

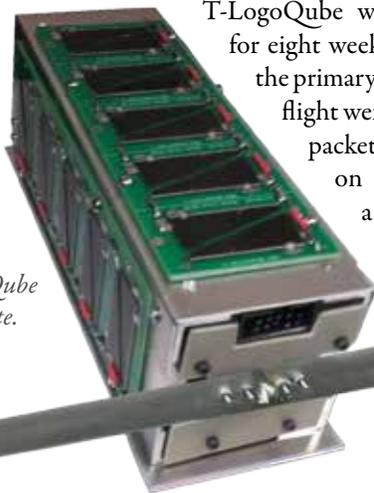
SSU Satellite Built and *in Orbit*

By Kevin Zack

Sonoma State's first satellite, T-LogoQube, is a first generation 3P (5 cm x 5 cm x 15 cm) PocketQube with on-board instrumentation. Designed and built by undergrads in a collaborative effort between Sonoma State University (SSU) and Morehead State University (MSU), the purpose of the T-LogoQube project is to develop a platform for future space-based scientific experimentation.

Launched on November 21, 2013, into a sun-synchronous polar low-earth orbit at an altitude of 700 km, T-LogoQube is one of the smallest, stand-alone satellites to send both a radio beacon and instrumentation telemetry. With the flight software written in the programming language MicroLogo, commands can be created, up-linked, and executed in real time, making this satellite the ideal platform for experimental space science.

T-LogoQube satellite.



T-LogoQube was in operation for eight weeks, during which the primary objectives of the flight were achieved. First packets were received on November 23; a command was



Satellite team at the Little h Ranch (left) Hunter M., Ben C., Kevin Z., Steve A., Aaron Pacheco (SRJC), Garrett J., Lynn C.

sent the following day, with a prompt response from the satellite orbiting 700km above the ground station. Using a 100mW radio, which is approximately 4 times less powerful than a typical cell phone, packets from the satellite were received and decoded at distances ranging up to 2700 km .

Research and development of the T-LogoQube provided the foundation for a next generation PocketQube. Development and construction of this next satellite is currently under way, with the flat-sat (engineering boards in a test array, not in flight configuration) built, and undergoing design reviews and testing. Still in its design phase, the hardware sub-systems are currently being improved with the information gained from extensive testing. Slated for a Spring 2015 launch from the International Space Station, the satellite will fly a Cadmium-Zinc-Telluride (CZT) array and magnetometer to detect hard cosmic X-rays and particles while measuring properties of the Earth's magnetosphere.

Steve Anderson Receives Excellence Award

By Prof. Jeremy Qualls

The SSU Staff Excellence Award was established to recognize outstanding service and significant contributions to the University. We congratulate Steve for receiving this prestigious honor. It is well deserved. We are thankful for his accomplishments and his dedication. Over his many years of service, Steve has been a vital part of the Department, giving selflessly to everyone and being a keystone resource. On a personal note, I met Steve in 2007 and was surprised by both his passion for education and his ability to jerry-rig equipment into a functional state. During the last seven years, he has continued to surprise me with his knowledge of all things mechanical and craft oriented. Just this semester, I heard him sing and play drums in his band then dismantle and repair a high end laser system the next day. I really believe Steve has tried every hobby and craft on the planet. This rich and diverse background

comes out when he is developing demos and operating on last minute notices. His demos are very impressive and are inviting to audiences. The recent total internal reflection exhibit for the SST Science Night and campus event laser shows are perfect examples of this. In addition to his daily duties of setting up labs, creating classroom demos, and maintaining instrumentation, Steve remains one of the best resources for new projects and bouncing ideas. For more information see:



Steve being Steve!

www.sonoma.edu/workplace/2013/05/anderson.html

American Physical Society California-Nevada Section Meets at SSU - *By Prof. Lynn Cominsky*

Beginning with a spooky and laser-lit Halloween Welcome Party sponsored by SSU's SPS chapter, over 175 paid attendees of the California-Nevada section of the APS met at SSU for the first time. It was also the last meeting of the California-Nevada section, as during the business meeting, members voted to change the name of the section to "Far West." SSU E/PO Scientific Illustrator Aurore Simonnet designed the logo to go with the new section name as well as the "Lobo on Halloween" conference poster.

Focusing on undergraduate and graduate student research, the meeting featured 95 contributed talks filling 11 parallel sessions. SSU students Kevin Zack and Stephan Jackowski won first and second place Steve Chu awards, respectively for their presentations. Invited speakers included SSU Professor Emeritus Bryant Hichwa, who reprised his popular lecture on the Physics of Baroque Bassoons, as well as UC Davis Prof. Daniel Cox, who described his research on using Proteins as Nanolegos, UC Berkeley researcher Marjorie Shapiro, who filled us in on what we know about the Higgs Boson and Stanford Prof. Kam Moler discussing her work characterizing Emergent Phenomena in Quantum Materials.

On Friday night 11/1, attendees were treated to a wonderful banquet in the Commons followed by an outstanding presentation about the



(L to R) Anna McCowan, Aman Gill and Stephanie Church.



hazards of near Earth objects by former SSU E/PO employee and "Bad Astronomer" Phil Plait. Events on Saturday 11/2 included a free lunch and networking session with more senior members of the section, and a panel discussion on careers in Education and Public Outreach that included the SSU E/PO group's Kevin John ('07), APS Public Outreach head Rebecca Thompson, SSU Physics Alumna Prof. Brooke Haag ('01) and SLAC National Accelerator Laboratory Scientific Editor Kelen Tuttle. Thanks to everyone in SPS, the SSU E/PO group and the P&A department for helping with all the organizational tasks and for making the meeting such a great success! As Chair of the Local Organizing Committee, and Past Chair of the section, I was very proud to show off our lovely campus and our excellent students. To see the meeting details:

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

Dr. Targett with some attendees at the free student lunch on Saturday.



(L to R) Stephanie Church, Kevin Zack, Lynn Cominsky, Danny Ryan, Aman Gill, Stephan Jackowski, Anna McCowan and Jordan Sperry.

