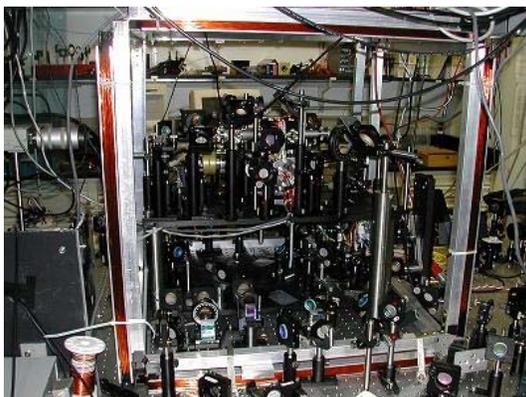


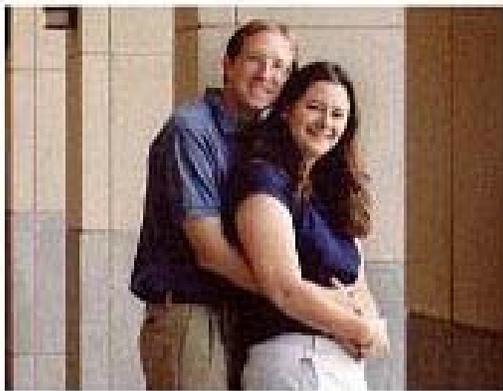


# the Photon online

April 2006– Issue 46



Dr. Luis Orozco wrote this month's Research Spotlight. The article highlights his work on Quantum Optics.



Alumni Dan and Beth Dakin share their experiences, at UMD, in the Alumni Spotlight section.

On Saturday, April 29, 2006 from 10a.m to 4 p.m., the University of Maryland will celebrate Maryland Day. The campus opens up its doors to alumni and their families, prospective students and parents, business and community leaders and the residents of the surrounding Baltimore-Washington metro area. To view other events in April, visit the Up Next section.

Students interested in volunteering for Maryland Day can register on the Physics website at:  
[http://www.physics.umd.edu/events/spevents/MD\\_Day/](http://www.physics.umd.edu/events/spevents/MD_Day/)

Dr. Sankar Das Sarma's work, on Topological Quantum Computation, is the cover story of April's 2006 Scientific American. Read about other faculty that have appeared in various media outlets in the News section.

Sameer Hemmady was the recipient of the GSNP Student Speaker award. Find out more about this honor in the News section.

Physics is Phun, Going in Circles with Physics, hosted by Richard Berg, was held on March 16-18 at the department lecture halls. To read more about the event or to view pictures, visit the Recent Events section.

Any Physics Faculty interested in judging events at the Physics Olympics, on April 22, 2006, please contact Richard Berg at 301.405.5994 or [reberg@physics.umd.edu](mailto:reberg@physics.umd.edu) .



DEPARTMENT OF  
**PHYSICS**  
UNIVERSITY OF MARYLAND



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## Quantum Optics at UMD

By: Dr. Luis A. Orozco

About one hundred years ago Einstein used the idea of the quantum of energy from Planck to explain the photoelectric effect. Shortly afterwards, Stark remarked that the same quantum carried momentum. Gilbert Lewis coined the word photon to express the quantum of light in 1926 and the developments of quantum mechanics that followed gave us quantum electrodynamics as one of the pillars of physics.

The discussion of the wave-particle duality, that has included many scientists such as Newton, Fresnel, Poisson and Maxwell, received a revival with the firm establishment of the photon as the quantum of light.

The argument of wave versus particle is resolved in quantum electrodynamics by a formalism that combines both of these aspects. The formalism is fundamentally statistical and, as with quantum phenomena in general, it is through statistical uncertainty, fluctuations, that the wave and particle natures of light sit self-consistently side-by-side. The solution carries other consequences that were not imagined before quantum mechanics; most notably, the answer depends on the detection process and the detection process affects the object we are trying to measure. An interference detector enhances the wave's nature of light, while a photon counter shows preferentially the particle's nature.

