

3

Inside: Tate Lab
dedicated historic
site

9

Inside: Physics from
the bottom of the
world.

Annual Magazine
ISSUE 14

SCHOOL OF

UNIVERSITY OF MINNESOTA

Physics and Astronomy



**Minnesota
and the
Higgs Boson**

**Jeremy Mans and other particle physicists at U play major
roles in finding the Higgs Boson.**

A letter from the Head of the School

Ronald Poling, School of Physics & Astronomy

It's been a momentous year for the School of Physics and Astronomy, with continued faculty expansion, major construction projects, and much individual and collective recognition. This past fall we welcomed Rafael Fernandes as an assistant professor specializing in condensed matter theory, an area that had gone decades without a junior hire. Fall 2013 will be marked by the arrival of Fiona Burnell, a second condensed matter theory assistant professor and the return to Minnesota of Tony Gherghetta, an elementary particle theorist who has spent the past few years at the University of Melbourne. With these additions the School's faculty will be 15% larger than it was in 2009, and it's still growing.

Two factors drive this expansion. The first is the growth of the College of Science and Engineering, capitalizing on extraordinary student demand. In 2012-2013 year 969 freshman were admitted from a pool of about 10,000 applicants. Dean Steve Crouch is focused on enhancing the experience for this strong student body, and considers physics to be critically important. The second factor is the excitement of the new Physics and Nanotechnology building, on schedule to open in November 2013. The wind in our sails should remain strong, as we've begun pre-design for a renovation of Tate Lab. The U Regents have approved this \$85-million project as part of a bonding request to the state of Minnesota. If funded, construction could begin in just a few years.

The School is proud of the achievements of our students, staff and faculty, only a few of whose recent

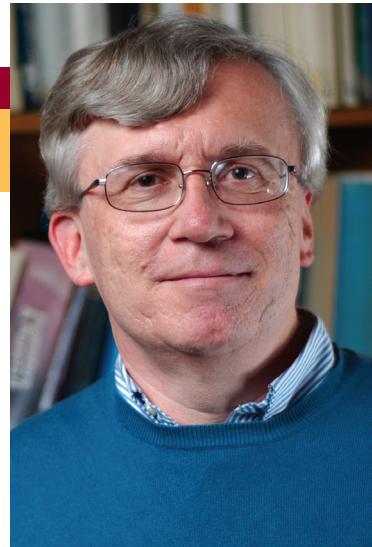
honors can be mentioned here.

Among our faculty we have several new society fellows: Ken Heller and Jim Kakalios in the AAAS and Prisca Cushman

in the APS. Allen Goldman (Grad Education Award) and Serge Rudaz (Morse-Alumni Undergrad Education Award) were inducted into the U's Academy of Distinguished Teachers. Roger Stuewer, who built our unique History of Science program, was awarded the APS Abraham Pais Prize. In addition to our human awardees, Tate Lab itself was honored last fall when the APS designated it as a site of historic significance and presented a plaque commemorating the pioneering work of Alfred Nier.

Our research programs have had an exceptionally productive year. The roles of Minnesota physicists and astrophysicists have been prominent in many breakthroughs. For example, the discovery of the Higgs boson at the LHC included major contributions from our CMS group. The year was also marked by many special events, including the formal launch of the Minnesota Institute for Astrophysics and several very well attended public lectures. Our Physics Force continues to be one of the U's most successful outreach programs, reaching tens of thousands of K-12 students this year.

Clearly there is too much news for me to do more than scratch the surface. I encourage you to visit our website (www.physics.umn.edu) for more details and for news of coming events. We take pride that the School is thriving even in challenging times. Among the keys to our success are the advocacy and contributions of alumni, friends and faculty. Thank you for your continuing interest in the School and your unwavering support.



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SCHOOL NEWS

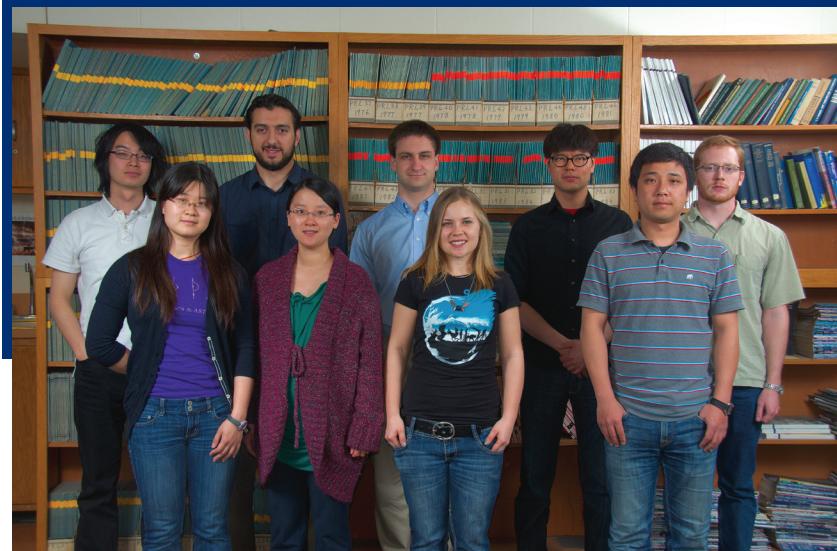
Tate Lab Dedicated Historic Site for Physics



Ron Poling, Keith Nier, Janet Marx at the plaque unveiling ceremony which took place at the Upson Room in Walter Library. More photos of this event can be found at www.physics.umn.edu/events/

Al Nier's family, friends and colleagues unveiled a plaque on October 24, 2012 which designated Tate Laboratory as a historic site for Physics. The plaque, provided by the American Physical Society, cited the pioneering work of the late Regents Professor Alfred O. C. Nier and his colleagues in the development and application of mass spectrometry, including the first-ever separation of the Uranium-235 isotope. Michael Turner, President of the American Physical Society spoke about the significance of Nier's work and its impact on physics, chemistry and geophysics. Ron Poling, acted as master of ceremony for speakers including Laura Brod, Regent of University of Minnesota; Dean Steven Crouch; Michael Turner, President of the American Physical Society; Ben Bederson, New York University, Editor-in Chief Emeritus, American Physical Society and Editor, APS Forum on the History of Physics Newsletter.

2013 Graduate Fellowship recipients



The 2013 Graduate Fellowship recipients are as follows:

Anatoly Larkin Fellowship: Michael Schechter,
Hoff Lu Fellowship: Sener Ozonder,
Leonard F. Burlaga Fellowship: Xiangwei Tang,
Robert O. Pepin Fellowship: Chein-Te Wu,
Aneesur Rahmen Prize: Yeonbae Lee, Chaoyun
Bao and Ryo Namba,
Outstanding TA Awards: Ebner Quentin, Alexey
Finkle, Melanie Galloway, Tyler Kelley, Kelly
Stifter and Allan Straub .

Front row: Chaoyun Bao Xiangwei Tang,
Melanie Galloway and Chen Te Wu,
Second row: Ryo Namba, Sener Ozonder,
Alexey Finkle, Yeonbae Lee and Alan Straub

SCHOOL NEWS



Shifman wins Pomeranchuk Prize

Professor Mikahil Shifman received the 2013 Pomeranchuk Prize, an international award for theoretical physicists given by the Institute for Theoretical and Experimental Physics in Moscow. Shifman was cited "for outstanding results in nonperturbative quantum field theory."



Stuewer wins Pais Prize

Roger Stuewer, was awarded the 2013 Abraham Pais Prize for History of Physics. The prize was established by the American Physical Society and American Institute of Physics to recognize and encourage outstanding

contributions to the history of physics and is widely seen as the highest honor one can receive for work in the history of physics. Professor Stuewer is the ninth recipient of this prestigious award. He won, as the citation says, "for his pioneering historical studies of the photon concept and nuclear physics, and for his leadership in bringing physicists into writing the history of physics by helping to organize and develop supporting institutions and publications."

EBEX: The Largest Balloon Payload Ever Flown

The EBEX balloon flight was launched on December 29, 2012 from McMurdo Base in Antarctica. Following a roughly circular path around the Antarctic continent, the flight terminated on January 23, 2013 and the payload landed on the Antarctic plateau, about 400 miles north of the launch site. Parts of the payload including the data discs and other electronic crates were recovered on February 2, 2013. The receiver and gondola will stay on the Antarctic ice and be recovered next year.

