The Wisconsin Physicist

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On the Cover

The IceCube Lab in March, 2013. Apart from the U.S. flag, the flags from Chile and the Philippines were flying at the Pole in honor of the home countries of the 2012-2013 IceCube winterovers. Image: IceCube Collaboration.

The IceCube project was awarded the 2013 Breakthrough of the Year by the British magazine *Physics World*. The Antarctic observatory was selected for making the first observation of cosmic neutrinos, but also for overcoming the many challenges of creating and operating a colossal detector deep under the ice at the South Pole.

The IceCube Neutrino Observatory was completed in December 2010, after seven years of construction at the South Pole. But the idea of a huge detector buried in the ice was conceived a long time ago. Back in the 1990s, the AMANDA detector was built as a proof of concept for IceCube. By January 2005, the first sensors of IceCube had already reached 2,450 meters below the Antarctic ice sheet.

IceCube is comprised of 5,160 digital optical modules suspended along 86 strings (cables) embedded in a cubic kilometer of ice beneath the South Pole. It detects neutrinos through the tiny flashes of blue light, called Cherenkov light, produced when neutrinos interact in the ice.

The IceCube Neutrino Observatory was built under an NSF Major Research Equipment and Facilities Construction grant, with assistance from partner funding agencies around the world. The project continues with support from a Maintenance and Operations grant from the NSF's Division of Polar Programs and Physics Division, along with international support from participating institutions and their funding agencies. UW–Madison is the lead institution, and the international collaboration includes 275 physicists and engineers from the U.S., Germany, Sweden, Belgium, Switzerland, Japan, Canada, New Zealand, Australia, U.K., Korea and Denmark

Inside this Issue

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Greetings from the Chair

Albrecht Karle
Department Chair

Dear Alumni and Friends —

We are looking back at a great year in 2014. The Department continues to be a vibrant place for Physics in a wide range of areas. Students, faculty and researchers are as productive as ever from theory to experiment, in labs in Chamberlin Hall, across campus, and at the most distant locations. This new edition of the Wisconsin Physicist will give you an opportunity to catch up with recent developments in research and education, awards and events in our Department.

Since starting as chair of the department last fall, I have been very busy learning a lot about the workings of the Department and even the University. I am grateful to Bob Joynt who served as Chair for the last three years—his help and support ensured a smooth transition. After my first few months as chair, I became increasingly appreciative of the service and dedication of past chairs. Their hard work and sacrifice have helped shape our Department into one of the best in the nation. I also owe a debt of gratitude to Mark Rzchowski who has kindly agreed to continue as Associate Chair—his advice and knowledge have proven to be invaluable.

As some of you may know, we are facing significant challenges in the upcoming years. The biggest being that our faculty count dropped to a critically low level of 41 in fall 2014. Due to the financial constraints imposed on us over recent years, we were not able to initiate an aggressive hiring campaign as we had hoped to do in order to compensate for these loses. In addition to departures in 2013/14 Franz Himpsel retired in January 2015 after a tremendously successful career and 20 years in our Department. In 2007 Franz was awarded the prestigious Davisson-Germer Prize of the American Physical Society. We are indebted to his many contributions to research, teaching and service in our Department.

As we move forward in the coming years, our highest priority will be to rebuild our faculty base. We have the support of the Dean of the College of Letters and Sciences who has authorized a search for four additional faculty. We will be intensely focused for the remainder of this year, and for the next few years, to rebuild our faculty base back to the historical level of around 50 faculty members. One positive recent addition is that of Dr. Dan Thurs who serves as course coordinator for 103/104, and is helping to manage the teaching load.

The Department continues to be a vibrant place for research in many areas of physics. Let me single out just two examples:

First, in 2012, Professor Coppersmith and collaborators proposed in Physical Review Letters a new semiconductor quantum bit ("qubit"). Their approach uses three electrons sitting in two neighboring quantum dots, also known as artificial atoms. The new qubit's key potential advantage was described as a combination of high speed and high fidelity. This past year, Professors Coppersmith and Eriksson, together with a team of students, postdocs and scientists in our department demonstrated this qubit in the lab. In the journal Nature they reported qubit gate operations that require only 100 picoseconds to perform. Eriksson and Coppersmith now are pursuing new ideas to increase the fidelity of this promising semiconductor qubit.

Second, IceCube has been closing in on more observations of high energy cosmic neutrinos. Physics World has named IceCube the No. 1 physics breakthrough of the year (see the coverpage) and Francis Halzen was named the winner of the American Ingenuity award. Additionally, Kael Hanson accepted the position of the director of the WIPAC (Wisconsin Particle Astrophysics Center). He also joins as faculty in the Department. His arrival made it possible indeed for me step back from some of my IceCube responsibilities and accept my new role as Chair.

Several faculty members, led by Peter Timbie, are continuing to review our undergraduate instructional program with the goal of bringing innovative methods to improve the student learning experience in the classroom.

The 13th Annual Awards Banquet was held in May 2014 and we are preparing now for the banquet in May 2015. The continued generosity of our alumni and friends allows us to present many awards to outstanding students. You can read more about the Awards Banquet on p. 6. In 2014 we presented the Distinguished Alumni Award to Roger Stuewer (Ph.D at UW 1968). Roger served as the Chair of the Forum on History of Physics, and received the APS Abraham Prize for History of Physics. The Distinguished Service Award was given to Carl Anderson (Ph.D. at UW 1979). Carl is an IBM fellow and received an honorary Doctor of Science from the UW-Madison for his accomplishments in microprocessor development. He continues to work on the latest developments at IBM. It is gratifying to recognize the accomplishments of so many of our current students and distinguished alumni.

The Physics Department Board of Visitors met again twice in 2014, in May and again on the Friday of Homecoming weekend, when we were fortunate enough to have gorgeous weather. The Board of Visitors continues to help is in a number of ways, by providing feedback to the Department, recruiting of graduate students, and not the least with fundraising.

Whether you are an alum, friend, employee, or student, we appreciate your interest in, and loyalty to, the University of Wisconsin-Madison Physics Department. All of the awards given out are based on donations. As an example, one substantial donation allowed the creation of a new fund, the Physics Alumni Graduate Support Fund which allows us to supplement the stipends of incoming graduate students. We had a matching donor to this fund in 2014. Donations also help in other ways, for example with the Ingersoll museum where we are working to improve the experience for our young visitors to spark their interest in physics. You can donate to the Physics Department online by going to http://www.physics.wisc.edu/giving. Please see page 36 for more ways to give.

I sincerely thank our generous alumni and friends who have financially supported the Department. This support is truly our margin of excellence.

Stay Connected!

Please continue sending us your professional and personal news!

We will be happy to include updates from alumni and friends in the *Wisconsin Physicist*.

- Do you receive email from the department?
  Sign up to receive our weekly seminar emails:
  https://www.physics.wisc.edu/twap/
  click on "Subscribe to receive email announcements of events"
- Send your updates to:
  info@physics.wisc.edu

New Faculty

Kael Hanson joined the department as a professor in Fall 2014. He is also the director of the Wisconsin IceCube Particle Astrophysics Center (WIPAC).

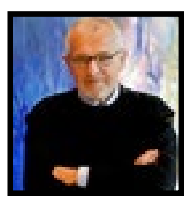
Promotions

Dan Chung, theoretical cosmology was promoted to the rank of professor.

Lisa Everett, phenomenology theorist was promoted to the rank of professor.

Robert F McDermott, condensed matter experimentalist was promoted to the rank of professor.

Awards



Francis Halzen named a winner of the 2014 American Ingenuity Award. Halzen was honored on Friday, October 17, 2014 in Washington D.C. for his decades-long effort to build a massive, cubic kilometer telescope under the Antarctic ice to detect cosmic neutrinos. Last year, the telescope yielded the first evidence of cosmic neutrinos, nearly massless high-energy particles thought to come from cosmic sources such as supernovae, black holes and the violent cores of galaxies. The work opened a new field of astronomy.

Board of Visitors

BOV

The Board of Visitors held its 5th meeting October 24-25, 2014, in Madison.

The agenda topics were:

State of the Department
Albercht Karle

Outreach
Justin Vandenbroucke

Barshall - Haeberli Fest
Baha Balantekin & Jay Davis

High-performance Computing in the Physics Department
Gonzalo Merino & Dan Bradley

Graduate Student Research Presentations:
Marty Lichtman, Quantum Computing (Advisor: M. Saffman)
Ian Wisher, HAWC & Garage Physics (Advisor: S. Westerhoff)
Kelsey Morgan, X-Ray Calorimeters (Advisor: D. McCammon)

Educational Program Assessment
Peter Timbie

WIPAC, IceCube, Future Plans
Kael Hanson, WIPAC director

UW Foundation Update
Chris Glueck

Update on AMEP Program
Fabian Waleffe & Cary Forest

Discussion of Board Initiatives
Jay Davis, et al.

The Department sincerely thanks the Board for their service. Specifically the Department thanks the Board members for their help in recruiting graduate students. Board members called prospective grads to talk about their experiences here and encourage the students to come to Madison. They plan to assist with this again. We have approximately 180 graduate students each year. Wisconsin has a broad research program and graduate students are key to our success. We recognize that our TA stipends are lower and our TA workloads are higher than many of our peers. We thus strive to augment the TA stipends with gift funds to attract the best students. At the meeting, Board Chair, Jay Davis, challenged the Board members to donate 30K/year for two years to provide funds to augment TA stipends. If you are interested in supporting graduate students please consider a donation to one of our graduate student funds listed at the back of the newsletter.

Please put a note on your calendars for the Barshall - Haeberli Fest to be held on April 18, 2015, in Madison. More details about this in the near future.

The next Board of Visitors meeting is scheduled for April 17, 2014.

If you are interested in serving on the Board of Visitors please contact the department chair, Professor Albrecht Karle, karle@icecube.wisc.edu.

To learn more about current board members please see our website: http://www.physics.wisc.edu/people/bov

Faculty List

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Faculty List—Area of Interest

Astrophysics and Cosmology

Experimental

Center for Magnetic Self Organization (CMSO): Boldyrev | Egedal | Forest | Sarff | Terry | Zweibel
Gamma-ray Astrophysics: Vandenbroucke | Westerhoff
IceCube: Halzen | Hanson | Karle | Vandenbroucke | Westerhoff
Observational Cosmology: Timbie
X-ray Astrophysics: McCammon

Theoretical

Theoretical Cosmology: Chung | Shiu

Atomic, Molecular, and Optical Physics

Experimental

Atomic Collisions: Lin
Atom Trapping: Walker
Gas Discharge Plasmas: Lawler
Laser Spectroscopy: Lawler
Nonlinear Optics and Atomic Physics: Saffman
Quantum Optics and Ultrafast Physics: Yavuz

Theoretical

Atomic, Molecular, and Optical: Lin | Walker
Neutral Atoms: Saffman

Biophysics and Condensed Matter Physics

Experimental

Biophysics: Gilbert | Coppersmith
Magnetic Fields: McDermott | Rzchowski
Nanostructures: Eriksson | Gilbert | Rzchowski
Polymer Photophysics and Structure: Winokur
Synchroton Radiation: Gilbert | Onellion

Theoretical

Complex Systems: Coppersmith
Silicon Quantum Dots: Coppersmith | Eriksson | Joynt | McDermott | Vavilov
Strongly-Correlated Systems: Joynt | Vavilov

High Energy Physics

Experimental

ATLAS at CERN: Wu
Collider Detector Facility at FNAL: Carlsmith | Herndon
Compact Muon Solenoid at CERN: Carlsmith | Dasu | Herndon | Smith
LBNE Project: Balantekin | Karle
Neutrino Physics at Daya Bay: Balantekin

Theoretical

Particle Theory: Bai | Balantekin | Barger | Chung | Everett | Hashimoto | Shiu
Phenomenology: Bai | Barger | Everett | Halzen
String Theory: Hashimoto | Shiu

Neutrino, Dark Matter, and Astroparticle Physics

Experimental

ARA Project: Halzen | Karle
Daya Bay Project: Balantekin
Deep Core Project: Halzen | Karle | Vandenbroucke | Westerhoff
DM-Ice: Karle
HAWC Project: Westerhoff
IceCube: Halzen | Hanson | Karle | Vandenbroucke | Westerhoff
LZ Direct Dark Matter Search: Carlsmith | Dasu
MARE Project: McCammon

Theoretical

Dark Energy: Chung
Neutrino Astrophysics: Balantekin | Barger | Everett

Nuclear Physics

Theoretical

Nuclear Theory (NucTh): Balantekin

Plasma Physics

Experimental

Center for Magnetic Self Organization (CMSO): Boldyrev | Egedal | Forest | Sarff | Terry | Zweibel
CMTFO: Forest | Terry
CPTC: Forest | Terry | Zweibel
Madison Dynamo Experiment (MDE): Forest
Madison Plasma Dynamo Experiment (MPDX): Forest | Zweibel
Madison Symmetric torus (MST): Forest | Sarff
Plasma-Couette Experiment (PCX): Boldyrev | Forest
Rotating Wall Machine (RWM): Forest | Sarff

Theoretical

MHD Turbulence: Boldyrev | Terry | Zweibel
Plasma Astrophysics: Boldyrev | Terry | Zweibel
RFP Theory: Boldyrev | Terry | Zweibel
Transport in Fusion Devices: Boldyrev | Terry | Zweibel

Quantum Computing

Experimental

Quantum Computing: Coppersmith | Eriksson | McDermott | Saffman | Walker

Theoretical

Quantum Computing: Coppersmith | Joynt | Vavilov

Selected Physics Faculty Profiles

Yang Bai

Ph.D., Yale University, 2007

Professor Bai's research area is theoretical particle physics with an emphasis on physics beyond the Standard Model including: the dark matter phenomenology, Large Hadron Collider physics, the electroweak symmetry breaking models and the underlying dynamics of quark and lepton masses. His recent works have been concentrated on understanding the dark matter particle properties and proposing new ways to search for dark matter particles at the Large Hadron Collider.

