

# Collective Behavior

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

## LU physics notes:

- The Lawrence physics program is **10th** on a list of all U.S. 4-year colleges and universities for per capita **physics PhDs earned** by its graduates.
- Richard Feynman's ***The Character of Physical Law*** is on the 2012-13 Freshman Studies reading list. Professor **Doug Martin** will deliver the lecture on Feynman.
- **Nine** students participated in the Lawrence Summer Research and Innovation Program (eight physics majors and one biochemistry major) in 2012.

## Inside this issue:

Senior Experience	<b>2</b>
Spotlight On Atomic Physics	<b>2</b>
Faculty Update: Rob Salgado	<b>2</b>
Alumna Profile: Jennifer Herek	<b>3</b>
Alumnus Profile: Erlan Bliss	<b>3</b>
Emeritus Focal Point: David Cook	<b>4</b>

## Letter from the Chair

Greetings to alumni and friends of the Lawrence University physics program. This is the second annual departmental newsletter, the purpose of which is to keep you up-to-date on developments in the department. The faculty in physics are fortunate to have ongoing contact and interaction with many of our alumni and we seek to establish connections with more of you in coming years.

On behalf of the department and the university more broadly, thank you for the many forms of support

you continue to offer to Lawrence. In addition to gifts you might give annually to The Lawrence Fund, consider directing a gift to the **J. Bruce Brackenridge Memorial Scholarship**. The Brackenridge Scholarship helps support a promising physics student and honors a late and much beloved former member of the department.

The department also honors Bruce's memory with two prizes (see below), one to the outstanding junior physics major of the year and another named for the Loyal



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

Society of S.I.N. (Sir Isaac Newton), a local society that Bruce founded based on his Newtonian scholarship.

## Departmental News: Student Awards

Departmental prizes were awarded at the Senior Tea in May 2012:

**Brackenridge Prize (Outstanding Jr. Physics Major): Karl Mayer ('13).** Karl did research with Professor **John Brandenberger** during the summer of 2011 and was at the University of Twente (The Netherlands) doing research this past summer.

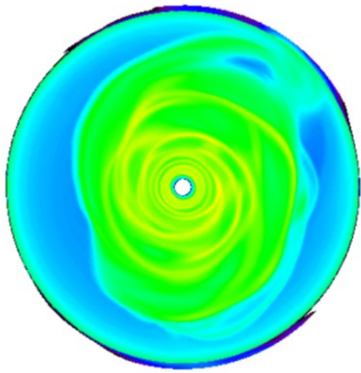
**Department Service Award: Melissa Klocke ('12).** Melissa organized student participation in departmental events including the Lawrence Physics Workshop and Bjorklunden retreats among many others. She did research with Professor **Doug Martin** on biophysics.

**Research Award: Brain Van Hoozen ('12).** Brian conducted two summers of research, one with Professor **Doug Martin** in biophysics and one at the University of Twente (The Netherlands). He completed an honors paper on his Twente research pro-

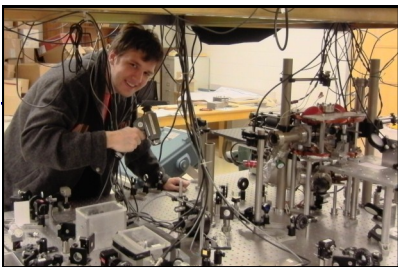


**2012 physics graduates with department faculty and staff.**

ject and is now a graduate student at Cornell University. **S.I.N. Prize** for outstanding problem solution in intermediate mechanics: **Michael Van de Graaff ('14)** and **Cooper Sinai-Yunker ('14).**



Simulation of a protoplanetary disk (gas cloud around a new star) showing spiral arm formation. The high density arms (yellow is high density, blue is low) are potential locations for planet formation. The star is at the center of this top-down view of the disk; the overall disk is about 30 AU wide.



A portion of the optical layout for the magneto-optical and dipole trap used in Pasad Kulatunga's laboratory to study coherent backscattering. Michael Van de Graaff ('14), shown, and Will Jakes ('14) helped assemble the experiment during the summer of 2012.