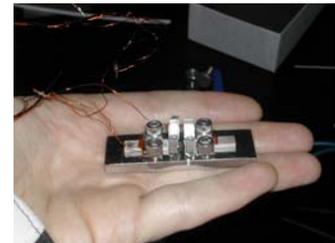


Experimental setup

Fluctuations and noise are intrinsic to light and their study has shown many fascinating aspects of the quantum world. The characterization of noise is usually made by making correlation measurements to find how random it is. When talking about photons, the minimum fluctuation in the number of photons is one. Counting the distribution of photons shows that some light carries fluctuations that are Poissonian in nature; the uncertainty is just the square root of the number of photons counted. The fractional noise or uncertainty can be very small if the number of photons is large, but for weak sources, such as a single atom, the fluctuations can be very large.

Quantum mechanics tells us that there will be fluctuations in the amplitude (wave) and fluctuations in the intensity (particle). It is interesting then to study correlations between pairs of photon detections (particle aspect of light), measure the fluctuation variance of the wave amplitude of light (squeezing) and correlate photon detection with the fluctuations of the electromagnetic wave amplitude. These conditional measurements are unique in the way they prepare a quantum system and even allow for quantum feedback.

Experiments in my Quantum Optics group address these issues using a cavity quantum electrodynamic (QED) system as source. It consists of two very highly reflecting mirrors facing each other and a few atoms. We drive the cavity with a laser beam and detect the light (wave and particle) emitted by the atoms or leaking out of the cavity to better understand the fluctuations and the quantum noise of light.



Cavity Quantum  
Electrodynamic systems

Dr. Orozco is a professor for the University of Maryland. He is a member of the Atomic, Molecular and Optical Physics group. Visit the group website at : <http://www.physics.umd.edu/rgroups/amo/orozco/index.html> or contact him at, [lorozco@physics.umd.edu](mailto:lorozco@physics.umd.edu).



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## Dan and Beth Dakin: Together at UMD and NIST

Dan Dakin received his bachelor's degree from the University of Delaware. Beth Rogers attended Georgetown University and graduated with a bachelor's degree in Mathematics and Physics. Eventually, they were both led to the University of Maryland where they obtained their Ph.D.s and began their relationship.

This past September, three months after defending their theses, Beth and Dan got married. Among those in attendance were their advisors, Tom Cohen and Raj Roy.

"We shared a TA office on the fourth floor during our first year at UMD," said Dan. "Our desks were next to each other. We took all the same classes and did our homework together."

For Dan, the Physics journey began as a child interested in Math. As a teenager, he'd spend time browsing through his father's chemical engineering textbooks. He was fascinated to see the world described with equations. As the popularity of "Star Trek" began to increase, so did Dan's curiosity in Physics.

"Star Trek" hit me and I began to wonder about the strange things they talked about," said Dan. "My mind and imagination has been running ever since."

While studying at Delaware, it was already in Dan's plans to attend grad school. After comparing the top 20 schools, and applying to those with nice weather, he decided on Maryland because of their wide variety of research opportunities as well as its close proximity to his home.

Beth's journey began in high school, where she excelled in mathematics and physics was a fun way to be able to use the math that she learned. In addition, she had a fascination with building things and tinkering in the lab. She came to Maryland to earn a graduate's degree and chose Physics, because the department was welcoming and friendly.

"I find it very exciting to be able to use small, understandable laboratory experiments to understand something as complex as the actual world that we live in," said Beth.

They both enjoyed their experiences at Maryland. With the added stress of dealing with graduate school, it helped that they had each other for support.

While they spent, almost, everyday of their first year together they found ways to keep the relationship separate.

"There was study time and fun time," said Dan. "Keeping them well-defined made our personal time together much more special."

The following years were spent focusing on different projects at different locations.

"I learned a lot from my courses and did a lot of exciting research," said Dan. "I enjoyed the Physics department (tea at 3:30 p.m.), the campus and College Park. I started to enjoy college sports: ACC football champs and NCAA basketball champs my first year there."