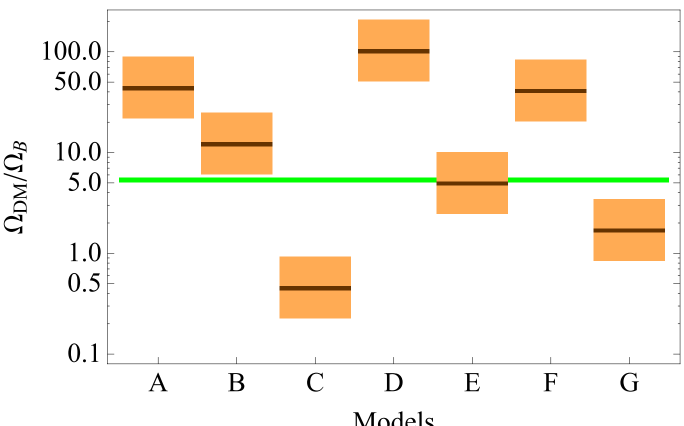


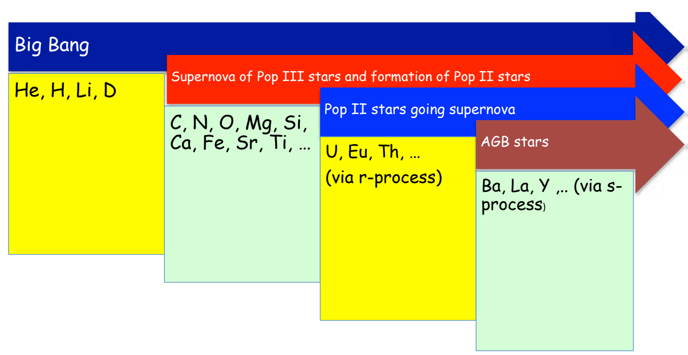
Figure: The ratios of the dark baryon energy density over the ordinary baryon density for different models. The green line is the measured value of Ω_{DM} / Ω_B from the Planck Collaboration.

Baha Balantekin

Ph.D., Yale University, 1982

Professor Balantekin is a theorist working at the interface nuclear, particle physics, and astrophysics. Much of his research is focused on the role neutrinos play in astrophysical settings.

One of the key questions of modern science is where and how various nuclei are synthesized during the evolution of the Universe. Understanding the underlying astrophysical processes gives us clues about the origin of the elements and their abundances. Typically copious amounts of neutrinos are present in most nucleosynthesis sites. This feature makes neutrino physics and neutrino-nucleus interactions salient components of many nucleosynthesis scenarios. Much of Balantekin's research is guided by developments in projects that are two of the highest priorities of the U.S. Nuclear Physics: Facility for Rare Isotope Beams which will measure properties of intermediate nuclei in various nucleosynthesis chains and neutrino experiments performed in various underground laboratories, nuclear reactors, and accelerators around the world.

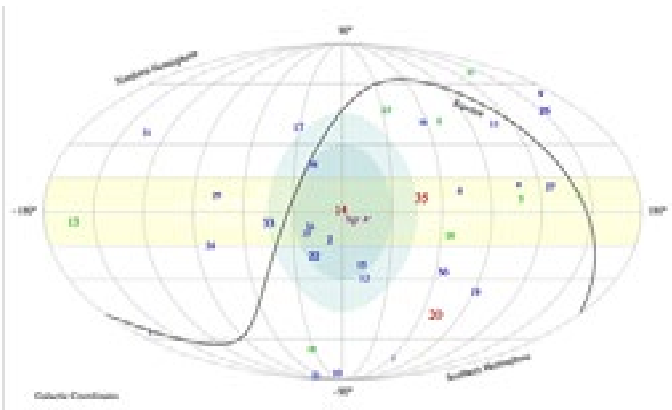


Selected Physics Faculty Profiles

Vernon Barger

Ph.D., Penn State, 1963

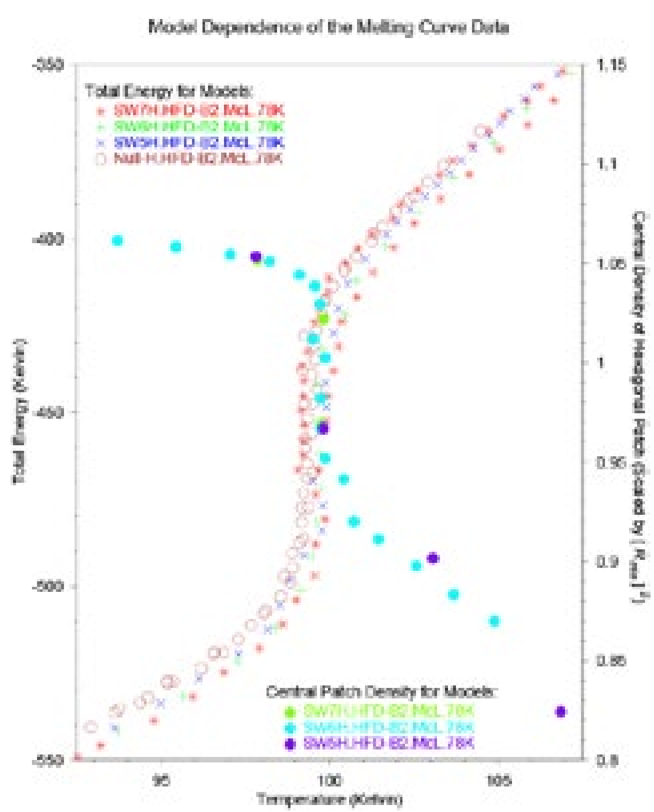
Professor Barger continues his illustrious studies of theoretical particle and neutrino phenomena. IceCube has observed cosmic neutrinos with PeV energies which raises important questions: Where are these cosmic neutrinos coming from? Do they originate from Galactic or extragalactic astrophysical sources? Are they associated with Dark Matter annihilations or decays? Professor Barger and his collaborators are studying possible ways that these questions may be answered.



Lou Bruch

Ph.D., University of California San Diego, 1964

Professor Emeritus Bruch continues collaborations on the theory of physically adsorbed layers. These are systems in which van der Waals forces are the main forces acting and which are simple enough that a realistic goal is to give a quantitative treatment of the structural and thermodynamic properties of the dense monolayers. Sometimes this is actually achieved, as shown in the accompanying figure [below] taken from a recent paper with A. D. Novaco, *Thermal excitation in a spatially modulated monolayer solid: incommensurate xenon/graphite*, *Phys. Rev.* B **89** (2014) 125431. What is shown is the temperature variation of the total energy and density of very large 2D xenon islands. The temperature at which the sharp changes occur is essentially the same as the experimental triple point temperature $99–100$ K for this system. The energy jump amounts to a (small) latent heat of melting of 0.5–0.7 kjoule/mole and overlaps the experimental value. The notations SW5H etc. denote variants on the interaction model and the figure shows that the results are insensitive to such details. Such agreement between experiment and modeling for the 2D melting of an inert gas solid has been a long time in coming.



Selected Physics Faculty Profiles

Duncan Carlsmith

Ph.D., University of Chicago, 1984

Professor Carlsmith (and Dasu) have joined the LUX-Zeplin (LZ) collaboration in a search for weakly interacting massive particle (WIMP) dark matter. The LZ experiment is a7-ton two-phase xenon time-projection chamber sensitive WIMP interactions with xenon nuclei. The LZ liquid xenon and the SuperCDMS cryocrystal detector concepts were approved during the summer of 2014 by DoE and NSF to advance the cosmic frontier program in dark matter searches.

Carlsmith received an award from National Collegiate Inventors and Innovators Alliance (NCIIA, now Venturewell) to support entrepreneurial student R&D in Garage Physics in 2014–16.

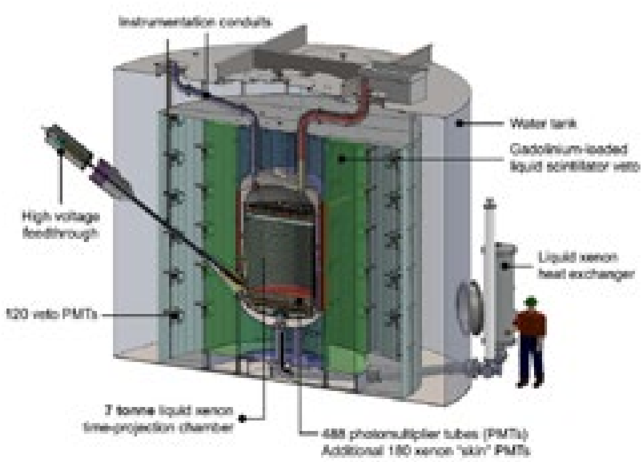


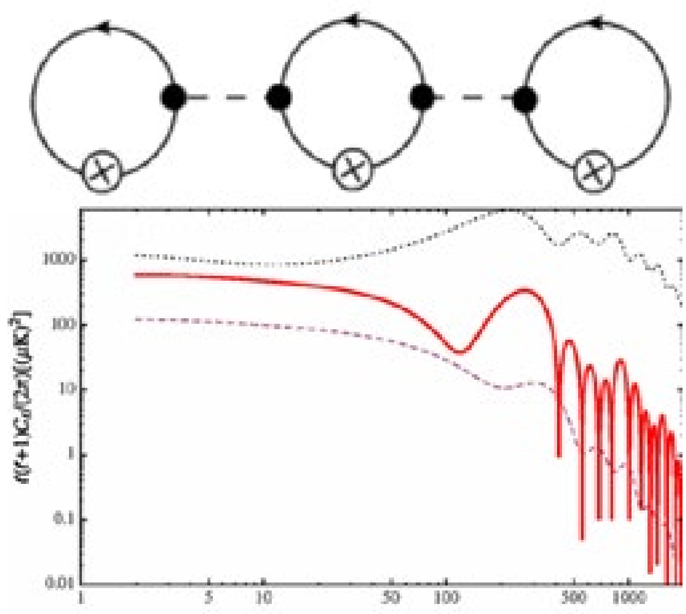
Figure: The LZ Dark Matter Experiment.

Daniel Chung

Ph.D., University of Chicago, 1998

Professor Chung works at the interface of high energy theory and cosmology. He is currently working on computing new observables associated with the very beginning of the "big bang" universe within the paradigm of inflation and non-thermal dark matter. One of the new observables that he has uncovered recently is associated with the inhomogeneities of the fermion particles that are Hawking radiated during the earliest moments of the inflationary universe (see figure). Measurements of such observables will tell us about the earliest history of our universe and give us clues to the physics beyond the Standard Model of particle physics.

With the hopes of predicting new particle physics signatures at colliders such as the LHC, he is also interested in finding new models of explaining why we have more protons than antiprotons. Finally, he is searching for novel models of dark matter that can be tested at the LHC and other dark matter experiments.



Susan Coppersmith

Ph.D., Cornell University, 1983

Professor Coppersmith is a theoretical condensed matter physicist who has worked on a broad range of problems in the area of complex systems, including glasses, granular materials, the nonlinear dynamics of magnetic flux lattices in type-II superconductors, biomineralization, and quantum computing. Her current research focuses mainly on quantum computing, with a particular focus on understanding how to construct a large-scale quantum computer using silicon nanostructures. Much of her theoretical work is closely coupled to experiments being performed in Mark Eriksson's laboratory. In addition to devising and developing the theory underlying the quantum dot hybrid qubit described in Mark Eriksson's writeup, she is working on theoretical tools that will enable efficient optimization of device designs that will enable scaleup to large numbers of qubits. The figure shows a design with four qubits (four coupled double dot qubits plus two sensor dots designed using a new method for device optimization (Compressed Optimization of Device Architectures) developed by Coppersmith and collaborators.

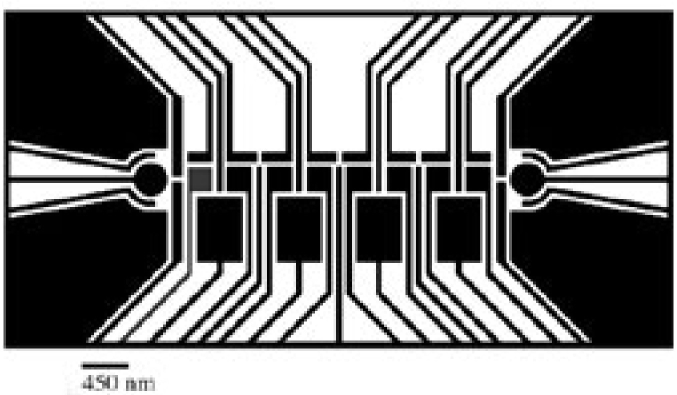


Figure: Design for four-qubit device (four coupled double-dot qubits, plus two readout dots) developed using CODA (Compressed Optimization of Device Architectures).

Reference: Adam Frees, John King Gamble, Daniel R. Ward, Robin Blume-Kohout, M. A. Eriksson, Mark Friesen, S. N. Coppersmith, preprint arXiv:1409.3846

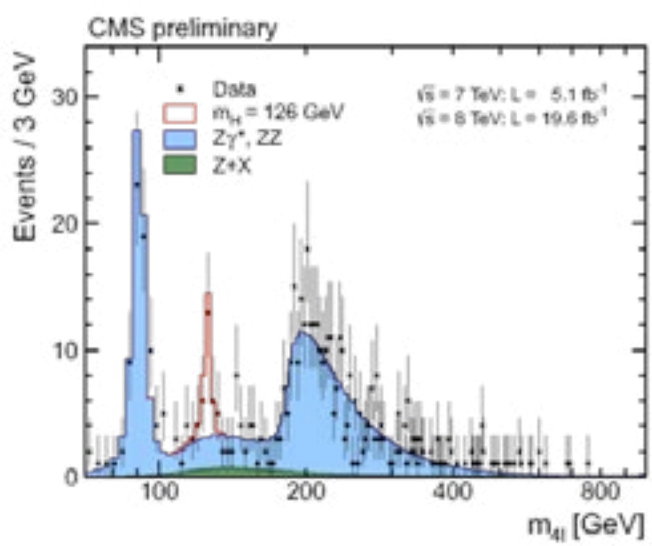
Sridhara Dasu

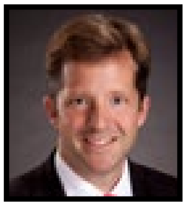
Ph.D., University of Rochester, 1988

Professor Dasu works with the UW High Energy Physics group, on CMS experiment at the CERN laboratory in Geneva, Switzerland and LZ experiment in South Dakota. His scientific interest is in the study of elementary particles, to probe unresolved questions about the current standard theory of matter and energy, and develop an even deeper level of knowledge about fundamental interactions in nature.

The physics adventure of CMS has begun with the discovery of the long sought Higgs boson (see figure), in which his group played an important role. The study of highest energy collisions of protons created using LHC continues to thoroughly map out the Standard Model of particle physics, including detailed study of the properties of the Higgs boson. When the LHC resumes data taking in 2015 with unprecedented 13 TeV center of mass energy, the focus will be to look for new physics processes, including search for an elementary particle candidate that can explain the dark matter, which makes up the bulk of the matter in our Universe.

