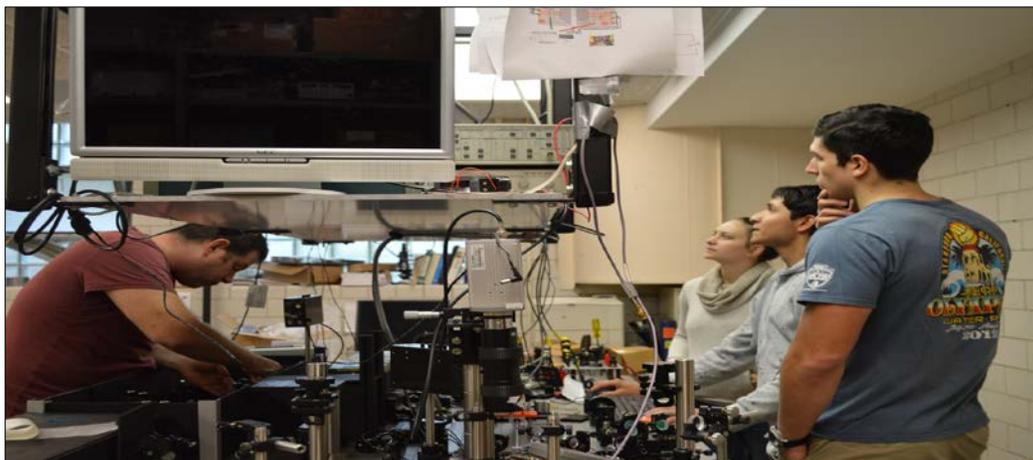


# DEPARTMENT OF PHYSICS

NEWSLETTER

AUTUMN 2015



## Working with Ultrafast Laser Instrumentation

Undergraduate research continues to be a vital component to the Department of Physics, and students benefit from working alongside faculty in laboratories equipped with the latest technology. During the summer, Dr. Eric Landahl worked with senior Mary Tarpley, junior Fabricio Marin, and sophomore Andrew Rocco to develop a new apparatus for measuring ultrafast phenomena in semiconductor materials. Using Byrne Hall's femtosecond laser, the group designed, built, and tested a computer-driven delay stage that has a range of 50 cm with an accuracy of nearly one micrometer.

Applications include studying the materials used in solar cells as well as future high-speed computer chips. Fabricio and Andrew were both supported by summer research grants (URAP) from the College of Science and Health. Andrew and Mary also participated in related ultrafast x-ray measurements at Argonne National Laboratory. Dr. Landahl and Mary are co-authors of a journal paper on some of this work that has recently been accepted for publication in the *Journal of Synchrotron Radiation*. In working with Dr. Landahl, Mary commented, "We have learned a lot because his patience and ability to give thorough and clear explanations provide us with a true understanding in what we are doing".

*S. Ross, M. Haji-Sheikh, A. Huntington, D. Kline, A. Lee, Y. Li, J. Rhee, M. Tarpley, D. Walko, G. Westberg, G. Williams, H. Zou, and E. Landahl, "X-Ray Characterization of a Multichannel Smart-Pixel Array Detector," Journal of Synchrotron Radiation (2015 in press).*

## Note from the Chair

This year we welcome over 80 majors, a new office assistant Mary Ann Quinn, and professor (and) provost Marten denBoer to the department. Enrollments in most physics courses are at an all-time high. Our renovated teaching facilities are feeling the strain! This summer many of our undergraduates were engaged in research with faculty, continuing our tradition of involving students in the many areas of physics. Whether in the lab, collaborating with mentors and peers, or traveling domestically and internationally to conferences, students experienced physics in a range of challenging opportunities further developing their skills as future physicists. We look forward to an exciting and productive year in the Physics Department.

 **DEPAUL UNIVERSITY**

College of Science & Health



## Special Recognition

**Dr. Jesús Pando**, Physics Chair, was awarded Outstanding Student Organization Advisor for his mentoring and leadership.

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**Dr. Eric Landahl** served as Chair of the Advanced Photon Source User's Committee for the past year, culminating in the May 2015 User's Meeting entitled "Celebrating the International Year of Light". As Chair, Eric represented the 5,000 users of Argonne National Laboratory, the nation's largest scientific facility.