After graduation, their major problem was searching for jobs in the same area. They considered all possible options and were flexible about the area of Physics in which they looked for positions. Their resumes were sent to universities within high-density areas, including Boston and North Carolina.

In the end, they each got offers at three places. However, they both decided on the National Institute of Standards and Technology.

"Working at two different places was an option, but we knew that would not be ideal since someone would suffer a nasty commute," said Beth. "Besides, we really enjoy being together and having a job at the same place allows us to share a commute and time during the day."

Beth is a National Research Council Postdoctoral Fellow. She is currently working on experiments in nanometrology. Dan is a Postdoctoral Researcher studying atomic physics with the grand goal of building a quantum computer.

"There is an initial uncomfortable period that almost all post-docs go through when they start to do research on their own, without the guiding hand of an advisor," they've both said. "But we stayed focused and feel comfortable and happy. The government is a good place for couples. There are a lot of organizations that pursue a diverse selection of science."

*If you are interested in contacting Dan or Beth Dakin, please send your messages to the Editor, who will be happy to forward your questions and comments.*

## NEWS



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### Congratulations

Sameer Hemmady, a Ph.D. student in electrical and computer engineering, was the recipient of the Topical Group on Statistical and Nonlinear Physics (GSPN) Student Speaker award. The award was presented to Hemmady at the 2006 American Physical Society's March Meeting in Baltimore, MD.



There were 12 nominations and five finalists. The finalists spoke in a special morning session at the meeting. Hemmady was chosen as the best student speaker. His talk was entitled, "Universal Impedance, Admittance and Scattering Fluctuations in Quantum-Chaotic Systems."



Lauranne Lanz was the recipient of the Barry M. Goldwater Scholar. Up to 300 scholarships are awarded nationwide for the junior and/or senior year of undergraduates in mathematics, natural sciences or engineering.

This is a very prestigious award in honor of her stellar record and research in physics and astronomy.

### In the News

Dr. Sankar Das Sarma's work was the main subject of April's 2006 Scientific America. The cover story highlighted Topological Quantum Computation in the article entitled, "Computing with Quantum Knots." To read an excerpt visit:  
<http://www.sciamedigital.com/index.cfm?fa=Products.ViewIssuePreview&ARTIC>

Drs. James F. Drake and Mikhail Sitnov appeared in a news article on ABC News 7's website. The University of Maryland researchers were awarded nearly \$1 million for research on radiation from the sun and its affect on astronauts traveling to Mars. Dr. Drake also appeared in a news segment by Channel 13 News regarding the same grant. To view the article, visit: <http://www.wjla.com/news/stories/0206/306350.html>

The following excerpt is a quote from the Asbury Park Press, regarding Dr. James Gates:

"The symposium in Taiwan was the most exciting event I have ever participated in," he said. "From meeting famous physicists to discussing, even arguing, about physics subjects with students from all over the world, it will forever influence my love of physics."

Sauer took the chance to meet renowned physicist James Gates of the University of Maryland, who, until the symposium, he had only seen on television or read about on the news. Gates is to an aspiring physicist what Tiger Woods is to an aspiring golfer. To view the entire article, visit: <http://www.app.com/apps/pbcs.dll/article?AID=/20060202/REPORTER03/60202>

The Fusion Energy Science Program was highlighted in an article that appeared in the Diamond Back. The article included quotes by Drs. Adil Hassam and Richard Ellis, as well as graduate student Andrew York. To view the article, visit: <http://www.diamondbackonline.com/vnews/display.v/ART/2006/02/17/43f5b6>

## RECENT EVENTS



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## Physics is Phun



On March 16-18, Dr. Richard Berg hosted a Physics is Phun event in the lecture halls of the Physics Building. The event is free to the public and offers physics presentations at high school level through the use of demonstrations, aimed to educate, inform and entertain.



