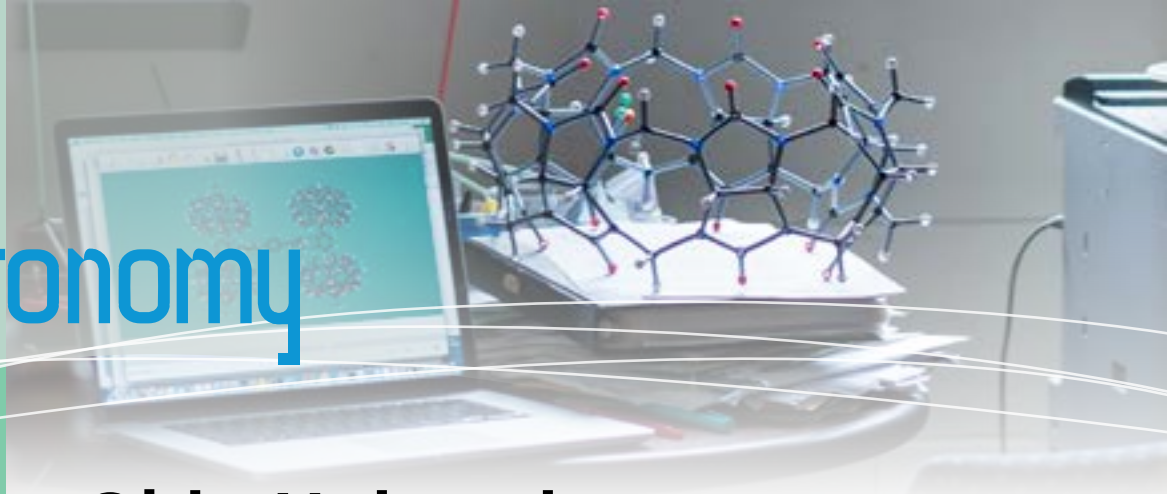
Department of
physics + astronomy



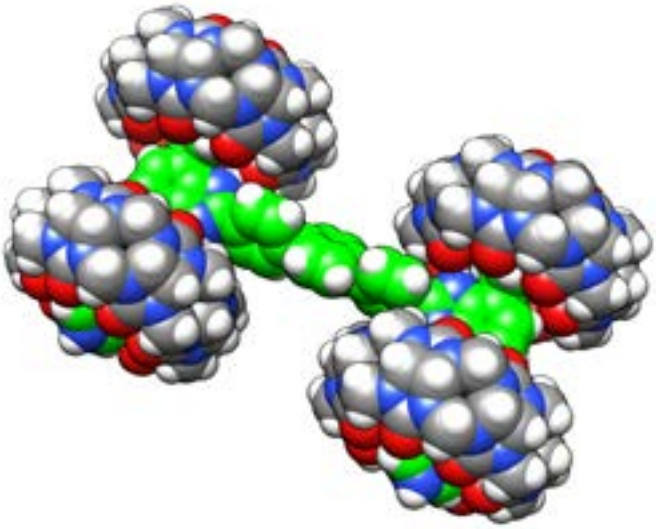
2015-16 Newsletter
No. 29

The Department of Physics & Astronomy is dedicated to developing a deeper understanding of the natural world, to educating undergraduate and graduate students, and to conveying the concepts and logic of the discipline to the broader community.

Ohio University group to take part in NanoCar Race Spring 2017

What is the smallest mechanical machine that can be built? Since the building blocks of our material word are atoms, it's easy to imagine a machine built from just a handful of atoms. That's easier said than done. But with recent advances in technology, it's now possible to take a small cluster of atoms and make them rotate on a molecular axis. In fact, the 2016 Nobel Prize in Chemistry was awarded "for the design and synthesis of molecular machines".

At Ohio University, **Saw-Wai Hla** has been spearheading research into this same topic. A few years ago, Hla and his students demonstrated the first controlled directional rotation of molecular clusters on a gold surface, which was published in the journal *Nature Nanotechnology*. More recently, in collaboration with colleagues from France, Hla was able to show the simultaneous rotation of up to 500 molecular motors on a gold crystal surface, which was published just this year, also in *Nature Nanotechnology*.



Ohio University team's molecular car design concept, the "OHIO Bobcat Nano-Wagon".

Now Hla, along with Eric Masson (Associate Professor of Chemistry & Biochemistry), have synthesized four-wheel molecular nanocars (shown in the figure) and will compete in the International NanoCar Race, sponsored by France's National Center for Scientific Research. The event is scheduled to take place on April 28-29, 2017.

OHIO UNIVERSITY

139 University Terrace
Clippinger Laboratories 251B
1 Ohio University
Athens, OH 45701

The entry by Ohio University is one of just 6 groups in the world that will compete in "driving" the cars along a slalom-like track on a gold surface using the tip of a scanning tunneling microscope (STM) to provide the propulsion.

"The whole competition is not just about building the car... We are trying to develop a technology to transport at the molecular scale," Hla said.

Masson's team of graduate students is constructing the race car while Hla's team will drive the car. Masson explained that the nanocar is made of two types of organic molecules: an H-shaped frame and four "wheels" made of a molecular grouping called a Cucurbituril. The name comes from the resemblance of these molecules to pumpkins, which are members of the Cucurbitaceae family of plants. "There's no chemical bond between the frame and the wheels, so the frame is really floating into the wheels," Masson said.

Given their design, the biggest challenge will be ensuring that the frame stays in place, Masson said. He said that a wheel may potentially fall off during the race and the team would have to rebuild the car on the gold surface to continue. "In fact, we would be absolutely delighted if that incident were to happen during the race!" he said, noting that that reconstruction process has never been published.

While Masson's team is working on the chemical synthesis of the car, Hla's team is strategizing how to drive a car that does not have a steering wheel. Hla explained that the car will be driven by using the electric field energy supplied from the tip of an STM. The tip is a nanosized metal needle with an applied voltage. Several test drives are necessary to ensure the car will move according to plan.

Maintaining the temperature of the molecules is also essential. If the molecules get too hot, they will not stop moving. So, the car has to be cooled using helium to -400 degrees Fahrenheit prior to the race.

The event will be filmed live, showing photo images captured at various points in the race via the STM. If Ohio University wins, they will receive worldwide recognition. But of course the real prize is proving that science can make almost anything seem possible.

Greetings Alumni and Friends

Continual improvement is one of the goals of our department. Each year, new ideas come up for ways to improve the student experience, the research environment, curricular development, and so on. We also learn from our alumni about what we are doing right and ways to improve on current methods. Below are a few highlights from the 2015-16 academic year.

This year we welcome back our colleague, and editor of this newsletter, **Ken Hicks** who has been on assignment with the National Science Foundation as a program manager in nuclear physics. We also welcome a new faculty member in nuclear physics, **Zach Meisel**. Zach is an Ohio native who got a Ph.D. in nuclear physics at Michigan State University and was a postdoctoral fellow at Notre Dame before coming to us. He is an experimentalist in low energy nuclear physics and will be using the Edwards Accelerator Laboratory for his research.

We received a very welcome surprise this year. **Robert Ackley**, B.S. 1941, generously left about $5,000,000 in his estate to be split 40% to Physics & Astronomy and 60% to Chemistry & Biochemistry. He joined Union Carbide when he graduated and moved to Oak Ridge National Laboratory in 1944 to join the Manhattan Project. He retired from Oak Ridge in 1977. We do not have a lot of information about him other than he fondly remembered late professor of chemistry Donald R. Clippinger, saying "he was the best professor." If there are alums reading this who can remember him I should appreciate hearing from you.