The principal investigator of the EBEX mission is Professor Shaul Hanany. EBEX, or E and B Experiment, took measurements of the cosmic microwave background radiation, a radiation that is a relic remnant of the big bang. The aim of the experiment to understand the physical processes that took place at or very near the big bang. Signatures of these physical processes may appear as specific patterns in the polarization of the cosmic microwave background radiation.

EBEX is an international collaboration with experimental contributions by Minnesota, Columbia University, McGill, Brown and UC Berkeley. The EBEX team is now busy analyzing the data. Support for the EBEX is provided by a NASA grant.



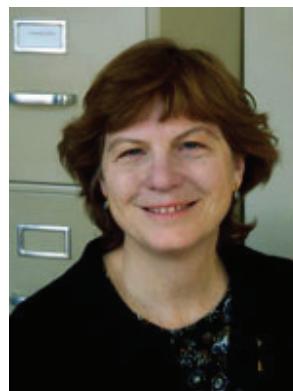
The Minnesota Antarctic team included Research Associate Asad Aboobaker, graduate students Jeff Klein, Kate Raach, Kyle Zilic, Dr. Milligan (former student and now at MSI) and PI Shaul Hanany.

SCHOOL NEWS



Heller and Kakalios made Fellows of American Association for Advancement of Science

Ken Heller and **Jim Kakalios** were elected to the Association for the Advancement of Science. Heller was cited "for distinguished contributions to the field of experimental high energy physics for investigations of spin dependent strong interactions and neutrinos, and to physics education research in the field of teaching problem-solving in college level introductory physics." Jim Kakalios was cited "for distinguished contributions to the field of condensed matter and materials physics, particularly for experimental studies of amorphous semiconductors, and for innovative efforts in science communication."



Cushman named APS Fellow

Priscilla Cushman has been named a 2012 Fellow of the American Physical Society. She was cited for her "outstanding contributions in the design and execution of experiments probing beyond the Standard Model especially the Cryogenic Dark Matter Search and the

precise measurement of the muon magnetic moment, and the development of photodetection and low radioactivity instrumentation to advance the capabilities of high energy physics experiments."

Minnesota SPS group named "Outstanding Chapter"



Standing (left to right): Emily Duffield (Outreach Coordinator), Isaiah Gray (Webmaster), Charles Brown (President), Blake Antos (Membership Coordinator), Alex Card (Treasurer) and Dan Cronin-Hennessy (Faculty Advisor). **Seated (left to right):** Alex Codoreanu (Communications Officer), Chris Nolting (Secretary) and Michael Hepler (Vice President).

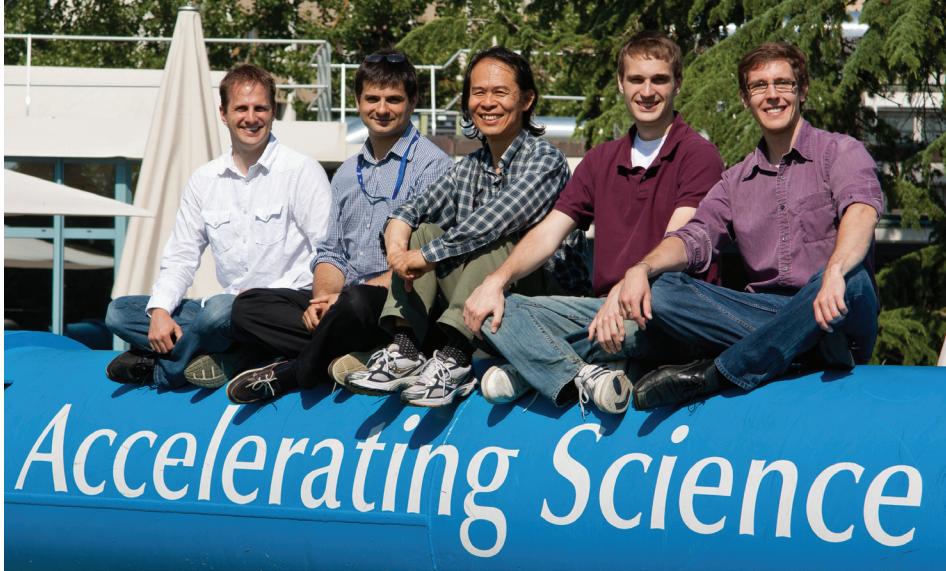
The Society of Physics Students (SPS) at the School of Physics and Astronomy was named an "Outstanding Chapter" by the national organization. Fewer than 10% of SPS chapters nationwide are given the honor. The group will receive a certificate for display and will be featured in the magazine, *The SPS Observer*. Among the accomplishments cited by the national organization were recruiting efforts, and outreach programs such as the The Mystery Science Room, the group puts on every year at the College of Science and Engineering's Family Fun Day.

When asked about the honor, Chapter President, Charles Brown said, "This recognition foreshadows a bright future for the U of M SPS Chapter, in terms of how well we support our members and the lasting impact we wish to have on society."

University physicists

PLAY KEY ROLE IN SEARCH FOR

Higgs boson



Minnesota particle physicists at CERN: Bryan Dahmes, Giovanni Franzoni, Yuichi Kubota, Mitchell Ambrose, Alexander Gude

When CERN announced last July that physicists at the Large Hadron Collider (LHC) had observed a particle with Higgs-like qualities, it was a cause for celebration and an international news story. But after the champagne corks have popped and the interviews aired, scientists are left with the far less glamorous job of defining what it is that they have discovered and how it fits in with the theoretical models of the Higgs boson. According to Professor Jeremiah Mans, a Deputy Project Manager on the Compact Muon Solenoid (CMS) experiment at the LHC, “particle physics is a field that moves forward by both discoveries and precision measurements, and it’s the interplay between the two which can see in action through the whole history of particle physics.” Mans said that for much of the last twenty years of particle physics has been dominated by precision measurement, though there have certainly been discoveries along the way, “there hasn’t been anything since the mid-eighties as significant as what is unfolding at the LHC. I say unfolding because though it’s clear that we are observing a new particle, we don’t have enough data to pin down its behavior.”

“When you’re looking for something new, you look

for its most obvious properties, but this is just the tip of the iceberg. The two channels in which it was observed, were on the order of 2% or less of the Standard Model Higgs.” There is a very real possibility that the new particle will not adhere to the Standard Model. With the goal of understanding the new particle and its behavior, Mans and his research team are helping the LHC prepare for precision study.

When the Higgs particles are produced, it was theorized, two “forward tagging jets” would sometimes appear and, indeed, physicists found this signature to be crucial in the particle’s discovery. The emphasis on the forward tagging jets has meant that the forward detector in CMS has been put to heavy use and needs to be reconfigured to clean out noise. “The next steps have to be done carefully, because you could be wildly off without a systematic approach.” The Minnesota group designed a new set of electronics that is far more capable than the original electronics developed in 2002, and will allow CMS to handle much large data volumes in the future. The new electronics will help the experimental groups improve on the triggering, or selection, of the forward tagging jets. “We’ll replace off-detector electronics with the new systems that we developed at Minnesota, then we will upgrade the electronics on the detector to have new ways to eliminate fake particles and fake signals,” Mans said.

The LHC is tackling other major questions in particle physics such as trying to discover the identity of Dark Matter. “From astrophysics we know it is present in the universe, we believe we should be able to produce it at the LHC,” Mans says. Because potential Dark Matter

candidates do not interact significantly, they require a lot of advance planning to do an effective search. "You have to pen it well, and close every exit to make sure it doesn't slip by you," Mans says.

Mans is also leading the charge on the search for the right-handed W boson, particularly when produced with a right-handed neutrino. This is a Minnesota driven effort to solve a very old problem in particle physics. "As particle physicists, we're used to it now -- it's just built into the Standard Model. When you really think about it, though, it's very strange that the weak force cares so much about handedness. It's the only force that does so. It would be more natural for the Standard Model to be symmetric. For that to be the case, there would need to be two Higgs bosons. One would look just like the Higgs we've seen, but there would be a second Higgs that interacted with the right-handed bosons and would be much, much heavier. This is another reason you want to look at the couplings of Higgs carefully, and to keep looking at regions where the Standard Model Higgs has been excluded -- there could still be a second non-standard Higgs lurking there. So this theorized second Higgs would provide the mass to right-handed particles. We can look for the other particles coupled with Higgs. One of the cool possibilities about finding these heavier right handed particles is they would balance out the regular left-handed neutrinos which are so much lighter than all the other particles."

