THE WISCONSIN PHYSICIST

A NEWSLETTER FOR UNIVERSITY OF WISCONSIN PHYSICS ALUMNI
VOL. 12 NO. 1 SUMMER 2006

WAVE

"Wave" and sculptor Peter Flannery arrive on site.

"Wave" has landed!

Left: Naturally sculpted river rocks were placed inside the hollow frame of "Wave." The gray, rock dust has been washed off these samples to reveal their true colors.

Below: Peter (and his two assistants) hand-fitted every rock.

FEATURES

THE WISCONSIN PHYSICIST

University of Wisconsin–Madison

Department of Physics

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On the cover

Sculpture Peter Flannery (in blaze orange cap) riding Wave with Mohammad "Mo" Fayyaz of the Botany Department.

The aerial image of Wave was taken from the roof of new Chamberlin Hall.

- *Can you find the hidden message in the column of four Wave images on the front cover?*

Peter selecting the last rock with his assistants.

VIEW FROM THE CHAIR

Greetings from the UW-Madison Physics Department! There is quite a bit of news to report since last year. One big change is that starting in fall 2005 the whole department is now housed in the newly renovated Chamberlin Hall. We celebrated this milestone, along with the World Year of Physics, with an Alumni Celebration on August 12-13, 2005. We hope that you were able to join us for this big event.

Another big change for the department is the retirement of four of the department's longtime faculty. We are deeply indebted to Al Erwin, Willy Haeberli, Marty Olsson, and Don Reeder for their enormous contributions to the research, teaching, and daily life of the department. To do justice to these contributions would take a lot of space, so I will just refer you to the short summary write-ups posted on the physics department web page. I would especially like to acknowledge Don Reeder, who as Chair of the department, led it through the Chamberlin renovation and also initiated the process of faculty renewal. Don's wise leadership has enabled the department to achieve some remarkable accomplishments over the past few years. We will all miss his excellent leadership and good sense in the years ahead.

Susan Coppersmith

Funding is an important requirement for having an excellent Physics Department. We are proud that the Physics Department has had significant successes in competing for external grant support in the recent past — for many individual investigator grants as well as large group grants in plasma physics, plasma astrophysics, particle physics, quantum computing, and in particle astrophysics. The world-class cutting-edge research is a crucial base on which truly excellent educational programs can draw, and we have continued to strengthen our efforts to involve our students in the cutting edge of the research enterprise. State support for the University continues to shrink, so to maintain programs that improve the quality of life for students we rely increasingly on external donations. We thank everyone who has donated to the Physics Department, and we assure you that your support has made an enormous difference.

The Physics Department has recruited several excellent new faculty members, including Matt Herndon in experimental particle physics, Teresa Montaruli in particle astrophysics, and Frank Petriello in particle phenomenology. We are also welcoming back Andrey Chubukov, who is returning to Madison after being on leave for a year at the University of Maryland. These faculty are all bringing exciting new research perspectives to the department, and they will also enrich the educational experiences of our students.

Several faculty enjoyed sabbatical or other extended leaves during the 2005–06 academic year. Cary Forest worked with collaborators in Germany, pupa de Stasio worked with collaborators in California to finish her textbook on Physics and the Arts, Mark Saffman made extended visits to Australia and Denmark, and Dan McCammon visited Japan. Franz Himpsel received a prestigious Humboldt fellowship and visited the University of Erlangen in Germany. Hakki Ögelman took a sabbatical to research and prepare materials for a revised course on Energy in a societal and political context.

The Fifth Annual Awards Banquet was held in May, 2005. In addition to presenting awards to outstanding undergraduate and graduate students, Don Reeder presented a Distinguished Alumni Fellow Award to Dr. Jay Davis, who has had a distinguished career at Lawrence Livermore National Laboratory and who served as the first director of the Defense Threat Reduction Agency, integrating the Defense Department's technical and operational activities to deal with weapons of mass destruction. The department also awarded a Distinguished Alumni Fellow Award to Dr. Art Hundhausen of NCAR, who has made seminal contributions to our understanding of solar physics and the solar wind.

At the Awards Banquet, Don Reeder also presented Distinguished Faculty Fellow Awards in recognition of their outstanding and productive careers to former UW faculty members Professor (Emer.) Barney Webb and Prof. Raymond F. Sawyer, who was on the faculty first at UW and later at the University of California at Santa Barbara.

Susan N. Coppersmith
Professor and Chair of Physics

***Editor's note**: The new Chair of the Department of Physics is Professor Susan Coppersmith, a member of the Condensed Matter group. Coppersmith received her Ph.D. in 1983 from Cornell. She then worked at Brookhaven National Laboratory, AT&T Bell Laboratories, and Princeton University before becoming a Member of the Technical Staff at AT&T Bell Labs in 1987. She moved to the University of Chicago as a Professor of Physics in 1995, and joined the faculty of the University of Wisconsin in August 2001. Professor Coppersmith is also a Fellow of the American Physical Society and of the American Association for the Advancement of Science.*

ALUMNI SYMPOSIUM ATTRACTS GREAT GROUP

by Jean Buehlman, Alumni Relations

You'll be glad to know that the newly renovated Chamberlin Hall, built in the early 1900's, was officially "opened" and dedicated by Chancellor John Wiley in a ceremony on Friday, August 12, 2005. In addition, a wonderful group of alumni came to Madison to assist with the "housewarming" activities surrounding the dedication. Besides celebrating the move of the Physics Department from Sterling to Chamberlin, the symposium also marked the "World Year of Physics 2005" and honored "Einstein's Miraculous Year."

Prof. Emeritus Jack Fry explaining the acoustical physics of the violin.

Friday morning started with coffee, muffins and registration at 8:30 pm. As alumni and their families strolled through the doors of Chamberlin Hall, they were awed by the spacious new lobby. It was fun greeting them and actually putting faces with the names of alumni with whom I had been corresponding over the past few months. In all, attendance came to around 150 including alumni, staff and students.

After checking in, attendees filed into room 2241 in Chamberlin (the replacement room for 1313 Sterling). The first event of the morning included a welcome by former chair, Don Reeder, followed by "A Look Forward" by new Chair, Sue Coppersmith. The expertise of Emeritus Professor Bob March was called upon next to provide everyone with a historical "Look Back." At a mid-morning break, the visitors scooped up "I ♥ Physics" T-shirts for the young at heart and UW Physics logo shirts, as well as, more UW Physics mugs to tuck away in their suitcases. Our special guest, Bob Adair, then provided the audience with his view on an interesting topic, "Power Lines & Cell Phones: A Physicist Looks at Voodoo Science."

At noon, the crowd chose a box lunch and many headed for the new botany garden or found benches out in front of Chamberlin Hall. The afternoon session was chaired by Associate Vice Chancellor Bernice Durand. Chancellor John Wiley, who received his Ph.D. in the Physics Department, came by for the building dedication and, of course, added his tales to our departmental stories. He also asked the department for a favor — to provide the wording to put on a plaque which will be placed near Sterling Hall in honor of Robert Fassnacht, a victim of the bombing 35 years ago (August 24, 1970).

UW Chancellor John Wiley recounted his early days in the Physics Department.

As the afternoon progressed, Emeritus Professor Jack Fry not only told alumni about the mysteries of the Stradivarius violin, but even brought a violinist, Rose Mary Harbison, along to demonstrate. As we listened to the strains of the violin echoing in Chamberlin Hall, it once again reminded us of the intertwining nature of art and science.

Professor Francis Halzen wrapped up the afternoon with an interesting talk on "Extreme Astrophysics," and his group was kind enough to provide two very interesting displays of the IceCube project in the front lobby.

Concert violinist Rose Mary Harbison assisted Jack Fry in demonstrating how precise thickness adjustments can alter a violin's sound quality.

Alumni were reunited in the evening with a cocktail hour at Lowell Hall, followed by a huge banquet. Five alumni/visitors were asked to provide glimpses of life in Physics in earlier eras and each provided a unique picture of their time here. The speakers included Marv Ebel, Jack Fry, Bob March, Bob Morse and Barney Webb. Jane English also shared a few memories of her years here. The audience went home chuckling.

On Saturday morning, visitors returned to Chamberlin Hall for self-guided tours, poster sessions in labs, museum visits and an extra special version of "The Wonders of Physics" presented at 10:00 am by Professor Clint Sprott. The event was also open to other University departments, and many visitors with kids in tow could be seen enjoying both "Wonders" and testing out the hands-on demonstrations of physics in the new Ingersoll Museum.

The two-day event wrapped up with an old-fashioned picnic near the Lakeshore Dorms — between Adams and Tripp. As the kids merrily chewed on watermelon, their parents reminisced, re-established old friendships, and made new ones. Oh, the stories I heard! By mid-afternoon, the group was visited by a friendly rain shower and bid each other farewell. As I got in my car in the parking lot, an alumnus driving by stopped me and said, "Hey, this was great fun. When are we going to do it again?"

SOME RECOLLECTIONS OF STERLING HALL

by Truman Hunter (huntert82@cs.com)

I was very fortunate to have worked in Sterling Hall from August 1941 through January 1943, and again from July 1947 through January 1949.

I think the history of Sterling Hall should be more than just the floor plan of the building.

In 1941, I was one of a new crop of grad students in the department. I was chosen to work for Prof. Wahlin and became a teaching assistant in his advanced lab.

Each of the teaching assistant grads had a desk and chair to call his own. There were no female teaching assistants at that time. We were mostly located in a large room on the second floor looking north over the courtyard. It was there on Dec. 7, 1941, on Sunday afternoon, I was listening to my radio studying when the radio announcement about Pearl Harbor came along.

My records indicate that there were about 25 grads in 1941. A few were married. The Ingersolls had all the graduate assistants and their wives/dates at their house for dinner one time, about 50 in total. So it really was a fairly small, comfortable group.

