The Dilated Times

The Newsletter of the Drew University Society of Physics Students

Spring 2018 Volume 28 Number 1 Editor: Jenny Soter

Physics Department Welcomes Dr. Kouh as New Chair!

By Jenny Soter '18

The physics department saw several new exciting events during the past 2017-2018 academic year – an intimate talk with Dr. Neil deGrasse Tyson, SPS's first annual egg drop, a high school STEM outreach program, and numerous student research projects, to name a few that are featured in this issue of the Dilated Times. However the department's most noteworthy event of the year is the recent appointment of Dr. Minjoon Kouh as the new chair and his plans for Drew Physics in the years to come.

Dr. Kouh has been teaching physics courses and running a computational neuro-physics research laboratory at Drew since 2009 after earning his PhD at MIT. Since his time at Drew, he has been constantly involving students in his research, bringing in undergraduates to mentor through research projects during summer programs or semester-long independent studies. Dr. Kouh particularly emphasizes opportunities for student research and particularly the connections between neuroscience, physics, and computer science. While at Drew, with the Center for Global Education, Dr. Kouh organized a physics-related study abroad program in South Korea. Dr. Kouh teaches the hands-on robotics course himself in South Korea for three weeks during the summer when he is not working with students during the Drew Summer Science Institute (DSSI).

Dr. Kouh succeeds the physics department's previous chair, Dr. Robert Murawski. When I asked about the new directions of the department, Dr. Kouh stated, "My goal is simple, to keep the department running smoothly as it has been in the past years under Dr. Murawski." During this meeting, it was clear to me that student engagement was something Dr. Kouh was passionate about increasing in the upcoming years. We discussed new initiatives he plans to implement in order to increase student collaboration among physics majors, including plans to renovate the "H-Bar" to make the outdated lounge a more inviting space for group study, as well as organizing course-specific weeknight study groups.

Other initiatives include updates to the department's bulletin boards and a Drew physics Facebook group to organize and announce depart-

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Exploration of Deep Neural Networks with TensorFlow

By Drew Goldstein '18

My 2017 Drew Summer Science Institute (DSSI) experience was a wonderful opportunity to pursue a long-held interest of mine – Convolutional Neural Networks (CNN). For those unfamiliar, CNN are algorithms that model biological neural networks found in animal brains. In order for biological systems to see, stimuli interact with a receptive field causing the visual-sensory neuron to "fire" action potentials in response. Overlapping receptive fields of different neurons comprise the entire visual field. This electrical activity travels along the neuron's axon and is conveyed to other neurons via the diffusion of neurotransmitter molecules across synapses. Inspired by biology, a model of neural networks can be represented as an interconnected group of nodes where the output from one node is fed to other nodes as input. Instead of using neurotransmitters, the model uses mathematics to accomplish comparable results. Some of the mathematical operations often used in neural network models are weighted summation (or 2D convolution on images) and max-pooling operations. A Deep Neural Network (DNN) is a type of neural network with many layers of these nodes.

The code, which Dr. Minjoon Kouh and I developed, focused primarily on parts of the visual systems of the brain. We implemented a DNN model for visual object recognition by integrating several pieces of open source software including

OpenCV (a vision library), TensorFlow (a machine learning library), and a DNN model trained on ImageNet database. Using OpenCV, our system took in an image from a webcam at a rate of a few frames per second. TensorFlow then processed each frame and returned the top five guesses (out of 1,000 possible categories) about the object contained in that image. The system was implemented with Python programming language on an Ubuntu operating system.

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Smart Phone Physics

By Rutendo Jakachira '20

Thanks to the Verizon Integration of Technology into Higher Education Grant of The Independent College Fund of New Jersey, Dr. Kouh, Drew, and I are investigating the use of smart phone applications on understanding physics concepts including acceleration, velocity, and vector decomposition.

We have made use of two smart phone apps, Physics Toolbox Sensor Suite (Vieyra Software) for Androids, and Google Science Journal for iPhones to carry out a survey. The survey consists of three parts: the Pre-Activity Survey, the Smart Phone Physics Activities, and the Post-Activity Survey. The Pre-Activity Survey prompts students to answer a range of questions about these particular physics concepts. The Smart Phone Physics Activities are aimed at helping students gain a better understanding of the physics concepts. Then, the Post-Activity Survey asks the students the same initial questions from Part 1 to gauge how the activities impacted the understanding of the survey takers.

The survey process is still underway and we invite any science students interested in participating to reach out to me. A limited number of Starbucks and Amazon gift vouchers are available and will be awarded on completion.

Drew Physics Students Mentor High Schoolers in Optics Research

By Jenny Soter ’18

For the 2017-2018 academic year, 2 students from Dr. Larson’s applied optics lab won competitive grants from the Research & Development Council of New Jersey to mentor 10 high school students through a year-long original research project culminating in a final conference presentation to compete for a patent.

The program, in its fourth year of operation, is called NJ Governor’s STEM Scholars (GSS). GSS aims to select the highest-achieving high schoolers (<10% acceptance rate) interested in STEM across New Jersey. Governor’s STEM Scholar’s program also seeks NJ college students with original research proposals to act as mentors to these high schoolers through a year long project. Students from all NJ colleges with prior research experience are eligible to apply. Out of the 12 college students selected, 4 were from Drew University including 1 physics, 1 math, and 2 computer science majors.

