



Elementary Charging: A Lesson on Electricity and Magnetism for Fourth-graders

By Jack Horowitz and Travis Pappa

In California, it is often easy for elementary school teachers to forget the importance of science under the pressures of statewide-standardized examinations (such as STAR testing) which stress on mathematics and reading skills. The Society of Physics Students (SPS) chapter members of Sonoma State University (SSU) have become aware of the plight of science in the local schools and believe it is important for elementary students to be exposed to the sciences. SPS members have therefore, developed and presented a small lesson plan for a local fourth-grade class which involves an interactive, experiential presentation of electricity and magnetism.

To help carry out all of these tasks, SPS commissioned a small committee (consisting of Jack Horowitz, Travis Pappa and Amandeep Gill) to create a proposal for the SPS national Marsh White Grants – an award given out to SPS chapters with some of the best ideas to take physics education to the public. SPS is proud to say that we have won the award and that, using the award, took physics to students at Roseland Elementary School to help inspire a new generation of scientists.

The physics lesson that SPS presented to the fourth-grade class of Roseland Elementary School demonstrated electricity and magnetism and how they interact with each other in the real world. The lesson involved assisting the students in building simple electric motors, showing new and interesting demos of electricity and magnetism, and providing more



Roseland Elementary school students as they excitedly raise their hands to answer Travis' questions about magnetism.

materials (such as more magnets) for the students to take home with them to further their understanding. In addition to the simple electric motor and displays already made, SPS created a superconducting levitation demonstration. This consisted of a superconductor ($\text{YBa}_2\text{Cu}_3\text{O}_7$), liquid nitrogen and small neodymium magnets. It was made in the hopes of showing the fourth-grade students a fun and weird side of magnetism.

The outreach was considered a success as evidenced by how engaged the students were with the lesson. By providing students with a science experience that is not easily forgotten, SPS demonstrated how engaging science can be for students by allowing them to participate in active, hands-on learning. Furthermore, our chapter designed a format for future elementary school outreach that our chapter can utilize and improve upon. It is our hope that by doing this, our chapter has made it easier for future outreach teams to engage the community with hands-on science lessons, particularly for electricity and magnetism.



SPS members as they interact with fourth-grade students from Roseland Elementary.



Cominsky Honored by Scientific and Local Societies

Professor Lynn Cominsky, Chair of the Department of Physics & Astronomy, was recently honored by two different scientific societies and one local group. In September, 2012, she was named the "Woman Physicist of the Month" by the Committee on the Status of Women in Physics of the American Physical Society (APS). A profile of Cominsky is featured on the APS website (<http://www.aps.org/programs/women/scholarships/womanmonth/2012.cfm>). Cominsky just finished her term as chair of the APS California-Nevada section of the society at the end of the 2012 calendar year, and was previously named a Fellow of the APS in 2009. In November 2012, the American Association for the Advancement of Science (AAAS) notified Cominsky that she was chosen to be a 2013 AAAS Fellow, having been nominated by the Astronomy section "for her work in outreach for X-ray and gamma-ray astronomy (NuSTAR, Fermi, XMM, Swift) and for her inspiration to her undergraduate students at Sonoma State." AAAS Fellows are elected each year whose "efforts on behalf of the advancement of science or its applications are scientifically or socially distinguished."

Then in March, during Women's History Month, Cominsky was honored by the Sonoma County Commission on the Status of Women. She was one of three recipients of the "Women Honoring Women" award, which is given to outstanding women of the community who have made great efforts for the enhancement and well-being of women and girls. This award was especially timely as the theme of Women's History Month for 2013 was "Women Inspiring Innovation Through Imagination: Celebrating Women in Science, Technology, Engineering and Mathematics" and Cominsky was honored for her "continuing work for the education of women and girls in the field of Science."



Faculty Highlights

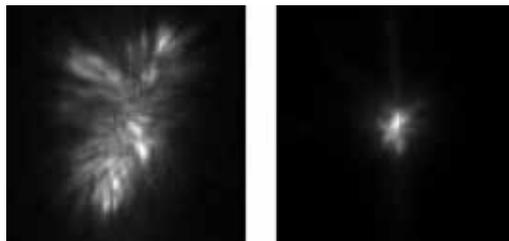
Sharpening our View of the Universe

Dr. Scott Severson achieved a milestone in his work on making sharper astronomical images this past summer. The technique, called Adaptive Optics (AO), uses small silicon mirrors to "straighten" the path of light and remove the blur of the Earth's atmosphere. In June, Dr. Severson, along with his colleague Dr. Phil Choi of Pomona College and several undergraduate students, succeeded in building a prototype AO system (named KAPAO) and using it on the Table Mountain Observatory 1-meter telescope. SSU Physics alumnus Blaine Gilbreth ('10) broke the news on Facebook, "KAPAO is running!" Students at Sonoma and Pomona are involved in all aspects of the development of this cutting edge instrumentation: optical design, mechanical engineering, fabrication, alignment, software development and astronomical data reduction. Future work includes replacing the prototype's off-the-shelf optics with custom high-performance optics, adding an infrared camera and conducting the astronomical surveys made possible with this system.



Top: KAPAO Alpha on the Table Mountain Observatory 1-meter telescope

Right: KAPAO Alpha First Light at TMO. Arcturus shown without [left] and with [right] the adaptive optics system working to correct for atmospheric blur.



