American Physical Society New England Section Newsletter

Volume 23, No. 1 Spring 2017

Co-editors

- Edward Deveney
- Peter K. LeMaire

Inside this issue:

Theme: Nanoscience and biophysics

At the nanometer scale, many disciplines converge into nanoscience and biophysics. The 2017 Spring meeting of the New England Section of the APS, along with NanoWorcester, will focus on these topics.

Invited speakers include:

Bryan Huey (University of Connecticut) SPM studies of ferroelectric domains in perovskite photovoltaics
Milicent Firestone (Los Alamos National Labs) Soft-matter and biophysics
Suzanne Scarlata (Worcester Polytechnic Institute) Membrane biophysics
Charles Schmuttenmaer (Yale University) Carrier dynamics in solar energy materials
David Weitz (Harvard University) Colloidal Nanomaterials for Biomolecular Sensing

Friday Night Banquet Speaker:

Larry Bell (Boston's Museum of Science) *Informal nanoscience education*

For registration, travel and lodging information, and an up-to-date conference schedule, and workshop information, please visit the meeting website at apsspringnes.wpi.edu/

For questions, please send email to Nancy Burnham (nab@wpi.edu)

News from Spring 2017 APS-NES Host and Meeting at WPI, Worcester, MA

WPI Ranked Top in the Nation for Quality and Accessibility of Professors

The Wall Street Journal/Times Higher Education College Ranking has devised a new ratings system that strives to recognize universities focused on doing an outstanding job of educating students, unlike many other rankings which applaud universities for simply being exclusive. This new ranking is specifically focused on the teaching performance of U.S.-based colleges with over 1000 students. Within this ranking, WPI has rated first in the nation for the category of "The Top Faculties; Schools that do the Best in Combining Scholarly Research with Classroom Instruction."

The article "Where Great Research Meets Great Teaching," which appeared in the September 28, 2016 issue of *The Wall Street Journal,* noted that, "Some schools hire brilliant professors whose research expand the boundaries of their academic discipline. Others attract great teachers who inspire and engage their students. A handful, like Worcester Polytechnic Institute in Massachusetts and Pomona College in California, can boast they offer both."

The article also noted that "To gauge both the quality and accessibility of professors, *The Wall Street Journal/Times Higher Education College Ranking* looked at how many research papers per faculty member each school produced and asked student to rate on scale of 0 to 10 how accessible their professors were to them and to what extent the school provided them with opportunities for collaborative learning."

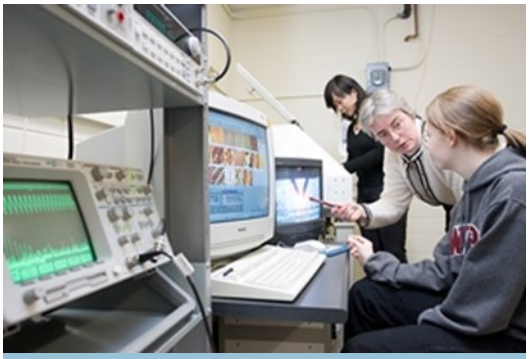
WPI's Project Based Learning around the World

Projects are at the core of the WPI curriculum, requiring students to apply the knowledge learned in classes and labs to real-world situations, developing solutions to problems that matter to real people. Project work helps students become better collaborators, critical thinkers, public speakers, and communicators— vital to success at WPI and the skills that distinguish WPI graduates throughout their careers.

Our signature project-based approach to undergraduate education, known as the WPI plan, prepares students for success. These great young minds bring ingenious approaches to an astounding array of challenges--and the projects fundamentally change the students, building leaders who possess passion, proficiency, and a

certainty that their life's work can change the world.

Nancy A. Burnham (center, in the Atomic Force Microscopy Laboratory), Associate Professor of Physics and Biomedical Engineering, is the site leader for the Switzerland Project Center. A country with robust scientific and technological production, an excellent education system, and a strong international outlook, Switzerland is a natural fit for WPI's project program. Students traveling to Switzerland work with local universities, government agencies, and nonprofits to

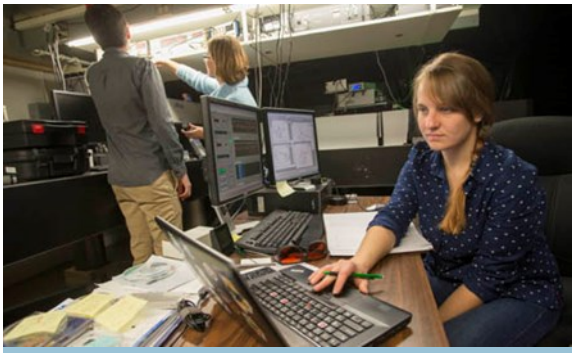


Atomic Force Microscopy Lab with Nancy Burnham (center)

Clare Boothe Luce Research Undergraduate Research Scholars at WPI

Lyubov Titova (Physics), Suzanne Weekes (Math), Sarah Olson (Math), Kathi Fisler (Computer Science), Carolina Ruiz (Computer Science), are in the second year of the Henry Luce Foundation award for Clare Boothe Luce Research Scholar Awards to support undergraduate women in Math, Computer Science, Physics, and Robotics Engineering. This grant supports eight undergraduate research awards per year over a three-year period.

Since its inception in 1989, the Clare Boothe Luce Program has been one of the most significant sources of support for women seeking to study science, engineering, and mathematics. These awards recognize the students' academic accomplishments and provide them with the opportunity to deepen their education by working on a research project closely with a Luce faculty mentor throughout the award and a research advisor. This grant to WPI is very significant for the talented young women whose research work it will support, and who will have the distinction of being a Luce Research Scholar on their professional resumes. The grant also represents success for WPI in an intensive grant competition at a highly regarded national-level private foundation.



Claire Boothe Luce research scholar

News from Spring 2017 APS-NES Host and Meeting at WPI, Worcester, MA

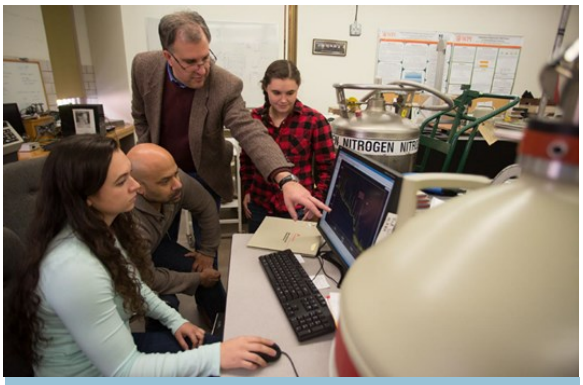
Physics PhD Launch Program

Interested in applying to a doctoral program in physics? Take the first step in this academic Career with the Physics PhD launch program at WPI, a Saturday afternoon program on April the 15th following the APS-NES meeting for students to learn how to prepare a competitive graduate school application. Participants take part in a variety of interactive sessions, get feedback from the faculty and ask questions. Session topics include: Finding a program that is right for you, Preparing a good Curriculum Vitae (CV), Writing an effective personal statement, Preparing for the GRE Subject test, Looking for financial support, Preparing for a visit or online interview, You were accepted, What's next? You will also get a chance to meet graduate students to learn from their experiences. There is no registration fee. WPI will cover the meals and refreshments during the workshop and arrange parking. At the conclusion of the workshop, participants will receive a certificate of completion. Space is limited and admission to the workshop is competitively determined. Women and traditionally underrepresented minorities are especially encouraged to apply. For more information, please visit wpi.edu/+physicsphdlaunch

WPI Receives More Than $1.1 Million in Awards from the Nuclear Regulatory Commission

The Nuclear Regulatory Commission (NRC) has awarded WPI four nuclear education grants totaling more than $1.1 million for scholarships, fellowships, curriculum development, and medical and health physics research within its revitalized Nuclear Science and Engineering (NSE) Program. WPI currently offers a concentration within the physics major at the undergraduate level and a graduate certificate, including an on-line option.