By the end of December 1941, five of ten faculty members had left for secret research. Four grads also left. We now know that most of them went to the Los Alamos Laboratories.

Each day two people were delegated to go to the store and get some bread, meat, lettuce, cookies, etc. At the end of the month people reported their expense from shopping. A log was kept of the number of sandwiches which had been made and consumed. Simple calculations determined who owed what. A "Dagwood" sandwich made by some counted as two units. Breakfast of dry cereal and milk was one unit. We also had to take our turn in dishwashing and clean up.

Dr. Ingersoll and Dr. Wahlin were both working to help me and other grads from a planning and financial view. The relatively small size of the department made for personal attention which helped the spirit of the staff.

In May 1942, the department took the annual spring picnic hike about 40 miles north for the day. An 8-mile hike at the end of a car ride brought about 45 of us to a picnic location. Students did the planning and handled all preparations. Lemonade was provided in a large metal milk can. The head of the department said it was the best he had ever tasted. There was a rumor it contained some alcohol to enhance the flavor. We cooked steaks and had other picnic food. Again, the small size of the department made for very friendly relations.

I left in January 1943 because of the uncertainty of class offerings (missing professors), teaching loads (hundreds of military personnel coming in), draft status, etc. I went to MIT to teach in military/electronic radar classes.

By 1947, WWII was over; grads and faculty were returning; and the old Van de Graffs were brought back into the basement. The atmosphere now was that finally Physics was important, particularly Nuclear Physics, and research was important so get on with it.

Prof. Richards was new. He was my advisor, and I was his first graduate student. There were at least twice as many grad students as before. Security of equipment and supplies was tightened. Space was at a premium.

The total staff and grad numbers were now much larger. The whole atmosphere had changed. It was now hard for a person to know personally all the staff and grads.

I finally got to use the big Van de Graff generator in August 1948 for research. It ran 24 hours a day, with operation and data taking by me and several graduate students. This was an education to prepare them for their own future research work with this equipment.

In 1948, radiation danger became a concern. Cement block shielding was placed around the big machine. Radiation danger signs were placed in the hall nearby. Personal dosimeters were beginning to be issued to operators.

In January 1949, my work was finished and I left Madison, returning in June for graduation for my Ph.D. degree.

REMINISCENCES OF STERLING HALL

by Robert D. Krohn

I read with great interest the two articles in the recent The Wisconsin Physicist about memories of Sterling Hall. After reading them, I felt compelled to write you about some of my experiences. I was sorry that the Physics Department was vacating Sterling Hall as I have a special fondness for it and used to visit it on my infrequent trips to Madison.

I spent much time there because, as an Electrical Engineer undergrad, I was required to take three years of physics taught, of course, by the physics staff, and then as a graduate student in physics, had what was my own lab under Professor Wahlin. All of my physics courses as an undergrad were taught by Wahlin with the exception of one-half semester under Professor Ray Herb which was interrupted when he went to MIT to the Rad Lab to help develop the radar program for the war. In that short half semester, I became acquainted with Dr. Herb and was pleased to see an article by Anne Herb in The Wisconsin

Physicist. In later years a visit to his "Van de Graff" factory was a real treat as his machines were absolute jewels in their design. Absolute Jewels!

I remember: Professor Ingersoll was the Department Chairman and Moll McGuire was housemother to all the physics students. She was just marvelous. The battery room run by (I think his name was) Dobbs who also kept the supply of chemicals we physicists needed such as cyanide for plating and his magic fluid for cleaning glassware which was extremely powerful. I remember once about a week after I cleaned a number of glassware pieces when I was working in the lab late and it was raining out, I decided to put on my dirty lab trousers to walk home rather than the better trousers I was wearing. I did so and was annoyed when two different groups of coeds pointed at me and laughed as they passed me. It turned out that when I got to my room I discovered that parts of my trousers were missing (eaten away) and they were looking at my undershorts. After I recounted that experience to Dr. Wahlin, he told me that one morning he had stepped in a spill of the fluid and later when he walked to the Faculty Club for lunch, he discovered that on both shoes the sewing on the soles had eaten away and the soles of both shoes flapped on the sidewalk as he walked. Wahlin also enjoyed showing visitors his class record book from about 1925 where a student in one of his physics courses named Charles Lindbergh had failed his course. (He also flunked out of Wisconsin.) Then there was the time when a young graduate student, last name Sears, arrived and all other students tried to talk Professor Roebuck to write an article with him submitted, of course, by Sears and Roebuck.

I remember the Department picnics at picnic point and the great times using Wahlin's canoe to tour the four lakes.

As I stated at the beginning, this is more than you want to know and I apologize, but I am very sad with the move of the Department, but I understand the necessity. Even when I was there, Sterling Hall was overcrowded. Incidentally, my lab was right next to the then general shop and is now part of the student shop.

UNIVERSITY PHYSICAL SOCIETY

The Physics Club of University of Wisconsin-Madison, also known as the University Physical Society, can be found at ups.physics.wisc.edu. Check it out! Also, check out our new room in 2328 Chamberlin Hall, which overlooks the Charter Street entrance.

They feature information on:

- Jobs: job posting in the UW Physics Department
- Events: Upcoming UPS Events
- Officers: Your UPS Officers
- Research: How to find research opportunities
- About: What is the University Physical Society?
- Tutoring: We offer volunteer tutoring
- Humor: Bad physics humor
- Photos: Physics Club memories

They also provide links to The American Physical Society and the Society of Physics Students.

UPS officers:
Shane McMahon (President)
Seth Bruch (Vice President)
Don Fahey (Treasurer)
Kristen Jones & Jonathan Hedstrom
(Activities Coordinators)
AJ Carver (Outreach Coordinator)
Ben Payne (Secretary)

UPS officers (L-R): Shane McMahon, Kristen Jones, Don Fahey, Ben Payne, Jon Hedstrom & Seth Bruch

FACULTY NEWS & AWARDS 2005–06

After a vigorous 2004–05 faculty recruitment effort led by the New Staff Committee, the Physics Department started last fall with three new Assistant Professors: **Teresa Montaruli, Matthew Herndon** and **Frank Petriello**.

Teresa Montaruli

Assistant Professor **Teresa Montaruli** received her Ph.D. in physics in 1998 from the University of Bari, working in the MACRO Collaboration on the measurement of atmospheric neutrinos. MACRO was an Italian-American experiment located in the National Laboratories under the Gran Sasso mountain in central Italy mainly devoted to monopole, neutrino and cosmic ray searches. After her Ph.D., the experiment published the results on the evidence for neutrino oscillations and on searches for astrophysical neutrino sources in the universe. A part of the thesis was also devoted to Monte Carlo calculations of atmospheric showers. This work resulted in one of the most widely used estimates of the atmospheric neutrino flux by underground experiments such as Super-Kamiokande, MACRO and Soudan-2.

Following these activities, in 2001 she was presented the Shakti P. Duggal Award at the opening ceremony of the 27th International Cosmic Ray Conference in Hamburg, an award "introduced since 1983 in recognition of significant contributions to cosmic ray physics by a young scientist of outstanding ability." From 1998 to 2001 she was a post-doc and researcher for the Istituto Nazionale di Fisica Nucleare (INFN) — Laboratori Nazionali di Frascati and of the University of Bari. During this period she performed many feasibility studies for an underwater detector in the Mediterranean made by an array of photosensors. This project became funded as an R&D study for a cubic-kilometer detector close to Sicily's coast and INFN joined the European underwater neutrino telescope project ANTARES.

She was an Assistant Professor beginning in 2001 at the University of Bari, and she joined the Physics Department at the University of Wisconsin-Madison in 2005. Here, she joined the IceCube Collaboration for the construction of the largest neutrino telescope in the world at the South Pole.

Assistant Professor **Matthew Herndon** received his Ph.D. in experimental particle physics in 1998 from the University of Maryland at College Park. He worked with Hassan Jawahery on a search for evidence of the Bc meson using data from the Omni-Purpose Apparatus at the LEP (OPAL) experiment located at the Large Electron Positron collider (LEP) at the European Organization for Nuclear Research (CERN) Laboratory on the French-Swiss Border near Geneva, Switzerland. The Bc meson is interesting because it is the heaviest possible bound state of two different quarks.

After working on the OPAL experiment he went to the Collider Detector at FermiLab (CDF) located at the Tevatron p-pbar collider at the Fermi National Accelerator Laboratory in Batavia, Illinois. There, working with the Johns Hopkins University group, he continued studies in heavy flavor physics involving b quarks primarily working on searches for rare decays of the Bs meson. An example is the Bs meson decay to two leptons which if observed would be unambiguous evidence of physics beyond the Standard Model (SM) of particle physics.

Matt Herndon

Currently Professor Herndon leads the CDF B physics group which includes 200 physicists working on 50 different B physics topics. In addition, he is preparing for the start of data taking of the Compact Muon Solenoid (CMS) experiment which will be located at the Large Hadron p-p Collider (LHC) at the CERN Laboratory. There he intends to work on searches for the evidence of new physics particles detected though decays to very high momentum leptons.

Assistant Professor **Frank Petriello** is a theoretical particle physicist who seeks to uncover the underlying structure of Nature using data from high energy collider experiments. His research directions include sharpening our understanding of what the Standard Model of particle physics predicts for important experimental observables, and devising signatures for theories of new physics at future experiments such as the LHC. He received his Ph.D. from Stanford University in 2003, and was most recently a postdoctoral researcher at Johns Hopkins University.

Frank Petriello

Faculty Promotion

Congratulations to **Albrecht Karle**, who was promoted to Full Professor, effective August 2005.

Faculty Retirements

Willy Haeberli was born in Zurich, Switzerland in June, 1925 and received his Ph.D. from the University of Basel in 1952. He came to Wisconsin first as a postdoctoral research associate in 1952 and then, after a short period as a Visiting Professor at Duke, returned to Madison as an Assistant Professor in 1956.