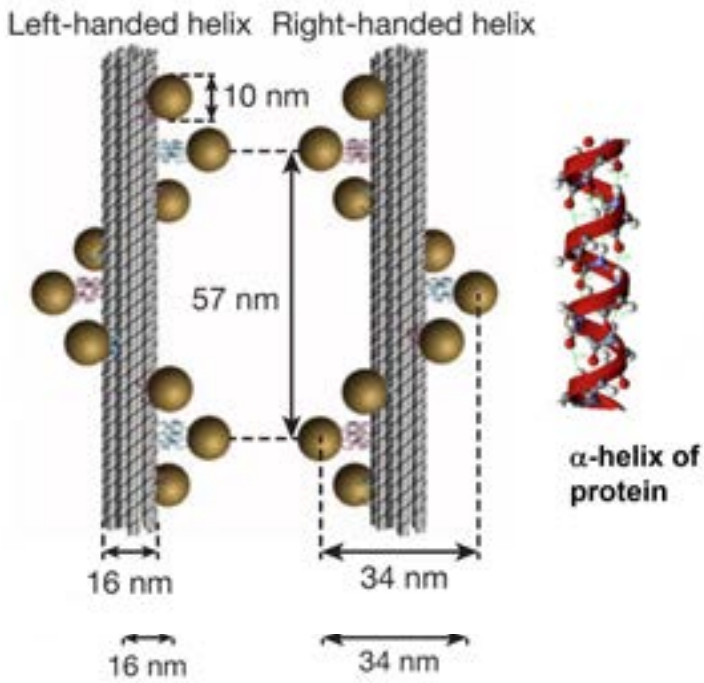
The Trustees have approved a new master plan for the University that contain plans for Clippinger Research Laboratories, named after Professor Clippinger, and known by just his name. The Trustees have approved funding for hiring an architectural company to plan for an addition to Clippinger and then its subsequent refurbishment. The proposal runs for many years. The plan is for some of us to move into the addition in the Summer of 2020. We then begin a two-phase refurbishment of the existing building. That will end in 2024/2025. It will be almost ten years before the project is complete, if it goes according to plan. Next year will be spent on planning the entire project so I should have more details by this time next year.

We greatly value the support we receive from our friends and alumni in helping our department in the pursuit of its mission. We always appreciate visits by our alumni, as a means to educate our students about possible career paths and to help our department remain connected to a larger community. This year **Satya Narayana**, Ph.D., traveled from India to the US and stopped by to visit us. He worked for many years in medical physics and recently retired to India. We also express our sincere thanks to those who have contributed financially to our program, as listed elsewhere in this newsletter.

- 71 graduate students
- 69 undergraduate students
- 32 countries represented in the department
- Programs in astrophysics, biophysics, condensed matter physics, surface science & nanoscience, nuclear and particle physics
- International travel opportunities for both graduate and undergraduate students
- 4.5 MV high-intensity tandem Van de Graaff accelerator
- Member of the MDM Observatory on Kitt Peak, AZ
- Alumni receive international awards including one Nobel Prize

David Ingram
Chair

Physics and Astronomy gains another Distinguished Professor



Chiral assembly made of DNA molecules and gold nanoparticles that exhibit plasmon resonances. This plasmonic helix exhibits very strong optical responses for circularly-polarized light. The right panel is a helical protein that motivated the idea of the plasmonic helix.

At the spring 2016 commencement, it was announced that **Alexander (Sasha) Govorov** would be Ohio University's next Distinguished Professor. He joined Ohio University in 2002 as an Associate Professor and is an esteemed researcher on the theory of optical properties of nanomaterials.

Sasha's interests concern nanocrystals and biomolecules and their interaction with light and heat. Being initially an expert in low-temperature physics of nanostructures, Sasha changed his research field when he moved from Russia to the US, starting very active collaborations with researchers working in chemistry and biochemical engineering.

Since coming to the US, Sasha has published over 100 papers with theoretical predictions that have been realized by many groups worldwide. One of his more famous theoretical predictions is that a chiral biomolecule should interact with metal nanocrystals so as to create special chiral fingerprints in the optical spectra. This had never been seen experimentally before. Indeed, his prediction was shown to be true when such chiral optical signatures were then reported later by many experimental groups. Sasha's papers also established the theoretical foundations of two new fields of research in plasmonics (the study of collective oscillations of electrons in a material induced by light). One new field is called chiral plasmonics, and the other concerns the effects of plasmonic photoheating in collections of nanocrystals illuminated by light. This regime of the photo-thermal effect is now used conveniently by many research groups for creation of phase transformations at the nanoscale, i.e. a melting of biomolecules, and other applications.

The goal of a microscopic theory of collective excitations of metal nanocrystals, so-called plasmons, is to understand and control photochemical applications. Sasha's recent publications, in the prestigious journal *Nature*, describe the phenomenon of generating of electron emission in specially-designed nanostructures with plasmonic hot spots, where this effect becomes strongly amplified. The bottom line is that there are new applications in optical control of chemical reactions that are now possible due to the theoretical ideas first described by Sasha.

Faculty News

Alexander (Shura) Neiman, who specializes in techniques to separate signals from a noisy background, was promoted to full Professor. Shura co-authored several articles recently on this topic in the prestigious journals Physical Review Letters and Physical Review E. His work with biologists on campus to mathematically model how paddlefish use electroreceptors in their noses, to sense small movements of prey, is remarkable and has resulted in several earlier publications.

Alum Rong Yang, Ph.D. '06 (center) hosts Sergio Ulloa and Nancy Sandler at the National Center for Nanoscience and Technology Center in Beijing where Yang is a research scientist. Yang was supervised by Dr. Arthur Smith while she was a doctoral student at OHIO.

Nancy Sandler attended and gave talks at two high-profile conferences in the past year, one at the Aspen Center for Physics in Colorado and the other at Beijing, China. The Aspen Center is a premier research center that hosts a limited number of scientists each week, where they can meet and generate close collaboration in a relaxed atmosphere. She gave a short presentation on work she did with graduate student **Dawei Zhai** on the topic of light-matter interaction and quantum control in many-body systems. In Beijing, she and **Sergio Ulloa** were hosted by OU alumni **Rong Yang** and **Wei Zhang** at the International Conference on the Physics of Semiconductors, where both Sergio and Nancy gave invited talks.

Carl Brune was voted an Outstanding Referee by the American Physical Society (APS). Carl joins Steven Grimes and Sergio Ulloa, who have received this award in previous years. The APS initiated these awards in 2008 to recognize scientists who have been exceptionally helpful in assessing manuscripts for publication in the APS journals. In receiving the award, Carl noted that "it helps maintain standards in our publications. Besides weeding out sub-standard work, the referee can help make a good paper better or sometimes catch mistakes that would otherwise go unnoticed."

The search to replace departing nuclear physics experimentalist Heather Crawford has resulted in the hiring of **Zach Meisel**, who received his PhD from Michigan State and specializes in the field of nuclear astrophysics. Zach's expertise complements that of Carl Brune and overlaps with the interests of our theoretical nuclear physics faculty members. Zach will start teaching in the fall semester of the 2016-17 academic year.

After serving a two-year term at the National Science Foundation (NSF) as a Program Director of Experimental Nuclear Physics, **Ken Hicks** has returned to Ohio University. The NSF employs people in temporary (few-year) positions called "rotators", who rotate in and out of the NSF to provide advice from active researchers. The allows a fresh perspective at the NSF as well as giving the researcher an opportunity to see how federal funding decisions are made.

