DEPARTMENT OF PHYSICS NEWSLETTER

FOR ALUMNI AND FRIENDS

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SANTA CLARA UNIVERSITY

Inside this issue:

Letter from the Chair, John Birmingham

It has been two full years since our previous edition of the newsletter, and, as you might expect, there have been many developments and transitions over that time. Many thanks to our departmental admin **Diane Idemoto** who started with us last winter and who has done the lion's share of the work on this newsletter! On the following pages you will read about faculty research efforts, meet new members of our department, and hear about the achievements of some of our graduates. A sad piece of news I must report is the passing last fall of **Fr. Carl Hayn, S.J.**, our dear friend and colleague. Fr. Hayn's life is profiled on page 7 of the newsletter.

One of the most significant events of the past two years was our departmental program review. Every seven years or so, we pause to reflect on our departmental aspirations, and we invite external reviewers to visit with and observe us and to give their recommendations. In response to their comments we have made some exciting changes to our majors' curriculum. Two elective courses in astrophysics (with more planned) are now being taught annually by our new Lecturer **Kristin Kulas** (who is profiled on page 3). **Omid Ahmadi** (page 3), recently hired as a Senior Lab Instructor, spent much of the fall developing the curriculum for the mechanics lab that has returned to the introductory sequence this winter. This spring I will be teaching our first course in biophysics, and starting in the fall SCU will be offering a "Biophysics Emphasis" within the physics major. This new program will be an excellent preparation for students interested in employment or further study at the exciting boundary between the physical and life sciences, as well as for those who wish to go into medicine and other health-related careers.

My departmental colleagues remain busy with teaching and research. **Guy Ramon** was tenured and promoted to Associate Professor in Spring 2013. He continues his work on spin qubits in semiconductor quantum dots. Current efforts are focused on formulating a theory for the effects of nearby fluctuating charge states on the qubit coherence and finding strategies to mitigate these effects. Guy's work is funded by a three-year research grant from the National Science Foundation. **Chris Weber** was tenured and promoted this past spring and has begun research on the newly discovered "Dirac semimetal" cadmium arsenide, which is the three-dimensional analogue of graphene. Due to peculiarities of the crystal symmetry, electrons in the material move as though massless! **Phil Kesten** has had his second textbook appear in print. "College Physics" is published by W.H. Freeman and was co-authored with Roger Freedman, Todd Ruskell and David Tauck. Phil's latest project is "blogging" on physics for SCU. Check out http://www.scu.edu/alumni/illuminate/. **Rich Barber** is continuing his research (page 2) on polymer-based solar cells, with one paper published and another submitted in 2014. As part of his sabbatical in the fall, he also relocated a one-of-a-kind scanning tunneling microscope used for studying disordered superconductors from UC Berkeley to UC San Diego. Since the last department newsletter appeared, **Betty Young** has co-authored 12 peer-reviewed publications, most of which included SCU student or alumni co-authors. Her papers focused on a range of topics including superconducting films and detectors, as well as recent results from the SuperCDMS experiment. She has recently entered into a new collaboration with Prof. Kent Irwin (page 8) and was named the Lee and Seymour Graff Professor II (Endowed Chair in Physics).

We are always delighted to receive visits from alumni and friends of the Department. Information about departmental events is posted on our departmental home page: http://scu.edu/physics/. If you'll be in the area and would like to meet with me or have other questions about the department, please contact me via e-mail (jbirmingham@scu.edu) or phone (408-551-7185).

With best wishes,
John Birmingham

Faculty Spotlight: Dr. Rich Barber, Professor

Solar Cells Made from Goo

Photovoltaics, the direct conversion of solar energy into electrical energy, is a rapidly-growing sustainable-energy sector. The technologies that are currently most widely implemented use silicon (Si) based solar cells. While these systems are becoming more efficient, they are relatively expensive due to high manufacturing and material costs. Manufacturing requires a fabrication line similar to those used in standard microelectronics production. Since the crystalline Si wafer is the primary material ingredient, these solar cells also compete with the broader electronics industry for an expensive resource. This high cost has motivated the study of alternative materials for next-generation photovoltaics.

