The Dilated Times

The newsletter of the Drew University Society of Physics Students

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Editors: Arlene Ovalle and Adam Friedman

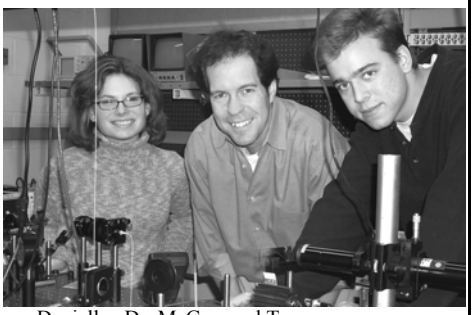
Light and Magic in the Drew Laser Photonics Lab

We had another exciting and productive summer in the Physics Department's Laser Photonics Laboratory. This was the first summer of a 3-year National Science Foundation grant to study the electro-optic properties of blended polymer films, and we started off in late spring with a rather extensive lab renovation. Overhead equipment racks and utilities were installed as well as a laminar flow clean-bench for the fabrication of defect-free polymer films. Following the renovation, we hired two student research assistants for the summer: Danielle Bousquet, a chemistry major, and Tom Zielinski, a physics major. Danielle and Tom did an outstanding job in fabricating and characterizing some novel electro-optic materials in the rather short 10 week period available for summer research.

Given the potential applications of electro-optic polymer films in optical communications systems, we have developed a close collaboration with the Materials Research department at nearby Bell Labs. One goal of the collaboration is to develop polymer blends that can be formed into optical waveguides. An optical waveguide constructed of an electro-optic polymer can be used to control the speed of light through the application of a voltage across the guide. Such devices are known as optical modulators, and are a key component in fiber-optic data transmission systems. Conventional optical modulators for Internet-based communications are based on electro-optic crystals, which can provide up to approximately 40 Gbit/s transmission. While this is certainly quite fast, advanced graphics and realistic video transmission may require the potentially ultrafast transmission afforded by organic materials.

Danielle spent most of her summer at Bell Labs, working with a team of engineers to synthesize strongly polar dye molecules which can blend easily into a polymer host, and which would exhibit large changes in their refractive index when subjected to a voltage. Constructing a highly polar molecule that can "slip" into a polymer matrix, remain transparent to infrared laser radiation, and resist crystallization is by no means trivial. Preliminary results from Danielle's synthetic work are very promising, however, and the Materials Research group at Bell Labs is anxious to continue its relationship with Drew chemistry students.

Tom Zielinski developed the optical characterization experiments to study



Danielle, Dr. McGee, and Tom

(Continued on page 3)

S and Grill Open For Business

Katy Rolfe makes good use of the S and grill

This semester, Drew Physics students were greeted with a great surprise– the S and grill. Over the summer, the small room across from the Advanced Physics Lab was cleared out, painted and made into a study room/lounge for physics majors.

The S is equipped with a desk and a computer connected to the internet, printer, and a very comfy chair. There is also a table with chairs (great for cranking out Math Physics Problems), a blackboard, a couch, magazine rack (*Physics Today* and *Popular Science* of course), a really pretty carpet, and a tv/vcr. We don't exactly have a working grill, sorry no hamburgers in between classes; but we do have a refrigerator (usually stocked with soda), a microwave oven, a coffee-maker and tea kettle. The cabinets are stocked with plenty of coffee and tea for those mid A-lab breaks. And every now and then Dr. Boeshaar leaves us a treat. We are real fans of caffeine and candy.

At the beginning of the semester, each physics major was handed a key to the S and grill. A quiet, comfortable place to study is now available at any time for us.

The S and grill is a great place for physics majors and SPS members to do homework, take a break between classes, and is a meeting place for study groups and the SPS Officers. We are really lucky to have it.