The program is directed by David C. Medich, Associate professor of Physics, who joined the WPI faculty in 2012. His group performs experimental and computational (Monte Carlo) research in the field of applied nuclear physics with a focus on Medical and Health Physics. Presently his research group is investigating: the development of a unique technique to enable high-resolution in-vivo functional imaging using neutrons, the adaptation of a 169Yb brachytherapy source to enable localized intensity-modulated radiation therapy, the creation of a field-deployable device for radiological and topological characterization, and are analyzing the time-dependent resuspension of radioactive Am-241 into the atmosphere. He is always interested in having new students at both the undergraduate and graduate level join our research program. He is a qualified expert and consultant for the International Atomic Energy Agency who earlier in his career conducted research on the efficacy of high-dose-rate brachytherapy treatment while a senior radiation physicist at Implant Sciences Corporation.



David C. Medich (second from right), with students

WPI's NSE program focuses on energy, medicine, the environment, and economics. It draws on the university's traditional strengths in mechanical engineering (thermodynamics, materials, power generation and transfer), electrical and computer engineering (power controls and distribution), and chemical engineering (processes and materials), along with its expertise in the life sciences (medical physics, radiology, biomedical engineering), environmental engineering, and sustainability.

Using Neutrons to Shed Light on Diabetes

With neutron reflectometry technology at Los Alamos National Laboratory, a research team that included Izabela Stroe, an Assistant Teaching Professor at WPI, explored the role that amyloid polypeptides may play in the onset of type 2 diabetes.

Amyloid polypeptides are short chains of amino acids that have been linked to a variety of diseases, including Alzheimer's and Parkinson's. Their tendency to aggregate into fibers leads to the disruption of the normal functioning of cells and organs. In a recent paper published in the journal Langmuir ("Influence of the Human and Rat Islet Amyloid Polypeptides on Structure of Phospholipid Bilayers: Neutron Reflectometry and Fluorescence Microscopy Studies"), WPI physicist Izabela Stroe, PhD, in collaboration with colleagues at Los Alamos National Laboratory, the University of California Davis, and Yale University, reported on discoveries that shed new light on the role of amyloid polypeptides in type 2 diabetes, the seventh leading cause of death in the United States.

While the genesis of diabetes remains unknown, it is clear that the disease occurs when cells in the periphery of the body become less sensitive to insulin. Beta cells in the pancreas then step up their production of the hormone, which regulates blood glucose. Along with insulin, the beta cells produce islet amyloid polypeptide (IAPP). As insulin production increases, the excess amyloid molecules begin aggregating into fibers. Somewhere along the way, the beta cells begin to die (leading to insulin deficiency) through an as yet unknown mechanism that appears to involve damage to the cell membranes.

To get a better idea of the process that may lead to beta cell death, the research team conducted studies of the interaction of human IAAP and rat IAAP with several model cell membranes. Rat IAAP, which differs from the human variant by only a

News from Spring 2017 APS-NES Meeting Host - WPI, Worcester, MA

Izabella Stroe

few amino acid sequences, was used because it does not form fibers; in the studies, it appeared to have no interaction with the membranes, leading the researchers to conclude that the beta cell damage is connected with amyloid fibers.

Using specialized equipment at Los Alamos, the team observed what happened to the model membranes when they came in contact with human IAPP. One of the tools they used, neutron reflectometry, is able to produce images of the membranes with high spatial resolution due to the way neutrons scatter from biological objects. The images showed that membranes with negatively charged and unsaturated lipids were particularly vulnerable to damage from the positively charged aggregated amyloid molecules. Since the negatively charged lipids tend to be in the inner leaflet of cell membranes, the researchers speculated that defects in the membrane might be an entry point for the IAAP fibers.

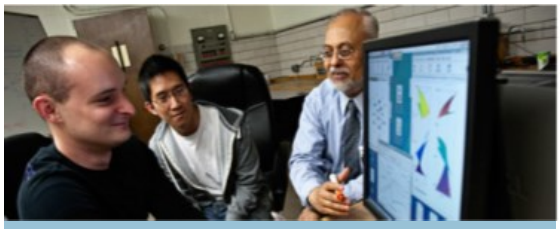
"There is more work to be done to fully understand how the amyloid fibers and the lipids in the membrane interact to produce membrane disruption," Stroe says. "This knowledge could be crucial in developing strategies to counter the development of type 2 diabetes and physiochemically similar neurodegenerative diseases like Alzheimer's."

WPI Physics Professor Is Elected Fellow of the American Association for the Advancement of Science

L. Ramdas Ram-Mohan, professor of physics at WPI, has been elected a Fellow of the American Association for the Advancement of Science (AAAS), the world's largest general scientific society. *Ram-Mohan was elected by the AAAS Section on Physics "for major contributions to the development of computational algorithms and important advances in theory of electronic and optical properties of solid state and semiconductor materials."*

Since joining the WPI faculty in 1978 he has developed an international reputation as a pioneer in solid-state physics, a field that has helped propel extraordinary advances in the speed and power of computers, telecommunications systems, lasers, and other high-tech devices. In addition to exploring the quantum mechanical properties of condensed matter, Ram-Mohan has developed powerful computational tools that have made it possible to predict with great accuracy the properties of increasingly complex semiconductor and optoelectronic devices and to precisely control the design of these ubiquitous systems.

The director of the university's Center for Computational NanoScience, Ram-Mohan's work on high-energy physics, condensed matter, and semiconductor physics has resulted in more than 200 peer-reviewed publications that have garnered more than 3,800 citations. He is also the founder of wavefunction engineering, a method for specifying certain quantum properties of semiconductor heterostructures—assemblies of two dissimilar semiconductor materials that display unique electrical or optoelectronic properties. This innovative method arises from the application of the finite element method, or FEM, a numerical analysis technique used widely in engineering, to quantum heterostructures.