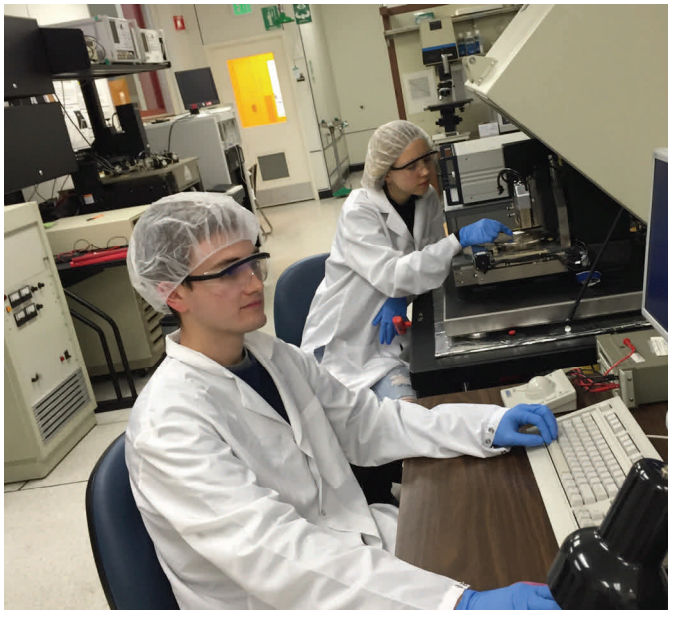
Polymer-based photovoltaics (PPV) offer the promise of low-cost and mechanically robust photovoltaic systems. Because they have the material properties of plastics, they can be made into flexible devices that are also highly resistant to breakage from mechanical stress or impact. In contrast, Si-based counterparts are very fragile. Furthermore, PPVs can be manufactured in a roll-to-roll process that essentially prints the materials from a solution form onto flexible substrates. Because this approach more closely resembles newspaper printing than electronics manufacturing, the cost of production for PPVs is a fraction of that for Si.

So why have PPV systems not been widely utilized in technology? It turns out that these materials suffer from two disadvantages: lower efficiency and shorter lifetime. Although the lower cost might mitigate the lower efficiency problem (just make more panels), lifetime is a serious issue. Just as plastic toys left in the yard for a long time tend to crumble, PPVs left in the sun (and that's the point, isn't it?) tend to suffer chemical and structural reorganization that reduces their efficiency.

A collaboration between Rich Barber (Physics) and Brian McNelis (Chemistry and Biochemistry) has been working on understanding how to improve these shortcomings. Specifically this group has focused on how variations in the chemical components in PPV might improve both efficiency and lifetime. In one of the more commonly studied PPV systems, the two primary components are a thiophene (sulfur ring) polymer (P3HT) which acts as an electron donor and a fullerene (C60 molecule) that acts as an electron acceptor. In solution by itself, the polymer is iridescent. In other words, when it is illuminated with a source of light, excitations of charge in the polymer relax and produce outgoing light. In order to harvest these charge excitations before they recombine, an electron acceptor is needed. Since straight C60 suffers from extremely low solubility, it is "functionalized" in order to enable "wet processing" of the samples. The resulting molecule (PCBM) is typically blended in chlorobenzene solution with the P3HT in equal weight. This solution becomes the active layer of the solar cells. When deposited into a device, the solution dries to form a tangled blend of P3HT-rich and PCBM-rich regions. This aspect of the experiment is really a "black art" in that the only control of the structure is indirect. In other words, experimental parameters like the specific molecules, the relative quantities of material, the amount of solvent in the blend and the temperature to which the samples are heat-treated will determine the structure of the active layer.

The project at SCU started with our substituting different functionalized C60 molecules into the material to see if there was an effect on stability. The first experiment involved taking PCBM (a C60 molecule that has a "tail" that ends in a methyl (CH3) group) and converting it into PCBOD (a C60 molecule that has a "tail" consisting of an 18 carbon chain). PCBOD is much more soluble than PCBM, so as expected there were significant differences in the solar cells. Although the efficiency went down, the stability was enhanced. This observation led the group to try a "library" of different molecules. The results obtained revealed that each new acceptor molecule yields working devices, but the functional changes produce differences that are hard to predict. Specifically, acceptor molecules that are isomers (same chemical composition but slightly different structures) produce solar cells with significant differences in performance. The working conclusion is that each new combination must be separately optimized, and that a library approach might prove valuable in assessing new molecules for this class of photovoltaic devices.