-Arlene Ovalle '04

Check out the Physics Department Web Page at

http://www.depts.drew.edu/phys/

Really Big Magnets Equal Fun

Adam in the 3-Tesla magnet lab at the CNMRR

This last summer, I spent my time working at the Center For Nuclear Magnetic Resonance Research (CNMRR) at Penn State Medical School in Hershey Pennsylvania under the direction of Michael B. Smith ,Ph.D., Qing X. Yang, Ph. D., and Jianli Wang, Ph.D., M.D. The lab was dedicated to furthering the science of Nuclear Magnetic Resonance Imaging and Spectroscopy through developing new methods and materials and doing research to apply existing methods to medicine and biochemistry. The lab facility itself was located in a small compound behind the medical school and was totally self sufficient. By this I mean they had a computer lab, chemistry lab, engineering lab, laser lab, biology lab and animal housing facility, electronics lab, three magnet rooms containing 1.4 Tesla, 3.0 Tesla, and 9.4 Tesla magnets, and staff qualified to work in all of these areas. Not to mention they also had a complete kitchen and bathroom with shower. The scientists working there literally did not ever have to leave their work–and I am quite sure that some of them were so dedicated to nuclear magnetic resonance that they really didn't leave.

I spent my summer working in many areas of the lab, and my work included doing electronics on the magnets, proofreading scientific papers, collecting research documents, helping to design coils, and working to match the magnetic susceptibility of brain tissue with various laboratory chemicals. But, I spent the majority of my summer on a main project. This was an ongoing study of the olfactory gland in the brain. The basic idea is that when the olfactory gland is activated, blood rushes to it and blood contains an amount of iron. This iron can then cause current flow in a wire coil placed over a person's head that is inside of the 3 Tesla magnet. Radio waves are sent to the coil tuned to resonate with a certain atom in the brain (usually Carbon-13 or Hydrogen-1). In this way, the place in the brain that is activated can be determined, and the information can be recorded in three dimensions (called voxels), and sent to a computer. The degeneration of the function of the olfactory gland is often sited as a portend to Alzheimer's Disease. So, I saw volunteer healthy patients of varying ages a few days a week to measure the function of their olfactory glands and compare them to those of Alzheimer's patients. The subjects were placed in the magnet and brain scans were taken while they smelled certain substances. Then I took the information gained with the magnet and processed it with a program that interfaces with MATlab called Statistical Parametric Mapping (SPM). This program basically runs a series of statistical analysis steps that in the end yields a three dimensional picture of a person's brain along with where it was activated, graphs of the signal strengths, and other information that can be used in analysis. To totally process one patient from start to finish took about 6 six hours.

I enjoyed myself very much last summer working in this lab, although I am quite sure I do not want to pursue a career in nuclear magnetic resonance imaging. I really learned quite a bit about NMR, along with how a research facility runs its daily operations. Overall, it was definitely a good experience.

-Adam Friedman '04

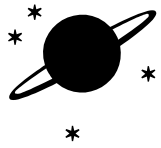
Karen's Governor's School Experience: More than "Smart Camp"

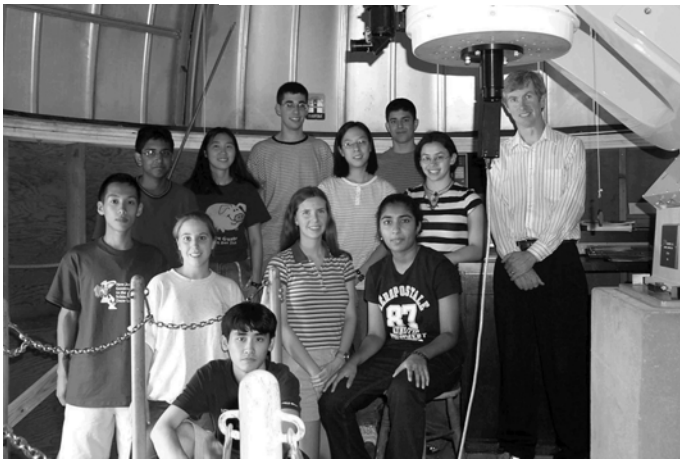
This summer, from July 19 to August 18, I worked as a counselor at the New Jersey Governor's School in the Sciences. NJGSS is a group of 90 high school seniors who come to Drew to take some classes, go on trips, listen to speakers, and participate in a team research project. As a counselor, I helped run a team project, assisted in a class, and checked in a group of girls at night.