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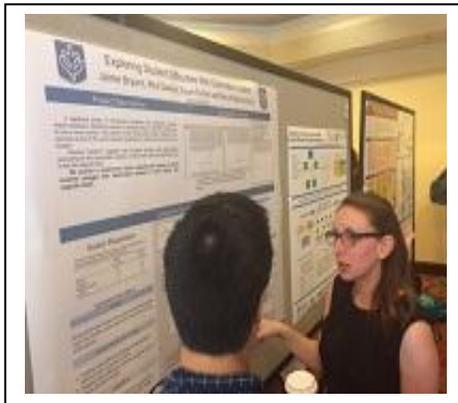
Awarded the National Science Foundation grant entitled "Fundamentals of Amorphous Oxide Semiconductors", **Dr. Gabriela Gonzalez-Aviles**, is one of eight principal investigators. This Interdisciplinary Research Group focuses on understanding and optimizing the structural, electrical and optical properties of amorphous oxide semiconductors that have opto-electronics and photovoltaic applications.

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**Fabricio Marin**, junior Physics major, is the recipient of the McNair Fellowship which prepares undergraduate students for doctoral studies through involvement in research and other scholarly activities.

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Graduate student **Pinyaphat Srikrishna** earned her MS in Physics in July. Her thesis is entitled "Dynamics of Saturable Absorption in the Semiconductor-Doped Glass RG850".



## Summer Experience @ AAPT and PERC

Dr. Mary Bridget Kustusich attended the American Association of Physics Education (AAPT) Meeting and the Physics Education and Research Conference (PERC) this summer with her two research assistants, seniors Jaime Bryant and Rita Dawod. At the PERC, both students presented posters on their summer research.

Rita's research (right), entitled "Exploring Student Ideas about Metacognition", was conducted in collaboration with Dr. Kustusich and the Integrating Metacognitive Practices and Research to Ensure Student Success (IMPRESS) team at Rochester Institute of Technology (R.I.T.). The research, funded by IMPRESS, AAPT, and DePaul's USRP, analyzes video of a pre-enrollment summer program at R.I.T. for first-generation and deaf and hard of hearing STEM students that is designed to help them develop metacognitive skills that will better prepare them for success in college. Rita is working on two papers based on her summer research which will be submitted to both *DePaul Discoveries* and the *International Journal of Science and Mathematics Education*.

Jaime's research (left), funded by DePaul's URAP, was entitled "Exploring Student

Difficulties with Observation Location" and involved analyzing student responses on quizzes to better understand student difficulties with electric and magnetic fields. Jaime also submitted a paper based on her research to the *Physics Education Research Conference Proceeding*, and it is currently undergoing peer review. This research was an initial exploration of an extensive data set from the Spring Quarter PHY 152 classes which includes approximately 180 hours of classroom video and all written work. In reflecting on her experience, Jaime comments, "It was amazing. Many of Dr. Kustusich's colleagues attended the conference with their undergraduates, so we were able to connect with other young individuals who share similar academic passions. The friendships that were formed as a result of Dr. Kustusich's connections and our participation in the conferences are ones that we, the undergraduates, are all actively trying to maintain. Furthermore, having the opportunity to hear and participate in conversations regarding the history of PER, current research and how PER is influencing other fields and pedagogy was extremely enlightening".



## Collaborating About Nanotubes

Under the guidance of Dr. Chris Goedde and funded by URAP in the College of Science and Health, I investigated the behavior of water molecules in nanotubes. The project is a molecular dynamics simulation of the single-file flow of a chain of molecules through a restricted channel called a nanotube. A nanotube can be thought of as a sheet of carbon that is rolled into a straw or tube shape. We are primarily interested in armchair Single-Walled Carbon Nanotubes (SWCNT) are nanotubes with walls only one atom thick, and an armchair nanotube is a type of nanotube that has specific carbon geometry. To look at the motion of water molecules in these nanotubes, we used simulations as both the time and physical scale of the events are so small that it becomes very difficult to perform real world experiments. My goal this summer was to expand on the research of the effect of constant forces acting on water molecules in these armchair nanotubes. Prior research has shown that there is an inherent temperature dependence on the speed at which water can travel through these nanotubes that is in disagreement with the Frenkel-Kontorova model which describes the motion of these systems. This research was done using a carbon nanotube that is fixed, or has every carbon atom as being completely stationary in space and time. To investigate this result, I have replicated the simulations now using a “flexible” carbon nanotube where the nanotube is now affected by the waters. Currently, I am analyzing the results of these simulations and intend to either prove or disprove this result. *By Matt Kwiecien, Alumnus '15*

