

The Dilated Times

The Newsletter of the Drew University Society of Physics Students

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Editor: Ashish Shah

Drew Physics Welcomes Dr. Bjorg Larson

By Melissa Hoffman '13

This semester, the Drew Physics Department welcomed Dr. Bjorg Larson as the newest member of our faculty. Dr. Larson received her bachelor's degree in physics from the University of Iowa. As an undergraduate, she had many opportunities to broaden her research skills and interests as she spent each summer working on different research projects. Included among them were one on the physics of hot star winds, building a custom coil for a plasma chamber, and a theoretical string theory project at the University of Maryland. Dr. Larson then continued on to Stony Brook University in Long Island, NY to pursue her Ph.D. in Physics. In the summer before graduate school she worked at CERN on the Higgs Boson ATLAS detector, testing the high voltage high vacuum feed-throughs for power connection. She explained, "I realized that ATLAS wouldn't get data in the time I was there, so I made the decision to leave, and I'm glad I made that decision." After leaving ATLAS, Dr. Larson joined the X-ray microscopy group at Stony Brook, an area she had no familiarity with. "I liked working with my hands... I knew nothing about X-rays or really microscopy at all. So it was all new to me, and I really liked it. I liked making tools that had so many applications." She spent a lot of time working at the National Synchrotron Light Source (or just 'synchrotron') at Brookhaven National Lab, but realized that she wanted to move into an area where her research could be more independent work for herself.



Dr. Larson then became involved in confocal microscopy, where she could apply her skills in X-ray microscopy, but also get a more hands-on lab experience. Confocal microscopy is a form of microscopy that provides optical sectioning. Remember looking at onion slices under a microscope in high school biology? Confocal microscopy allows us to look at samples without physically sectioning them. A confocal microscope consists of a pinhole in front of a detector which rejects all unfocused light. This allows one to build up an image point by point. Confocal microscopy has many applications, and two that have particularly influenced Dr. Larson are biological and environmental applications. In fact, the idea of creating a tool with so many applications was part of what drew Dr. Larson to confocal microscopy. She elaborated, "I'm interested in both developing the tool and analyzing the data that comes from it." Additionally, she enjoys understanding the physics behind both the microscope and the sample.

...Continued on Page 3



NOTES FROM THE OUTSIDE

By Eirik Holbert '89



A Career Wander in Space Science



It was Electronics Laboratory and I remember it distinctly. Dr. Fenstermacher leaves Mike Kelly and me with this pearl of wisdom, “You don’t have to be smart to get a PhD, you just have to be determined.” Well as anyone in the program knows, stubbornness comes with the territory.

Florida Institute of Technology had a program in Physics and Space Sciences and as I came to find out, they were working on getting a Space Science PhD program accredited. After too many cold nights in the Drew Observatory (there was no warm room then), warm weather, the beach, and Shuttle Launches seemed very attractive. Eventually, I was the first PhD graduate from the FIT Space Sciences Program.

I joke that my career path has been more of a career wander. It’s always been about what’s sounded fun and interesting. I’ve worked with large telescopes doing signal processing, developed some of the first generation of hyperspectral imagers for eventual launch, performed staff work making sure all the right signatures were on the right paperwork and everyone was equally unhappy with the compromise, tested advanced sensor systems for the USAF, and collected a wealth of stories along the way. The ability to reinvent myself was the best thing I took from Drew. Eventually, with the Space Shuttle Program winding down, I managed to make the jump from Defense work to NASA.

I started working at the Kennedy Space Center as an International Space Station (ISS) Payloads Operations Engineer during the processing of the Columbus module for STS-122. An Operations Engineer oversees the day-to-day tasks to prepare a payload. They fix the small problems that threaten to derail the schedules, communicating between the different engineers and management. We also oversaw the late load of all the science to the ISS aboard the Orbiters at Launch minus 24 hours, as well as the early destow two hours after wheel-stop upon landing. Personally, I was responsible for payload operations at KSC for, among others, the last Hubble Servicing Mission, the Tranquility module with the Cupola (the big windowed area), Robonaut (check out his Facebook page), and the Robotic Refueling Mission (RRM) demonstration project.