This kind of experimental effort is well-suited to a collaboration between chemists and physicists: the former make the molecules, and the latter perform the electrical characterizations of devices made from them. To date over 20 SCU undergraduate students have been involved in this project. Almost all of them have appeared or will appear as co-authors on articles published in a top solar materials journal.



Grace Chesmore (Physics, '17) and Kyle Bandaccari (Chemistry, '16) operate the atomic force microscope at the SCU Center for Nanostructures to study organic solar cells.

New Faces in the Department

Dr. Kristin Kulas is our new renewable-term Lecturer and teaches our astronomy courses. She completed her B.S in Physics at UC San Diego in 2006 and her Ph.D. in Astronomy at UCLA in 2013. After earning her Ph.D., Dr. Kulas worked as a NASA Postdoctoral Fellow before coming to SCU. Her research interests include examining how galaxies form and evolve over cosmic time. In addition, she has worked on astronomical instrumentation for telescopes used at the Keck Observatory and in the NASA SOFIA project. In her spare time she enjoys hiking with her husband, young daughter, and dog, as well as playing tennis and cooking.

Dr. Omid Ahmadi-Gorgi is our new Senior Laboratory Instructor. He is from the "Windy City" of Chicago, Illinois, where he received his Ph.D. from the Illinois Institute of Technology in 2011. His research topics included High-T_C superconductors and the role of antiferromagnetic spin fluctuations as the pairing glue mechanism in cuprates, along with computational analysis of tunnel junctions, ARPES, and inelastic neutron scattering experiments. His current interests involve many-body physics, space-time physics, lab development and physics pedagogy.

Dr. Sucheta Jawalkar is an Academic Year Lecturer for 2015-2016. She is originally from Mumbai, India — home of the Bombay Stock Exchange, Bollywood, and a population of over 11 million people. Her family home is in the suburb of Bandra, which was an old fishing village and still has very strong Portuguese influences and a large Anglo-Indian population. Dr. Jawalkar received a B.S. from Truman State University in May 2006 and was awarded a Ph.D. from the College of William and Mary in January 2012 in the field of experimental nuclear/particle physics. For her Ph.D., she studied proton spin structure using a 6 GeV electron beam at the Thomas Jefferson National Accelerator Facility in Virginia. After graduate school, Dr. Jawalkar spent two years as a post-doctoral researcher with the Medium Energy Physics Group at Duke University where she was involved in experiments in which Helium-3 was polarized in a solenoid magnet in order to study neutron spin structure. Dr. Jawalkar is currently interested in real-world applications of nuclear structure in medical physics and detonation forensics. At SCU she teaches PHYS 31-33, and she is focused on improving instruction for first-generation students. In her spare time she enjoys reading, good barbecues, good sandwiches, and traveling with her husband.

Dr. Nathan Williams is an Academic Year Lecturer for 2015-2016 teaching General Physics, primarily to Biology majors. He grew up in Kansas City, living on both the Missouri and Kansas sides of town. His love of science was fueled by a high school biology teacher who focused on making the learning experience enjoyable and entertaining. Dr. Williams received his B.S. degree in physics, mathematics, and astronomy from the University of Arizona in 2005. He then went to the University of Rochester to study theoretical quantum optics, where he earned a Ph.D. in 2011 investigating the use of weak quantum measurements for amplification and control of quantum systems in solid state and optical environments. After graduating he spent two years teaching at Willamette University in Salem, Oregon, where he also found time to continue his work in theoretical quantum optics and developed an undergraduate lab to perform single-photon and quantum weak measurement experiments. Outside of the academic setting he enjoys disc golf, ultimate frisbee, hiking, backpacking, and science fiction. Each summer he works towards completing his goal of climbing every mountain over 14,000 feet in California, although this summer he will be taking a break from climbing to marry his fiancée.

Catching up with alumni: Updates from some of our former students

Jimmy Williams, B.S. Engineering Physics '02

Prof. Williams inside the ellipse of the new Physical Sciences Complex at the University of Maryland

I graduated from SCU in 2002 with a B.S. in Engineering Physics. I was an avid car mechanic in high school and Prof. Betty Young helped put those skills to work doing research for the Cryogenic Dark Matter Search (CDMS). I contributed to low-temperature (~20 mK) measurements in a dilution refrigerator affectionately known as "Bertha". Working on CDMS, I became enamored with fabrication of small devices; after graduation I spent some time working in a molecular electronics lab at NASA-Ames.