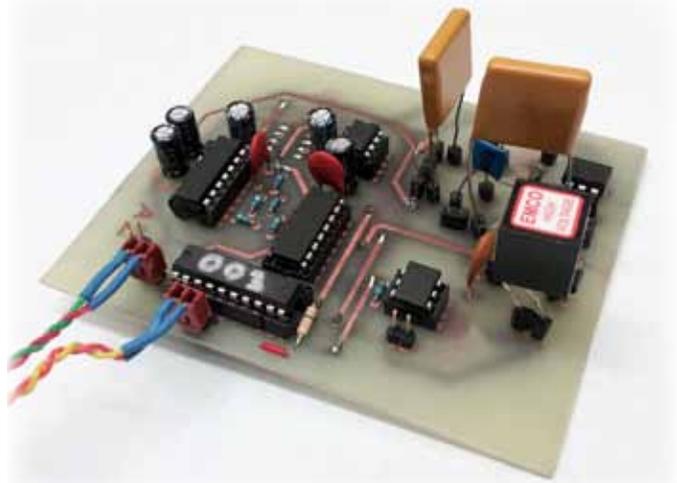
Newkirk Award 2012: High-voltage Low-power Supply for Satellites

By Kevin Zack

For this year's Newkirk assistantship program, and with Prof. Lynn Cominsky and volunteer Dr. Garrett Jernigan as my advisors, I built an efficient high-voltage low-power supply for a CZT (Cadmium Zinc Telluride) array that was developed for the CXBN (Cosmic X-ray Background Satellite). The CZT sensor is designed to detect energetic (>10 keV) X-rays and needs a large potential difference to sweep the electrons, generated by the X-ray hit, to the detector. The voltage needed depends on the thickness of the CZT; the two current designs need either a -600 Volt or -120 Volt supply, which has to be generated from the 5 Volts available on the CubeSat. Additionally, the CZT has an impedance of 10 MOhm which, when operating at -120V, consumes only 1.5 mW and 36 mW at -600V. Right now the best DC-DC converter wastes 500 mW during operation, while providing a maximum of 500 mW of power at 900 Volts; meaning that for the -120V CZT it will draw ~ 502 mW of power with continuous operation.

To maximize efficiency, the DC-DC converter would need to deliver the maximum amount of power to a storage source and then turn off until needed again. Therefore, in my design, the circuit duty cycles the DC-DC converter and only uses it to charge a primary capacitor. A constant DC voltage is achieved by using an optocoupler, which is pulse width modulated to deliver the power to a secondary capacitor, similar to a linear regulator. The difference lies in that the primary capacitor would have a varying voltage with large voltage swings. To adjust for this, a low power MSP430 microcontroller, with MicroLogo as the programming language, would dynamically change the pulse width to maintain the constant desired voltage.

Measuring the floating high voltage of the capacitors was initially problematic, but I accomplished it by using an instru-



Kevin's work on an efficient high-voltage low-power supply

mental amplifier to isolate the high voltage and the low voltage components. With this setup I was able to get a 4.5% duty cycle of the DC-DC converter, which would roughly average a power draw of only 36mW. Since the circuitry that runs the system draws around 60mW, this new design sets the overall power draw at 20% of the energy needed to run the CZT array. Additionally, the output has a ripple voltage of 1%, or approximately 1 Volt at the -120V operating point. This setup is particularly effective because it only requires a slight change to the program to achieve any desired voltage output.

Continuation of this project will require obtaining more accurate readings of the total power draw of the system to precisely determine the fraction of saved energy. Long-term functional testing will also have to take place in order to ensure flight readiness.

In closing, I would like to thank the Newkirk family for their endowment which made my work on this project possible. Thank you.

ALUMNOTES

Earl Boyesen ('75) included "the physics and chemistry faculty of Sonoma State University in the 1970s, where the small class size and personal guidance by the professors made for a great learning environment." in the dedication of his most recent book, *Complete Electronics Self-Teaching Guide with Projects*. He is also the author of a blog on nanotechnology and the websites *BuildingGadgets.com* and *UnderstandingNano.com*.

Doug Morris ('78) teaches physics and astronomy at Folsom Lake College. He earned an M.S. in physics at Michigan State University.

Ron Bleau ('79) passed away 2 January 2013 in Florida. Last year he wrote that he enjoyed spoiling grandkids, assisting his wife Dianne with her two APHA Paint horses, riding and working on motorcycles and working on his tan. He was busy teaching the basics of physics and astronomy to several of his grandchildren and was an active Cub Scout Den Leader. He had retired in 2008 as a Senior Staff Research Engineer from the Skunk Works in Lockheed Martin Aeronautics Company.

Stephan Crandall ('82) is now an artist and photographer. He formerly managed a team of engineers for Polaris Networks in San Jose. "My degree in physics got me my first job. The problem solving skills helped me advance."

James A. Patrick ('83) is a military pilot based in Arizona and currently serving in Afghanistan.

Charles Carpenter ('84) is a programmer with Western Industrial X-ray, Inc. in Fairfield.

Paula Bennett ('86) is a nurse in an intensive care unit at a hospital in Rocklin, CA. She has taken classes in photography and took the photos of the Department's reunion in 2001.

Bill Kobabe ('90) is teaching fifth grade at Woodland Star Charter School in Sonoma.

Holly Jessop ('93) is now the lead statistician in the Worker Health & Safety Branch of the Department of Pesticide Regulation in the California Environmental Protection Agency. She is also a Ph.D. student in epidemiology at the University of Hawai'i at Manoa.

Sean Fraser ('95) is now a graduate student and teaching assistant in physics at the University of California, Riverside. He previously taught physics and astronomy at Moorpark College in Moorpark, CA.

Shawna Moyer Baskin ('02) is a bookkeeper and office manager at DeepNet Computer Consulting LLC.

