The Dilated Times

The newsletter of the Drew University Society of Physics Students

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Science Expansion at Drew?

For more than a year now, the Hall of Science Renovation and Expansion Program (HaSREP) Committee has been meeting, with the goal of making plans for improving the science facilities at Drew. The committee includes representatives from the traditional occupants of the current building as well as psychology and physical anthropology. The Hall of Science opened in 1968 at a time when new science facilities were popping up on campuses all across the country. Now, thirty years later, most are tired, full, and not particularly well suited for the demands of teaching science well into the next century. New connections across disciplinary boundaries require new adjacencies among the departments and new laboratory facilities. Neuroscience, formerly psycho-biology, molecular biology/biochemistry, and lab components in anthropology are cases in point at Drew. It is therefore not surprising to see science facility projects now occurring at many competitive schools. Since the opening of the Hall of Science, RISE has been added to our program, computer science is part of the curriculum, the observatory is in place, and every department has more faculty, putting a strain on office and laboratory resources. In fact, the building is so full that even well meaning and needed equipment donations have been rejected for lack of space to put them. And finally, as undergraduate and faculty research become more the norm at strong liberal arts colleges, space must be available for student/faculty research labs.

The committee hired an architectural firm for this academic year to work with HaSREP and produce a planning report including costs for the Board of Trustees this May. This goal will take us to the point where, if approved, we can move toward construction plans. Members of the committee visited other schools where new facilities, similar to what we are considering, have recently been constructed. It didn't take very long to discover that science facilities are VERY expensive, especially if built in NJ. But we discovered other things as well. We learned about the visual impact and integrating aspects of the sciences on a campus, the importance of gathering spaces for interchanges among faculty and students, and the difficulties of planning for additional expansion and technology needs. Our work has explored several options for meeting our needs. One was a large addition to the building that would totally replace the front section (psych wing and auditorium), provide all the new space required and offer a new entrance to the sciences at Drew. Another would preserve the front of the building and add a structure at the back, taking part of the current parking lot behind the building. And all options would involve some level of renovation of the existing three floor main building housing the lab sciences.

While the entire process has been a wonderful learning experience, and all of us quickly saw our "dream" facility in the making, the real world of financial constraints will ultimately determine the path we follow. At this moment, before the final report is written, plans appear to be converging toward a three step process. The first would be to build an addition somewhere at the back of the building housing chemistry and adjacent program labs like molecular biology. The second step would be to renovate the current main building allowing physics to expand into abandoned chemistry space. And perhaps, sometime down the road a bit, the third step would be to rebuild the front piece of the building. Many

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questions remain and, while we have been working at it for over a year, the process is really just beginning. The issue of phasing, or placing departments in other locations while renovations are completed, needs to be carefully explored to minimize disruptions in programs and cost to the project. The next five years will surely be an exciting, albeit trying at times, adventure for the sciences. Where will physics eventually land? Stay tuned.

-Dr. Robert Fenstermacher

Metric Humor

The following humorous information was received off the internet:

10**12 Microphones = 1 Megaphone
10**6 bicycles = 2 megacycles
500 millinaries = 1 seminary
2000 mockingbirds = two kilomockingbirds
10 cards = 1 decacards
1/2 lavatory = 1 demijohn
10**-6 fish = 1 microfiche
453.6 graham crackers = 1 pound cake
10**12 pins = 1 terrapin
10**21 piccolos = 1 gigolo
10 rations = 1 decoration
100 rations = 1 C-ration
10 millipedes = 1 centipede
3 1/3 tridents = 1 decadent
10 monologues = 5 dialogues
2 monograms = 1 diagram
8 nickels = 2 paradigms
2 snake eyes = 1 paradise
2 wharves = 1 paradox
1 millihelen = sufficient beauty to launch a single ship

And the Winner Is . . .

Learning of the departure of our dear Dr. Namiotka, the physics department had to undertake a quest to find someone to replace her teaching position. Placing an ad in Physics Today and a hope to the stars, their search began. The applications poured in, and the process of sifting through the masses of paper began. After a couple months, Dr. F. finally surfaced with the final four applicants. Being a devoted SPS member I attended all four of the afternoon lectures that each of the applicants gave, which is how I got to write this article. However also being devoted to my sleep, I was unable to make it to the Physics 12 sessions that each of them taught at 8:45 am.

