

*All the v's that's fit to print*

# ΦYAST ΦLYER

*The Homer L. Dodge Department of Physics and Astronomy*

## John Stupak and John Tobin Join the Faculty



*John Stupak*

Members of the Department of Physics and Astronomy are pleased to welcome John Stupak and John Tobin as new assistant professors in high-energy and astrophysics, respectively. Tobin becomes the new Homer L. Dodge Assistant Professor of Astrophysics. Both will move to OU this August.

Stupak received his doctorate in 2012 from Stony Brook University under the direction of Michael Rijssenbeek and Dmitri Tsybychev. He then spent four years as a postdoctoral research associate at Purdue University-Calumet, during the final two years of which he was the recipient of a Distinguished Researcher Fellowship from the LHC Physics Center at Fermilab. Stupak's research activities are focused on the search for new physics at the LHC. He has searched for new particles and forces as a member of both the ATLAS and CMS collaborations as a graduate student and postdoc, respectively. Stupak also focuses on precision studies of the recently discovered Higgs boson and has contributed to both the ATLAS and CMS pixel detector upgrades. He plans to continue this hardware work with the second of the planned upgrades of the ATLAS pixel detector.

Outside of the office, Stupak enjoys watching movies and rock climbing.



*John Tobin*

Tobin received his Ph.D. in 2011 from the University of Michigan under the direction of Lee Hartmann and Ted Bergin. Following his Ph.D, he was awarded a Hubble Fellowship and spent three years at the National Radio Astronomy Observatory in Charlottesville, Virginia. In 2014, he won a Veni Fellowship from the

Netherlands Organization for Scientific Research and has spent the past two years at Leiden Observatory in the Netherlands. Joining OU represents a return to Oklahoma for Tobin, having been stationed at Fort Sill while in the U.S. Army.

Tobin's research focuses on the early stages of star formation, specifically on the structure of the star-forming molecular clouds, the origin of binary/multiple star systems, the formation of proto-planetary disks and how stars reach their observed masses. To carry out this research, John observes young star systems at multiple wavelengths, from visible light to centimeter wavelengths.

*Continued on pg. 4*

## OU Joins Apache Point Observatory



*UL to LR: NMSU 1 m, SDSS 2.5 m, ARC 0.5 m and 3.5 m telescopes.*

Following several years of effort and negotiation, OU is now a permanent member of the Apache Point Observatory (APO). Managed by the Astrophysical Research Consortium, the observatory site is located in southeastern New Mexico, roughly 130

miles northeast of El Paso, Texas, near Sunspot at an altitude of 9100 feet. Besides hosting the Consortium's

3.5-meter and 0.5-meter telescopes, the 2.5-meter Sloan Digital Sky Survey and New Mexico State University's 1-meter telescopes also are located there. Other Consortium members include the University of Washington, New Mexico State University, the University of Colorado, Johns Hopkins University, the University of Virginia, Georgia State University and the University of Wyoming.

The APO membership provides a transformative boost to our astrophysics program. This development will provide astronomy faculty and students guaranteed access to a world-class observing facility. It will enable them to pursue

*Continued on pg. 4*

# From the Chair



*Eddie Baron*

The year of 2016 has seen changes here at the Homer L. Dodge Department of Physics and Astronomy. Department Chair Greg Parker took a well-earned sabbatical leave and I have been filling in for him until his return July 1. The precipitous drop in the price of oil has led to a budget crisis throughout the state and consequently the university announced a special retirement initiative. Six of our faculty have expressed interest, but at this writing only our newsletter editor Dick Henry has announced his retirement in August of 2016. We hope that he will continue to be a fixture around the department. The students will miss his firm, but gentle teaching methods.

After more than 35 years, our shop foreman, Joel Young, also has decided to slow down and has gone to part-time status. The shop is now in the capable hands of Barry Bergeron, who has been a machinist for many years in our shop. Our lab demonstration specialist, Bill See, also has announced that he will retire at the end of 2016. In addition, after 21 years at OU, condensed matter experimentalists Sheena Murphy and Matt Johnson are moving to our Big 12 partner West Virginia, where Sheena will be associate vice president for research development and both will be professors of physics. We wish them the best in their future endeavors.

We were lucky to have two successful faculty searches this year, hiring John Tobin as the Homer L. Dodge Assistant Professor of Astrophysics and John Stupak as assistant professor, joining the High Energy Experimental Group.

Our building committee, the architects and engineers from Miles Associates, HDR and Flintco are hard at work designing the new Lin Hall Research Laboratory building as well as the complete Dodge Physics Complex. Demolition of Gittinger Hall to make room for the Dodge

Physics Complex will begin very soon. We cannot fully express our gratitude to Board of Visitors Chairman Chun Lin and the Avenir Foundation for their generous support of this project.

In honor of OU Alumnus and Board of Visitors member Neal Lane, we are planning a symposium on the “State of the Research Enterprise in the U.S.”. A panel of distinguished scientists, engineers and educators will share perspectives on the state of U.S. science and technology and the unique role of America’s research universities. Panelists will reflect on challenges facing the American research enterprise and higher education, particularly the nation’s public universities. The symposium is tentatively planned for February, 2017, so mark your calendars.

Finally, the university has committed to our buy-in to the Apache Point Observatory at the 6.25 percent level, which will give our astronomers access to 40 half-nights of observing on the 3.5-meter telescope in Sunspot, New Mexico. The department will take on a new challenge of raising \$110,000/year for the operational costs of the observatory, and we hope that our alumni will be willing to help with “subscriptions”, just like to National Public Radio. There is a special account at the OU Foundation for Apache Point Operations; please give what you can.

The Dodge Physics Complex will provide us with facilities for our laboratory experimentalists, Apache Point will provide us with facilities for our observational astronomers, and the Large Hadron Collider provides facilities for our high energy physics experimentalists. We are lucky in these trying budget times to have set on a path of excellence for the rest of the 21st century. It is only with your support that we continue to maintain our position of research excellence.

We are all looking forward to a productive summer of research.

## What Is Where?

- Stupak And Tobin Join Faculty, 1
- OU Joins Apache Point Observatory, 1
- From The Chair, 2
- Lin Hall Update, 3
- Remembering Tibor Herczeg, 4
- Student News, 5-8, 15
- Faculty News, 9-13
- Scientific Instrument Collection, 14

The ΦYAST ΦLYER is the official newsletter of the Homer L. Dodge Department of Physics and Astronomy, College of Arts and Sciences, University of Oklahoma, and is published each spring by OU Printing Services at a cost of \$1.70/copy to the taxpayers of the State of Oklahoma. The newsletter staff includes Dick Henry, Mukramin Kilic, Kieran Mullen, Arne Schwettmann and Bruno Uchoa. The University of Oklahoma is an equal opportunity institution. [www.ou.edu/eo](http://www.ou.edu/eo)

# Lin Hall Update



President Boren

University of Oklahoma President David L. Boren announced on March 9 two lead gifts that will provide resources to construct a new academic building and research laboratory on the Van Vleet Oval that will house the Homer L. Dodge Department of Physics and Astronomy. The new building together with Nielsen Hall will comprise a new physics complex.