Willy Haeberli with statue of Einstein by sculptor Wilhelm Uhlig — a retirement gift from Erhard Steffens.

Willy's research career spans more than 50 years and is filled with a great number of remarkable accomplishments. During the '60's he played a central role in the development of polarized ion sources. By the middle of the decade two novel polarized sources were installed on the Wisconsin Tandem Van de Graaff Accelerator — PSI, that produced polarized negative ions by an atomic beam method, and PSII, the first operating Lamb-shift polarized source. Work on both techniques continued, and by 1970, he brought PSIV, an improved lamb-shift source, on-line. About the same time Willy proposed a scheme for direct production of polarized negative ions by charge transfer with a crossed beam of cesium ions and, by 1982, a crossed beam ion source (PSV) had been installed. This source became the workhorse for the Wisconsin nuclear physics program for the next 15 years.

Throughout this time period, Willy's group performed a wide variety of nuclear physics experiments using polarized beams. One of many highlights was the study of polarization effects in transfer reactions, which was shown to provide an efficient means to determine spins of nuclear states and additionally led to the study of D-state components in the A=2, A=3 nuclear wave functions.

In the '70's, Willy began work on a series of important and well-known experiments in Switzerland in which beams of polarized protons were used to observe parity violation in *pp* and *p*α scattering. These experiments set a new standard for precision measurements and were the basis of the eventual determination of the weak meson-nucleon coupling constants. Meanwhile his group in Madison began their study of the fundamental strong nucleon-nucleon interaction by measuring polarization effects in *pp* and *np* elastic scattering. The *pp* measurements were later extended to higher energies in a series of difficult and impressive experiments at the IUCF cooler ring.

In the '80's he conceived of producing polarized targets using a storage cell to capture atoms from an atomic beam. As the design of these devices evolved, polarized gas targets developed at Wisconsin were installed in a number of storage rings worldwide including the machines at Indiana, at DESY in Germany, and most recently, at RHIC in Brookhaven National Lab.

Willy is the recipient of numerous honors. He was awarded the Bonner Prize in Nuclear Physics in 1969 for his work on polarized targets, and was named the R. G. Herb Professor of Physics in 1977. He was a Humboldt Fellow and a Japan Society for the Promotion of Science Fellow. In 1984 he was awarded the Steenbock Professorship in the Natural Sciences. In 1988 he was made a Fellow of the America Academy of Arts and Sciences, and in 2002 he was elected to the National Academy of Sciences.

Throughout his career, Willy has served the department and the University with honor and distinction. He is perennially one of the top teachers in the department and is a model of rationality in committee work. Together with Ugo Camerini, he conceived and developed Physics 109 (Physics in the Arts), one of the most popular courses in the department.

Don D. Reeder entered graduate school at the University of Wisconsin in 1961, after graduation from the University of Illinois, and service in the United States Navy. He received his Ph.D. in Physics in 1966 under the guidance of Professor Myron Good. Reeder joined the faculty as an assistant professor that same year. He was promoted to associate professor with tenure in 1968, and to full professor in 1971. His entire professional career has been at Wisconsin.

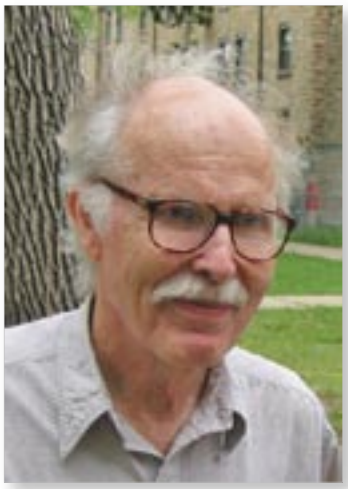
Reeder's research has been in the fields of experimental high energy particle physics and experimental cosmic ray physics. He has carried out a number of experiments at national laboratories and remote cosmic ray sites over the forty-year span of his activities. Reeder was one of the first experimenters at the Fermi National Accelerator Laboratory when it opened for business in 1971. He began a program of experiments to study the interaction of high energy neutrinos in a large detector built of iron plates and spark chamber particle detectors.

Don & Carol Reeder at the 2005 Physics Awards Banquet.

Reeder has served as the advisor to twenty-one graduate students at Wisconsin, many of whom have had distinguished careers in teaching and research themselves. Reeder has taught a broad range of courses, including introductory and intermediate undergraduate and graduate

level subjects. He has been innovative in undergraduate teaching of physics to both science and non-science majors.

Martin Olsson was born and raised in Los Angeles, California. He received his BS degree from Caltech in 1959. His graduate work was at the University of Maryland, where he received his PhD in 1964 under the direction of Gaurang Yodh. He joined the Fry-Camerini group as a post-doc in 1964 and joined the Physics Department as an Assistant Professor in theoretical physics in 1966. He has been a member of the Phenomenology Institute since its founding in 1984. Martin served on the UW-Madison faculty continuously until his retirement in May 2005.



Marty Olsson at the 2005 Alumni Celebration picnic. *Photo: Bob Morse*

Martin has made major influential contributions toward academic life in our Department. He was active in departmental governance, serving as Department Chair from 1988 to 1991, and Associate Chair from 1998 to 2004. He has been widely known as an excellent teacher, developing two new courses and receiving the recognition of the Chancellor's Teaching Award in 1989. He co-authored two successful textbooks (with Vernon Barger), one on junior-level mechanics and the other on junior-level electricity and magnetism. These books are still widely used, one of them after 35 years.

Martin's research interests lie primarily in the area of elementary particle theory, especially in the theory of the properties of strongly interacting matter (hadron physics). The contributions for which he is best known are:

1960's: The coherent isobar model (his PhD thesis), Regge pole theory and analysis, and dispersion relations for pion-pion and pion-nucleon scattering.

1970's: Current algebra/PCAC models of a wide variety of processes, featuring a new treatment of the Delta (1232) resonance.

1980's: Heavy quarkonia, introducing new numerical methods to efficiently solve relativistic wave equations such as the spinless Salpeter and the reduced Salpeter equations.

1990's: The relativistic flux tube model of hadrons. This QCD-inspired model holds considerable promise as a realistic hadron model. Much work was also completed on form factors for heavy-light mesons.

2000's: A new method for extracting the pion-nucleon sigma term and continued progress on the flux tube model with fermionic ends and relations to potential models.

Martin directed the PhD theses of 15 students and collaborated closely with them. Some of those collaborations have endured for many years. He is a Fellow in the APS Division of Particles and Fields.

Martin has retired to Portland, Oregon. For his leadership, teaching, research and unique sense of humor, Martin will be sorely missed by his colleagues, friends, and our physics students.

Albert Erwin joined the faculty at the University of Wisconsin as an Assistant Professor after earning his doctorate at Harvard in 1959. He was promoted to Associate Professor with tenure in 1962, and to Full Professor in 1965. His entire professional career has been at Wisconsin.

Denise Morchand-Erwin and Al Erwin at the 2005 Physics Department Awards Banquet.

Erwin's research has been in the field of experimental high energy particle physics. He has carried out a number of experiments at national laboratories over the 40 year span of his activities. His last 30 years of research covered many interesting aspects of particle physics at the frontier of knowledge. In his retirement, Erwin is working on a Fermilab-based neutrino experiment. Neutrinos are currently a very hot topic in particle physics. Erwin has always remained at the cutting edge.

Erwin has trained thirteen Ph.D. graduate students, many of whom have had very active research careers themselves. Erwin has taught a broad mix of courses, including introductory and intermediate undergraduate, and graduate level subjects.

Erwin is a fellow of the American Physical Society. He has served the Physics Department and the physics community through numerous committee assignments over the years. Through the years, Albert Erwin made distinguished contributions to teaching, research, and service.

Faculty Awards 2005–06

Professors **Bob Joynt, Mark Saffman** and **Mark Friesen** have recently received National Science Foundation EMT (Emerging Models and Technologies) for Computation grants for work on quantum computing. NSF was estimating that nationwide there would be 35-45 awards, so having three Wisconsin Physicists among this group is quite an honor.

Assistant Professor **Gary Shiu** was the recent recipient of a Research Corporation Cottrell Scholar Award for $100,000. This

follows his 2003 Research Corporation award of $35,000. Thirteen awards were made out of 136 applications received. The title of his project is "Connecting String Theory to Experiment." Frederick Gardner Cottrell, the chemist for whom these awards are named, founded and endowed Research Corporation with the patent rights to his invention, the Cotttrell electrostatic precipitator. The award honors his generosity as a benefactor of science through Research Corporation and his lifetime devotion to helping young scientists get their start. Cottrell forsook personal wealth by founding Research Corporation in a philanthropic gesture that still stands as an inspiration for others.

Assistant Professor **Dan Chung** was named a Department of Energy Outstanding Junior Investigator in High Energy Physics for his proposal, "Connecting Cosmology and High Energy Physics." The principal purpose of this program, which began in 1978, has been to identify exceptionally talented new high energy physicists early in their careers, and to assist and facilitate the development of their research programs. Each year since the program began, between five and ten new Outstanding Junior Investigators have been added to the program. Awards made under this program help to maintain the vitality of university research and assure continued excellence in the teaching of physics.

Sabbaticals Awarded

Professors **Baha Balantekin**, **Tao Han** and **Dan McCammon** were each awarded a sabbatical for the academic year 2004–05, and Professor **Franz Himpsel** was awarded a sabbatical for the Fall semester 2004–05 to pursue his research.

New Ingersoll Physics Museum

PHYSICS MUSEUM OPENS IN CHAMBERLIN

Please Help Us With Our Dream For the Future.
(For photos, go to www.physics.wisc.edu/museum/)

The L. R. Ingersoll Physics Museum is now located on the second floor of Chamberlin and is open for visitors. The museum has a wonderfully large room facing University Avenue and has actually doubled in size from its previous location in Sterling Hall. We are still in the process of reconstructing. Signs are still missing from current exhibits and new exhibits are being prepared. Brand new ideas on what the future may hold as we strive to improve our "outreach" activities are being discussed. (Do you have good ideas? Send them to buehlman@wisc.edu.)