Small Satellites for Secondary Students

By Kevin Zack

This past year at NASA E/PO I have worked on the Small Satellites for Secondary Students project, otherwise known as S4. Funded by a three-year grant from NASA, the S4 project is still in its development stage. The goal of the project is to use the excitement of high-powered rocketry and tethered balloon flights to improve STEM (Science, Technology, Engineering and Mathematics) education for middle and high-school students. Through this project, we are developing resources for instructors and training teachers to teach the scientific and technological concepts needed for students to design their own experiments which will be flown



Balloon Flight with Paso Robles HS Students

on either a tethered helium-filled weather balloon up to 300 m or a high powered rocket capable of reaching altitudes from 3 km to 10 km.

My job was to build and test the prototype payloads, and currently we are on the fifth, and hopefully final, version of the prototype. Our goal was to make a payload that was as off-the-shelf and as trouble-free as possible. In fact, the pre-etched base board is the only part that is not off-the-shelf because it eliminates

error in wiring and provides a better connection for the high vibration environment of a rocket launch as compared to wiring harnesses. An Arduino Uno is the brain of the payload and formats the telemetry stream from the GPS and the various sensors. The payload has real-time capability through the use of WiFi, allowing the students to graphically see the data from their payloads while they monitor from the ground. The payload can also receive commands and operate devices such as a camera, or to release an egg for a 300-meter drop from a balloon gondola. Some sensors that we currently have debugged and written libraries for include a humidity sensor, a barometric pressure sensor, a temperature sensor, 3D accelerometer, a 3D magnetometer, and any analog sensor. Additionally, after the payload has been recovered, the data can be retrieved from the onboard microSD card and the flight can be replayed on Google Earth. Furthermore, because most of the base code has been written, students can get their experiments up and running quickly. However, depending on the type of class and ability level, instructors have the option to vary the amount of pre-done code used.

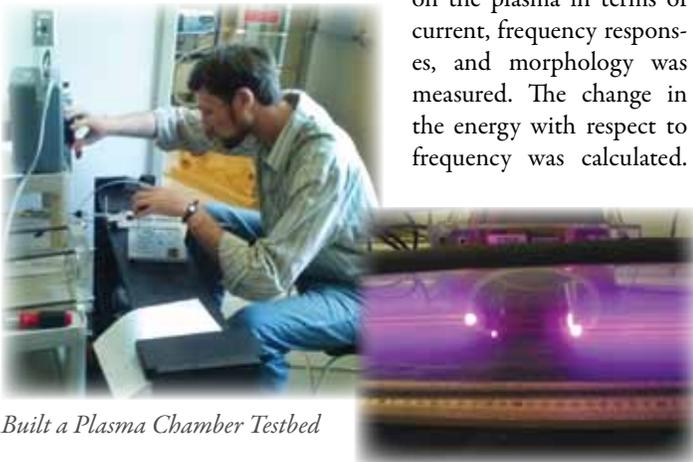
As a relatively new program, the prototyping and development of S4 is still underway. The first educator training seminars are scheduled for the summer of 2013 at NASA Dryden's Aero Institute in Palmdale and the Lucerne dry lake bed and by Spring 2014 we expect the first student built payloads to be flown. For more information about the project, visit

<http://epo.sonoma.edu/s4>

Bryant & Diane Hichwa Research 2012 Award: Investigating Plasma Properties

By Jude Rowe

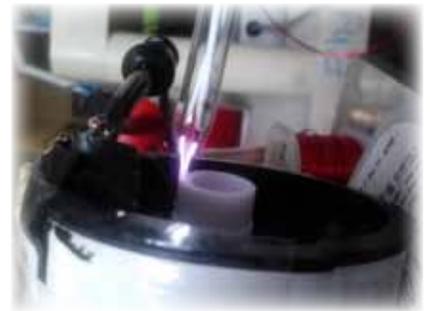
Receiving the Hichwa Summer Research Grant, allowed investigation into the frequency response of plasma and formed the basis of my capstone work. The initial starting parameters were established by confining the plasma and characterizing it. Three materials were introduced into the chamber one by one and the impact this had on the plasma in terms of current, frequency responses, and morphology was measured. The change in the energy with respect to frequency was calculated.



Built a Plasma Chamber Testbed

These calculations were completed for both air and helium plasma. The 60Hz, 120 Volt power used to excite the gases was amplified to 10,000 Volts and then put through a Variac to vary the power delivered to the device.

Measured voltages ranged from 0.40 to 2.5 kilovolts, while amperage ranged from 16-40 milliamps. After analyzing the data I have found that there may be some interaction, however the scale the response would be most pronounced is in the terahertz range of frequencies. The challenge of working with measuring plasma stemmed from designing and building the device. This research helped provide the foundation of my capstone work on developing an atmospheric plasma torch. A thorough theoretical understanding had to be gained before this became possible. Thanks Dr. Qualls and Sonoma State Physics & Astronomy Department for this opportunity to do research and thank you Dr. Hichwa for supporting this research.



Atmospheric Plasma Torch

McQuillen Scholar 2012: Investigating Temperature-Dependence of Charge-Transfer Salts

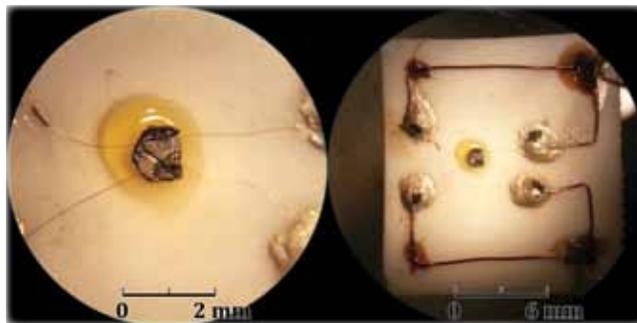
By Anna Wojtowicz

As students, when we think of having a summer job, many of us have spent at least a summer or two doing less glamorous things like flipping burgers or selling frozen yogurt. This past summer being the last before I graduate, I decided I wanted to do something totally different. I was fortunate enough to be selected as the recipient of the 2012 McQuillen Summer Research award, and spent my summer in the lab of Dr. Jeremy Qualls. Dr. Qualls introduced me to the world of materials science, and more importantly, the world of academic research.