L. Ramdas Ram-Mohan (right)

Ram-Mohan, recognized as one of the foremost authorities on FEM, described this new field in his landmark 2002 book, *Finite Element and Boundary Element Applications to Quantum Mechanics*. He is also the founder of Quantum Semiconductor Algorithms Inc., which he established to commercialize his software for designing quantum semiconductor heterostructures. In 2012 he was named a Coleman Fellow at WPI in recognition of his entrepreneurial experience and expertise.

In Memory of Steve Jasperson

Steve Jasperson, who taught physics at WPI for 39 years, died Oct. 5, 2016, in Plymouth, Minn., after a long struggle with supranuclear palsy (PSP). He was 75. Described as "pumped about physics," his devotion to teaching and to his field inspired colleagues and earned praise from students.

Jasperson grew up in central Wisconsin, where he worked in his family's cranberry marsh and developed a deep love of the outdoors that carried through his life. Educated in a two-room schoolhouse in grade school, he went on to become valedictorian of his class at Port Edwards High School. He earned his bachelor's degree in physics from the University of Wisconsin, Madison, where he met his wife, the former Ann Eckstein.

The couple moved to New Jersey, where Steve earned a master's degree and a doctorate in physics at Princeton University. After completing postdoctoral research at the University of Illinois at Champaign-Urbana, he joined the WPI faculty in 1970 as an assistant professor. He rose to associate professor in 1975, and as full professor in 1992. He served as department head from 1984 to 1994, and also served a term as secretary of the faculty.

At WPI, Jasperson was recognized as a key contributor to the quality of the first year experience. He was known for devoting time to help students master key concepts and prepare for exams, both in and outside the classroom. He taught a wide range of undergraduate and graduate courses, but his specialty was solid-state physics, with research that included optical detection of plasma oscillations in metals and semiconductors.

For a time, he co-taught an undergraduate seminar on electronic music, along with music professors from Clark University and the College of the Holy Cross, as part of the Tri-college Group for Electronic Music. His role was to bring in the scientific perspective to help students understand the physical attrib-

...continued on page 5

In memory of Ed Eyler

Edward Eugene Eyler passed away at his home in Coventry, Connecticut on September 19, 2016, at the much-too-young age of 61. He had battled colon cancer for several years, but motivated by his dedication to physics, continued working in the Physics Department at the University of Connecticut to within days of his death. He is survived by his loving wife Karen Greer, his parents Mary and Gene Eyler, his sister Marian Harmount and her husband Scott, as well as sisters-in-law Joyce, Janice, and Elizabeth Greer and Christine Collymore, and many nieces, nephews, and cousins.

Ed was born in Akron, Ohio on March 8, 1955. He received his BS in Physics from MIT in 1977, and his PhD in Physics from Harvard in 1982, where he worked with Frank Pipkin on precision laser spectroscopy and excited-state lifetime measurements of molecular hydrogen. After a brief postdoctoral appointment at Harvard, Ed joined the Physics Department at Yale as an assistant professor. He then spent several years in the Physics Department at the University of Delaware, before coming to the University of Connecticut as a Professor of Physics in 1995.

Ed's research spanned a wide range of topics in experimental atomic, molecular and optical physics, resulting in over 90 publications. Early in his career, he focused on precision laser spectroscopy of atoms, mainly helium, and molecules like hydrogen (H_2) and nitric oxide (NO). He was a pioneer in developing techniques for the production of precise pulses of ultraviolet light and using these laser systems to access excited states, including highly-excited Rydberg states, of the species under study. Highlights included precise measurements of the dissociation and ionization energies of molecular hydrogen, and, in collaboration with colleagues at NIST and Australia National University, a determination of the helium ground-state Lamb shift via precise two-photon spectroscopy. After relocating to the University of Connecticut, Ed expanded his interests by collaborating with Phil Gould and Bill Stwalley on ultracold Rydberg gases and ultracold molecules. The Rydberg work included ionization dynamics, molecular resonances, forbidden transitions, superradiance, and the first demonstration of the excitation blockade. The molecular work encompassed photoassociative molecular formation of various alkali dimers, resonantly-enhanced multiphoton ionization (REMPI) detection, spectroscopy of unusual states, and resonant coupling between excited states. He also pursued experiments on the bichromatic force, a potential means of rapidly decelerating a molecular beam. Ed had a real knack for technical details, especially in the areas of lasers, electronics, and computers. He developed a large number of microcontroller-based circuits which were used in a variety of experiments.

Ed was a valuable member of the UConn Physics Department, as well as the physics community as a whole. He was a Fellow of the American Physical Society (APS), helped establish the APS Francis M. Pipkin Award and later chaired the Award Committee, and served on the Executive Committee of the APS Topical Group on Fundamental Constants and Precise Tests of Physical Laws, as well as the Editorial Board of Physical Review A. He spent productive sabbaticals at JILA (2007) and MIT (2015). At UConn, he chaired the Space Committee for many years, and devoted a great deal of effort to developing new labs for the optics, electronics, and advanced lab classes. In recognition, the labs for these courses are now named in his honor. Ed taught a variety of classes at both undergraduate and graduate levels, including electricity & magnetism, optics, lasers, atomic physics, electronics, and the advanced lab sequence. He was a dedicated and effective teacher who always had the best interests of his students in mind.

Although Ed worked extremely hard, he also knew how to enjoy himself. He was an avid outdoorsman who enjoyed back-country skiing, biking, back packing, and photography. A 100 mile bike ride or a 20 mile alpine hike were nothing out of the ordinary for Ed. He was always up for a challenge - the steeper the hill or mountain, the better.

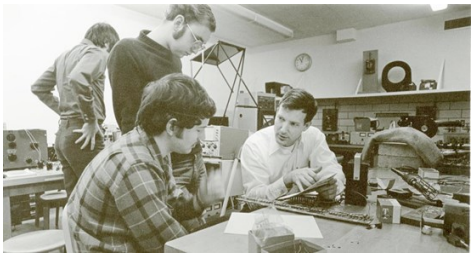
Ed was a dedicated citizen of the Physics Department. He was devoted to pushing the frontiers of science and advancing the careers of his students and colleagues. He will be sorely missed and fondly remembered.

Submitted by:
Phil Gould and Bill Stwalley
Physics Department
University of Connecticut , Storrs

…Jasperson cont'd

utes of what they were hearing. Jasperson's own musical endeavors included singing with the Worcester Chorus and playing the piano.

Through the Tri-College Group, which included concerts and grant writing, the professors were able to equip electronic music studios at their respective colleges. Jasperson reached out to WPI alumnus Alan R. Pearlman '48, inventor of the ARP synthesizer, and was able to add four of Pearlman's machines to WPI's studio in Olin Hall. "Sound is something we all take for granted," he said in a 1988 WPI Journal article about the unusual collaboration. Pointing out that sound is also fundamental to communication and in monitoring conditions around us, he would tell his students, "I hope you never hear sound in the same way again."



