University of Minnesota
school of physics & astronomy

Spring 2009 Newsletter • Issue 10

A letter from the department head

This summer we welcomed the newest addition to the faculty Professor Alexander Heger, who joined us from Los Alamos National Laboratory. His research is highlighted in this issue. We are in the process of searching for new faculty in experimental and theoretical particle physics, astro-particle physics, experimental condensed matter physics, and theoretical condensed matter physics. In the case of the latter, we are seeking two individuals at the senior level in the William I. Fine Theoretical Physics Institute. We have so many search committees that we have effectively run out of faculty to serve on committees.

The NoυA project, which will build and operate an off-axis neutrino detector at Ash River, in northern Minnesota, received a new lease on life with the passage of the supplemental budget during the summer. With this program, Minnesota will be major players in two neutrino investigations using the Fermilab neutrino beam. The next budgetary hurdle will be encountered next March.

The faculty and staff are struggling with the implementation of a new Enterprise Financial System (EFS), supplied by PeopleSoft, which has replaced the CUFS system used for more than a decade. For many months the state of our accounts was in limbo, as the software needed to generate reports was not working. Hopefully we will in the near future be seeing the "light at the end of the tunnel."

We are looking forward to the Van Vleck Lectures this year, which will be presented on April 8 and 9th by Professor Albert Fert, a French physicist and the co-discoverer, with Peter Grünberg, of giant magnetoresistance. This phenomenon facilitated the development of gigabyte hard disks. Fert is currently professor at Université Paris-Sud, Orsay and scientific director of a joint laboratory Unité Mixte de Recherche between the Centre National de la Recherche Scientifique and the Thales Group. He was awarded the 2007 Nobel Prize in Physics with Peter Grünberg. For more information go to: www.physics.umn.edu/outreach/vanvleck/.

Physics major wins Rhodes Scholarship

Ashley Lynne Nord, a senior in the University of Minnesota's Honors Program, has been named one of 32 Rhodes Scholars for 2008. She is a summa cum laude candidate for a Bachelor of Arts degree in global studies with a minor in Spanish studies, and a candidate for Bachelor of Science degrees in physics and astrophysics.

"Considering the talent, intellect and poise of my fellow Rhodes candidates, I was surprised to receive the Rhodes scholarship," said Nord. "I am very honored by the award and incredibly excited at the opportunity to study in Oxford."

Nord intends to pursue a doctorate in condensed matter physics at Oxford University, in preparation for a career in the field of biophysics. In the School of Physics and Astronomy, Nord has worked on software for the motor and temperature control system of the cryogenic portion of a new instrument that is being built for the Massive Mirror Telescope on Mt. Hopkins in Arizona; studied a simulated neural network that interprets signals from the forearm; and conducted research on counter-terrorism. Nord's name has appeared on the Dean's List in every semester of her enrollment. She has been the recipient of a National Merit Scholarship, the Robert C. Byrd Excellence in Academics Scholarship and several other awards honoring her accomplishments in her diverse fields of specialization. Nord is an accomplished pole-vaulter and was a member of the university's Track and Field team. She placed in several Big Ten championships and was an Academic All-Big Ten Honoree every year. According to Nord, her experiences as an athlete, including her recovery from several injuries, led to a passionate interest in the biological and medical applications of physics.

Inside

Awards & Announcements

Anderson wins prize for presentation

Jon Anderson, PhysTEC Teacher in Residence, has won second prize from the 2008 Kavli Institute for Theoretical Physics Teachers Conference for the best presentation by a secondary school teacher on the subject of Particle Physics in the Age of the Large Hadron Collider. Anderson won $2,500 for his presentation.

Crowell and Qian elected APS Fellows

Professors Paul Crowell and Yong-Zhong Qian were recently elected Fellows of the American Physical Society (APS). Crowell was selected for "the application of elegant optical and transport techniques to the study of spin dynamics and transport in metals and semiconductors; and experiments probing the excitation spectra of inhomogeneously magnetized systems, particularly magnetic vortices."

The APS cited Qian's "contribution to theoretical nuclear astrophysics, including the production of heavy elements via the rapid neutron capture process and to theoretical studies of collective neutrino flavor transformations in supernovae."

Courant in Voices of the Manhattan Project

Professor Hans Courant, veteran of the Manhattan Project, was featured in the New York Times, "Voices of the Manhattan Project" which was taped at the "Doctor Atomic Symposium" at the City University of New York, where the recording was made. Professor Courant worked on the Manhattan Project from 1942 - 1945 at Los Alamos as a Special Engineer. He witnessed the Trinity Test on July 16, 1945 from a distance of 10,000 yards away.