## Research Projects with Dr. Susan Fischer

Senior Megan Mikota and junior Ali Ryder participated in research projects in collaboration with Dr. Susan Fischer. Both projects are part of a larger embodied cognition study that assess how students learn when they directly experience, or feel, the consequences of physics concepts such as angular momentum, torque, and center of gravity. Funded by URAP, Ali’s work included analyzing answers to multiple choice and free response questions from a pre-lab assignment that introduced students to angular momentum and the right hand rule. Megan’s work, funded by an NSF grant, involved analyzing student work on conceptual questions about center of gravity and collecting data for non-physics participants who were introduced to center of gravity through either through a traditional hands-on approach or through an embodied training in which the participants balanced simple objects (e.g. a meter stick plus a small mass) on their hands.

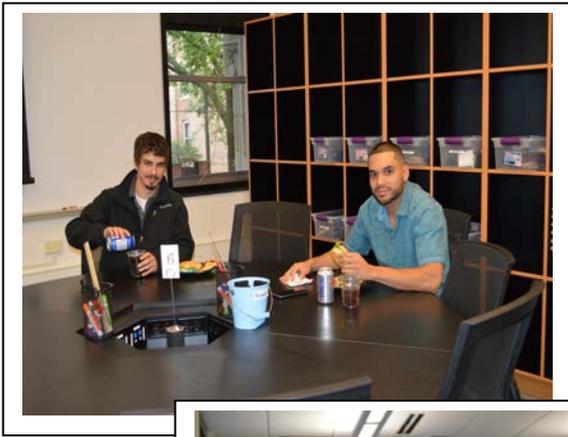
## Meet Sigma Pi Sigma 2015



The Society of Physics Students (SPS), a student led group of physics students and enthusiasts, provides opportunities and experiences to help develop practical and professional skills that can be used in fields like engineering, materials science and computer science. Additionally, the club promotes a community for sharing similar interests and developing long-term relationships within the field.

Both seniors, president Spencer Everett and treasurer Kayla Lynch, are coordinating several exciting opportunities to build these relationships and skills. This year, they have completed the construction of a radio telescope and will conduct their first observation in the coming weeks! They are also working on a muon detector. On September 28, they viewed the lunar eclipse at the Adler Planetarium where they captured some amazing photographs. Visit their Facebook page to see their pictures.

Upcoming events include a stargazing/camping experience, movie gatherings, and other physics projects.



More than 30 physics graduate and undergraduate students enjoyed lunch and mingled with the faculty in the annual **Welcome Back Celebration** on September 18. Our Chair, Dr. Pando opened the gathering by welcoming everyone to the event paying special recognition to the graduate students (bottom right). Students conversed with each other and their professors, even learning a few fun facts about our faculty. SPS also shared information about their upcoming club activities.

## **News-worthy Alumni, Graduates and Undergraduates**

Professor Emeritus **John Milton** currently serves as a mentor for the high school physics teacher in both regular track and AP at Cristo Rey St. Martin College Prep (CRSM) where he provides ideas and materials for enhancing the physics laboratory.

**Matt Rickert '11** is pursuing his PhD at Northwestern University. Matt spent the summer working on observations of water masers toward the Galactic Center at the National Radio Astronomy Observatory in Socorro, New Mexico. Dr. Sarma was able to visit his former student this summer at the NRAO.