The resources are being made possible through major gifts from the Avenir Foundation, and Chun C. Lin, who served on the OU physics faculty from 1955 to 1968. In appreciation of the gifts, Boren recommended that the OU Board of Regents recognize Homer L. Dodge, who served as chair of the OU physics department from 1919 until 1944, by naming the physics complex “The Dodge Physics Complex” and Professor Chun Lin by naming the new academic building “Lin Hall.”

“We are extremely grateful to the Avenir Foundation and to Chun Lin for these generous gifts, which largely will fund the new addition to our Physics building,” Boren said. “These gifts are even more appreciated in these tough economic times,” he said.

The new academic building will feature modular design for maximum flexibility in the more than 18,000 square feet of research laboratory space as well as office space for faculty and graduate students and an astronomy observatory on the roof. The laboratories will have advanced temperature control, vibration and acoustic isolation, and electromagnetic shielding in addition to providing critically needed space. The building will be located south of Nielsen Hall, the current home of the physics and astronomy department. Construction of the new physics building will begin in the fall on the site now occupied by Gittinger Hall. The laboratory spaces in the building will undergo extensive testing for various certifications. The building is expected to be completed by spring of 2019.

Chun Chia Lin, a former University of Oklahoma faculty member and current chair of the OU Department of Physics and Astronomy Board of Visitors, is a noted research

physicist and distinguished faculty member who has led one of the world’s foremost groups of physicists studying atomic collisions. His studies have increased the world’s understanding of the basic nature of the atomic and molecular process in ionized gases.

Lin, who now serves as the John and Abigail Van Vleck Professor of Physics at the University of Wisconsin-Madison, is a consummate teacher who has provided educational supervision for more than 48 Ph.D. candidates, many of whom went on to achieve prominent positions within the field.



Chun Lin

Lin earned his undergraduate degree at the University of California-Berkeley and his doctorate from Harvard in 1955, the same year he joined OU as an assistant professor in physics. While at OU, he helped initiate a seminal program on electron excitation of atoms. He has served as the chairman of the Gaseous Electronics Conference and chair of the Division of Atomic, Molecular and Optical Physics of the American Physical Society. In 1996,

the American Physical Society honored Lin with the Will Allis Prize for his contributions to the study of ionized gases. He is a fellow of the American Physical Society and a former Alfred P. Sloane Foundation Fellow. Lin received an honorary doctorate from OU in 2015.

The Homer L. Dodge Department of Physics and Astronomy offers degree programs in physics, astrophysics and engineering physics at the bachelor’s, master’s and doctoral level. Since 1909, the department has had a tradition of educating scientists, engineers and teachers who have distinguished themselves as leaders in industry and academia. Graduates include a former Science Adviser to the President of the United States, who was previously director of National Science Foundation; one president of a state university; one U.S. ambassador; five founders of corporations; one famous Arctic explorer; the founder and first editor of the *American Journal of Physics*; seven research laboratory managers; one Rhodes Scholar; and two Guggenheim Fellows among more than 500 other graduates devoted to advancing knowledge and improving quality of life.

# Remembering Tibor Herczeg



Tibor József Herczeg, Professor Emeritus of the department, passed away on July 7, 2014 in Budapest (his place of birth on November 4, 1926). He managed to escape Hungary in 1956 before the Russians crushed the Hungarian uprising and spent his early professional years as an astronomer in Germany. Tibor may be considered the grandfather of the astronomy part of the Physics and Astronomy Department. In 1968, following the retirement of Balfour Whitney, mathematics relinquished the only astronomy position at OU to Physics, which was then under the chairmanship of Dick Fowler. Tibor happened to be attending the Fourth Texas Relativistic Astrophysics Symposium in 1968 when some Hungarian friends from his childhood learned of our need for an astronomer. Tibor joined the department in 1970 and was a perfect fit for us. Without his professional experience as an observer, his deep commitment to science, his love of teaching and his absolutely gentle personality, the department may have remained permanently a physics department. However, in spite of his overwhelmingly positive influence on the department, we almost lost him to ICE (Immigration and Customs Enforcement). Because Tibor came from behind the Iron Curtain, it took a special act of the U.S. Congress for him to be eligible for citizenship. Tibor had a lasting interest in variable stars (double and multiple stars, close binaries) and stellar evolution. He even managed to use Balfour Whitney's old collection of photographic plates taken on the 10-inch reflector to study binaries and variables. More information about Tibor's career and his role in the development of the Department is available on the department's web page at [www.nhn.ou.edu/news-and-events/obituary-dr.-tibor-jozsef-herczeg](http://www.nhn.ou.edu/news-and-events/obituary-dr.-tibor-jozsef-herczeg) and in Dick Fowler's book *Late Start, Fast Finish*.

*New faculty: Continued from pg. 1*

\*\*\*\*\*

His recent work focuses on conducting surveys of hundreds of very young stars at radio wavelengths at the highest possible resolutions using the upgraded Very Large Array and newly commissioned Atacama Large Millimeter Array in Chile. These observations enable the youngest multiple star systems and the youngest proto-planetary disks to be resolved, some of which have sizes and separations smaller than our own solar system. These observations enable us to learn how binary/multiple stars form, finding strong evidence that companions

form within their proto-planetary disks. Having concentrated on radio observations in the past few years, Tobin is very excited to take advantage of the access to Apache Point Observatory to further the characterization of young binaries and accretion properties of young stars in the infrared.

Outside the office, Tobin enjoys spending time with his wife, Alice, and 5-year-old son Sean, as well as exploring nature, hiking, fishing, reading and watching sports.

*APO: Continued from pg. 1*

\*\*\*\*\*



*The ARC 3.5-meter telescope*

high-risk, high-reward research, pursue long-term research programs, and provide data to support their space-based (e.g., Hubble Space Telescope) research programs. Moreover, our

membership also will provide abundant opportunities for our graduate and undergraduate astronomy students to hone their observing skills as they acquire much-needed data for their research. At this time, data from APO observations may be used as the basis for lab exercises in our introductory astronomy classes as well as the current senior-level undergraduate and graduate course Observatory Methods. In addition, APO offers remote observing. Once astronomers have been trained on-site, they will be able to observe from their offices in Nielsen Hall, thereby saving on travel expenses.

addition to a yearly maintenance fee of \$110,000. Thus, over a 10-year period, OU's total cost adds up to \$1.6 million. The department's share is \$967,000. These financial commitments are being supported by the provost, the vice president for research, the Arts and Sciences dean, the Physics and Astronomy department and individual faculty research grants and start-up funds. As noted in the "From the Chair" article in this newsletter, we are hopeful that our alumni will be able to help support the department's annual obligation for operation costs via yearly subscription, akin to the way they might support National Public Radio. Anyone wishing to make a donation to help with APO expenses may do so by visiting [www.nhn.ou.edu/friends-alumni/donate](http://www.nhn.ou.edu/friends-alumni/donate) and choosing Apache Point Observatory in the "Use my gift for" dropdown menu after clicking on "Make a Gift."

The department is grateful to Kelly Damphousse and Ingo Schlupp, dean and associate dean, respectively, of the OU College of Arts and Sciences; Vice President for Research Kelvin Droegemeier; Provost and Senior Vice President Kyle Harper and President Boren for their generous assistance in making OU's membership in APO possible.