Admittedly, when I walked into Dr. Qualls' lab at the beginning of the summer, I was totally helpless. My only prior experience of doing any hands-on work was through the lower-division introductory lab classes. However, working in Dr. Qualls' lab, I quickly learned that there are no step-by-step instructions on how to conduct research—a lot like building a jigsaw puzzle, you just need to start sticking pieces together and see what works.

In Dr. Qualls' lab, I investigated the temperature-dependent conductance of organic crystals called 'charge-transfer salts.' Typically, organic materials are considered electrical insulators, however, charge-transfer salts are created in such a way—of alternating donor and acceptor molecule layers—that actually gives them the property of being electrically conductive. Since there already exists a wealth of information about the low-temperature (<10 K) behaviors of these materials (namely superconductivity), we decided to investigate the high-temperature (>300 K) properties.

My research focused on the family of charge-transfer salts known as BEDT-TTF (short for bisethylenedithio-tetrathiafulvalene—terrible, I know). What I discovered is actually a very peculiar behavior that occurs once the charge-transfer salts achieve their metal-insulator transition point of about 380 K. Although the-



The crystal samples Anna worked with were quite small, requiring very steady hands!

ory tells us the material's electrical properties should be forever destroyed once the crystals have been heated to this point, I observed that the crystals actually slowly returned back to their original conductive state after being left untouched for several days (although not without some consequences). This transient "self-healing" effect was so interesting, that I actually continued investigating it throughout the regular school year, with it eventually culminating as my capstone project for graduation. In addition, I also had the opportunity to present my results at the poster session of the 2012 Conference for Undergraduate Women in Physics at CalTech.

My summer experience in the lab has provided me with an invaluable introduction to the world of research, as well helped me develop an intuition for hands-on problem solving that I otherwise wouldn't have gained from classroom-learning alone. I would highly recommend all physics students pursue at least one research opportunity outside of the regular curriculum, as it definitely helps provide balance to a major that tends to be highly conceptual. For such a great opportunity, I owe many thanks to the Physics & Astronomy Department for selecting me, Dr. Qualls for showing me the ropes, and of course Mike and Sheila McQuillen for their generous annual donation that made this research experience possible.

ALUMNOTES

Joseph Lingad ('02) is a videographer and producer for the *Wall Street Journal* in New York City. He received certification in film production from the Center for Digital Imaging Arts at Boston University in 2008.

Jerilynn Schisser ('03) is a laboratory technician for Veolia Water at the Richmond Wastewater Treatment Plant. "My physics degree has allowed me to find a career that blends my social values with my scientific interests. I love it."

Ashley Janny [formerly Wiren] ('04) is an engineer at Boeing in Kent, WA. She is also an officer in the Washington National Guard in a chemical, biological, radiological and nuclear unit. She earned an M.S. in Aerospace Engineering Sciences at the University of Colorado at Boulder in 2005.

Andrew Clawson ('05) is the product line manager for optical products at OptoSigma in Santa Ana.

Marta Fuentes ('05) is teaching physical science at Making Waves Academy in Richmond after earning her teaching credential at San Francisco State University in 2012.

Kris Tyson ('05) is a product development supervisor in 3M's Optical Systems Division in St. Paul, MN, where he leads product development teams developing the next generation of LCD-based optical films for smartphones. He earned a master's degree in management of technology at the University of Minnesota in 2012.

Richard Peters ('06) is a patent attorney and head of intellectual property practice at Inventus Law in Palo Alto. "As a patent attorney, I draft patent applications for engineers. There is very little technical overlap between drafting software patent applications and actual physics. However, what I do demands the ability to quickly learn complex technical problems and think about them in creative ways. What better training is there for that skill than studying physics?"

Ryan Olson ('07) is currently working as a chemistry and mathematics tutor. In the summer of 2013 he will be organizing a youth outdoor leadership program and co-coordinating an outdoor education day camp for Cal Adventures, and in the fall he will enter the Naturopathic Doctor program at Bastyr University in San Diego.

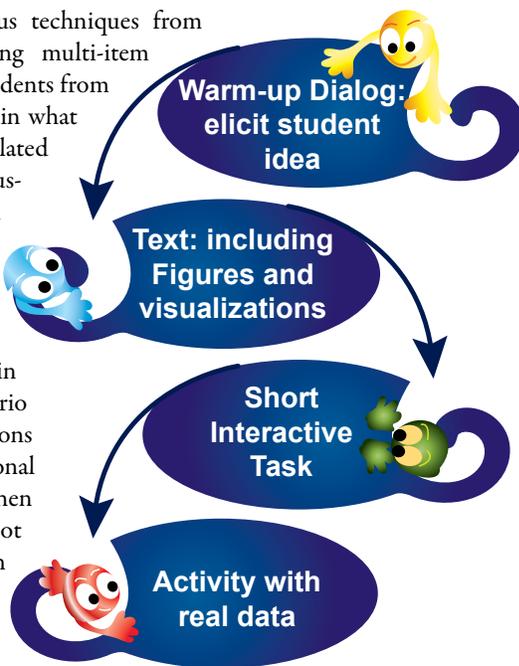
THE BIG IDEAS IN COSMOLOGY

Big Ideas in Cosmology

By Dr. Kevin McLin, NASA Education and Public Outreach

The NASA E/PO Group at Sonoma State continues to work on an online cosmology course for freshmen-level general education students. The course is designed to give a basic overview of the origin and subsequent evolution of the universe for non-science majors. The course goes beyond the typical treatment found in introductory astronomy courses - which often ignore cosmology entirely or cram it at the end of the semester and then run out of time to cover it - in that it relies heavily on student-driven interactive computer exercises and simulations. Incorporating these kinds of exercises into the main flow of the course was a primary motivator in creating it for an online format.