While I admit morale could be better after the completion of construction of the International Space Station and the retirement of the Space Shuttle, there is still much interesting work being done by NASA. Change is good. Embracing change gives you new opportunities to learn and make things better. I am part of the team developing the Deep Space Habitat (DSH). We are taking what we have learned from ISS to plan and design a vehicle to operate outside low earth orbit for 60-500 days. Major challenges include radiation shielding and a fully regenerative Environmental Control and Life Support System (ECLSS). The big question is where do we go first.

Similarly, the MultiPurpose Crew Vehicle (MPCV), carrying crew to low earth orbit and beyond, will be ready for its initial test flight in 2014 followed by a full-up test mission expected in 2017. The Space Launch System (SLS) with an eventual capability of 130 metric tons (over 5 times that of the Space

...Continued on Page 3

Shuttle) is being designed out of Marshall Space Flight Center along with the DSH to fly in 2017. The James Webb Space Telescope aside, Goddard Space Flight Center in Maryland is a hub of robotic activity. There is a program to robotically service and refuel satellites already in orbit with RRM as the pathfinder.

We are still operating the ISS at least through 2020 and perhaps 2028. Completion of the ISS has allowed for increasing amounts of performed science. Researchers working directly with crew members are finding some pathogens are more virulent in weightless conditions. This difference in genetic expression is leading to better treatments of bacterial infections including salmonella and antibiotic resistant *Staphylococcus aureus* (MRSA). Already, there is a candidate vaccine for salmonella and as one of the top three causes of infant mortality, this contribution to humanity would be immeasurable. New cancer treatments have been developed and are in clinical trial. The potential benefits are endless.

I am fortunate enough to be able to work with my wife as one of the assistant chief engineers and we worked together on the Tranquility module launch on STS-130. We are good about respecting each other's professional boundaries, but she definitely envies me my Drew experience. If I had to conclude with one specific piece of advice to those who follow after, it would be to enjoy what you are doing; when it stops being fun, don't be afraid to do something completely different. If you don't already, you will realize you have the education to reinvent yourself at every single point in your career. And remember, "Not all those who wander are lost."

Eirik continues his NASA work in Florida and welcomes questions about the space program. He can be contacted at: eirik.holbert-1@nasa.gov

Dr. Larson originally studied confocal microscopy in the context of cancer detection, and she now has a lot of interest in applications in environmental science. She explained that her first question is "what kind of samples would benefit from being studied with confocal microscopy?" and so she has begun a quest for interesting samples. At Drew, she hopes to continue her quest for interesting questions and samples in environmental science, and has also expressed interest in Raman spectroscopy with confocal microscopy. Her research plans here at Drew include many channels for student involvement at many different levels. "I will need help doing everything from building the instrument mechanically, figuring out the electronics, interfacing with software, and exploring applications – I'll need cool samples to look at. Physics students might be interested in the light interactions with the sample and spectroscopy analysis, and computer scientists could be involved in image processing and analysis." There will be many opportunities to work in Dr. Larson's lab once it is set up.

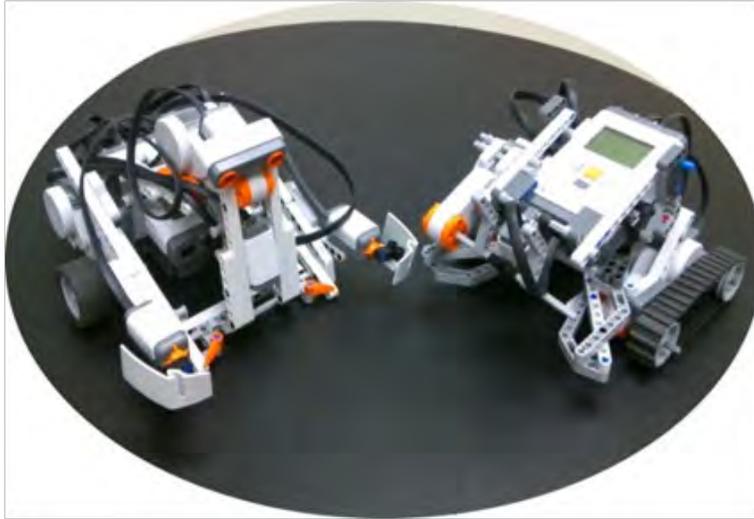
Drew University offers the perfect atmosphere for Dr. Larson's research. "I could build a confocal microscope at Drew and do everything with students. I worked with students as a post doc, and I really enjoyed that." This semester, Dr. Larson is teaching Physics 111, Introductory Physics and has been enjoying it immensely. She commented that "I found my students are amazingly open to learning physics. I've had more than one student tell me that they really enjoy the concepts."