OU's share of total observing time is 6.25 percent, which translates into 40 half-nights annually. The cost of our membership includes a one time \$500,000 buy-in fee in

# Student Awards

On April 30, the department held its annual awards ceremony to honor undergraduate and graduate students for their excellent work in courses and research. Chairman Greg Parker served as master of ceremonies and was assisted by Mike Strauss, Mike Santos and Kieran Mullen in distributing the awards. Following the event, students and faculty gathered in the atrium outside the first-floor lecture hall to enjoy refreshments and conversation. Listed below are the names of those students who were presented with awards. Note that there are three general classes of undergraduate awards (general departmental awards, P&A awards, and Engineering Physics awards). One of our undergraduates also was awarded a prestigious Goldwater Scholarship. The graduate awards include the Kalbfleisch Award and Nielsen Prize.

## Homer L. Dodge Departmental

### Dodge Outstanding Sophomore

Avraham Revah

### Dodge Outstanding Junior

Jonathan Kunjummen

### Fowler Prize

Brandon Curd

### J. Clarence Karcher Award

Taylor Murphy

Stephen Lacina

### Duane E. Roller Award

Christoph Kinzel, Matthew Peters,

Patrick Vallely

### William Schriever Award

Alison Roeth, Gavin Jergensen,

Christopher Leonard

### Outstanding Graduating Senior

Dillon Roberts, Steven Hefner, Reza Niazi,

Mohammad Niazi, Troy Southard

### Meritorious Scholarships

Carlos Balderrama, Samuel Bayliff, Finnian Bender, Ismael Beraza, Philip Bobek, Jonthomas Box, James Braden, Miranda Brugman, Sean Bruton, Caroline Buckles, Anthony Burrow, Zoe Cler, Phillip Collins, Courtney Crawford, Brandon Curd, Collin Dabbieri, Jennifer Davis, Alex Dorio, Aleksia Elmborg, Gary Ervin, Erik Flom, Kendall Gehrke, Dustin Gier, Jacob Gill, Steven Hefner, Madisyn Heimback, Phillip Heitert, Gavin Jergensen, Allison Jones, Tarryn Kahre, Jonathan Kendrick, Christoph Kinzel, Jonathan Kunjummen, Stephen Lacina, Christopher Lenhart, Christopher Leonard, Adam Marrs, George Mau, Joshua McDermott, Hunter Melton, Connor Moore, Taylor Murphy, Mohammad Niazi, Reza Niaze, Oskar Novak, Lucas Orman, Felicia Padilla, Lisa Patel, Matthew Peters, Thomas Pharis, Whitney Pontious-Wells, Josiah Purdum, Cody Ray, Avraham Revah, Andrew Richmond, Dillon Roberts, Alison Roeth, Samuel Rogers, Visal So, Samuel Spearman, Zoe Stearns, Brian Stephenson, Thomas Talbot, Jeffrey Terry, Joseph Tessmer, Tristan Thrasher, Jacob Tice, Morgan Turner, Patrick Vallely, Simon Vigil, Collin Wade, Cassidy Wagner, Nash Watchous, Ethan White, Riley Whitmore

## Engineering Physics

### J. Clarence Karcher Award

Nicholas Kantack

### Duane E. Roller Award

Christopher Brown

### William Schriever Award

Drew Wild

### Meritorious Scholarship

Robert Anderson, Lucas Barker, Christopher Brown, John Brown, Jacob Burcham, Brandon Carson, Olivia Caruthers, Daniel Chantland, Mary

Chenot, Zachary Chesnut, Timothy Corbly, Daniel Davidson, Hannah Day, Alexandra DiCarlo, Tyler Erickson, Alec Gaddie, Trenton Hamm, Hannah Harrell, Russell Hobson, Madison Jones, Nicholas Kantack, Shuli Liao, Nathaniel Lydick, Alexander Marrero, Roger Montgomery, Devon Moseley, Kennedy Reidy, Steven Roberts, Omar Robles, Jackson Sloan, Troy Southard, Bao Tran, Delano Usiukiewicz, Phan Vu, Jacob Whitson, Drew Wild, Nicholas Wiley, Jacob Young

## Patrick Vallely Named Goldwater Scholar



Patrick Vallely, a senior majoring in astrophysics, received word in late March that he has been awarded a Goldwater Scholarship. Besides the prestige that the award bestows upon the recipient, the scholarship will cover the cost of tuition, fees, books and room and board up to a maximum of \$7,500 during his senior year. As described at the scholarship website, “the purpose of the Barry Goldwater Scholarship and Excellence in

Education Foundation, as stated in the enabling legislation, is to alleviate a critical current and future shortage of highly qualified scientists, mathematicians and engineers. A more realistic statement of the purpose, in today's terms, is to provide a continuing source of highly qualified individuals to those fields of academic study and research.” Patrick was one of 252 persons selected nation-wide out of 1,150 students nominated by their home institutions this year. He also is one of only two successful applicants from his home state of Nevada and one of three OU students selected for the honor.

Vallely grew up and graduated from high school in Boulder City, Nevada, a town of 15,000 located about 25 miles southeast of Las Vegas near the Hoover Dam. He entered OU as a freshman National Merit Scholar in the fall, 2013. Vallely was first exposed to and became excited about physics in a high school physics class and subsequently came to OU with the goal of majoring in astrophysics. While at OU he has worked as a research student in our department for both Ian Sellers and Eddie Baron. While working with Sellers as an REU student in summer, 2015,

Vallely improved the Mathematica solar cell model that he had written during the prior spring semester. He also wrote Matlab scripts to run a newly acquired spectrometer setup. His research under Baron has involved the use of SINOW, a spectrum analysis code originally written by David Branch and used to interpret observed spectra of supernovae. Vallely's work resulted in a first author paper for him, which focused on the SYNOW analysis he made for SN2014J, a nearby Type Ia SN in the galaxy M 82. The paper has been accepted by Monthly Notices of the Royal Astronomical Society and is currently available at [arxiv.org/abs/1512.02608](http://arxiv.org/abs/1512.02608).

Vallely's future plans include attending graduate school to work toward a doctorate in astrophysics. He is interested in continuing research on supernovae, in particular the question regarding the nature of Type Ia events: are they products of single or double degenerate systems? He also is giving some thought to working in the field of cosmology.

Outside of academics, Vallely is an avid sports fan and is particularly partial to football and basketball (but says that was NOT his primary reason for attending OU!).

Vallely is the third student in our department (all astrophysics majors) to win a Goldwater Scholarship in the past four years. Adrian Lucy was awarded the prize in 2012 and is now a graduate student at Columbia University working on his Ph.D. in astrophysics. Likewise, Brandon Curd, who graduated from OU in May, won the scholarship in 2015. Curd plans to pursue a doctorate in astrophysics at Harvard University beginning this fall.

## Kalbfleisch Award to Serce Nielsen Prize to Bertsche and Sedlacek Liu Receives Shafer-Ray Ward

The George Kalbfleisch Memorial Scholarship is awarded to deserving graduate students of strong character showing potential in the field of physics, with preference to students studying High Energy Physics. It is not restricted to a graduating student, and the preference for the field of high energy is only applied if candidates are otherwise equal. This year, it was the unanimous vote of the Graduate Studies Committee to give the award and a \$1,000 check to **Hasan Serce**.