In 2001 Jasperson was honored with the WPI Board of Trustees' Award for Outstanding Teaching. Nominations from students and alumni described him as a skilled instructor who genuinely loved physics and enjoyed sharing his enthusiasm with students. "He's pumped about physics," said one student. "His door is always open," said another. A faculty nominator expressed admiration for Jasperson's demonstrations of fundamental principles and confessed, "I have regularly stolen his ideas in my own teaching."

Jasperson retired from WPI as professor emeritus in 2008, but continued to share his love of physics with senior citizens, teaching courses in the WISE (Worcester Institute for Senior Education) program.

Recap of the Fall 2016 Meeting at MCLA

The Fall 2016 Meeting of the APS New England Section took place at Massachusetts College of Liberal Arts (MCLA) in North Adams, MA on October 28 - 29, 2016
The theme of the meeting was "Undergraduate Research: Pedagogy and Possibilities." All agree that undergraduate research is a key learning component for physics students. At this meeting, talks and posters highlighted research done with undergraduates and explored some of the possibilities for research at undergraduate institutions.

Friday, October 28

The meeting began with welcomes from MCLA's Dean of Academic Affairs, Monica Joslin and chair of the physics department, Emily Maher. This session took place in MCLA's Feigenbaum Center for Science and Innovation. The first talk, "Precise measurements of atomic structure in heavy atoms with undergraduates at Williams College," was given by Tiku Majumder of Williams College. In addition to explaining his research, Dr. Majumder shared with the audience his experiences of building and maintaining a cutting-edge lab at an undergraduate institution.

Tiku Majumder giving his invited talk

The second talk, "Fostering undergraduate research at small institutions: the role of instructional labs," was given by Gabe Spalding at Illinois-Wesleyan University. Dr. Spalding introduced the audience to ALPhA (The Advanced Laboratory Physics Association, www.advlab.org) and how this group supports physics laboratory experiences for undergraduates beyond the first year.

Gabe Spalding giving his invited talk

After a short break, the poster session took place across the street at the Church Street Center Social Hall. The banquet followed in the same room. Students who elected not to buy banquet tickets were treated to pizza with MCLA's physics majors in the physics common room, and those students joined the larger group for dessert and the keynote talk by Chad Orzell of Union College, "Discovering Your Inner Scientist." In his talk, Dr. Orzell explained how doing science is a part of everyday life, and activities like card games, puzzles, and sports use the same part of our brain as does scientific inquiry.

Saturday, October 29

Saturday morning started off with a Continental breakfast between 8 am and 9 am in Murdock Hall's Samner Room, fol-

Recap of Fall 2016 Meeting…

Chad Orzel giving Banquet talk

Chantale Damas giving her invited talk

lowed by two parallel sessions of contributed talks.
Three invited talks followed the parallel sessions:

Chantale Damas of Queensboro Community College presented "Undergraduate Student Research and Education Program in Space Weather at a Community College." Dr. Damas shared with the audience how she and QCC have utilized grants from NSF and NASA to create year-round research experiences for 1st- and 2nd- year students in solar and atmospheric physics.

Erin Kiley of MCLA presented "Reduced-Dimensional Coupled Electromagnetic, Thermal, and Mechanical Models of Microwave Sintering." Dr. Kiley, an applied mathematician, outlined how she uses partial differential equations to model heat flow, current, and stress in sintered materials, and she demonstrated some ways to involve students in the work of modeling complex systems.

Ben Shumacher of Kenyon College presented "Quantum flows of probability and heat." Dr. Shumacher explained how he and his students use probability currents to study heat and work flows in quantum thermodynamic systems, including the tiniest possible heat engines

The meeting ended at 12:45 pm and was followed by the meeting of the Executive Committee.

Erin Kiley giving her invited talk

Ben Schumacher giving his invited talk

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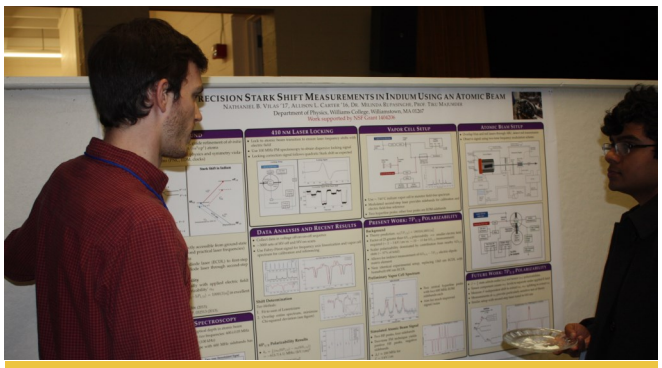
APS physics

Recap of Fall 2016 Meeting… Contributed & Poster Sessions

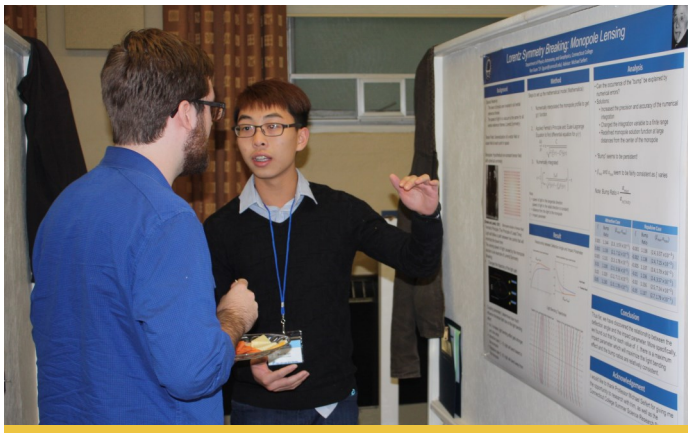
David Kraft, University of Bridgeport, presenting contributed talk "*Evolution of Asteroid Orbit in a Restricted Three-Body Problem Simulation*"

Ashay Patel, Williams College, presenting contributed talk "*Investigation of Losses in Four-Wave Mixing Squeezed Light Experiments*"

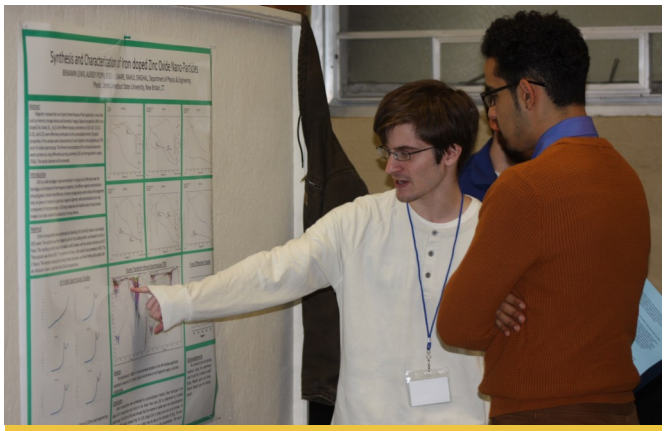
Olivia Comeau (right), University of Massachusetts, presenting poster on "*Parallel Implementation of the Dirac Equation*"