We are very excited to have Dr. Larson join us at Drew and welcome her to the department!

Drew University Offers Robotics Engineering Course

By Ashish Shah '13

The Physics Department at Drew offers a wide variety of courses. Courses range from Astronomy to Quantum Mechanics, and Introductory Physics to specialized courses such as Computational Modeling of Neural Systems. Our program is designed to provide foundational and rigorous preparation for those planning careers in the fields of science and engineering. Last year, Drew took another step in expanding its curriculum by offering a new robotics course for the first time in Drew's history. PHYS 201, "Robotics Engineering" was taught by Dr. Min-joon Kouh (Physics Department) and Dr. Peter Likarish (Computer Science Department) during the January term of 2011 for two credits.



This course was designed for students interested in engineering and applied physics. It was a hands-on, project-based course, where teams of two students built and tested robots to perform a pre-defined task such as navigating through obstacles, picking-up and carrying specified objects to a destination, etc. The purpose of this course was to learn how to program a robotic system with sensors and motors, and

develop an engineering problem-solving mindset. The lectures covered the basic physics of how certain sensors and motors work, and basic programming techniques for processing the sensor inputs and for generating motor outputs.

Having the co-instructor, Professor Likarish, from the computer science department was invaluable. "He provided more in-depth challenges and perspectives in robotics" says Dr. Kouh. The goal of the course was to study and understand the mechanism of the robots from both programming and physics perspectives. Students used the Lego NXT Robotics Kit and NXT-G, Java for Lego Mindstorms (LeJOS) and Matlab software to control the robot. Four students were enrolled, and at the end of the semester they were divided into two groups and assigned to build two robots to compete against each other. The goal of the project was to move white balls into a designated area, and each team had approximately two days to prepare. Both robots were equipped with a range sensor, color sensor and other mechanisms such as a claw to grab the balls. A goodly crowd assembled to watch the competition. Both robots functioned very well. The robot competition was an appropriate final for two intensive weeks of learning about robotic engineering.

Dr. Kouh would like to continue teaching this course in the future. He said, "this course was a lot of fun and it was a good educational experience for both students and professors." Dr. Kouh believes that there is a lot of potential and educational value for a hands-on, engineering course like this at Drew University. He would also like to work with Madison High School, which already has a well-established Robotics Team (they were in the State Championship last year).

DSSI Meets Science Day

By Ashish Shah '13

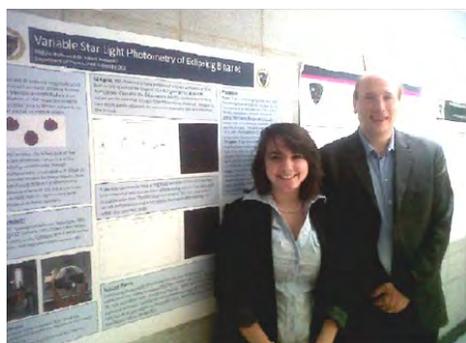
The Drew Science Summer Institute (DSSI) is the research program for students and faculty mentors conducted for six to eight weeks by Drew University. Approximately 30 students take part in DSSI every year, earning a research stipend and living on the campus. In the summer of 2011 five physics majors took part in various research projects and presented their summer research on Science Day, the annual open house for prospective science students. Last year Science Day was held on Friday, November 11, 2011. In the previous summer, more than 40 students participated in DSSI and there were over 20 posters presented on Science Day. Walls of the first and second floors of the Hall of Sciences were covered with posters on various topics from biochemistry, neuroscience, psychology, computer science, chemistry, and physics. Our visitors got to see firsthand what a science student might do at Drew.