The LZ experiment is in design phase and will be installed in a deep mine in South Dakota. This liquid Xenon time-projection chamber will search for very weak signatures of dark matter interactions with Xenon atoms.





Mark Eriksson

Ph.D., Harvard University, 1997

Professor Eriksson's experimental research group studies problems in nanoscience and nanotechnology related to both electronic and thermal transport. A large fraction of the groups' current activity focuses on the development of quantum bits—qubits—in gated semiconductor quantum dots. The Eriksson group fabricates these structures in group IV materials, because there are isotopes of both silicon and germanium with zero nuclear magnetic moment, making it more feasible to maintain quantum coherence in electron spins hosted in these materials. A recent highlight has been the experimental demonstration of a new type of qubit, formed from three electrons housed in a pair of tunnel-coupled quantum dots. This "hybrid quantum dot qubit" has a special property: it has a pair of pseudo-spin states (the qubit states) that can be coupled with electric fields, yet at the same time these qubit states are substantially protected from decoherence driven by electric field noise in the local environment. This qubit was proposed theoretically by Professor Coppersmith and her collaborators in a 2012 article in *Phys. Rev. Lett.* Working collaboratively, Eriksson and Coppersmith, together with a team of graduate students, postdcos, and scientists, published the first experimental demonstration of this new qubit in *Nature* a little over 2 years later, in summer 2014. Current work aims to increase the fidelity of this qubit through the use of a new manipulation technique involving short microwave bursts that are effective in gating the qubit at specific, well-defined operating points in the phase space of the device. The Eriksson group is also working on a number of other qubits, including those housed both in quantum dot "artificial atoms" – similar to the hybrid quantum dot qubit—as well as those that live in "real" atoms, like phosphorous donors implanted in semiconductors.

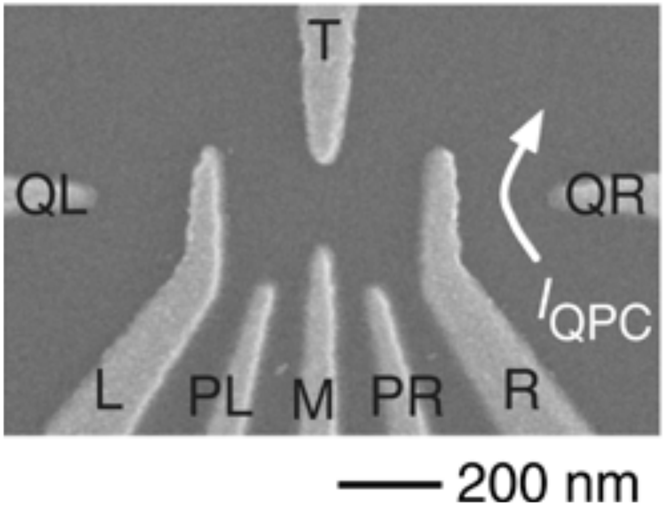


Figure: Gate-defined double quantum dot in a Si/SiGe heterostructure. The metal gates labeled have voltages applied to them with respect to the semiconductor and help define the quantum dot. A current flowing through the device in the direction of the arrow is used to detect changes in the charge states of the quantum dots. Image from Z. Shi et al., *Phys. Rev. Lett.* **108,** 140503 (2012).

Selected Physics Faculty Profiles

Lisa Everett

Ph.D., University of Pennsylvania, 1998

Professor Everett pursues a research program that seeks connections between observable particle physics and the domain of fundamental theory. Her goals are to understand and improve the extent to which experimental data from particle accelerators, astrophysical and cosmological experiments, and neutrino detection experiments can probe physics at ultrashort distance scales. She is an expert on extensions of the current standard theoretical paradigm for particle physics (known as the Standard Model of particle physics) which can address a number of well-known mysteries about elementary particles and their interactions. Her current work focuses on the following three general topics: (i) Higgs physics, in light of the ground-breaking discovery of a Higgs particle at the Large Hadron Collider in 2012, (ii) a proposal for new physics known as TeV-scale supersymmetry, which will be probed at unprecedented level at the next run of the Large Hadron Collider, and (iii) the origin of neutrino masses and lepton mixings, quantities that have either been measured in a series of extraordinary neutrino detection experiments over the past several decades, or are the primary aim for the future U.S. experimental program in high energy physics over the next decades.

Cary Forest

Ph.D., Princeton University, 1992

During the past three years, Professor Forest has embarked on an ambitious new program studying plasma hydrodynamics (flows of unmagnetized plasma) with the ultimate goal of observing self-generated magnetic fields in plasma. His work on the Plasma couette flow experiment (differentially rotating flows between two cyindrical walls is a classic geometry for studying hydrodynamics and has provided a test bed for his electrostatic stirring technique. This experiment not only validated his approach for confining and stirring unmagnetized plasmas, but also provided the first ever direct measurement of unmagnetized plasma viscosity. Leveraging off these results he then embarked upon a the construction of a major new basic plasma physics facility at the UW Madison, securing funding from both the UW Madison and the NSF to construct a large Dynamo experiment. The experiment was constructed on time and on budget and is now producing exactly the plasmas needed for studying astrophysical dynamos in the lab. These experiments are operating already a factor of 10 (magnetic Reynolds number) beyond where previous liquid metal experiments operated.

The experiment, constructed for the purposed of studying dynamos, is flexible enough to study a much broader range of topics and is now moving into a user facility type of mode and he has teamed with Egedal to carry out high Lundquist number, collisionless reconnection experiments. First results are outstanding and it looks like these plasmas are exactly the sort needed for the next generation of reconnection experiments.

Figure: On June 16, 2011, workers at Portage Casting and Mold Inc. in Portage, Wis., assembled a five-section-mold needed for the main vacuum vessel of the Plasma Dynamo Facility at UW-Madison.

Selected Physics Faculty Profiles

Francis Halzen

Ph.D., University of Louvain, 1969

Professor Halzen's research concentrates on topics related to the IceCube experiment. IceCube has transformed a cubic kilometer of Antarctic ice into a Cherenkov detector. His student Nathan Whitehorn was the leading player in developing the techniques and the design of the data analysis that resulted in the discovery of neutrinos reaching us from the cosmos with energies exceeding one thousand TeV. The flux observed is at the level of the gamma ray flux, establishing that neutrinos play a role similar to photons in the high-energy, non-thermal universe. He is building on this discovery in two ways: by using multiwavelength astronomical data to pinpoint the origin of the observed neutrino events observed and by helping to develop the concept for a neutrino telescope with ten times the instrumented volume of IceCube.

In collaboration with the phenomenology group, we are using IceCube data to search the atmospheric neutrino flux for telltale matter resonances that signal the presence of eV-mass sterile neutrinos in the beam. The existence of such neutrinos has been theorized since they were hinted at in data from the LSND experiment at Los Alamos.

We are trying to compute neutrinos cross sections at very high energies where perturbative QCD calculations no longer apply. The techniques will also allow us to calculate the production of heavy quarks in the atmosphere. Production and decay into neutrinos of charm particles is most likely a leading, though yet not yet observed, background in the ongoing refined searches for cosmic neutrinos.

Kael Hanson

Ph.D., University of Michigan, 2000

Professor Hanson's research is focused on astroparticle physics at the South Pole. IceCube is a cubic kilometer neutrino observatory located 1500 m beneath the ice surface, designed to detect cosmic neutrinos which it does with aplomb, snatching the Physics World 2013 Breakthrough of the Year for its technical achievements. The operations headquarters for the project is located at UW Madison. My current scientific interests on IceCube range from detection of relatively low-energy neutrinos from core collapse supernovae in our galaxy to new ideas for neutrino flavor ID at high energies. In addition to IceCube, which looks at optical photons emitted by charged particle showers in ice, I am interested in radio-frequency detection techniques which at high energies become favorable due to the extreme radio transparency of the cold glacial ice. The ARA project currently operates 3 detector stations at Pole exploiting this technique. Future methods involving scattering RADARs from neutrino-induced electromagnetic cascades are in concept phase.

Photo: Ian Rees, IceCube/NSF

Selected Physics Faculty Profiles

Pupa Gilbert

Ph.D., First University of Rome "La Sapienza," 1987

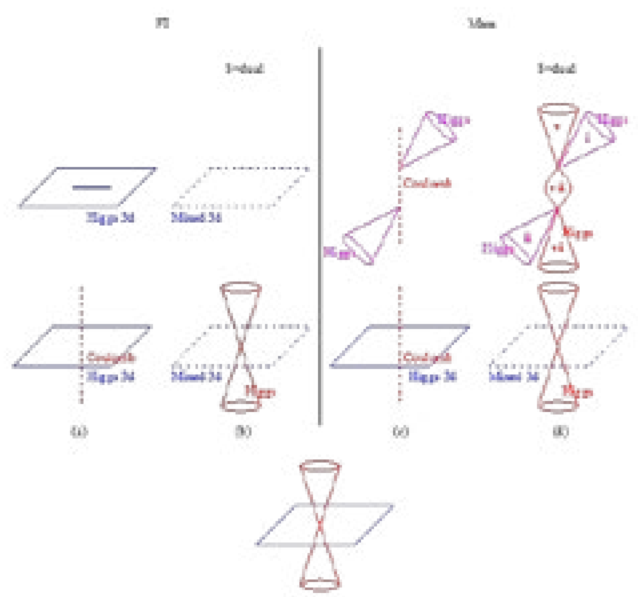
Professor Gilbert is working on biomineralization, that is, the processes by which seashells form, and how their structure relates to the environmental conditions at the time of their formation. She is currently on sabbatical at Harvard to collaborate with Andy Knoll and extend these observations to fossil shell.

Figure: *J Am Chem Soc* 134, 7351-8, 2012 cover image

Aki Hashimoto

Ph.D., Princeton University, 1997

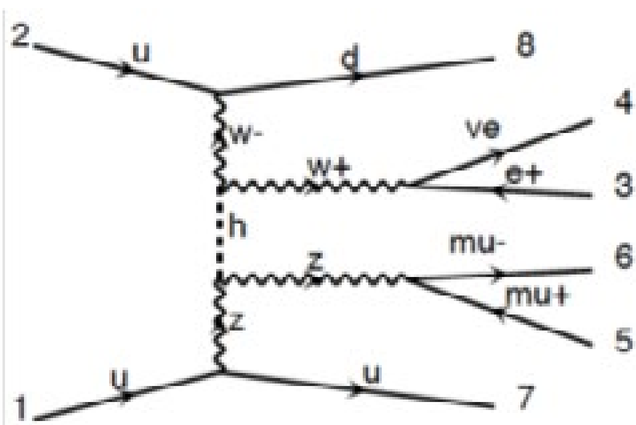
Professor Hashimoto is studying dynamical aspects of supersymmetric field theories. Recently, he completed a long term program of constructing field theories in 2+1 dimensions with N=2 supersymmetry by prescribing specific boundary condition to theories in 3+1 dimensions on an interval. Then, by exploiting the power of S-duality, he was able to map out the complex structure of the moduli space, a structure which is intrinsically quantum mechanical, using only classical analysis in the dual frame. He is also studying with several graduate students, issues pertaining to dynamical breaking of supersymmetry, solition spectroscopy and dynamics, and other related topics which arise from the perspective of string theory.



Matthew Herndon

Ph.D., University of Maryland, 1998

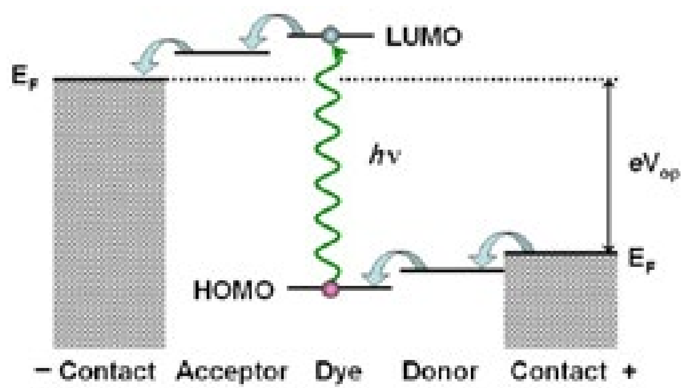
Professor Herndon and his group are studying the scattering of the massive W and Z gauge bosons via electroweak processes. In these interactions the W and Z bosons scatter by exchanging a gauge boson or a Higgs boson or they can interact directly via a process known as quartic coupling. The electroweak scattering process involving massive gauge bosons has never been observed before, but is expected to be observable at the large energies of the next run of the LHC. Also these processes are particularly sensitive to scattering via new particles such as additional Higgs bosons. For instance, new Higgs bosons are expected in theories such as Supersymmetry and electroweak scattering is a sensitive method to detect them even if the masses of the new particles are so high that they are hard to produce directly. The next run of the LHC will be an exciting time where new, never before seen, Standard Model processes will be observed and the signs of new physics might be uncovered by studying those processes in detail.



Franz Himpsel

Ph.D., Munich, 1977

Professor Himpsel uses synchrotron-based spectroscopy to find new materials for solar cells with better efficiency at lower cost. The performance of a solar cell is inlarge part determined by the energy levels of its components (shown below). A generic solar cell involves not only the light-absorbing material, such as an organic dye molecule. It also requires an electron donor which refills the hole created in the HOMO (Highest Occupied Molecular Orbital) of the molecule, plus an electron acceptor which extracts the excited electron from the LUMO (Lowest Unoccupied Molecular Orbital). These four energy levels can all be tailored. For example, one can maximize the output voltage V_{op} by minimizing the energy loss along the curved arrows. But that reduces the output current by reducing the driving force for separating electrons and holes. A typical dye-sensitized solar cell loses about half of its voltage because of a large energy drop on the donor side. Close collaboration with theorists reveals systematic trends in the energy levels and allows us to systematically design new molecules (or solids). Our ultimate goal is to combine all three components with atomic precision in a single molecular complex.