My team project involved working at the observatory with 10 kids and Dr. Keith Andrew, from Eastern Illinois University. It was a lot of fun helping the kids use the telescope and camera, and helping them analyze their results. I assisted in Dr. Fenstermacher's Modern Physics class, which involved going to class, helping the kids with homework, and grading homework. We also had movies, parties, dances, and athletic events. It was way better than my preconceived notion of "smart camp."

All of the kids, counselors, and professors I worked with during the Governor's School made the experience a fantastic one. I keep in contact with many of the kids and all of the counselors, and hope to be able to come back as a counselor another summer.

-Karen Mooney '04





Karen Mooney surrounded by her kids and Dr. Keith Andrew

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Laser Magic

the materials fabricated by Danielle and her collaborators from Bell Labs. Tom spent most of the summer in the Physics Department Photonics lab, building an experiment that would illuminate a polymer film with an infrared laser beam and then electronically detect the miniscule variations imposed on the beam by the electro-optic film. The experiment was particularly challenging because the invisible infrared laser beam had to hit a 25 mm^2 spot on the film, and then be directed onto a photodetector. Tom also automated the whole experiment, using LabVIEW to computer control the detection electronics and data acquisition.

Tom also helped out with some photonics equipment acquired as part of a recent state grant to Drew. A fiber-optics lab kit was purchased to add experiments in waveguide physics to the Advanced Lab course, and Tom performed some feasibility studies to see which experiments could be adapted within the Advanced Lab framework. He learned how to cut and cleave optical fibers, as well as couple laser light into the fiber and measure its transmission characteristics. The experiments are now being performed for the first time in Advanced Lab by Brett Becker and Arlene Ovalle, who have the challenge of extending the basic coupling experiments into building an actual communications link.

What's next for the Photonics Lab? The first batch of optical modulator chips using electro-optic polymer waveguides should be ready for stability testing this winter. The big challenge here is to see whether the dye/polymer blend can withstand continued optical irradiation without damage. Part of this testing will be done at Drew by monitoring the degradation of a bit-stream signal from the modulator under continuous operation. We will also continue to screen novel polymer materials for potential use in modulator applications. As before, we are always looking for motivated physics (and chemistry) students to participate in this program. During the semester, there are opportunities for Independent Study and Honors research. In the summer, sophomores can participate through the Drew Summer Science Institute while juniors and seniors can apply for NSF-RUI funding. Both summer programs provide students with a salary and housing, and perhaps most important, the opportunity to actually do science. Along the way, you may also find yourself working in a team with some world-class industrial scientists, just like Danielle and Tom did this past summer. Ask them about it!

-Dr. David McGee

Physics Quotations:

"David J. Griffiths is God."
—Adam, Optics Class

"The Scientific Method is Utter Bullshi*t."
—Dr. Supplee, Optics Class

"Imagine the destructive power of an absolute zero temperature gun…"
—Chris Vare, Thermodynamics Class

Telescope Operation "Warms" Up

During the summer of 2002 the physics department gained some much needed space for a telescope control room, or "warm room", on the third floor of the Hall of Science. Our astronomers now enjoy an office-sized room conveniently located opposite the stairwell leading to the rooftop observatory. The room serves to house the telescope control computer, related telescope accessories, astronomical reference materials, and a computer for data analysis. Students have an additional workspace for astronomy related independent study projects, and, with some modest additions to our computer hardware, a place for remote control of the telescope. The space was freed up when the department of economics moved out of the third floor to Lewis House, and in a game of musical offices, physics was fortunate to gain a former RISE office for the telescope use. The telescope control cables had to be pulled from the second floor room next to Dr. Boeshaar's office back through existing conduits into the dome, and then placed in new conduits to the third floor room. With some surprise, the telescope came back on with no problems and in time for operation with the 2002 Governor's School in the Sciences.