As a Drew physics major I earned the grant after completing two semester-long independent studies in Dr. Larson’s lab. My STEM project was closely related to my independent study: designing tissue-simulating solid optical phantoms for use in Dr. Larson’s confocal line-scanning microscope.

A second mentor, Ana Jesus, is a recent Drew graduate, having majored in math and minored in physics. After completing DSSI in Dr. Larson’s lab last summer, she was inspired to apply to graduate school and continue research through the Governor’s STEM program. Ana’s math-focused project involved developing a theoretical model of the photon propagation occurring within my unique samples using Monte Carlo techniques. Together

Pictured: Ida Behrini (Drew Computer Science Mentor), Jenny Soter, and Ana Jesus presenting research to legislators at the state capitol during STEM Month

with Dr. Larson, Ana and I collaborated closely. Through the program Ana and I have attended 3 conferences around New Jersey, had the opportunity to sit down for a private conversation with the president of prestigious Bell Labs at Murray Hill, NJ, and were able to present our research to legislators at the state capitol during STEM month.

NJ Governor’s STEM Scholars is a unique experience for both the college mentor and high school mentee, albeit demanding on both ends. The

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***Dr. Kouh**...Continued from page 1*

mental events as well as to connect current and former students. Dr. Kouh mentions he will be looking for students next year interested in doing these renovations. Also in an effort to encourage physics interest and engagement within the department, Dr. Kouh plans to organize trips to physics conferences such as “PhysCon” next fall.

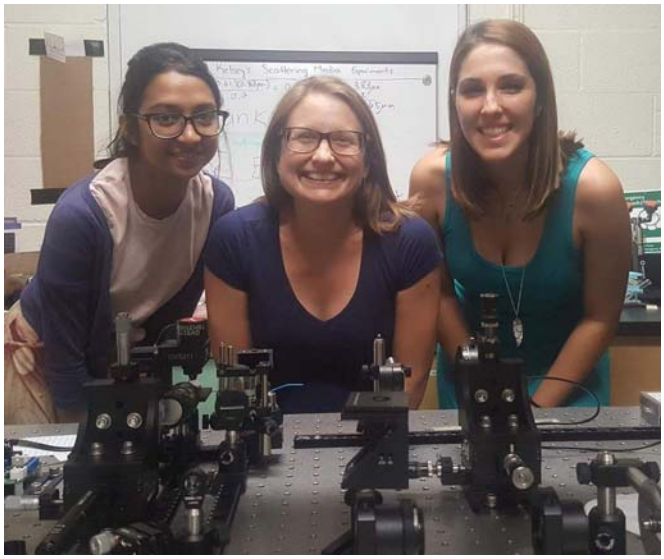
We’re excited to see how the department will continue to grow at Drew and develop young students into prosperous and successful scientists. We wish Dr. Kouh the best of luck in his new role as department chair.

Drew Summer Science Institute with Dr. Larson

By Shanu Khan '19

This past summer Ana Jesus and I had the amazing opportunity to work in Dr. Bjorg Larson's confocal microscopy laboratory as part of the Drew Summer Science Institute (DSSI) funded by the Robert L. Fenstermacher Summer Research Fellowship. The goal of our project was to continue previous students' research focused on improving the axial resolution of a confocal microscope.

Over the course of four weeks we spent a great deal of time physically building and learning how to construct the setup with small optical posts and mounts. We also learned how to use MATLAB in order to update previously written codes that were used to operate the motor and oscilloscope to collect and analyze data. In the end, we were able to make significant improvements to the previous alignment of the setup.



Pictured: Shanu Khan, Dr. Bjorg Larsen, Ana Jesus

Despite having no prior experience in research and computer science, Ana and I had an incredible time during those four weeks, usually staying in the lab until late evenings to resolve any experimental issues that arose. Undoubtedly we felt inspired by our mentor Dr. Larson and learned a lot from her. Even though DSSI lasted a short period, we had a lot of enjoyable and unforgettable moments together. This summer I look forward to again working with Dr. Larson along with a new team for DSSI 2018. I'm also looking forward to more research experiences.

Physics in the News 2018: Neutron Star Collision

By Matt Gronert '22

A long time ago in a galaxy far, far away, two neutron stars collided in an epic genesis of gold, silver, and platinum. A neutron star, the corpse of a star that was just too light to become a black hole, is a massive atomic nucleus approximately the width of Chicago, so densely packed that just one teaspoon weighs a million tons. The intense swirling, followed by violent impact, sent gravitational waves rippling across the cosmos, likely leaving a black hole behind. After travelling 130 million light years the waves were detected by the team at LIGO, which first proved the existence of gravitational waves in 2015. The extreme collision, named GW170817, has given astrophysicists and astronomers insight into how heavy elements formed in the universe, including iodine, gold, silver, platinum, bismuth, and uranium. Roughly 100 Earths worth of gold was made in one second, according to Brian Metzger of Columbia University, which at the current valuation would be worth 100 octillion dollars -- take that Bill Gates.

However, the most incredible result of the merger was the stunning show of international scientific cooperation. After LIGO detected the waves, they notified other observatories and telescopes. Their networking and connections enabled the international community to locate the origin of the waves quickly. The subsequent paper that was published on the event had almost 4000 contributors, which is about one third of all active astronomers in the world today. Drew was fortunate to hear from one of them, Dr. Melania Nynka of McGill University through the RISE Series, whose X-Ray telescope was a part of the observation. She detailed the excitement, stress, and satisfaction of being at the frontier of science for our faculty and students. When LIGO reopens next year after planned maintenance, they expect to "hear" several such events a year. They hope to learn even more about the origins of the stuff in your jewelry and your nuclear bombs.