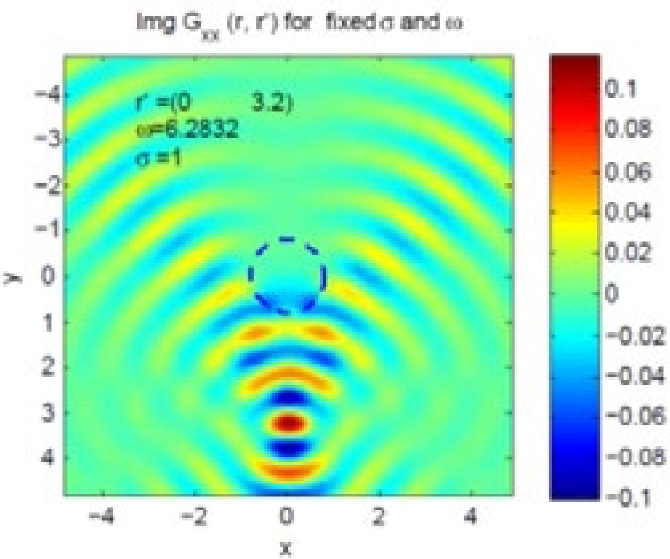


Selected Physics Faculty Profiles

Robert Joynt

Ph.D., University of Maryland, 1982

Professor Joynt researches how fluctuations in the electromagnetic field erase quantum coherence in the universe. This is a very lively area right now for theorists like because many experimental groups are trying to make quantum computers. The essential requirement for the hardware is that it resist decoherence – otherwise the quantum information is erased. Our group in the Physics Department has figured out how to compute the strength of the noise that comes from the fluctuations and exactly how it affects the tiny devices that are used in quantum information processing. The diagram at right shows how a noise source near the bottom creates electric field noise in the presence of a quantum wire.



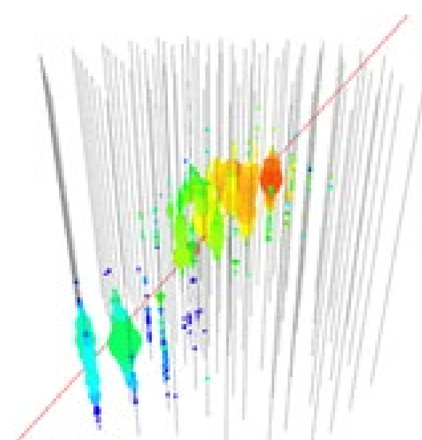
Albrecht Karle

Ph.D., Munich, 1994

Professor Karle works primarily on IceCube. High-energy neutrinos provide the opportunity to investigate the origin of highest energy particles in Universe. IceCube, with 1 billion tons of South Pole ice instrumented as a particle detector, has accumulated more than 300,000 neutrinos with (laboratory) energies comparable or higher than those achievable in particle accelerators for any particle (E>10^12 eV). Most of these neutrinos are decay products from cosmic rays hitting our atmosphere, however recently we were able to provide compelling evidence that the highest energy events are of cosmic origin. What are these powerful cosmic particle accelerators and how do the work? Professor Karle has traveled many times to the South Pole to oversee on-site the construction and operation of IceCube until completion in 2011.

The strategy is to investigate the observed neutrino data for their energy and direction. Most recently we were able to demonstrate that the cosmic neutrinos are present in multiple neutrino flavors, at least electron and muon neutrinos. We could also show that the flux is present in the Northern and Southern sky in entirely different analyses strategies. Some theoretical models are already constraint or ruled out by these results. The rapidly growing statistics will provide more insights. The attached figure shows an event display of a neutrino with energy 84 TeV coming from the Southern sky (zenith angle 55°) that originates with more than 99% confidence from a cosmic accelerator.

A new technology may allow a more efficient, cheaper approach to investigate neutrinos of even higher energies (E>10^16 eV). This detector uses radio antennas to observe neutrino interactions a several km distance from the near surface of the ice sheet at the South Pole. We are currently running and analyzing three such prototype detectors.



Selected Physics Faculty Profiles

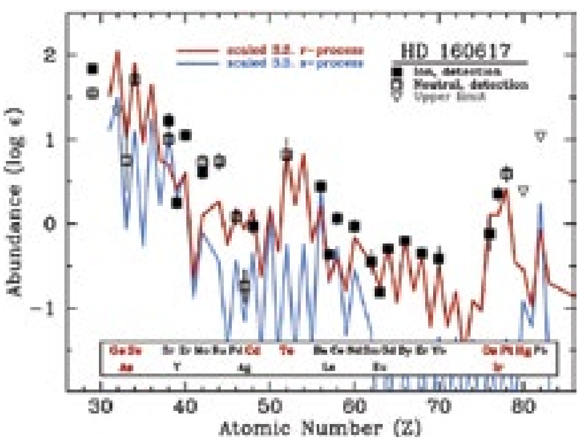
James Lawler

Ph.D., UW-Madison, 1978

Professor Lawler focuses on where, when, and how were the chemical elements made. H, He, and a bit of Li and Be were made 10 to 1000 s after the Big Bang. Elements from C through the Fe-group are made via exothermic fusion reactions in stars. Heavier elements are made via n(eutron)- capture. The s(low)-process n-capture mechanism makes ~ ½ of the heavy elements in AGB stars. The r(apid)-process makes the other ½ in brief, spectacular events. Where does the r-process occur? Type II (core collapse) Supernovae have been the favored site: stellar mass 9 solar mass and Fe core 1.44 > solar mass. Merging neutron stars are also a possibility! Human knowledge of the remote Universe is (almost) entirely from spectroscopy. Metal poor (old) stars provide a record of nucleo-synthesis in the Galaxy.

DETECTION OF ELEMENTS AT ALL THREE r-PROCESS PEAKS IN THE METAL-POOR STAR HD 160617

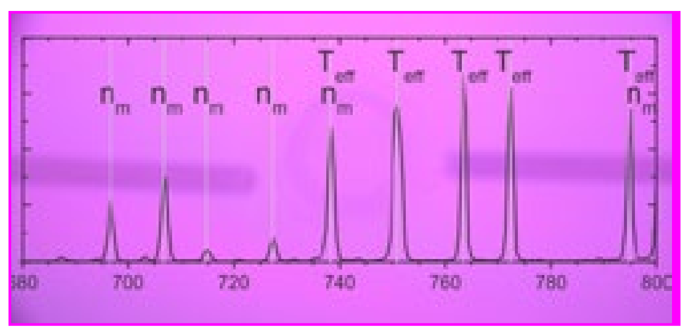
I. U. Roederer and JEL, ApJ 750, 76 (2012)



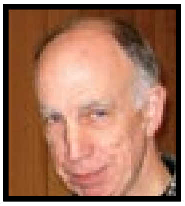
Chun Lin

Ph.D., Harvard University, 1955

For technological applications such as plasma etching, the operation of a low-temperature plasma depends critically on the rates of electron-driven processes so that an accurate knowledge of the electron energy distribution function is essential. The visible spectrum of argon plasmas are dominated by two families of emission lines in the 'red' (650-1150 nm) and 'blue' (390-470 nm) ends of the spectrum. These transitions arise from atoms populated by electron collisions with argon atoms in both the ground and metastable levels. Using a mono-energetic electron beam we have separately measured the cross sections for electron excitation into these radiating levels as a function of the incident electron energy for both excitation from the ground state and from atoms in long-lived metastable levels. In collaboration with Professor Amy Wendt (ECE at UW) and researchers at Applied Materials (Varian Semiconductor Equipment), we have developed a non-invasive diagnostic scheme for monitoring plasma characteristics in real time during the course of a plasma process. Non-equilibrium energy distributions have also been observed for some plasma conditions by combining the extensive set of cross section data with measurements of the optical emissions from the plasmas.



Selected Physics Faculty Profiles



Dan McCammon

Ph.D., UW-Madison, 1971

The X-ray group flew a sounding rocket from White Sands, New Mexico, to observe the diffuse X-ray background in the direction of the Galactic anticenter using an array of improved single-photon microcalorimeters, and analysis of the data is underway. Graduate student (and NASA technology fellow) Kelsey Morgan is developing detectors employing superconducting transition edge thermometers with the goal of a sounding rocket instrument that will have ~ 1eV FWHM resolution at 300 eV. Meanwhile a microcalorimeter instrument for the Japanese X-ray observatory Astro-H is fully assembled, undergoing testing, and scheduled for launch in late 2015. The detectors are very similar to those on our sounding rocket and will hopefully provide the first observations from orbit with these revolutionary devices. Operating at 0.05 K, they have ~4 eV resolution at 6 keV. This instrument is led by NASA/Goddard with Wisconsin hardware contributions and is intended primarily for the study of emission from black hole sources.

Graduate student Dallas Wulf is modifying the existing rocket cryostat to improve its performance as the detector for a collaborative laboratory astrophysics project at Oak Ridge National Laboratories. It will measure the X-ray emission from charge exchange in a series of ion-atom merged beam experiments at their Multicharged Ion Research Facility. Detailed knowledge of line emission from this process will open a potentially valuable new window on astrophysical interface regions, such as the collision of galactic winds with the hot intergalactic medium.

An added activity was resurrecting an old sounding rocket payload that had been sitting in the Chamberlin loading dock for 30 years, but amazingly still worked. We helped launch it at White Sands for a University of Miami experiment led by former UW postdoc Massimiliano Galleazzi. The large area proportional counters and relatively large field of view provided a throughput several thousand times larger than any current X-ray observatory, enabling the first actual measurement of the magnitude of the Solar wind charge exchange contribution to the ¼-keV diffuse background (*Nature* **512,** 171).

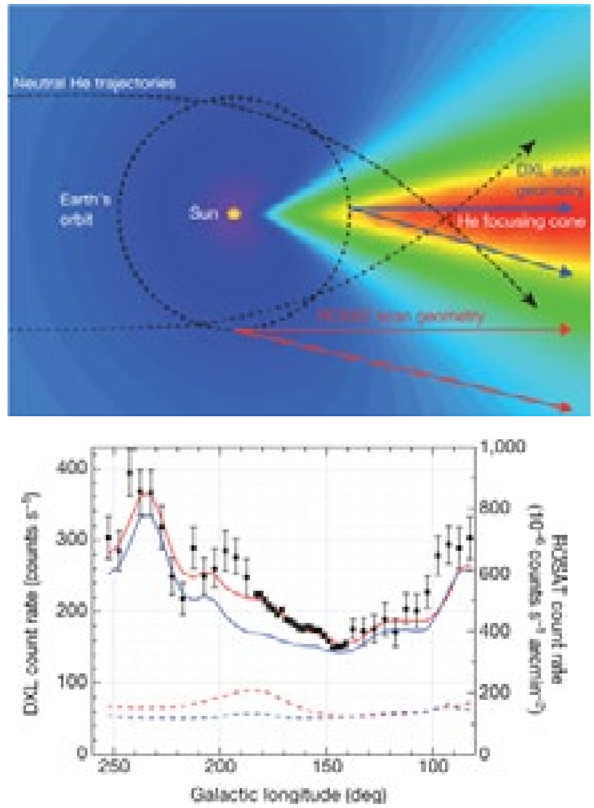


Figure: The sounding rocket viewed a strip of the sky that had been mapped earlier from a very different vantage point in the Solar system by ROSAT. The right figure shows the rate measured by ROSAT (upper blue line) and the rocket data. The solid red line is a fit to the combined data with the charge exchange emission per neutral helium atom as a free parameter. The lower two lines show the charge exchange contributions for both missions for the best fit value.

Robert McDermott

Ph.D., University of California, Berkeley, 2002

Professor McDermott's group is developing superconducting integrated circuits for scalable quantum information processing. Specific research directions include development of improved measurement tools based on quantum-limited amplifiers and microwave photon counters; investigation of new techniques for the high-fidelity coherent control of superconducting quantum circuits; and fundamental studies of qubit energy relaxation and dephasing. In addition, the McDermott group is collaborating with the group of Professor Mark Saffman on the development of a Rydberg atom-superconductor quantum interface.

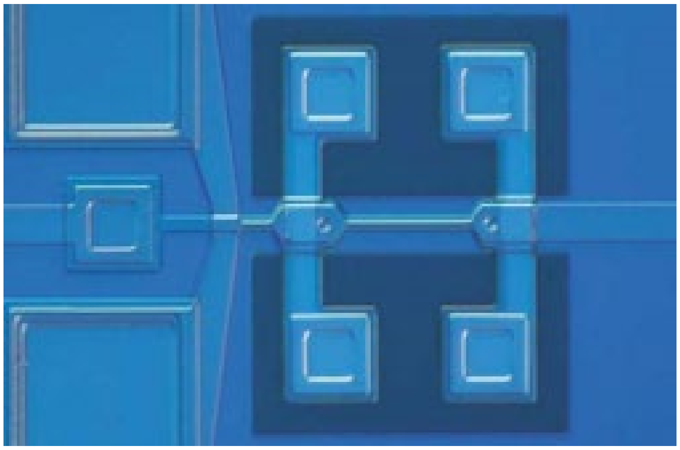


Figure: Near quantum-limited amplifier based on the dc superconducting quantum interference device (dc SQUID); the field of view is roughly 50 x 80 square microns. The amplifier was developed by the McDermott group for the high-fidelity quantum nondemolition measurement of superconducting qubit circuits.

Mark Saffman

Ph.D., University of Colorado at Boulder, 1994

Professor Saffman's research is in the area of experimental atomic physics and quantum optics with applications to quantum information processing. One of the great scientific challenges of this generation is the development of methods for harnessing the strange and counterintuitive properties of quantum objects including superposition and entanglement to create more powerful computing and measurement devices. In the Saffman lab laser cooled atoms are trapped in an array of laser beams and used as quantum bits in small scale quantum computing experiments. Laser cooled individual atoms are one of the most promising approaches for development of quantum computers and devices with up to several hundred qubits are now under development.