To improve our work with telescope imaging, a new $9K Santa Barbara ST-1001E CCD camera was acquired last summer as part of a NJ State Technology grant to Drew. With a CCD array of 1024 x 1024 pixels and 24 micron size, the Kodak chip in the camera has the highest quantum efficiency of any Kodak detector. The imaging area of this CCD array (24.5 x 24.5 mm) is nearly as large as a 35 mm film frame, and will afford a field of view on the order of a half a degree (the size of the moon). The camera runs at 40 degrees C below zero with thermoelectric cooling in order to achieve the low noise required for the acquisition of very dim images. Control of the camera is accomplished through windows based software which can be running along with the telescope control software. This makes overall computer control considerably more convenient. Images are stored on the local area network for analysis later.

For full use of the new camera, a filter wheel and mounting flange was specially designed by and purchased from the telescope manufacturer, DFM Engineering. With five software selectable photometric Bessell filters including the standard UBV filters, images can be acquired in the usual astronomical wavelength bands. The unique mounting flange allows both an eyepiece and the camera to be mounted on the telescope at the same time. A precision machined sliding plate allows either to be placed with ease at the telescope's focus.

The camera received its first light this summer with the Governor's School in the Sciences and will be used in the coming spring semester for independent study work with physics students.

-Dr. Bob Fenstermacher

SPS Field Trip to Worcester Polytechnic Institute

Four students and Dr. Fenstermacher went to the Society of Physics Students 2002 Fall Zone 1 Meeting. We left bright and early (well it wasn't really bright yet…) for Massachusetts and got there just in time for the lecture on quantum computing by Dr. Steven Girvin from Yale University. He discussed the possibility of input being both a zero and a one at the same time in order to make a quantum computer. At lunch we had the opportunity to talk to SPS students from other colleges. After lunch we learned from Germano Iannacchionne, from WPI, that physics is like an apple, which is not segmented, as opposed to being like an onion, which has separate layers. He also talked about order-disorder phenomena. We then got to tour the lab facilities at WPI and talked to several graduate students about their work.

Then we experienced the real high point of the day. Bill Berner, from the University of Pennsylvania, is lucky enough to have the job of making really neat demonstrations of first year physics principles. The best one, in our opinion, was the resonant wineglass demonstration. Berner found the resonant frequency of the wineglass by placing a ping-pong ball in it and adjusting the frequency of the sound that was focused on it. He then removed the ping-pong ball and enclosed the apparatus in order to protect our ears. He increased the volume, and eventually the glass broke. He made the oscillation of the glass visible by shining a strobe light on it. Finally we enjoyed a nice dinner out and trekked back to New Jersey.

-Katy Rolfe, '05

Female Physicists at Drew University

Physics Graduates 1990 -2001 and Declared Majors

Year	*Males*	*Females*
1990	2	0
1991	4	0
1992	2	2
1993	1	0
1994	1	2
1995	1	0
1996	3	2
1997	2	3
1998	1	1
1999	1	2
2000	3	0
2001	3	2
2002	1	0
Total	25	14
2003	4	0
2004	2	3
2005	0	3

Upon entering the door of the second floor of the Hall of Sciences one is greeted with the faces of the Physics Department. So far this year, before the rush when people are forced to declare their majors, we have a total of twelve physics majors. Of these twelve, six are female and we are sure that at least one or two more women will definitely declare (this is a hint ladies).

The American Institute of Physics cited Drew University as one of twenty colleges (excluding all women colleges) where women accounted for forty percent or more of the department graduates during the five academic years from 1994 to 1998. This is far above the national five year average of seventeen percent. The figures for an even longer period, the last decade, prove that this distinction was not something that occurred only within those five years. Since 1990, Drew has produced thirty-nine physics majors; fourteen of these have been women.

The table at the left shows the breakdown of males versus females every year since 1990. As indicated by the table, there have been several years where Drew has not produced a single female physics graduate; but considering that the overall number of graduates is small this is clearly a quantum fluctuation. Drew continues to produce fine physicists, and in the next few years a considerable percentage will be women. Something to be proud of!

-Arlene Ovalle '04

Welcome Dr. Wing!

Physics 1 and 3 students got a surprise in September when they found that the newest member of the physics faculty was teaching their classes. Dr. Thomas Wing will be at Drew for the fall semester covering for Dr. Supplee who is on sabbatical. He is also teaching the laboratory sections of those classes.