In May, 2016, **Julie Roche** was elected in the Chair line of the Jefferson Lab Users Group Board of Directors. The Users Group consists of approximately 1,200 nuclear physicists from over 200 institutions. The goals are to maintain an effective channel for exchange between users and the Jefferson Lab management on matters affecting access and usage of the facility as well as to promote the advancement of basic scientific knowledge thought the most effective utilization of the facility. Roche will serve on this Chair line for 4 years.

Richard Piccard was recognized for 25 years of Administrative Service at OHIO.

Two Conferences on Nuclear Physics Held in Athens

Two special events, the "JINA-CEE Satellite Workshop on Experiments for X-ray Burst Nucleosynthesis" on May 22, 2016, and the ``JINA-CEE International Symposium on Neutron Stars in the Multi-Messenger Era: Prospects & Challenges'' during May 23-27, 2016, took place in Walter Hall 245 in Athens, Ohio.

More than 80 scientists from 12 countries and 14 U.S. states took part in the Workshop and the Symposium. Graduate students, post-doctoral and junior-level researchers featured prominently in these meetings. **Madappa Prakash** of Ohio University and Catherine Deibel of Louisiana State University served as chairs of the organizing committees for the five-day symposium and one-day workshop, respectively.

Both events were co-sponsored by the Institute of Nuclear and Particle Physics (INPP) at Ohio University and the Joint Institute for Nuclear Astrophysics - Center for the Evolution of the Elements, or JINA-CEE, of which the INPP is an affiliate member. JINA-CEE is a Physics Frontier Center, funded by the US National Science Foundation. The center encourages research by addressing fundamental questions about the evolution and properties of matter in the cosmos, and the origin of the chemical elements that make up our world.

The purpose of the workshop was to bring theorists and observers together to foster collaborations, share resources, and discuss new experimental initiatives aimed at improving our understanding of X-ray bursts. Associated with neutron stars, X-ray bursts are characterized by occasional and often periodic emission of short, very powerful bursts of X-rays. Following reviews of observations of X-ray bursts and the understanding gained through model studies, future laboratory experiments using current and future accelerator facilities were identified in the workshop to better understand long-standing puzzles.

The symposium aimed to synergize the expertise of physicists and astronomers to assess the current state of knowledge about neutron stars, and to identify areas in which more work is needed to enable interpretation and extraction of information from astronomical observations.

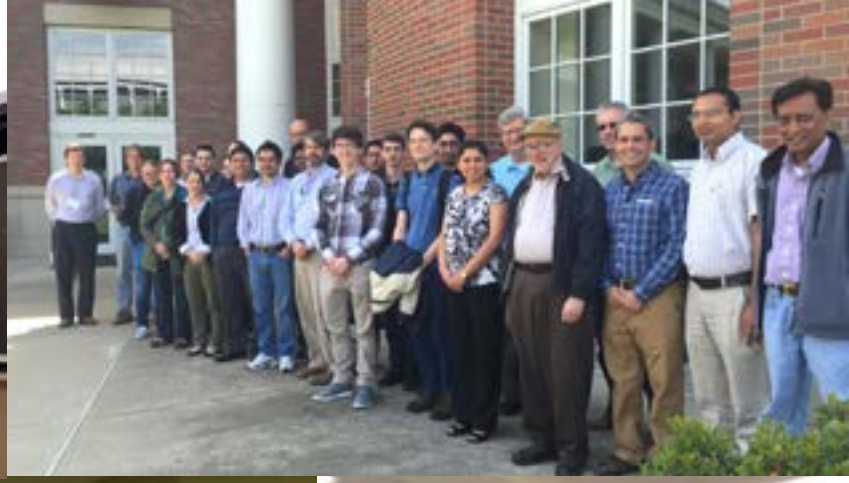
Several graduate students gave excellent talks on frontier topics such as neutron stars with unusually high magnetic fields (called magnetars), mass and radius measurements of neutron stars, and the recent direct observations of gravitational waves predicted by Einstein a century ago.

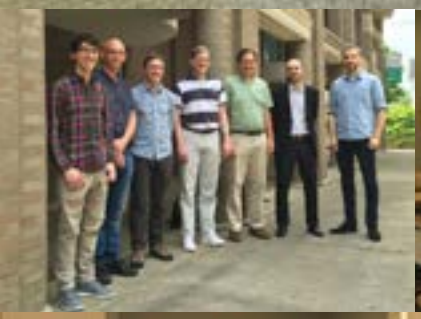
J. Nattila from Finland presents his talk on x-ray bursts at the symposium.

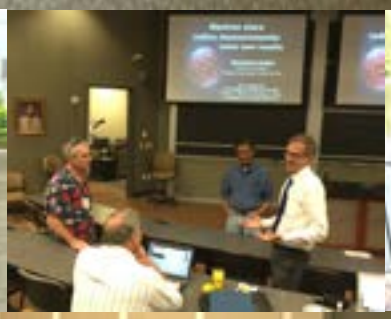
Progress made with NASA's Neutron Star Interior Composition Explorer, NICER, India's Multi-Wavelength Astronomy Satellite, ASTROSAT, and the search for gravitational waves using high precision radio millisecond pulsar timing in the NANOGrav project were reported and discussed.

In addition to talks and in-depth discussions on core-collapse supernova explosions, the birth of neutron stars, and other topics, a recurring theme in the symposium was the radius of a neutron star. A precise knowledge of a neutron star's radius sheds light on the fundamental interactions that are responsible for creating the densest form of observable matter in the Universe.

Slides of all presentations and photographs of participants in the workshop and the symposium can be found at: www.phy.ohiou.edu/~SoNS







Student News

Sean McGraw won 1st place in Ohio University's inaugural 3-Minute-Thesis (3MT) competition, hosted by Graduate College. His presentation title was "Black Holes: Little Engines that Control the Evolution of Galaxies."

Andrea Richard received the Science Graduate Student Research Award from the Department of Energy (DOE) Office of Science. This prestigious national award will support a 3 month stay at the Lawrence Berkeley National Lab, where she will do research in nuclear physics.

J. Connor Burgad was awarded Outstanding Teaching Assistant by the College of Arts & Sciences.

Sneha Pandya was awarded an Original Work Grant (OWG) from the Graduate Student Senate for summer 2015.

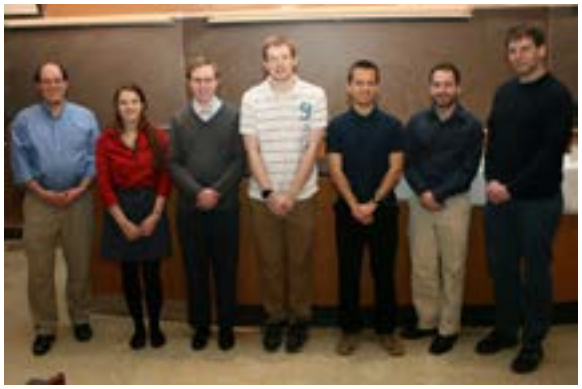
Graduate student **Kiran Prasai** received the Vishwa S. Shulka Memorial Scholarship and also the Donald Clippinger Graduate Fellowship. The latter includes a $15,000 stipend plus a full tuition scholarship. Kiran is being advised by Distinguished Professor David Drabold.

Recipients of awards at OU's Research & Creativity Fair were graduate students **Thushan Wickramasinghe, Mayur Sundarajan, Sudiksha Khadka, Oscar Avalos Ovando, Sean Krupa** and **Rekam Giri.**

Maxwell Camp received an award for Best Presentation at the 2016 Undergraduate Research Conference, organized by the local chapter of the Society of Physics Students. Honorable Mention was awarded to **Sara Sand** and **Andrew Dewald** for their research presentations.