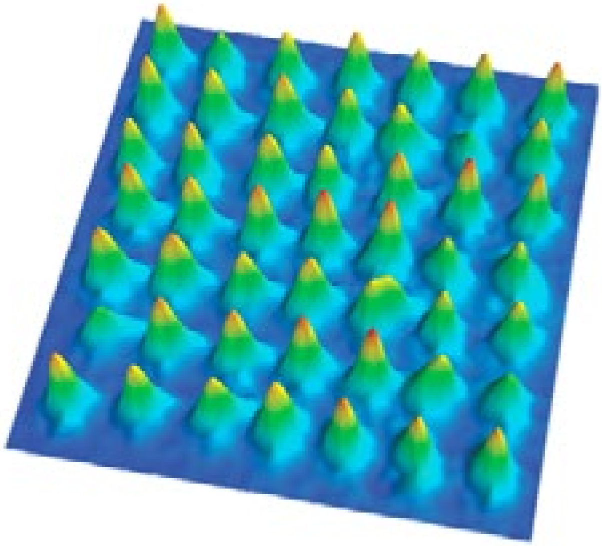


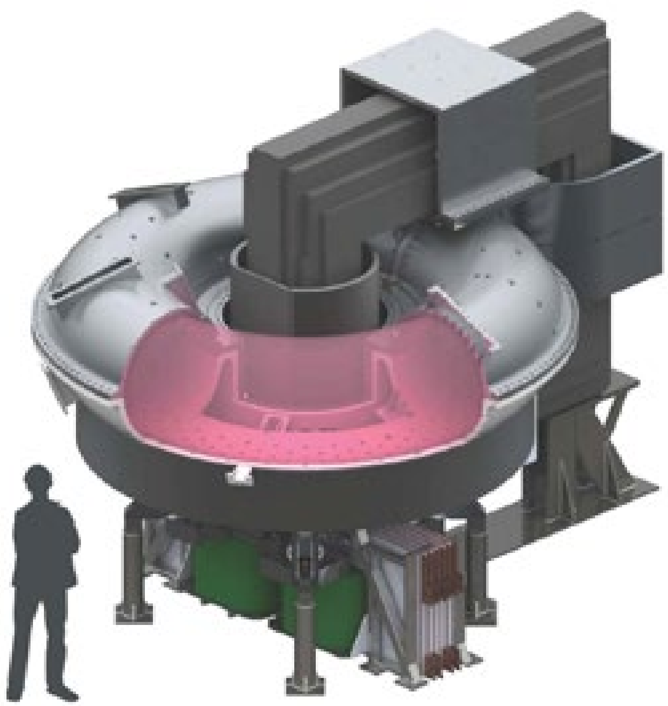
Figure: The figure shows an array of 49 atomic qubits, trapped in an optical lattice.

Selected Physics Faculty Profiles

John Sarff

Ph.D., UW-Madison, 1988

Professor Sarff directs the research program on the Madison Symmetric Torus (MST) plasma experiment located in the high bay of Chamberlin Hall. The local research team, numbering about 50 staff, students, and postdocs, works with national and international collaborators to lead U.S. research on the reversed field pinch (RFP) fusion plasma configuration. The MST is the fourth largest magnetic fusion experimental program in the U.S., and one of two large RFP facilities in the world. Advances made through MST research help validate fusion plasma physics models and inspire control strategies to improve the fusion potential of toroidal magnetic configurations. The RFP plasma also serves as a paradigm for the concept of magnetic self-organization, a set of coupled nonlinear plasma processes involving magnetic reconnection, self-generation of magnetic field, and particle energization. Similar processes are found in astrophysical plasma settings, and the advanced diagnostic capabilities available on MST provide a terrestrial laboratory to explore this basic plasma physics.



Gary Shiu

Ph.D., Cornell University, 1998

Professor Shiu is widely recognized as a world leader in string phenomenology. His research is marked with exceptional creativity and breadth. His pioneering work on string theoretical models of particle physics and cosmology has helped found this new and fast-growing field. His research contributions span a wide range of areas at the rich interface of string theory, particle physics and cosmology, with an emphasis on connecting fundamental theory to experiment. His findings have yielded important new insights into such central questions as the nature of cosmic inflation, dark energy and dark matter. The mathematical rigor and novel theoretical tools he brings to the field have also significantly influenced experimental missions searching for new physics. His research program is thus vital for bridging the gap between fundamental theory and experiment.

String theory, which unifies particle physics with gravity, provides an overarching framework to address questions at the energy, cosmic, and intensity frontiers. Many central issues in these three frontiers are deeply intertwined. An important goal of Professor Shiu's research is to find novel observables connecting them, and to explore how experimental results at these frontiers can be used to probe high scale physics. Professor Shiu has contributed to many exciting developments in a wide range of areas in string phenomenology. His recent research focuses include understanding particle physics beyond the Standard Model, inflationary cosmology, dark matter and dark energy through the lens of string theory.

Selected Physics Faculty Profiles

Wesley Smith

Ph.D., University of California, Berkeley, 1981

Professor Smith is a leader of the CMS experiment at the LHC at CERN in Geneva, Switzerland, serving as the Trigger Project Manager from 1994-2007 and then the CMS Trigger Coordinator from 2007 through 2012. As Trigger Coordinator of the CMS experiment at the CERN LHC, Prof Smith led an international team of more than 100 physicists responsible for reducing the input rate of a billion proton interactions every second by a factor of about 10 million to 500 per second, by processing data from all over the CMS detector in scores of racks of high speed electronics (the design and construction of which was also led by Prof Smith) and further analyzing with software algorithms on a 20k core computer farm. As the LHC luminosity climbed more than six orders of magnitude from 2010-2012, the achievements of this system exceeded its design and the capabilities of any other collider experiment in the history of the field and collected all of the data producing the discovery of a Higgs boson by CMS as well as more than 300 physics papers published by CMS on electroweak physics at the highest energies, searches for supersymmetry and extra dimensions. The Higgs discovery was recognized in the award of the 2013 Nobel Prize for physics, which cited, "the discovery of the predicted fundamental particle, by the ATLAS and CMS experiments at CERN's Large Hadron Collider." The figure shows a candidate Higgs decay to 2 photons in the CMS experiment. Among many results, the UW group on CMS, which Prof. Smith leads, is responsible for studies of the Higgs-like boson decays to taus and leptons, and W and Z boson production accompanied by hadron jets. In 2011-14, 10 UW students received Ph.D.'s on the new CMS data, of which 6 were Prof. Smith's advisees. Prof. Smith is now leading a team preparing for the upgrades of the CMS Trigger for the even higher luminosities and energies expected in the coming years as the Convener of the Trigger Performance and Strategy Working Group.

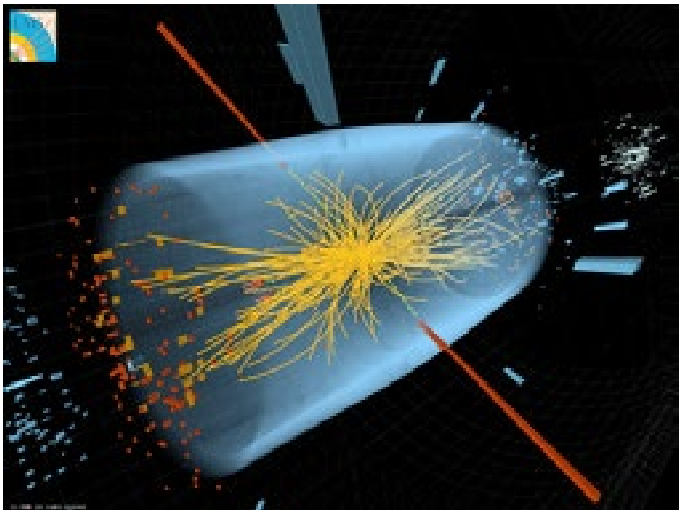
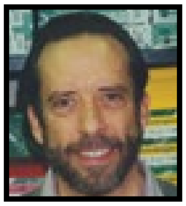


Figure: A candidate Higgs decay to two photons in CMS.

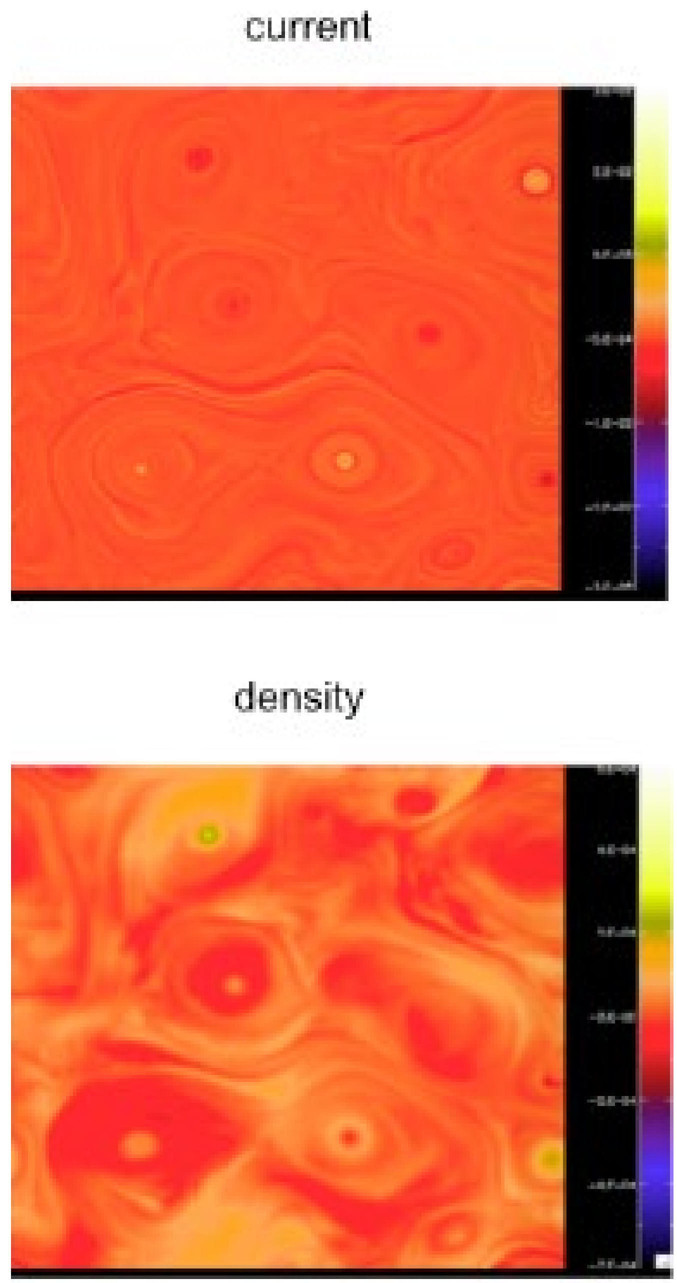
Selected Physics Faculty Profiles



Paul Terry

Ph.D., University of Texas at Austin, 1981

Professor Terry works in theoretical plasma physics, with research interests that range from fusion plasma physics to plasma astrophysics. A common thread in all of his research is turbulence and the transport of heat and particles caused by turbulence. In magnetically confined fusion plasmas, temperatures can reach 100 million degrees in the core of the plasma, but are close to room temperature at the walls. This very large gradient, and large gradients in density, drive turbulent fluctuations in the plasma whose effect is to produce a relaxation of the gradients, thus causing a loss of plasma and heat that is detrimental to fusion. His research is directed at understanding this turbulence and transport, modeling it with analytic theories and comprehensive computer simulation, and finding ways to reduce it. One method of reducing turbulence and transport involves stationary structures with large shears in flows and magnetic fields, which either shear apart turbulent eddies or turbulent wave fronts. This is a unifying theme in both his fusion and astrophysics research. Years ago he showed that in the most developed magnetic confinement fusion device, known as a tokamak, shear flow reduces turbulence. In recent work he has shown that magnetic shear can explain reduced transport in another device—the reversed field pinch—associated with a twisted structure in the core of the plasma known as the quasi single helicity state. In interstellar turbulence, it has been shown how magnetic shear gives rise to coherent electron density filaments that scatter the rf waves from pulsars in a characteristic manner observed in simulations. The accompanying figure shows the density structures (right panel) that arise in interstellar turbulence as the result of magnetic shear associated with current filaments (left panel).



Selected Physics Faculty Profiles

Peter Timbie

Ph.D., Princeton University, 1985

Professor Timbie's research group measures the structure of the universe to answer questions in fundamental physics. For example, to understand the physics of the inflation epoch his team observes the cosmic microwave background (CMB) radiation and its polarization. They are developing sensitive superconducting millimeter-wave cameras (see image) to map the polarization of the CMB and search for the polarization 'B-mode' signal from gravitational waves predicted by many models of inflation. They will deploy a polarimeter called QUBIC to Dome-C in Antarctica in 2016. Even more cosmic information is contained in the three-dimensional structure of the universe between us and the last-scattering surface of the CMB. Timbie is using a technique called 'neutral hydrogen tomography' to make 3-D maps of a large fraction of the universe. These maps will constrain models of dark energy and determine cosmological parameters precisely. In addition to observing with the Green Bank Radio Telescope, his group is currently deploying a dedicated radio interferometer called Tianlai to a radio-quiet location in Xinjiang, China.

Professor Timbie is working on innovative ways to improve teaching in introductory STEM courses at UW.

Justin Vandenbroucke

Ph.D., University of California, Berkeley, 2009

Professor Vandenbroucke's research focuses on neutrino and gamma-ray astronomy with the IceCube Neutrino Observatory, the Cherenkov Telescope Array (CTA), and the Fermi Gamma-ray Space Telescope. Vandenbroucke is working with other members of the Wisconsin IceCube Particle Astrophysics Center (WIPAC) to characterize the astrophysical neutrinos that IceCube recently discovered and to understand their origins. Vandenbroucke is also developing electronics for CTA and serving as co-leader of a project to build a camera for a prototype CTA telescope. The telescope features an innovative two-mirror (Schwarzschild-Couder) design to detect very-high-energy (TeV) gamma rays that hit the atmosphere and to precisely measure the energy and direction of each gamma ray. The innovative two-mirror design enables superior background rejection and signal reconstruction capabilities compared to the traditional one-mirror design. The prototype telescope, supported by an NSF Major Research Instrumentation grant, will be commissioned in Arizona in 2015. Finally, Vandenbroucke is leading the Distributed Electronic Cosmic-ray Observatory (DECO), a project that uses the camera image sensors of cell phones to detect cosmic rays and other high energy particles such as those produced by radioactive decays. Vandenbroucke is working with collaborators to develop the app and associated database, and with high school teachers to develop curriculum for use in the classroom. DECO is supported by the American Physical Society, the Knight Foundation, the Simon-Strauss Foundation, and QuarkNet.