Quantum Computing at the University of Washington

By Michael Clancy '18

This past summer I worked in the quantum computing lab at the University of Washington (UW) in Seattle through an NSF-funded "Research Experience for Undergraduates" (REU) program. I worked under the mentorship of Dr. Boris Blinov and his graduate students who were measuring the quantum state of Barium ions with the hope of unveiling new insights about the collapse of the wavefunction. I learned an extraordinary amount of physics and experimental techniques during my time there. There were 10 other students in the physics REU program from various colleges across the country. We would often spend late nights talking about our experiments, studying for the GREs, or preparing our final presentations about the work we did over the summer.

The supervisors of the REU program took the group on two trips across Washington – one to Caltech's Laser Interferometer Gravitational-Wave Observatory (LIGO) in Hanford and another to Mount Rainier. At LIGO Hanford, we were given a personal tour of the interferometer and learned many anecdotes about just how fancy and sensitive their equipment was. We learned that one major noise source of theirs comes from *waves crashing against the banks of Alaska* and this can shut down their experiment for days at a time. But as fascinating as that was, nothing could compare to the landscape of eastern Washington that we saw on the drive up or the beautiful views of the Paradise Trail at Mount Rainier.

The combination of my love for the state of Washington and the incredible physics program at UW made me decide to return next fall for a Ph.D. program in physics and jump back into research at the Blinov lab as soon as I get there. I cannot stress enough how influential this time of my life was. So I encourage all students at Drew to apply for REUs themselves.

***Mentors**…Continued from page 3.*

program, designed for about 30 hours of outside research for the high schoolers, is surely not for the light-hearted college mentor. Developing and running a successful research project for 5 high schoolers turned out to be far more demanding than I had expected.

"The responsibility of being a mentor to these high schoolers in Governor's STEM is like a second full-time job," mentor Ana states, "needing to fix every problem that comes up in the lab and understanding all the little details about the project so I can successfully lead these high schoolers to create a patentable project by the end of 10 months."

I'm familiar with the struggle of research and how rewarding the subsequent feeling of accomplishment can be, but I didn't expect myself to enjoy managing a group of high schoolers through research as much as I did. Being a role model, sparking interest in STEM research and teaching physics to these high schoolers turned out to be an extremely rewarding experience for me. The most worthwhile part of the program was getting to work with such an accomplished and eager group of high schoolers. They definitely pushed me to be better and when all my experiments seemed like hopeless failures in the lab, the thought of letting these high schoolers down motivated me to persevere with solving problem after problem.

In the end, Ana and I were able to successfully create original (never before published) solid, customizable optical phantoms to mimic human tissue and develop and verify a theoretical photon transport model to predict the experimental measurements of these phantoms. "You two have stumbled upon a PhD thesis," Dr. Larson warned us by the time it was too late to turn around. What truly felt hopeless, came together in a matter of days before the scheduled presentation. Now in the coming weeks, after our high schoolers compete for a patent, Ana and I will be working on the manuscript to publish our work.

In addition to gaining an immense amount of optics knowledge and independent research skills, the program opened my eyes to how running a lab in an academic career may be. Despite the unbelievable amount of work that went into making our projects competitive for the final patent awards, I feel very grateful for getting this opportunity with NJ Governor's STEM. I would also like to thank Dr. Larson for mentoring me during this whole process and allowing us to work on these spin-off projects in her lab for the past year.

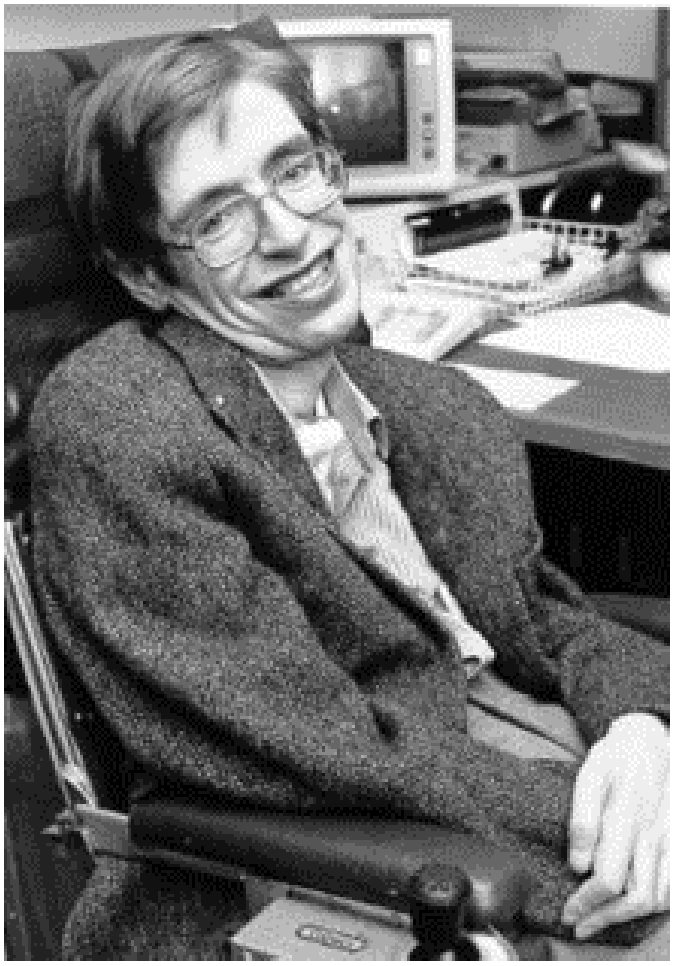
Famous Physicist: *Stephan Hawking*

By Katelynn Fleming '22

This past year Dr. Stephen Hawking passed away. A visionary physicist, he was well-known for his scientific prowess, accessible writing, and sheer resilience.