We are starting out our dream quite simply. To begin with, you will be able to see the passage of Cosmic Rays, observe the waveform and the Fourier analysis of your voice, see how the beauty of Lissajous curves correspond to pleasing consonances, note the shape of the magnetic field, view color addition and subtraction, among other things. Alumni who were here the weekend of August 12 & 13, 2005 were the first visitors to the museum and tried out our extended "hands-on" attitude. Young and old appreciated the opportunity to "touch" the exhibits and see how they worked for themselves. Many local people have told us how they came to visit the original physics museum in their youth and how much they remembered that experience. In some cases, it had an influence on what they chose to study.

What's next? With this wonderful space and your help, many more exhibits that will tickle your imagination and illustrate the laws of physics are possible. We are in the process of applying for grants for staffing. We have established a new "Friends of the L. R. Ingersoll Physics Museum" for those of you who are interested in helping to support this effort. If you wish to become part of the history of this endeavor, please go the "Support Physics at Wisconsin" page in this newsletter and designate your gift to the Friends of the L. R. Ingersoll Museum of Physics or go to www.physics.wisc.edu/giving/ to make an electronic donation. We feel this is a rare moment in time, and your donations to this cause will help determine the future of the Physics Department outreach effort for years to come.

Dynamo demonstrating a force exerted by a magnetic field on an electrical current.

WONDERS OF PHYSICS: PHYSICS FOR THE PEOPLE

by Jim Reardon (608) 262-2927, jcreardon@wisc.edu

If you have driven on the back roads of Wisconsin this year, you may have seen a white van with WI state plates filled with strange and shiny contraptions. This is the Wonders of Physics Traveling Show, sent from the UW–Madison Physics Department to schools around Wisconsin to get kids excited about science.

Jim Reardon

The Traveling Show visited Goodman-Armstrong Creek High School in Goodman, WI in October. The 100 or so students in grades 7-12 filled the gymnasium bleachers to watch the physics demonstrations. "The students were in awe about Physics and cannot wait to take Physics," said Laura Struve, Science Teacher at Goodman-Armstrong Creek.

The Traveling Show, and its main presenter, Jim Reardon, has logged over 10,000 miles during 2005, attempting to visit every county in the state. Since its founding in 1989 under the direction of Prof. Clint Sprott, there have been over 800 presentations of the Traveling Show in schools around Wisconsin, but as of the first of the year, 42 of the 72 Wisconsin counties had not yet been visited (see graphic below).

In celebration of the World Year of Physics 2005, the Traveling Show undertook a quest to visit schools in those 42 counties. Grants from the US Department of Energy and the National Science Foundation allowed the visits to proceed at no charge to the schools. "Taking the Traveling Show to the furthest corners of Wisconsin is entirely consistent with the department's service mission and is, in fact, a perfect example of the Wisconsin Idea upon which the University is founded," said Prof. Don Reeder, former Physics Department chair.

There were 83 free performances of the Traveling Show, to a total audience of over 14,000 students as part of the World Year of Physics. A snowstorm on December 14 closed schools in Vernon County, canceling that day's shows at Westby High School, but the Traveling Show made it to every other county (the Westby High School shows were rescheduled). The Traveling Show will continue traveling even after the excitement from the World Year of Physics is over. Should you venture off the main highways onto the back roads of Wisconsin, be on the lookout for a white van with state plates, filled with shiny contraptions, on the road in order to bring Physics to the people.

Wonders of Physics Traveling Show:
uw.physics.wisc.edu/~wonders

The next public presentations of *The Wonders of Physics* are:

February 11, 2007 at 1:00 pm and 4:00 pm
February 17, 2007 at 1:00 pm and 4:00 pm
February 18, 2007 at 1:00 pm and 4:00 pm

Scheduled presentations of The Wonders of Physics and tours of the Physics Department laboratories are given on the UW-Madison campus for the general public in mid-February each year. Tickets are recommended, are free and are available after January 1st by calling (608) 262-2927 or by email to wonders@physics.wisc.edu

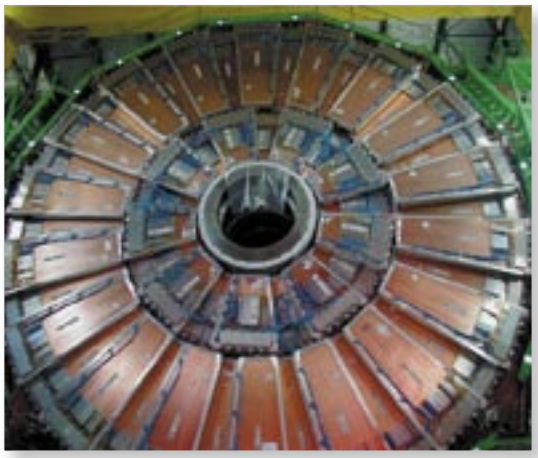
These presentations will be held in:
2103 Chamberlin Hall
1150 University Avenue
Madison, WI 53706-1390

Wisconsin counties visited by the *Wonders of Physics* traveling show.

NEW PHYSICS AROUND THE CORNER

by Sridhara Dasu

By all accounts we are on the verge of new discoveries in fundamental physics. The elusive Higgs boson, which provides masses for all fundamental particles, is within reach of the upcoming experiments at the Large Hadron Collider (LHC) being built at the European Organization for Nuclear Research (CERN). Whereas the Standard Model (SM) of particle physics is able to account for every detail of experimental observations so far, important questions remain unanswered. The instability of Higgs boson mass due to quantum corrections in the SM, proper unification of strong and weak interactions at very high mass scales, etc., beg for new symmetries, such as super-symmetry (SUSY) to provide an elegant framework for building models for the required new physics. If such new physics phenomena are realized in nature, they should become evident at the LHC energies. Our research group at Wisconsin is playing a leading role in the construction and commissioning of an experiment at the LHC called the Compact Muon Solenoid (CMS). We are also preparing to acquire and analyze data from CMS to exploit the unparalleled new physics discovery opportunities at the LHC.



Wisconsin engineering endcap muon system.

The LHC will collide protons on protons, at 14-TeV center of mass energy, at high luminosities. Unfortunately, both the rate of the strong interaction physics at the electro-weak symmetry breaking scale, and per event particle multiplicity are very large, providing a great challenge for CMS. At the design luminosity, an average of 17 collisions occur for each 25 ns crossing time, leading CMS to witness a billion proton-proton interactions per second, each with an average multiplicity of about 1000 particles. Extraction of signals, particularly those of the Higgs decays from the profusely produced SM background, requires exploration of low branching fraction leptonic or photonic modes with good energy resolution. Therefore, we helped design CMS with good resolution and high degree of segmentation, and a capability of withstanding a very high rate environment. The trigger system that we designed and built at Wisconsin is a crucial element in weeding out the well-understood background to retain the interesting high energy 1-MB sized events at the rate of about 100 Hz. Simulations of physics events, both signal and QCD background, that we perform remain crucial not only to characterize the physics performance of the detector and trigger systems, but also for developing sophisticated reconstruction software and analysis tools.

The projects of our Wisconsin group essentially span the full gamut of the CMS experiment: the construction of the muon detector, the calorimeter trigger electronics and the computing systems for data analysis. The CMS endcap muon detector, which we built with the collaboration of scientists from around the US, is on target for completion in 2006. The calorimeter trigger electronics that we designed at Wisconsin and manufactured using industrial contracts is also complete, and is scheduled for shipment to CERN. In preparation for the data analysis, we have built up large computing resources, some as part of the campus-wide interdisciplinary facility called the Grid Laboratory of Wisconsin (GLOW), using Condor-distributed high-throughput computing technology from the Wisconsin Computer Science department. We have also developed innovative software for harnessing these resources for CMS simulations, placing Wisconsin at the top of the CMS computing centers. In recognition of these successes, we have been selected to host one of the four US CMS Tier-2 centers funded as part of the Data Intensive Science University Network (DISUN) by the National Science Foundation.

Wisconsin-built trigger electronics.

The versatile and productive Wisconsin CMS group is all set to discover new physics that we believe is just around the corner.

HEP (High Energy Physics) computing facility

PHYSICS GRADUATE PROGRAM/ GRADUATE PROGRAM REPORT

by Barb Schutz

The year 2005 saw a return to the more typical numbers in our graduate program applicant profiles. The Admissions and Fellowships Committee (under the chairmanship of **Cary Forest**) is pleased to report that a total of 102 offers were made for Fall 2005. See Table 1 for admission statistics.

Table 1. Fall 2005 Applications and Admissions			
	Applications	Offers	Acceptances
Total	**369**	**102**	**31**
Domestic	169	71	23
International	200	31	8
Male	284	78	23
Female	85	24	8

Although the total number of applications was up approximately 7% from last year, domestic applications were down about 6%. International applications for Fall 2005 showed an overall increase of 21%. While Chinese applications remained the same as last year, the boost was seen in international applications from other countries. A notable statistic shows female applications up 10%. We have 31 new students for the Fall of 2005, including one Advanced Opportunity Fellowship.

Recruiting actions instituted in 2000 continue to be successful — namely, two group visit events in March and early April, greater involvement of current graduate students, an increased financial supplement to all TA offers with a marked boost to our top 5 applicants, and several summer RA offers to prospective students. Our current group of first- and second-year graduate students deserves special recognition for the effort and enthusiasm they demonstrated in assisting with our group visit events this year. They are a cohesive group who have proven to be terrific ambassadors for our graduate program. Prospective students unable to participate in the group events were given the option of an individual visit to campus.

Cavendish McKay

We invite you, as alumni, to encourage prospective graduate students to consider pursuing their graduate studies at UW-Madison.