Nathaniel Vilas (left), Williams College, presenting poster on "*High-precision Stark shift measurements in excited states of indium using an atomic beam*"

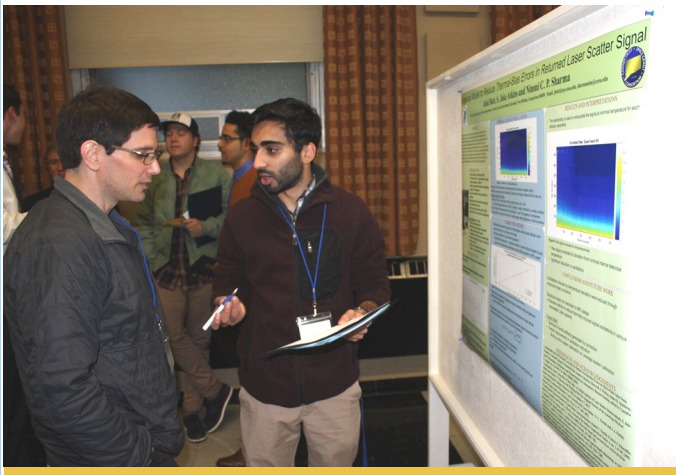


Ben Guan (right), Connecticut College, presenting poster on " *Lorentz symmetry breaking: monopole lensing*"

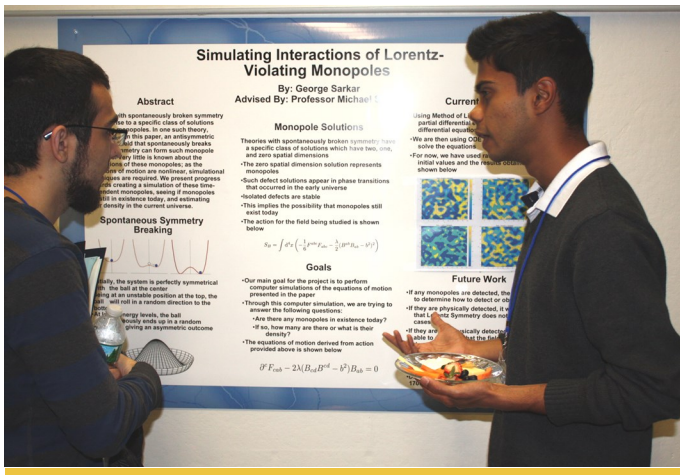


Benjamin Lewis, Central Connecticut State University, presenting poster on "*Synthesis and characterization of iron doped zinc oxide nanoparticles*"

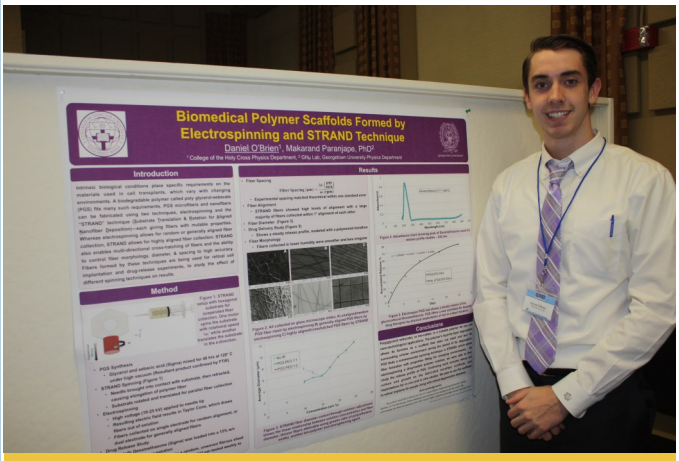
Recap of Fall 2016 Meeting…



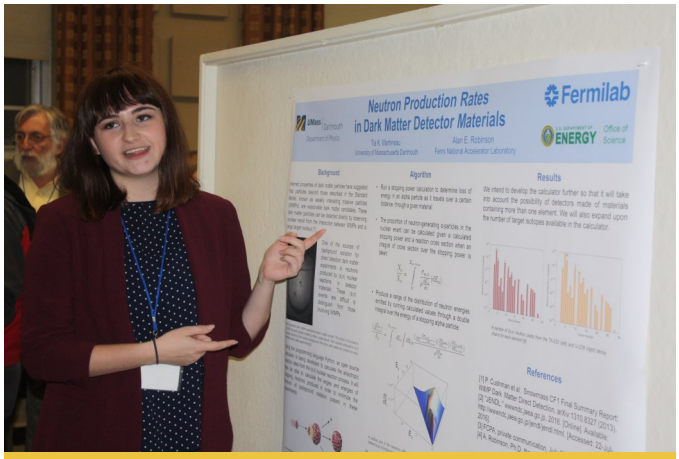
Jalal Butt (right), Central Connecticut State Univ., presenting poster on "*Empirical model to reduce thermal-bias errors in returned laser scatter signals*"



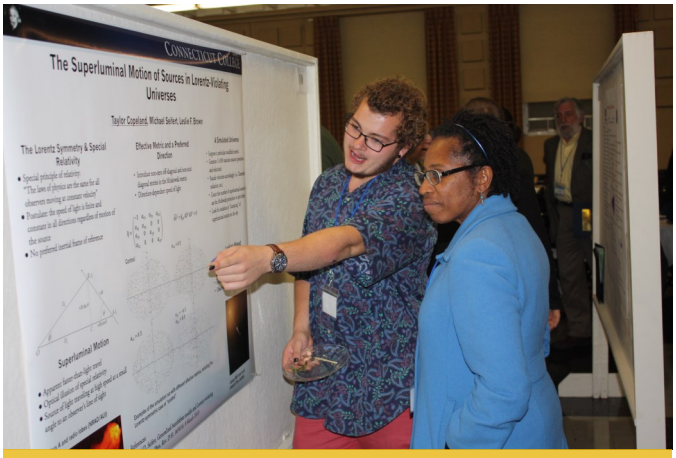
George Sarkar (right), Connecticut College, presenting poster on "*Simulating interactions of Lorentz-violating monopoles*"



Daniel O'Brien, College of the Holy Cross, presenting poster on "*Biomedical polymer scaffolds formed by electrospinning and STRAND technique*"



Tia Martineau, University of Massachusetts-Dartmouth, presenting poster on "*Neutron production rates in dark matter detector materials*"



Taylor Copeland (left), Connecticut College, presenting poster on "*Superluminal motion of sources in Lorentz-violating universes*"

Eli Hoenig, Williams College, presenting poster on "*Precise measurements of hyperfine structure, isotope shifts, and transition amplitudes in thallium, indium, and lead atoms using vapor cell spectroscopy*"

Recap of Fall 2016 Meeting…

Kebra Ward, MCLA, moderating one of the Contributed Sessions

Adrienne Wootters, hostess of the Fall 2016 meeting, MCLA, at the opening session

Invited speaker Chantale Damas (left), chats with meeting attendees during the reception before the Banquet

Invited speakers Chad Orzel (left) and Tiku Majumder (right) chat during the reception before the Banquet

James O'Brien (right), and Ed Deveney (left) chat during the reception before the Banquet

Allan Wuosmaa, APS –NES Chair (right), and John Collins, APS-NES Past Chair, chat during the reception before the Banquet

A Physics Career in Industry

A degree in physics can lead to a career in a variety of professional disciplines. Although it is still common for many undergraduate physics majors to pursue advanced degrees and academic positions, an increasing fraction are choosing employment in other sectors including finance, software, defense, robotics and medicine. Some of these careers are in government laboratories or government funded research groups, but the majority are in the private sector. Some positions require advanced degrees, but many do not. The American Institute of Physics offers an excellent survey of Initial Employment of Physics Bachelor's [https://www.aip.org/sites/default/files/statistics/employment/bachinitemp-p-12.1.pdf] This article describes my own career development to a senior position in a medical device company. I hope this will provide useful insight to newly minted, and soon to be minted, physics undergraduate majors.