Trigger Man

Sifting through data is a monumental task on physics experiments and the larger the experiment, the more the data piles up. At the CMS experiment the problem is so great that physicists can't even record all of the events created by the collider. "We get data at a rate of more than a million events per second," says Bryan Dahmes a Research Associate at the University of Minnesota, who lives and works at CERN.

"If we had infinite resources and disc space and could save everything we have, then we could sit down and crunch the data forever." Since the experiment does not have infinite resources, the selection from billions of events to an interesting few has to happen very early in the process. To help make that selection, physicists have invented a "trigger," a computer program which allows them to select which



The LHC is currently shut down in order to make upgrades necessary to run the machine at full power. "Because of flaws of the inter-connections between the magnets, it's not safe, to the LHC itself, to operate the magnets at full current. It's done great work so far, but done it at half power." The shut down will allow for the interconnections to be fixed. The LHC will start up again in 2014, operating at or close to the designed 14 TeV. The years after the shutdown will be particularly exciting, according to Mans. "While we're setting up the detector to do the precision measurements of the Higgs, which is now a 'known particle', there's also a strong possibility of a completely new discovery with the much higher energy coming online."

In 2018, there will be more improvements to the rest of the detector. "One of my roles over the last year, as the Deputy Project for the HCAL, is to determine what changes we want to make on the detector and what those changes will mean to our physics capabilities. The Technical Design Report describing our plans was recently accepted by the LHC oversight committee." This is a \$16 million project, some paid for by the US and some by other nations.

The future may hold many new discoveries at the LHC, Mans says, since physicists have only just begun to tap the power of the machine.

events will be of interest to the various searches at CMS, one of which was the hunt for the Higgs Boson.

"In the context of the Higgs discovery, everyone is obviously very excited. We've run for two years exceeding our expectations, and at the end of the day, you have maybe a couple hundred Higgs events total," Dahmes says. But the Higgs is just the beginning, and Dahmes, as the person in charge of the operation of the triggering system for CMS, needs to have a broad knowledge of the various priorities across the whole experiment. As such Dahmes and his team of students have designed a broad program to study in detail collect things both expected and hoped for, that that expect to see, or things they hope to see, using theory as a guide. "It's the job of the trigger to make sure these events can be selected. This is where that you want to make sure your software and hardware is very reliable so that you can very quickly find the interesting signatures and you don't spend a lot of time processing garbage." Currently, Dahmes and his team are looking at data of collisions spaced 50 nanoseconds apart. This is accomplished by looking at the data with using a farm of 5,000 very high speed computers, 5,000 of the best PCs they could build. Working together in synch, these computers decide which events to save.

FINDING THE GLUE IN UNCONVENTIONAL SUPERCONDUCTORS

Most metals, when cooled below a certain temperature, become superconductors. A superconductor not only carries electric current without dissipation but it also expels the magnetic field from its interior. “Microscopically we understand that the system is in a new quantum state where pairs of electrons form bound states, called Cooper pairs, in a coherent way,” says Rafael Fernandes, a theoretical physicist who studies superconductivity. In conventional superconductors, the bound state occurs because of a small attraction between the electrons promoted by fluctuations of the underlying crystalline lattice. Physicists have understood this phenomenon since the late 1950s – despite the fact that it had been discovered in the early 1910s.

In the late 1980s and again in the late 2000s, other classes of superconductors were discovered that do not fit this explanation. These materials display rather high superconducting transition temperatures – at least compared to those of conventional superconductors. If they could be elevated to room temperature, these superconductors would have a huge potential for technological applications. One of the main challenges of Fernandes’ research is to understand what is going on with these unconventional superconductors, in particular, whether the electrons still form bound states and, if so, what is the underlying microscopic “glue”. Unlike in conventional superconductors, where the lattice provides this glue, in unconventional superconductors it has been proposed that the electrons themselves provide the glue via fluctuations of the normal state. “We want to understand if there is anything unusual in the normal state of these materials, and whether this may affect superconductivity,” Fernandes says. The normal states of some of these unconventional superconductors display a rather unusual ordering called electronic nematic. Fernandes and his group are trying to understand whether this ordering is connected to unconventional superconductivity.

The name “electronic nematic” comes from an analogy with liquid crystals, which are systems commonly found in our daily lives, for example in LCD displays. In the nematic phase of a liquid crystal, rotational symmetry is broken but translational symmetry is not. This is an intermediate situation between a liquid and a crystalline solid, where both



symmetries are either preserved or broken, respectively. When electrons interact with each other, they may behave analogously to these liquid crystals. Specifically, in an electronic nematic phase, the rotational symmetry of the system is lowered, whereas the translational symmetry remains unaffected.

“This is a very unusual state. It’s an odd thing that the electrons, instead of the lattice, would drive this rotational symmetry breaking.” Lately, Fernandes has focused on not only understanding microscopically this nematic state, but also proposing specific experimental signatures of this somewhat elusive electronic phase. So far, he says, experiments have been in good agreement with their models.

Now that Fernandes and his collaborators have studied the nematic phase extensively, the next step is to find whether – and how – it is connected to superconductivity. Does nematicity help or harm the superconducting state? How important is it to form the Cooper pairs? “I don’t believe that the nematic phase is irrelevant for superconductivity,” Fernandes says, “but we are trying to understand exactly what its impact is, because there are also other ordered phases near the onset of the superconducting state, such as magnetism.” Whether or not the nematic phase turns out to be important for the microscopic mechanism behind unconventional superconductivity, Fernandes and his group will have brought about a better understanding of this elusive phase of matter.

VIEWING THE BEGINNING OF THE UNIVERSE FROM THE

Bottom of the World

Clem Pryke is a cosmologist who uses telescopes at the South Pole in Antarctica to learn about the origins of the Universe.

Over the last couple of decades cosmology has moved from being the domain of mystics and philosophers to being a hard observational science. One of the pillars of this progress has been measurements of the radio “after-glow” of the Big Bang - known as the Cosmic Microwave Background (CMB).

Pryke and his collaborators have used a series of highly specialized radio telescopes to make increasingly precise measurements of the CMB helping to answer such questions as “How old is the Universe?” (answer: 14 billion years), and “What is it made of?” (answer: mostly mysterious stuff called Dark-Matter and Dark-Energy). The South Pole is amongst the best places on Earth to make such observations - the extreme cold and high altitude combine to make the atmosphere there almost free of water vapor - and thus allows an incredibly clear view of the microwave sky.

While contemporary cosmology is amazingly well developed and successful many questions remain - for example why is the Universe almost perfectly isotropic (the same in all directions)? The outrageous theory known as “Inflation” explains this and other mysteries through a tremendous hyper expansion of the fabric of space taking place in the first tiny fraction of a second after the Big Bang. If this theory is correct there should be a faint but highly specific pattern imprinted in the polarization of the CMB.

Inflation is fundamental physics of the highest order and a global race is on to try to detect its polarization signature. Pryke's latest experiment called Keck-Array is a battery of

exquisitely sensitive receivers and is a leader in the field.

Clem Pryke is an Associate Professor in the School of Physics and Astronomy and is co-leader of the Keck-Array project (with John Kovac of Harvard). The collaboration has members at UMN, Harvard, Caltech, Stanford and other institutions. Keck Array is supported by the National Science Foundation and the Keck Foundation.



Clem Pryke just after getting off a C17 US Air Force Plane at McMurdo, Antarctica.

CLASS NOTES

2011

Mark J. Madland (B.S., Astrophysics, 2011) I am enjoying working in battery development for Medtronic.



Ilan Sagiv (Ph.D. Physics, 2011, Advisor: S. Hanany) After graduating, I got a position as a staff scientist at the Weizmann Institute of Science in Israel. I am the Project Scientist for an Israeli science space mission - a first of its kind. The mission is a wide field transient explorer in the UV which we are designing with the theme 'Less is More'. I have a new daughter named Netta, who is my first Israeli born child after two

Minnesotan kids. Fortunately in Israel I can continue my hobby of jumping out of airplanes which I did avidly in Minnesota as part of the University skydiving club.