New Club on Campus

By Cody Johnson

The Material Science Club (MSC) is the newest science club on campus. It was started just a few months ago by President Cody Johnson, Treasurer Stephan Jackowski and Vice President Daniel Ryan, in an attempt to provide a more specialized science club on campus for those interested. Material science has become one of the most important scientific fields of the past few decades, combining the best parts of physics, chemistry, and engineering. Although SSU lacks a degree program in material science, there are plenty of students and faculty conducting research on materials and their properties. Dr. Hongtao Shi, for example, is working on creating and characterizing Co-doped ZnO samples, a material which has possible applications as a dilute magnetic semiconductor. This is amazing research with far-reaching implications and it's being conducted right here at SSU!

MSC is currently being held in conjunction with the Society of Physics Students' meetings but, once the club becomes more self-supporting, we will branch off and hopefully obtain a university charter from the Material Research Society (MRS). An MRS-chartered club would be a great resource for STEM majors on campus and would also provide more opportunities for students to attend conferences, network, and learn more about material science.

We aim to provide a fun social setting for students to discuss and learn more about material science. If you would like to be part of the club or would like to become a club officer please contact the club president, Cody Johnson, through email at johnscod@seawolf.sonoma.edu.



Newkirk Award 2013: Developing Next Generation Torque Coils

By Maxfield Torke

In 2013, the T-LogoQube satellite was launched into orbit. The satellite contained a torque coil to allow the satellite to re-orient itself by spinning. A torque coil is a coil of wire (solenoid) that generates a magnetic field when a current is passed through it. This magnetic field interacts with the Earth's magnetic field to apply a torque on the satellite. Through support available through the Newkirk Research Award, I have been working with Dr. Garrett Jernigan to recreate and investigate the torque coil that was implemented on the satellite. My goal is to understand the dynamics of the torque coil and modify design as needed to allow for precise control of the satellite's orientation while it is in orbit. Currently I am measuring the torque produced by an external magnetic field and programming a simulator to model satellite orientation. Preliminary measurements of the applied torque are being made using a torsional pendulum and an electromagnet (as well as utilizing the Earth's field) to measure the angular displacement with respect to time. Several other methods for experimental measurements are being considered. I have started to do basic programming in jLogo and will continue the project over the



Torque coil in test station

summer with hopes to build the next generation of coils for the next satellite to be launched in January 2015. I am very grateful to Nadenia Newkirk for the award and support during the past semester.

What Physicists Do

by Wes Watson

What Physicists Do has been an SSU tradition for over 40 years, and this year we were fortunate as always to host brilliant men and women doing their part to advance the physical sciences.

We started the 86th/87th seasons off with Dr. Brian Welsch's presentation on the far-reaching influence of the sun's magnetic field. Our newest professor, Dr. Tom Targett, proved his science communication skills during a heavily attended lecture on applying the scientific method to the virtual world of Starcraft 2. A few speakers bridged the gap between physics and the rest of the world, with Wayne Sobon discussing the need for physicists in the field of patent law and Dr. Leslie Atkins highlighting the exclusionary effect of over-formalized scientific writing. Dr. Deborah Bard sent us off for winter break mulling over her explanation of gravitational lensing and its applications in observing the strange and distant bodies of the cosmos.

Spring semester kicked off with an exciting talk by graduating physics major Kevin Zack on SSU's own T-LogoQube satellite, which he helped to design. In February, Dr. Warren Wiscombe gave us a look at climate science in its formative years and Dr. Charles Lawrence presented the Planck mission's "map of the universe" - the most accurate measurement to date of anisotropy in the cosmic microwave background. In March the department celebrated women's history month with a group of all-female speakers including Dr. Jocelyn Read, who discussed the emerging field of gravitational wave astronomy and the neutron stars it will help us observe. We closed for the year with Dr. Beate Heinemann's explanation of the Higgs boson detection at CERN.

We would also like to express our gratitude to all the other speakers who've made the 2013-2014 series of What Physicists Do another enthralling venture into the frontiers of modern physics. What Physicists Do will resume in the fall with another round of talks about the captivating mysteries of the universe and the folks who try to sort them all out.

ALUMNOTES

Jon Simmonds ('74) is a pilot with Alaska Airlines, based in Seattle. He has flown for Alaska and Eastern Airlines for a total of 34 years. Before that he flew in Antarctica in support of NSF polar research projects while a pilot in the U.S. Navy.

Bert Plambeck ('78) is a supplier quality engineering manager at JDSU in San Jose. He has held similar positions with several other technical firms in the Bay Area. He has published papers on overlay metrology and the implementation of coherence probe microscopy.

Jacques Schlumberger ('82) sold Michel-Schlumberger Benchland Wine Estate and retired in 2012. He and his wife Barbara were recognized by SSU with an Alumni Community Achievement Award in 2007.

Peter Sieck ('82) is a consultant in thin film design and manufacture for R&D and production groups. He was for many years a senior scientist with AFG Development Corporation in Petaluma, where he developed new window coatings for buildings and cars.

Teresa Bippert-Phymate ('84) has launched LookingUP! Astronomy Services, LLC, a business that brings astronomy to the resorts and camps in the Big Bear Lake area of southern California. She formerly worked at Steward Observatory as Interferometry Technical Specialist for the Large Binocular

Telescope Interferometer and as the technical writer for the SOLIS project at the National Solar Observatory.

Geoffrey A. Wilson ('84) is a consultant specializing in signal processing algorithms and optics in Oregon. He has worked on bioparticle detection at Hach Homeland Security Technologies in Grants Pass, OR, coherent laser radar at Coherent Technologies in Boulder, CO, and experimental quantum optics at the University of Oregon in Eugene, OR, since earning his Ph.D. in applied physics at the Oregon Graduate Institute of Science and Technology in 1992.

Keyvan Farahani ('85) is the chief of the Imaging Guided Intervention Branch of the Cancer Imaging Program in the National Cancer Institute. He also teaches part-time in the Johns Hopkins University school of medicine. He was formerly an assistant professor of radiological sciences and biomedical physics at UCLA, where he received his Ph.D. in 1993.

Tom McMahon ('85) works at the University of Arizona, where he is now the program manager for the Center for Astronomical Adaptive Optics, project manager for the Large Binocular Telescope Interferometer, and deputy project manager for OCAMS suite of cameras for the OSIRIS-REx Asteroid Sample Return Mission. He was previously principal systems engineer of the Multiband Imager for the Spitzer Space Telescope, and he has worked on several other major instruments.

