

# Collective Behavior

*Distinguishing the physics major from the sea of liberal arts graduates.*

## LU physics notes:

- Emeritus Professor **David Cook** is completing his four-year term in the presidential chain of the American Association of Physics Teachers (AAPT).
- Associate Professor **Megan Pickett** is the current chair of Gender Studies at Lawrence and will be the next director of Freshman Studies.
- **LeRoy Frahm** has worked as electronics technician for the LU physics and psychology departments since 1975.

## Letter from the Chair

I follow **Jeff Collett**, who ably served the Department as chair for several years. I am pleased to report that the tradition of excellence in physics continues at Lawrence. Four of this year's nine physics graduates are heading immediately to respected graduate programs at the U. of Cincinnati (medical physics), UW-Madison (plasma physics and engineering), and the U. of Arizona (2 students in optical sciences). Two or three others are likely to pursue graduate study within a year or two. The Department's research programs

and teaching laboratories have benefited from external grants in recent years from the NSF [plasma physics (**Stoneking**) and teaching physics students to innovate (**Brandenberger, Stoneking, and dept.**)], NASA [computational astrophysics (**Pickett**)], Research Corporation [biophysics (**Martin**)], and a grant from a private foundation [to the natural sciences at Lawrence including quantum entanglement (**Collett**), microscopy (**Martin**), and astronomical observing (**Pickett**)]. The Lawrence Physics Workshop continues to



**Matthew Stoneking**  
Professor of Physics  
and Department Chair

attract a nucleus of dedicated physics students who perpetuate a spirit of community through hard work and mutual support.

## Departmental News: Student Awards

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The *J. Bruce Brackenridge Prize*, named for the late Newton scholar and favorite professor of many LU physics alumni, is awarded to an outstanding junior physics major with a strong academic record and great promise for continued work in physics. **Zhe Zhang ('12)** is the 2010-11 recipient of this award. Zhe has excelled in his coursework and has done computational astrophysics research with Professor **Megan Pickett** and fluid mechanics research with LU alumnus, **Steven Wereley ('89)** at Purdue.

The Department inaugurated several new awards at the Senior Tea event in May 2011:

*Department Service Award:*

**Bradley Bodee ('11)**

Brad was a leader of the SPS chapter and an outstanding contributor to the life of the department.

*Research Award:*

**Faraz Choudhury ('11)**

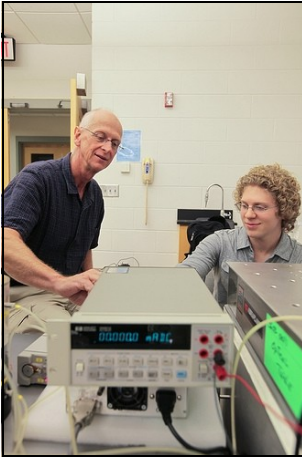
Faraz conducted two years of research on toroidal electron plasma and is now a graduate student at UW-Madison.

*S.I.N. Prize\** for outstanding problem solution in intermediate mechanics:

**Alex Patterson ('14)**



\*The name recalls the local society founded by **Professor Brackenridge**, pictured here with his wife, **MaryAnn Rossi** and bust of **Sir Isaac Newton**.



Associate Professor Jeff Collett with student, James Darrell ('12) in the surface physics laboratory.

## Summer Research Program

Seven physics majors and one biology major participated in the physics research program this summer. Research stipends were provided by the NSF grant on teaching physics students to innovate, the Dale L. Skran, Sr. Fellowship Fund, and the Lawrence University Excellence in Science Fund. The ten week program included, in addition to focused work on their respective projects, group activities intended to foster innovative tendencies. Frequent presentations

for the faculty and their peers and weekly brainstorming sessions constituted elements of this program. Students worked on:

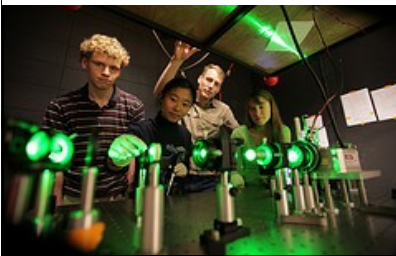
- The development of quantum entanglement experiments for use in the curriculum
- Measuring the stiffness of molecules (microtubules) that form the skeleton and transportation system in cells (see below)
- Measuring excited state

lifetimes of cold rubidium atoms in a magneto-optical trap (MOT).