Hawking's renown originated in several groundbreaking theories in black hole physics. His early work with Roger Penrose focused on general relativity and showed that if general relativity is correct, the universe must have been condensed to a singularity, a point of infinite mass and curvature of spacetime. At the singularity, time as we know it would end and general relativity would break down. Consequently, there is no way to know what the universe was like before the big bang. They also showed that stars of a certain mass can collapse under their own gravity to a singularity of infinite density, known as a black hole.

Later in his career Hawking applied quantum theory to black holes. It was previously believed that any information that falls into a black hole is lost. However this idea conflicts with the laws of thermodynamics, which state that energy is always conserved in thermodynamic processes, and that entropy of a system always increases. Using Einstein's $E=mc^2$ and the theory that energy can be converted to matter-antimatter pairs and vice versa, Hawking postulated that matter being created from latent energy around the black hole could escape into the universe as a real particle if its antimatter pair were sucked in. The matter that escaped would make it appear that the black hole was emitting matter. This phenomena was aptly named Hawking Radiation, and implied that black holes could have a finite lifespan.



Hawking's work and legacy will inspire and assist physicists for generations to come, as we continue under his belief that mankind has the capability to understand the workings of the universe.

***Neural Networks**…Continued from page 2*

I always have found the field of machine learning fascinating. However, until this past summer, I was merely a spectator, never a participant. Even finding out where to begin in this field was intimidating to me. I am pleased to say that having Dr. Kouh as my mentor has made all the difference in allowing me to begin discovering all the opportunities machine learning has to offer. What I thought seemed impossible before, is now possible. Despite the long, frustrating hours spent troubleshooting, I truly feel that machine learning will make the world a better place.

I am very grateful for receiving this opportunity to work with Dr. Kouh and be a part of machine learning. I would like to thank Dr. Kouh and the Weddell Family Summer Research Fellowship in Physics who made this experience possible.

From Pocket Protector to the Battlefield: the Real Life Journey of a Physicist

By Lawrence J. D'Aries '83

After arriving at Drew as pre-med and then pre-dent, and moving from a biology major to a math major, and finally to a physics major, I eventually shipped off to The Pennsylvania State University to earn a Masters Degree in physics with thesis option in 1986. I then began the search for a job to start earning some income and turn from the academic life to the employment life, alas something that all physics majors must eventually do.

The 1986 job market was not good; I had never, ever thought about teaching but an opportunity arose for teaching at Delbarton School, my alma mater, and so I accepted the challenge. And as fate would have it, while teaching, I became involved in a summer STEM program offered by the US Army at Picatinny Arsenal here in NJ. The program employed high school math and science teachers over the summer and allowed them to take some of what they learned and experienced back into the classroom to engage and stimulate their current students. This wound up becoming that connection, that bridge, from the academic world that I was still in, to the R&D world that I sought.

Connections were made and I was eventually hired into the Army, initially as a health physicist. And as fate would strike yet again, one of my students in my radiation safety training classes, who was a prominent physics Ph.D. researcher in the area of radiographic equipment development, was looking for an assistant, and as they say, the rest is history.

Twenty years later I am now considered the subject matter expert (SME) for radiographic inspection technologies integration at Picatinny. In other words if the solution to a problem requires x-ray inspection of some sort I am the go-to guy for that solution. Accomplishments include, but are not limited to, the Armor Inspection System (AIS) whereby a fully automated, turn-key, x-ray based inspection system for the ceramic tile insert in the body armor that all soldiers (US Army, US Marine Corps and US Navy) wear in battle, was designed, developed, assembled, tested and then deployed in a record 18 months. First deployment was into Ali Al Salem Air Field in Kuwait in 2008, where I got to visit. There are currently 16 of these AIS units up and running around the world.

A current project is neutron radiography that is actually practical because of new developments that allow for very high flux of neutrons. A future project will be using this same high flux neutron technology to detect and then identify improvised explosive devices (IEDs) buried under roadways that are traveled by our convoys.

If there is any theme to this life journey of mine it is this: you can't plan this and you can't make this up! I planned on being a dentist and even went as far as applying to and getting accepted to dental schools. But I wound up in retail, teaching, and radiation protection all before I found my eventual career. And when you actually do find it, and you all will, you will look back and realize it was all worth the journey. Everything I did was a learning experience, a joyful experience and somehow and in some way each experience led to the next challenge. I have no regrets. It is all good.