Dr. Wing spent 32 years at Bell Labs before teaching introductory physics at CCM (County College of Morris) last fall, and now at Drew. At Bell Dr. Wing initially worked in acoustic transmission in the deep ocean. Some of his later work at Bell in the wireless area resulted in three patents in Dr. Wing's name. His focus area was software based operational fault detection in wireless networks.

Dr. Wing earned his undergraduate degree at Princeton and went on to earn his Ph.D. from Columbia. He believes that Drew provides as good of an undergraduate preparation for Ph.D. programs as any other University, largely due to the emphasis on personal attention and teaching. The mission of the physics faculty here is clearly to teach, he says.

Dr. Wing also says that he is impressed with the physics department at Drew and noted that his students are especially eager to learn, and direct themselves towards their work.

Hopefully when Dr. Supplee returns this spring it won't be the last time we see Dr. Wing. The students and department have enjoyed his time here.

-Brett Becker, '03

Physics Quotations:

"I have a friend that tried to measure the difference between omega naught and omega resonance, and well, he shot somebody and went to jail, and I think he is still in jail."
—Dr. Supplee, Optics Class

"Wait! Stop! Can you just slow down a minute!"
—Colin, Thermodynamics Class

Paradox

The word *paradox* derives from the Greek para (beyond) and doxa (belief). In common usage it refers to something that is contrary to general opinion or common sense. Webster offers a slightly narrower definition: an argument that yields apparently self-contradictory conclusions by valid deduction from apparently acceptable premises. Note the double use of the word "apparently."

An example is Bertrand Russell's famous barber paradox: "In a certain village there is a barber that shaves all and only those men in the village that do not shave themselves. Does the barber shave himself?" (The resolution is that there is no such barber.)

Last May I had the pleasure of taking a three-day course entitled "Paradox," given in New York City by philosopher Ralph Davis and physicist Hans Christian von Baeyer. The 25 students were all faculty members of U.S. colleges and universities. I learned that there are literally hundreds of paradoxes named after individuals. The bibliography for the course ran to 21 pages! Only a few were discussed in detail. Professor Davis is especially fond of visual paradoxes such as the paintings of Hogarth or the incredible drawings of M. C. Escher. Professor von Baeyer's favorites, and mine also, spring from mathematics and physics.

Remember Zeno's paradox? (Actually 40 paradoxes are attributed to him.) Before you go from A to B, you have to reach the midpoint C; of the remaining distance, you have to reach its midpoint D, and so on ad infinitum. So there is an infinite number of finite segments each requiring a finite time to transverse it, showing that you can never reach B in a finite amount of time. The flaw in Zeno's argument is the assumption that the sum of an infinite number of finite intervals of space or time must itself be infinite. The seeming contradiction is the root of calculus and its notion of a limit. The inset is a beautifully simple proof that the series converges.

Let S = 1/2 + 1/4 + 1/8 ….
Then S/2 = 1/4 + 1/8 + ….
Subtracting, S/2 = 1/2,
so S = 1.

Professor von Baeyer discussed Olber's paradox in astronomy, the twin paradox in special relativity, and the Gibbs paradox of thermodynamics. He considers quantum mechanics to be fundamentally paradoxical: The laws that govern atomic systems don't apply to the classical realm of the measurement apparatus, which is itself made up of atoms.

Each student in the course had to present his or her own favorite paradox. Mine arises in statistical physics. The behavior of molecules in a gas at ordinary temperatures is described by Newton's laws of motion, which are time invariant. That is, the equations are the same whether time goes forward or backward. But the second law of thermodynamics specifies the forward direction of the flow of time. How does the irreversibility of the world emerge from its reversible building blocks? Boltzmann suggested that two factors are crucial: The assembly of molecules must be very large and there must exist ordered initial conditions.

Take a motion picture of billiard balls moving randomly on a pool table. Run the movie backwards; the picture looks no different. But start with the balls in the rack. Break up the arrangement with the cue ball. People would laugh at a movie run backward in that case. The motion is irreversible; the world always progresses towards a state of greater disorder.