The Physics Department was well represented at the poster session. Melissa Hoffman, working with Dr. Robert Murawski, presented her research on Eclipsing Binary Stars. Ashish Shah, working with Dr. Robert Murawski, presented his research on Raman Spectroscopy and Disperse Red 1 molecules. Mary Lamont, Danielle Holz, and Adam Fanslau, working with Dr. Minjoon Kouh, presented their research on acceleration experiments using a Wii-mote. It was a good Science Day.

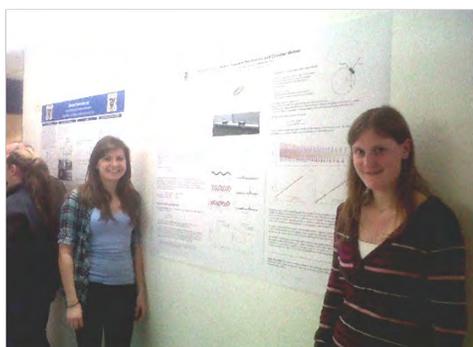
Science Day Presentations

October 8, 2012

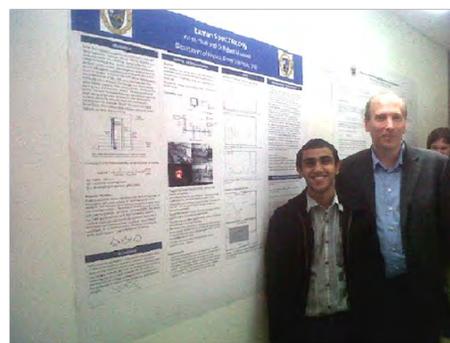
Courtesy of Melissa Hoffman



Melissa Hoffman '13 presenting her research on variable stars with Dr. Robert Murawski.



Mary Lamont '14 and Danielle Holz '15 presenting their research on Wii-mote.



Ashish Shah '13 presenting his research on Raman Spectroscopy with Dr. Robert Murawski.

Radio Telescope

By Andrew Bryar '12

The Drew Physics Department has been building its new radio telescope! After being awarded an SPS Research Grant, the SPS group has begun construction of this new addition to the Physics Department. The low frequency telescope is part of the Radio Jove Project. The project, started in 1998, is geared towards giving students the ability to build their own equipment and collect and exchange data with thousands of others in the project. Radio Jove is primarily focused on obtaining radio “short waves” from the Sun and Jupiter’s magnetic fields. From these radio waves and their interactions with other celestial bodies, such as Jupiter and Io, we can better understand these bodies and the Earth’s magnetic fields as well. This will not be the first time Drew has had its own radio telescope, as Dr. Fenstermacher established a microwave solar radio telescope earlier in his career at Drew. After Radio Jove is built, we hope to begin taking data before the next issue of the Dilated Times.



2012 Sigma Pi Sigma Congress

By Melissa Hoffman '13

Last November, Orland, Florida experienced an invasion. It wasn't an invasion of Disney princesses, families of four, or elderly people on golf carts – it was an invasion of physicists and physics students attending the quadrennial Sigma Pi Sigma Physics Congress! This year over 800 people gathered to celebrate Connecting Worlds through physics, which was the theme of this year's Congress. From Thursday to Saturday, 530 students from over 60 schools attended workshops, plenary talks, and even a tour of Kennedy Space Center, and I was lucky to be a part of this incredible experience.

During Summer 2012, I was an intern at the national SPS office in College Park, MD, working on the Science Outreach Catalyst Kit. Our program included nine interns, and as part of our internship we had to present our projects at a conference of our choice. We were very lucky to have internships in the same year as the Congress. Over half of the SPS 2012 interns met at the Congress to present our projects and participate in one of the largest gatherings of undergraduate physics students in the world (as far as we know!).