2010

Marc T. Dunham (B.S., Physics, 2010) In February 2012, I married my wife Carly. I have a young step-son who enjoys asking me many questions about physics and engineering. I am completing my Master's in Mechanical Engineering at the University of Minnesota. My thesis is on heat transfer and thermodynamics in concentrated solar thermal power systems. I received the 2012 National Defense Science and Engineering Graduate Fellowship (NDSEG). I will pursue my Ph.D. at Stanford, focusing on heat transfer and energy conversion. I worked two internships: one as an experimentalist at the NASA Jet Propulsion Lab, and the other as a researcher with the Sandia National Laboratories Concentrated Solar Energy division. My favorite memory was Professor Rudaz's bewilderment after realizing how many Joules are in two liters of Mountain Dew. My favorite courses were Introductory Physics with Serge Rudaz and Quantum Physics with Marco Peloso.

2009

Alexander R. Cram (B.S., Physics, 2009) I am working at a design/denolgent agency, Momerton Design Lab, as a UX Developer. I am playing guitar and exploring San Francisco. I remember staying up late working on my MXP projects. Professor Kubota made quantum class fun and interesting!

2007

Tom Dombeck (Ph.D., Astrophysics, 2007, Advisor: R. Gehrz) After an Air Force career in flight test and space shuttle operations and then flying as a general aviation instructor and Alaskan commuter pilot, I have been with Boeing soloing short notice flight dynamics problems for the world's 747 fleet for ten years. The best parts of grad school were those first days getting to know and being accepted by all the younger grad students who were so very talented. I recall learning more from them than most of the professors. My favorite professors were Tom Jones who taught all the amazing physics involved with high-energy astrophysical bodies, and the reclusive Kris Davidson who taught how stars light up the sky. Both subjects opened up an incredible new world to this forever young and eager-to-learn Minnesotan. Bob Gehrz supported me as an older student, provided laboratory telescope experience needed to actually acquire astrophysical data, and perhaps most



2009

Katherine Whitney Szot (B.S., Physics, 2009) After

I graduated, I got a job in the technical office of Volkswagen in China. I am now the local head of

a CO₂ strategy. In China, while hiking on the Great Wall, I met a handsome young Swiss man, to whom I am now married. We had a small ceremony in Hong Kong and are now living here. We had a baby boy on June 23, 2012. Some fond memories from the School of Physics and Astronomy include spending late nights in the physics lab with friends finishing homework – and getting inspired by sleep deprivation to post answers or questions to the online participation forum in Klingon; helping Fred get his blackboards from the basement; and, my amazing trip to the Beijing Particle Accelerator with Professor Dan Cronin-Hennessy. I wish every professor could be as patient and helpful as Dan. I was lucky to get to work with him. Professor Qian also had an amazing teaching gift, and although I already enjoyed particle physics, his particle and nuclear class was fantastic. I wish I could take it again from him.

important, he formed an ad hoc committee to hear my master's oral at the annual American Astrophysical Society conference in Seattle where I completed my studies. It is the efforts of Bob, Tom, and the others in the School of Physics and Astronomy, not the least Terry Thibeault in the office, who have left me with a strong desire to return to the department, and in my dreams, teach and do physics there. What a wonderful retirement that would be!

Bradley "Peanut" McCoy (Ph.D., Physics, 2007, Advisor: C. Huang) I was recently promoted to Associate Professor at Azusa Pacific University. In my first five years, I have led efforts to revise our physics major and general education curriculum. As a result, our physics major population has increased from four to over 20.

2006

Daniel L. Bruzzone (B.S., Physics, 2006) and **Jessica M.**

Buchholz (B.S., Physics, 2006) We met in Professor Crowell's quantum physics lab during the Millikan oil drop experiment in 2005. We got married in 2010. Our cat is named Millikan. We are living the geek dream in St. Paul. Jessica is a researcher at 3M. I am finishing my J.D., focusing in intellectual property law and working at Kinney and Lange, PA. Our favorite physics classes were Allen Goldman's research lab and Yuichi Kubota's quantum physics.

Vanessa M. Krake (B.S., Physics, 2006) I am living it up as a bachelorette and enjoying some travel. I am a lab analyst with Pace Analytical working onsite for 3M Corporate Research Analytical Division. I remember quiet summers working in the labs without worrying about exams. My favorite class by far was Methods of Experimental Physics with Kurt Wick and Professor

CLASS NOTES

Crowell. Other professors who stood out to me were Professors Ruddick, Rusack, Dahlberg and Goldman.

Nathan T. Moore (Ph.D., Physics, 2006, Advisor, A. Grosberg) I currently live in Winona, MN with my wife Sara and our three children, eleven chickens, and three beehives. I am an Associate Professor of Physics at Winona State University. I have the good fortune to work with **Andy Ferstl** (Ph.D., Physics, 2000) and **Jennifer Bath-Anderson** (B.S., Physics, 1998) In graduate school I mostly did computational and theoretical work. At Winona State, I have had a chance to play with and teach digital circuits, microcontrollers, FPGA's, etc. I have been involved in disseminating Shayer and Adey's work with "Cognitive Acceleration through Science Education" (CASE) materials, which focuses on Piagetian reasoning ability ("Formal Reasoning"). My time at the University was wonderful. I miss the first five minutes (the part which I thought I understood) of the colloquium, as well as the collegiality of the grad student offices. If I were to do it again, I would spend more time in the office of my advisor Alexander Grosberg, go to more seminars, and take the MEXP class, which was probably my most glaring deficiency when I started teaching.

2005

Erik B. Beall (Ph.D., Physics, 2005, Advisor: Marvin Marshak) I was not on the fast track out of grad school, but hastened to graduate as I was marrying my wife, Courtney, who I met in Naperville during a Fermilab collaboration meeting. We moved to Cleveland where I switched to MRI physics and neuroscience research. I worked as a postdoc at the Cleveland Clinic under **Mark Lowe**, (Ph.D., Physics, 1991). Physics was good preparation for my current work. Particle accelerators are like a big MRI scanner, but every muon looks and acts differently. I have been very fortunate in starting out in a good hospital and our department is looking forward to getting a 7 Tesla MRI scanner. I have done studies of brain function in Parkinson's disease, Multiple Sclerosis, traumatic brain injury and others. An algorithm and software package I developed is now in use in dozens of labs for neuroimaging. We had our first child, Amelia, in 2011. My favorite memory of grad school is getting yelled at by a professor down the hall for playing foosball too loudly one too many times. My favorite professor was Dr. Grosberg who taught condensed matter physics -- "today we are going to derive a transistor."

Jacob Haqq-Misra (B.S., Astrophysics, 2005) In 2010, I completed my Ph.D. in meteorology and astrobiology at Penn State University. My research focused on atmospheric dynamics and planetary habitability. I then spent a year as a postdoctoral scholar at the Rock Ethics Institute, where I researched the scientific and ethical interconnections of geoengineering. I am now a research scientist with the Blue Marble Space Institute of Science, a 501(c)3 non-profit virtual research institute with an interdisciplinary approach to the relationship between Earth system science and the future of humanity. I married Gina Riggio on June 16, 2012. We met through music and are still very active playing live shows.

2004

Eric Hallman (Ph.D., Astrophysics, 2004, Advisor: Tom Jones) My wife Denise and I have two kids, Charlotte (10)

and Graham (8). We also have two dogs, Clara and Hunter. I worked as a postdoc at University of Colorado, and as an NSF Fellow at Colorado and Harvard before taking a job as a research scientist at Tech-X Corporation in Boulder, CO. Though I have taken a job at a private company, I still have multiple NASA grants to work on WHIM and galaxy clusters. So I spend up to two-thirds of my time doing astrophysics. My favorite memory is the office camaraderie with my co-grad students **Naomi McClure-Griffiths** (Ph.D., Astrophysics, 2001), **John Cannon** (Ph.D., Astrophysics, 2004), **Mike Kelly** and others. I loved astrophysical fluids with Tom Jones, and I was blown away by Cosmology with Liliya Williams.

Frank L. Hunte (Ph.D., Physics, 2004, Advisor: D. Dahlberg)

I was married for five years and am now divorced. I have a three year old son, Franz. Being a father is by far the best experience in life. I enjoy soccer and traveling to Barbados. I am an Assistant Professor of Materials Science and Engineering at North Carolina State University. I do experimental research on magnetic materials and high temperature superconductors from basic materials physics to technological applications. I am a member of the National Research Council's Committee to Assess the Current Status and Future Direction of High Magnetic Field Science in the US. At the U, one of my favorite memories was winning a TA Award. I remember when Dan Dahlberg's students gathered at his house to install the dock on the lake. Dan was an excellent advisor and mentor in addition to being a giant in the field of magnetism. I also recall useful discussions about experimental research with Paul Crowell. Bob Lysak's course on Solar and Magnetospheric Physics was outstanding. Chuck Campbell's course on Transport Theory and Woods Halley's course on Solid State Physics were also among my favorites. Russell Hobbie and Hans Courant also stand out in my memories of the school.