Rob Salgado joined the LU physics department in September 2012.

## Senior Experience in Physics

In 2012, for the first time, all graduating Lawrence seniors completed a capstone project - a Senior Experience. What kind of experience do physics students receive? The rewards, frustration, and excitement of an individual research undertaking in experimental, theoretical, or computational physics. Each graduating senior, with mentoring from a physics department faculty mem-

ber, completed a project driven by the student's own interest.

So what kinds of things did our seniors tackle? Some primary research in biomedical imaging, cold atomic force microscopy, super-resolution (better than diffraction limit) microscopy, computational astrophysics, and non-neutral plasma physics; some education-driven work in experi-

mental quantum mechanics and laboratory plasma physics; and some student-driven interests in electronic neurons and soccer-ball technology. In addition to presenting results in departmental seminars, three students presented their results at national meetings, and one senior experience paper has been submitted to a peer-reviewed journal.

## Spotlight On Atomic Physics

Atomic, molecular and optical physics has undergone a rebirth in the past two decades. Cooling and trapping atoms using light and magnetic fields permits AMO practitioners to probe the interaction of light and matter with remarkable precision. Experiments of this sort have won Nobel prizes, including this year's prize won by David Wineland and Serge Haroche.

Lawrence supports work in AMO physics. **Professor Brandenberger** investigates the interaction of light with ultracold and warm Rb atoms. And **Visiting Professor Kulatunga** laser cools atoms in a magneto-optical trap and subse-

quently traps some of those atoms in a purely optical dipole trap. Students, **Michael Van de Graaff** and **Will Jakes**, are using this special trap to study quantum multiple light scattering by a high-density collection of trapped atoms. They will present their work at the Mid-states undergraduate research symposium in St. Louis in November.

Brandenberger, along with ten students in as many years have used multiple laser excitation to examine excited states of various atoms. In the case of Rb, they measured fine structure splittings in  $n^2F_J$  states using spectroscopic techniques. However, as Brandenberger puts it, "we once made the

'mistake' of reducing the intensity of one of the lasers, much to our surprise, the absorption reversed sign. This sign reversal became even more noticeable the more we *reduced* the power." Unraveling this behavior has been hard to come to grips with because it involves signal amplitudes, signs, and widths rather than simply frequencies. Recent students, **Karl Mayer** and **Cooper Sinai-Yunker**, have both presented posters at national meetings. Recent results suggest that the group is making some headway now that it is guided by a density matrix formulation of quantum mechanics.

## Update on Faculty Changes

This year we welcome **Rob Salgado** to the department as visiting assistant professor. He taught at Bowdoin College, Mt. Holyoke College, Dillard University (until Katrina chased him out of New Orleans), and Truman State University. Professor Salgado's Ph.D. is from Syracuse University and his thesis was on the causal

set approach to quantum gravity. He was an undergraduate at Cooper Union and SUNY-Stony Brook (B.S. math and physics) and also has a Masters degree from the University of Chicago. In recent years he has been working on reformulations of special and general relativity, including novel pedagogical

approaches to those subjects. He is teaching Principles of Mechanics and Computational Physics during the fall term. Rob's wife, Taviare Hawkins, is a biological physicist and is on the faculty at the University of Wisconsin—La Crosse.

## Alumna Profile: Jennifer Herek ('90)

Although she was a chemistry major at Lawrence, **Jennifer Herek '90**, got her start in research by pursuing laser spectroscopic work in the physics department with John Brandenberger. Upon entering the physical chemistry graduate program at Caltech, Jennifer joined Professor Ahmed Zewail's research group where she helped develop ultrafast, time-resolved spectroscopic techniques to observe the dynamics of molecular bonds on a time scale much shorter than

the time required for a bond to vibrate. This approach let the Zewail group observe transition states in chemical reactions that exist for only a few femtoseconds. Hence Jennifer played a role in the work that ultimately yielded the Nobel Prize in Chemistry for Professor Zewail in 1999. This effort involved long hours and much hard work. Jennifer says of Zewail, "He often told us that we would look back on this time as the best days of our lives." At the time she wasn't

so sure. "But he was absolutely right," she acknowledges. Following Caltech, Jennifer took her work to Europe via the University of Lund in Sweden. While in Sweden, she attended the Nobel ceremonies that recognized her graduate mentor and the work of his group. Jennifer now chairs the Optical Sciences group at the University of Twente in The Netherlands. In addition to leading the optics group, Jennifer now serves as the Dean of ATLAS University College, the