From Ames I went to Harvard for graduate studies, where I researched a material called graphene (single-layered graphite). When a material conducts electricity, the particles that carry electrical current don't necessarily have to behave like electrons — you can trick them into behaving like almost any particle you like. In graphene, the electrons resemble photons and you can make devices that exploit the photon-like properties of these electrons. So if I can make electrons behave like photons, what else can I do with them? That was the question on my mind when I finished graduate school.

After receiving my Ph.D., I took a postdoctoral position at Stanford where I could address this question. One of my projects was to search for the "Majorana fermion", a particle that was predicted to exist more than 75 years ago. From Dirac's solution to the relativistic wave equation describing spin-1/2 particles came the idea that each particle has a partner, an antiparticle. Electrons have anti-electrons (positrons), for example. The wave functions of particles and antiparticles are related by complex conjugation. About ten years after Dirac's solution, Ettore Majorana showed that quantum mechanics allows for neutral spin-1/2 particles to be described by a *real* wave equation (now known as the Majorana equation), and hence to be their own antiparticles!

One candidate for this hypothetical "Majorana fermion" is the neutrino (already known to exist in the Dirac form), and particle physics researchers have spent the past few decades looking for evidence that Majorana neutrinos exist. Condensed-matter physicists are also looking for Majorana fermions, but our experiments usually center on studying fundamental physics with custom-fabricated nanoscale devices in "bench-top" physics labs.

In some sense, the work I participated in with Prof. Young at CDMS looking for exotic particles has come full circle. The search for Majorana is still on. In March of this year I moved to the University of Maryland as an Assistant Professor. I have been working on an approach to identify concrete signatures of the Majorana particle. It's a great job! I have a big lab and a bunch of money to do whatever physics I want. It doesn't get any better than that.

Will Boenig, B.S. Engineering Physics '04

Will Boenig and his wife, Rebecca, and son, Henry.

Alumni continued

I recall as a new admit to Santa Clara reviewing the booklet of majors and coming upon the description for Engineering Physics. Depth and breadth in BOTH engineering and physics!

Theory AND application...understanding how the world works. I was hooked. In the whirlwind of my first quarter, I knew I made the right decision when I was at a department BBQ at Dr. Kesten's house. I loved being around so many talented, friendly people and trying to keep up. My four years gave me all the academic jousting I bargained for and more!

After graduation I pursued my interest in architecture and civil engineering, earning an MS in Structural Engineering at Stanford. But in my first job in that field, I found myself unfulfilled (albeit with a couple of really great mentors). With their support, I searched for a field that I could be passionate about, and that's when I discovered healthcare. I landed a job with VNUS Medical Technologies as an R&D engineer. It was a terrific time to be there. Over the next three years I contributed to a new product's design, performed lab testing, set up a manufacturing line, assisted with the patent and regulatory filings, and tested our product in humans. (It worked!)

It was around that time that I found myself growing a bit restless, itching to start something myself. I had the opportunity to do this with my roommate, founding SRECTrade, a company that supports the market for renewable energy credits, in our living room in Menlo Park. This fantastic experience motivated me to go to the Stanford Graduate School of Business, where I came to fully appreciate the analytical skills I had acquired as an Engineering Physics major. At Stanford I had to decide between energy and healthcare. Ultimately, I concluded that healthcare was going to undergo significant and disruptive change in the near future, and I wanted to be a part of it.

I now live in Denver with my wife Rebecca (SCU Biology '04) and our 15 month-old baby boy, Henry. I'm a director of operations for DaVita Healthcare Partners and work in their disease management business. We miss the buzz of the Bay Area but have made great friends here and occasionally reconnect with a fellow SCU alum who has also transplanted here. I'm grateful that I started in Physics at SCU and wholeheartedly recommend it to young people who love to learn and want a solid academic foundation that can take you anywhere in life.