Awards Honor Graduate Students

Cavendish McKay won the **Joseph Dillinger Award for Teaching Excellence** in May, 2005. Cavendish has served as a TA for the new majors sequence, Physics 247 and 248. Congratulations, Cavendish!

Guiyu Huang and **Brian Boland** won the **Emanuel R. Piore Award**, which is presented annually to recognize excellence on the Qualifying Examination.

The **Jansky Award** was given to **Peter Hyland** of Physics. This award goes to an outstanding graduate student pursuing an advanced degree with interest in astrophysics and astronomy.

Peter Hyland

Peter writes, "I came to UW from Case Western Reserve University. At Case, I became involved with the Cryogenic Dark Matter Search while looking for work over one summer. I found that the questions about astrophysics which CDMS dealt with very interesting and decided to continue investigating astrophysics when I graduated and moved on to graduate school."

"When I came to Madison Prof. Timbie offered me a part-time research appointment in his lab. I knew very little about the Cosmic Microwave Background Radiation, but Prof. Timbie and everyone else in his group were very helpful in bringing me up to speed. I find the concept and questions addressed by our research to be a lot of fun and engaging. I will be finishing the construction of our experiment, the Millimeterwave Bolometric Interferometer, and then sharing responsibility for running it and analyzing the data. I also plan to take advantage of the Delta program here at UW-Madison. Teaching others has always been of great interest to me and ultimately I would like to end up with a Professorship that will allow me time for both research and teaching."

This year three women were awarded the **Hirschfelder Award**, to pursue travel or a conference in support of their area of research, **Evelina Tsoncheva**, **S. Gwynne Crowder** and **Maria-Teresa Herd**.

Gwynne Crowder

Teresa writes, "I went to Bryn Mawr College, where I graduated with a degree in Physics and Astronomy in May 2002. I started my graduate work at UW-Madison the following fall and began working with Jim Lawler in Spring 2003. Currently, I am studying

the infrared continuum of HID (High Intensity Discharge) Metal Halide lamps. This summer I have an internship with the lighting division at GE."

Jeremiah Bodenner and **Nicolas Nelson** won the **Advanced Opportunity Fellowship** for 2004–05.

Jeremiah Bodenner

Jeremiah writes, "While an undergraduate at UW-River Falls, I participated in the McNair program. With it, I was able to do a project at Washington University under the guidance of Dr. Clifford Will. To second order, I calculated the light deflection angle about objects exhibiting Schwarzschild gravity (i.e. stars). I showed that in three different coordinate systems, the predicted deflection was the same."

"I'm interested in fundamental physics and the problem of unifying general relativity with quantum mechanics. I desire to put one of the pieces of the puzzle together."

Fan Zheng received a Vilas travel award.

Christopher Carey, currently pursuing his Ph.D. in Plasma Physics, has been awarded a **Computational Science Graduate Fellowship** from the **Department of Energy**. The DOE CSGF is a highly competitive program funded by the Office of Science and Office of Defense Programs. These fellowships are awarded annually and support the education of doctoral students focusing their studies on the use of high-performance computers to solve complex problems in science and engineering.

"The DOE CSGF program gives me the freedom to take my graduate research in whichever direction most interests me, since it frees my research from being tied to a grant," said Carey. "This is a fantastic opportunity which doesn't happen often in a person's career. I am also excited about the practicum at a DOE laboratory. I have worked at Los Alamos National Laboratory in an experimental division. I enjoyed the work there and the beautiful country around the lab very much. The practicum presents the opportunity for me to return and experience a theory division there."

APS Meeting, November 2005, Denver, Colorado

A UW-Madison alumni of our program, **Dr. Stefan Gerhardt**, received an award for the best Graduate Student Thesis. (Stefan did his Ph.D. work in electrical engineering at the UW-Madison with Prof. Dave Anderson).

NEW PHYSICS PH.D.'S

August 2004

David Albers — *A Qualitative Numerical Study of High-Dimensional Dynamic Systems* (Sprott), Postdoctoral Scholar, Center for Computational Science, UC-Davis

Bryan Barnes — *Correlating the Physics Interfaces and Magnetically Active Thickness of Ultrathin Cobalt Films* (Lagally) Postdoctoral Fellow, NIST, Gaithersburg, MD

Ran Liu — *CP and Branching Ratio Measurement in B to P pi(k) Processes at BaBar* (Wu), Marshall School of Business

Jessica McChesney — *Connecting Electronic Structure with Interatomic Potentials: Si(III)5x2-Au* (Himpsel) Postdoc, Lawrence Berkeley National Lab, Advanced Light Source

Stephen Peterson — *Image-based Dosimetry of an Implanted Radioactive Start Using IVUS* [Nickles/Thomadsen (Med Phys)] Professor, Davidson College Physics Department

David Steele — *A Search for Extraterrestrial Point-Sources of Neutrinos with AMANDA-II* (Halzen)

Krupakar Subramanian — *Diagnostic Study of Steady State Advanced Fusion in an IEC Device* [Prager/Kulcinski (EP)] Plasma Tech Engineer, Microntechnology

December 2004

Olivia Castellini — *Photoconductivity Studies of Carbon Nanotubes on Quartz Substrates* (Eriksson), Research Associate, UW-Madison, Engineering Physics Department

Sean Cordone — *Instrumentation for Precision Measurements of Anisotropy in the Cosmic Microwave Background* (Timbie) Senior System Architect, ISLO International

Andrew Eichenbaum — *Direct CP Violation in b to S Gamma Decays* (Prepost), Research Associate, UW-Madison Engineering Chemistry Department

Matthew Marcus — *Characterizing Carbon Nanotube Structures: Optical & Mechanical* (Eriksson), Research Associate, UW-Madison, Engineering Chemistry Department

Jennifer Sebby — *Production of High Density Mesoscopic Atom Clouds* (Walker), Postdoc, NIST

James Truitt — *Spin Coherence in Silicon/Silicon Germanium Nanostructures* [Eriksson/van der Weide (ECE)], Instructional Specialist, UW-Madison, Liberal Studies & the Arts Department

Jinwei Wu — *Study of Branching Fractions and CP violating Asymmetries in B Meson Decays to rho and pion Final States with the BaBar Detector* (Wu), Postdoc

May 2005

Earl Babcock — *Spin Exchange Optical Pumping with Alkali Metal Vapors* (Walker), Postdoc, Institute Laue-Langevin, Grenoble, France

Kyle Cranmer — *Searching for New Physics: Contributions to LEP and the LHC* (Wu), Postdoc, BNL, Omega Group, Upton, NY

Ana Garcia Perciante — *Temporal and Spatially Dependent Neoclassical Viscosity* (Callen/Terry), Postdoc, UW-Madison Engineering Physics Department

Liang Li — *Three Jet Production in Neutral Current Deep Inelastic Scattering with Zeus at HERA* (Smith)

Zhitang Yu — *Dalitz Plot Analysis of Decays* (Wu), Senior R&D Engineer, Clear Shape Technologies Inc., Sunnyvale, CA

Hasan Yuksel — *Constraints on Neutrino Properties from Astrophysical Observations* (Balantekin), Postdoctoral Research Associate, Ohio State University

Master's Degree Recipients		
August 2004	**December 2004**	**May 2005**
Dahai Liu	Ying Hsiang Cheng	Ramesh Bagadi
	Terrance Figy	Melanie Clarke Dosaj
	Jessica Hodges	Sarah Crowder
	Matthew Wilson	Joshua Kogut
		Paul Kutter
		Attila Mihalyi
		Meghan Curry O'Connell

AWARDS HONOR UNDERGRADUATE STUDENTS

At the APS meeting in early November 2005 (the Division of Plasma Physics in Denver, Colorado), several of our undergraduate researchers made presentations and were recognized for their contributions.

There were 65 undergraduates at the meeting. Of these, six were selected by a panel of judges to have made an outstanding presentation (poster) of their work. Three students were from the Plasma Physics Group at Madison! These individuals were: **Sam Stambler**, **Craig Jacobson**, and **Shane McMahon**. All three students were recruited from the Physics majors sequence: 247-248-249, and all graduated from UW-Madison this year. Congratulations Sam, Craig and Shane!

Undergraduate/Faculty Hilldale Awards

Kristen Jones received several awards this year. Since September 2004, she has been a **URS scholar**. She also was awarded a **Liebenberg Award** for summer 2005, and Kristen earned a **Sophomore Summer Honors Research Award** as well.

Steve Kaeppler was awarded an **REU** at Purdue University for summer 2005. He also received a **Wisconsin Space Grant Award**.

Seth Bruch received an **REU** at Michigan State for summer 2005.

Zacariah Labby won a **Sophomore Honors Summer Research Apprenticeship** to work with Professor Jim Lawler.

L.R. Ingersoll Awards

Michael Slutskiy

L.R. Ingersoll Awards for Distinguished Achievement in Undergraduate Physics for spring and fall were awarded on May 6, 2005 at the Physics Banquet & Awards Ceremony at the Fluno Center. Awardees included:

Spring 03-04

(103-104) **Amber Alisa Frank**
(201-202) **Allison Rebecca Bichler**
(207-208) **Matthew A. Bayer**
(248) **Michael Slutskiy**

Fall 04-05

(103-104) **Grace Tang**
(201-202) **Dean Sayre**
(207-208) **Michael Line**, **Nathaniel Brown**
(247) **Erin Conrad**

Nathaniel Brown & Michael Line

Albert Augustus Radtke Scholarship

The 2005 Albert Augustus Radtke Scholarship for Distinguished Achievement in the Study of Undergraduate Physics was awarded to several Physics students, including **Zacariah Labby**, **Christopher Yu** and **Douglas Lipinski**. **Zak Labby** wrote, "I am finishing up my sophomore year in the Applied Math, Engineer-

ing, and Physics program with a secondary major in Physics. As the title would imply, my degree work provides a broad foundation of math and physics courses, and courses from a chosen area of engineering. Since I was in kindergarten, I've always dreamt of being involved in the space program in some way, so I take classes from the Engineering Mechanics department aiming for an emphasis on fluid and aerodynamics. And not to be biased, but the physics classes have so far been my favorite."