McQuillen Scholar 2013: Observed Effects of Mg-doped Zinc Oxide (ZnO) Thin Films via Electrochemical Deposition

By Jordan Sperry

The concepts and ideas I have been exposed to thus far as a Physics major at SSU, along with my own independent study, have led me to an interest into the realm of materials science. The research that I performed this summer for the 2013 McQuillen Summer Research Award with Dr. Hongtao Shi involved the development of Zinc Oxide thin films ideal for optoelectronic use. This is a fascinating field in physics and engineering that is continuing to grow due to the number of devices that can be developed with optoelectronics, such as solar panel components.

In order to develop these thin films, we decided to use a method that isn't typically used in industry, but is useful due to its low cost and low requirement of sophisticated tools or machinery. This method is called electrochemical deposition, and essentially works by applying a current to a chemical solution, which causes the charged ions in the solution to bond to a substrate in contact with a metal plate, due to a potential difference.

Dr. Shi had previously grown ZnO samples on Indium Tin Oxide (ITO) substrates with this method, and for my research, I wanted to dope the Zinc Nitrate $Zn(NO_3)_2$ solution with Magnesium Nitrate $Mg(NO_3)_2$ in order to create Mg-doped ZnO in the deposition process. In theory, the incorporation of Mg into the sample should widen the energy band gap of the grown ZnO sample. Based on previous research, Mg-doped ZnO has a highly tunable band gap, which only furthers the number of applications that this material can be used for.

I was able to successfully dope a number of ZnO samples with Mg using this process, however the ratio of Mg to Zn was far too large. I was not creating Mg-doped ZnO, but was instead creating Zn-doped MgO! This was a problem because MgO is an insula-



tor and is not useful for semiconductor purposes. Adjusting the concentration of $Mg(NO_3)_2$ either gave me far too much Mg in the sample, or none at all. Near the end of the summer, I switched to a very common Sol Gel method in order to successfully incorporate the right amount of Mg and successfully shift the band gap of the ZnO.

The research I performed this summer provided me with an invaluable amount of experience with a number of microscopy methods, such as SEM, EDX, XRD, PL and UV-Vis Spectroscopy, all of which were required in order to obtain both the quantitative and qualitative results I needed in order to determine the validity of the samples I made. I would like to thank Mike and Sheila McQuillen for providing the means for this research to happen, the Physics & Astronomy Department for selecting me for this award, and Dr. Shi for his very valuable guidance and advice throughout the entire process. This was my first stab at research in the field of materials science, and it excited me to continue to do other research projects in this field in the future. I plan on continuing research on this project for my capstone research project in Fall 2014, in order to successfully create Mg-doped ZnO using this electrochemical deposition method.

ALUMNOTES

Allyson Bishop ('86) has returned to California after more than twenty years in Europe and is now a self-employed property manager in San Francisco. She received her Ph.D. in biomedical physics at UCLA in 1994 after winning a fellowship upon graduation from SSU.

Dan Nottingham ('89) is director of product management at Imprivata in the Boston area. He has done similar work for several companies after participating in rocket-launching experiments for the Boston University Center for Space Physics.

Jason I. Alexander ('92) is director of business development at Metrue in Fremont. Formerly a marketing manager of organic light emitting diode (OLED) displays for OSRAM in San Jose, he earned an M.S. in physics in 1995 at Indiana University-Purdue University at Indianapolis.

Benjamin J. Owen ('93) was elected a Fellow of the American Physical Society in 2013 "for leadership in understanding how neutron stars can produce gravitational waves, for creating better methods to search for these waves, and for demonstrating how gravitational wave observations can be

used to probe the structure and dynamics of neutron stars." A professor of physics and director of the Center for Gravitational Wave Physics at Pennsylvania State University, he received his Ph.D. in physics in 1998 at Caltech, where he was awarded the Milton and Francis Clauser Doctoral Prize for the most original and ingenious dissertation research that year. He received a National Science Foundation Graduate Fellowship upon graduation from SSU.

Geoffrey Syphers ('93) was recently appointed chief executive officer of Sonoma Clean Power, the new, locally controlled electricity provider in Sonoma County. He earned his M.S. in Energy Engineering at the University of Massachusetts, Lowell in 1994.

Mallory Roberts ('94) is a visiting professor at New York University Abu Dhabi and an astrophysicist with Eureka Scientific. He earned his Ph.D. in astrophysics at Stanford University in 2000.

John H. Hayes ('97) is the principal of Hayes Graphics in Camarillo. He was formerly a computer specialist with the high energy astrophysics division of the Smithsonian Astrophysical Observatory in Cambridge, MA, where he worked on the Chandra X-ray Observatory.

Never a Dull Moment

By Prof. Jeremy Qualls

It is safe to say I have not had a dull year since being at SSU. This last year has been no exception. My work on organic charge transfer salts continues to elucidate the weak electron-electron and electron-phonon interactions that arise in the low dimensional regime and create



Prof. Qualls with the Freshman SCI 120 Cohort

environments susceptible to complex density wave ordering. I have continued publishing in this area in a number of journals and have been happy to serve as a material science expert for the National Science Foundation and the National High Magnetic Field Laboratory. In addition to this work, I branched into two new areas of research; water harvesting and shear thickening composites. In collaboration with physics major Danny Ryan, our first successful prototype design harvested ~100 ml of water from the air with no electrical power draw. I am very excited about this work and its potential to transform water impoverished areas of the world. The other research area, driven and initiated with physics major Cody Johnson, investigates composite systems and the feasibility of impregnating Kevlar and Dyneema to create stronger materials. We are collaborating with the Franklin County, Tennessee Police Department to develop these materials.

Of great importance this year were my efforts to coordinate the Science 120 program. Our STEP NSF-funded work on enhancing STEM education and developing a freshman entry program has been very successful and continues to evolve into a paragon transformative experience. I am still learning so much about our local ecosystem and watershed sustainability as well as teaching general education courses.