Check it out! **John Mark Kreikebaum** (SCU Physics '13) and **Matt Cherry** (SCU Physics '07) were interviewed for a National Geographic article. Look at the second photo at http://ngm.nationalgeographic.com/2015/01/hidden-cosmos/clark-photography. That is John Mark's reflection on the surface of a SuperCDMS detector!

Charles Hall, B.S. Physics '13

I started at SCU as a mechanical engineer but switched to a Physics major so I could study a diversity of subjects. (A conversation with Prof. Betty Young helped, too!) Along the way I added an Electrical Engineering minor. My junior and senior years I worked with Mr. Bill DeHart as a student lab instructor, and the summer before my senior year I was an intern at Titan Aerospace, when the whole company consisted of fewer than a dozen people.

After graduation, I took a position as a test engineer at SPX working on antenna arrays. I was well prepared for this job by classes in upper-division electrodynamics and by the advanced lab course I took as a senior. After almost a year of this I decided I wanted to work in a startup again and talked to my former boss at Titan Aerospace about returning. Unbeknownst to me, Google was in the process of acquiring the company, and so I ended up applying to and receiving an offer from Google. I moved to Moriarty, New Mexico to work on unmanned solar powered aircraft for what is now the Titan Aerospace Project at Google. The aircraft has been designed strictly for civilian uses, such as providing internet access and disaster relief. Specifically, I am responsible for the telemetry and control data links. It's a great project, but in the longer term, I am planning to pursue graduate studies in physics, machine learning or medicine.

Alumni - we want to hear from you! Please email us your information including name and year of graduation, what you did after school, what you are doing now, and/or how your SCU degree contributed to your current activites. We would love a picture as well! With your permission, we may feature you in an upcoming newsletter. E-mail us at physics@scu.edu.

Student News

2013 and 2014 Physics Awards Dinners

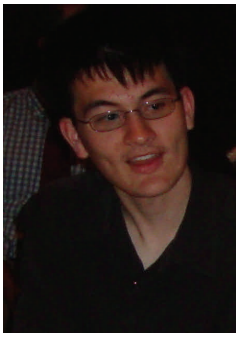
Each year the Physics Department has an opportunity to present students with three different awards: the David L. Blockus Award, the John Drahmann Prize and the Carl H. Hayn Physics Prize.

The Blockus Award, established in memory of Dr. David L. Blockus, Ph.D., is presented each year to the outstanding senior student in the Physics Department. The Drahmann Prize is presented to the graduating senior Physics or Engineering Physics major who best exemplifies the hardworking and earnest values of Dr. Drahmann, long time Dean of Sciences and Professor of Physics. Lastly, the Hayn Prize is awarded each year to the most outstanding student in the Physics for Scientists and Engineers introductory sequence.

The following students were recognized at the 2013 and 2014 Physics Awards Dinners:

2013
David L. Blockus Award – Eric Kittlaus
John Drahmann Prize – John Mark Kreikebaum
Carl H. Hayn Physics Prize – Jared Hara and Jasper Tan

2014
David L. Blockus Award – Richard Schulte
John Drahmann Prize – Edward Tortorici
Carl H. Hayn Physics Prize – Eric Beckmann



The 2014 Physics Award dinner was held in mid-May at Maggiano's Italian Restaurant in Santana Row. Senior award recipients Rick Schulte and Teddy Tortorici are shown above. Eric Beckmann ('16) (at left) is majoring in Computer Science and Engineering. (We tried to convince him to major in Physics but to no avail.)

Congratulations Class of 2013

Connor Gemmel – Physics
Charles Hall - Physics
Justin Isaac – Physics
Tor-Elias Johnson – Physics
Eric Kittlaus – Physics and Mathematics
John Mark Kreikebaum – Physics
Aaron Lynch – Physics

Class of 2013 continued

Kassandra Mattia – Physics
Charles McArthur – Engineering Physics
Tommy McCann – Engineering Physics
Mark Spain – Engineering Physics
Christopher Waight – Engineering Physics

Congratulations Class of 2014

Thomas Bohn – Physics
Matthew Copley – Physics
Robert Craugh – Engineering Physics
Lucas Flagg – Engineering Physics and Chemistry
David Oparko – Physics and Mathematics
Will Patterson (Fall 2013) – Physics
Richard Schulte – Physics and Mathematics
Teddy Tortorici – Physics and Mathematics