Zac Labby

"For my academic future, I foresee graduate school in Aerospace Engineering, hopefully earning a Ph.D. For the near future, I work in a physics lab run by Prof. James Lawler, and summer 2005 I helped him build a spatial heterodyne spectrometer (SHS) for research in laboratory astrophysics. Being in an environment focused on atomic physics, I have recently been contemplating graduate school of some sort in Physics, studying tribology on the atomic or molecular level. Learning how nature works at its most fundamental level has always intrigued me, so I hope to attend graduate school in these multiple areas and draw some connections between fluid dynamics and tribology (and who knows, maybe discover the meaning of life, the universe, and everything along the way)."

Fay Ajzenberg-Selove Award

The 2005 Fay Ajzenberg-Selove Award for outstanding undergraduate women majoring in Physics, Astrophysics or Astronomy had two winners: **Adrienne Stilp** (Astronomy) and **Rebecca Shapiro** (Physics).

Adrienne Stilp

Liebenberg Family Undergraduate Summer Research Fellowship

Our thanks go to the family of Maude Liebenberg and her son, Don. Because of their generosity, the Undergraduate Summer Research Fellowship was available for **Kristen M. Jones** at the May awards banquet. This award provides funding to encourage undergraduates to become involved in summer research programs.

Dr. Maritza Irene Stapanian Crabtree Undergraduate Award

2005 was the third year of this award, which stems from a bequest by William Crabtree on behalf of the late Dr. Maritza Irene Stapanian Crabtree to the University of Wisconsin to support tuition and fees based equally on merit and need for undergraduate students in Physics. 2005's winner was **Jon Hillesheim**. Congratulations, Jon!

Jon states, "I have always been interested in trying to figure out the world around me and how things work and why things happen. As I progressed through my education, this led naturally to the field of physics. In addition to wanting to understand the world around me, I also like putting that knowledge to use, getting a tangible outcome and seeing the results of my labors. These factors have guided me towards my chosen majors of physics and electrical engineering. I am also considering adding a third major in mathematics."

Jon Hillesheim

"I have just completed my second year at Madison. Currently, my primary interest is plasma physics and controlled fusion, and Madison is a great place for it with several plasma experiments on campus. During the coming year I plan on getting involved with one of the research groups. If things go as planned, I will graduate in May 2007, which will be followed by graduate school. Beyond that, the future is ripe with possibilities."

Bernice Durand Undergraduate Research Scholarship

Our award that goes to undergraduate women or minorities majoring in or planning to major in Physics or Astronomy is made possible through the generosity of Associate Vice Chancellor and Physics Professor Bernice Durand, who established this scholarship to encourage young women and minorities to do research and continue their career in science. 2005's winner was **Jessica R. Waters** who will work with Professor Peter Timbie doing research this fall.

Henry and Eleanor Firminhac Physics Scholarship

This was the first year for this award, which is given to undergraduates or graduates in Physics with financial need as the primary consideration, with at least one-half of recipients being women. 2005's winner is **Jonathan Carl Hedstrom**.

Erin Conrad

CONNECTING COSMOLOGY & HIGH ENERGY THEORY

by Daniel J.H. Chung

Cosmology is the study of the history of the universe. As it involves physics at vastly disparate time/energy scales ranging from 10 billion years (the age of the universe) to 10-43 seconds (the birth of the universe), cosmology is an intrinsically interdisciplinary field. Given that high energies correspond to short distances and times in quantum mechanics, and that cosmological phenomena can typically reach energies far greater than those available at terrestrial colliders, the study of high energy phenomena in cosmology has the best chance at giving us a glimpse of physics at the most fundamental level.

The basic observation that led to the birth of cosmology is that the universe appears to be isotropic about every point and is expanding. This means that when averaged over about 3x108 light year scales, every clump of matter is receding away from every other clump of matter. It is a kind of an explosion without a unique detonation point since every point looks like a detonation point. Of course, in principle, this interpretation of a large body of astronomical/astrophysical observations would not be compelling without a theoretical framework: Einstein's General Relativity. According to Einstein's theory, which is summarized by a set of second order nonlinear partial differential equations of the form

$$G_{\mu\nu}[g_{\alpha\beta}] = 8\pi T_{\mu\nu}[g_{\alpha\beta}, \{\psi_i\}], \qquad (1)$$

spacetime's meter stick and clocks encoded in the metric field $g_{\mu\nu}(x)$ evolves and interacts with energy and momentum encoded in the stress energy tensor $T_{\mu\nu}(x)$ (containing information about protons, neutrons, electrons, photons, etc. represented by $\{\psi_i\}$ in Eq.(1)]. Eq. (1) must be supplemented by equations governing the evolution of the nongravitational fields $\{\psi_i\}$ and initial conditions for all fields. According to Eq. (1), a homogeneous and isotropic universe should be generically expanding or contracting because a static universe is unstable to perturbations. This model is known as the Friedmann-Robertson-Walker (FRW) model. The success of Einstein's theory and the FRW model in light of mounting observational data makes this cosmological model very compelling, at least on the surface.

To account for the inhomogeneities that are obviously present in the universe, perturbation theory is used to introduce inhomogeneities about the homogeneous FRW solution. In this way, cosmologists can build a realistic model of the universe and compare with observations. Basic experimental observations include the cosmic microwave background, galaxy/cluster matter distributions inferred from various electromagnetic observables, gravitational lensing, atomic/molecular emission and absorption spectra, cosmic rays, and astronomical data.

Currently, we have a remarkably self-consistent picture of cosmology, which consists of the following ingredients of the stress energy tensor $T_{\mu\nu}$ which enters the right hand side of Eq. (1): 73% "dark energy" (DE); 22% cold dark matter (CDM); 4.4% in baryons (protons and neutrons); 0.6% neutrinos; 0.005% in photons. The exciting challenge for cosmologists is that we do not know the nature and composition of 95% of the energy density in the universe (DE and CDM) in the same way that we know what protons and neutrons are (we only have an approximate volume dilution and gravitational property of the DE and CDM). We only know that these unidentified fields exist in nature mainly because observations interpreted in the context of Einstein's equations require more stuff that gravitates (CDM and DE) and something that has negative pressure (DE). In particular, we have good evidence that CDM cannot come from the Standard Model (SM) of particle physics, the current fundamental theory that governs the $\{\psi_i\}$ (on the right hand side of Eq. (1). (Note that the SM has been extremely well tested at colliders, and is the pride and joy of high energy physics.)

Including these problems, the current problems in cosmology can be listed as follows:

C1. What is dark energy?
C2. What is cold dark matter?
C3. Why are there more baryons (e.g. protons) than antibaryons (e.g. antiprotons)?
C4. If inflation solves the cosmological initial condition problems, what is the inflaton?
C5. How are classical singularities of general relativity resolved?
C6. What is the origin and identity of ultra-high energy cosmic rays?

As we have already discussed the first two problems, let us briefly consider the other four problems. Problem C3 refers to the fact that in the SM, baryon number (more correctly, baryon plus lepton number) can be erased when the universe is at a high temperature. If such erasure would occur, there would be an equal number matter and antimatter. However, just as you and I are made of matter, most baryons in the universe are matter and not antimatter. Problem C4 refers to a particularly successful paradigm for constructing initial conditions for cosmology called "inflation," which has been gaining more and more favorable observational evidence, particularly from cosmic microwave background (CMB) measurements. This paradigm, just like the dark energy problem, requires something that provides negative pressure, but as far as we know, this negative pressure cannot come from something in the SM. Problem C5 refers to the fact that classical General Relativity is generically self-destructing, as evinced by the Hawking-Penrose theorem, which states that any realistic classical general relativistic solution will be singular (which will imply a dead end for the evolution of a physical system or a loss of predictivity for the theory). Problem C6 refers to the problem that there may be observational evidence for cosmic rays traveling cosmological distances at energies far beyond that which can be explained by the SM.

Astute readers would have noticed that many of the cosmological problems discussed previously involve the SM (and General

Relativity), and that the problems may be solved if the SM were corrected appropriately. Interestingly enough, from purely high energy theory considerations, the SM also contains a number of puzzles/inconsistencies:

P1. If a fundamental scalar field called "Higgs" exists, why is it light?
P2. What is the origin of electroweak symmetry breaking?
P3. Is it simply an accident that the gauge couplings seem to meet?
P4. How is gravity incorporated into the SM?
P5. Why is CP violation from QCD small?

The first two problems are associated with the fact that without special symmetries, quantum fluctuations render any perturbatively interacting scalar field sensitive to physics at higher energies than at which we know the physics. The third problem is associated with the observation that the strengths of the fundamental forces become the same at high energies (~ 1016 GeV) in the SM. The fourth problem is that since all SM fields are quantized, one would expect gravity to be quantized as well, but straightforward quantization renders the theory unpredictive. The final problem is that an incredible tuning of parameters (1 part in 109) is required in SM to suppress (in accordance with observations) naturally large asymmetry that exists due to QCD between matter and anti-matter reactions of the form $ab \to cd$ and $\bar{a}\bar{b} \to \bar{c}\bar{d}$.

As one may surmise from the problems just discussed, there is a natural symbiotic relationship between high energy theory and cosmology. Solving cosmological problems may inspire conjectures of physics beyond the SM (fundamental physics at energies beyond what is currently testable in laboratories) and solving high energy theoretical problems may inspire solutions to cosmological problems. My research program at UW-Madison is to exploit this symbiotic relationship between cosmology and high energy to provide insights into both fields.