The Nielsen Prize is awarded to graduating doctoral students who have displayed excellence in research. It is intended to be given only to students who are exceptional among those who have been awarded doctoral degrees from the Department of Physics and Astronomy over the years. The award is intended for students who have completed their thesis and defense in that academic year, and there is

no limitation on their number, nor a requirement to give out any award at all if the faculty so chooses. The award comes with a \$1,000 check and a standing invitation to return in the future to give a departmental colloquium on a research topic of their choice. For the academic year, fall-2015 to spring-2016, the faculty voted to give the award to two graduating students: **Callie Bertsche** for “Measurement of the Top Quark Pole Mass and QCD Radiation in Top-Antitop Pair Production using Electron-Muon Events with b-Tagged Jets in Proton-Proton Collisions at 7-8 TeV with the ATLAS Detector at the LHC”, and **Jon Sedlacek** for “Microwave and Surface Electrometry with Rydberg atoms.”

Additionally, the Shafer-Ray award was given to **Ang Liu**. The award includes a check for \$2,000.

### Seven Departmental TAs Receive Teaching Award

Seven departmental teaching assistants were honored for their hard work and dedication to their students. **Cedric Correge, Dylan Frizzell, Matthew Holtfrerich, Alekzander Kosakowski, Hasan Baris Serce, Shaun Steele, and Timothy Woodworth** were presented with the Provost’s Certificate of Distinction in Teaching for Outstanding Graduate Assistants. These students are part of a larger group of OU TAs who represent the top 10 percent of all graduate assistants across campus, as determined by student evaluations for courses taught during the fall 2015 semester. The students were recognized at a special reception on March 1 at the Crawford University Club honoring their outstanding teaching performance.



Hasan Serce



Callie Bertsche



Jon Sedlacek



Ang Liu

### Provost’s Dissertation Prize to Friesen

**Brian Friesen** has been awarded the Provost’s Dissertation Prize for his 2015 thesis titled *Spectrum Formation at Late Times in Type Ia Supernovae*. Brian was the student of Eddie Baron and is now an Exoscale Science Postdoctoral Fellow at the National Energy Research Supercomputer Center, Lawrence Berkeley National Laboratory. This is the first time in many years that someone from our department has won this prize. Congratulations, Brian!

### PhDs, Masters Degrees Awarded

Since May, 2015, eight graduate students have successfully defended their dissertations. Those students completing their Ph.D. degrees (and advisers) are: **Maren Padeffke** (Baer), **Priyangika Wickramarachchi** (Kao), **Carolyn Bertsche** (Strauss), **Jon Sedlacek** (Shaffer), **David Bertsche** (Abbott), and **Erin Cooper** (Leighly). Two students also defended their master’s thesis: **Michael Malatesta** (Wisniewski) and **Claudia Belardi** (Kilic). We congratulate these individuals and wish them well in their careers.

## Summer Research for Undergraduates

Twelve students from around the country as well as from OU will help conduct research in the department for two months this summer, thanks to the NSF-sponsored Research for Undergraduates program. The OU program is overseen by Mike Strauss and Brad Abbott, as well as graduate student Rishabh Jain. The students, home institutions and OU mentors are: Katie Fasbender (Humboldt; Dai), Craig Holliman (Bates; Marino), Justin

Kittel (Indiana U.; Schwettmann), Anurag Kurumbail (SIU; Shaffer), John Marchetta (SIU; Milton), Seth Miller (KU; Bumm), Steven Okada (MIT; Mullen), Derek Preslar (Harding; Kao), and Julissa Sarmiento (Wellesley; Kilic), Johnthomas Box (OU; Abbott), Erik Flom (OU; Abraham), Josiah Purdum (OU; Kaib), Jackson Sloan (OU; Kao), and Brian Stephenson (OU; Henry). We welcome all of these students and wish them success in their summer work.

## Astronomy Education and Public Outreach Activities



*Back Row: Allie Jones, Jenna Miller, Malia Jenks, Hora Mishra, Renae Wall (treasurer), Kyra Dame (secretary), Jon Franco, Saloni Bhatiani. Front Row: Braden James, Rhiannon Griffin, Adam Marrs, Francis MacInnis, Shaun Steele (vice president), Paul Canton, Tim Miller, Evan Rich (president), James DerKacy (engineer), Sean Bruton, Erin Cooper*

Lunar Sooners had great fall and spring semesters! This past year, we have participated in two conferences; the Oklahoma EPSCOR Women in Science conference in Tulsa, and the Oklahoma City STEM Expo. Both were great opportunities to connect with students throughout the state, and get them excited and engaged about science. In collaboration with the Galileo's World monthly lecture series, we hosted star parties in the parking lot of Sam Noble from November to April. We have also hosted star parties for boy scout troops, Terra Verde Discovery School, NASA OSGC EPSCOR Teachers,

the College of Arts and Sciences' Kaleidoscope Evening, Camp Classen, and the Oklahoma Arts Institute at Quartz Mountain. Finally, through work with the Cheyenne and Arapaho Tribes, we have received an award for Excellence in Multiculturalism from the Student Government Association.

We all look forward to a busy summer, with our new officers: Evan Rich (president), Shaun Steele (vice-president), Kyra Dame (secretary), Renae Wall (treasurer), and James DerKacy (engineer). We thank our leaving officers Rhiannon Griffin (president), Jenna Nugent Miller (treasurer), and Tim Miller (engineer) for their wonderful hard work and dedication to Lunar Sooners.

Lunar Sooners is a student-led outreach organization in the department founded in 2014 by graduate students Sara Barber, Jeremy Lusk, and Brian Friesen. Our mission is to share the excitement of scientific discovery with our fellow Oklahomans. We provide interactive demonstrations, lectures, question-and-answer panels, and star-gazing events free of charge to any group in Oklahoma. We continue to be grateful for the generosity of Jeanne Hoffman Smith, who made possible our receipt of the 2014 Thatcher Hoffman Smith Creativity in Motion Prize. This past spring, Lunar Sooners took over all astronomy outreach activities in the department to better unite various efforts and increase the usefulness of broader impacts through NSF.

# Faculty Research Programs

## Astronomy, Astrophysics and Cosmology

**Mukramin Kilic's** research group consists of Alex Gianninas, Paul Canton, Kyra Dame and Brandon Curd. First-year grad students Renae Wall and Alek Kosakowski also are exploring projects. Alex recently has found the first-mixed atmosphere pulsating white dwarfs using the Gemini telescope. Paul is finalizing his calculations for the initial-final mass relation, which is a fundamental relation used in astrophysics. Kyra has installed the HOPANTS image subtraction pipeline, and is working on 6TB of imaging data obtained at the Cerro Tololo 4m Telescope in Chile to look for transiting planets in the habitable zones of white dwarfs. Brandon, who is a Goldwater Scholar and also an Astronaut Foundation Scholar, has finished his Gemini and APO 3.5m telescope observations, and discovered three pulsating massive white dwarfs, which he will present in a first-author publication in the coming months.