Cheers,
Larry

PS: Maybe what comes around really does go around. You see after my Army career comes to a close, likely in the next 4 years when I will have 30 years of Government service in and qualify for retirement, my hope is to be able to return to teaching again. When all is said and done the most satisfying years of my career to date were the years I spent teaching. I hope that will inspire others to a STEM career, and so the cycle continues…

Where Are They Now?
Advice from Last Year's Graduates in the Workforce

by Jenny Soter '18

For a new feature to add to this year's Dilated Times as the editor, I reached out to some recently graduated physics majors who went straight into the workforce and asked about their perspective on the job market and whether they had any advice to share. ***Zoe Hughes at Thor Labs*** and ***Sebastien Etta-Ashu at Panasonic*** shared their thoughts on how they put their Drew physics degree to use and offered unique perspectives on what was helpful during their time at Drew.

Q: Can you briefly describe your job and how soon after graduation you started?

Zoe: I am a technical writing scientist/marketer in the Marketing Department at Thor Labs and I started July after graduation. I create effective product presentations for the website, catalogs, and tradeshows. I get to work with and release different product lines ranging from optogenetics to mechanical stages to quantum lasers. I ensure that all documentation (i.e. drawings, CAD files, manuals) is present and adheres to the guidelines. If a product changes, for example an engraving is added, I work with graphic artists to update photos, and I update the website with the most current specifications.

Sebastien: I am a product specialist for Wireless Connectivity at Panasonic and I started my full time position a couple of weeks after graduation. On a day to day basis, I offer technical support towards mostly engineers who want to design in our Panasonic Bluetooth and Wi-Fi modules. In other days I am working with marketing to develop strategies (blogs, videos etc.) to further promote our products in the market. I would say my job is currently 60% business and 40% engineering.

Q:Any specific classes you took at Drew that you found particularly helpful for your job?

Zoe: Dr. F's seminar. I can now discuss so many relevant topics. The knowledge that I gathered in that class has been the most useful in my day to day life. And Optics, looking at you Dr. Supplee and Dr. Larson. I use physics concepts to understand products and how customers would use them because I was one.

Sebastien: Electronics. This class gave me an understanding of electronics components and how they play a big role in the network (signal) communication world.

Q:Looking back at your time at Drew, now as a working adult, do you feel the physics major prepared you?

Zoe: YES. A physics background is essential to correctly perform my job. I get to use my technical knowledge of physics concepts when understanding what a product does or when writing tutorials for the website. Being a writing fellow for Modern Physics definitely prepared me to write in a scientific and informative style. THANK YOU, THANK YOU DREW PROFESSORS!

Sebastien: Yes, I am satisfied. The physics program was intense but at the end, I now realize that it was worth it.

Q:What is one piece of advice you would give to current or aspiring physics majors at Drew?

Zoe: Drew may be small, but people do know about it. My boss did her undergraduate degree at Drew and my boss's boss taught at Drew for a couple of years. Drew does provide a network in the real world.

Sebastien: I wish I would have known to take a business class. It is very important in the job market today.

A Nashville Eclipse Adventure

By Bob Fenstermacher '63

After reporting on the upcoming "America's Eclipse" last year, and encouraging you to experience this wondrous and rare astronomical event, I thought I would report on my adventure to seek it out. My wife Anne and I had to choose a viewing location along the approximately 100 mile wide swath of land running from the Oregon coast to Charleston, South Carolina. This was the path that the lunar shadow would race across at over 1000 mph on August 21, 2017. We eventually chose the Nashville, TN area, very close to center line of the eclipse path, and with a better than average prospect of good weather. The sun would be high in the sky near mid-day for better viewing of our expected two plus minutes of totality, Nashville was easily accessible by air, and if the unthinkable bad weather occurred we would at least have much to enjoy among the Nashville sights and sounds.

With the eclipse scheduled for Monday, we flew into Nashville earlier on Friday giving us the weekend to explore the area for good viewing sites, and to enjoy the region a bit. It was sunny, in the 90's, with good weather predicted for Monday. But the city was filling up fast with tens of thousands of hopeful eclipse viewers. I think we were lucky to get the last two tickets on Saturday night to the Grand Ole Opry, the nation's home to country music, and a must-see attraction in Nashville.

Given the projected crowds we drove north to explore viewing in the small town of White House, TN. It was a winner, closer to center line thus adding almost 40 seconds to our potential totality duration, and outside the huge gathering growing back in Nashville. We found a beautiful town park with open fields for good viewing, yet plenty of shade for avoiding the sun's heat, and including rest rooms and a local refreshment stand. What more could you ask for? While a local fireman suggested that they were possibly expecting "hundreds of thousands of people on Monday," I discounted that as somewhat unrealistic for this small town! We selected our spot for Monday's spectacle. The people we met were clearly excited by this once-in-a-lifetime event coming to their hometown, and it was evident that they had no clue about what might happen on Monday. But they were exceptionally welcoming, warm and friendly, and offering anything they could do to make their

visitors comfortable. They seemed surprised at us traveling all the way from New York to their small town for this event.

By great good luck Bill Clark ('92) along with his wife, daughter, and some friends had also chosen Nashville for the occasion, traveling from Denver. We all enjoyed a fine dinner in Nashville on Sunday night, catching up on life and families. Bill is also a veteran of several eclipse outings.

Monday morning we set out early on a beautiful day for the thirty mile return trip to White House, making sure to secure our chosen spot in the park. A few clouds were in sight. The eclipse was scheduled to begin about noon, with the partial phase lasting about 1.5 hours before totality at 1:30 pm, and another 1.5 hours after totality. We settled in and enjoyed watching the small crowds arrive, some with telescopes, many with picnics and whole families. School, already in session here, had closed for the "eclipse holiday." I had my Nikon digital camera with a 250 mm lens, the neutral density solar filter from our Questar telescope, and a tripod. It didn't take long to set up and try some test shots of the brilliant sun overhead.