And the nominees for the newest assistant professor at Drew University are: Dr. Carl Mungan, Dr. Jeffrey Olafsen, Dr. David McGee, and Dr. Eric Arons.

The first of the fantastic four was Dr. Carl Mungan from the University of Western Florida who gave an interesting lecture on light and heat. He talked about laser cooling as well as fluorescence, and the interrelations between them. For in one you turn light into heat or the absence of heat, and in the other you turn heat into light.

The second of the four musketeers was Dr. Jeffrey Olafsen, who is a postdoctoral fellow at Georgetown University. His lecture was on the study of ideal gases applied to granular media and macroscopic particles. The process involved vibrating large ball bearings in an attempt to simulate the behavior of ideal gases. The kinetic energy of the vibrating balls was an analogy to the temperature of the gas particles. For the demonstration of some of the effects of the particles, he brought us some souvenirs from the beach: different shaped containers filled with sand. It was quite interesting how the granular media behaved quite like a fluid in some respects, yet had its own unique properties that were very different from the fluids in other respects.

Dr. David McGee from Moravian college was our next contestant on the Physics is Right. His was certainly one of the more interesting presentations, at least in the research possibilities that were presented. His research involved more than just physics, for it brought the organic chemists out to the show too. His research proposed the idea of storing data in organic crystals through optical holography. This was an amazing idea that could eventually replace our magnetic hard drives with optical ones. His lecture discussed how images could be stored in a crystal by shining light it. The applied optical field (a.k.a. light) would then cause the charges in the crystal to move and the resulting arrangement would be determined by the applied field. So by shining light on the crystal the electrons of the crystal moved and the

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WANTED

One newsletter editor seeking one or two enthusiastic SPS members to take on the responsibilities of publishing this newsletter. No experience required, can be trained. See either Dr. F. or Jeannine for more information.

Check out the Physics Web Page at:

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

Notes From the Outside

Hello Drew students and fellow alumni. I graduated from Drew in 1994 with a B.A. in physics. Since that time, I have been busy both academically and professionally. I would like to share with you some of my experiences over the past five years.

Upon graduating from Drew, I accepted a National Physical Sciences Consortium Graduate Fellowship. As part of the fellowship I did research at Lawrence Livermore National Laboratory in Livermore, California during the summers of 1994 and 1995. Although the Lab is a center for Department of Defense research, the project in which I participated was not classified. The project goal was the design and testing of an extremely powerful laser to be used for laser fusion. Guided by Dr. David Milam, my contribution to the project was to test a method of protecting the laser from itself. If such a powerful laser beam was accidentally reflected back into the laser, it could easily damage or destroy the laser. The technique I tested used a nonlinear optical process to redirect a back reflected beam. Although I gained much experience over these two summers, I decided that I was not interested in a career with the Department of Defense.

In the fall of 1994, I started my graduate studies in the physics department at Brown University in Providence, Rhode Island. My first year and a half at Brown consisted primarily of course work, and by spring 1996 I had earned my Master's degree. After passing the departmental Ph.D. program qualifying exam in the fall of 1995, I began concentrating on my Ph.D. research. My thesis advisor, Dr. Nabil Lawandy, had previously discovered a substance called laser paint which exhibits characteristics of a laser. This material contains paint which scatters light and dye molecules which amplify light. Laser paint has numerous potential applications, such as color-dependent codes, identification markings, and medical photodynamic therapy. I conducted both experimental and theoretical studies that demonstrated how light interacts with and propagates through laser paint, thereby furthering our understanding of this unique substance. In May 1998, I completed this research, defended my dissertation, and received my Ph.D. from Brown. Overall, I greatly enjoyed my years at Brown, both personally and professionally.