Kakalios named Taylor Professor

James Kakalios has been named one of four Institute of Technology Taylor Distinguished Professors. This is a three year appointment to work as a team of key advisors on matters related to improving undergraduate education within the college. The four Taylor Distinguished Professors, with Paul Strykowski, the Institute of Technology associate dean for undergraduate programs, will form the Taylor Committee. The committee will deliberate and make recommendations on matters of strategic importance to the undergraduate vitality of the college. The first charge of the Taylor Committee will be to explore the benefits of establishing a required freshman experience for all incoming Institute of Technology students, with the primary goal of increasing student retention and graduation rates. The Mr. and Mrs. George W. Taylor Professorship Fund was created by the Taylor Family in the spirit of improving the undergraduate experience in the Institute of Technology.

Rusack made ECAL project manager

Professor Roger Rusack has been made project manager for the Electromagnetic Calorimeter (ECAL) portion of the Compact Muon Solenoid experiment at CERN in Geneva, Switzerland. There are ten institutions involved in building and monitoring ECAL, which is one the Large Hadron Collider's (LHC) sub-detectors. ECAL consists of 75,000 lead tungstate crystals (the largest number ever assembled for a single experiment). The ECAL team finished installing the last of the crystals into the barrel of CMS in late summer. CERN successfully made the first beam test on September 10, 2008.

School of Physics and Astronomy 2008

Albert Fert to deliver Van Vleck Lecture

Nobel Laureate, Albert Fert will deliver the 2009 Van Vleck lecture. Fert is a French physicist and one of the discoverers of giant magnetoresistance. Albert Fert and Peter Grünberg were awarded the 2007 Nobel Prize for Physics for their independent co-discovery of Giant Magnetoresistance. Fert is currently professor at Université Paris-Sud in Orsay and the scientific director of a joint laboratory ('Unité mixte de recherche') between the Centre national de la recherché scientifique (National Scientific Research Centre) and the Thales Group.

Professor Fert's experimental (and theoretical) research is in condensed matter physics (metals, magnetism, magnetic nanostructures, spin electronics). Professor Fert was one of the co-discovers of Giant Magnetoresistance (GMR) in 1988. He determined that alternating thin layers of magnetic and nonmagnetic metals respond to even minute changes in magnetic field. The effect has been of critical importance to the electronics industry. The storage density of hard drives underwent a huge increase when GMR-based sensors were used in the read heads of hard disks. The increased storage density means that greater amounts of information were able to be stored in a much smaller space. Everyday devices like portable MP3 digital audio players would not be possible without the miniaturization of hard disk technology.

Professor Fert has made many contributions to the development of spin electronics, a sub-field of condensed matter physics which studies the intrinsic spin of electrons its associated magnetic moment, and its fundamental electronic charge, in solid state devices. He has published more than 270 scientific articles. One of the publications currently has 4030 citations and is one of the ten most cited articles in *Physical Review Letters* since the creation of the journal in 1953.

Professor Fert has received a number of other prestigious awards including the American Physics Society International Prize for New Materials (1994), the Grand Prix de Physique Jean Ricard of the French Physical Society (1994), the Hewlett-Packard Europhysics Prize (1997), the Centre National de la Recherche Scientifique Gold Medal (2003), the Wolf Prize in Physics (2006) and the Japan Prize (2007). He was elected to the French Academy of Sciences in 2004. He also received an honorary degree from the University of Leeds in the United Kingdom.

Professor Fert was born in 1938 in Carcassonne in the south of France. He is a second-generation physicist. His father taught physics in high school and after the Second World War got his Ph.D in physics and became a professor at Toulouse University, where he made contributions to the field of electron microscopy. Albert Fert left Toulouse for Paris and the Ecole Normale Supérieure in 1957. He received a Master's degree from the University of Paris in 1963. He earned his Ph.D. at the University of Paris-Sud in 1970. His thesis was aptly chosen given his future as a Nobel Laureate, "Testing the suggestion of Neville Mott (future Noble Prize laureate) that the mobility of electrons in a ferromagnetic metal depends on the orientation of their spin in relation to their magnetic orientation." Professor Fert says that the technology in 1970 could not create sufficiently thin films for layers of magnetic and non-magnetic materials for the effect of Giant Magneto-resistance to be seen. Fifteen years later when the technology was available he returned to his thesis inquiries and discovered the phenomenon.

Fert joined the University of Paris-Sud in 1976 where he is a Professor of Physics. Since 1985, Professor Fert has also been the scientific director of the National Center for Scientific Research Thales Joint Physics Unit.

Albert Fert has been married to Marie Josée Ortega since 1967. They have two children.