- Confining electrons and studying their collective properties in a toroidal magnetic field.

Two LU physics students are also doing research at the University of Twente in the Netherlands with LU alumna **Jennifer Herek ('90)**. One LU physics student was at Stanford and another at Purdue University this summer.

## Spotlight On Biological Physics



The single molecule fluorescence microscope at Lawrence. From left-right: Brian Van Hoozen, '12; Lu Yu, '11; Douglas Martin; Carol Bodnar, '11. The green light is low-power laser light used to illuminate fluorescent molecules; the microscope itself is just visible at Carol's right.

Over the past decade, there has been a revolution in molecular biology and biochemistry: a revolution based on physics. Traditionally, processes that involve the interactions of molecules (nearly every process within biological cells) have been studied with ensembles of  $10^6 - 10^{20}$  molecules. However, within the past decade, it has become possible to observe and study single biological molecules with a spatial precision of one nanometer and temporal

precision approaching one millisecond. As a result, the physical processes which underlie life (transport, division, localization, diffusion) are being teased apart, one molecule at a time.

Since arriving at Lawrence in 2007, my students and I have built a microscope capable of observing single molecules and even following the actions of these molecules in time and space on the scale of milliseconds and nanometers. The biological physics problems I work on relate to molecular-scale pro-

cesses involved in most living systems – processes such as transport of cargo within biological cells and cell division. Over the past four years, we've presented our work at two national and four regional conferences, received a grant from the Research Corporation for Science Advancement, and published a new method in *BioTechniques - The International Journal of Life Science Methods*.



Pasad Kulatunga joined the LU physics department in September 2011.

## Update on Faculty Changes

This summer we bid a sad farewell to Visiting Assistant Professor **Adam Clausen** and Lawrence Postdoctoral Fellow **Shannon O'Leary** after four and three years of service to the department respectively. We wish Shannon the best as she starts her tenure-track job in the physics department at Lewis and

Clark College in Portland, Oregon. And we know that Adam will endear himself to students and colleagues alike at the University of Portland this year.

We are pleased to welcome Visiting Assistant Professor **Pasad Kulatunga** and his family to Appleton and the Lawrence community. Professor Kula-

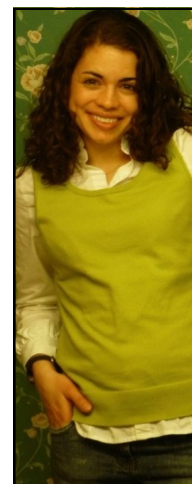
tunga does atomic, molecular and optical physics (AMO) and brings a laboratory research program to the department. Pasad comes to us most recently from Hobart and William Smith Colleges but is returning to the state where he was an undergraduate (UW-Whitewater) and post-doc (UW-Madison).

## Alumna Profile: Sarah Curry ('08)

During her senior year at Lawrence **Sarah Curry ('08)** was offered a position at MIT Lincoln Lab in Cambridge, Mass. She began work there in August 2008 and three years later is happy to be working on robotics projects at the lab, making use of many of the skills she acquired in the physics program at Lawrence. Sarah says that

“Lawrence focused my career path from ‘some sort of scientist’ to physicist... Lawrence’s Physics Department also strengthened my analysis skills by encouraging students to question the meaning of numerical answers to problems and check the units.” The Lawrence physics alumni network helped Sarah identify the job opportunity at Lincoln

Lab, and her story provides an excellent example of the value of an undergraduate education in physics. She is a recent graduate who continues to support the department in valuable ways by, for example, appearing via Skype during our recruiting workshops to give prospective students her view of the Department.