Robert Radloff and **Jacob Williamson** were inducted into Sigma Pi Sigma, the honor society for the Society of Physics Students.

Sean McGraw won 1st place in Ohio University's inaugural 3-Minute-Thesis (3MT) competition.



Undergraduate Research Conference, from L to R: Dr. David Tees, Sara Sand, Andrew Dewald, Jacob Williamson, Ryan Goetz, Max Camp, and Dr. Ryan Chornock. Tees and Chornock served as judges.

Sigma Pi Sigma induction, L to R: Jacob Williamson, Robert Radloff, and Dr. David Ingram

Staff News

Outstanding Staff Award

We would like to congratulate **Doug Shafer** as the Outstanding Staff Member for our department this year. Our machine shop supports the teaching, research and service mission of our department and the college. Doug's knowledge of all systems electrical and mechanical is surpassed by no other. Doug has built or improved equipment in many of our teaching and research laboratories. He has the ability to design, build, diagnose, and repair complex equipment and systems. He is able to reverse engineer many parts needed to fix complex equipment. Projects would be impossible without the assistance or expertise that he offers. Any project that is built, fixed or refurbished by Doug is usually as good, and more often, improved upon by his involvement.

A recognition of Doug's level of professional competence is the fact that he has been a co-author on a peer-reviewed scientific publication due to his effort in designing a critical piece of equipment. Another example of the work done by Doug is the refurbishment of the JW Fecker telescope. Originally acquired in 1950, the telescope was used on the roof of RTEC until the location was deemed unsafe and the condition of the telescope made it inoperable. The restored telescope is fully operational and will be located in the new observatory dome which will be located on the Ridges. In 2017, we will be able to use the telescope in the new observatory thanks to Doug's exceptional work.

Doug Shafer and Dr. Joe Shields survey the sky at the proposed site of the new telescope observatory.

Devon Jacobs was recognized for 15 years of service in the Department of Physics & Astronomy.

Outreach Activities

Dr. Gang Chen Visits Beacon School

Dr. Gang Chen and several students spent two afternoons helping students from the Beacon School learn about electricity and electrical circuits during their 2016 Summer Camp for students with developmental disabilities. (L to R: Beacon School Camp Director Samantha Dunlap greets Dr. Gang Chen and undergraduate student Katelyn Nichols.)

Undergraduate 'Makers' Katelynn Nichols, Daniel Ivory and Dylan Wright try their hand at constructing a marble run.

Athens Makers

With support of the Department for space and resources, Dr. Mark Lucas has been organizing a dozen informal science-based 'maker' workshops for area middle school and high school students. (http://athensmakers.net) Summer 2016 was the fourth year for the group as we explored everything from Arduino microcontrollers and 3D printers to popsicle stick marble runs, marshmallow shooters and home automation.

Graduate student Sneha Upadhyay introduces students to the wonders of infrared imagery at the 2016 Coolville Elementary Math and Science Night.

School Science Nights

Drs. Sergio Ulloa, Nancy Sandler and Mark Lucas along with a number of graduate and undergraduate students represented the Department of Physics and Astronomy at a number of local School Science Nights.

Ohio University Science Cafe

Dr. Nancy Sandler presented "Physics of New Materials: From Lasagna to Pancakes and Back" at the Oct 21, 2015 Science Café' at The Front Room in . Sandler opened the discussion with an overview of the kinds of materials that exist around us and the relation with their nanoscale structure. She invited the audience to consider the idea of taking materials we already think we understand and manipulating them into new ones.

Alumni News

2010 – 2016

Sean McGraw, PhD 2016 (advisor Shields), will start in Fall 2016 as a Postdoctoral Researcher at Penn State in the Department of Astronomy and Astrophysics.

Brian Muccioli, PhD 2016 (advisor Prakash), is working for Frontier Technologies as a research scientist, working to calibrate satellites both before launch and when they are in space using special software. He lives in Beverly, MA.

Sneha Pandya, PhD 2016 (advisor Kordesch) is a Process Engineer at Intel, where she develops nano-scale e-beam lithography patters to be used for polymer-based optical systems and organic sensor transistors. She lives in Hillsboro, Oregon.

Ramana Thota, PhD 2016 (advisor Stinaff), is working as a Process Engineer at Intel, where he is developing the next generation of materials and processes that will advance the scope of semiconductor applications. He lives near Portland, Oregon.

Alexander Marshall, HTC Engineering Physics 2015, is working as a data scientist for The Perduco Group, a data science consulting firm that specializes in defense, healthcare, and sports, in Dayton, OH.

Shloka Chandavar, PhD 2015 (advisor Hicks), is working as a Postdoctoral Researcher at Michigan State University in the field of nuclear physics. She lives in East Lansing, MI.

Haocheng Zhang, PhD 2015 (advisor Boettcher), is a Postdoctoral Researcher at Los Alamos National Lab and will be moving to a postdoc position at the University of New Mexico in 2016.

Karina Avila-Coronado, PhD. 2014 (advisor Castillo), has been working as a Postdoctoral Researcher in Goettingen, Germany, and she will move in Fall 2016 to be a Visiting Scholar in the Physics Department at the University of Illinois, working with Karin Dahmen.

Norman Israel, MS 2014 (advisor Roche), is a Science Teacher in Jamaica where he will be implementing a Physics program at his high school for the first time. He is also working on a project with John Moffat of the Perimeter Institute for Theoretical Physics based on his generalized theory of gravity.

Sajida Khan, PhD 2014 (advisor Hla), is a Postdoctoral Researcher at the University of Colorado Boulder, where her research interests are molecular physics, condensed matter, and cryogenics.

Rakitha Beminiwattha, PhD 2013 (advisor Roche), will join the faculty of Louisiana Tech University as an Assistant Professor of Physics in Fall 2016. His main research interests remain precision tests of the Standard Model (SM) of particle physics, and the search for new physics beyond the SM.

Yinyun Li, PhD 2013 (advisor Jung), is an Assistant Professor at a university in Beijing, China, and teaches classes on Statistical Physics.

Greg Peterson, PhD 2013 (advisor Sandler), holds the position of Algorithm Engineer in TSI Incorporated. He and his wife Mahin Shahlari (also an OHIO alumna) become parents of Cyra Petersen this year. They live in Shoreview, Minnesota.

Keith Hawkins, B.S. 2013, is a Marshall Scholar who completed a PhD in Astrophysics at Cambridge University in the UK in August 2016. He returned to the department as a presenter at the Astrophysics seminar in January 2016. The title of his presentation was "Galactic Archeology: Piecing together the Milky Way with Large Surveys. He is a Research Fellow in Astrophysics at Columbia University, New York, NY.

Tejinder Kaur, PhD 2013 (advisor Sandler), is a Technical Lead Consultant at CVS/Caremark and lives with her husband in Allen, Texas. She is mom of Jasmine and she is expecting a baby.

David Ruiz-Tijerina, PhD 2013 (advisor Ulloa), is a postdoc at the Univ de Sao Paulo, Brazil. He has accepted a postdoc position at the Graphene Institute at the Univ of Manchester, UK, to start in 2017.

Gcina Mavimbela, PhD 2012 (advisor Castillo), is a Lecturer of Physics at the University of Swaziland, in Kwaluseni, Swaziland.

Chen Ji, PhD 2012 (advisor Phillips), is a postdoctoral researcher at the European Centre for Theoretical Studies in Nuclear Physics and Related Areas located at Trento, Italy. Starting from September 2017, Chen will take an associate professor position at the Central China Normal University located at Wuhan, China.