David W. Kleinjan (B.S., Physics, 2004) I am finalizing my thesis work on nuclear spin physics at the PHENIX detector, which is at RHIC at Brookhaven National Lab. My favorite course in school was Dr. Ruddick's lab 2603.

2003

Hassib Amini (Ph.D., Physics, 2003, Advisor: A. Vainshtein, B.S., Physics, 1998) I was recently married. I have been working as a staff engineer at Seagate Technology for about nine years. My favorite memory from grad school was being a TA. Some of my favorite professors included Ben Bayman for Classical Mechanics and Mikhail Shifman for Quantum Mechanics.

Aron J. Cooper (B.S., Astrophysics, 2003) I enjoy fishing, camping, boating, hiking, cycling. I play hockey on a regular basis. I am married to U of M alumni Heather Nguyen, and we have three children; Gideon (14), Lillian (7), and Oliver (5). I work as a Portfolio Manager at global hedge fund Marshall Wace. I manage systematic strategies for North and South America. My favorite memory from my time in the School was interning at NASA-Goddard Space Flight Center as part of the NASA-USRP. My favorite course was Quantum Physics I and II.

CLASS NOTES

Luke A. Corwin (B.S., Physics, 2003) My wife, Kelly and I are members of a church called The Well in suburban Chicago. I am a Research Associate at Indiana University working on two neutrino experiments (MINOS and NOvA) at Fermilab. My favorite memory is of Marvin Marshak standing on his head to demonstrate the difference between stable and unstable equilibrium! I look back at the opportunities my degree has given me as well as the friends I made while earning it, and know that all the hard work was worthwhile. Experimental Methods gave me my first experience with the joys, struggles, frustrations and other realities of experimental physics. Ron Poling was a good honors advisor and professor in particle physics. Jon Urheim supervised my research on the CLEO experiment and helped recruit me to my current job.

Ricky Egeland (B.S., Physics, 2003) I met my wife, Patricia, while working at CERN. She was from the Universidade do Estado do Rio de Janeiro (UERJ) in Brazil. We married in Brazil in 2010. We lived there for a year, while I learned Portuguese and an appreciation for Samba and Bossa Nova. I was a software developer managing the PhEDEx data transfer project from 2003-2010 for CMS at CERN, with the Minnesota group led by Roger Rusack. I worked at the Observatório Nacional in Rio de Janeiro on an analysis system for the Dark Energy Survey. I am now a grad student in physics at Montana State University. My favorite memory of the School is having 6:00 a.m. study sessions at the Borealis Café with my colleagues **Kevin Renna** (B.S., Physics, 2005) and **Charles Midwinter** (B.S., Physics, 2003). I also enjoyed building the pendulum-balancing robot as part of Methods II. For favorite professor, it is a tie between Waves, Optics, and Relativity with Joe Kapusta and Astrophysics with Kris Davidson.

2002

Thomas Gredig (Ph.D., Physics, 2002, M.S., Physics 1998, Advisor: D. Dahlberg) I am an associate professor at California State University, Long Beach, where my research interest is organic semiconductors. I have two young boys who are more or less trilingual. I remember Paul Crowell's late-night visits to check whether any research was being done. My favorite courses were Oriol Vall's Statistical Mechanics and Thermal Physics classes.

2001

John W. Pint (B.S., Physics, 2001) I am recently divorced. I am focused on raising my three year-old son. My favorite professors and classes were: Professor Kapusta for Quantum Mechanics/Waves; Professor Erheim for Elementary Particles; and Professor Rudaz for an Undergraduate Honors Colloquium.

2000

Bryant J. Grigsby (B.S., Physics, 2000) I recently finished seven years as an Astronomer at Lick OBS/4CO and am now starting a NASA/SEII grant. I am also the program director at Accelbiotech. My favorite memory was going to the O'Brien Observatory to see WGC 4565. My favorite professors were Keith Ruddick, Terry J. Jones, and Roger Rusack.

Kristine M. Sigsbee (Ph.D., Physics, 2000, Advisor: C. Cattell; M.S., Physics, 1995, B.S., Physics, 1992) I was a post-doc at NASA Goddard Space Flight Center. I now work in Physics and Astronomy at the University of Iowa. My research involves

testing electron detectors and analyzing Langmuir probe data for NASA sounding rockets, archiving plasma wave data online at the European Space Agency Cluster Active Archive, and studying the Van Allen radiation belts. I am currently modeling the response of the Electron Drift Instrument (EDI) for NASA's upcoming Magnetospheric Multiscale Mission. The EDI uses the drift velocity of a weak beam of test electrons in the Earth's magnetic field to determine electric fields in space. Since 2001, I have done outreach with K-12 students for Solar Week. I have worked since 2009 on the Landlocked Film Festival. I am the editor of the Eastern Iowa Orchid Society newsletter. My favorite memories from the School were Hans Courant's stories about famous physicists he has met, Dan Dahlberg's physics demonstration shows, and traveling to Alaska to see the aurora borealis.

1994

Jennifer M. Blue (MS, Physics, 1994) I was granted tenure in the Department of Physics at Miami University in 2011.

William (Bill) Ketzeback (B.S., Physics, 1994) My wife Lisa and I have been married for six years. Our sons, Ben (22), and Keegan (20), both attend New Mexico State University in Las Cruces. Our daughter, Maggie, is a precocious six-year-old who has her daddy wrapped around her little finger. We have two Basset Hounds and a cat. After completing my Masters in Wyoming, I started out at National Radio Astronomy Observatory as an Array Operator on the Very Large Array Telescope. I then spent a few years at the US Naval Observatory in Flagstaff as an Optical Technician on the Naval Prototype Optical Interferometer. I am currently the Chief Telescope Engineer on the Astrophysical Research Consortium 3.5-meter Telescope at Apache Point Observatory. I am the Principle Investigator on a two-year study of high resolution optical and NIR spectroscopy of the long period eclipsing binary system Epsilon Aurigae (Almaaz). Perhaps my favorite physics course was Intro to Waves, Optics, and Special Relativity, taught by C. J. Waddington, who made the material interesting and easy to follow. I also recall fondly courses from Hans Courant and Joseph Kapusta as being quite memorable and entertaining. The courses that were the most valuable to me were the Methods of Experimental Physics series. The long hours analyzing circuits and developing experimental setups with a lab partner were the best times of my undergraduate experience. I will be forever thankful to Evan Skillman, Roberta Humphreys, Bob Gehrz, Terry Jones and Tom Jones. They are the reason I am an astronomer. Working in the Automated Plate Scanning lab, IR lab and at O'Brien Observatory were excellent introductions to research in the field. I learned so much from each of them--although one might not guess from my grades at the time!

Dimitris N. Mihailidis (Ph.D., 1994, Advisor: N. Hintz) I have been married for 12 years and have a son (11) and daughter (7). I am a division director at Charleston Radiation Therapy, a cancer clinic in West Virginia. I selected Minnesota because of the long history at LANL-LAMPF. I was not sure which direction I would take, until I met Norton Hintz, whose influence is still vivid in my life as a true mentor and academic father. I was his last Ph.D. student. I worked on medium energy proton scattering and nuclear structure experiments. Ben Bayman helped foster an affection for theoretical nuclear physics. Though I chose to work in experiment, I never lost my interest in theory. I loved

CLASS NOTES

Joe Kapusta's class in high-temperature nuclear matter theory. Advanced courses would not have been possible without the foundation laid down by S. Gasiorowicz, R. Lysak, T. Walsh, K. Heller, M. Marshak and the late P. Ellis. During my time at Minnesota I spent endless hours at Espresso Royal in Dinkytown talking about politics, science and God. I used to hold my TA office hours there. With Norton's blessing I studied Radiation Oncology Physics at the U's School of Medicine. Though I have been working in medical physics since 1994, I still puzzle over the meaning of reality in quantum mechanics and the theory of nuclear fission here on earth and in the stars. Since Los Alamos, I have studied the effect of the Manhattan Project on large scale science. In the last two years, I was elected as a fellow of both the American Association of Physicists in Medicine and the American College of Medical Physics.