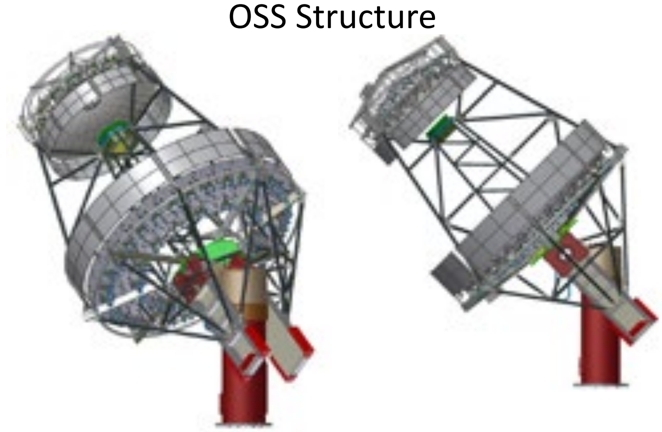


Figure: Design of the Schwarzschild-Couder prototype telescope under construction in Arizona for the Cherenkov Telescope array. The primary mirror (9.5 m diameter), secondary mirror, and camera are visible.

Selected Physics Faculty Profiles

Maxim Vavilov

Ph.D., Cornell University, 2001

Professor Vavilov's research is focused on theoretical description of quantum effects in novel materials and nanoscale electronic devices. He investigates interaction and non-equlibrium effects in novel multiband materials, such as iron-pnictides and topological insulators. His recent work provided an explanation of the phase diagram of iron-pnictide superconductors. He also works on development of control and measurement techniques for quantum information technology. He and Prof. McDermott proposed a new approach for accurate rotation of qubit states using single flux quantum circuits. Prof. Vavilov investigates the effect of the environment on topological properties of quantum systems and searches for unconventional signatures, such as non-Abelian Berry phase and quantum chaos, in dynamics of interacting quantum systems.

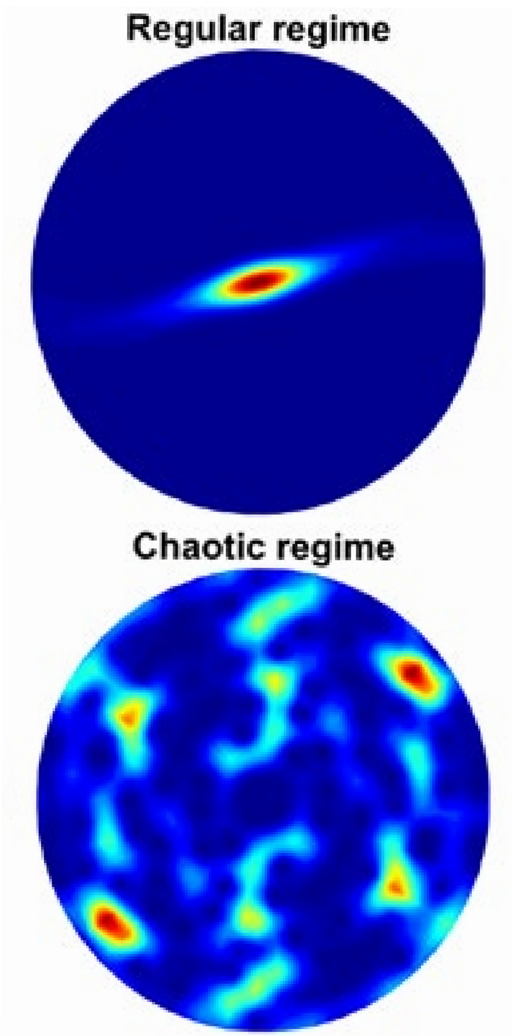


Figure: Dynamics of a spinning quantum top subject to periodic kicks. As the amplitude of kicks increases, the dynamics changes from regular quantum evolution (top) to quantum chaos (bottom).

Thad Walker

Ph.D., Princeton University, 1988

Professor Walker's "Atom Trainers" research encompasses two types of atomic physics experiments. In his cold atom life, he collaborates with Professor Mark Saffman on the fundamental physics behind using cold neutral atoms for quantum information processing. A few years ago their experiment demonstrated the first quantum gate using neutral atoms. They are able to control the quantum evolution of one Rb atom based on the quantum state of a 2nd atom 10 microns away. Currently they are investigating the properties of atomic ensembles as single qubits.

Professor Walker's hot atom life is focused on the development of quantum-based sensors. In one set of experiments, his team uses atomic magnetometers, sensitive at the picoTesla level, to detect the magnetic fields produced by fetal heartbeats. Another effort investigates a novel type of nuclear magnetic resonance optimized for detection of very small frequency shifts, at the nanoHertz scale or below. These sensors have the potential to be exceptionally stable and sensitive for inertial rotation sensing, or for looking for "fifth-force" extensions of the Standard Model.

Photo: Professor Walker getting his magneto-cardiogram measured by the UW ultrasensitive magnetometer array.

Selected Physics Faculty Profiles

Stefan Westerhoff

Ph.D., University of Wuppertal, Germany, 1996

Professor Westerhoff works in astroparticle physics and is currently involved in the IceCube Neutrino Observatory at the South Pole and the HAWC (High-Altitude Water Cherenkov) TeV gamma-ray observatory in Mexico. The two experiments have similar goals and complement each other; with data from IceCube and HAWC, we search for the elusive sources of galactic and extragalactic cosmic rays and explore the Universe at the highest energies. While IceCube probes the Universe in neutrinos at PeV energies, HAWC maps the northern sky in high-energy gamma rays between around 100 GeV and 100 TeV.

HAWC is currently still under construction on the slopes of Sierra Negra near Puebla, Mexico, at an altitude of 14,000 feet above sea level (see photo). Upon completion, HAWC will comprise 300 large light-tight water tanks arrayed over an area of 20,000 square meters. Each tank will be instrumented with four photomultipliers to detect particles from extensive air showers produced by gamma rays and cosmic rays. Construction is scheduled to be completed in early 2015, but data taking with the partial detector started in 2013. HAWC will provide an unbiased map of the TeV sky with a daily coverage of more than 6 steradian. The high-altitude location, the large field of view, and the almost 100% duty cycle make HAWC sensitive to both extended and point-like gamma-ray sources and allow for searches of transient phenomena like gamma-ray bursts and flares in active galactic nuclei.

The UW–Madison HAWC group has developed the experiment's data acquisition system and worked on event reconstruction and analysis tools. We also used early HAWC data to study anisotropy in the arrival direction distribution of cosmic rays at TeV energies. The study revealed small- and large-scale anisotropy, which is similar to structures observed by IceCube in the Southern Hemisphere.

Sau Lan Wu

Ph.D., Harvard University, 1970

Professor Wu is an experimental high-energy physicist with a keen focus on discoveries. Prof. Wu has made important contributions to three major discoveries in the field: the J/psi particle in 1973, the gluon in 1979 and the Higgs boson in 2012. For the discovery of the gluon, she was awarded the High-Energy and Particle Physics Prize by the European Physical Society in 1995. Currently, she is involved in the ATLAS experiment at the Large Hadron Collider at CERN, near Geneva, Switzerland.

In 2012, she and her group played a crucial role in the discovery of the Higgs boson by the ATLAS experiment. The Higgs, sometimes called the God Particle, is responsible for giving masses to all elementary particles; the universe as we know it would not exist without the Higgs boson. The 2013 Nobel Prize in Physics was awarded to the theorists who had formulated the Higgs mechanism.

During Run 2 of the Large Hadron Collider, due to start in 2015, the Wu group will focus on searches for Dark Matter, which makes up over 70% of the matter content of the universe, but we do not know what it is. A candidate for dark matter will be a very significant discovery in the field, solving an 80-year old mystery. An exciting period in high-energy physics is coming up!

In addition to research, training of students and postdocs has been one of her major goals throughout her career.

Selected Physics Faculty Profiles

Deniz Yavuz

Ph.D., Stanford University, 2003

Professor Yavuz's group aims to demonstrate the fundamental principles of the next generation of optical tools. Optics and optical tools have played a key role in the scientific development over the last century. In particular, after the invention of the laser in 1960, optical methods have penetrated into and revolutionized many fields of science including biological imaging and nano-technology. Specifically, the group develops methods to address two important questions: (1) How can we optically image very small objects? Can we construct optical microscopes that will be capable of imaging objects at the nanometer scale using visible light? (2) How can we probe and understand very fast processes? Can we devise techniques to explore electronic processes that typically happen in sub-femtosecond time scales (one femtosecond is one millionth of a billionth of a second)? These two questions are relevant to a broad range of research areas. As an example, optical microscopes with a nanometer resolution may allow a clear understanding of biological processes at the molecular level. To address these questions, the Yavuz group is working on (1) constructing lenses that are capable of resolving very small objects using a new type of materials called negative-index materials, and (2) producing very short flashes of light by generating many lasers with different colors simultaneously.

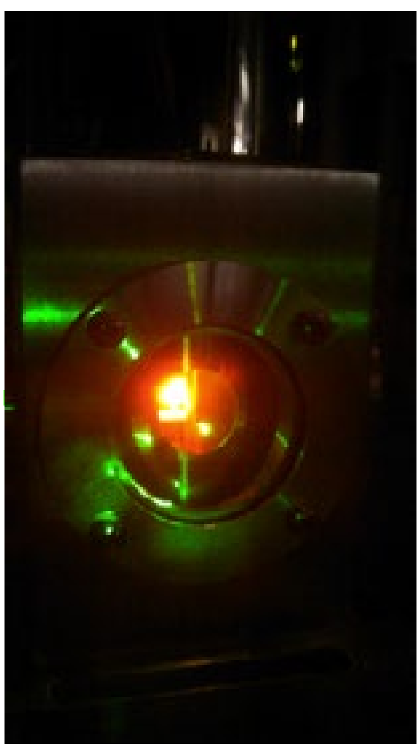
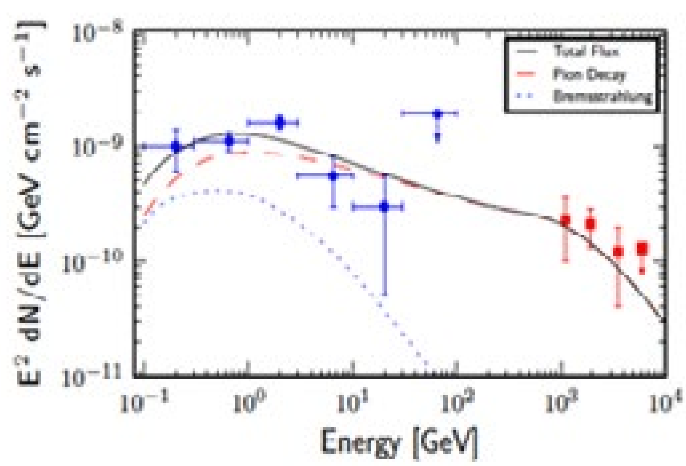


Figure: The fluorescence in the orange of a rare-earth doped crystal at a temperature of only 4 degrees above absolute zero. We are using this crystal to possibly construct lenses that will be able to image very small objects.

Ellen Zweibel

Ph.D., Princeton University, 1977

Professor Zweibel is jointly appointed in the Physics and Astronomy Departments, and has a broad program in astrophysical fluid dynamics and plasma physics. Her current interests include the generation and evolution of magnetic fields in stars and galaxies, how relativistic cosmic rays interact with their environments, and how magnetic fieldlines reconnect and transfer their energy to particles. An example of her interests is shown in these two images. The first is a composite x-ray and optical image of the starburst galaxy M82 (courtesy NASA). The second is the result of fitting a model of cosmic ray acceleration originally developed for the Milky Way to the observed γ-ray spectrum of M82 (Yoast-Hull et al. 2013). Despite the differences between these galaxies, the model fits very well. Her group is currently investigating the role of cosmic rays in the halos and winds of galaxies.



Outreach

Since 1984, the Wonders of Physics shows have reached 300,000 people, with 700 shows in the past 5 years alone. Originally developed by Clint Sprott, the Wonders of Physics is now run by Mike Randall. The performances use fun, fast-paced demonstrations to illustrate fundamental concepts and generate enthusiasm about physics among people of all ages. The Wonders of Physics is presented in several annual shows in February as well as individual shows to groups of students and the general public throughout the year.

With support from a special gift to the Friends of the L. R. Ingersoll Museum Fund, graduate student Jay Ludden is updating the signage and usability of the museum. The new signs have large, inviting text and images to encourage inquisitive interaction with the exhibits. Visitors can choose the depth of their engagement with each exhibit by flipping to pages with more information. A QR code on the final page points to a web site for further reading. This strategy is designed for the full range of museum visitors: K-12, undergraduate, and beyond. Both organized student trips and drop-in guests visit the museum.

The Wisconsin IceCube Particle Astrophysics Center (WIPAC) leads several education and outreach projects at the regional, national, and international level. The WIPAC high school internship program brings 20-25 local high school students to WIPAC once per week after school for group research projects led by WIPAC graduate students and researchers. The recently completed Bringing the Universe to Wisconsin project visited nearly every 4-year and 2-year college in the state, with WIPAC members traveling to 26 communities to discuss the science of IceCube. The Distributed Electronic Cosmic-ray Observatory is an Android app that detects cosmic rays and other ionizing radiation using the phone's camera image sensor, for use by the general public or by students in class projects.

Billy Gates, Jr. and Jim Reardon have developed a program called the Badger Jets Solder Squad. With initial support from the American Physical Society, this program has worked with the Nehemiah community organization, Wright Middle School, and the PEOPLE program to teach soldering and simple electronic circuitry to middle school students. Through after-school sessions, students develop hands-on scientific and technical skills and earn a certificate of completion.

The Physics Department contributes several events to the annual Wisconsin Science Festival. In October 2014, this included an IceCube exhibit, a Physics of Plasma show, a talk by Prof. Sau Lan Wu about the discovery of the Higgs Boson, and a showing of Chasing the Ghost Particle, a film co-produced by WIPAC and the Milwaukee Public Museum.

The department's outreach activities are in many ways the public face of the department. They enable us to engage with the community locally and beyond and to demonstrate the excitement of both our cutting edge research and of basic concepts of physics. We are grateful for the ongoing support provided by donations, without which many of these activities would not be possible.

LPhots, top to bottom: Jay Ludden working at the L.R. Ingersoll Physics Museum. WIPAC high school interns developing an Arduino system to test the DECO app. Billy Gates, Jr. working with students learning to solder through the Badger Jets Solder Squad.

2014 Physics Awards Banquet

The 2014 Physics Banquet and Awards Ceremony to honor the Department Award Recipients and Alumni Fellows was held on Friday, May 2, 2014 at the Fluno Center. We honored our award winners with a reception, dinner, and awards ceremony for the family and friends.