In addition to its computer-centric design, the course is being written with common student misconceptions about the relevant science in mind. The authors have employed various techniques from educational research, including multi-item surveys and interviews with students from the target class level, to ascertain what subjects from cosmology and related fields students find most confusing. We have then designed the course materials with the results from these surveys and interviews. For example, when a new topic is introduced, students are prompted to begin thinking about it with a scenario in which common misconceptions are introduced as part of a fictional dialogue. The students are then asked to relate whether or not any of the opinions expressed in the dialogue seem reasonable to them, and to explain their reasoning. An example of such a dialogue follows:



Some students are looking through a telescope at a star.

Alicia says: How many light years away do you think this star is? Do you think we could measure the distance to it?

Bill says: No way, it's physically impossible because we can't go there.

Corey says: I don't think we have to go there if we use the correct method. Like in geometry class when we learned how to triangulate distances on construction sites.

Alicia says: But I thought that would only work on Earth because we can go there.

Corey says: I think it will work everywhere, it's just a different scale.

Which student(s) do you agree with and why?

- Alicia
- Corey
- Bill

Eighth Annual Conference for Undergraduate Women in Physics

By Katie Badham

During the weekend of January 18 through 20, three female physics students, Anna Wojtowicz, Aman Gill, and I, Katie Badham had the privilege of attending the eighth annual Conference for Undergraduate Women in Physics (CUWIP). This conference took place in Pasadena at the California Institute of Technology (Caltech) along with over 200 other undergraduate women. Five other institutions across the Country also hosted this conference. On Friday in one of the lecture halls we heard an impressive talk about Quantum Matter by Nai Chang Yeh and a welcoming speech by Caltech president Jean-Lou Chameau. Later that evening we went out for ice cream while chatting with Caltech faculty and graduates. On Saturday, a truly inspiring talk was given by Regina E. Dugan who has an impressive career trail including once working as the director of DARPA (Defense Advanced Research Projects Agency). In her talk titled "Do Epic Sh*t... Scientists and Engineers Change the World", she initiated by asking the audience "What would you attempt to do if you could not fail?" She urged that as physicists we must know how to think differently and require both driving application and high basic science content in order to pursue our innovative goals because the future is what we choose to build.

Several lab tours and graduate school workshops and panels across the Caltech campus were held Saturday Afternoon. We had the opportunity to tour the labs on campus which consisted of Quantum Optics, LIGO

The interactive computer exercises are also being designed with common misconceptions in mind, and they use actual scientific data when appropriate. The strategy here is that by directly addressing student misconceptions in the course, and by making students interact with real data, the course will be able to avoid many of the false impressions and incorrect ideas that students develop when first encountering the very unfamiliar ideas found in modern physics and cosmology.

The online cosmology course is designed around a 15 week semester and is comprised of three autonomous modules, each of which is five chapters long. The first module deals with basic concepts like the size and time scales of the universe, properties of electromagnetic radiation, and the modifications of our view of space and time made necessary by special relativity. The second module deals with gravity, both from the Newtonian and general relativistic points of view, and with the evidence for dark matter. Finally, the third module deals with the big bang

(Laser Interferometer Gravitational-wave Observatory), and the NuSTAR (Nuclear Spectroscopic Telescope Array) Explorer Mission. The ability to see these labs gave us a true taste of what physicists and graduate students work is comprised. The graduate school panels discussed research, experience, fellowships and admissions. We learned the great importance of experience in research as undergraduates and helpful steps to take while applying for the most appropriate, personally enjoyable graduate programs. Other talks included research for the National Science Foundation (NSF) by Denise Caldwell, and a talk by Margaret Murnane on how physics and engineering project challenges can be faced efficiently with the ability to collaborate with others. This particular talk was held over webcam where all six conferences got to simultaneously participate and communicate with each other with different viewpoints. We got to see extraordinary posters presented by many undergraduate women, as well

as four very intriguing talks where students explained their own research studies. Amongst the posters was one belonging to one of SSU's physics students, Anna Wojtowicz who entitled it "High-Temperature Induced Changes of Electronic Properties in (BEDT-TTF)₂ Organic Conductors". On Saturday we got to watch the comedy movie, "The Ph.D Movie" along with questions for the cast who are current graduate students of Caltech. For the final event, we got to visit the Jet Propulsion Laboratory (JPL) where we viewed a presentation about Cassini's mission to Saturn, and a video about the exploration of our solar system with Voyager 1 and 2. We also explored the JPL visitor center which had remarkable artifacts including a moon rock from Apollo 16 and robotic models and replicas such as Galileo and Voyager.

It made us feel confident and comforted to be surrounded by many other women who take interest in the same studies we do. One of the main takeaways I got from this conference is that as physicists, we are smarter as a group than an individual and it is important to interact with others, both men and women, in order to gain creativity. CUWIP provided imperative information that we will hold dear to us for a very long time. We are more aware that it is extremely vital to choose a career path that you know you are passionate about and will enjoy doing throughout future endeavors.