As an undergraduate I did not have a set career path and spent freshman and sophomore years selecting a major. I sampled pre-medicine, but found the required rote memorization tedious. Having strong technical, analytical and mathematical skills I next chose engineering. I enjoyed those classes and still remember a few specific lectures quite clearly, one on the Gray code (cool binary logic) and another on thermodynamics (every student radiates like a 75 Watt light bulb and that's why it's so darn hot in the classroom). I did not enjoy homework particularly, but the problem sets were challenging and rewarding. It was satisfying to work hard at the "puzzle," often with a small team of fellow students, and arrive at a solution you were confident was correct even before the assignment was graded. However, despite being generally satisfied with the engineering curricula, I went in another direction after taking the modern physics class which was a requirement for the engineering major. This class was outstanding and inspirational. The elegance of special relativity, the quantum mathematics which solved the ultraviolet catastrophe in blackbody radiation, our laboratory on Milikan's oil drop experiment, and the incredible scaling of nuclear energy and power were just a few of the educational gems that led me to switch majors. Further, the classes were small and the other students also had strong analytical and mathematical and reasoning skills. This created a rich learning environment. Since I was starting a new major late, at the end of sophomore year, I had to scramble to complete all the requirements. I was able to double up by taking some classes in other departments including quantum chemistry and geophysics so that I could graduate with my own class. One of the last courses I took was a memorable plasma physics course with Professor Mary Hudson. At the end of the term, in 1985, I wrote a paper on nuclear fusion and the technical challenges of the tokomak reactor. More than thirty years later this is still an active challenge for the world's scientists and engineers! My experience in this class was in some measure responsible for my later return to graduate school and my concentration in accelerator science and technology.

In grad school….

In 1990 I enrolled in the physics graduate program at Boston University. After spending a few years away of school, working at various jobs and spending significant time out of doors in the White Mountains and on a continental divide trek in the Rockies, I was focused and ready to study hard. The incoming class of twenty PhD candidates was a near equal mix of students from the United States and students from other countries. The geographic list included China, India, Iran, Italy and England to name a few. I enjoyed meeting this diverse group whose experiences and cultures were quite different from my own. I recall one of the foreign students expounding on the fantastic qualities of the Indian Sanskrit epic, the Mahabarata which was then being dramatized on public television. I dove into the drama and my homework suffered a small bit. While I felt that my educational preparation and competency were comparable to that of my counterparts from the U.S. I was amazed and somewhat intimidated by the brilliance and mastery of many of the foreign students in subject areas that were brand new to me. The first two years of graduate school challenged me academically to a degree that far exceeded any previous experience. The professors were excellent, but the material was difficult to master. The classic electromagnetism course with the tome-like JD Jackson textbook was particularly challenging. In one statistical mechanics exam the average grade was a 27% even after accounting for the 92% grade of one of the Chinese students. I studied very hard and managed to pass the qualifying exam which allowed one to pursue a PhD. While all of the foreign students also passed, some without any apparent effort, a few of my colleagues from the United States were not so fortunate. This time up and though the exam was quite stressful, but I am proud of what I learned and of my ability to pass that bar.

After the qualifying exam we selected thesis advisors (or they selected us) and began the long and somewhat indeterminate process of identifying and completing a thesis worthy of a PhD. A good thesis advisor is absolutely one of the most important parts of a physics graduate degree. I am forever indebted to Ed Booth, my own advisor, for the help and guidance he provided me as I finished the second half of my graduate experience and began my professional career. During this time I began to concentrate on Accelerator science. Professor Lee Roberts arranged for me to attend several United States Particle Accelerator Schools, http://uspas.fnal.gov/. These excellent programs, offered in two week intervals once or twice a year were exciting and challenging. They put us in touch with the some of actual builders of some of the larger U.S. accelerators at Fermilab, Brookhaven and SLAC. I spent two summers working on an experiment at Brookhaven before settling on a thesis experiment with Ed and William Turchinetz on an electron storage ring at the smaller MIT Bates Accelerator Laboratory.

Following graduate school I stayed on at the Bates laboratory. This small lab of 70 employees just North of Boston is run by MIT and funded by the United States Department of Energy. We provided precision high energy polarized electron beams up to one Gigavolt and high resolution

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spectrometers which academic researchers used to measure the fundamental structure of light nuclei. The lab included all manner of magnets, cryogenics, computers, control systems, ultra-high vacuum chambers, particle detectors, electromagnetic modeling software, lasers, high power microwave sources and accelerating structures. Due to the limited number of employees at the lab and my own wide ranging interest I was fortunate to work on, and gain experience with, most of these systems. I am extremely grateful for this opportunity especially considering the experience of some of my classmates who, as students and then as young professionals, worked on much more narrowly focused projects in larger laboratories. At MIT Bates the team included many very talented engineers, technicians, researchers and students. The researchers and students came from colleges and universities across the country. The professional mix at the laboratory was also diverse, including staff from Russia, Iran, Germany, Ireland, China, Switzerland, Italy, Canada and other countries. This made for fascinating dialog around the lunch table and was culturally enriching and personally rewarding.

When I turned 40 and the MIT Bates lab completed a decade long program of measurements I began to consider other professional opportunities. I was fortunate to be approached by Ken Gall (Boston University PhD 1991) who had recently launched a medical device company to produce an ultra-compact gantry mounted proton accelerator to treat cancer. I was just the fifth employee so this was an exciting time with rapid growth and extreme pressure to deliver on the development of the technology. The proton accelerator is a miniature superconducting synchrocyclotron with a diameter of only one meter and a peak magnetic field of more than ten Tesla. The development of this device was an ideal project for me as it combined aspects accelerator technology that I used at the Harvard Cyclotron Laboratory, that I studied in graduate school and that I applied at the MIT Bates center.

The regulatory environment of a medical device company was new to me and required some acclimation. Over my time with the company I have come to appreciate the role this regulatory environment plays in producing devices that are safe and effective for treating patients. The careful crafting of device requirements and evidentiary tracing of tests proving the proper function of a device can result in elegant engineering solutions. Not only is this required by law, when executed well it also results in the construction of superior devices.