Undergraduate Awards

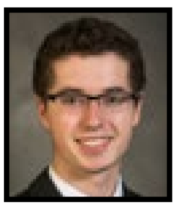
Fay Ajzenberg-Selove Award


Chunling Yan

Chunling Yan

This award is presented to undergraduate women majoring in Physics, Astronomy, or Physics/Astronomy to encourage them to continue their careers in science. Dr. Ajzenberg-Selove received her Ph.D. in Physics in 1952.

Dr. Maritza Irene Stapanian Crabtree Award


Ethan Kay

Ethan Kay

This fund was established by William Crabtree to honor his wife, Dr. Maritza Crabtree, who graduated with a Physics degree in 1971. This annual award benefits undergraduate students in physics based equally on merit and need.

Bernice Durand Undergraduate Research Scholarship


Anna Christenson

Anna Christenson

This award was established by Emerita Physics Professor Bernice Durand to promote meaningful undergraduate research and to support and encourage women and ethnic minorities as undergraduate majors in Physics and Astronomy.

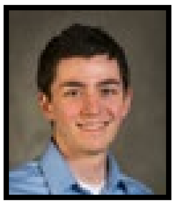
L. R. Ingersoll Prize

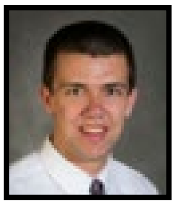
Spring 2012–2013: Dustin Richter (103) | Natalie Dosch (104) | Yunsheng Ji (201) | Boru Wang (202) | Xiaoqing Li (207) | Samuel Kellen Hartwick (208) | Cory Hawley (248)

Fall 2013–2014: Cody Lane (103) | Katherine Umhoefer (104) | Michael Soukup (201) | William Maes (207) | Xiaoqing Li (208) | Weifan Chen (247) | Cory Hawley (249)

This prize is given for distinguished achievement in introductory physics. It is underwritten by a fund established by the family and friends of the late Professor Ingersoll, a distinguished physicist and teacher at the University who served as Department Chair for many years.


Weifan Chen

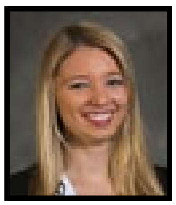

Samuel Hartwick


Cory Hawley

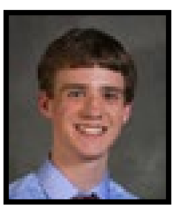

Xiaoqing Li


William Maes


Dustin Richter


Katherine Umhoefer

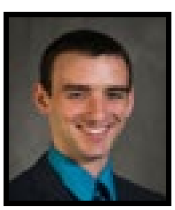
Liebenberg Family Research Scholarship


Stephen Taylor

Stephen Taylor

This scholarship is awarded is for Physics, AMEP, or Astronomy/ Physics majors. This scholarship opportunity was initiated by the Liebenberg family for the purpose of promoting undergraduate summer research opportunities.

Albert Augustus Radtke Scholarship Award


Kevin Meaney

Kevin Meaney

This scholarship is given to outstanding junior or senior students majoring in Physics or Applied Mathematics Engineering and Physics. This award was made possible by a bequest of the late Mrs. Elizabeth S. Radtke in honor of her husband, a 1900 degree recipient from UW-Madison.

Graduate Awards

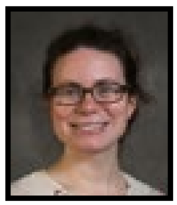
Joseph R. Dillinger Award for Teaching Excellence


Jianjia Fei

Jianjia Fei

This Award for Teaching Excellence was made possible by the family of Joseph Dillinger in honor of their father. The award provides recognition to an outstanding teaching assistant in undergraduate-level Physics. Prof. Dillinger was a faculty member of the department with a special interest in improving undergraduate education.

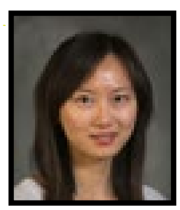
Albert R. Erwin, Jr.-Casey M. Durandet Graduate Student Award


Laura Dodd

Laura Dodd

This award is made possible through a fund established to support graduate students working in experimental high energy physics. The late Professor Albert R. Erwin, Jr., joined the UW faculty in 1959 and remained until his retirement in 2005. One of his most important results was his co-discovery with Professor William Walker of the rho-meson in 1961.

Phyllis Jane Fleming Graduate Student Support Award


Xian Wu

Xian Wu

This Award is made possible through the generosity of Linda B. Miller and Dr. Fleming. Phyllis received her Ph.D. in 1955 under Professor Dillinger. This fund provides support for a female doctoral candidate in physics.

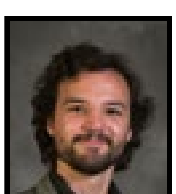
Mendenhall Graduate Fellowship

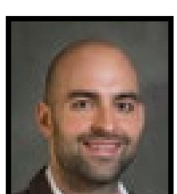

Matthew Ebert

Matthew Ebert

This Award is to be used for the support of a graduate students in experimental physics.

Emanuel R. Piore Award


Duncan Pettengill


Matthew Meehan

Duncan Pettengill (Fall 2013) |
Matthew Meehan (Spring 2014)

The award is made possible through the generosity of the Piore family. It is awarded to the graduate student with the highest score on the qualifier examination.

Van Vleck Award


Todd Garon


Canran Xu

Todd Garon | Canran Xu

This Award is used to support graduate students in physics.

Department TA Awards

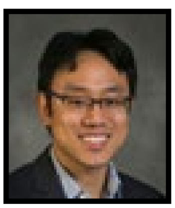
Best Teaching Assistant Rookie of the Year


Zach Simmons


Zachary Williams

Zach Simmons, Best TA Spring 2013
Zachary Williams, Best TA Fall 2013

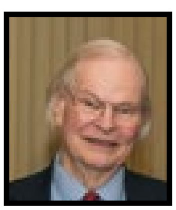
Rookie of the Year


Dahan Kim

Dahan Kim Rookie of the Year

Alumni Awards

Distinguished Alumni and Distinguished Service Awards


Roger Stuewer

Roger Stuewer, Distinguished Alumni Award

Roger H. Stuewer received Ph.D. in Physics from UW in 1968. His wife is also an alum. Between them they have five UW degrees from UW. He served as Chair of the Forum on History of Physics. He received the APS Abraham Pais Prize for History of Physics.


Carl Anderson

Carl Anderson, Distinguished Service Award

Dr. Carl J. Anderson received his BS in physics from the University of Missouri in 1974 and his Ph.D. in Physics from the University Wisconsin in 1979.

UW Physics Degrees Awarded

Undergraduate Degrees

AMEP

Fall 2012
Greenheck,Daniel Robert
Jiang,Mingchuan
Marshall,Tyler Virgil

Spring 2013
Cusentino,Michael Thomas
Frost,Ethan Adam
Gohr,Andrew Donald
Matzke,Karl Erwin
Puglielli,Antonio
Saw,Lip Fung
Upadhyay,Sunil

Fall 2013
Fleming,Laura Susan
Hodson,Mitchell Alan
Law,Blaine David
Marti,Colton Jay
Zhao,Pingchuan

Spring 2014
Antropova,Natalia
Carlsson,Nils Philip
Maclaughlin,Jasmine Nicole
Maki,Keith Andrew
Miller,Christopher Roman
Stuyvenberg,Luke Adam
Varda,Stephen James

Astronomy-Physics

Spring 2013
Hilgenberg,Christopher Michael
Honor,Jack
Huang,Matthew Scott
Klawiter,Steffi Amalia
Metko,Karissa Michelle
Pingel,Nickolas Michael
Ramuta,Michael Plese
Westphal,Maximillian Simeon
Ramuta,Michael Plese

Summer 2013
Heile,Jonathan Daniel
Otradovec,Jessie Lee

Fall 2013
Choedak,Tenzin
Shearier,Ryan David

Spring 2014
Bartosz,Curtis Michael
Bitant,Sarah Ann
Bossler,Ryan Jay
Bottleman,Brian James
Falk,Jordan David
Hesse,Daniel Lee
Indahl,Briana Lane
Jiang,Linbailu
Jung,Paul
Meyer,McKinley Taylor
Steffel,Catherine Nicole
Wunderlin,Jennifer Joyce
Bossler,Ryan Jay
Jiang,Linbailu

Physics

Fall 2012
Sauter,Patrick Edward

Spring 2013
Chew,Kit Shawn
Christensen,Brendt Allen
Defillippo,Greg James
Feight,Jarrod Michael
Hendries,Eric Robert
Hilgenberg,Christopher Michael
Jones,Danny R
Kass,Alexander Jonathan
Kenyon,James
Marulli,David Manuel
Metko,Karissa Michelle
Nims,Jesse
Olson,Todd James
O'Neil,Connor Joseph
Patton,Taylor Jordan
Perkins,Max Louis
Pillai,Mohandas Kumar
Pingel,Nickolas Michael
Plunkett,Alexander Christian
Saw,Lip Fung
Skinner,Duncan Geoffrey
Smart,James Blanchard
Splettstoeszer,Phillip Edward
Stratis,Georgios
Tao,Zhengcheng
Thompson,Mark Andrew
Walter,Nicholas Mark
Yeow,Ji Mi
Zhan,Li

Summer 2013
Harper,Matthew Kennedy
Heile,Jonathan Daniel
Kowalski,Joseph Daniel
Otradovec,Jessie Lee
Powers,Mitchell Danger

Fall 2013
Carozza,Roberto Paolo
Fleming,Laura Susan
Fontana,Anthony James
Grabon,Nicholas Christopher
Johnson,Jay
Marti,Colton Jay
Sanchez,Joshua Javier

Spring 2014
Antolak,Alexander Geoffrey
Bartosz,Curtis Michael
Bautista,Daniel Alexander
Beres,Jacob Michael
Bitant,Sarah Ann
Britton,David Paul
Cooperstein,Stephane Brunet
Edel,Ross Anthony
Falk,Jordan David
Godfrey,Charles Wesley
Grenzow,Ryan John
Hesse,Daniel Lee
Hou,Yubing
Indahl,Briana Lane
Li,Yaqiong
Luo,Ran
Meyer,McKinley Taylor
Muhowski,Aaron J
Rao,Nishaad Shrinivas
Sebald,James Lee
Steffel,Catherine Nicole
Stuyvenberg,Luke Adam
Weber,David Scherer
Zutter,Brian Travis

Master's Degrees

Fall 2013

Crow, Daniel Edward M.S.
Advisor: Joynt

Garon, Todd Spencer M.S.
Advisor: Everett

Hubbard, Antonia Jeanne M.S.
Advisor: Maruyama

Lewis, Christine Anne M.S.
Advisor: Heeger

Wielgus, Lauren Ann M.S.
Advisor: Maruyama

Spring 2014

Adhikarla, Vikram M.S.
Advisor: Jeraj

Hinojosa Alvarado, Alberto M.S.
Advisor: Chubukov

Hostetter, James M.S.
Advisor: Saffman

Lee, John David M.S.
Advisor: Sarff

Sizyuk, Yuriy M.S.
Advisor: Perkins

Wulf, Dallas William M.A.
Advisor: McCammon

Summer 2014

Ducatman, Samuel M.S.
Advisor: Perkins

UW Physics Degrees Awarded

Doctoral Degrees

Fall 2013

Churchill, Tyler | Advisor: Litovsky | Thesis: Investigations in mechanisms and strategies to enhance hearing with cochlear implants | Employment: Quality Assurance Analyist with US Navy

Collins, Cami Starr | Advisor: Forest | Thesis: Spinning an unmagnetized plasma for magnetorotational instability studies in the Plasma Couette Experiment | Employment: Post Doc—UC Irvine

Hartman, Timothy Leonard | Advisor: Lawler | Thesis: Double photoionization mechanisms in aromatic molecules | Employment: CVS

Hover, David James | Advisor: McDermott | Thesis: Dispersive readout of a superconducting qubit using a slug amplifier | Employment: M.I.T. Lincoln Labs

Koliner, Jonathan Jay | Advisor: Forest | Thesis: Neutral beam excitation of Alfvén continua in the Madison Symmetric Torus reversed field pinch | Employment: Post Doc—UW Madison

Shi, Zhan | Advisor: Eriksson | Thesis: Spin and charge qubits in Si/SiGe quantum dots | Employment: Sr. Member of Technical Staff, Reliability at Maxim Integrated

Stone, Douglas Robert | Advisor: Sarff | Thesis: Magnetic relaxation during Oscillating Field Current Drive in a reversed field pinch | Employment: Post Doc—U Maryland College Park

Spring 2014

Eilerman, Scott Joseph | Advisor: Forest | Thesis: Ion runaway during magnetic reconnection in the reversed-field pinch | Employment: Post Doc—NOAA in Boulder CO

Gill, Alexander Thomas | Advisor: Saffman | Thesis: Progress towards deterministic generation of entangled W-states of neutral atoms using Rydberg blockade | Employment: Laser Engineer at TeraDiode, Inc.