Department of Physics Student Research Symposia

Presentations in 2013 and 2014 by some of our majors on their undergraduate research projects are listed below:

Incorporating Spike-rate Adaptation into a Neural Rate Code: What a Model Can Tell Us About Biology
Lucas Flagg and Bridget Ralston (Faculty advisor: John Birmingham)

Fabricating Transition Edge Sensors
John Mark Kreikebaum (Faculty advisor: Betty Young)

Transition Edge Sensor Data Analysis Using Numerical Methods and Machine Learning Techniques
Teddy Tortorici (Faculty advisor: Betty Young)

The Search for T-Tauri Stars Continues as MIRA Astronomers and Interns Look Deeper into the Pelican Nebula
Thomas Bohn (Mentor: Arthur Babcock, Monterey Institute for Research in Astronomy)

Effects of Chemical Modification in Polymer-Blend Photovoltaics
Michael Tro (Faculty advisors: Brian McNelis and Rich Barber)

Venus Terminator Temperature Structure: Venus Express SOIR and VTGCM Comparisons
Rick Schulte (Mentor: Steve Bougher, University of Michigan)

Atomic Force Microscope Application of Optomechanical Transduction by a Microdisk Resonator
Max Silva (Mentor: Vladimir Aksyuk , NIST)

Polymer Solar Cells with Varied Dye Percentages
Grace Chesmore and Kyle Bandaccari (Faculty advisors: Rich Barber and Brian McNelis)

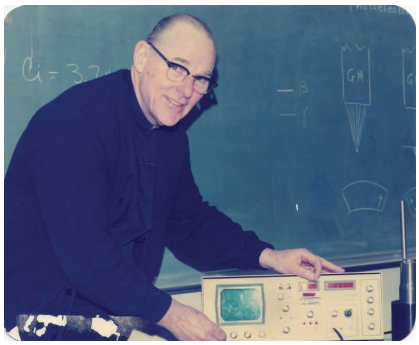
Behavior of Photo-Excited Dirac Fermions in Cadmium Arsenide
Bryan Berggren (Faculty advisor: Chris Weber)

A New Perspective on Genome Sequencing
Garrett Huening (Mentor: Michael Dorwart, Genia Tech / Roche)

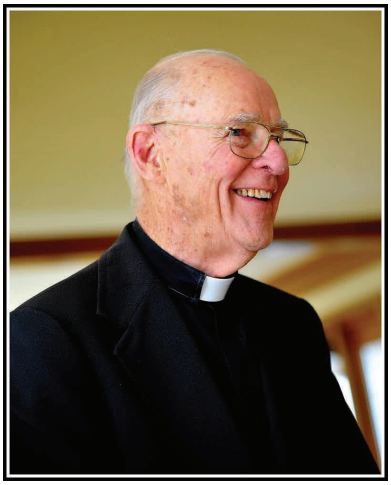
3D Mapping of Radioactive Material
Jake Ososke (Mentor: Edward Walsh, Sandia National Labs)

Fr. Carl Hayn, S.J. (1916—2014)

Our beloved colleague Fr. Carl Hayn, S.J. died October 21, 2014, at Sacred Heart Jesuit Center in Los Gatos at the age of 98. He had been the oldest living member of the California Province of the Society of Jesus.



Fr. Hayn was born July 13, 1916 in Los Angeles and graduated from Loyola High School. He entered the Jesuit novitiate in Los Gatos in September 1933 and received A.B. and M.A. degrees in Philosophy from Gonzaga University in 1939 and 1940. He returned to Los Angeles and taught physics and mathematics at Loyola High School, 1940-43, and engineering physics at the Army training program at Loyola University, 1943-44. For his theological studies, Fr. Hayn again relocated to Los Gatos, where he studied at Alma College. He was ordained a priest in 1947 and received his S.T.L. degree in 1948. For graduate studies in physics, he attended St. Louis University, receiving his Ph.D. in 1955. He later did postdoctoral work at Oak Ridge Institute of Nuclear Studies and Washington State University.



Fr. Hayn joined the new Department of Physics at the (then) University of Santa Clara in 1955. He taught full time for more than 50 years and served as president of the Northern California/Nevada section of the American Association of Physics Teachers. Even towards the end of his career he continued to publish scholarly articles in journals such as the *American Journal of Physics* and *The Physics Teacher*. He retired from teaching in 2006 but worked in the department until 2012 – writing, tutoring students, and receiving visitors.