Baron      Dai      Henry      Leighly      Kilic      Wisniewski      Kaib

**Nathan Kaib's** planetary research group includes Matt Clement, Josiah Purdum (capstone) and Arthur Bulin (capstone). Clement is studying whether systems of terrestrial planets formed via accretion of planetesimals typically organize themselves into a chaotic state similar to our solar system. Purdum is working to determine how the planet-planet scattering thought to occur within most systems of giant planets will affect the orbits of Earth-mass planets within the habitable zone. Finally, Bulin is measuring how easily our solar system's inner planets are destabilized with small changes to the eccentricities of Jupiter and/or Saturn.

**Eddie Baron's** supernova group is proceeding apace. They finally published their PHOENIX analysis of early-time SN 2011fe spectra, they are about to submit their analysis of late-time SN 2011fe spectra, and undergraduate Patrick Valley's first-author paper on SN 2014J spectra is under review. The group consists of Jeremy Lusk working on core collapse photometry and spectra; Malia Jenks working on metallicity variations and physical properties in the Supernova factory dataset, and carbon accretion in Type Ia; and Lisa Simpson, who is in her second year, is planning her general exam and thinking about a thesis pursuing atomic physics in core collapse supernova. First-year student James Derkacy is exploring possible projects.

Undergraduates include: Patrick Valley, who worked on SN 2014J and is now working on fast, dim objects; Braden James, who is working on HDF5 for restarts and checkpointing and plans to begin work on hydro models of the Sun; and Dustin Clouse, who is working on using Fourier techniques to reduce noise in observed spectra. The group also is working on our NESAP award to understand the burst buffer on the latest Intel machines, and are preparing for the advent of Knight's Landing many integrated cores this summer.

**John Wisniewski's** research group this past year included Jamie Lomax, Evan Rich, Steven Silverberg, Mike Malatesta, Anthony Burrow, Matthew Peters, Brennan Kerkstra and RET Kevin Warren. Malatesta completed his terminal master's degree on the V356 Sgr interacting binary system. Rich published a paper on the DoAr 28 transitional disk system, and submitted a paper on the VHS 1256 hierarchical triple brown dwarf system. Silverberg completed his specialist exam on his work on Kepler observations of GJ 1243, and is conducting research at NASA/GSFC with the Disk Detective project. Burrow, Kerkstra, and Peters worked on ground- and space-based observations of Be stars.

**Karen Leighly** was awarded a new NSF grant in fall 2016. Her first effort on this grant was a broader impacts endeavor. The project involves the use of modern, advanced statistical methods that have recently become popular due to the wide availability of medium and large-scale computing. Leighly taught a graduate seminar class titled Machine Learning in Astrophysics. The course covered topics including Bayesian statistics, Monte Carlo Markov Chain, time series analysis, cluster analysis, principal components analysis, regression and classification.

**Dick Henry** finished a long-term project in which photoionization models constrained by new HST spectral data were used to determine effective temperatures and luminosities of planetary nebula central stars. This led to the determination of progenitor star masses, which then enabled a comparison of observation and theory regarding C and N production rates for stars between 1-8 solar masses. Henry also is part of an HST project whose goal is to study the

*Continued on next page*

**Nate Kaib News Release:** "The fragility of the terrestrial planets during a giant-planet instability," [www.forbes.com/sites/startswithabang/2015/11/03/leading-theory-for-how-the-solar-system-formed-just-disproved/#16750d253d4c](http://www.forbes.com/sites/startswithabang/2015/11/03/leading-theory-for-how-the-solar-system-formed-just-disproved/#16750d253d4c)

*Continued from previous page*

chemical evolution of C in dwarf galaxies over time. Graduate student Tim Miller has been evaluating spatial differences in C and N abundances within each of eight planetary nebulae observed by HST in order to learn about the extent of chemical mixing of newly formed elements in the atmospheres of evolved stars.

### Atomic, Molecular and Optical Physics

**Arne Schwettmann's** group made great progress towards studying collisions in ultracold atomic gases in their new lab. Graduate students Shan Zhong and Anita Bhagat joined Delaram Nematollahi and Qimin Zhang. Undergraduate students Kyle Yates and Joseph Altermatt did excellent capstone research in the group before graduating. Delaram built a vacuum system with Qimin and a laser cooling system with Shan. Shan worked on the magnetic field control. Anita worked on pulse sequencing and imaging systems. Qimin continued work started by Aaron Foster on supercomputer simulations of collisional spin dynamics. The group presented results at the DAMOP conference in Columbus, Ohio.



AMO l-r: Abraham, Marino, Moore-Furneauux, Schwettmann, Shaffer, Watson, Parker

**Jim Shaffer's** research group had a new student join the group this year, Quang Phan. Jon Sedlacek and Haoquan Fan are graduating this year and currently are writing their theses. Jon accepted a job at MIT-Lincoln Laboratories. Haoquan currently is interviewing for postdoc positions. The group is looking for a few more students again this year to replace Jon and Haoquan! Shaffer's team has published 10 papers over the past year, including a paper in *Physical Review Letters* and one that made the top papers of the year in *Journal of Physics B* (downloaded more than 1,100 times over the past year!). Group members presented numerous invited talks at Michigan and USP-Sao Paolo. Some individuals also are giving invited talks at DAMOP, the upcoming Rydberg workshop in Leiden and the LAOP (OSA) conference. They also have some exciting new developments in the lab: like the Rydberg atom cavity quantum electrodynamics experiments and the laser system for absolute radio frequency electric field sensing. Shaffer still is working hard on planning the new building (see page 3) and making it come to life. The group really is looking forward to seeing the ground breaking this year.

**Alberto Marino's** interests lie in the field of experimental quantum optics, with particular emphasis on quantum information and quantum metrology. His research focuses on the use of atomic systems to generate and control quantum states of light and on applications of these quantum states towards sensitivity enhancements of

devices. In addition to his current funding from the W.M. Keck Foundation to study "Quantum Enhanced Plasmonics Sensors," last year his group obtained funding from AFOSR to develop a resonance source of quantum states of light. His group is currently composed of four graduate students and one postdoc.

**Deborah Watson's** study of large systems of cold fermions has achieved ground state energies in the unitary regime competitive with benchmark Monte Carlo results and has recently demonstrated the validity of an alternative way to enforce the Pauli principle. This approach circumvents the construction of an explicitly antisymmetric wave function, often the most numerically demanding task in fermion studies. Current work is focusing on obtaining thermodynamic quantities using the accessible energies and multiplicities. A senior capstone student, Stephen Lacina, is attempting to use elegant mathematical techniques to formulate a wave function using collective coordinates. Their work in the unitary regime is relevant to several areas of physics including superfluid systems, neutron stars, as well as cold Fermi gases.

Last year, **John Moore-Furneauux** was on sabbatical at the Max Planck Institute for Biophysical Chemistry in Göttingen Germany with Samuel Meek. There, they concentrated on building a laboratory to perform extremely precise molecular spectroscopy. For this program, they are utilizing the relatively new laser equipment, a frequency comb, as a precise transfer standard of frequency, from the radio frequency band near 1 GHz, where time and frequency standards such as GPS are accessible in the near infrared and visible bands from 1064 nm to 532 nm. The goal of the research is to measure vibration modes of simple molecules such as OH more precisely and accurately than previously possible.