Peng Zhao, B.S. 2012, received a M.S. in Electrical Engineering from the University of Michigan in 2014 and is currently working at Intel as a Validation Engeinner. He lives in California.

Anton Wiranata, PhD 2011 (advisor Prakash), is a Lead Data Scientist at Overstock.com, developing mathematical models for Machine Learning applications which can be used for pricing, optimizing sales, etc. He and his wife live in Salt Lake City and have a 13-month old baby daughter.

Juan Enrique Rolon, PhD 2011 (advisor Ulloa), has taken a Lecturer position at Centenary College of Louisiana, in Shreveport, LA.

Sergey Postnikov, PhD 2010 (advisor Prakash), is Head of Research and Development at AR3C, where he develops energy efficient technologies for sustainable post-agricultural products.

Joel Vaughn, PhD 2010 (advisor Kordesch), and his wife are awaiting the arrival of their second son in Oct. Joel was granted two more patents for improved sintering and testing of polycrystalline diamond compacts. His business continues to grow.

Chieh-Jen (Jerry) Yang, PhD 2010 (advisor Phillips), was a post-doctoral research at the University of Arizona and is now with the European Center for Theoretical Studies in Nuclear Physics and Related Areas. He lives in France with his wife Huichun (who is also an OHIO alumna with a Masters in Counsellor Education) and daughter Lotus (who just turned four).

2000 – 2009

David Principe, B.S. 2009, completed his PhD at Rochester Institute of Technology in 2014 and is currently a Fondecyt Postdoctoral Fellow at Universidad Diego Portales in Santiago, Chile. He will be transitioning to a postoc at MIT in 2016.

Daniel Hoy, HTC Physics 2008, is working at Lake Shore Cryotronics in the Columbus area as a manufacturing engineer doing design and manufacture of magnetic sensors.

Justin Fink, PhD 2007 (advisor Boettcher), is an Astrophysicist at the Naval Research Laboratory in Washington, DC.

Saima Naz Khan, PhD 2007 (advisor Kordesch), is Assistant Professor of Physics at AWK University in Pakistan.

Aurangzeb Khan, PhD 2006 (advisor Kordesch), is Dean, Faculty of Physical and Numerical Sciences and Professor in the Department of Physics at AWK University in Pakistan.

Yuri Pidopryhora, PhD 2006 (advisor Shields), holds a research appointment in the Argelander-Institut fuer Astronomie at the University of Bonn, Germany.

Deepshikha Shukla, PhD 2006 (advisor Phillips), is currently an Associate Professor and the Program Chair of Physics at Rockford University (RU), a small private liberal arts college in Northern Illinois. She also serves as the International Faculty Fellow at RU and says that teaching undergraduate physics has been a very rewarding experience.

Anca Constantin, PhD 2004 (advisor Shields), is an Associate Professor in the Department of Physics & Astronomy at James Madison University.

Andreas Weichselbaum, PhD 2004 (advisor Ulloa), is a Privatdozent at Ludwig Maximilian University in Munich, Germany. An independent researcher in the group of Professor Jan von Delft, he has been named a Heisenberg Fellow in 2015. This fellowship identifies outstanding researchers and supports their work in advanced research topics.

Jacob Bak, PhD 2000 (advisor Statler), is Director of Emerging Markets at MacKay Shields, an investment management firm in New York City.

Bassem Sabra, PhD 2000 (advisor Shields), is Associate Professor and Chair of the Department of Physics & Astronomy at Notre Dame University-Louaize, located at Louaize, Lebanon.

1990 – 1999

Derek W. Beck, HTC Physics 1999, remains an active US Air Force Reservist, and has been selected for a promotion to lieutenant colonel. He should actually promote midsummer 2017. While Derek spends much of the year on active duty with the Air Force working in space operations for the Joint Space Operations Center, he spends his remaining time writing action-driven history books.

1980 – 1989

Satya Narayama, PhD 1986 (advisor Grimes), has retired after working for three decades at five hospitals as a radiation physicist, to administer the proper radiation dose to treat cancer. These included hospitals in Illinois, Michigan, New York and New Jersey. He currently lives in Bangalore, India.

Paul Koehler, PhD 1984 (advisor Lane), is currently Acting Group Leader in P-27 Division at the Los Alamos National Laboratory. He is working on the Detector for Advanced Neutron Capture Experiment (DANCE) and is using improved neutron resonance data to improve theoretical models of nuclear reactions. He lives in Los Alamos, New Mexico.

Cornelius Bennhold, PhD 1987 (advisor Wright), Professor and Chair of the Department of Physics of the George Washington University, passed away after a prolonged battle with cancer in early 2016. Cornelius had a prolific career, with many publications in the field of theoretical nuclear physics. Throughout his career, he collaborated with several faculty and students at OHIO and even hired another OHIO alum, Frank (Xiaodong) Lee (PhD 1993), to be on the faculty at GWU. He is survived by his wife, Laurette, and his daughter, Catalina

PhD Alumni Satya Narayama and his wife, Pankaja, visited the Edwards Accelerator Lab during the summer of 2016. Dr. Grimes was his PhD advisor.

Laurette Bennhold-Samaan and Catalina Bennhold-Samaan with a picture and dedication plaque of deceased OHIO alum Cornelius Bennhold at a 2016 ceremony held for him.

Graduate Degrees

Pooja Chopra (MS)
Saroj Dhakal (MS)
Sushila Khadka (MS)
Riffat Munir (MS)
Yuanzhi Wang (MS)
Leo Zella (MS)

Rami Amro PhD
Advisor Dr. Alexander Neiman

Dissertation: 'Nonlinear Stochastic Dynamics and Signal Amplifications in Sensory Hair Cells'

My dissertation research was concerned with understanding the underlying biophysical mechanisms in saccular hair cells in the inner ear. Sensory hair cells are the first stage in conveying the mechanical vibration into electrical current that initiates propagating action potential to the central nervous system. Inner hair cells are well known for their frequency selectivity, tuning, high sensitivity and nonlinear amplifications for the incoming stimulus, thus understanding their basic mechanisms helps in advancing the knowledge of projecting solutions for defects in the auditory and vestibular systems.

Present Position: Postdoctoral Scholar, University of California, Los Angeles, CA

Mahmoud Asmar, PhD
Advisor Dr. Sergio Ulloa

Dissertation: 'Electronic and Spin Transport in Dirac-Like Systems'

My primary research was on graphene and Dirace-like systems. It was theoretical research.

Present Position: Postdoctoral Researcher, Louisiana State University, Baton Rouge, LA

Shloka Chandavar PhD
Advisor Dr. Kenneth Hicks

Dissertation: 'Photoproduction of Scalar Mesons Using the CEBAF Large Acceptance Spectrometer CLAS'

For my thesis project, I analyzed data from an experiment conducted at the Thomas Jefferson National Accelerator Facility, or JLab, located in Virginia. The results show evidence for production of a particle called a scalar meson, made from a quark-antiquark pair when a high-energy photon from the JLab accelerator hits a proton. The scalar meson seen has a mass of about 1.6 times the proton's mass and provides new information about another hypothetical particle called a glueball, which has the same quantum numbers but is made only from gluons, with no quarks. This was the first observation of this particular scalar meson at JLab and was possible because of the high statistics of the data.

Present Position: Postdoctoral Researcher, Michigan State University, East Lansing, MI

Christopher Diltz PhD
Advisor Dr. Markus Boettcher

Dissertation: 'Time Dependent Leptonic and Lepto-Hadronic Modeling of Blazar Emission

My research focused on understanding the high energy emission of a sub-class of active galactic nuclei called blazars. I used two codes that I wrote, in order to model the high energy emission of different blazars.