Fr. Hayn had two careers, which he integrated perfectly. Before he started his day as a physicist and professor, he celebrated the daily 6:00 A.M. Mass in the Mission Church with a group of regulars he fondly called the "Usual Suspects". He also provided priestly service to the Carmelite Sisters of Santa Clara, a community of which he was very fond.

For each of us on the faculty in the Department, it was a blessing and privilege to work alongside Fr. Hayn. He was equally skilled and patient whether explaining the subtleties of a physics demonstration that he had developed years prior or listening to and counseling a colleague regarding a personal issue.

Just after Fr. Hayn's death, the Department received a note from one of his former students, Greg Smestead (SCU Biology, '83), an excerpt of which he has kindly allowed us to share.

Photo provided by Tom Bracco S.J., SCU Jesuit Community

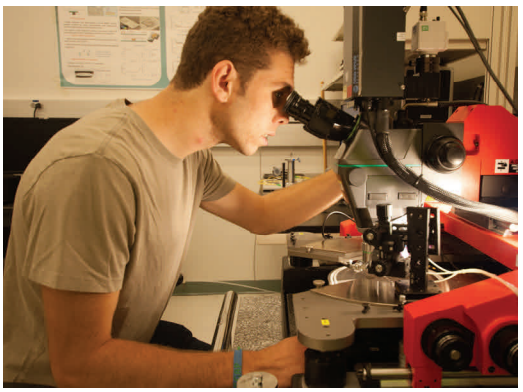
He was my Physics Professor at SCU in the mid-1980s and his interest in science and his love of God made a big impression on me. Suffice to say, he's one of the reasons I became a scientist and a professor. I will never forget how he would always add a quotation on the board in the lab from the scientist whose experiment we were studying to show that they were human beings, just like us. For me, he is the face of both the Jesuit order and Santa Clara University.

Time passed and we stayed in touch. Carl presided over the burial of my maternal grandmother and later my mother, both at Santa Clara Mission cemetery. My family and I visited Fr. Hayn several times after he retired, most recently on the day before St. Patrick's day this year. We had a lovely lunch together, sharing laughter and memories. His smile, his kindness and good humor charmed my young daughter (and anyone else with whom he had contact). I attended the celebration of his life (and death) at the Mass of Christian Burial and his interment (today) near my beloved mother and grandmother.

I write all this, because it shows some of the many ways that his spirt will continue. You see, I must be representative of hundreds of students whose lives were touched by this man of science and God.

Sincerely,
Greg

Student Research Spotlight : Superconducting Sensor Arrays



Max Silva-Feaver (B.S. Physics, 2015) during his 2014 research internship at NIST, Gaithersburg, in the Center for Nanoscale Science and Technology.

Senior **Max Silva-Feaver** is working in **Professor Betty Young's** lab as part of a new collaboration between Stanford, SLAC, SCU and NIST (Boulder) that is funded to build and optimize advanced superconducting transition-edge sensor arrays that will enable new cutting-edge physics experiments in a variety of fields. Applications include precise measurements of the Cosmic Microwave Background, X-ray astronomy with improved energy resolution and imaging sensitivity, and fundamental studies in physics, biochemistry and material science on a beamline of the Stanford Synchotron Radiation Lightsource (SSRL). The collaboration is also working to improve RF-microwave SQUID-based multiplexing technology to advance read-out capabilities beyond what is currently available.

As a member of the new collaboration, Max has helped develop and prepare lab infrastructure by designing and building a high-vacuum pumping station, manufacturing in-house and testing the efficacy of a conductive adhesive for use at 0.05 K, and fabricating custom sample mounts for new sensors and multiplexing chips that will be tested in early 2015. He has also completed formal Class 100 cleanroom training at the Stanford Nanofabrication Facility (SNF), and has started working alongside John Mark Kreikebaum (SCU Physics, '12) on the fabrication of micron-scale, thin-film devices.

Before joining Prof. Young's lab, Max had internships at NIST Gaithersburg and at Asylum Research, where he worked on new atomic force microscope (AFM) techniques. After graduation, he plans to continue to work in physics research labs before pursuing a PhD in condensed matter physics.

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