Katie, Aman, and Anna at the CUWIP

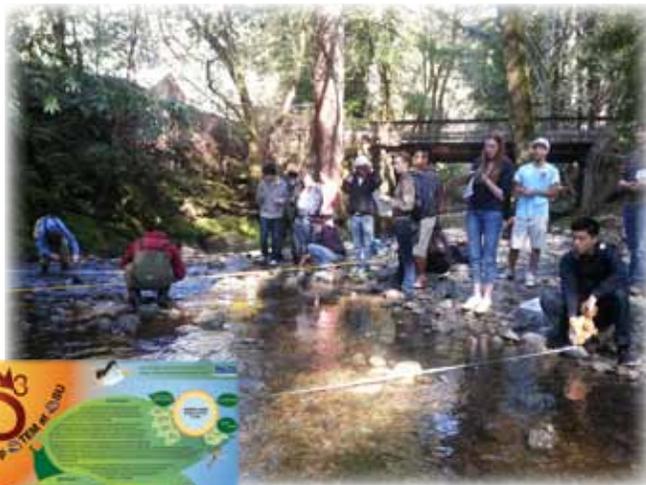
Modules	Chapters
1. Our place in the Universe: Space and Time	1. The Size and Scope 2. Light and Telescopes 3. Motion and Time 4. Measuring Distances 5. Special Relativity
2. The Dark Side of the Universe: Gravity, Black Holes and Dark Matter	6. Classical Physics: Gravity and Energy 7. Dark Matter 8. General Relativity 9. Black Holes 10. Gravitational Lensing
3. Our Evolving Universe: Past, Present and Future	11. Cosmic Expansion and the Hubble Law 12. The Early Universe 13. The CMB and Large Scale Structure 14. Dark Energy and Supernovae 15. Geometry and the Fate of the Universe

theory, the early universe and inflation, galaxy evolution, large scale structure and the fate of the universe. While the modules flow together to form a coherent course, they can also be used individually to supplement a more traditional introductory astronomy course.

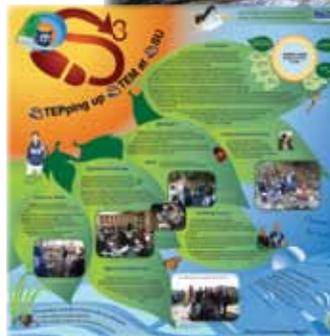
The authors for the course are Professor Kim Coble, at Chicago State University, Professor Janelle Bailey at UNLV, and Professor Lynn Cominsky, Dr. Anne Metevier and Dr. Kevin McLin all from SSU. Significant contributions have been made by Kevin John and Aurore Simonnet of the SSU's NASA E/PO Group. Testing the first versions of the course began last fall at several universities, and the course should be available for general use in another year through our publisher-partner, Kendall-Hunt, after revising and refining the materials. Development of the course has been supported by NASA, both through the outreach program of the Fermi Gamma-ray Space Telescope and through a separate EPOESS grant.

Out in Nature: Exploring Copeland Creek from its source to the ocean

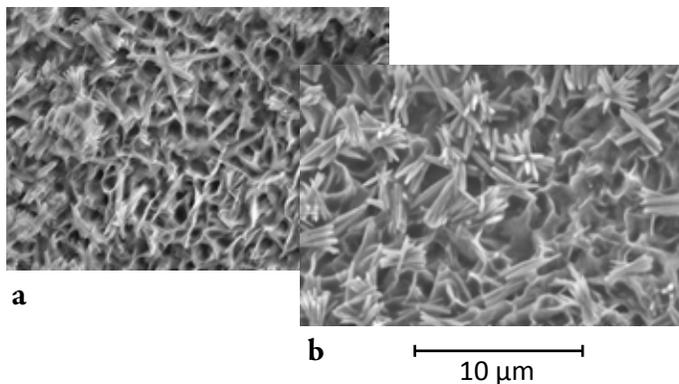
Dr. Jeremy Qualls has been busy working with the new S^3 (STEPping up STEM at SSU) grant supported through the NSF STEM Enhancement Program (STEP) to enhance STEM (Science, Technology, Engineering and Mathematics) education efforts. In particular, Dr. Qualls has led the school-wide development and integration of a new course: Science 120: A Watershed Year, (<http://www.sonoma.edu/aa/flc/nonresidential/science.html>). It was designed from scratch by faculty across the School of Science and Technology to showcase what various STEM disciplines have to offer with Copeland Creek and our local watershed as the common theme. This class merges many general education units into one seamless experience and creates an ideal environment for students transitioning into college. The pilot class has been very successful and is loved by the students. Dr. Qualls also published new results on the complex density wave nature of organic conductors and has successfully designed a new air-to-water collection system.



Professor Jeremy Qualls at the creek with Sci 120 students



Poster (designed by Aurore Simonnet) presented by the S^3 team at the March 2013 annual STEP meeting in Washington, D.C



Developing New Materials

Dr. Hongtao Shi continues his exploration of surface science and has been successful in publishing his work done in collaboration with undergraduate students on Mg-doped ZnO. This exciting work is the first successful demonstration of magnesium doping to further broaden the bandgap of the material.

(Left) Scanning electron microscopy micrographs of (a) pure ZnO and (b) Mg-doped ZnO. The scale bar represents 10 μm .

ALUMNOTES

Gabi Sanz-Douglass ('08) is a graduate student in aerospace engineering at San Diego State University. She is spending spring 2013 working at NASA Langley Research Center in Virginia. "SSU prepared me for the next step in my educational career by thoroughly teaching the physics basics necessary in all engineering fields."

Michael Duncan ('09) is a graduate student in physics at California State University, Fresno, doing research in experimental particle physics with data from the Large Hadron Collider at CERN. He plans to go on for a Ph.D. at the University of Alaska, Fairbanks.

Adam Dye ('09) is a full-time mathematician at International Game Technology in Reno and a part-time graduate student in mathematics at the University of Nevada, Reno

Eric Lundy ('09) is a manufacturing process engineer at Sirrus Technology, Inc. in Santa Rosa. He earned an M.Sc. in mechanical engineering at Manchester Metropolitan University in 2012.