1996

Milena (Groblewski) Higgins (Ph.D., Physics, 1996, Advisor: D. Thomas) I started a new job as Director of Litigation Knowledge Management at Fish & Richardson, an Intellectual Property law firm in Minneapolis I am responsible for driving business process improvements to increase efficiency and productivity in the firm's litigation department. I am finishing the University's Management of Technology program, and thoroughly enjoying it. I celebrated my 20th wedding anniversary in 2012 with my husband **Michael Higgins** (B.S., Physics, 1996).



Mark J. Lattery (Ph.D., Physics, 1996, Advisor: Y. Kubota) In 2012, I was promoted to full Professor of Physics at the University of Wisconsin Oshkosh. My research areas include student model formation and development in physics, models and analogies, and foundations of mechanics. I have been married to my wife Stephanie for 20 years. We have two children, Gabrielle (14) and Grant (12).

1988

Roger Wiens (Ph.D., Physics, 1988, Advisor: R. Pepin) I am busy exploring Mars. I lead the ChemCam investigation on the Curiosity rover which landed in August, 2012. ChemCam uses laser-induced breakdown spectroscopy (LIBS) to analyze the composition of rock and soil samples up to 7 m from the rover, and also provides the highest resolution images ever taken from the surface of the red planet. Curiosity is exploring Gale crater, a 150 km diameter impact structure near the north-south dichotomy and near the equator. The ultimate goal of the mission is to explore the base of Mt. Sharp, a 5 km tall mountain of sedimentary material in the center of the crater. I have written a book, *Red Rover: Inside the Story of Robotic Space Exploration from Genesis to Curiosity*, published by Basic Books, 2013. Our oldest son started at Calvin College in Michigan this last year. Our younger son is still in high school. My wife Gwen and I celebrated our 25th anniversary in 2012. We are active in the music program in our church and are enjoying life!

1977

Randall Falkenberg (M.S., Physics, 1977, Advisor: B. Bayman) I have spent my entire career in the electric utility



Gary and Joann Sjolander, Rocky Mountain National Park

1975

Gary Sjolander (Ph.D., Physics, 1975, Advisor: A. O. C. Nier; M.S., Physics, 1974, B.S., Physics, 1970) My wife Joann (B.S., EHD, 1975) and I both graduated within days of each other in 1975 ... what a party! My professional life as a physicist has been mostly in industry working on research and development projects that support new business. Research projects have ranged from low drag hydrodynamics to space chemistry to automatic image recognition applied to mammogram screening. After graduation, I worked with Charley Johnson, a pioneer in ionospheric research with the Naval Research

Laboratory. This was my most enjoyable professional experience. Our son Toby was born in 1978. In 1985, I joined Martin Marietta Astronautics in Denver, CO. My favorite experience as a student was working for Karlis Kaufmanis as a TA for the astronomy lab. I taught one evening when it was -25 F. After preparing the observatory, I came into the classroom with icicles clinging to my beard. One student was wearing sandals. That had to be the shortest time observing Saturn and picking out constellations on record. Joann and I celebrated our 46th anniversary this year. We love Colorado, the Rocky Mountains, and each other. I first retired in 2008. That summer I found my favorite place on a floatplane on an Alaskan fjord. In 2010 I worked at Raytheon for a few months on a special Air Force study for the next generation GPS. I am in my second retirement, and loving it!

industry as a consultant and expert witness in matters related to power system modeling, reliability and planning. In 1984, I started a consulting firm with two other partners. In 2000, I started my own firm, RFI Consulting, Inc. I am also working on projects for wind power planning and conventional generation technologies. My wife, Rebecca and I were married in 1978 and we have twin daughters, Angela and Lauren. Angela is a teacher and pursuing a graduate degree. Lauren works for me in my consulting firm.

1974

Bradley Peterson (B.S., Physics, 1974) I am Professor and Chair of Astronomy at The Ohio State University, a U of M partner in the Large Binocular Telescope in Arizona. In 2010, I received an Ohio State Distinguished Scholar Award. In 2010, I was also elected a Fellow of the AAAS. I currently serve on the NASA Advisory Council's Science Committee where I chair the Astrophysics Subcommittee.

1972

Ellen Kuhlfeld (Ph.D. Nuclear Physics, 1972, Advisor: N. Hintz, M.S., Nuclear Physics, 1966) My first mystery novel, *Secret Murder*, was published in the fall of 2011. The Kindle edition is doing relatively well; the trade paperback, not so much. I cannot wait for the royalty statements to see what a year of sales adds up to!

(Class Notes Continued on Page 15)



SAM KEAN

Sam Kean is New York Times Bestselling author of two popular science books about genetics, *The Violinist's Thumb* and *The Disappearing Spoon*. Find out more at samkean.com or follow him on twitter at "sam kean."

Why did you pick Minnesota? I wanted a school that offered a wide range of classes in all areas of science. I was excited about moving to a metropolis as well. It was the breadth of the educational opportunities and the chance to take an unusual classes in relativity or biophysics or whatever - something I wasn't going to find at any other nearby school - that drew me.

Who were your favorite professors? I turned out to be a storyteller, and Professors Marshak and Broadhurst were full of great stories. I also loved Serge Rudaz's Intro Honors Physics Class. It was tough to get thrown into calculus-based physics my first week on campus. It really helped shape me and showed me how physicists work through problems and approach the world, something I still draw on today.

Favorite classes? The Honors Physics, and the special relativity class. I liked the courses that gave me breadth about the classic topics in physics.

Favorite memories? I have to admit to being a little scared of Kurt Wick. A friend and I were working in a lab the summer after my sophomore year, and the lab didn't seem to have a lot of really basic equipment, like coax cables and things like that. So we always had to go to the basement and bug Kurt for supplies, and I think he got a little exasperated with us stopping by so often. I was nervous when I found out that Kurt would be assisting with a class my junior year. But he turned out to be a really nice guy, and we got along well – as soon as I didn't have to bother him all the time!

Why did you become a writer? I figured out pretty quick that I didn't have the temperament to be a real, practicing research scientist. I have tremendous respect for what they do, but they seemed to spend about 90 percent of their time making and especially fixing and testing equipment, and I just couldn't do that. Words were so much easier to manipulate, and get them to do what I wanted! I knew I needed to stay in touch with science and keep learning about it, and thankfully science writing ended up working out for me.

Tell us about your career as a published author (any lucky breaks or breakthrough moments?) I was lucky enough to appear on some NPR shows like "All Things Considered" and "Radiolab" that really gave me a big boost.

What are your favorite parts of your job? I just love putting the stories together - everything from digging up strange, funny, obscure facts in the library all the way to perfecting the wording in the final drafts. Editing hundreds of pages can be a drag, but even then you get the satisfaction of knowing that something you labored over for years is finally about to appear in front of people's eyes. Hearing from fans who enjoyed the book is gratifying, too. Writing is solitary, which suits me, but you can't be solitary 100% of the time.

Where did you grow up? What was the best part of growing up there? I grew up in Sioux Falls, SD. I loved it because I had the chance to do some of everything - run track, act in plays, join math club, and play the clarinet (albeit badly). I draw on all that stuff when I write, too. I have eclectic interests, and I got my start in so many different things because of South Dakota.

What got you interested in physics? This might sound a bit strange, but I was actually drawn the uselessness of the field. I started off as an engineering major, where you're constantly focused on building and making things, and then eventually selling stuff. I loved that, with physics, you could study things that were simply interesting or even just beautiful, without regard for whether there was a direct application. Physics is enormously useful in many ways, of course – I don't mean to imply it's not. The real draw of

CLASS NOTES

physics for me was the timelessness and abstract beauty of the theories and equations, and I think a lot of people who study physics can relate to that.

What are your hobbies? I'm a big theater-goer, and I love track and field.

Any advice on how to be successful? I'm so glad I studied physics, even though I didn't end pursuing a job in science per se. The field really taught me how to reason and think, and that's something I draw on all the time, even today.

Is there anything else you would like us to know about you or your career? Well, I am happy to announce that both my books have now landed on the New York Times bestseller list. I'm really grateful for that, and I think it shows that people really, really responded to all of the stories inside both books.