Present Position: Software Developer, MDS Engineering, Dayton, OH

Linda Hlophe PhD
Advisor Dr. Charlotte Elster

Dissertation: 'Separable Representation of Nucleon-Nucleus Optical Potentials as Input to (d,p) Reaction Calculations'

My research was dedicated to the construction of separable representations of the nucleon-nucleus optical potentials. Theoretical calculations for deuteron-induced nuclear reactions require nucleon-nucleus optical potentials as input. The calculations are greatly simplified if the nucleon-nucleus potentials are of separable form.

Present Position: Gregory P Hansen Fellowship Postdoctoral Researcher, Michigan State University, East Lansing, MI

Chandrasiri Ihalawela PhD
Advisor Dr. Gang Chen

My primary research was to understand and tune the crystallization properties of phase-change materials under nanoscale confinement to provide a better insight for efficient device applications.

Present Position: Visiting Assistant Professor, Miami University, Oxford, OH

Johnson, Christopher PhD
Advisor Dr. Peter Jung

Dissertation: 'Investigating the Slow Axonal Transport of Neurofilaments: A Precursor for Optimal Neuronal Signaling'

My research entailed modeling the dynamics of enzyme motor proteins that are associated with the slow axonal transport of neurofilament polymers. These models were used to test hypotheses on the motile mechanism of neurofilament movement observed in axons. Additionally, we developed computational models to explore the physiological function of axon morphology, which is sculpted by the aforementioned neurofilament movement.

Present Position: Data Analyst/Consultant, IBM Corp. Dublin, OH

Heath Kersell PhD
Advisor Dr. Saw-Wai Hla

Dissertation: 'Alternative Excitation Methods in Scanning Tunneling Microscopy'

I investigated single molecule systems and molecular networks at low temperatures, geared toward the development of devices at the nanoscale. I also utilized the X-ray absorption combined with scanning tunneling microscopy to establish the elemental identity and properties of nanoscale structures.

In conjunction with this effort, I designed a first of its kind low temperature – ultrahigh vacuum – synchrotron X-ray assisted – scanning tunneling microscope capable of probing magnetic and chemical properties of materials.

Present Position: Postdoctoral Fellow, Lawrence Berkeley National Lab, Berkeley, CA

Sean Krupa PhD
Advisor Dr. Eric Stinaff

Dissertation: 'Nonlinear Optical Properties of Traditional and Novel Materials'

My research focused on non-linear optical processes which are used by emerging, quantum-based technologies. Specifically I conducted optical characterization on devices, materials, and applications based on photon pair production via nonlinear optics.

Present Position: Optical Engineer, Sotera Defense Solutions, Naval Research Lab, Washington, DC

Andrada-Oana Mandru PhD
Advisor Dr. Arthur Smith

Dissertation: 'Ferromagnetic Thin- and Ultra-Thin Film Alloys of Manganese and Iron with Gallium and Their Structural, Electronic, and Magnetic Properties'

In my research, I prepared atomically smooth samples that I then investigated using a scanning tunneling microscope to probe the surface structure down to atomic level. I mainly investigated magnetic samples with great potential for real-world applications. These studies were combined with a variety of other methods through our many collaborations, in order to obtain a complete picture of the investigated systems.

Present Position: Postdoctoral Researcher, EMPA – Institute, Dubendorf, Switzerland

Sean McGraw PhD
Advisor Dr. Joseph Shields

Dissertation: 'Outflow and Accretion Physics in Active Galactic Nuclei'

I studied the interaction between supermassive black holes and their host galaxies by probing winds in active galaxies. Specifically, I acquired spectra of these winds using a telescope and estimated their kinematics and energetics by conducing variability analyses.
My plan is to first acquire additional research experience as a postdoctoral scholar. I hope to become a professor at an undergraduate institution where I can focus on teaching and research with students.

Present Position: Postdoctoral Research Scholar, Pennsylvania State University, University Park, PA

Brian Muccioli PhD
Advisor Dr. Madappa Prakash

Dissertation: 'Equations of State for Simulations of Supernovae, Neutron Stars and Binary Mergers'

In my research, I employed state-of-the-art models of nuclear interactions to calculate the equation of state. The resulting equation of state is to be used in simulations of astrophysical objects.

Present Position: Scientist, Frontier Technology, Beverly, MA

Sneha Pandya PhD
Advisor Dr. Martin Kordesch

Dissertation: 'Modification of Inert Gas Condensation Technique to Achieve Wide Area Distribution of Nanoparticles and Synthesis and Characterization of Nanoparticles for Semiconductor Applications'

I synthesized nanoparticles using a bottom-up vapor phase technique and characterized them for semiconductor applications. I also built the nanoparticle synthesis instrument and upgraded it for large area, direct deposition of nanoparticles.

Present Position: D1C Process Engineer, Intel Corporation, Hillsboro, Oregon

Arbin Thapaliya PhD
Advisor Dr. Daniel Phillips

Dissertation: 'Topics in Effective Field Theories for the Strong Interaction'

My primary research was looking at various low energy QCD processes.

Present Position: Tenure-track faculty member, Franklin College, Franklin, IN

Venkata Ramana Kumar Thota PhD
Advisor Dr. Eric Stinaff

Dissertation: Tunable Optical Phenomena and Carrier Recombination Dynamics in III-V Semiconductor Nanostructures'

My primary research was focused on studying the light matter interaction at the nanoscale. Using ultrafast lasers, I was able to measure the optical interaction of III-V semiconductor nanostructures with high spectral and temporal resolution.

Present Position: Process Technology Development Engineer, Intel Corporation, Hillsboro, OR

Haocheng Zhang PhD
Advisor Dr. Markus Boettcher

Dissertation: 'Polarization signatures in blazar emission'

My primary research involved radiation and polarization signatures from blazar emission.

Present Position: Postdoctoral Research Associate, University of New Mexico, Albuquerque, NM

Undergraduate Degrees

Maxwell Camp (B.S., Physics with Honors)
Henry Cornell (B.S., Astrophysics)
Andrew Dewald (B.S., HTC Physics and B.S. Chemistry)
Miguel Gomez (B.S. Physics and B.S. Computer Science)
Erin Grimes (B.S. Physics and B.S. Applied Mathematics)
Cates Harman (B.S. Physics)
Kylie Holmes (B.S. Astrophysics and B.S. Meteorology)
David Overton (B.S. Physics)
Robert Radloff (B.S. Physics)
Thomas (Tad) Riley (B.S. Physics)
Jacob Hartman (B.S. Physics)

L to R: Erin Grimes, Miguel Gomez, Robert Radloff, Kylie Holmes, Cates Harman

L to R : Dr. Lauren McMills (Chemistry), Andrew Dewald, Dr. David Drabold

2015 Summer Research Interns

Zachary Bernens (with Julie Roche) 'BCM Calibration and Charge Analysis for E12-06-114 Winter 2016' Understanding the internal structure of protons and neutrons is a gateway to understand the origin of the vast majority of ordinary matter. A tool commonly used toward this goal is to smash accelerated electrons and smash them onto protons and neutrons targets. In that context, a precise count of the number of electrons impinging on the targets is essential to quantify their interactions. During his 2016 summer internship, Bernens analyzed data from a recently performed experiment, and estimated the number of electrons impinging on the target with a precision better than 1%.

Ari Blumer (with Martin Kordesch) 'The Observation of MoS2 Two Dimensional Crystal Growth in a Tube Furnace at 1000C' Blumer is building a system consisting of a furnace with an open area for viewing the growth of MoS2 crystals at up to 1000 C. The growth of these crystals is currently a "recipe" driven art. The actual process is usually hidden in the furnace, and the results are unreliable. Ari is looking at the process as it occurs, so that the growth of the material can be better controlled or tailored to the requirements of applications.