Last year, **Eric Abraham's** group graduated two Ph.D. students, Sean Krzyzewski and Thomas Akin. Both have moved on to prestigious postdoctoral positions: Sean at NIST in Boulder and Tom has a National Research Council Postdoctoral fellowship at the Naval Research Laboratory. The group published some of their efforts in *Optics Communications and Physical Review A* and the members continue to collaborate. Two new students have joined Abraham's research group: a new graduate student, Matthew Holtfrerich and an undergraduate student, Erik Flom. They are continuing work started by Akin studying laser modes that carry orbital angular momentum and their interactions with ultracold gases.

*Continued on next page*

**Xinyu Dai News Release:** "OU Astrophysicists Detect Most Luminous Diffuse Gamma-Ray Emission from Arp 220," [adsabs.harvard.edu/abs/2016ApJ...823L..17G](http://adsabs.harvard.edu/abs/2016ApJ...823L..17G)

Continued from previous page

### Condensed Matter Physics

**Bruno Uchoa's** group recently has been joined by a new postdoctoral fellow, Kangjun Seo. In the past 12 months, Bruno has published papers in *Physical Review Letters*, *Rapid Communications* and *Physical Review B*. He has been an invited speaker at several universities, including the University of Cambridge, University College of London, UT Houston and the Aspen Center for Physics. Bruno's research has been looking for



Uchoa Bumm Mullen Santos Sellers Murphy Johnson Mason

new exotic strongly-correlated states of matter in nature (for details see pg. 13). In a recent submission, graduate student Xu Dou and Bruno proposed a new way to create quantum spin-orbital liquids in an artificial solid state system that mimics an antiferromagnetic spin lattice with SU(4) symmetry. This proposal could lead to the first experimental observation of those elusive states, which are highly entangled, have non local excitations but do not break any symmetries.

This year, several members of **Ian Seller's** group presented their work at various meetings across the country, including the recent APS in Baltimore, Photonics West in San Francisco, the IEEE PVSC in New Orleans, and the recent NASA Energy Research Symposium in Tulsa. Group members also have published several articles in peer-reviewed journals on hot carriers in quantum wells (Esmailpour *et al.*, Tang *et al.*), quantum dot solar cells (Cheng *et al.*), and hydrogenated dilute nitrides (Fukuda *et al.*). Finally, this year saw the departure of Jinfeng Tang and Anthony Meleco, who both successfully defended their master theses. We wish them all the best in the future!

**Mike Santos's** research group continues to focus on the molecular beam epitaxy of narrow-gap semiconductors. They collaborate with Sheena Murphy's group on new topological insulator materials, and with Ian Sellers's group on superlattices and quantum-dot structures for photovoltaic applications. They also collaborate with Rui Yang's (Electrical Engineering) and Matthew Johnson's groups on infrared devices made from complex multilayer structures. This year's highlights include Hao Ye, completing her Ph.D. degree with Santos and Yang as co-

advisers, and invited conference presentations in Germany, Japan, and Bangladesh.

**Kieran Mullen** continues his research project with Dan Glatzhofer from the Department of Chemistry and Biochemistry to design molecules that will improve heat conduction in plastics. This combined theory/experiment effort uses computers to investigate molecular designs that

can then be synthesized and tested in the lab. This has led to an exciting side project in a new type of structure: the hyper-

honeycomb. In collaboration with Glatzhofer, Mullen explored structures with a never-before-seen feature: a continuous set of electronic states zero energy, and about which the energy varies linearly with momentum. Materials with these novel "Dirac loops" have unusual transport properties.

### High-Energy Particle Physics

Research in 2015-16 by **Kim Milton's research group** has concentrated on various aspects of quantum vacuum energies and forces. The group continues to study the meaning of negative Casimir entropies, which occur ubiquitously in the interaction between nanoparticles or atoms and surfaces. With graduate student Li Yang, Kim has shown, at least in some cases, that these negative entropies are precisely cancelled by positive self-entropies from the nanoparticles. With high school student Philip Hwang, Milton has made new contributions to the rather old subject of Casimir or quantum friction between an atom and a conducting plate, and hope that the effects might be observable in experiment.

**Brad Abbott** has continued his work on the ATLAS experiment. He and graduate student David Bertsche recently have finished a measurement of the cross section of prompt J/Psi + W boson at an energy of 8 TeV. David defended his thesis in April and has taken a new position as a postdoc at DESY. Abbott and another graduate student, Othmane Rikfi, have been searching for Supersymmetry in the same sign dilepton channel. A new run has just started at the LHC, so they hope to have new results soon in their search for physics beyond the Standard Model. Abbott also has recently become a Co-PI for the OU REU program.

Continued on next page

**Jim Shaffer News Release:** "Second Quantum Revolution a Reality with Chip-Based Atomic Physics," [www.oudaily.com/news/university-of-oklahoma-explores-chip-based-atomic-physics/article\\_f47c34c6-0574-11e6-b031-43d7a9cd6792.html](http://www.oudaily.com/news/university-of-oklahoma-explores-chip-based-atomic-physics/article_f47c34c6-0574-11e6-b031-43d7a9cd6792.html)

Continued from previous page

During 2016, **Howie Baer** has continued studies of natural supersymmetry with his students and postdoc Kyu Jung Bae, who has now moved on to a position at University of Tokyo. With Hasan Serce, they have investigated prospects to measure anomalous Higgs couplings in natural SUSY; in this case, the Higgs boson looks very Standard model-like.



Abbott Baer Gutierrez Milton Skubic Strauss Kantowski Kao

Students Serce and Zhang also investigated various baryogenesis-via-leptogenesis scenarios and found that Affleck-Dine flat direction baryogenesis and non-thermal leptogenesis via inflation decay work best. With Mike Savoy, Howie also has calculated upper bounds on sparticle masses as a target for collider searches.

The Large Hadron Collider has recently begun operation at a record center of mass energy of 13 TeV, and **Mike Strauss'** research is using data from the ATLAS detector at the LHC. He and graduate student Ben Pearson are searching for Higgs particles that have a higher mass than the discovered standard model Higgs particle and

are predicted by certain theories that go beyond our current understanding of particle physics. Within the past year, Strauss and his graduate student Callie Bertsche completed a measurement of the production of top quarks with associated jets. Callie has since graduated and is now a post-doctoral researcher at DESY in Hamburg, Germany. David Shope is working with Strauss on developing primary vertex finding software and algorithms, and will begin measuring properties of the standard model Higgs Boson in the near future.