It was not a surprise to see the first bite being taken out of the sun's limb right at the predicted time. But I always experience a small chill at that moment realizing how amazing it is for us to know the exact second it will begin.

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***Eclipse**...Continued from Page 9*

I began a sequence of bracketed exposures of the partial phase every ten minutes. This left a lot of time for conversations with other eclipse chasers, and for admiring their equipment. We even met several other physicists. As a faculty member it was easy to fall into "eclipse lecture mode" for many eager first time watchers. It didn't take long to notice the pin hole camera effect of the partially covered solar crescent being projected onto the ground through small openings between tree leaves. We arranged a large white sheet on the ground for group viewings bringing lots of ooh's and aah's.

The sky was generally bright and sunny, but with disturbing groups of white puffy clouds moving across the sky. As totality approached it became cooler, and as the coverage of the disk exceeded 90%, the light became eerily dim, perhaps like the light of a planet with a much smaller sun. Seconds before totality a diffraction effect caused large dark shadows or shadow bands to race across the field coming toward us. And then the sun went out, and the full outer solar atmosphere that we never observe, the corona, glowed pearly white. Brightness was similar to a bright full moon. We had 2 m 39 s to view this fleeting event, and it went by in a flash. I removed the filter from the camera and shot a series of pictures, attempting to capture the diamond ring effect, and using a wide range of shutter speeds to view the corona. And then I spent about 30+ seconds to just watch with the naked eye. It is a phenomenal and spectacular sight, and such a different view of our sun. As the sun too quickly emerged from the shadow, the first light from the edge of the brilliant disk caused the famous diamond ring effect to appear, and then totality was over. Smiles were on every face, and everyone began talking about how amazing it was. We breathed a sigh of relief at dodging the spotty cloud cover during totality. We learned later that some in downtown Nashville missed the brief totality entirely because of an ill-timed cloud moving across the sun, not a pleasant outcome. We enjoyed the rest of the beautiful afternoon, finishing the photo sequence of the partial phase, and sharing the wonderful sights we had seen with our many fellow observers. We packed up and headed back to Nashville for an appropriate celebratory dinner.

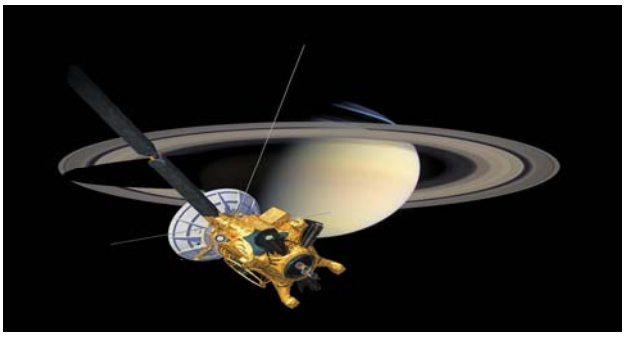
Did we travel all that way for such a brief event? Was it worth it? Absolutely!! And while I'm now three for three in observing attempts, no doubt we will seek out more opportunities to watch it yet again. If you missed it, you'll have another chance here in the U.S. to see one in 2024. Put it on your calendar.

Physics in the News 2018: Cassini

By Katelynn Fleming '22

This year Cassini's mission to explore Saturn, its rings and its moons finally came to a close. The probe was running out of fuel, so NASA sent it plummeting into Saturn's atmosphere rather than risk crashing into and contaminating the moons that might be hospitable to life. However over its twenty year lifespan, Cassini produced an impressive portfolio of discoveries.

Cassini arrived at Saturn seven years after its launch in 1997. It was carrying the Huygens probe, which it released to land on Saturn's moon, Titan. Huygens took data for less than four hours, but the information is so complex that it is still being analyzed today. The probe provided many discoveries



including a detailed atmospheric profile, indications of methane trapped in layers of ice on the surface, and dry river and lake beds similar to those on Earth.

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SPS Fall Egg Drop

By Natalya Shcherban '18

The egg drop was a successful SPS event mixing physics and engineering principles with a healthy bit of competition. To any passerby, the collection of items in HS 305 would be confusing. Toilet paper, styrofoam peanuts, boxes, cotton balls, and most importantly tape, littered the table. In the first hour of the event groups from 1 to 4 used creative combinations of these to create a supportive package for their egg. Cotton balls were a favorite, and groups thought "outside of the box" with parachutes, capes, and external supports. Dr. Minjoon Kouh and his son Chris, and Dr. Bjorg Larson and her son Aslak, stopped by to try their hand at the competition. Chris focused on engineering a box, while Aslak had a few different priorities with the candy and all the people there. The SPS Board also had different priorities, and despite Drew Goldstein's efforts to focus them on making a "Board Box," they instead ended up focusing on trying to calculate the drag force on a falling egg box.