In the first few years our company worked closely with the superconducting magnet group in the Plasma Fusion Center of MIT. Ken rapidly hired a small core team of engineers, physicists and technicians to develop the product. Working with this multidisciplinary and talented team to solve complex technical problems resulting in a product that improves patients' lives is one of the chief satisfactions of my career. During these years we were under intense pressure to complete the system and deploy the product. In the end we required several rounds of reinvestment from our financial backers and more than seven years before we treated our first patient. Now six systems have been installed and our seventh is underway. This latest system also includes significant new technology involving active rastering of a proton beam about the size of a pencil rather than a uniform spreading and masking of a broad proton beam. This technology makes the treatment delivery more flexible and the treatment of slightly superior quality and also avoids cumbersome workflow associated with producing masks particular to each patient.

In this time the company has also grown to more than 150 employees. My role has transitioned from that of an individual contributor to a manager, and subsequently, to my present role as Senior Director of Advanced Development. A career which evolves from technical to managerial is common for many physicists who have wide ranging technical and analytical abilities. However some physicists do stay focused on individual and often highly expert responsibilities and this can also be satisfying professionally.

Over time MEVION has hired many physicists in varying roles across the company. These roles include everything from Senior Medical Radiation Physicists (a position which requires a distinct professional degree), to particle beam specialists, to Monte Carlo simulation experts, to superconducting magnet physicists. We have also employed more than a dozen employees who hold physics bachelor's degrees. These young individuals have made valuable contributions in mechanical engineering, controls software, analysis software, and testing, operation and commissioning of our devices. We have also hired physics interns who are still active in undergraduate programs. Some of these physicists have returned to school to pursue advanced degrees, some have decided to pursue other fields and some have taken on more senior positions within the company. MEVION also employs physicists in the Manufacturing and Installation departments in both junior and management roles.

I feel quite fortunate in my professional career. This physics pathway has allowed me to meet, study and work with intelligent and capable people from many backgrounds. I have had an opportunity to work on challenging technical projects in a discipline that excited me since I first encountered it in college. In the field of medical physics there is the added reward of knowing that the devices we are constructing are improving the quality of people's lives. I am still in touch with several of my classmates from graduate school. A few of them went on to Professorships, mostly at small colleges, but the majority has, like me, found careers in industrial settings outside of academia. For the most part, due principally to the fact that we get to exercise our brains and work with smart people for work, we are a rather contented lot.

Townsend Zwart
Senior Director of Advanced Development
Mevion Medical Systems, Inc.

Recap of Winter 2017 CUWiP Conference, Harvard University

Full conference photo (photo credit: www.tomkatesphotography.com)

On a clear winter weekend, the halls of the Science Center at Harvard were filled with an unusual sight: nearly 250 bright, motivated, undergraduates interested in physics...and overwhelmingly female. These students were attending the northeast site of the 12th Conference for Undergraduate Women in Physics (CUWiP) on the 13th-15th of January, the first to be held at this institution. And some fifty of these participants were fresh from attending the first ever Supporting Inclusion of Underrepresented Peoples (SPIN UP) workshop on the 12th-13th, a focused program for those at the intersection of multiple minorities in physics.

CUWiP is a network of nine simultaneous conferences across the United States that aims to increase the representation of women in physics by fixing the leaky pipeline at the critical undergraduate stage. Women earn only 20% of physics bachelors' degrees nationwide, despite much larger gains in other sciences and near-parity female participation in physics at the high-school level. At the CUWiP conference, participants can build networks with other students, learn about research performed both by top physicists and their peers, and explore a wide range of career opportunities available to those who study physics.

From talking to previous attendees and reviewing what data we could find, we realized that for many attendees who are women in physics, this conference is unique because it's the first time that they are in the majority. Many have had to navigate being the only female in a classroom, and some have never even had the chance to interact with a female physicist further along in her career path. This makes the opportunities to develop peer and professional mentor relationships at CUWiPs all the more valuable.

Even at CUWiPs, however, not all attendees share this experience of being in the majority. What many of us feel every day when we are surrounded by men in the classroom or lab, some participants still feel at these conferences. Women and femme folk who also are members of racial and ethnic minorities; members of gender and sexual minorities; have physical, mental, or learning disabilities; are from low-income backgrounds; are first-generation college students; and/or are members of other underrepresented or underserved communities continue to face additional hurdles and barriers that many of us may be unfamiliar with.

For this reason, the Harvard organizing committee decided to create SPIN UP as a one-day workshop to precede the CUWiP, aiming to create a supportive, intimate environment for the participants. SPIN UP featured a research talk (Chanda Prescod-Weinstein of the University of Washington), a forum-style discussion, and panels on combating discrimination and on the next steps after college, each composed of thoughtful and encouraging people. The full list of the excellent speakers and panelists can be found at our website, cuwip2017.physics.harvard.edu.

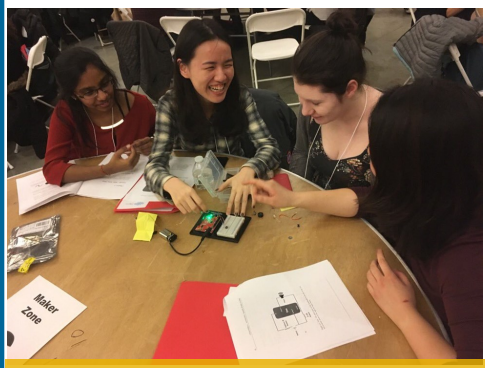
The feedback from SPIN UP was overwhelmingly positive. Several participants and speakers said that they were pleasantly surprised by how welcomed and included they felt. That comfort was reflected in the frankness and openness of the conversations, both during the open forum and during the various meals. Participants discussed instances of discrimination and harassment. Speakers and other attendees offered, crucially, advice about how they dealt with and overcame those setbacks.

After the conclusion of SPIN UP, most of the participants joined 200 of their peers for the CUWiP. We encouraged all CUWiP participants to continue the discussion of the SPIN UP themes of inclusion and diversity, and selected speakers, panelists and breakout session topics with those themes in mind.

Over the busy three days of the CUWiP, the students attended a number of research talks by leading scientists, including the keynote given by Prof. Nergis Mavalvala of MIT and the LIGO collaboration. In true keeping with the intentions of CUWiP, each speaker included comments about their often-winding career paths that led them to their current positions and pursuits. Questions from the students spanned both scientific and personal topics.

Other events included a talk on progress and obstacles for women in

Recap of Winter 2017 CUWiP Conference...