Much of what I learned at Brown about light scattering can be applied to biological systems, such as blood and tissue. A growing interest in biological and medical physics lead me to accept a position as a scientist in the advanced technology department at Cytometrics, Inc. in Philadelphia, PA in October 1998. Cytometrics has developed a technique of imaging on a computer screen the blood vessels under the tongue by using reflected light from a hand held probe placed in the mouth in the same manner as a thermometer. From the images, we are working on calculating the hemoglobin associated with needles and biohazards. Currently, my primary task is to develop, through experiments and theoretical models, a greater understanding of how light interacts with blood and tissue. One of my projects is to set up a blood flowing system to study the optical effects of blood in a controlled manner outside the body. I also work closely with the clinical group and the image analysis team. I have already been sent on a business trip to England to visit a leading laboratory in the field. I am looking forward to a productive and satisfying future in research with this growing company.

-Amy Perkins (CLA ' 94)

The Ubiquitous Hyperbolic Secant

In 1834 J. Scott Russell, an engineer, was riding his horse along the Edinburgh-Glasgow canal when a boat he was watching in the channel came to a sudden stop. A mass of water welled up at the bow of the vessel and moved forward at great velocity. Russell followed it on horseback and noted that the wave was a foot or two high and 30 feet long and rolled on at a speed of about eight miles an hour. Amazingly, the wave didn't change its shape over a distance of more than two miles.

Russell dutifully reported his observations to the British Association and tried to re-create the event he had witnessed by dropping a weight into one end of a water channel. Several distinguished scientists, Lord Rayleigh among them, attempted to explain the phenomenon. However, a complete understanding was not achieved until 1895, when Korteweg and deVries showed that the wave is the solution of an equation that now bears their names. The equation is a third order, nonlinear, partial differential equation that looks fearsome at first glance. But it's not hard to demonstrate that under appropriate boundary conditions, the profile of the wave is the square of a hyperbolic secant. (Recall that the function is the reciprocal of the hyperbolic cosine and looks like a "stretched out" Gaussian function.) The mathematical model shows that the waveshape is preserved because the expected dispersion is counterbalanced by the nonlinearity of the medium.

In the 1960's Norman Zabusky and Martin Kruskal did an extensive numerical analysis of such solitary waves. They coined the name "solitons" after photon, phonon, etc., to emphasize the particle-like character of the waves, which seem to retain their identities in a collision.

Now consider this. When an incident wave encounters a finite square well in quantum mechanical scattering, both a reflected wave and a transmitted wave are produced. Does there exist some kind of square well with rounded corners for which there is <u>no</u> reflected wave? The answer is yes; it's an upside-down hyperbolic secant squared. And inverse methods show that this "reflectionless potential" is unique. But there's more: the bound-state wave functions are hyperbolic secants!

Next consider an entirely different area of physics–sound propagation in the ocean. The acoustic index of refraction varies with depth because of solar heating near the surface and the depth dependence of the hydrostatic pressure. The combination of the two effects gives a maximum refraction index at a depth of about 4000 feet in temperate regions, causing a sound channel to be formed . Sound rays in the channel experience intense periodic focusing as the horizontal range from a source is increased. But the focusing is imperfect and the convergence zones get "fuzzy" at distances greater than a few hundred miles. What index of refraction profile would produce perfect focusing? It's easy to show that it's the hyperbolic secant.

Now switch your attention to electromagnetism. Fiber optic cables used in long distance digital telecommunications require expensive repeaters because the transmitted laser light pulses tend to spread out and have to be regenerated. Maxwell's equations tell us that if the electric polarization vector is a cubic function of the electric field, a pulse can be made to propagate in a dielectric waveguide without distortion. Scientists at Bell Laboratories have shown that many fewer repeaters are needed, with a great savings in costs, if the laser light source is suitably designed. The pulse shape? The hyperbolic secant, of course.

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How Do Things Really Work?