Bill Garcia ('10) is a field service engineer with AlsoEnergy in Boulder, CO.

Blaine Gilbreth ('10) is a graduate student in computer science at the University of Pennsylvania.

Ryan Young ('10) is a sales engineer at AER Worldwide in Fremont.

Luke Haley ('11) is a process engineer at Agilent Technologies in Santa Rosa.

Jay Hubbard ('11) is a calibration field service technician at International Process Solutions in San Carlos, CA.

Kathleen Morrison ('11) is teaching physical and life science as a long term substitute teacher at Lawrence Jones Middle School in Rohnert Park and also teaching in the district's Home to Hospital Instruction program. She earned her teaching credential at SSU in 2012. "I feel very blessed to have been a part of the P&A Department. I would not be a science teacher if not for the support, encouragement and advice I received during my time at SSU."

Crystal Ewen ('12) is a graduate student and teaching assistant in applied physics at Northern Arizona University.

Jarod Fable ('12) is an acoustic test engineer at SGS in Lenexa, KS.

Matthew Fontana ('12) is a graduate student and teaching assistant in chemistry at UCLA.



What Do Retired Professors Do?

By Joseph S. Tenn, Professor Emeritus

Since retiring almost four years ago I have become much more involved in the history of astronomy. I have continued as secretary-treasurer of the Historical Astronomy Division of the American Astronomical Society (<http://had.aas.org/>) and also as an

associate editor of the Journal of Astronomical History and Heritage (<http://www.narit.or.th/en/index.php/jabh>), both of which I began before retirement. In addition I have been researching and writing more on the history of astronomy. I have recently written a paper on long-publishing astronomers, four entries for the second edition of the Biographical Encyclopedia of Astronomy, a paper on V.M. Slipher based on a talk presented at a conference in Flagstaff last September, and a paper on cataloguers of double stars. For a complete list with links to the publications see <http://phys-astro.sonoma.edu/people/faculty/tenn/pubs/>.

What do I do when not working on history of astronomy? Mostly, I hike. I also continue to maintain contact with SSU physics graduates. See the list of what they are up to on the department website.



Updates on Emeritus Professors Hichwa and Spear



Dr. Bryant Hichwa is currently researching the physics of baroque bassoons. A wonderful result of his research is the marked improvement in pitch by making design changes to the bassoon, such as swapping out the crook for one perhaps more historically accurate or to change the diameter of a tone hole. Dr. Hichwa presented his research with the musical talent of bassoonist Rufus Olivier Jr. III at a recent lively What Physicists Do.

Dr. Gordon Spear continues his astronomical research. One research project that currently is taking most of his time involves wide-field near-infrared imaging. He is attempting to document and catalog an unusual category of objects. These objects appear stellar, but they move and can occasionally change in brightness over a matter of seconds. These objects nominally resemble satellites, but can occasionally change direction of motion, and can occasionally stop moving. As of now, they can be called UFOs, even if they are not directly connected to visits from ET.



Enjoying Retirement

By John Dunning, Professor Emeritus

Remaining mentally active is an important benefit of my originating: Energy American Style; Jamestown to the Present. This course was offered in winter 2013 through the Osher Life-long Learning Institute at SSU. I get satisfaction from well performed physics demonstrations (with coaching from Steve Anderson). Exciting innovations enliven both past and present. Americans were first to drill for oil in the 19th century. Nuclear power was first harnessed to produce electricity in the mid-20th century. A 21st century American success involves horizontal drilling followed by hydraulic fracturing of shale. Vast quantities of natural gas and oil become economic. Most of the action occurs more than a mile underground. Extraction has much less surface impact compared to 19th century methods. Is the passive safety of the new generation III+ nuclear plants sufficient? Is an answer blowing in the wind? How renewable is electricity from the Geysers? I offer a virtual field trip using my own 1970's slides and a 40 year perspective. How attractive are solar solutions? Examples are drawn from my 90° F pool, photovoltaic installed by the Sonoma Valley School District and the Ivanpah solar thermal power tower system rising in the Mohave.

Nondestructive analysis of stamps using X-ray diffraction continues along with analysis of samples of interest to my colleagues. This brings me to SSU about one day per week which is good for my longevity. Our seminar series, What Physicists Do, is supportive therapy. The absence of responsibility for radiation safety helps my sleep.

Previously, travel was largely for professional enrichment. Now the emphasis has shifted toward relaxation.



ALUMNOTES

Brooks Hanley ('12) is a graduate student at California Polytechnic State University, San Luis Obispo, where he is pursuing both an MS in electrical engineering and an MBA.

Kalie Miller ('12) is a stress analyst working on the KC-46 tanker program with the Boeing company in Everett, Washington.

What Physicists Do

by Amandeep Gill

The 84th and 85th series of What Physicists Do have been very successful in showing the various paths a physics major may take. We had many remarkable speakers join us in imparting their knowledge of the field and how they got to their current careers. As we had 20+ speakers in the past two semesters, just a few will be summarized here.

We started off the Fall semester with Dr. Jon Jenkins from the SETI Institute on finding exoplanets with the Kepler Space Telescope as they transit their home star. Dr. Gabriel Orebi Gann from University of California, Berkeley discussed her work with SNO (Sudbury Neutrino Observatory) and future with SNO+, detecting solar neutrinos in a mine about 2 kilometers below the surface in Canada. Our own chair of the Physics & Astronomy Department and director of the NASA E/PO group, Dr. Lynn Cominsky, had a wonderful talk on NASA education, including how they train master teachers over summers who then go home and train more teachers about science education. An especially lively, well-received talk was by Dr. Alexander Pines, from University of California, Berkeley. He discussed not only the physics behind Magnetic Resonance Microarray Imaging, MRMI, but also the biological and chemical aspects.