*Sarah Curry works at MIT Lincoln Lab.*

## Alumnus Profile: Chuck DeMets ('83)

Following completion of his double major in physics and geology at Lawrence University, **Chuck DeMets ('83)** received a M.S. and Ph. D. in the Department of Geosciences at Northwestern University. He then spent 1.5 years as a National Research Council post-doctoral researcher at the Naval Research Laboratory in Washington, D.C., and another 2 years as a staff scientist at the NASA Jet Propulsion Laboratory in Pasadena, California. In 1992, he began as an assistant professor in the Department of Geoscience at the

University of Wisconsin-Madison and he now occupies a named faculty chair (the Weeks Professor of Tectonics) at UW-Madison. His research interests are plate tectonics ranging from the present back through the past 50 million years, and earthquake cycle research using high-precision GPS measurements in zones of active faulting. Chuck has served the LU Physics Department in recent years as an external evaluator of our efforts to teach innovation and will join the LU Physics Advisory Committee in 2012.



*Chuck DeMets uses GPS measurements to track tectonic plate movement in places like Mexico (shown here).*

## Other Alumni News

Thank you to many of you who submitted your contributions to the LU physics alumni database. This valuable collection of biographical and contact information is available for use by alumni and current students to network and seek career advice. If you would like to submit your information and gain access to the database, complete the webform at:

[www.lawrence.edu/alumni/physics.shtml](http://www.lawrence.edu/alumni/physics.shtml)

Send an email message to the department chair at

[matthew.r.stoneking@lawrence.edu](mailto:matthew.r.stoneking@lawrence.edu) to obtain access to the database.

**Cindy Regal ('01)** was recognized during reunion weekend with the Nathan M. Pusey Young Alumni Achievement Award. Regal is the Clare Boothe Luce Assistant Professor of Physics at U. of Colorado and Associate Fellow at JILA.

**Lou Jost ('80)** received the George B. Walter Service to Society Award during reunion weekend for his work on preserving threatened species in Ecuador.



*Cindy Regal ('01)*

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*The Department of Physics at Lawrence University strives to be one of the best undergraduate physics departments in the country. To that end, we teach physics and practice it. In teaching physics, we acquaint students with the fundamental principles, major accomplishments, current challenges, and contemporary tools of theoretical, experimental, and computational physics. Since physics comprises an important component of the liberal arts, we seek to communicate a coherent scientific world view to all members of the Lawrence community. In practicing physics, faculty members continually engage in scholarly activities that contribute new knowledge to the discipline, maintain our professional vitality, enrich the curriculum, and involve students in collaborative physics research.*

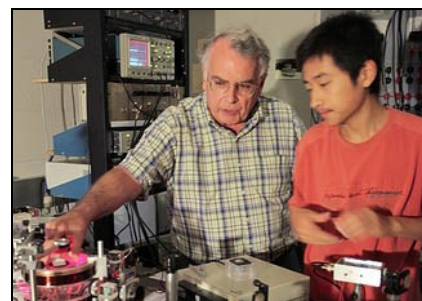
<http://www.lawrence.edu/dept/physics/>

## Emeritus Focal Point: John R. Brandenberger

As some of you know, the Department is investigating how one might teach physics students to be more innovative. Some experts question whether innovative attitudes/behaviors can actually be taught, but we're trying anyway through the use of two thoroughly transformed courses in optics and plasma physics, through the assignment of open-ended homework problems, and through student immersion in our ongoing faculty research programs. The impetus for this investigation is the widespread belief that a stronger commitment to innovation by tomorrow's workforce might help reverse the current slippage in US competitiveness and help our graduates better contribute to solving difficult problems that humanity is facing worldwide.

In the process of exploring how one might teach innovation, we have identified some character traits that we believe to be conducive to or at least correlative with innovation. Our current list of traits includes being *creative*,

*imaginative, curious, divergent in one's thinking, willing to risk failure, ambitious, competitive, skilled at speaking, insightful, self-reflective, and promotional.* I share this list with you so as to ask whether you think it is appropriate for the Department to be emphasizing these particular traits? When you graduates return from time to time, we note that you have taken on many of these characteristics and you seem to be thriving partly as a result. Current students, however, seem reluctant to view these traits as characteristics they should embrace. So we wonder if you would kindly drop us an e-mail or two (at brandenj@lawrence.edu) and reflect a bit on what, if anything, might have caused you to adopt these characteristics (while at Lawrence or since)? We would also value your suggestions on how, when, and whether we should promote these matters to students while they are still here at Lawrence. In the meantime, our best regards to you all, and thanks in advance for sharing with us some of your reactions.



*Emeritus Professor of Physics John Brandenberger with Fangzhou Qiu ('12)*