Thursday started off bright and early with a tour of Kennedy Space Center. Each group toured through Kennedy Space center via bus, with a helpful tour guide pointing out landmarks and stopping the bus for photo ops. The first plenary talk of the weekend was given by astronaut Dr. John Grunsfeld, who has been in space five times and repaired the Hubble Space Telescope three of those five times. His talk set the tone for the entire conference – inspiring, energetic, and optimistic for the future of physics. Dr. Grunsfeld talked about his experiences in space and his enthusiasm for the future of space exploration and research.

The schedule of talks, workshops, and events for the Congress was extensive. I couldn't get to everything, but the following were some of my favorites.

...Continued on Page 7

Friday began with an incredible talk by Dr. John C. Mathers, the senior project scientist on the James Webb Space Telescope. Dr. Mathers, a Jersey native, shared his story of his journey through physics and his work on the James Webb Telescope. His talk was especially interesting for future astrophysicists, because the James Webb will be directly affecting the research of astrophysicists all over the world for years to come.

Friday night, the American Physical Society hosted a dance with liquid nitrogen ice cream and a D.J. Just imagine – an entire dance floor populated with physics undergraduates from all over America, doing the Cha Cha Slide, the Cotton-eyed Joe, and the Gangnam Style dance (which this physics student still can't figure out the mechanics of...).

Saturday, I trooped over to the University of Florida to take the Physics GRE's with a group of other students, and unfortunately missed a talk given by Dr. Freeman Dyson and a lunch talk with Dr. David Saltzman [*an alum of the 1984 Drew Governor's School in the Sciences, ed*], who is the science consultant for *The Big Bang Theory*. The last talk on Saturday, and of the Congress, was by one of my favorite speakers of the weekend, Dr. Jocelyn Bell Burnell, an astrophysicist who contributed to the Nobel Prize winning discovery of radio pulsars. Dr. Burnell gave the final talk - "Reflections on the Predicted End of the World in December 2012." She led us through an analysis of the many catastrophes that are supposedly befalling the world this winter. Dr. Burnell talked about weird theories such as the Sumarian's alleged Planet Nibiru, to the less understood scientific phenomena of shifting poles and planetary alignments, to the somewhat probable solar storms and asteroids that could hit the Earth. While her explanations of each possible fate were very amusing and witty, Dr. Burnell ended on a serious note – that while we at PhyCon can logically understand why the planets aligning will have no effect on the Earth, some people will never be persuaded, no matter how convincing the logic or how good the argument.

Of the workshops I attended at Congress, my favorite had to be "Connecting Scientists & Policy" led by Dave Mosher and Anna Quider. As many readers may be aware, sequestration will automatically reduce federal funding to the sciences by 9% in March if no action is taken to prevent it. The Scientists & Policy Workshop gave us a rare opportunity to be in the shoes of a U.S. Congressman. We were given a list of scientific organizations and asked to decide how we would split up funding cuts – would we cut evenly across the board? Favor certain administrations? Completely cut a program? It was a truly eye opening experience to debate with fellow scientists and science students about which programs deserve more funding and which need less. After this workshop, I realized how extremely pertinent it is for scientists to become intimately aware of science policy, and important for politicians to become familiar with the science that they so readily influence with funding decisions. At this workshop I also learned we have good reason to boast as New Jerseyans, because Congressman Rush Holt of the 12th District of N.J. is the *only* physicist currently serving in the U.S. Congress.

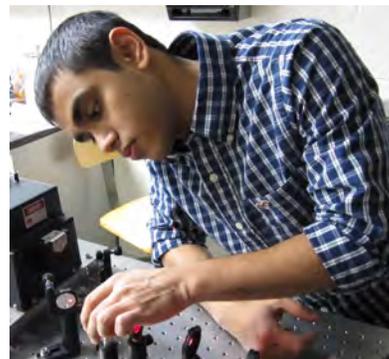
PhysCon was an incredible experience for me – it was the first conference I've ever been to in my life, and I couldn't have picked a better one to attend. I always thought physics students were few and far between, but the sheer number of enthusiastic physics majors, science enthusiasts, and scientists, proved me utterly wrong. I learned an incredible amount from some of the most amazing minds at work today, and had the privilege to meet other physics majors from all over the country. The final announcement revealed the location of the 2016 Congress – San Jose, California – so you'll know where to find me in November of 2016 – I'll hope to see you there, too!

