and minors must take together before enrolling in a more specialized curriculum. The gateway into our physics program is Physics 234, Optics and Special Relativity. The SPIN UP group has focused much of its work on recruiting for this class, enriching the course (especially through pedagogical activities outside of class), and integrating sophomores into the activities of the department. The group’s work has paid off: Historically, the course has had enrollments of 20 to 25 students, with about 10 to 15 ultimately getting a B.S. in physics. For the past three years, enrollment has jumped to 50 to 60 students, and the first post-SPIN UP cohort are now a senior class of 20 physics majors.

Offer opportunities to do breakthrough research

Optics research has been one of the linchpins of our recruiting efforts. In any course with optics content, examples from the lab inevitably excite students and show them the opportunities in hands-on research. Giving undergrads the opportunity to participate in an active lab is a great way to capture their interest.

Use partnerships to strengthen the department

The California Arizona Minority Partnership for Astronomy Research and Education (CAMPARE), led by CPP professor Alex Rudolph, sends students to conduct astronomy research at the

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University of Arizona’s Steward Observatory and other research institutions every summer. Additionally, through a memorandum of understanding with the Steward Observatory, CPP faculty and their students have access to Steward Observatory telescopes on an equal footing with University of Arizona faculty. This was a big draw in our most recent faculty search for an astronomer. In 2011, we renamed our department “physics and astronomy” to recognize our new strength and to attract students interested in astronomy.

Train future teachers

To address many students’ interest in teaching careers, CPP is in the process of approving a degree option that would focus on training aspiring high school physics teachers. This change will improve the quality of physics instruction in high schools and help us to prepare future generations of physicists to be leaders in their field.

This broad wave of activity has carried the department a long way. Our physics department has gone from being a small program under threat of closure to a thriving one that is poised for big leaps in the future. We hope our strategies help you to come up with ideas to strengthen and expand your own departments. ▲

Ertan Salik (esalik@csupomona.edu) is an associate professor, and Alex Small is an assistant professor, with the department of physics and astronomy, California State Polytechnic University, Pomona, Calif., U.S.A.

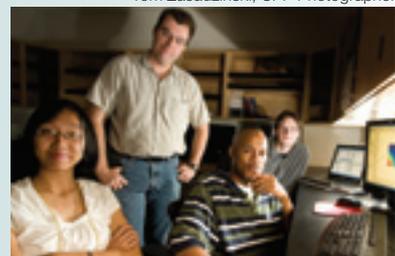
The Authors’ Work with Students

As a theoretician, Alex Small works on superresolution fluorescence imaging. He studies a family of techniques that image live cells with nanometer resolution. Working primarily with undergrads, he has shown that the performance of algorithms that reconstruct the superresolution images is a key determinant of how much information can be extracted in a given time. This work has resulted in external recognition for two students: An award to Forrest Hippensteel (class of 2011) from the fluorescence subgroup of the Biophysical Society in 2010 and a research scholarship from the Microscopy Society of America to support Shane Stahlheber (class of 2013) while he works with Small this summer.

Tom Zasadzinski, CPP Photographer



Michael Medrano (right, class of ‘12) tests one of the fiber optic biosensors developed at Ertan Salik’s (left) laboratory.



Alex Small (second from left) in the computer lab with research group members Adeline Kornelius (‘10), Michael Mansell (‘10) and Forrest Hippensteel (‘11).

Ertan Salik works on single-mode-multimode-single-mode and tapered fiber sensors to measure temperature, stress, chemicals and protein concentration in biological samples. His group studies methods to enhance sensitivity while keeping the sensor system as simple and low-cost as possible. They have recently demonstrated real-time detection of botulinum neurotoxin and are currently developing sensors to detect the O157:H7 strain of *E. coli*—one of the organisms responsible for the recall of tons of produce in the United States and Europe.

The proximity of Small and Salik’s labs makes for a tight-knit group of biomedical optics students. The California State Polytechnic University in Pomona is in the process of approving a minor in biophysics.