Bryant & Diane Hichwa Research 2013 Award: Investigating Plasma Properties

By Amandeep Gill

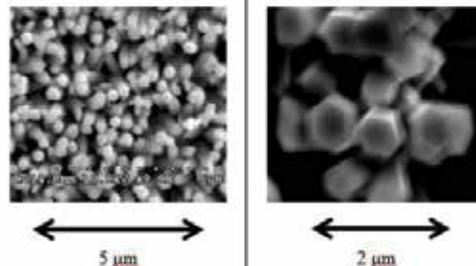
Last summer I had the delight of conducting research through the department's Hichwa Research Award. I worked with Dr. McLin at SSU E/PO, formerly NASA E/PO, using the robotic telescope, GORT at the Hume Observatory on the Pepperwood Preserve. GORT stands for GLAST Optical Robotic Telescope, and its primary mission is to track gamma-ray bursts and their afterglows. My goal was to study known quasi-stellar objects (QSOs), which are a type of radio-quiet AGN, to search for variability. The study of active galactic nuclei (AGN) is important to the understanding of the evolution of the universe. Taking QSO observations over many nights enabled me to establish a baseline luminosity and to search for variability.

GORT is a 14" aperture telescope that was recently fully automated, with a CCD and filter wheel. When I began at E/PO, GORT was only partially automated, so many late nights and early mornings were spent powering up or down the telescope. After a night of collecting data on the target objects, I would use AstroImageJ to combine stacks of images and reduce for bias, dark, and flat fields. Image analysis was done using APT, Aperture Photometry Tool. I quickly learned that data collection is quick compared to the photometric analysis; however, the analysis is very important to reporting your data. An exciting outcome of my project was that I got a chance to present at the APS Far West meeting we hosted on campus last fall. It was a great chance to practice giving a professional talk. I would like to thank Bryant and Diane Hichwa for their support for this project.

Nanowires for Optoelectronics

By Prof. Hongtao Shi

At the nanometer level ($1 \text{ nm} = 10^{-9}$ meters), some material properties are affected by the laws of atomic physics, rather than behaving as traditional bulk materials do. These man-made nanomaterials have the potential for wide-ranging industrial, biomedical, and optoelectronic applications and are the focus of my work. The electrochemical solution approach I have been using is appealing for the growth of Al-doped ZnO (AZO) because of its low growth temperature, low cost, ease of operation, and good potential for scale-up. Using the facilities in the Keck Microanalysis laboratory, we have demonstrated that the AZO films can be successfully grown on silicon wafers. The morphology of the samples can change from one dimensional nanowires to two dimensional flaky films. Ultraviolet light emission from these samples can be significantly enhanced after certain annealing processes. While as-prepared ZnO is often an insulator, AZO films could have tunable conductivity for different optoelectronic applications. Last November, Stephan Jackowski presented this work at the American Physical Society Far West Section, which won him the second place Steven Chu Undergraduate Research Award.



Scanning electron microscope images of Al-doped ZnO Hexagonal nanowires.

Education and Public Outreach group gets new name and new focus

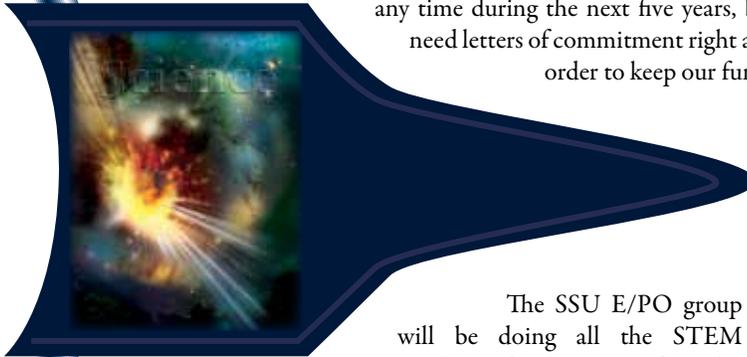
By Prof. Lynn Cominsky



This past year has been filled with dramatic changes for SSU's Education and Public Outreach (E/PO) group (formerly known as the NASA E/PO group). In April 2013, President Obama announced plans to consolidate Science, Technology, Engineering, and Mathematics (STEM) funding throughout the federal government. Part of this plan aimed to zero out the E/PO efforts at NASA that have supported the SSU group for the past fifteen years. Faced with the loss of nearly \$1 million in funding, I began looking at other programs and federal agencies and writing many proposals to try to keep our efforts alive.

to the UC or CSU systems. Our new curricula will focus on developing computational thinking by having students build experiments, use the Logo language to program computers to acquire data from sensors in the experiments, and analyze the data from sensors.

However, unlike the NASA programs that have supported the group in the past, the i3 program requires that 15% of the \$3 million in funds that we receive from the government must be matched by private in-kind or financial contributions. To date we have secured most of the required match as in-kind services from Logo programming language expert Brian Silverman (President, Playful Invention Company), Dr. Garrett Jernigan (retired from UC Berkeley, expert in both Logo and experiment design) and Barry Silverman (Disus Inc., expert in web programming). We have also been offered discounts on parts from Adafruit Industries and Sparkfun Electronics. However, we still need to raise the rest of the required match by July 1, 2014. If you are interested in contributing to support this program, please let me know. Contributions can be accepted at any time during the next five years, but we need letters of commitment right away in order to keep our funding.



Teaming with Susan Wandling, Director of SSU's Early Academic Outreach program, I wrote a proposal that successfully competed against over 600 other groups to win one of only 18 Development grants from the Department of Education's Investing in Innovation (i3) program. Our program "Learning by Making: STEM Success for Mendocino County" will be designing two years of integrated STEM curricula that will be piloted with six high-needs high schools in Mendocino County: Ukiah, Willits, Anderson Valley, Round Valley, Fort Bragg and Point Arena. All of these schools have large populations (over ~60%) of students who are eligible for free or reduced price lunches, as well as poor scores on the California Academic Performance Indices and low eligibility rates (less than 30%) for admission

The SSU E/PO group will be doing all the STEM curriculum development for the Learning by Making program, building on the experience that we have gained during the past with programs such as our "Small Satellites for Secondary Students" (S4) program. The S4 program designed Arduino-based payloads to be built by middle and high school students and flown on high-powered rockets and tethered weather balloons. Last summer we all went down to Palmdale, CA to train 14 middle and high-school teachers and 4 Girl Scout leaders to build the S4 payloads, then launched them all at the Lucerne dry lake bed. To see photos and video from this event, see <http://s4.sonoma.edu>. This year, the educators are helping the students to build their own payloads and we are helping them launch this spring and summer.