I like the analogy. However, a rigorous mathematical proof of the second law has not yet been achieved, despite the efforts of a legion of theoreticians, including Einstein.

I learned from the course that many paradoxes are just fallacies or illusions. Once you spot the error, everything is okay. But the paradox of irreversibility bothers me a lot. I hope that it bothers you a little bit, too.

-Dr. Ashley Carter

Physics Quotations:

"Oh No! Why do I have Two Boases?!!?!"
—Arlene, Math Phys Study Group

SEND US YOUR FAVORITE PHYSICS QUOTES!!
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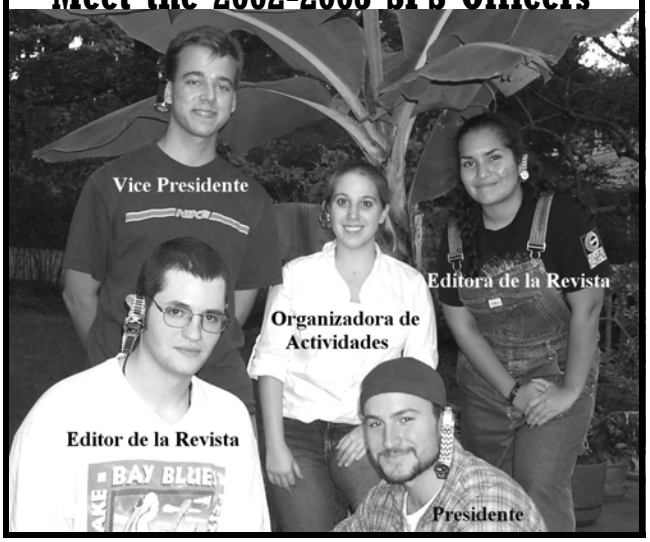
Meet the 2002-2003 SPS Officers



From left to right: Adam, Tom, Karen, Brett and Arlene

Upcoming SPS Events

Friday, November 8

Science Day
The Physics department welcomes prospective physics students to a physics open house on the second floor of the Hall of Sciences

For more information, see http://www.depts.drew.edu/claadmis/openhouses/science.html

Tuesday, November 12

Dr. Jim McKenna
of R.I.S.E.
"Fiber Optic Fundamentals"
S-244, 12 p.m.
Pizza will be served

Tuesday, December 10

Holiday Taco Party
Dr. F's House
Time T.B.A.

Attention Alums!

Many thanks to those of you who have assisted us with our business card requests. Your contributions help to inform present and prospective students of the sweeping occupational range of Drew physics graduates. We are still asking those of you who haven't responded yet to send us your business card. Just write your year of graduation on the back and mail it to Bob Fenstermacher here in the department. (You don't have to write a miss you letter, - just do it!) We will then add yours to our display of cards for all to see in the hallway. By allowing current students to see what you are doing, you will be both promoting our cause and creating possibilities for informational contacts with these students. If you don't have a card because you ran out of them, can't find them, you are still a student, etc… MAKE ONE! The column to the right lists all of those that have so far contributed.

- The 2002-2003 SPS Officers

Steve Apotheker
Lawrence P. Barisciano, Jr.
Mike Berry
Wayne R. Chase
Robert M. Eichhorn
Robert L. Fenstermacher
Steven Gausepohl
Helen K. Geib
J. Storrs Hall
Michael B. Headley
Rassmidara Hoonsawat
Heather Hughes
Michael L. Kelly
Christopher A. Kendziora
Harry M. Kriz
Amy Perkins
Christopher C. Perry
Bill Pezzuti
Michael Richichi
Brad Schoening
Hugh C. Staley
Nimel Theodore

Thanks Again!

The Dilated Times

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Address Correction Requested

Inside… Women in Physics, Lasers, Really Big Magnets, A Pair of Ducks, and more!!
Contributors: Dr. Bob Fenstermacher, Dr. Ashley Carter, Arlene Ovalle, Brett Becker, Karen Mooney, Adam Friedman, Dr. David McGee, and Katy Rolfe