For more information on the budget cuts to the sciences visit the APS website and sign the letter petitioning members of Congress to make a change! <http://ultron.aps.org/forms/aps.cgi?ID=1084>

An Off-Campus Research Adventure

By Ashish Shah '13

REU (Research Experience for Undergraduates) programs are designed to provide rising juniors and seniors with an opportunity to participate in summer research programs. During Summer 2012 I was fortunate to be accepted into an REU program at Lehigh University. My summer experience at Lehigh was phenomenal. It was unique, fun and educational. It was unique because it gave me an opportunity to experience graduate level research at Lehigh and a graduate lifestyle. I had an opportunity to meet with very smart graduate students who were pursuing a Ph.D. path. I learned a lot about research at the next level. The program was definitely fun. The Lehigh physics department organized picnics and trips such as white water rafting and hiking trips. In addition, all of the physics REU students stayed in the same house so I got to meet physics students from all over the country. It was definitely one of the best and most productive summers I have had. To top it off, my summer project at Lehigh involved one of the most popular research topics in materials and nanoelectronics. My project at Lehigh was spectroscopic analysis of single wall carbon nanotubes for dielectrophoresis.



The following is an abstract of my research:

Carbon Nanotubes (CNTs) have high potential as building blocks for nanoelectronics. Extraordinary mechanical and electronic properties of the Single-Wall Carbon Nanotubes (SWNT) make them excellent candidates for biosensors, electronic transistors, and photosensors. Dielectrophoresis (DEP) is the movement of a particle in a non-uniform electric field. It describes the translational motion of particles due to the non-uniform electrical fields. DEP uses predominantly AC fields to align CNTs in solution on electrodes. DEP trapping of CNT represents a more reproducible method for forming CNT Field Effect Transistors (FETs). The technique is quick and inexpensive with recent reports demonstrating parallel FET array fabrication. Presence of both metallic and semiconductive carbon nanotubes in solution is the main reason why forming single nanotube conductance channels is unreliable. The dielectrophoretic forces on CNTs are influenced by the electronic properties of the CNTs and cause a separation of metallic and semiconductive nanotubes.

SWNTs can either be semiconductive, semimetallic, or metallic depending on the symmetry of the tube defined by unique indices n and m . Spectroscopy techniques such as absorption spectroscopy and photoluminescence (PL) spectroscopy are common and effective ways of characterizing different types of tubes in a solution. PL spectroscopy is a very efficient method for deducing (n, m) indices since different nanotubes absorb and emit at different wavelengths. The peaks in the PL/PLE (PL excitation) map define (S_{22}, S_{11}) pairs, which correspond to excitonic transitions in 1st and 2nd subbands for the unique (n, m) index of a tube.

Optical absorption is routinely used to quantify quality of the carbon nanotube powders. The spectrum is analyzed in terms of intensities of nanotube-related peaks, background, and the pi-carbon peak. Absorption in nanotubes originates from electronic transitions from the v_2 to c_2 (energy E_{22}) or v_1 to c_1 (energy E_{11}) levels, etc. The peaks corresponding to the transitions are relatively sharp and they can be used to identify nanotube types in a solution. Absorption spectra can also provide the relative concentration of the tubes present in the solution. Thus combining both absorption and PL spectroscopy is a very efficient way to characterize SWNTs for applications such as optimization of DEP.



Senior Farewell

By Andrew Bryar '12



“No.... no, you don't want to do that.” I had just told Dr. Supplee about my half-hearted ambition of going pre-med. He was teaching the freshman seminar in special relativity that I was in, and was therefore in charge of my future as it were. He must've known something he wasn't telling us about relativity because, before I knew it, 20 minutes had passed and I was outside his door with an entirely new curriculum geared to make me a physics student. Being the only kid in my physics high school class, I knew it wasn't for everyone, and it only got tougher, but I liked that. It constantly forces you to destroy previous standards and expectations, and reform them into crazier, outlandish principles that most people don't expect to be true. Yeah, and that was just Dr. Fenstermacher's Taco Party.