Another major accomplishment for the group this past year was the pilot in two different SSU classes of our "Big Ideas in Cosmology" web-based curriculum. The curriculum consists of three modules with 5 chapters each, and is being distributed by Great River Technologies, a subsidiary of Kendall-Hunt publishing. "Big Ideas in Cosmology" is authored by Kim Coble (Chicago State University), Kevin McLin (SSU), Janelle Bailey (Temple University), Anne Metevier (SSU and UC Santa Cruz), Carolyn Peruta (SSU), and me. Illustrations



West Coast Conference for Undergraduate Women in Physics

By Anna McCowan

The Annual West Coast Conference for Undergraduate Women in Physics (CUWiP) was held in Berkeley, CA in January of this year. Aman Gill, Nicola Peyko, Stephanie Church, and I (Anna McCowan) were able to attend, along with nearly 200 other women from all different institutions who were equally passionate about Physics.

Because of its great location, the hosts were able to offer to those who were interested a tour of Lawrence Livermore National Laboratory. The opportunity to tour a renowned research and development institution for science and technology was a privilege in itself. We were able to peek into the windows of laboratories that have contributed so much to our current advancement in physics, engineering, and technology of our nation's security. The experience was truly remarkable.

The Conference itself opened our eyes to all of the great opportunities for women in the field of Physics. One highlight of the weekend was meeting with graduate students who are currently working towards their Ph.D.s. We were able to address any questions we had about research, careers, and life after graduation. It was refreshing meeting so many intelligent women who we could really relate to and open up about undergraduate life as a female in the science field. Another great aspect of CUWiP was the panels. They focused on getting involved at your institution, undergraduate and graduate research, balancing work and personal lives, and careers in all sorts of different fields. The speakers ranged from those who studied astrophysics to those who found a career in



Aman Gill, Stephanie Church, Anna McCowan, and Nicola Peyko at CUWiP

Pixar animation. There were scientists who found a passion in nuclear engineering and physics graduates who took the path to scientific journalism. I was in awe of all the different directions these women took from the same starting point, and they all seemed very proud of their accomplishments. I can say the same for all of the remarkable undergraduate students who presented their research and displayed their posters on the last day. I enjoyed seeing the different projects that students from a variety of schools had been working on.

CUWiP was a great experience because we were able to make connections and find allies in a field where historically women have been underrepresented. Being able to walk into a room full of young women who share my nerdy, yet awesome, interests was a fantastic and life-changing opportunity.

were created by Aurore Simonnet, and computer interactives were designed and programmed by Kevin John ('07). The work was funded by an EPOESS grant from NASA, the Fermi Gamma-ray Space Telescope E/PO program, NASA's Illinois Spacegrant Consortium, and the California State University's Promising Course Redesign project.

During the spring 2014 semester, the "Big Ideas" curriculum was tested in Astro 100 and Astro 350 classes taught by Visiting Faculty member Tom Targett. The intro class started with Module 1 and made it into Module 2, while the upper division class started with Module 2 and ended up somewhere in the middle of Module 3. Through all this testing, we received valuable feedback on how well our instructional strategies worked and found many bugs in the web implementation. We will be working all summer to incorporate changes based on our experiences using the material with these real students, as well as ensuring accessibility. The plan is to market the curriculum nationally starting in the fall.

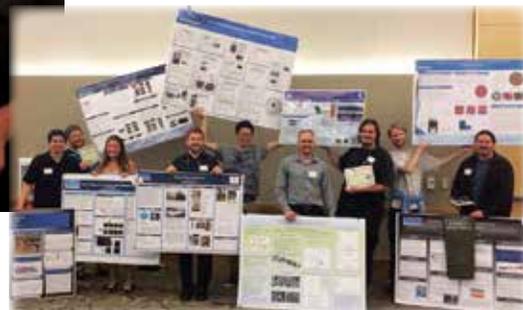
2014 SSU Science Symposium

By Prof. Jeremy Qualls

The School of Science and Technology (SST) in partnership with the WATERS collaborative hosted the 2nd annual SSU Science Symposium. Held in the new Student Center, this event highlighted the research of over 120 students and included both open poster session and talks by Science 120 freshman students. There were 56 research posters from all of the SST departments with physics & astronomy tied with chemistry for most posters at 12 each. Awards were given out for Best Poster, Best Poster Runner Up, Best Water Related, and Most Innovative. Physics major Hunter Mills took Best Poster for "An Optical System for Application in Medical Physics and Astronomy" and Kevin Zack took Best Poster Runner Up for "Putting Sonoma State University into Space". Judges were very impressed by our majors and their ability to communicate their research to a general audience.



Physics majors Hunter Mills and Kevin Zack winning Best Posters!



Acoustic Measurements of Weill Hall and other venues of Green Music Center

By Dr. Mike Jones

It is quite possible that Weill Hall, the feature venue of the Green Music Center, is the finest concert hall located on a university campus. The presence of the Hall presents Sonoma State with unique educational and research opportunities. The Department of Physics & Astronomy is now proceeding to take advantage of both opportunities.

In the Spring of 2011, in anticipation of the completion of the Green Music Center, the Physics and Astronomy Department reestablished the Physics of Music (Phys 300) course. The new version of the course will be taught for the fifth time next Fall.

It has been the ongoing intent of the Physics of Music course to feature the various venues of GMC and the particular acoustics of each. The GMC is ideal for this purpose because of the extraordinary level and variety of acoustic control present in the different venues. Students are given a one or two class period tour featuring the solo and group practice rooms, the smaller concert rooms and finally Weill Hall. The students are fascinated by the elements of acoustic design on display and the distinct acoustic environments created. The tour is always the highlight of the class for the students.

Unfortunately, the interaction of the students with the GMC was limited to a walk-through tour. The Physics Department lacked the equipment necessary to actually measure and/or demonstrate the unique acoustics of the rooms. In the Fall of 2013, the department proposed the purchase and utilization of a room acoustics measurement system. The funding was granted as a Green Music Center Academic Integration proposal, and the equipment was purchased in early 2014. The system utilizes the Dirac measurement and analysis software and in-



cludes both omnidirectional and vocal-simulation sources along with omnidirectional and bidirectional microphones.