Second semester had a central theme of SSU relations. We had three former students, Jim Eyer ('83), Frederick Arioli ('75), and Monika Ivancic ('93), as well as Dr. Kevin McLin (NASA E/PO) and faculty member Dr. Jeremy Qualls. The semester started with Jim Eyer's timely talk on a super relevant issue in science: energy storage. He works on energy solutions with his company, E&I Consulting.

Dr. Franck Marchis from the SETI Institute presented his work on the Moons around Asteroids and discussed the importance of human exploration of these asteroids. An exciting talk by a SSU

professor emeritus, Dr. Bryant Hichwa, on his work understanding the physics of baroque bassoons was greatly enhanced with the musical talents of his guest bassoonist, Rufus Olivier Jr. III. The series wrapped up with Dr. Monika Ivancic's talk on NMR. She is the assistant director of the NMR facility at the University of Wisconsin.

We look forward to the 86th series in the fall!

Rufus Olivier Jr. III, guest bassoonist



Excellent Society of Physics Students year!

By SPS President Jude Rowe

This past year in SPS has been an astounding experience. Members came together to create a welcoming environment that created friendships and collaboration. Our teamwork showed some exciting results. We won third place in the yearly Geek Week Darwin Cup. We were awarded the National SPS March White Grant and taught a fourth-grade class in Roseland elementary about electricity and magnetism. The elementary students were more than interested in learning about science and were extremely enthusiastic about all of the demos brought to the classroom, which made the visit worthwhile and made SPS very glad our presentation was a success in getting younger children interested in the sciences.

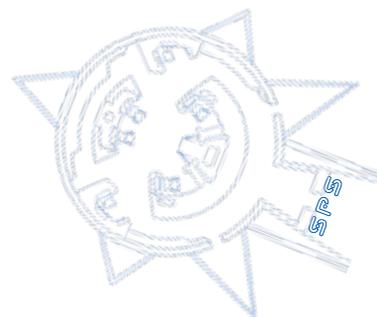
We relaxed watching movies together. Though perhaps the most important accomplishment is the graduation of another class of wonderful physics majors. These accomplishments are but the highlights of what we have done. Thank you for your hard work and commitment. On a personal note, I am proud of the community we have as physics majors here at Sonoma State University. I know that as I commence what is to come, those still here will keep calm and fermion. Congratulations physics class of 2013!

Students interested in joining SPS should go to :
<http://www.students.sonoma.edu/clubs/sps/index.shtml>.

Prospective and current physics majors are encouraged to view the web site for any news and upcoming events.



Top: Stephanie Church, Brandon Baker, Katherine Bruzzone, Danny Ryan, Jude Rowe, Rob Millikin, Max Torke
Bottom: Collin Crites, Aman Gill, Katie Badham



Thank You for Your Support!

We are truly grateful to those who continue to support the Department as we try to maintain our traditions and offer our students new opportunities for research and personal growth. Private donations have been crucial in the growth and continuation of excellence in the Department of Physics and Astronomy, especially important as state contributions continue to decline. Our academic programs rely heavily on the generous support of donors and your contributions help advance science and learning, making the world and our Department a better place for our students.

The “What Physicists Do” lecture series is supported through donations and grants from SSU’s Instructional Related Activities Fund. Dr. Scott Severson (scott.severson@sonoma.edu) ran the series this past year - we have just completed our 85th semester! This year we received a generous donation from alumnus James ('75) and Patricia McBride to support the series, which was most welcome and is greatly appreciated. We now have three ongoing student research assistantships: The Horace L. Newkirk Endowed Assistantship (spring semester), and the Mike & Sheila McQuillen and Bryant & Diane Hichwa Summer Research Awards. Research is thriving within the Department, and funded research experiences have provided our students with a great boost, helping them get into selective graduate programs and to begin successful careers in science. Other scholarship funds, such as the Duncan E. Poland Physics and Astronomy Scholarship, the Sol and Edith Tenn Scholarship, and the Joseph S. Tenn Scholarship, also support and provide students with opportunities they would not have if not for the generosity of donors.

If you would like to support our program and students please see <http://www.phys-astro.sonoma.edu/public/Support.shtml>, contact the SSU Development Office at (707) 664-2712 or contact the Department.

Current Funds:

#C0141 Public Programs

Richard M. Bell, Lynn Cominsky and Garrett Jernigan, Ed. J. LeDu (Forestville Mini Storage), Francis V. Marshall, James A. ('75) and Patricia McBride (McBride Group)

#C0142 Physics & Astronomy Equipment and Supplies

David Munton ('82)

#C0143 SSU Observatory

Jo-Ann Smith

#C0144 Student Development Program

Bryant P. and Diane Hichwa, Michael T. and Sheila McQuillen

Endowment Funds:

#E0185 Charles and Norma McKinney Fund

The Charles and Norma McKinney fund supports public programs.

<https://www.lsc-group.phys.uwm.edu/webcommphp/science/Publication-S6PE/index.php>

#E0208 Horace L. Newkirk Memorial Student Assistantship

Established by Nadenia Newkirk in memory of her father to support student research.

#E0231 Duncan E. Poland Physics & Astronomy Scholarship

Lynn Cominsky and Garrett Jernigan, Bruce Kemmell ('72)

#E0269 Science at Work Fund

Established by John Max to support What Physicists Do.

Gifts In Kind:

William Imler: many high power, InGaAs and InGaP multi-color LEDs

JDSU: a variety of different magnets



**Showing off the
SPS 2013
T-shirt!**

*Top Row: Katie Badham, Ben Cunningham, Jacob Lewis, Aman Gill, Anna McCowan, Jordan Sperry
Front: Jude Rowe, Jack Horowitz*



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