There is not one person in the Physics Department I won't miss dearly. Each professor has uniquely destroyed what I thought about the world and completely reformatted my thinking into a new perspective on the universe and nature. They gave me simple tools that I can use to move mountains. Jackie Cress is an amazing woman, for every time I had a serious problem I couldn't fix in weeks, she literally could fix with a smile and one phone call. To Mr. Takacs, I'd like to thank you for being a great mentor and friend. I'd also like to thank Dr. McGee. Although he may not be at Drew anymore, after Electronics, two semesters of Advanced Lab and Quantum, he was essentially my sophomore and junior years at Drew. Hoffman, I couldn't have had better company working at the Observatory, so please keep the Drew University Weather Department alive and well.

Summer at Drew Summer Science Institute

By Christopher Mascia '13



I spent Summer 2012 working with Raman spectroscopy with Dr. Murawski. The focus of the research was to determine if Raman spectroscopy could be used as an effective tool for detecting water pollutants. Raman is an appealing method of water quality testing since it is a non-destructive process, in which only a sample needs to be collected. We performed a rigorous examination of the two ponds located in the Zuck arboretum on campus using Raman to see if we could detect any pollutants such as fertilizer. We concluded that the concentration of any pollutant in the water was beyond the detection limits of our apparatus. I will be continuing this research in an independent study in which

other methods such as surface enhanced Raman spectroscopy will be attempted. This research demonstrated the applicability of physics to other fields of science and how it can be used to solve real world problems. I would like to thank the Fenstermacher Summer Fellowship Program for allowing me to have this valuable learning experience and I am honored to be the first Fenstermacher Summer Research Fellow.

How Well Do you Know the Physics Department?

By Melissa Hoffman '13 and Nicole Cicchetti '13

Match the quotes with the professor most likely to say them:

Dr. Supplee

I won't draw infinitely many lines because that takes too long.

If energy is conserved why is there a crisis?

This is the 4th cutest thing I've seen.

A diatomic molecule is a molecule with one atom too many.

How small does the triangle have to be? Depends if you are physicist or a mathematician.

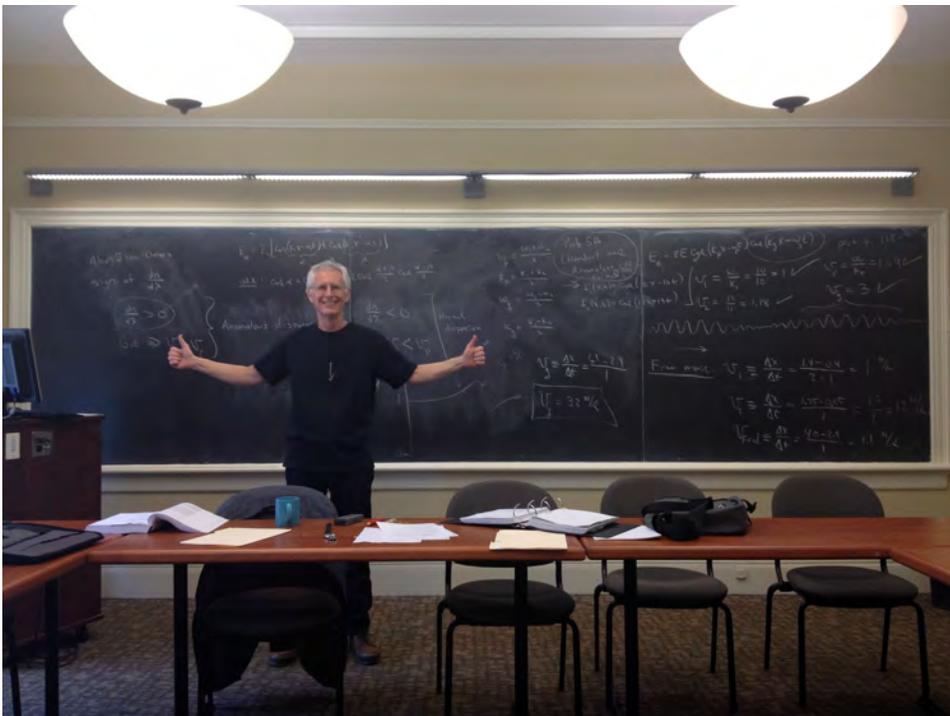
Dr. Murawski

Me, the Earth and my scissors picked alpha.