The system will be used to make detailed measurements for use in the Physics of Music class. The acoustic parameters of music and speech reproduction will be measured for rooms in the GMC as well as classrooms and other larger venues such as Person Theatre. We will use the equipment to demonstrate the effectiveness of acoustical elements during tours of the GMC facility.

Weill Hall is not just invaluable for demonstrating the principles of musical acoustics, it also offers a unique facility for research into concert Hall acoustics. Senior Jacob Lewis has selected as his Capstone Project the first measurements of Weill Hall. Jacob assembled and calibrated the complete system described above. Several classrooms in Darwin Hall were measured to establish a baseline and to confirm the correct operation of the measurement system. Measurements at 12

locations within Weill Hall were completed in April and the results were presented in early May.

Because of the deliberate physical and acoustic similarity of Weill Hall to the world's two highest ranked concert venues, Vienna's Musikverein and Symphony Hall in Boston, it is expected that these

measurements of Weill Hall will show that it closely matches these Halls in the five ISO concert Hall parameters.

It is hoped that future research will result in extensive measurements of the acoustic parameters of the Hall as a function of listener location, under different arrangements of the acoustic curtains, and with and without the rear wall open.

In summary, we feel strongly that the Green Music Center is not just an artistic asset but a valuable scientific and educational asset for the Sonoma State University community.

ALUMNOTES

Brooke Haag ('01) is now an assistant professor of physics at American River College. She formerly taught physics at Hartnell College. She earned her Ph.D. in nuclear physics at the University of California, Davis in 2009.

Justin Flory ('02) completed his Ph.D. in biological design at Arizona State University in 2014. He researched how to build an artificial device to convert water and sunlight into fuel, based on the natural process of photosynthesis. He plans to apply his research experience in artificial photosynthesis to improve solar energy technologies.

Tyana Stiegler ('03) earned a Ph.D. in experimental particle physics at Texas A&M University in 2013. She is continuing research there and also teaching physics at Blinn College in Houston. Her thesis research was done on the LUX (Large Underground Xenon Detector) Project, a dark matter direct detection experiment in South Dakota. She earned a master's degree in physics at the University of California, Davis.

Michelle Valencia [formerly Jones] ('03) educates the public about astronomy at the Ukiah Latitude Observatory. She also tutors mathematics at the Tutoring Center.

Tiffany Davis [formerly Borders] ('04) is now living in Emeryville and studying at Animation Mentor. She worked as a research and instrument analyst at the Space Telescope Science Institute from 2008 to 2013. She earned her M.S. in astronomy at San Diego State University in 2008.

Daniel Gospe ('04) is chief operating officer at dmi Networking Solutions in Santa Rosa.

Tedman Torres ('04) is an officer in the U.S. Navy and is now in the nuclear propulsion program. He was formerly a postdoctoral researcher at the H. Lee Moffitt Cancer Center & Research Institute in Tampa, FL. He earned his Ph.D. in biological physics at Arizona State University in 2009 with a dissertation on fluorescence correlation spectroscopy.

Roman Hewette ('05) is serving in the air force as a space event duty technician at Vandenberg Air Force Base responsible for orbital protection and overall space situational awareness. He is also working on an M.S. in aeronautical science.

Danielle Beddow ('07) is teaching English in Taipei, Taiwan, where she is also an engineering consultant to East Tender Optoelectronics Corp. She was formerly a senior engineering technician at View, Inc. (formerly Soladigm, Inc.) in Santa Rosa.

Melissa Geissing [formerly Crain] ('07) is the principal of New Skin Media, Santa Rosa, which specializes in website development, branding, and marketing for professional photographers. She is also the president and COO of Web and Interactive Media Professionals, a community of designers, programmers, marketing specialists, search engine optimization experts, social media gurus and just about anyone having to do with the evolving technological world. She has just published a book on designing a website in one day.

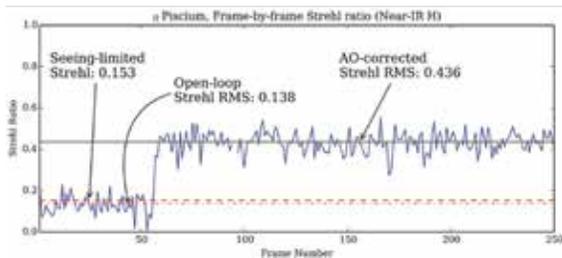
Alexander Sevilla ('07) was recently promoted to production supervisor at Deposition Sciences, Inc. in Santa Rosa. He formerly worked on the design and construction of electric vehicles for Thunderstruck Motors in Santa Rosa.

Progress in Adaptive Optics: KAPAO

By Prof. Scott Severson

KAPAO is an astronomical instrument that we have built in partnership with Pomona College and collaborators from Harvey Mudd College and Caltech. Behind a 1-meter telescope located at Table Mountain Observatory, a Jet Propulsion Laboratory site, the system brings high-resolution astronomy to Sonoma State University students. We completed "first light" with a prototype system in 2012 and "first light" with the much more capable final system in 2013. In Fall of 2013, I was honored to have a sabbatical semester to work with the system at Pomona College and at the observatory.

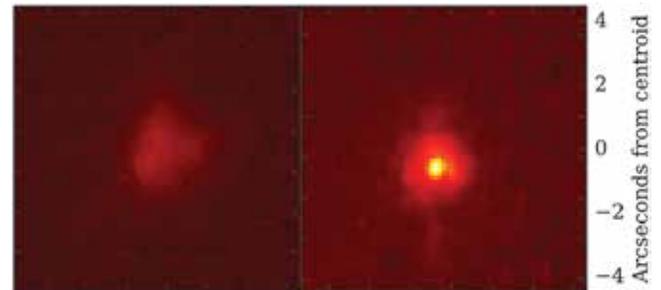
As seen in the image and plot of the star Eta Piscium, taken during this sabbatical, we are able to sharpen images of distant astronomical objects that are otherwise blurred by the Earth's atmosphere. The Hubble Space Telescope is able to take high-resolution images by going above the atmosphere, but Adaptive Optics allows us to measure and correct for the atmosphere and make superb images from the ground. Our KAPAO instrument, built with the explicit inclusion of undergraduates in every step of the process, measures the atmospheric distortion with a Wavefront Sensor, and corrects the distortion with a Deformable Mirror. These exciting technologies have students designing and building optical and mechanical components and developing control and analysis software. The KAPAO system is unique in the way it splits the light from a distant star to be captured by separate visible and near-infrared cameras simultaneously.