For more information regarding Physics is Phun, visit:  
<http://www.physics.umd.edu/deptinfo/facilities/lecdem/outreach/phph/phph.htm>

## GRADUATE BLOG



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There were no graduate blogs to post this month. If you, or someone you know, is interested in contributing a blog, please contact Carole Cuaresma at [ccuaresm@physics.umd.edu](mailto:ccuaresm@physics.umd.edu).

UP NEXT



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April 1- Graduate Open House

April 4- Colloquium  
Physics of the Top Quark  
Evelyn Thomson , University of Pennsylvania

April 11- Colloquium  
Thermal Fluctuations in Nonequilibrium Thermodynamics  
Jan Sengers, University of Maryland

April 18- Colloquium  
Rhythms of the Nervous Systems: From Biophysics to Cognition  
Nancy Kopell, Boston University

April 25- Colloquium  
Exploring the Final Frontier of the Solar System  
Ed Stone, California Institute of Technology, JPL

April 29- Maryland Day  
10:00 a.m.- 4:00 p.m. University of Maryland, College Park

May 11- Last day of classes

May 13-19- Final Exams

May 21- UMD Commencement Ceremony  
7:00 p.m., Comcast Center

## LETTER FROM THE CHAIR



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Dear Colleagues,

I'd like to take this opportunity to remind everyone about one of our department's most exciting events: Maryland Day, where the campus will host alumni, prospective students and residents of the surrounding Baltimore-Washington metro area to enjoy Physics demonstrations, lab tours and interactive activities. I'm excited to spend the day with students, faculty, staff and alumni, who are attending or even volunteering for the day's festivities.

Stop by the Physics building where we will provide exciting hands-on demonstrations for kids of all ages. On the Physics' front lawn, we will provide demos for tots, where toddlers can come participate in interactive demonstrations sure to spark the interest of, possible, future physicists. For older kids, we're offering liquid nitrogen ice cream, a homemade Physics' specialty, as well as physics make & take demos and fun with illusions.

There will also be several lab tours and Dr. Richard Berg will host, his popular, Physics is Phun demonstrations. Also, I will be giving a talk entitled, "What We Thought We Knew, What We Know Now, What We Know Now We Don't Know: 150 Years of Physics," where I'll talk about the mysteries explained in Physics history.

This is our annual event that gives us the opportunity to reconnect with our alumni and their families. Come and show them, why our alma mater is so great!

We are all really excited about this year's events and I hope to see all of you out there enjoying in the day's festivities. If you're interested in volunteering, visit [http://www.physics.umd.edu/events/spevents/MD\\_Day/](http://www.physics.umd.edu/events/spevents/MD_Day/) to register. It's a great way to meet and spend time with our outstanding department!

Regards,

Jordan Goodman  
Professor and Chair



## EDITOR'S NOTE



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Dear Readers,

I tend to take recreational activities for granted. Riding my bicycle, watching television and riding roller coasters, but I've pretty much categorized them as mindless...until now. Leave it to our professors and alumni to give me different views on these popular pastimes.

Early in March, Dr. Richard Berg held his regular Physics is Phun event, in which he demonstrated physics using wheels, spinning table tops, swivel chairs and tire swings. In this issue's Recent Events section, we've included information and photographs of this entertaining weekend.



Dan and Beth Dakin were the subjects of this month's Alumni Spotlight, in which they explain why they chose a field in Physics. Beth gives credit to her joy of building things, while Dan became a physicist due to his interest in *Star Trek*, the popular sci-fi television show.

I guess no activity should be written off as mindless. For it's those activities that end up being used as demonstrations to explain physics or that eventually lead us into figuring out future careers. I'll be sure to remember that the next time I'm upside down, screaming, on a roller coaster!

Best,  
Carole

## CONTACT US



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The Photon Online is the official University of Maryland-Physics online newsletter. We release an issue monthly to highlight researches, alumni, awards, honors and events. The views and opinions of our readers are valued; please contact us with any questions, ideas or comments.

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