1969

Fred Becchetti (Ph.D., Physics, 1969, Advisor: G. Greenlees) I am on phased retirement as a professor of physics at the University of Michigan – Ann Arbor. I will be fully retired from teaching June, 2013. My plans are to continue in research, including exotic beam research at the new facility (FRIB) planned nearby at Michigan State University. This will extend low-energy work presently being done with exotic nuclear beams (www.umich.edu/twinstol/). I recently have taken up amateur radio (again) and obtained expert class license as conveniently no high speed code expertise is required now for that license. I am a klutz with Morse code. While working at UMN Linac years back as a graduate student, I had to operate high-power Collins Radio "resnatron" RF power tubes, which had megawatts (pulsed) peak power output. I recently set up an old Collins short-wave transceiver (KWM-2, 100 watts max) for use on amateur bands and feels like I am back at the old Linac controls again. Any interested School of Physics and Astronomy radio amateurs can contact me and chat at my call sign W8ZLK (or by email fbd@umich.edu).

Charles Reinert (Ph.D., Physics and Mathematics, 1969, Advisor: W. R. Webber; M.S., Physics, 1963; B.S., Physics, 1961) I taught physics at SMSU in Marshall, MN in 1969 while running the family beekeeping operation. I had modest research efforts in bee diseases, flat plate solar heating, and general intelligence (what a combination!). I founded Helping To Heal, Inc. in 1998. It is a natural therapies clinic in Tracy, MN, where we work on the problems that western medicine is not very good at, such as PTSD, autoimmune diseases, cancer. I also do some entertaining at nursing homes with voice and guitar. I help my grandkids with their projects. I write some health blogs, and nip at the heels of modern medicine when it seems wrong-headed.



1961

Earle F. Kyle, Jr. (B.S. Physics, 1961) I am the Executive Director of TCC Systems, LLC in Rochester, MN. I am in my tenth year as a NASA Solar System Ambassador (SSA) providing community outreach to inspire the next generation of space explorers. Recent activities have included: mentoring Perpich Center for Arts Education students on a Mars simulator for their international ArtScience competition in Paris, France; helping Owatonna High School students design a wind tunnel; and working with students in the Baltimore, MD area compete in the Google Lunar X-Prize to place a private robotic rover on the Moon. More information on the NASA SSA program is available at the web site: www2.jpl.nasa.gov/ambassador/profiles/Earle_Kyle.htm. My favorite memory from grad school was being a TA. Some of my favorite professors included Ben Bayman for Classical Mechanics and Mikhail Shifman for Quantum Mechanics.

GLORIA MARTINEZ-ARIZALA



Who were your favorite professors? What helped you decide to come to the University for your PhD? I sat next to an Egyptian Chemistry Professor on a flight to New York, around the time I was selecting and applying to graduate schools. He was doing a sabbatical at the University, and he spoke so highly of the School that I decided to apply. I visited MN in April, 1988. The weather was gorgeous and I loved the campus and the people I met, so that made up my mind.

Who were your favorite professors? Among my favorites were Ben Bayman, Jim Kakalios, Boris Shklovskii, and Charles Campbell, but I liked most of them.

What were your favorite classes? Quantum Mechanics and Electromagnetic Theory.

Who was your advisor? Allen Goldman

What was your thesis topic and what made you choose it? Anomalous Field Effect in Ultrathin Films of Superconducting Metals. It was a variation on studying electrical properties of superconducting films, which was the main subject in Allen Goldman's lab. Allen suggested it after my initial project did not work out so well. I initially attempted using Reflection High Energy Electron Diffraction (RHEED) to image the surface of superconducting thin films.

What was the best part of doing the research? It was very interesting. The low temperature experiments lasted for months and it was fun monitoring the changes as time went on. I really enjoyed the hands-on aspects of Low Temperature Experimental Physics, which allowed me to learn many practical things along the way that have been useful to me on numerous occasions throughout my life. I also became proficient in LabVIEW, a programming language that helped me land my first job after graduating.

What was the hardest part of the research? Keeping the experimental apparatus at liquid Helium temperatures, somewhat analogous to indentured servitude.

What were some of your favorite memories of your time while you were here? I love old buildings, so spending time in Tate Lab was fantastic. One of my favorite memories was the annual School photo, where you got to see all the people that were in the building come outside at the same time. Working in Allen Goldman's lab was a great experience. As an advisor, Allen was very understanding, but at the same time had high expectations, allowing students to work independently as much as possible. The pool parties at the Goldman's were awesome and Katherine Goldman was a wonderful hostess.

Who or what helped you make decision to join Medtronic? Except for a two year period working at the University, teaching physics and working in a research lab in Kinesiology, I have always worked in the medical device industry.

My first job was at Guidant Corporation as a Test Engineer for cardiac devices. Guidant was purchased by Boston Scientific in 2006. A year later, one of my managers at Boston Scientific who had moved to a startup company, Transoma Medical, called to see if I'd be interested in working there. I left Boston Scientific for Transoma, on what was a risky but exciting opportunity. Transoma Medical did not survive, but just prior to its demise I was transferred to its parent company, Data Sciences International (DSI). DSI is a manufacturer of wireless implantable sensors for animals, mainly for academic and clinical research. I stayed at DSI for a year, but missed the medical device industry. A colleague at Transoma had moved to Medtronic and let me know of an opportunity in the Electrical Test group, which is where I have been for the last four years.

Tell us about your career at Medtronic. I work in the Neuromodulation Division, on implantable Neuro-stimulation devices. The particular device I currently work with alleviates back pain by directly applying small electrical signals on the vicinity of the pain site. My job is to develop Test Systems to be used in the manufacturing environment to test the RF or wireless communication of the device.

Alumni Profile

GLORIA MARTINEZ-ARIZALA



What have you liked best about your time at Medtronic?

Medtronic has a fair number of products offered by its many divisions that significantly improve quality of life for patients all over the world. Once a year, employees get to personally hear from patients who are invited to share their stories during the company's holiday party. It is very touching to hear first hand how our work personally affects these patients.

Tell us about your service activities. I volunteered for Girl Scouts for nine years, as a troop leader for my daughter Emma's troop. I also volunteered as a girls' soccer coach for three years. At Emma's elementary school, I ran the book fair for three years. I served in the Roseville District Curriculum Advisory Committee from 2005-2008.

Emma and I enjoy going to Feed my Starving Children a couple of times a year. I also participate in service activities through my employer, Medtronic.

What was/are your favorite parts of your job? The fun part for me is developing test systems, working with the Design Engineers to develop test requirements and then implementing them with software. In an FDA regulated environment, then comes the not so fun part, tons of paper work.

Where did you grow up? I grew up in San Juan, Puerto Rico. My family emigrated from Cuba when I was a baby, and after some time in Spain with my maternal grandfather's relatives, we ended up in Puerto Rico. I moved to Georgia when I was 19, then to Minnesota to attend graduate school, and never left.

Who or what influenced your decision to become a physicist? I wanted to be a scientist or something of the sort, from a

very early age. Being the only female in a Cuban family, I was strongly steered towards a career in music, but my heart was not in it. In other words, I was influenced to not be a physicist, but it didn't work!

Tell us about your family. I have four children, three of them adults, and a teenager, Emma, who is 15. My oldest, Michelle, lives in Miami and has three kids, Lisa(6), Kaylee(5) and Angelo(1). The others live in MN, my daughter Nicole lives with me with her son Max (7). It is awesome to have Max around, he is a charming little boy. My son Dan lives in the Twin Cities. My husband Richard teaches at the University at the School of Kinesiology.

What advice to you have for current students and recent alumni? Don't be discouraged by not getting replies when you apply for jobs, that seems to be pretty common these days, just keep trying! In your interactions with your peers and professors, remember that one day you may need recommendations from someone. Try not to burn any bridges.

Gloria's contact information:

gloria.martinez-arizala@medtronic.com



CHARITABLE INVESTMENT IN THE SCHOOL OF PHYSICS AND ASTRONOMY:



Paul DeGeest

As we know, a top-flight university education, especially in a demanding area of study such as Physics and Astronomy, can be a financial challenge for students and their families. The School remains committed to offering the highest quality educational experiences that will prepare our students for a wide variety of post-graduation opportunities in science, engineering and beyond. Gifts from alumni and friends like you fill a critical funding gap for our students, and help the School support essential learning opportunities.

The School of Physics and Astronomy teaches its core courses to over 3,000 students each academic year. Our undergraduates have opportunities to apply their studies in active laboratories, both here at the University of Minnesota, and around the world. In order to meet this high level of demand, we must attract and retain the best and brightest minds in the fields of physics and astronomy – as professors, researchers and graduate students. Further, we must provide laboratory space and equipment to make learning and exploring possible.