Zak Blumer (with Martin Kordesh) 'TiN plasmonic solar-thermal concentrators fabricated by electrospinning' Blumer fabricated a mat of electrospun high-temperature polymer fibers loaded with titanium nitride particles. The fibers were floated on the surface of water, and illuminated with a solar simulator. The fibers collected the incident radiation, heating the water below. The efficiency of this method of heating water with plasmonics particles embedded in the fibers was investigated.

Jack Bruno (with Arthur Smith) 'Startup of a Laser Deposition System at Ohio University' Bruno completed the setup of an excimer pulsed laser deposition system. After finishing the setup, Jack did the first tests of firing the laser and then the first tests of depositing a series of thin metal films using this laser system. He began to develop a substrate heater for future growth of crystalline thin films.

Brandon Coleman (with Hee-Jong Seo) 'Statistically measuring large-scale galaxy distribution' Coleman's project was to produce a python code that calculates the galaxy density field using cosmological N-body simulations and transform it to Fourier space.

Colton Feathers (with Carl Brune) 'Accurate Determination of the Thicknesses of thin Films of Carbon-12 and Carbon-13' Feathers performed experiments using alpha-particle beams at the Edwards Accelerator Laboratory to accurately determine the thicknesses of films of 12C and 13C. In preparation for the measurements, Colton learned about the energy loss of charged particles and the physics governing the probability of alpha-particle scattering. He was also trained to be an accelerator operator. These thickness measurements are important for determining the absolute normalizations of cross section measurements performed with other beams on these targets.

Taylor Gardner (with Ryan Chornock) 'Insights on Supernova Ia Progenitors from Their Locations' Limits on the Globular Cluster Production Efficiency of Type Ia Supernovae from their Spatial Distribution Type Ia supernovae (SNe Ia) are produced by the explosions of white dwarf stars, but the identity of their progenitor systems has remained controversial. One currently popular model invokes a pair of white dwarfs in a binary system that merge. If it is true, many dynamical models predict that the formation rate of such systems should be substantially enhanced in the dense environments of globular clusters. Gardner constructed a large sample of SNe Ia that occurred in elliptical galaxies and examined the distribution of their spatial offsets from the nucleus to set upper limits on the presence of a population that follows the globular cluster spatial distribution instead of that for the stars as a whole.

Benjamin Hirt (with Martin Kordesch) 'Electron emission behavior from selected electron emitters' Hirt built an ultra-high vacuum "close-spaced diode test" system to investigate the electron emission from cold cathode and thermionic cathode electron emitters. He verified several fundamental equations from the physics of electron emission: The Fowler-Nordheim equation for field emission,

anomalous field emission, the Richardson-Dushman equation for thermionic electron emission and Child's law of space charge. Bare tungsten and graphene coated field emission tips were fabricated and tested. Bare tungsten wires and oxide coated cathodes were examined for their thermionic emission characteristics.

Daniel Ivory (with M Prakash) 'Computational Physics' Ivory learned computational techniques required to solve non-trivial problems encountered in many branches of physics and astrophysics through several projects laid out in the text book Computational Physics, by S.E. Koonin and D.C. Meredith.

Jamison Lahman (with M Prakash) 'Computational Physics' Lahman learned computational techniques required to solve non-trivial problems encountered in many branches of physics and astrophysics through several projects laid out in the text book Computational Physics, by S.E. Koonin and D.C. Meredith.

Miles Lindquist (with Eric Stinaff) 'Photolithography for 2D materials device fabrication' Lindquist has been using photolithography to produce metallic patterns. He then subsequently grows single layer films which form two dimensional semiconducting material between the metallic patterns. He is currently working on studying the dependence of the pattern sizes and geometry on the growth process.

Katelynn Nichols (with Gang Chen) 'Optical Absorption Spectroscopy and Small-angle X-ray Scattering Studies of Metal Ion Diffusion in Ag-Ge-Se Thin Films' Nichols learned how to synthesize amorphous thin films using a thermal evaporation method and how to characterize the electrical and optical properties and nanostructure of amorphous semiconductors.

Brandon Niese (with David Tees) 'Adaptation of photolithographic techniques for fabrication of multi-channel microfluidic devices for assessment of cell rheology' Niese learned and adapted photolithographic techniques for making microfluidic devices. He made single channel devices and also troubleshot issues with making multi-channel devices. He perfected protocols for filling the channels with fluid. He assessed the flow rates in the channels as a function of pressure using video microscopy. He continued work by graduate student Saroj Dhakal on using the image processing packing ImageJ to track cells as they travel through the channels.

Joseph Pincura (with Ryan Chornock) 'A Search for Echoes of Old Tidal Disruption Events' A Search for High-Ionization Emission Lines from Tidal Disruption Events at Late Times Tidal disruption events (TDEs) are objects where the supermassive black hole in the center of a galaxy disrupts and accretes a star that wanders too close. Joe worked with some spectra of four TDEs observed at late times with the 2.4 m telescope at MDM Observatory. Joe calibrated the raw data and analyzed the resulting spectra to put upper limits on the luminosity of certain high-ionization emission lines that have been seen in other possibly similar TDEs at late times.

Robert Radloff (with Paul King) 'Qweak analysis procedure checks' The Qweak experiment at Jefferson National Laboratory is a test of the Standard Model of Particle Physics, in which the parity-violating scattering of spin-polarized high-energy electrons from protons is used to determine the relative couplings of the electromagnetic and weak forces. The scattering rates for electron spins parallel or antiparallel to their motion are different by only about 200 parts per billion. During the analysis of the data, the measured difference in the rates is "blinded" by a hidden value to avoid subconscious bias in the analysis procedure. After all corrections have been determined, the final result is "unblinded" by subtracting the previously hidden value.

During his summer internship, Radloff verified that the blinding and unblinding procedures do not alter the final result. He did this by comparing the published result of the Qweak commisioning run with a new analysis which was otherwise identical except with the blinding disabled. He found the results without blinding were identical to the results after the blinding-and-unblinding process.

Sara Sand (with NOAA Hollings Internship, Colorado) 'Using Doppler Lidar Data to Analyze Wind Turbine Wakes and Ramp Events' Sand works with Dr. Yelena Pichugina and Alan Brewer at the Earth System Research Laboratory to analyze the length and velocity deficits of the wakes created by wind turbines using data collected from two Doppler lidars located in the Columbia River Basin in Oregon. Sand is using this data to do case studies on significant ramp events and the efficacy of our models in the complex terrain of this area.

Heath Scherich (with David Drabold) 'Amorphous Zinc Oxide and GPU Computing' Scherich worked with graduate student Anup Pandey and Drabold on making computer models of the novel electronic/thermoelectric material ZnO, and ported VASP to run on a GPU. A paper on ZNO is submitted to a scientific journal.

Charles Seacrist (with Hee-Jong Seo) 'Sound waves in the gravitational week lensing survey' Seacrist worked on estimating the probability of detecting Baryon Acoustic Oscillations directly from the dark matter distribution using weak lensing surveys.

Cole Spencer (with Eric Stinaff) 'Nanoscale Lithography Using an Atomic Force Microscope' Spencer has been working on making nanometer sized patterns using an atomic force microscope (AFM). Our goal is to see if a procedure we have developed to grow two dimensional material between metallic patterns will work on the nanometer scale. With optical lithography we can only make patterns on the order of 1 to 2 micrometers whereas most modern electronics have features as small as 14 nanometers. Cole's work will help us explore the size limitations of our process.