The actual competition started an hour later. Michael Clancy and some supporting cast went up to the Hall of Sciences roof with the 8 egg boxes while the groups waited below on the lawn between Brother's College and HS. In only the first round, 4 competitors were knocked out. After one latecomer box was added, the second round consisted of 5 competitors. These egg boxes turned out to be tougher than anyone imagined. They survived falling off the roof multiple times until the Board had to resort to extreme measures. To make sure the event did not go too much over the original proposed time, instead of throwing the boxes off the roof, they kicked them into the brick walls outside of Hall of Sciences. This proved to be only slightly more effective. However, it was just effective enough to dwindle the competition down to 4

groups. These groups were even more resistant to repetitive attacks against the wall. Finally two winners prevailed, Chris Kouh and Arya, and to finally wrap up the event, Chris was unfortunately disqualified due to his earlier departure.

All in all, the event successfully drew a large crowd of students and professors and tested the group's ingenuity and ability to apply physics concepts to a project.

***Cassini**...Continued from Page 10*

Cassini continued to observe from its orbit around Saturn, revealing incredible phenomena: a storm on Saturn which encircled the Northern Hemisphere, the moon Daphnis which carves a path through Saturn's rings with its gravitational field, and immeasurable contributions to the study of Saturn's moons, specifically Enceladus and Titan.

During its dramatic descent, it took multiple passes into the space between the rings and Saturn to help reveal more about the origins of the rings and the nature of Saturn's interior. As it executed its final descent into Saturn's atmosphere, it fought to keep its antenna toward Earth to stream atmospheric sampling data for as long as possible. Cassini has a webpage dedicated to its legacy and discoveries, a fitting end to a historic mission.

Career Corner: The AIP Physics Careers Toolbox

By Bob Fenstermacher '63

This issue brings your attention to and briefly explores an online resource for students and mentors in considering physics major career decisions. Similarly to how Drew is often described, this is truly "a hidden treasure." It is called *The Physics Career Toolbox for Undergraduate Students and Their Mentors*, and has been beautifully assembled by a group of faculty, staff, and students from the Society of Physics Students (SPS) and the American Institute of Physics (AIP). As you know from past issues, the AIP has a major database tracking career patterns over the years and is in a unique position to speak to career trends for physics majors. The following information is borrowed liberally from the online Toolbox.

To begin we can see from the first figure that about half of all physics majors go on to graduate

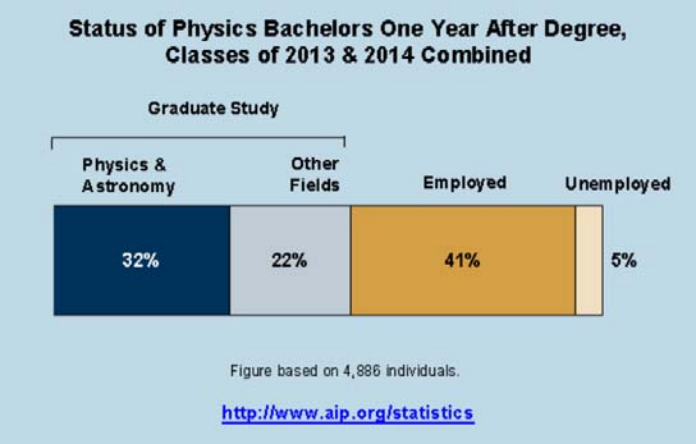

Figure 1 shows the fields of employment for jobs in the private sector (65%). The remaining employed (35%) are distributed among education (19%), the military (6%), and government national laboratories (5%).

school, and half go directly into employment. And while physics departments often focus on preparing students for physics graduate school, only about one third of all physics majors end up in graduate school for physics and astronomy. Thus there is room and need for much more information about career opportunities and how to pursue them for many physics majors. So why not exploit the vast resources of the AIP for guidance? Who better knows the state of employment for physics majors? And why might such a resource be necessary? The following is taken directly from the online motivation for producing The Careers Toolbox:

> *The physics degree program, whether in a large research Institution or a small liberal arts college is often one of the most revered (and feared) majors. Most physics students who successfully graduate gain a unique set of skills and knowledge relative to other degree programs. The kinds of problem-solving abilities gained by undergraduate physics students are desirable in a wide range of work settings.* ***However, translating these abilities from an undergraduate program to a great job can be challenging****.*
>
> *Despite their strong preparation for tackling a wide range of problems, a student may face the following obstacles:*
>
> - *Hiring professionals may not understand what a physics student actually knows or is capable of doing.*
> - *Physics faculty may not understand what a physics student actually knows or is capable of doing outside of academia.*
> - *Individual students may not understand the value of what they know or are capable of doing!*
> - *Campus career professionals may not know about the kinds of positions typically available to individuals with a physics background.*
>
> *The Careers Toolbox is designed to provide tools to overcome these obstacles and to specifically assist physics students in becoming more effective job seekers.*