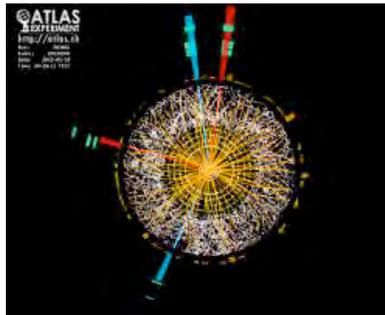
\*\*\*

**Alexandros Gianninas News Release:** "Helium's Role in the Pulsation of Early White Dwarfs," [www.gemini.edu/node/](http://www.gemini.edu/node/)

**Mukramin Kilic News Release:** "Mystery of a Dimming White Dwarf," [aasnova.org/2015/12/02/mystery-of-a-dimming-white-dwarf/](http://aasnova.org/2015/12/02/mystery-of-a-dimming-white-dwarf/)

## LHC and LIGO Updates

The field of High Energy Physics, or HEP, enjoyed another exciting year during 2015-2016. Of most importance is that the CERN Large Hadron Collider re-started after a long shutdown, this time at nearly double its previous energy value, with proton-proton collisions at a record 13 trillion-electron-volts (TeV). The Atlas group, staffed by over 3,000 experimentalists, including the OU contingent of Abbott, Gutierrez, Skubic and Strauss, recorded over four inverse femtobarns of data. This was enough to test that the Standard Model is still valid. It also turned up some slight bump in the photon-photon spectrum at about 750 GeV, which may or may not turn out to be real: stay tuned for more data starting in spring 2016, when the goal is to obtain roughly 20-30 inverse femtobarns. The main goal on the theory side is to ascertain whether supersymmetry exists at the weak scale. So far, no evidence, only stronger mass limits: now the gluino – superpartner to the gluon particle – is required to have mass beyond 1.8 TeV. According to grad student Mike Savoy and Howie Baer [*Phys. Rev. D93 (2016) 035016*], the gluino may range up to 4 TeV while maintaining the critical property of "naturalness", so these new mass limits are not so alarming: LHC has probed less than half of the expected parameter space. Another exciting



development is that a new generation of WIMP dark matter detection experiments has been deployed. The Xenon-1-ton experiment has been constructed in the Gran Sasso laboratory beneath a mountain near Rome, Italy. Using one ton of liquid Xenon as a target for WIMP-nucleon collisions, the Xenon experiment will push for over an order of magnitude additional sensitivity in the hunt for WIMP dark matter particles. Simultaneously, the Axion Dark Matter Search Experiment, or ADMX, located at University of Washington Seattle hopes to re-start this summer with a greatly improved detector. The OU theory of dark matter claims both axions and WIMPs should pervade the universe, but experiment is the final arbiter. The LHC is further discussed in an article in the June, 2016, issue of *Scientific American*.

On a related front, the Large Interferometer Gravity Wave Observatory experiment detected an unambiguous gravity wave signal in 2015. The signal presumably came from a black-hole-black-hole merger event some 1.3 billion light years away. This confirms a key prediction of Einstein's theory of general relativity during the 100th anniversary of its formulation. Howie Baer

# Quantum Hall Effects Meet Superconductivity

**Bruno Uchoa** proposed the existence of an exotic condensate of electron pairs, which can live deep inside the quantum Hall regime. This novel quantum state of matter may be present in a class of materials with synthetic gauge fields. Those crystals can form the so-called Landau levels, a fingerprint of the quantum Hall effect, in the complete absence of a magnetic flux at every lattice site. Known examples include strained honeycomb crystals and deformed optical lattices. In a recent article published in *Physical Review Letters*, Bruno suggested that this novel state offers promising perspectives for studying the coexistence of quantum Hall effects and superconductivity, even in the quantum limit.

A cornerstone of quantum physics and transport is exemplified in the quantum Hall effect, where electrons moving in a 2D plane subjected to a perpendicular magnetic field form cyclotronic orbits having a discrete spectrum of energy levels, known as Landau levels. In bulk, the cyclotronic motion of the electrons leads to insulating behavior, while at the edges, skipping orbits create metallic edge states with quantized conductivity. Another cornerstone is the phenomenon of superconductivity, where electrons form Cooper pairs, which can carry charge without dissipating any current. Those two quantum states do not typically coexist with each other, because of a known property of superconductors to completely expel magnetic fluxes in their bulk, the Meissner effect.

“This system behaves as if half of the electrons perceived a magnetic field in one direction and the other half in the

opposite, in such a way that the local net flux is always zero,” said Uchoa. Unlike in conventional quantum Hall states, those Landau levels preserve time reversal symmetry. For that reason, the Landau levels do not break Cooper pairs, the elemental quantum coherent building blocks that macroscopically populate a superconducting condensate.

This new quantum state of matter proposed in Bruno's work could be an example of a class of phase transitions driven by quantum fluctuations. Here, zero temperature phase transitions separate compressible superconducting states, at partial filling of the Landau Levels, from incompressible non-superconducting states, at integer filling.

In a subsequent work published in *Rapid Communications*, Uchoa predicted that those novel states show exotic transport and spectroscopic signatures, such as anomalous quantized conductance in normal-superconducting junctions and Andreev edge states, which form an exotic coherent superposition of electrons and holes. The high degeneracy of the Landau levels also motivates serious proposals for the detection of high temperature superconductivity in similar systems. Bruno's research is currently supported by a National Science Foundation early CAREER award. For more information contact [uchoa@ou.edu](mailto:uchoa@ou.edu). Read more: B. Uchoa, Y. Barlas, *Phys. Rev. Lett.* 111, 046604 (2013); and K. G. S. H. Gunawardana and B. Uchoa, *Phys. Rev. B.* 91, 241402(R) (2015)

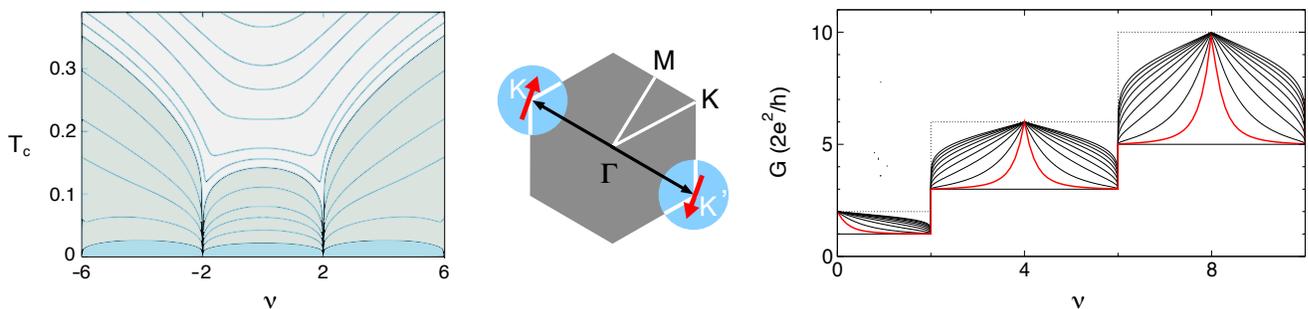


Figure Caption: Left: Phase diagram for singlet state. Superconducting transition temperature (normalized by the inverse of magnetic length) versus filling factor at fixed attractive interaction (solid lines). The blue solid regions are quantum critical in the zeroth and first LLs. The gray regions correspond to larger coupling and are quantum critical in the zeroth LL only. Center: Pairing across the center of the zone, with two electrons occupying the same LL, and with opposite guiding centers (opposite momenta). Right: Longitudinal conductance  $G$  along the edge cross a normal-superconducting junction as a function of the filling factor  $\nu$ . Different curves correspond to different values of the gap. Solid line plateaus: Normal conductance. Dotted lines: Upper bound for the conductance, which occurs when the Landau levels are half-filled. In that case, particle-hole symmetry and charge conservation at the interface double the quantized conductance compared to the normal state.