This figure shows the improvement of near-infrared image of the star Eta Piscium, as measured by a metric called "strehl", during an on-sky run in December 2013.

We have set the KAPAO system up to be used remotely. Living on the back of the telescope, it can send the light to the older non-adaptive optics camera, or can capture and correct the light. With a fast network connection, and enough monitor space for the myriad of control windows, a remote computer can control the telescope, the adaptive optics system, and the science cameras. In these early days with the system, we are certainly more comfortable up on the mountain top, so we can fix any stray technical challenge, but the system is designed to be used remotely to give SSU students the chance to work with the system from campus. This is quite an achievement for such a sophisticated system, and it is a testament to the hard work of the many students who have worked on the project over the years. (For a sample of the student perspective, please see Katherine Badham's article below.)

The KAPAO project is just getting started. In June, I will be presenting the final design and early results of the system at the SPIE Astronomical Instrumentation conference in Montreal, Canada, and serving as lead author on the companion paper. With the grant funding we are seeking, we expect to support several ongoing observing campaigns. These include monitoring volcanism on Jupiter's moon Io, follow-up on Kepler's extrasolar planet host stars, population studies in crowded stellar regions, to name a few. Stay tuned for the latest news!



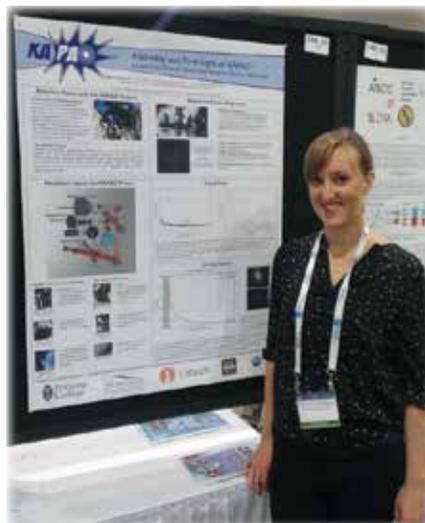
An uncorrected (left) and AO corrected (right) image of the star Eta Piscium from the near infrared camera during an on-sky run in December 2013.

Closing the Loop

By Katie Badham ('13)

During the summer of 2013 I had the honor of working with my advisor, Dr. Severson, and fellow undergraduate students at Pomona College on the most exciting venture of my life - the KAPAO project. I worked on KAPAO Prime, which is an Adaptive Optics instrument built in partnership by Sonoma State and Pomona, for the 1-meter Table Mountain Telescope. My role in this project involved characterization of camera performance, alignment of the deformable mirror and wavefront sensor, and data analysis for the assembled system. Christian Guerrero and I created code, in a language called IDL, that calculated several parameters for the system's near-infrared camera to determine its sensitivity to light, as well as the performance of KAPAO's optical camera. I also performed data analysis on telemetry produced during open and closed loops for the fully aligned system. During the last week of my work, after our tests ensured the system would perform well on-

sky, we attached it onto a telescope at Table Mountain Observatory. On August 1st at 4:00 A.M., the KAPAO Prime system showed us that our hard work had paid off. We "closed-loop" on the star Beta Pegasi. This means we witnessed the blurry twinkling star close into a defined point of light. At that moment I had the pleasure of witnessing the beauty of Adaptive Optics.



I presented KAPAO Prime's in-lab tests and on-sky results at the American Physical Society meeting at SSU in November 2013 and later made a poster discussing the hardware, system alignment and on-sky results which I presented at the American Astronomical Society meeting in Washington D.C. Over the course of my time working on KAPAO, I learned an extensive amount about adaptive optics, instrumentation and a plethora of data analysis techniques as well as the focus and patience required to produce a successful system. I hope to work with adaptive optics systems like KAPAO in the future and build my knowledge in the world of astrophysics.



An OUT OF THIS WORLD Year

By SPS President Amandeep Gill

Conferences and grants and skills labs, oh my! The past year for Society of Physics Students has been one of firsts. We started off in Fall 2013 implementing a new peer-teaching program, Skills Lab, in which SPS members teach their fellow students skills such as soldering, photometry, or Arduino microcontrollers. The goal is to teach the research techniques necessary for a successful capstone project, as well as provide the peer-instructors a friendly setting to strengthen their understanding of the topic by presenting it to peers. In addition to starting up Skills Lab, SPS also began School of Science and Tech's Movie Nights, where all science majors come together and watch a nerdy movie. We continued to provide free tutoring to the lower division physics and astronomy students.



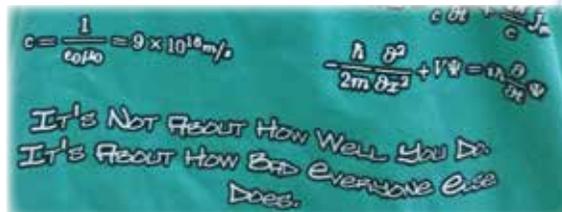
SPS BBQ

SPS competes during Geek Week

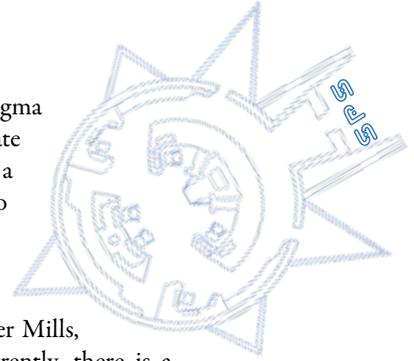


Perhaps most importantly, November 1-2, 2013 the Physics and Astronomy department hosted the American Physical Society's Far West Regional Meeting, with SPS members not only volunteering in large numbers to help run the event smoothly but also represented by seven (!) of us giving talks on the various research projects in the department. Additional, SPS hosted a Halloween reception the night before the conference to welcome visiting SPS members from around California, complete with mummy bowling and a laser light show courtesy of Steve Anderson! It was so great to see everyone come together to put on a great event and showcase our wonderful department.