We've gotta move, kids. We've got a hundred years of physics to do today.

You can sound like you go to college if you say it in Latin.

Football is like rugby for wimps.



Dr. Supplee pretending to be an electromagnetic wave in optics class.

Photo by Melissa Hoffman

Dr. F's Alumni Quiz



A Drew Physics TEE shirt will go to the first alum who can identify this person along with his year of graduation AND current coordinates.



Send your entry to Dr. F at:

rfenster@drew.edu

GOT PRE-OWNED LAB EQUIPMENT/INSTRUMENTATION??

The department asks that alums remember us and our continuing need for laboratory instrumentation and equipment. If you have a particular item that is no longer useful to you and could find a new home at Drew, we would be very happy to hear from you at any time. While not limited to these, some current needs include:

General Lab Instrumentation

- Digital scopes
- Function/pulse generators
- Meters

Gas handling – regulators

Microscopes

Optomechanics (e.g. Newport, Thorlabs, etc)

Power Supplies

- High voltage power supplies – 5 to 10 kV (e.g. Bertan)
- Low voltage, general-purpose

Vacuum pumps – general purpose roughing pumps and diaphragm/oil free pumps (for use with small vacuum ovens)

More specific research equipment:

Electronics – Stanford Research SR280 NIM bin, SR250 Integrator, SR645/535 digital delay

Fiber optic equipment – fiber cleaver, fiber optic switches

LASERS – NdYAG, Argon Ion, Diode-pumped solid state, fiber-coupled, HeNe

Microscope hot stage

If you have equipment you would like to donate, please contact:

Dr. Robert K. Murawski

Drew University

Department of Physics

Madison, NJ 07940

E-mail: rmurawsk@drew.edu

Send The Physics Department Your Business Card!

We're very proud of our alums and want to share your paths with current students. Let us know what you are up to and where you are working. Send us your business card for our display. Please send your card or cards to Dr. Robert Murawski, Department of Physics, Drew University, Madison, NJ 07940.

If Physicists Wrote Warning Labels...

PLEASE NOTE: Some quantum physics theories suggest that when the consumer is not directly observing this product, it may cease to exist or will exist only in a vague and undetermined state.

CONSUMER NOTICE: Because of the “uncertainty principle,” it is impossible for the consumer to find out at the same time both precisely where this product is and how fast it is moving.

PUBLIC NOTICE REQUIRED BY LAW: Any use of this product, in any manner whatsoever, will increase the amount of disorder in the universe. Although no liability is implied herein, the consumer is warned that this process will ultimately lead to the death of the universe.

HANDLE WITH EXTREME CARE: This product contains minute electrically charged particles moving at velocities in excess of five hundred million miles per hour.

IMPORTANT NOTICE TO PURCHASERS: The entire physical universe, including this product, may one day collapse back into an infinitesimally small space. Should another universe subsequently re-emerge, the existence of this product in that universe cannot be guaranteed.

Remember:

The observatory is open to the public on clear Friday nights!

Visit the NEW physics department website at:

<http://www.drew.edu/phys/>

The Dilated Times

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Department of Physics
Madison, NJ,
07940

Address Correction Requested

Inside...

Drew welcomes Dr. Larson, DSSI and HHMI Summer Research, Sigma Pi Sigma Congress, Drew's Radio Telescope, Notes From the Outside, Science Day, Robotics at Drew, Senior Farewell!

Contributors...

Drew Bryar, Melissa Hoffman, Eirik Holbert, Ashish Shah, Chris Mascia, Nicole Cicchetti