Two faculty members garnered University awards this year. **Jim Shaffer** received the Regents Award for Research and Creative Activity, while **John Wisniewski** was presented with the President's Associates Presidential Professorship. Congratulations to Jim and John for their hard work!

# Scientific Instrument Collection

by Stu Ryan

Memories of Nielsen Hall undoubtedly include: colleagues, equation-filled chalkboards and labs stuffed with apparatus. Over the years, as new research and teaching lab instruments were acquired, the “old” were saved – ‘cause they might be useful! Nielsen Hall’s cabinets became a “museum” of physics pedagogical and research apparatus. As electrical measuring techniques and instruments improved significantly during the past quarter of the 19<sup>th</sup> century, research in physics began to rely on electrical instrumentation.

After the Physics Department’s founding in 1909, its new faculty invested heavily in: potentiometers, bridges, meters and galvanometers as well as resistance, capacitance and inductance “standards” for both research and student labs. Much of this early instrumentation – typically lacquered brass in polished wooden cases – was acquired from Central Scientific, a manufacturer and importer of scientific equipment, and companies such as Leeds & Northrup and Weston Instruments.

Fast forward to present day. As you may know, one of OU’s “Crown Jewels” is the *History of Science Library*. With nearly 100,000 books, it is the third-largest collection of its kind. It is the only library with all 12 of Galileo’s published books, four of which are annotated by Galileo! If you have not yet visited the *HoS Library*’s remarkable *Galileo’s World* exhibit, there is still time to see it before it closes in September.

In a casual conversation with Kerry Magruder, curator of the *HoS Library*, I asked if the library had any interest in the *antiques* stored in Nielsen Hall’s cabinets. His answer was a resounding YES! So with the blessing of Greg Parker, chair of the Homer L. Dodge Department of Physics and Astronomy, these instruments joined some chemistry equipment at the library to form a permanent *Scientific Instrument Collection*, now on display in the foyer of the *HoS Library* through September 2017. As funds become available for additional display shelves, this *Collection* will expand to include instruments from other scientific disciplines. When you are on campus, come visit your old laboratory friends!

The photographs below show the collection of scientific instruments now displayed prominently in the entrance lobby of the *HoS Library*, located on the fifth floor of Bizzell Memorial Library. An enlarged photo of the potentiometer found in the bottom section of the middle panel in the right photo below is shown on page 15 along with the accompanying text and circuit diagram.

**A Plea:** As you may know, William Peter Haseman, the first Physics Department chair, and his student J. Clarence Karcher invented the technique of reflection seismography. The *Collection* needs a Haseman-Karcher geophone! If you know where one is or how we could acquire one, please let me know by contacting me at [dr.indestructo@gmail.com](mailto:dr.indestructo@gmail.com).

*Continued on the next page*



A view of the entire *Scientific Instruments Collection* currently on display in the entrance lobby of the *History of Science Library*, located on the fifth floor of Bizzell Memorial Library. Each panel contains one or two related instruments along with a description of the instrument on display.



An enlarged view of the *Scientific Instruments Collection*, showing five of the 13 panels.



**Potentiometer**  
Otto Wolff, Berlin  
Sold by Central Scientific Co  
circa 1915

A potentiometer measures an unknown voltage  $E_x$  by comparing it to a known Standard Cell. This particular instrument measures a voltage of 15 volts with an accuracy of 0.0001 V. It uses switches instead of the slide wire discussed below, as its high resistance minimizes switch problems. It is just one of the many variations of the elementary circuit described below. In 1909 this instrument cost \$185, the equivalent of \$4,740 today.

The elementary potentiometer circuit consists of a long, uniform conducting wire (line "OB" in the diagram) on a

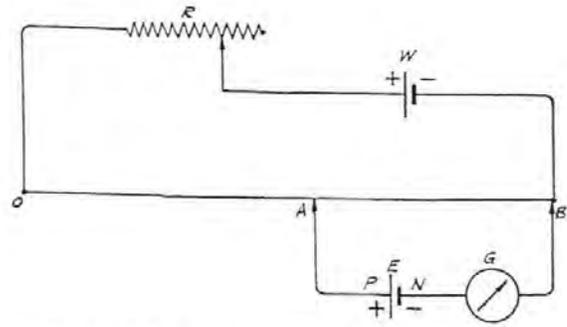


Diagram of an elementary potentiometer circuit  
Courtesy of Leeds & Northrup Co.

graduated scale. Battery W supplies the current that flows through both "OB" and resistor R (used to adjust current). The sliding contact "A" selects a length "AB" of wire "OB".

To calibrate the instrument, a Standard Cell with voltage " $E_s$ " is connected between A and B. Galvanometer "G" compares the difference between  $E_s$  and  $V_{AB}$ , the voltage difference between points A and B. Resistance R adjusts the current until the deflection of the galvanometer is zero. The voltage difference per unit length of wire  $V_{UL}$  equals  $E_s$  divided by the distance between A and B.

The unknown  $E_x$  now replaces  $E_s$  and the galvanometer is checked for a deflection. Point A is moved until any deflection is zero. Thus,  $E_x$  equals  $V_{UL}$  times the new distance between A and B.

## Students Observe at Apache Point Observatory

The astronomy group entered into its third year of a three-year lease arrangement with the Apache Point Observatory (APO) 3.5m telescope consortium. As mentioned in the chair's column, we will join the APO consortium as full partners in 2017. Access to OU's share of observing time on the 3.5m telescope has been distributed amongst many research groups in the department, and has provided data used in five refereed papers and one Ph.D. thesis to date. A group of five undergraduate and graduate students visited the observatory in April for a three-day on-site observing run as part of Wisniewski's Advanced Observatory Methods class. All students gained hands-on experience using the 0.5m and 3.5m telescopes, and each is now qualified to run these telescopes remotely from Nielsen Hall.

Members of the Observatory Methods class who traveled to APO in April are shown in the photo at right with the 3.5m telescope in the background.



From left: Saloni Bhatiani, Josiah Purdum, Ang Liu, Renae Wall, and Shaun Steele



*Members of the Homer L. Dodge Department of Physics and Astronomy, May 2016. Photo by Hugh Scott.*

## Please consider making a donation to the Homer L. Dodge Department of Physics and Astronomy

Your donations to our General Fund are used to support such critical departmental activities as physics and astronomy conferences on the OU campus; high-profile colloquium speakers; programs for women and minorities; outreach; alumni reunions; faculty and student research; postdoctoral fellows; graduate research assistants; and newsletter publication. The two major immediate needs are the building and a buy-in to a national telescope. Remember, what you give to the department stays in the department. Go to <https://www.nhn.ou.edu/friends-alumni/donate> for details.



*Nielsen Hall, home of the Homer L. Dodge Department of Physics and Astronomy*



*Foucault pendulum, located in the Nielsen Hall atrium, where tea is served each weekday from 3:30 to 4:00 pm.*