**Bridget McEwen '11** will be in a Pre-Doctoral position at the National Radio Astronomy Observatory next year.

Graduate student **Dylan Smith** is working on analyzing x-ray synchrotron data collected on zinc- and strontium-doped hydroxyapatite samples (synthetic bone) to study their phase evolution as a function of temperature and to better understand the zinc-strontium-doping mechanisms in these materials. In October, he attended the APS National Mentoring Community & Bridge Program Conference in Florida.

Graduate student **Thomas Bsaibes** and senior **Joe Boesso** are collecting and analyzing e-ray synchrotron data for Dr. Gonzalez-Aviles project for the NSF grant "Fundamentals of Amorphous Oxide Semiconductors".

Under the guidance of Dr. Gonzalez-Aviles, seniors **Jennifer Rodriguez** and **Mary Tarpley** worked in the Physics lab this summer to continue research on aluminum-doped zinc oxide transparent conductors. They are preparing a publication of their results.

Senior **Jaime Bryant** is student teaching physics prep to high school juniors and seniors and physical science to freshmen and sophomores.

Graduate **Mir Iqbal** completed the final stages of his research entitled "The Phase Stability and Crystal Structure of Aluminum-Doped Lithium Lanthanum Ziconate Materials" and is in preparation for publication.

**DePaul Physics Alumni:** *What are you doing since graduation? Please email the department at [www.physics@depaul.edu](mailto:www.physics@depaul.edu).*

## eBOSS Presented at SDSS Meeting

One of the most exciting prospects for students in astrophysics is the chance to participate in leading edge research and then to present it at a scientific conference. As research assistants for Dr. Jesús Pando, graduate student Kevin Kadowaki, and junior Noel Garcia and sophomore Taurean Ford attended the Sloan Digital Sky Survey (SDSS-IV) Collaboration Meeting in Madrid, Spain at the Instituto de Física Teórica in July. SDSS attempts to survey all objects in the northern sky. The DePaul team is specifically working on the extended Baryon Oscillation Spectroscopic Survey (eBOSS) which maps galaxies and quasars at redshifts out to six. The objective of eBOSS is to quantify large scale structures and help determine basic cosmological parameters. Funded by a grant from the Sloan Foundation, the DePaul team is part of FAST program within SDSS which aims to encourage more undergraduates to participate in leading edge research.



Taurean Ford, Noel Garcia, and Kevin Kadowaki

At the meeting, Dr. Pando presented the group's results on measuring the matter power spectrum from the eBOSS galaxy survey. The group continues to refine their approach and is laying the groundwork on the latest data release from SDSS. As part of the SDSS collaboration, the group has full rights to the data. Working with partners from Carnegie Mellon University, the group hopes to publish its work on the new data release next summer.



Dr. Beck-Winchatz, Justin Potvin, Kayla Lynch, Camille Ellis, Samuel Montag, & Krzysztof Skwirut

## DePaul Astrophysics Working Group

DePaul professors embrace teaching as well as mentoring students in many subjects within the "world of physics". Our program strengthens students in a variety of inter-disciplinary topics including astrophysics. In April, Dr. Jesús Pando and Dr. Anuj Sarma of the Physics Department, along with Dr. Bernhard Beck-Winchatz of STEM Studies, formed the DePaul Astrophysics Working Group, better known as DAWG, to explore opportunities for collaborative research in astrophysics. The group recruited five physics undergraduates including seniors Kayla Lynch, Samuel Montag, and Justin Potvin, and juniors Krzysztof Skwirut and Camille Ellis. During the summer, these students conducted research on exoplanets, which are planets that orbit stars other than the Sun.

Exoplanets are of high interest in the astrophysics community because they can help us understand how our own solar system formed and evolved, as well as the possibility of discovering an Earth-like exoplanet with the potential to harbor life.

The students' research focused on two main methods for detecting exoplanets. The transit method is based on high-precision light intensity measurements to detect the slight dimming of a star when an orbiting planet moves in front of it and blocks some of its light. The radial velocity method is based on measuring the periodic motion of a star caused by its planet's gravity. Funded by URAP, the students continue to collaborate and will present their work at the 2015 Science Undergraduate Research Showcase on Friday, November 6<sup>th</sup> in McGowan. Stop by to see their presentation.