The debut offering of Physics 7, How Things Work, occurred last Fall with a brave group of 35 students taking a chance on this new opportunity to meet their science distribution requirement. The course was based on one by the same name at the University of Virginia, and used the text from that course by Louis Bloomfield. While still a physics course, it became an experiment to see if physical topics could be taught almost entirely from a concepts approach - very few equations and little mathematics. And the physical topics would all come out of the workings of objects we see and experience regularly in our daily lives. And so we explored translational and rotational motion from the experience of balls and amusement park rides, thermodynamics from wood stoves, furnaces, and car engines, light from all types of bulbs, electricity from xerographic copiers and house circuits, and nuclear explosions from a "critical" collection of set mousetraps and ping pong balls. Problem sets and exams which asked for conceptual explanations of physical phenomena, and a short paper describing as much physics as possible in the workings of an actual object formed the basis for the grade. And demos abounded! Opening day featured the familiar tablecloth pull from under a table setting replete with flowers and wine glass, and the parents weekend class simulated the action in a car cylinder by adding a few ml of methanol to a plastic gallon jug, shaking it, and then igniting it with a spark gap! Parents in the first row moved quickly to safer seats for the rest of the class. Other superb resources for the course came from web sites and David Macaulay's book and CD-ROM entitled, "The Way Things Work." The CD-ROM is especially good and features excellent animations of all kinds of devices - a recommended addition to a family collection of software and usable by children and adults alike.

So did the course work? From both the formal and informal course evaluations, students liked it very much. Some concepts were learned better than others, and many were transferred, at least during the course, to everyday happenings in the students' world. Interestingly, students in the class were split almost evenly among those who had had a physics course in high school and those who had not. Those without a previous course did better with the format of thinking about concepts. Those with a physics course wanted to rely more on equations and actually asked for more mathematics in the course. This was a shock! Perhaps the comfort associated with plugging numbers into an equation was a factor here. That can often be easier than carefully thinking through the conceptual issues involved in a problem. One young woman acknowledged that she now knew what a cylinder was in her car. If there were a number of these "discoveries" to come out of the course, and if the students have a better sense of there being underlying physical principles behind all of our technology, then I believe the course to be successful. And the instructor, while spending every waking hour thinking about the next demo, learned an enormous amount too! I look forward to next fall for the next happening of the course. Wonder what the enrollment will be......

-Dr. Robert Fenstermacher

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This spring, senior Kevin Missett, RISE fellow Jim McKenna, and I are trying to understand the behavior of solitons in various contexts and applications. Wherever we look, the hyperbolic secant keeps popping up. Solitary water waves, the reflectionless potential, perfect focusing, optical cables with few repeaters--these are only a few examples. We keep asking ourselves: What are the properties of the hyperbolic secant that make it appear in connection with so many seemingly disparate phenomena? Any ideas?

-Dr. Ashley Carter

Upcoming SPS Events...

Tuesday, April 13 …
(4:15 PM, S-244)
SPS Elections for 1999-2000

Saturday, April 17 ...
Spring Saturday
SPS Demos and Greetings for Prospective Students

Tuesday, April 20 …
(5:30 PM, University Club/ Commons)
SPS/Physics Dept . Banquet
Sigma Pi Sigma Induction
Annual Awards and Prizes Dinner
Dr. Steven Gausepohl (CLA '92)

Monday, May 10 …
(3 – 7 PM)
SPS/Physics Dept. Spring Picnic

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pattern of the electrons is the recorded data. This recorded data could then be taken from the crystal by shining another light on it.

And then there was one, Dr. Eric Arons from California, where he is an adjunct at several colleges. His was a similar lecture to Dr. McGee's, as it was on holography. I wish that Dr. Arons would have gone first, however, for he gave a more basic background of the ideas in holography that would have been useful for Dr. McGee's lecture. Dr. Arons' research focused on an attempt to diagnose breast cancer without using high powered X-rays. Instead, Dr. Arons searched for a way to send visible light through the material and then to see anything bad inside through holographs. An experiment was devised where he placed a small wire X in the middle of some wax and then was able to create a picture of the X. In the end though, the resolution was not good enough and the method for detecting breast cancer was never realized.

That is the summary of the nominees. And now for the winner. Envelope please. (rip, rip, shuffle shuffle)... *ahem* And the winner is: Dr. David McGee. Dr. F. offered the position to him and he has accepted. So, Dr. David McGee is to come here in the fall, replacing our beloved Dr. Namiotka. Good luck to all.

-David Benjamin (CLA '01)

The Dilated Times

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