Justin Thompson (with Gang Chen) 'Kinetics of Conductive Filament Growth under Electric Field in Conductive Bridging Random Accessory Memory (CBRAM) Devices' Thompson learned how to measure the electrical property of CBRAM materials and study the growth kinetics of conductive filaments under electric field.

Ryan Tumbleson (with Saw Hla, Argonne National Lab) 'Scanning Tunneling Microscope Study of Nanomaterials' Tumbleson learned how to use the Synchrotron X-Ray Scanning Tunneling Microscope at the Argonne National Lab. He assisted in preparation of the SXSTM for an experiment. During the fall semester and as part of the Hla Group, Tumbleson is preparing to drive a molecular car in the inaugural NanoCar Race taking place in May, 2017 in Toulouse, France.

Jacob Williamson (with Ryan Chornock) 'The Nature of the Unusual Supernova 2005da' Williamson continued his work from the previous summer. He examined the light curve and spectra of supernova (SN) 2005da. This object had previously been classified as a SN with high velocities from an energetic explosion. Instead, Jacob found evidence that the light curve of this SN decayed too quickly to be consistent with a SN of that type. Instead, it is more similar to a class of SNe that result from interaction of the SN explosion with circumstellar material that is deficient in hydrogen (and helium in this case).

2015-2016 Scholarship Recipients

Edwin and Ruth Kennedy Distinguished Professor Scholarships (full tuition)
Kate Nichols
Daniel Ivory
Jacob Williamson

John E. Edwards Fellowship
Brandon Coleman
Anika Friedman
Taylor Gardner
Daniel Ivory
Jamison Lahman
Hunter Lawson
Miles Lindquist
Katelyn Nichols
Nick Zalensky

Lela A Ewers Science Scholarship
Heath Sherich

Robert P. Gecsy Physics Scholarship
John Auker

Mark H. Grimes Memorial Fund
Sara Sand
Heath Sherich
Yonry Zhu

Darrell Otto Huwe Scholarship
Claire Schrantz

Edwards R. Sanford Astronomy Fund
Jacob Williamson

Physics & Astronomy Endowment Fund
Claire Schrantz
Ryan Tumbleson
Nick Zalenski

James T. Shipman Physics Scholarship include
Ari Blumer
Zak Blumer
Mikenzie Hiler
Grant Merz
Graham Tupper
Kevin Ward, Jr.

The Abhishek Singh Scholarship
Sara Sand

C. Paul and Beth K. Stocker Scholarship
Jack Bruno
Alexandra Semposki
Ryan Tumbleson

Donors to the Department

During the past academic years, the department received contributions from many alumni, friends, and members of the faculty and staff. We are very thankful to all of our donors. Listed below are donors from the 2015-16 academic year. (We apologize if we have overlooked any contributions made during this period,)

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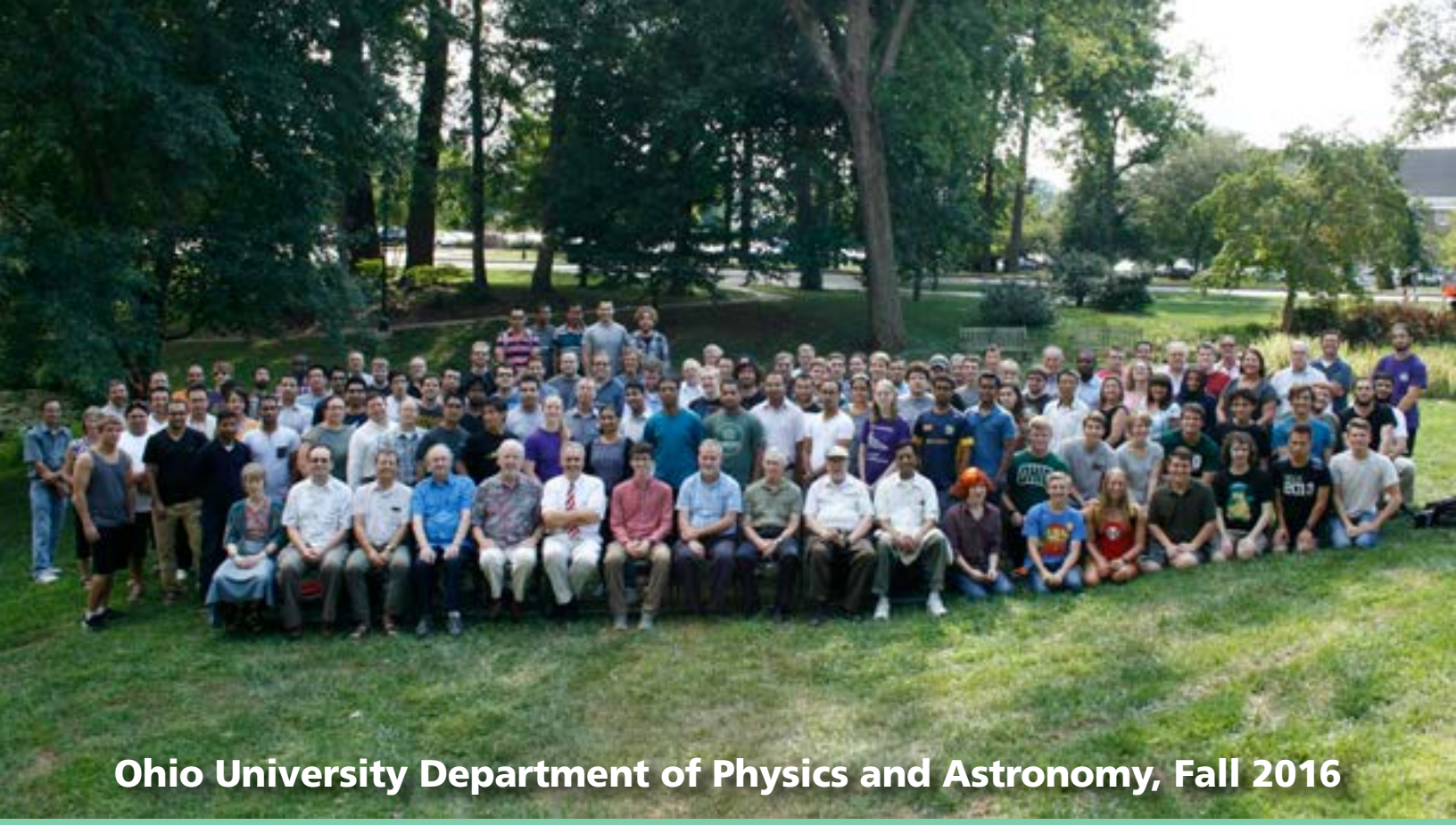
David Tees
James & Barbara Tison
Sergio Ulloa

Building a Strong Tradition of Networking

Thanks to all of you that have stayed in touch with faculty and friends of the Department of Physics and Astronomy. Your feedback and contributions keep our networking tradition strong.

Throughout the year we invite you to send us news of personal and professional highlights as well as photos to share. To keep in touch with us submit your news at physics@ohio.edu or Newsletter Editor **Kenneth Hicks** at hicks@ohio.edu.

Photography by Jean Andrews and Robert Hardin



Ohio University Department of Physics and Astronomy, Fall 2016

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If you would like to make a contribution to one of the departmental funds, include the following information in a letter to **Professor David Ingram, Department of Physics and Astronomy, Ohio University, Athens, OH 45701** or for on-line giving visit **www.ohio.edu/give** and select Other on the pull-down menu and enter the fund you wish to contribute to. There is also a toll free phone number to the Ohio University Foundation (800-592-FUND) for making contributions.

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