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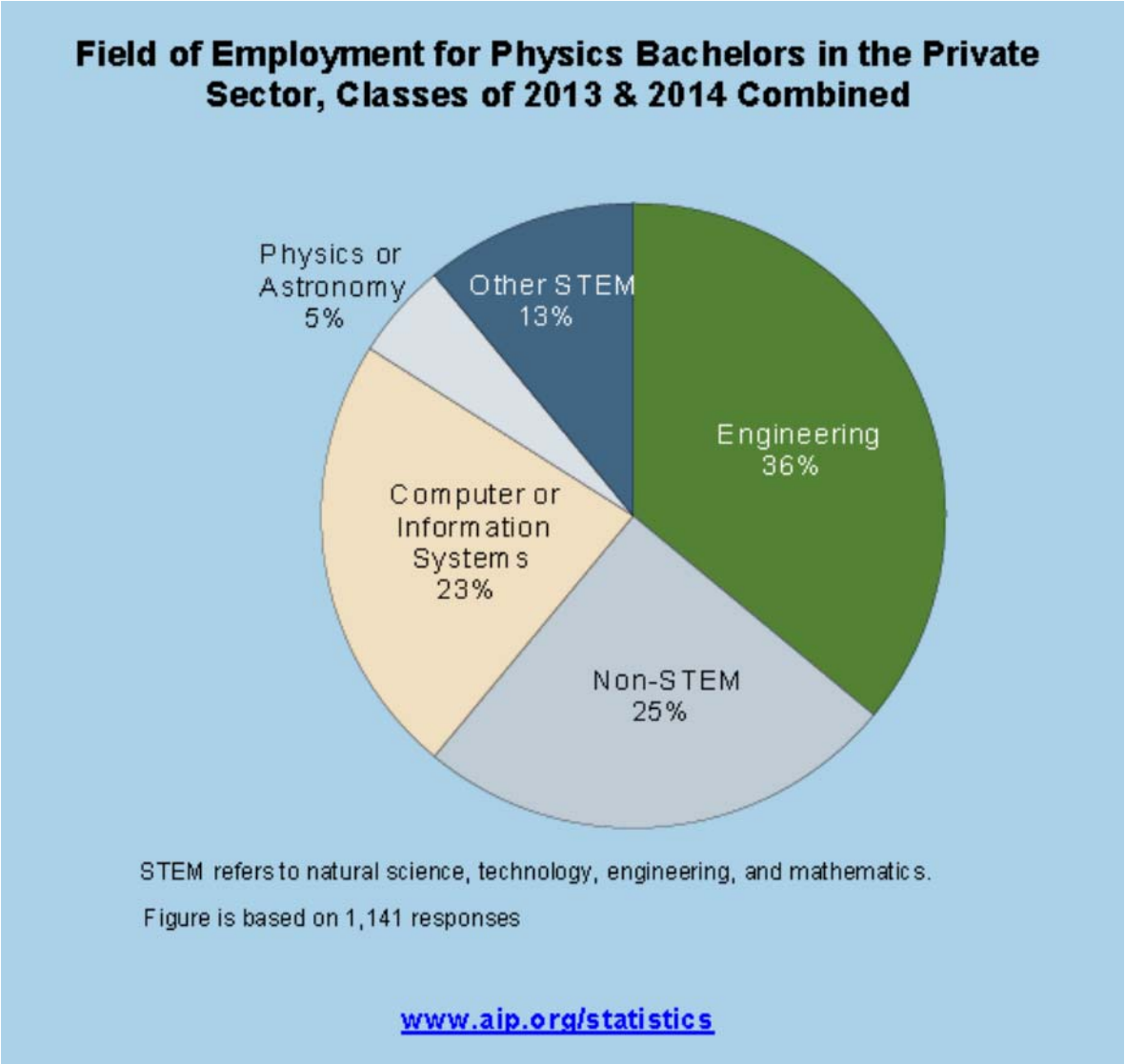
CAREER …Continued from page 12.



The Toolbox itself is divided into nine comprehensive "Tool" sections including Common Job Titles, Networking, Assessing Your Knowledge and Skills, Effective Job Searching, Building Your Resume, Writing an Effective Cover Letter, and Acing the Interview. Each of these sections expands significantly to focus on specific information, tips and examples, and many additional references applicable for each Tool. Tool #7 on Building Your Resume, for example, looked to be incredibly helpful in describing the difference between a Resume and a CV, and providing excellent hints on resume style, numerous ideas for making your resume as strong as possible, and clear samples to review.

This is a highly recommended resource for all students considering employment, but particularly those still wondering and perhaps worrying about how to go about finding that first job. Faculty members may also find it helpful in having conversations about the many steps in that path for their students. It's a gem!

To access The Careers Toolbox, or to download it for your own desktop in pdf format, go to:

https://www.spsnational.org/sites/all/careerstoolbox/

2018 Sigma Pi Sigma (∑∏∑) Induction

by Jenny Soter ‘18

From Left to Right: Natalya Shcherban (’18), Drew Goldstein (‘18), Mack Fox (‘18), Scott Kim (‘18)

Congratulations to the 2018 Sigma Pi Sigma Inductees: Natalya Shcherban (’18), Drew Goldstein (‘18), Mack Fox (‘18), Scott Kim (‘18)

To qualify for induction into Sigma Pi Sigma, the national physics honor society, Drew students should meet the following requirements:

1. All members-elect shall have completed at least the equivalent of three-semesters of full-time college work.
2. All nominees shall have completed at least two upper-level semester courses in physics, each of at least four credits, which must be credible toward a physics major.
3. All nominees must have maintained a GPA of 3.0 on a 4.0 scale, in both their physics courses and for a cumulative course load.
4. All nominees shall be paid members of the Drew University Chapter of the Society of Physics Students.

The next Sigma Pi Sigma Induction Ceremony will occur during the next Annual Society of Physics Students (SPS) Banquet in Spring 2019. If you think you qualify, talk now with Dr. Kouh about joining this year’s inductees.

Look for announcements regarding the date of the banquet and Sigma Pi Sigma Induction early next spring!

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.

Visit the physics department website at:

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

Remember:

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

The Dilated Times

Drew University
Department of Physics
Madison, NJ,
07940

Address Correction Requested

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