My research has examined aspects of all cosmological problems C1 through C6 which have had impact on high energy theory problems P1 through P5. Most of my research is focused on observable connections between high energy theory and cosmology rather than purely theoretical conjectures. For example, my collaborators and I have popularized a class of dark matter called "nonthermal dark matter" and proposed a very broad new class of "nonthermal dark matter" candidates called "superheavy dark matter" which naturally connects C2, C4, C6 and has implications for P1-P5. Recently, we have uncovered new observational signatures for this class of dark matter. The new observational signature ties in CMB temperature fluctuations, CMB polarization fluctuations, and LHC/collider physics in the context of supersymmetry (which extends Einstein's Theory of Relativity by uniting bosons and fermions).

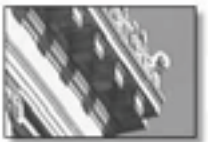
In another example of this symbiosis, my collaborators and I have shown that Lorentz violations are naturally induced in braneworld models (scenarios in which the SM fields are confined to a subspace of spacetimes with dimensions greater than four) and that they may lead to a distinctive Lorentz violation signature. This has implications for tying C5 and P4 in the context of string theory, a promising candidate for a self-consistent quantum theory of gravity. (The UW effort in string theory is led by Professors Albrecht Klemm, Akikazu Hashimoto, and Gary Shiu.)

Very recently, my collaborators and I have also made progress in C4 by asking in the context of supersymmetry, what kind of MSSM (Minimal SuperSymmetrical Models) fields can be "part" of the inflaton. We have found a "unique" candidate based on physics associated with C3. Given the MSSM context (with string theory inspiration as well) of the investigation, this may have implications for P1-P4. What is particularly important for this line of reasoning (regarding C4) is that we find models that can be tested at terrestrial colliders such as the LHC (Large Hadron Collider) which is due to turn on in 2007.

UW-Madison has many other professors also involved in cosmological research. On the observational side, Peter Timbie is a world leader in the cutting edge research of CMB polarization measurements. These measurements not only shed light on C4 but may yield the first evidence for quantization of gravity. These experiments are extremely difficult in that they aim to measure temperature fluctuations on the scale of 10^{-9} K.

Gary Shiu is searching for connections between cosmology and string theory. He has recently proposed a candidate for superheavy dark matter, and in a separate work with me, analyzed particle theory implications of WMAP CMB data for field theories of inflation. Currently, together with graduate student Bret Underwood, we are also investigating the possibility of cosmological viability of modified General Relativity since some cosmological problems may disappear with correct modifications of gravitational physics. (Recall that most cosmological problems involved to some extent Einstein's relativity.) Vernon Barger has interests in obtaining information about neutrinos and physics beyond the Standard Model in general from cosmology. Indeed, cosmology is currently the most promising method to obtain the absolute mass scale of the neutrino. Francis Halzen, Albrecht Karle, Bob Morse, and Teresa Montaruli are interested in implications for cosmology for their ongoing IceCube experiment, the world's biggest neutrino telescope at the South Pole. Dan McCammon uses X-ray measurements to probe the baryon distribution in the universe.

The Astronomy Department also maintains some of the world's best astronomers whose knowledge is invaluable for observational cosmology. Indeed, for example, the trustworthiness of recent CMB observational claims for percent level precision hinge on crucial inputs from their work (particularly with respect to foreground contamination). With a large number of cosmological observation experiments planned and underway, the future for cosmological discoveries seems ever brighter. Given that C1-C6 and P1-P5 are all still open questions, the grounds for theoretical discovery are fertile.



ALUMNI CORNER

We heard from **Nelson Tansu**, Ph.D. "I am doing fine here as a faculty member in the Department of Electrical and Computer Engineering at Lehigh University (Bethlehem, PA). After teaching as a faculty member here at Lehigh for 2 years, I feel so fortunate that I had taken courses with many of the Wisconsin physics and engineering professors."

"In particular, my experience as an undergraduate student (Fall 1997, as 5th semester undergraduate junior) taking the PHY 711 (Classical Mechanics) taught by Prof. Loyal Durand stands out. Professor Durand, with his excellent teaching ability (and expertise & commitment) in conveying very challenging topics in a very coherent and understandable manner, has been my prime teaching role model for me as faculty member at Lehigh."

Barbara Wilson (Ph.D., 1978) received an honorary degree from Mount Holyoke (her undergrad college).

The Award is made by the Physics Department at the University of Wisconsin in Madison to recognize a graduate of the Department who, during an outstanding career, has earned the admiration and respect of the entire scientific community.

Jay Davis was born in Texas some time ago (I, Don Reeder, was in school in Illinois at the time and was not reading the Texas news). He was reported to be in good shape when he appeared in Madison so I can infer that he had a reasonably uneventful childhood and early education. He went to the University of Texas at Austin receiving his B.A. with honors in physics in 1963 as well as his M.A. in 1964. During this time he was a member of a number of Greek honorary societies: Phi Eta Sigma, Sigma Pi Sigma and Phi Beta Kappa. (In order to receive his security clearances in this day and age I am sure that he would have to explain to the FBI his membership in these elitist — arguably middle eastern — societies.) He then came to the UW in 1964 and received his Ph.D. in physics from the University of Wisconsin in 1969.

Jay Davis

In one of the serendipitous discoveries I have made in this Chair, I recently learned of a grad student party that Jay attended in the '60's. Without investigation into the circumstances, I learned that Jay — perhaps even accidentally — sat down in a large bowl of chip dip which was invitingly situated on a coffee table. The very next day the Sterling Hall cartoonist, a grad student named John Wiley (who is now the chancellor of UW-Madison), documented his proposed Davis-proof dip delivery system — a bowl with several sharp points sticking out.

Jay remained in Madison for two years as an Atomic Energy Commission Postdoctoral Fellow. These were eventful years. During his postdoctoral period his job description changed abruptly with the bombing of Sterling Hall in August 1970.

Leaving the discouraging situation here, he went to Lawrence Livermore National Laboratory in 1971 and retired after thirty one years of service to the nation. At Livermore he initially led the design and construction of several unique accelerator facilities. In the 1970s, he was principal scientist for the design and construction of the most intense 14-million-electron-volt neutron source in the world. For nine years it was used to test fusion materials. In the 1980s, as the founding Director of the Center for Accelerator Mass Spectrometry, he built the most versatile and productive accelerator mass spectrometry lab in the world. Jay has been a major player in the application of accelerator mass spectrometry to the biosciences, such as low-level toxicology or in dose reconstruction from events at Hiroshima, Nagasaki, and Chernobyl.

In 1998, he became the first Director of the Defense Threat Reduction Agency, integrating the Defense Department's technical and operational activities to deal with weapons of mass destruction. As we have become aware, the identification and definition of weapons of mass destruction is a difficult and controversial topic.

Jay Davis has authored more than 80 publications. He holds patents on spectrometer technologies and methods for low-level dosimetry of carcinogens and mutagens and for the study of metabolic processes. He has been a scientific advisor to the UN Secretariat and has served on advisory committees for the Lawrence Berkeley National Laboratory, the Australian Nuclear Science and Technology Organization, and the Institute for Nuclear and Geologic Sciences of New Zealand. He is on advisory bodies for the Central Intelligence Agency and the National Nuclear Security Administration. He has served as a visiting professor at Texas A&M (chemistry) and Angelo State University (government). He is on the Board of Directors of the Fannie and John Hertz Foundation, the Board of Directors of Large Scale Biology Corporation, and the Board of Governors of Argonne National Laboratory.

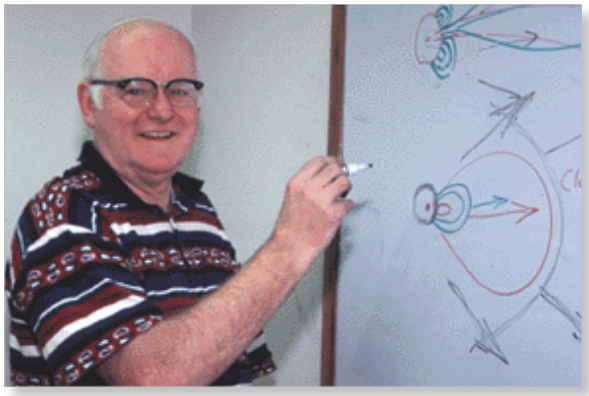
Jay had major operational and scientific responsibilities as a participant in two UN inspections of Iraq in 1991. He was selected as the only non-UN member of the team that briefed the UN

Security Council after the confrontation at Fallujah in June that produced conclusive evidence of Iraqi evasion of the inspection process and violation of the Non-Proliferation Treaty.

Dr. Jay C. Davis, with the thanks and appreciation of the entire nation as well as respect and recognition of the Department of Physics of the University of Wisconsin, I designate you as Distinguished Alumni Fellow.

The Distinguished Alumni Fellow Award is made by the Physics Department at the University of Wisconsin in Madison to recognize a graduate of the Department who, during an outstanding career, has earned the admiration, respect and recognition of the entire scientific community.

Art Hundhausen is a Wisconsin native, born and raised in Wausau. He attended the University of Wisconsin as an undergraduate and graduate student, earning a Ph.D. in physics in 1965. Art had a brief flirtation with CalTech when he received an NSF fellowship. After testing the waters (or the equivalent in the desert) he returned to the UW to complete his graduate study.



Art Hundhausen

He went to NCAR in 1971 from the University of California's Los Alamos Scientific Laboratory. (I think Art found that predicting solar weather yielded many fewer complaints that predicting weather on Earth!)

Hundhausen's early interest in interplanetary space evolved into pursuit of questions about the physical structure of the solar corona and its influence on interplanetary magnetic fields and plasma flow. His pioneering work in the 1970s contributed to the discovery of structures on the sun that produce the solar wind — the ionized gas that flows out from the sun's corona on a regular basis.

Then, in the 1980's, Hundhausen helped identify the magnetic regions in the sun's corona that give rise to coronal mass ejections. His contributions have helped explain these as the source of interplanetary shock waves that produce "space weather." When those shock waves reach the earth's magnetic field, the effects can include disruptions in radio transmissions or interruptions in electrical power supplies, as well as the beautiful auroras.