Charitable contributions from alumni and friends provide essential resources needed to educate the “best and most insatiable young minds” here at the U. Learn more about the ways in which your gift will make a difference in the lives of our students by visiting the department’s website at www.physics.umn.edu and click on Alumni and “Make a Gift.”

As the external relations officer dedicated to the School of Physics and Astronomy, I am delighted to work with charitable investors at all levels who wish to contribute to the success of the next generation of experimentalists, cosmologists and theorists who will answer the most fundamental and important questions in science. I invite you to contact me at (612) 624-5433 or by email at dege0106@umn.edu to begin a conversation about your personal philanthropic investment strategy.

Background:

Paul DeGeest graduated from the University of Minnesota in 1992 with a bachelor's degree in History. He went on to earn a masters' degree in Philanthropy and Development from Saint Mary's University of Minnesota in Winona. He has been a development professional since 1993, when he joined the founding staff at the United States Holocaust Memorial Museum in Washington, DC. He earned a "B" from Dr. Robert Gehrz in his introductory astronomy class as a freshman, but loves science nonetheless.

Contributions Make a Difference

As we know, a top-flight university education, especially in a demanding area of study such as Physics and Astronomy, can be a financial challenge for students and their families. The School remains committed to

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Why We Give: Nier Scholarship

The A. O. C. Nier Scholarship is a \$10,000 award made to a physics major in their sophomore year. Robin Heinonen was the 2012 winner. Heinonen is working with Professor Woods Halley in condensed matter theory. He is originally from Eden Prairie and used the scholarship money for rent and extra courses in the summer. He plans to attend graduate school in either mathematical or theoretical physics, in pursuit of a Ph.D.



Heinonen says that he became interested in this topic because, “when I first talked to Woods about doing research with him, I wanted to this project because it was largely mathematical in nature and my math background was at the time considerably stronger than my physics background. Woods had initially conceived of the project when he discovered that electrons moving in a uniform electric field parallel to the direction of motion will accrue an interesting phase that is cubic in the wavevector k , and his idea was to apply the result to three-body electron scattering in quasi-one-dimensional wires. However, we found after a few months of work, that within second-order perturbation theory the phases in fact completely cancel out and have no effect on the scattering amplitudes. We changed gears and have since been studying electron interference problems involving this longitudinal electric field and the resultant phase.”

Heinonen's research has applications for other areas of study because interference effects are an important aspect of transport phenomena in solids. “We hope that this work will help us understand the effects of external fields on transport in electronic devices. Secondly, we can theoretically apply an electric field in order to deliberately control the relative phases of the electrons, perhaps to turn the current on or off or to make it noisy.”

**Carl L. Bailey** (Ph.D., Physics, 1942)

Bailey was born on August 2, 1918 and died September 15, 2012. He received his undergraduate degree from Concordia College in 1940. He was a collaborator of John H. Williams, on the Manhattan Project in World War II. Bailey was a Professor of Physics at Concordia College, and was the longest serving dean in the history of that institution.

Thomas R. Carlson (B.S., Physics, 1965) Born December 4, 1943 in St. Paul, MN and died in his Mountain View, CA home on April 7, 2010.

Gary L. Cleveland (B. A., Physics, 1960) 76, of Lolo, MT passed away on April 8, 2012. He was born on June 28, 1935, in Chicago, IL. He earned his bachelor's degree in physics from the University of Minnesota. He served in the U.S. Army for several years. Following his military service, he worked at Honeywell Inc.'s aerospace division. In 1981 he returned to the University Minnesota to earn an MBA. In 1985 he joined the School of Business Administration at the University of Montana to teach courses in operations management and management science. He completed his Ph.D in 1986. In 1989 he was nominated for the Distinguished Scholar award.

Daniel R. Croswell III (B. A., Physics, 1988) age 55, of Brooklyn Park, died October 22, 2008. Croswell and his wife Linda have their name on a U.S. Patent that improves the performance of fishing line.

Forrest I. Glick (Ph.D., Physics, 1966; M.S., Physics 1959) 77, died February 17, 2012, after complications due to Parkinson's and dementia. Glick attended St. Olaf College, and graduated in 1956 Cum Laude. He attended the University and received his Ph.D. in Physics in 1966. He began his tenure at Mankato State University in 1966 and was a professor there until 1993.

Rondel J. Holliday, (Ph.D. Physics, 1970) was born March 13, 1942, died August 8, 2012. Brown was an Emeritus Faculty member in Chemistry and Physics at John Brown University in Siloam Springs, AR. He taught at John Brown University from 1970 until his retirement in 2008. There is an endowed scholarship in his name at John Brown University. He graduated from John Brown University with a B. S. degree in chemistry. He received a M.S. degree in chemistry from the University of California, Berkeley and a Ph.D. in chemical physics from the University of Minnesota.

David E. Maxam, (B.A. Physics, 1989) Born May 4, 1956, and died October 3, 2011.

Anne V. Mason (MS, Physics, 1984) 54, of El Segundo, CA died February 6, 2012 of brain cancer. She graduated from Smith College. She worked as a System Scientist in space applications at Boeing for over 20 years.

**Frank B. McDonald**, (Ph.D., Physics,

1955, M.S., Physics, 1951), a pioneering space scientist and former NASA chief scientist died on August 31, 2012 of a cerebral hemorrhage after giving a speech at a scientific symposium in Ann Arbor, MI. He was 87. He was born in Columbus, GA., on May 28, 1925. He graduated from Duke University in 1948, and obtained a master's degree and doctorate in physics from the University of Minnesota. He joined NASA in 1959 at the Goddard Space Flight Center, and then served as NASA chief scientist (1982-1987). In 1989 he joined the Institute for Physical Science and Technology at the University of Maryland where he was a Senior Research Scientist until his death. Author of more than 300 scientific articles, he was a member of the National Academy of Sciences. When interviewed about his work on the Voyager 1 Spacecraft, he said, "Half the fun is getting there."

Charles M. Stevens (B. A., Physics, 1942) was born February 23, 1920, in Lewistown, MT. He attended the University from 1938 to 1942, and was recruited by his mentor and friend Professor Al Nier into the Manhattan Project. In 1950, he was hired by Argonne National Laboratory to do uranium and plutonium analysis. In 1953, he designed and built the world's largest mass spectrometer and began analyzing atmospheric concentrations and origins of greenhouse gases including carbon monoxide and methane. In 1956, he contributed to the creation of the new element Fermium (#100). He retired from Argonne Laboratory after 39 years. Stevens died on September 28, 2011, in Naperville, Ill., after a stroke and subsequent illness.

Roger L. Struve (B.S., Physics, 1972) Age 62, of Shoreview, MN died October 21, 2011.

**Donald R. Thompson Jr.** (Ph.D., Physics,

1968) died on Dec. 1, 2011. Thompson was born in Sidney, OH, in 1942. He received a B.S. from Case Western Reserve University in 1964 and a Ph.D. from the University of Minnesota in 1968. Thompson joined the Applied Physics Laboratory of the Johns Hopkins University in Laurel, MD, where his research focused on radar remote sensing of the ocean. Several of his findings resulted in the development of new techniques for ocean measurement. He published more than 80 papers on these topics.

Donald E. Young (Ph.D., Physics, 1959; M.S., Physics, 1951) Young was born in 1922, died March 30, 2012 in Downer's Grove, IL. He served as an Officer in the infantry during World War II. After he received his Ph.D., he joined MURA laboratory to begin his life's work helping to understand the physical world through research into high energy physics. He was the first person hired into Fermi National Accelerator Laboratory and led the fabrication of the 50 MeV Linac, before serving as Deputy Director of the Accelerator Division. He retired in 1990 and was the first official Scientist Emeritus for the laboratory.

Coming November 2013: The Physics and Nanotechnology Building



The new Physics and Nanotechnology building construction has moved into its final stages. Exterior building work is essentially complete and site activities include work on storm-water control systems, grading and sidewalks. Inside the building labs are receiving finishing touches, including installation of casework and check-out of systems and fixtures to ensure that experimentalists' specifications are met. Offices are also progressing toward completion with installation of carpeting, ceilings and utilities. Furniture orders have been placed and the future occupants are eagerly anticipating move-in activities beginning in November. An official grand opening will take place in the spring 2014 semester.

Images clockwise from top: Physics and Nanotechnology Building exterior, new office space, high bay, new lab space and atrium.

Photos by Vadim Romanets.