Ji, Haoshuang | Advisor: Wu | Thesis: Discovery and measurement of a Higgs boson | Employment: ASML, a supplier of photolithography systems for the semiconductor industry

Lewis, Christine Anne | Advisor: Heeger | Thesis: Measuring the antineutrino spectrum at the Daya Bay nuclear reactors | Employment: Research Staff Member at Institute for Defense Analyses

Ojalvo, Isobel Rose | Advisor: Smith | Thesis: Measurement of $W + b\bar{b}$ and a search for MSSM Higgs bosons with the CMS detector at the LHC | Employment: Post-Doc—UW Madison (at CERN)

Taylor, Nicholas Zane | Advisor: Forest | Thesis: Optimizing the flow in a liquid sodium dynamo experiment | Employment: DIII-D

Summer 2014

Adhikarla, Vikram | Advisor: Jeraj

Carr, Alexander Walter | Advisor: Saffman | Thesis: Improving quantum computation with neutral cesium: readout and cooling on a quadrupole line, conditions for double magic traps and a novel dissipative entanglement scheme

Caspary, Kyle | Advisor: Sarff | Thesis: Density and beta limits in the Madison Symmetric Torus Reversed-Field Pinch | Employment: Post Doc—UW Madison

Eisch, Jonathan Daniel | Advisor: Westerhoff | Thesis: A multi-variate fit to the chemical composition of the cosmic-ray spectrum | Employment: Post Doc—Iowa State University

Gao, Yuanfeng | Advisor: McDermott | Thesis: Crystalline dielectrics for improved Josephson qubits | Employment: Intern at The Office for Technology Transfer and Licensing, Boston College

Johnson, Phillip Steven | Advisor: Himpsel | Thesis: Electronic structure measurements of metal-organic solar cell dyes using X-ray absorption spectroscopy | Employment: Intel in Hillsboro

Kiewe, Michael | Advisor: Litovsky | Thesis: Sound localization training with audio-visual integration in sub-optimal listening environments | Employment: Professor of Physics at Red Rocks Community College

Kruse, Amanda Kaitlyn | Advisor: Pan

Kuzmanovski, Dushko | Advisor: Vavilov | Thesis: Transport and thermodynamic properties of iron-based superconductors | Employment: Post-Doc Uppsala

Lim, Hyungjun | Advisor: Joynt | Thesis: Quantum correlation and decoherence in quantum computation | Employment: Software Engineer at Cisco Systems

McFarlane, Michael Curtis | Advisor: Heeger | Thesis: Observation of antineutrino oscillations from spectral distortions at the Daya Bay Reactor Neutrino Experiment

Parke, Eli | Advisor: Den Hartog | Thesis: Diagnosis of equilibrium magnetic profiles, current transport, and internal structures in a reversed-field pinch using electron temperature fluctuations | Employment: Post Doc—UCLA

Peterson, Andrea Dawn | Advisor: Barger | Thesis: The phenomenology of extended gauge and Higgs sectors at the LHC | Employment: Post Doc—Carleton University

Reilly, Bethany Nicole | Advisor: Karle | Thesis: Background simulation and verification for DM-Ice | Employment: Associate Lecturer of Physics and Astronomy at University of Wisconsin-Fox Valley

Rudinger, Kenneth Michael | Advisor: Joynt | Thesis: Theoretical issues in quantum computing : graph isomorphism, PageRank, and Hamiltonian determination | Employment: Post Doc—Sandia

Weber, Joshua Joseph Advisor: Yavuz | Thesis: Continuous-wave light modulation using stimulated Raman scattering | Employment: Post Doc—UW Madison

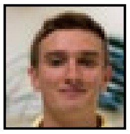
Wood, Michael Patrick Advisor: Lawler | Thesis: A new echelle spectrometer for measuring UV branching fractions of Fe-group ions | Employment: Physicist at NIST

Yoo, Hojin Advisor: Chung | Thesis: Particle production under external fields and its applications | Employment: Post Doc at LBNL

2014 Fall Admissions


Andrew Brickman
Columbia University
Timbie—Astrophysics

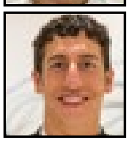

Zachary Buckholtz
Pennsylvania State University
Yavuz—AMO


Chad Bustard
Rice University
Zweibel—Plasma/Astrophysics


Neil Campbell
Kenyon College
Rzchowski—Condensed Matter Experiment

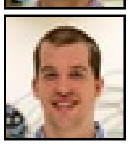

Steven Casper
Carnegie-Mellon University
Hashimoto—String Theory


Allison Christian
Massachusetts Institute of Technology
Wesley Smith—High Energy Experiment

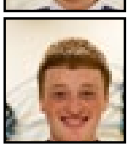

Douglass Endrizzi
Yale University
Forest/Egedal—Plasma

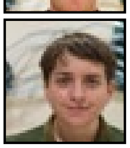

Hasim Ercan
Bilkent University
Vavilov—Condensed Matter Theory


Benjamin Faber
California Institute of Technology
Hegna—Plasma

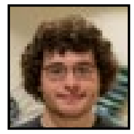

Samuel Fahey
University of Wisconsin-Eau Claire
Timbie—Astrophysics


Ruiyang Feng
Tsinghua University
Walker—AMO

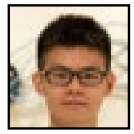

Adrian Fraser
University of Oregon
Zweibel/Terry—Plasma/Astrophysics

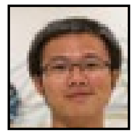

Samuel Greess
Carnegie-Mellon University
Egedal—Plasma

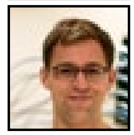

Usama Hussain
New York University-Abu Dhabi
Smith—High Energy Experiment


Joshua Karpel
University of Colorado at Boulder
Yavuz—AMO

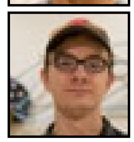

Benjamin Lemberger
Oberlin College
Coppersmith—Condensed Matter Theory


Jiande Li
Peking University
Dasu—High Energy Experiment


Sida Lu
Peking University
Bai—High Energy Theory


Samuel Neyens
Indiana University
Eriksson—Condensed Matter Experiment

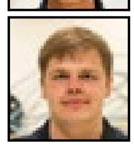

Vickram Premakumar
University of Chicago
Smith—High Energy Experiment

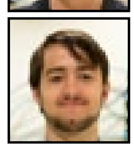

James Sebald
University of Wisconsin-Madison
Halzen—High Energy Theory

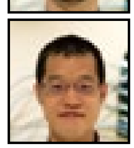
Dillon Skeehan
University of Rochester
Eriksson—Quantum Computing

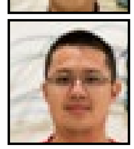

Huichen Sun
Tsinghua University
Saffman—AMO


Bunheng Ty
University of Michigan at Dearborn
McDermott—Condensed Matter Experiment


Patrick Vanmeter
University of Kentucky
Westerhoff—Astrophysics

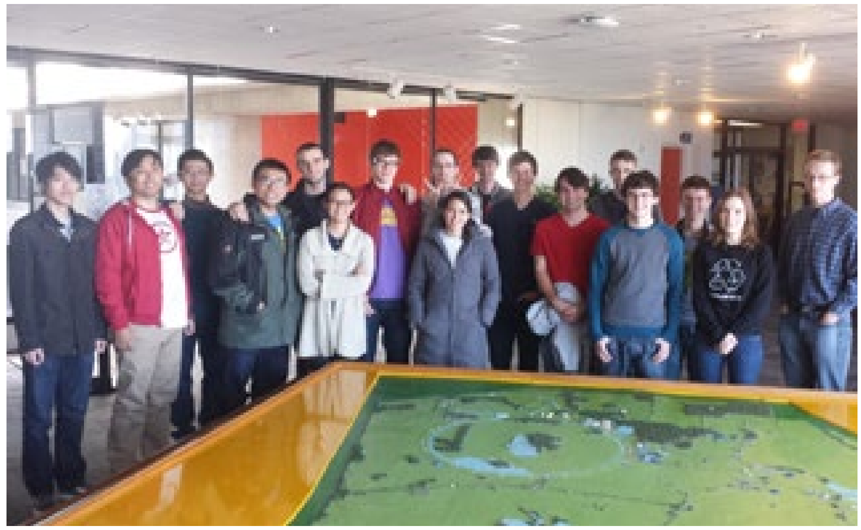

Brandon Wilson
Hamilton College
Vandenbroucke—Astrophysics


Yuan-Chi Yang
National Taiwan University
Coppersmith—Condensed Matter Theory


Christopher Yip
University of San Diego
Eriksson—Condensed Matter Experiment

Undergraduate Students

UPS Club



The Physics Club has had a very successful year. Membership currently includes 147 members due in part to the very successful Fall Kick-off where more than 100 students signed up.

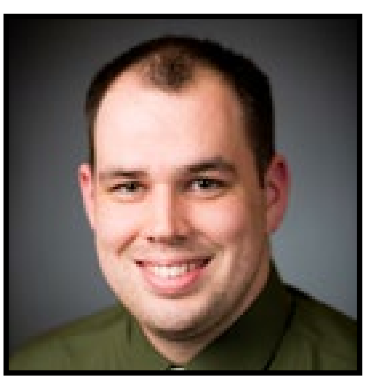
Last spring was filled with many fun and physics-y events ranging from playing laser tag at Ultrazone, meeting theoretical physicist Lawrence Krauss, and reaching out to younger students through Wonders of Physics in February and the Physics of Breakdancing in May. We said goodbye to our dear veteran members at our final event of the year, a cook-out at Devil's Lake, where we had a fantastic time hiking and eating food together before parting ways with our graduated seniors.

This Fall had included events like touring Fermilab National Lab and stopping for Giordano's deep dish on the way back. The student rush symphony has been a monthly outing for the Physics Club, seeing both the The Russian Spirit and Scandinavian Wonders performances with many more planned. We've also made a trip to see the movie Interstellar at the IMAX as well as met with graduate student panel to discuss physics graduate school. Later this year we'll see Neil deGrasse Tyson speak on Earth Day, organize an industry panel, and tour the labs of the physics department.

The club continues to have regular events such as meeting the colloquium speaker every Friday and having officer meetings every Wednesday. We also hold Physicsgiving every fall and celebrate the birthday of Nobel-prize winning Wisconsin physicist John Hasbrouck Van Vleck every March.

2014–15 Officers

President: Ayah Almousa
Vice President: Kevin Meaney
Treasurer: Kyle Kretschmann
Professional Development Coordinator: Ethan Kay
Social Events Coordinator: Adam Blonsky
Outreach Coordinator: Phillip Buelow



Student Receives Hilldale Undergraduate Research Fellowship

Aaron Stemo will be working with Prof. Cary Forest during the next year on his senior thesis and has received a Hilldale Undergraduate Research Fellowship to support this work. He will be building and studying a novel system for creating plasma flares and jets in the lab.

The solar flare problem Aaron is attacking with his proposed research exemplifies the multi-process aspects of plasma astrophysics. Magnetic fields generated deep in the solar interior bubble to the solar surface, are twisted up by hurricane like storms in the solar atmosphere, and then these tubes of plasma suddenly and explosively detach themselves from the solar surface and are flung into space as a solar flare. In our lab we are working on understanding all parts of this process, from the self-generation of magnetic fields (in the to studies of magnetic instability and most recently on how these magnetic fields detach through a process called "magnetic reconnection". Aaron's work will be the first experiment we try that might lead to a detached flare for study.

Support Physics via the UW Foundation

Undergraduate

132691618. Fay Ajzenberg-Selove Undergraduate Scholarship provides encouragement for undergraduate women majoring in Physics, Astronomy or Physics-Astronomy to continue their careers in science.

132693412. Dr. Maritza Irene Stapanian Crabtree Undergraduate Scholarship provides assistance to undergraduate students based on merit and need.

132693561. Bernice Durand Research Scholarship promotes meaningful undergraduate research opportunities, plus supports and encourages women and ethnic minorities as undergraduate majors in the Departments of Physics and Astronomy.

132693645. Henry & Eleanor Firminhac Scholarship provides assistance to students in Physics with financial need. (Undergraduate or Graduate)

132692683. Liebenberg Family Research Scholarship supports Physics, AMEP or Astronomy-Physics majors in summer research experiences.

132697989. Hagengruber Fund provides assistance to undergraduate physics students who are Wisconsin residents with financial need; and who show exceptional promise for a future in physics or a related field.

112697824. Physics Board of Visitors Undergraduate Research Fund provides funding for awards that will assist directed study projects in pure and applied physics; multidisciplinary projects linking physics to such fields as biology; engineering; business; and creative expression; and participation in related conferences.

Graduate

132697960. Allan M. and Arline B. Paul Physics Fund provides support to graduate students in memory of Walter Max Borer (MS 1937).

132697988. Carl and Brynn Anderson Graduate Physics Fund provides support for graduate student recruitment and retention, travel for study and research, materials for study or research; recognizing achievement in scholarship.

132697201. Casey M. Durandet Graduate Fund provides support, in memory of Albert R. Erwin, Jr., to graduate students working in experimental high energy physics.

132692082. Cornelius P. & Cynthia C. Browne Endowed Fellowship Fund provides support to graduate students pursuing doctoral studies in the Physics Department.

132693190. Elizabeth S. Hirschfelder Endowment supports women graduate students in Physics research.

132691960. Jeff & Lily Chen Wisconsin Distinguished Graduate Fellowship provides a full year fellowship to an outstanding graduate student in the department.

132691359. Joseph R. Dillinger Teaching Award Fund provides recognition to an outstanding teaching assistant in the Department of Physics.

132693916. Karl & Alice Knapp Jansky Fellowship Fund provides alternate year funding to an outstanding graduate student in Physics and Astronomy.

132696175. Phyllis Jane Fleming Graduate Student Support Fund provides support for a female doctoral candidate in any year of training in physics.

112698294. Physics Alumni Graduate Award Fund provides support to incoming graduate students who hold Teaching Assistant appointments in the department.

132695150. E. R. Piore Award provides support to the recipients of the highest qualifying exam scores each semester.

132692106. Graduate Student Recruiting provides assistance in recruitment expenses of Physics graduate students.

132691808 and 132692368. Ray & Anne Herb Wisconsin Distinguished Graduate Fellowships provides a full year fellowship to one or two outstanding graduate students engaged in materials research in the department.

132697430. Robertson Leach Graduate Student Fund provides support for incoming, first year graduate students in the department.

112696443. L. Wilmer Anderson & Dave Huber Graduate Support Fund provides a number of awards to new graduate students entering the department. This award is in honor of Profs. L. Wilmer Anderson and David Huber.

132695370. Van Vleck Fellowship Fund in Physics provides support to graduate students in the department.

General/Research

132694421. Barschall Enterprise Fund was established in 2005 in honor of former Professor Heinz Barschall. Provides unrestricted-use fund for Chair in recruiting senior researchers to faculty.

132906418. David Grainger Physics Library Fund provides funding for the acquisition of books and other materials related to physics.

132694069. Friends of the Physics L. R. Ingersoll Museum provides funding for museum display upgrades and student docents.

112694622. Physics Community-Building Fund provides funding for Chair in establishing and reaffirming a sense of community among the faculty, staff, students, and alumni of the Department.

112698078. Wonders of Physics Outreach Fund provides support for the continuation of the Wonders of Physics annual shows as well as the grade school show program.

132692106. Atomic Collision Research Fund encourages and supports research on atomic collision processes and their application to studies of weakly ionized gases in perpetuity.

112691418. Elementary Particle Physics Institute provides funding for activities of the institute.

132690387. L. R. Ingersoll Fund provides support for colloquia and seminars in the department.

132691720. Physics Newton Fund is a general, unrestricted fund administered by the Department Chair. The purpose of this fund is to aid the Department of Physics in its research, teaching and public service roles.

132697999. Quantum Computing Research Center Fund provides support for research in quantum computing in the physics department.

112696250. Thomas G. Rosenmeyer Cosmology Fund provides support for the Prof. Peter Timbie research group in its teaching, research, and public service roles.

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For a description of all UW Foundation Physics Funds, go to: www.physics.wisc.edu/giving/fund-details.html

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