*Jennifer Herek works at the University of Twente in the Netherlands..*

Academy of Technology and Liberal Arts & Sciences. While the liberal arts may be new to European technical universities, Jennifer is being asked to bring a bit of the Lawrence experience to Europe. In recent years her group has hosted a number of Lawrence research students.

## Alumnus Profile: Erlan Bliss ('63)

A research semester at Argonne National Laboratory helped prepare **Erlan Bliss ('63)** for his graduate work in Solid State Physics at Carnegie-Mellon University. After completing his Ph.D., Erlan began working with high powered lasers as a research physicist in the Air Force. In 1972, he joined the laser program at Lawrence Livermore National Laboratory (LLNL) where he has worked on many problems related to the construction and use of high powered pulsed lasers. Since 1995, he has worked on the National Ignition Facility (NIF), by far the largest laser system in the world with 192 beams, each 40 cm by 40 cm. It is now operational and can deliver 1.8 megajoule

pulses of focused ultraviolet light to targets designed for laser fusion and other high density and temperature physics experiments. During his time at LLNL, Erlan has been involved in fundamental physics experiments as well as project management. While Lawrence helped Erlan get started in physics, he also took advantage of the conservatory to advance his trombone performance. Erlan has regularly supported the department with gifts that have been used to enhance the research experiences of Lawrence physics majors. While no longer working full time, Erlan still participates in the NIF project and regularly plays his trombone in local ensembles.



*Erlan Bliss has spent much of his career at Lawrence Livermore*

## 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.

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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.*

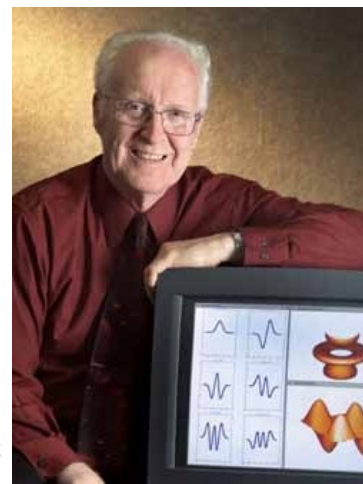
<http://www.lawrence.edu/dept/physics/>

## Emeritus Focal Point: David M. Cook

A large fraction of my time from shortly before retirement in June 2008 was spent in the presidential chain of the 11000-member American Association of Physics Teachers (AAPT). Starting as Vice-President in January 2008, I moved each year from VP to President-Elect to President to Past President, and left the 15-member AAPT Executive Board in January of 2012. Attending four Board meetings each year, serving on several AAPT committees, and representing AAPT to the American Physical Society and the American Institute of Physics involved traveling to six or seven meetings each year and also participating in numerous conference calls. Serving in this way is very time consuming but also extremely rewarding, and I am grateful for the opportunity I had to become well acquainted with numerous colleagues around the country and to have some impact on guiding the professional organization of physics teachers.

In the spring of 2012, after leaving the AAPT Board, I stepped for a term back into the classroom. Together, Professors Stoneking and Pickett in the laboratory and I in the lectures guided about 45 students, more than half from the Conservatory, through the Physics of Music course. During my four-year absence from the classroom, I had forgotten the joys of interacting with young minds in this way.

Finally, twice each year, my wife and I enjoy visiting our three grandchildren, two girls (ages 6 and 3) in St. John's, Newfoundland, and a boy (age 4) in the Boston area. Clearly, as both John Brandenberger's and my trajectories since June 2008 make clear, being retired is not in any way synonymous with being idle. Lawrence continues to provide offices for us, and each of us is on campus nearly all day every weekday. Please stop by to greet us all if you are ever anywhere near Appleton.



*Emeritus Professor of Physics  
David M. Cook*