It was only natural to keep the ball rolling, so the club applied for three different grants through National SPS. It made for a busy busy Spring 2014 when we won all three! SPS, in partnership with MESA, was awarded the SPS Future Faces of Physics Award to present a two-day long skills lab on microcontrollers after which attendees were loaned starter kits for the semester to further explore microcontrollers on their own. For a second year running, our chapter received the Marsh W. White Outreach award to promote physics and science in the community. The outreach event was held during the last Public Viewing Night of the semester and SPS put on a physics fair with demos explaining concepts like sizes and distances of the Solar System. In addition to the physics fair, SPS used the funds to digitize a collection of marvelous astronomical slides to present at the physics fair and to generally make them more accessible. Last but by far



not least, we received the Sigma Pi Sigma Undergraduate Research Award to build a CubeSat ground station to complement the recently launched T-LogoQube satellite, built by SPS members Kevin Zack, Hunter Mills, and Ben Cunningham. Currently, there is a second satellite in development for a Spring 2015 launch off of the International Space Station; our goal is to have the ground station done in time to communicate with the next satellite.



It has been a demonstration of this SPS chapter's commitment to each other and physics that we have not only received every grant we applied to but also completed each to such a high level of success. More information for all the grants awarded to SPS this year can be found at the SSU School of Science and Tech's Spring 2014 newsletter: http://www.sonoma.edu/scitech/newsletter/spring_2014.pdf. While spring was a busy time for SPS, we still found time for fun activities, such as participating in the annual Geek Week on campus and tabling at various events to promote membership and interest in physics. We would like to thank the department, particularly our advisor Dr. Shi and Steve, for supporting us through all the various endeavors! It has truly been an out of this world year.

Behind every SPS accomplishment there is a member or a group of members who put in an extraordinary amount of time and effort through many sleepless nights and coffee cups to honestly make this year the club's best ever! I am so happy to have been a part of it all, it has been a wonderful experience being club

president and I look forward to what SPS will achieve in the coming year.

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

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

Showing off the SPS 2014 T-shirt!



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. Prof. Lynn Cominsky (lynnc@universe.sonoma.edu) ran the series this past year - we have just completed our 87th 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/publicSupport.shtml>, contact the SSU Development Office at (707) 664-2712 or contact the Department.

ALUMNOTES

Charles Granger (’08) is a graduate student in optics at the University of Rochester. He earned an M.S. in physics at San Diego State University, concentrating on electro-optics, in 2013.

Bill Garcia (’10) has returned to California and is now a winery equipment technician with the Criveller Group in Healdsburg. He was formerly a field service engineer at AlsoEnergy in Lafayette, CO.

Matthew Fontana (’12) is a graduate student and teaching assistant in chemistry at UCLA. He received his M.S. in 2013.

Joshua Stortz (’12) is an assistant A/V technical manager at AvaCon, Inc. and the principal and executive producer of the Vesuvius Group, LLC, an international collaborative of creatives specializing in developing online environments for community-building.

Current Funds:

#C0141 Public Programs

Richard M. Bell, Robert Fisher, James A. (’75) and Patricia McBride (McBride Group), Joe and Eileen Tenn

#C0142 Physics & Astronomy Equipment and Supplies

Lauren Novatne (’89), Rivendell Heights, Inc. (Greg Sprehn ’93), Deposition Sciences Inc.

#C0143 SSU Observatory

No donations this past year.

#C0144 Student Development Program

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

#S0265 Duncan E. Poland Physics and Astronomy Scholarship

Lynn Cominsky and Garrett Jernigan

Endowment Funds:

#E0185 Charles and Norma McKinney Fund

The Charles and Norma McKinney fund supports public programs.

#E0208 Horace L. Newkirk Memorial Student Assitanship

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

#E0269 Science at Work Fund

Established by John Max to support What Physicists Do.

#E0304 Sol and Edith Tenn Scholarship

Joe Tenn

#E0305 Joseph S. Tenn Scholarship

Established by relatives of Joe Tenn to honor his service to the Department.

Gifts In Kind:

Dean Wilson at JDS Uniphase: New BNC cables, HP 8921A Cell Site Test Set

New to the New World

By Visiting Assistant Professor Thomas Targett



Aman G., Anna McC & Dr. Targett.

One year ago, I was in a New York hotel room waiting to begin a phone interview with the Physics and Astronomy department at Sonoma State University. I had “Google-stalked” the staff, reviewed their academic courses, and located Rohnert Park on a map.

Today, I am in my office at the SSU Physics and Astronomy department, having completed my first year of full time teaching, learned so much about education, and am looking forward to Fall 2014 when I will resume my duties.

It’s always a little scary moving to a new place, but the faculty and university have been most welcoming, and as my colleague Wes Ferris puts it “This is one of the best little departments in the world”. The quality of teaching and research is truly excellent, and I’m very happy to be a part of it.

It has also been a pleasure to involve SSU students in my academic research. At present I am measuring the size-mass relation of galaxies at very great distances, and creating telescope-like images from numerical simulations of the early universe. I have been amazed by how well my project students have engaged with their projects, and am glad to provide them their first (hopefully of many) experiences with professional astronomy.

All-in-all, I find myself very happy here at SSU.

ALUMNOTES

Katie Badham ('13) is an intern working on femtosecond laser ablation at Raydiance in Petaluma.

Chuck Neely ('13) is an associate engineer at Deposition Sciences, Inc. in Santa Rosa.

Anna Wojtowicz ('13) is a research associate at Oak Ridge National Laboratory, where she is developing software for enhancing nuclear reactor simulation modeling and data analysis.



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The Physics Major - No. 39 May 2014

Published by:

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Photos by: Jeremy Qualls, Lynn Cominsky, Steve Anderson, Hongtao Shi, Scott Severson, Tom Targett, Kevin Zack, Aman Gill, Anna McCowan, Katie Badham, Cody Johnson, Jacob Lewis, Maxfield Torke.

Layout and design by: Aurore Simonnet.