In 1999, at a ceremony in Washington, DC, the National Academy of Sciences awarded the Arctowski Medal to Art. This prestigious award celebrates and supports research in solar and solar-terrestrial physics. Art was recognized "for his exceptional research in solar and solar-wind physics, particularly in the area of coronal and solar-wind disturbances."

Outside of science, Art is passionately a student of Italian history and culture, particularly that of Rome. Visiting Rome, he says, is "like science — the more you understand, the more things hold together, and the more you enjoy it."

Dr. Art Hundhausen has repeatedly and truly earned this award.

Chuck Mistretta and I, Don Reeder, began our journey into Physics in very similar fashion. We were both raised in Illinois and both attended the University of Illinois at Urbana, graduating with the B.S. in Engineering Physics. Although we were not in Champagne at the same time, even then our careers began to diverge. Although we both were in Tau Beta Pi, Chuck alone went on to Phi Kappa Phi and highest honors. Also he worked as an undergraduate with Professors Jim Smith and Hans Frauenfelder — two of my favorite instructors. I spent my time on Illiac II a computer — an omen for the future, although I did not recognize it at the time.

The separation in our careers widened after graduation as I went into the Navy and Chuck went to Harvard — clearly he made a better choice! There, studying with Dick Wilson, he earned his M.S. and later his Ph.D. in '68 with a thesis on "Pion Electroproduction Coincidence Experiments Near the First Pion-Nucleon Resonance." I did not follow his example into the study of electromagnetic interactions until the early '80's.

Chuck Mistretta

We joined up again in Madison in '68 when he came to the Walker-Erwin group as a post-doc in HEP and I was an Assistant Professor. Chuck became a lecturer in the department and in 1971 was appointed an Assistant Professor in Physics and Radiology. Working with him, I clearly remember being jealous of his casual East coast mastery of Brooks Brothers clothing. His tenure track appointment was, in part, a reaction to an unprecedented ground swell of student concern that he might leave. Chuck is one of the most effective teachers I have known.

Professor John Cameron, always on the alert for talent, spotted Chuck and as they say, the rest is history. In 1974 Chuck took his considerable talent in instrumentation to a full time tenured position in the Department of Radiology, and from the outset, he developed innovative and successful methods of harnessing state-of-the-art technology to the problems of diagnosis and imaging — beginning with his invention of digital subtractive angiography.

Connie Blanchard and his wife, June Weisberger

His success in his chosen field is represented by the honors awarded by his peers. In 1983 he received the Laufman-Greatbatch prize of the Association for the Advancement of Medical Instrumentation, followed in 1986 by the John R. Cameron Professorship of the UW. In 1998 he shared the J. Allyn Taylor International Prize in Medicine, sponsored by the Robarts Research Institute and the University of Western Ontario, for "distinguished lifetime achievement" and "outstanding contributions to the advances in the use of medical imaging in diagnosing and treating human diseases." Chuck was elected to Fellowship of the American Association of Physicists in Medicine in 1999 and, two years ago, he became a Fellow of American Institute for Medical and Biological Engineering.

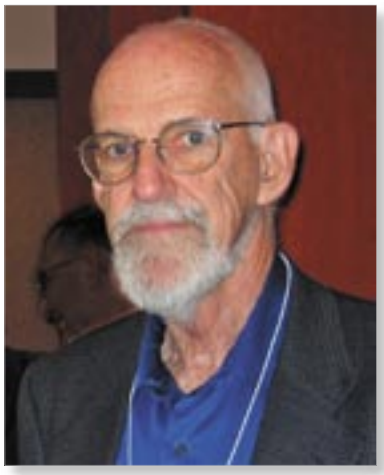
His teaching prowess is clearly evidenced by the 31 students he has guided to the Ph.D. degree. Together with the more than a score of postdoctoral assistants, he has personally populated a significant fraction of the positions in medical physics throughout the United States — at universities, in hospitals and in the health care businesses. By example and mentoring he has fostered a host of inventions and applications of technology to problems in diagnosis.

I could go on to cite the tens of millions of dollars in support of research he has brought to the UW, the myriad papers he has written, etc. But to me the most noteworthy of Chuck Mistretta's accomplishments is that he is the holder of three world records in muskie fishing as noted in the National Fishing Hall of Fame in Hayward, Wisconsin. Clearly he can apply his expertise in imaging even in the murky waters of Lake Mendota! In 1988 he caught a 22-pound muskie on 6-pound line and in the same autumn caught an 18-pounder on 15-pound test line. Three years later he did it again.

I am privileged — on behalf of the members of the Department of Physics, University of Wisconsin to recognize the unique and varied contributions and service to the campus and, particularly, to both Physics and Medical Physics by a truly accomplished physicist. The Physics Department and I are unanimous in presenting our Special Recognition award to our friend and colleague, Chuck Mistretta.

Raymond F. Sawyer was born in Minnesota and — apparently — as quickly as possible went east. He went to Swarthmore College and graduated with a B.A. in 1953. He certainly made a mark at Swarthmore for his next stop was Harvard. He prospered as a theoretical student under the tutelage of Julian Schwinger, who received the Nobel Prize in 1965 for his work in quantum electrodynamics. Ray got his own ticket in 1958 from Harvard.

After graduation, he made the obligatory trip to Europe and was a post doctoral fellow at CERN in Geneva Switzerland. He returned to the U.S. from CERN and came to the Midwest again. He was a WARF Fellow at the UW for the 1959–60 academic year and quickly climbed the academic ladder — to Assistant Professor the next year, to tenure two years later and on to Professor in 1964. Alas, the UW attempt at preemption failed (so what's new?) and Ray, together with colleague Hal Lewis, were seduced by the opportunity offered by the rapid expansion of the University of California in its various venues — most particularly at Santa Barbara. Ray stayed at the UC-Santa Barbara from 1965 until he retired.



Ray Sawyer

One of the dated features of those days was that much of his file relates to obtaining a deferment from the omnipresent draft. Luckily, a physicist still garnered some respect in those days.

Parenthetically, I recall my pathetic attempts to master quantum electrodynamics in the Schwinger perspective as taught by Ray. I left the course with only a meager understanding of

Feynman rules and ample admiration and respect for the mathematical approach. As I became accustomed to this defect of my character through the years, I appreciated even more Ray's deep understanding of topic.

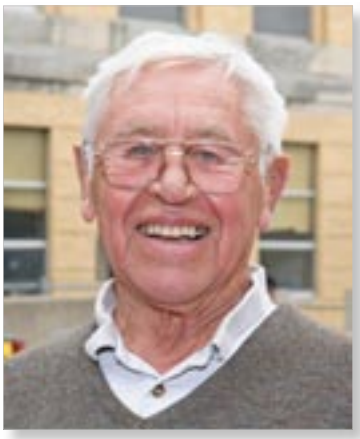
In perusing the record, I came across the notes from a telephone conversation with Schwinger concerning the appointment of Ray. (Of course, I suppressed the very good statements the effect of which has already been factored into his rapid rise at the UW and Santa Barbara.) I cite this only because it provides insight into the subtle and difficult process of evaluating people.

"He made no negative statements at all. Since Schwinger has been extremely critical of his students in the past, this seems to me to be a very good recommendation."

This seems to set the record for succinct evaluation.

Although initially Ray dealt in the theory of particles and quantum field theory, there must be an untold story there somewhere because he has spent most of his recent time in astroparticle investigations where experimental confirmation or refutation is either difficult or impossible to interpret.

In the opinion of all his students and colleagues at the UW, Professor Raymond Sawyer is thoroughly deserving of such recognition.



Barney Webb

Maurice Barnett Webb is a Wisconsin native, born in Neenah. He demonstrated his loyalty early in coming to the UW for his undergraduate education culminating in a B.S. degree in 1950 and then right on here for the Ph.D. in 1956. Not only was he an exemplary TA; he was in complete charge of one of the introductory courses as a grad student. Barney has always been a conscientious, gifted and prize-winning teacher, and we were lucky to have him.

Barney then went to General Electric Research Laboratory as staff scientist. But the Department had not forgotten him and attempted to woo him back as an Assistant Professor. But Barney, demonstrating his characteristic sense of responsibility, declined in order to complete his work at GE. Luckily for us, the Department had the wisdom not to take no for an answer, and in 1961, Barney returned to the UW as a tenured Associate Professor. One can only conclude that he was already wise to the idiosyncrasies of academe.

Barney had an extraordinarily productive scientific career at the UW. In addition to his 70 plus published papers he has given 40 invited lectures and guided more than 23 students to the Ph.D. (By the way, half of these went on to very distinguished careers of their own.) His contributions to surface science received national recognition with the award of the Davison-Germer Prize of the American Physical Society, the most distinguished award in surface science.

Darlene and Chuck Mistretta with Barney Webb.

His loyalty and commitment to the Department of Physics and, indeed, the University of Wisconsin, is evident in the vast and varied administrative responsibilities he accepted — another example of his sense of responsibility. In 1971 he became Chair of a Physics Department that had been traumatized by the bombing of August 1970. He was a tower of strength in leading us out of the wilderness of despair. In 1977, with the University still coping with the aftermath of the time of troubles, Barney was chair of the University Committee, the Executive Committee of the faculty, and the most important and visible manifestation of faculty governance at the UW.

With his record as exceptional administrator clearly and solidly established, perhaps his most challenging assignment was as Chair of the Athletic Board for five years (1985–90). As any unbiased observer has noted, the athletic prowess of the UW seems much more highly prized than its academic prowess. As always he did his best, which in this case was setting things up for the arrival of Donna Shalala for whom this activity was of great concern.

There can be no doubt that Professor Barney Webb deserves recognition for his contributions and exemplary service. I only regret the mismatch of the recognition to our debt to you, Barney. But, be assured of our continued love, admiration and respect. We miss you.

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