Maker event (photo credit: Susannah Dickerson)

At the poster session: Photo credit: www.tomkatesphotography.com

Questions at Prof. Nergis Mavalvala's keynote talk (photo credit: www.tomkatesphotography.com)

Lunchtime (photo credit: www.tomkatesphotography.com)

physics (Prof. Amy Graves, Swarthmore College) and one on intersectional feminism in STEM (Prof. Sarah Richardson, Harvard University). Panelists on the non-academic careers not only exposed students to their varied career choices, but also gave advice on how to succeed as a woman in a technical field. "Stay connected," recommended Edna Conway of Cisco. "Twenty years from now, you're going to want to know the person sitting next to you." This panel was followed by the Industry and Graduate School Fair, with representatives from nine Northeast graduate schools and fourteen diverse companies, including IBM, Oxford Instruments, and Kensho Technologies.

In an inspiring demonstration of the enthusiasm the participants have for actively engaging in research, more than fifty participants presented their own research through posters and talks. Well after the official presentations times had ended, you could find students crowded around the posters, which stayed up throughout the last two days of the conference. In addition, many took advantage of the lab tours offered, learning about the different avenues of research pursued under the umbrella of physics.

Because a major goal of the conference series is to nurture connections amongst the participants, we planned a number of social events and encouraged the students to sit at meals with people they did not know. The highlight of these efforts was the ice-breaker on Friday evening: a maker event where groups of participants built a piano from an arduino and basic electronic components. Through teamwork, experimentation, and laughter, every group had successfully assembled a working example by the end of the session. Together they played a synchronized performance of "Mary Had a Little Lamb" and the Star Wars theme.

Participants, speakers, and organizers alike left the conference exhausted, but with bolstered enthusiasm and hope. Coupling the CUWiP to the preceding SPIN UP workshop was an experiment never done before, and we'd like to thank the attendees for joining us on the journey. We will take what we learned from them to continue building a more inclusive physics community where every voice is equal.

To quote our keynote speaker, Professor Mavalalva "to inspire, you have to do kind of wild things.' The CUWiP and

Prof. Nergis Mavalvala's keynote talk (photo credit: www.tomkatesphotography.com)

Gravity waves were the focus of keynote talk (photo credit: www.tomkatesphotography.com)

SPIN UP attendees have inspired us to try wild things. We hope that you will join us.

As a final note, we were thrilled to have Dr. Liz Wayne as a presenter at both SPIN UP and CUWiP. As she is also one of the hosts of the podcast PhDivas, she produced an episode featuring participants of this CUWiP. To hear participants describe their paths towards the sciences and their experiences to date, listen to the episode found at https://soundcloud.com/phdivas/womeninphysics.

[1] *Evaluating and Exploring a Professional Conference for Undergraduate Women in Physics: Can One Weekend Make a Difference?*, G.A. Buck, M. Mills, J. Wang, X. Yin, Journal of Women and Minorities in Science and Engineering 20 359 (2014).

Authors: Susannah Dickerson, Ellen Klein, Anne Hébert

ALPhA Advanced Laboratory Physics Association

ALPhA New England Regional Conference

WHEN: 9 AM– 6 PM, June 14th, 2017

WHERE: Piano Lecture Hall, Beneski Building, Amherst College
11 Barrett Hill Drive
Amherst, MA 01002-5000

WHO: You! This is a conference for instructors, faculty, staff, and industry partners interested in Advanced Physics Laboratories beyond the first year in undergrad.

WHAT: This Regional ALPhA Conference has three goals:

1) **Networking**. To facilitate networking and cooperation among Advanced Lab folks in New England. Come and meet others interested in improving labs, get ideas, and local help implementing them.

2) **Hands-on Experience**. There are workshops and tours that participants can sign up to do. These get everyone in the lab doing an experiment or set of experiments. This is a fun way to get ideas or try something new.

3) **Latest News**. Come hear three speakers update our Region on things happening related to the Advanced Lab. Topics range from first-hand lab experiences to implementation of new teaching styles.

Participation is limited to the first 30 registrants. No registration fee. Lunch and dinner will be provided. Details and full schedule will be emailed to participants after registration.

To Register: Go to https://www.amherst.edu/academiclife/departments/physics/conference and register. Once you register, we will then email you a confirmation with detailed logistical instructions for the conference including parking and housing.

Do you have interesting Physics related articles, new programs, research report, physics talking points etc. that you will like to share with the New England Physics Community?

Send them to
Peter K. LeMaire (lemaire@ccsu.edu)

Conference for Undergraduate Women in Physics (CUWiP), Rochester Institute of Technology, January 12-14, 2018

The Rochester Institute of Technology (RIT) has been selected as one of the host sites for the 2018 Conference for Undergraduate Women in Physics, which is sponsored by the APS, DOE, and NSF. RIT has a vibrant research community in physics and astrophysics, is home to a PhD program in Astrophysical Sciences and Technology, and is dedicated to undergraduate research experiences. We are honored and excited to have been selected as a host. RIT is committed to diversity in the sciences and promoting an inclusive and welcoming environment. The unique community of Rochester, home to multiple colleges and universities as well as many industrial ties, will enable us to showcase the broad range of physics research and job opportunities for students with physics degrees.

Our goal is to provide an intersectional perspective on the research, career paths, and experiences of women in a broad range of career stages. Our proposed agenda includes research talks from women in physics, an overview of the status of women in physics, an in-depth discussion of intersectional feminism, and research sound bites and posters from student participants. Our program will also include a number of interactive workshops on topics such as impostor syndrome, the graduate school application process, and obstacles students may face along the way. We will also invite experts from throughout the region to participate in discussions on academic and non-academic job possibilities, finding and promoting and inclusive environment, work/life balance, and experiences in graduate school.

A number of undergraduate and graduate students are on our organizing committee and we are planning several social events to facilitate networking and informal opportunities for students to discuss their own experiences and goals. We will also have a career and graduate school fair to connect interested students with graduate programs and representatives from industry.

Stay tuned for more information about this event! We will begin advertising and contacting department chairs in the fall. Our website is still under construction, but if you are interested in participating or have any questions about the event, please contact

Jeyhan Kartaltepe at jeyhan@astro.rit.edu.

Seeking co-editor for the New England Section Newsletter.

Dear APS New England Section Members,

The term of APS New England Section newsletter co-editor Ed Deveney has ended and he officially stepped down after our fall 2016 section meeting. We are seeking someone to take on this important and rewarding role. The position is for a 3-year term.

The New England Section newsletter is published twice per year, coinciding with our two section meetings in the spring and fall. The co-editors are responsible for gathering articles of interest to our members for publication in the newsletter. This usually includes a review of the previous section meeting, and a preview for the upcoming meeting. He/she must also be able to coordinate and communicate effectively with the co-editor and APS-NES.

The newsletter co-editors also serve as non-voting members of the Executive Committee of the section, attending the EC meetings which are held immediately following the scientific program at the spring and fall section meetings.

If you are interested in taking on this important role, please fill out the Statement of Interest at: https://goo.gl/forms/URIckFtT6fD8VdWm2

If you would like further information about what the role would entail, please email Peter LeMaire: lemaire@ccsu.edu or Ed Deveney: edeveney@bridgew.edu .

With thanks from the New England Section Executive Committee.