You are cordially invited to the 34th Annual Abigail and John Van Vleck Lecture

Albert Fert

Unité Mixte de Physique CSRS/Thales &
Université Paris-Sud Orsay, France

Public Lecture
April 8, 2009 5:00 p.m.
Room 150, Tate Laboratory of Physics

Spintronics: electrons, spins, computers and telephones

Physics and Astronomy Colloquium
April 9, 2009 4:00 p.m.
Room 150, Tate Laboratory of Physics

Carbon nanotubes, graphene, molecules : promising materials for spintronics

Faculty Profiles

Alex Schumann

C. C. Huang

For the past ten years, Cheng-Cher "C.C" Huang and his collaborators have been exploring properties of liquid crystals with a technique called resonant x-ray scattering. This is the most reliable and effective method for getting to the specific liquid crystal states that Huang and his group are researching. Liquid crystals, a phase of matter between a liquid and a solid, have been used in technologies from high-resolution camera viewfinders to large-area "liquid crystal displays" used in monitors and televisions.

Resonant x-ray scattering is the most reliable and effective method of studying liquid crystals, but it requires the use of synchrotron radiation at Brookhaven National Laboratory. Because of the group's success with this method they have been given a prime slot at the lab which amounts to 10 days a year. "If we do not do preliminary studies," Huang says, "we won't get any physics out of that time."

In order to optimize their results at Brookhaven, Huang and his group have come up with alternative methods of exploring liquid crystals in his laboratory in-house. Huang has developed a series of optical probes, which are elaborate laser/refractivity experiments set up on large stability tables in his labs. The light moves through various optical elements striking the sample to provide information. In one set up there is no light emanating through the sample. This is called null transmission ellipsometry and the goal is to find out the effect of the film the orientation of polarized light and how the film reacts to two simultaneous stresses. From this experiment Huang and his group can learn about the molecular packing of a free standing film.

In another set-up light moves through a polarizer, then through the sample of liquid crystal, and is collected and recorded by a CCD camera in a process is called depolarized reflected light microscopy. The sample of liquid crystal looks like a simple soap bubble on a slide. Huang uses the soap bubble analogy to explain liquid crystals since the structure is similar, but the components are different. In a soap bubble as in a liquid crystal there is movement similar to a liquid, but there is also a crystalline structure which makes the shape of the bubble. Liquid crystals of course are not soap and water, but are unique materials manufactured to exhibit certain properties. Huang is investigating the orientational order of liquid crystals because that is an important area with many unknown variables. As liquid crystal devices become more widespread, the need for understanding all phases and their reaction to electrical field, heat, light, etc. becomes more important.

Huang explains that the optical probes in their lab have been so accurate that they probably could publish their results based only on those techniques, but that the group still prefers to use the x-ray scattering technique at the Brookhaven synchrotron to verify their findings.

Alex Schumann

Alex Kamenev

What does epidemiology have to do with quantum physics? Condensed matter theorist, Alexander Kamenev has been using the tools of the quantum mechanic to help biologists further understand the behavior of diseases. "If you think about it, an epidemiologist tries to describe a large community of bacteria to determine their behavior statistically." Kamenev says that task is not that different from what a condensed matter theorist does when studying interacting groups of particles.

Kamenev's area of interest is in physics at mesoscopic scales, those sizes which are small enough to exhibit quantum coherence and interference effects, but large enough so that they are not easily described by the well-developed theory of bulk materials. The problem with the mesoscopic scales is that they are very complex due to the major role played by electron interactions between themselves. Kamenev uses a metaphor to explain strongly interacting versus weakly interacting systems. He compares a mesoscopic system to a small village, where one is forced to be dependent on one's neighbors to strongly interact with them in order to survive. A bulk system is like a big city, where one may go about one's business without even knowing one's neighbors names. Kamenev says that this village of electrons is similar in many ways to a community of microbes. A biologist looking through a microscope can not know whether a microbe will eat or be eaten by its neighbors. In the same way a physicist observing a group of electrons can not how it will interact with another electron. "Amazingly the same tools can be used to make a prediction on both systems," Kamenev says.

Kamenev and his collaborators have been able to yield results which were not previously available to biologists by using tools commonly employed in mesoscopic physics such as eikonal approximations. He published his results in physics journals with the hope of applying condensed matter physics to epidemiology.


Alex Schumann

Alexander Heger

Alexander Heger is a new professor in the area of nuclear theory and cosmology. His research involves creating and running computer simulations of "massive stars" (those that are 10-1000 the size of the sun) from formation through nuclear burning phases. "I like to say I blow up stars for a living." Heger explains that massive stars have comparatively short life spans, around 2.5 million years versus the 10 billion estimated for the sun. "Big stars are very bright and wasteful with their energy." In the final stage of a massive stars life, the nuclear burning stage, the star burns its fuel to heavier and heavier nuclei, which in turn produces the heavier elements in the universe. "I think it's good to know where the gold is being made in the Universe," Heger kids. The goals of his research are the origins of the elements. "This information will help us put the entire picture together about how our own galaxy was formed." This area of study includes stellar rotation, how the elements were formed "nucleosynthesis" and the mechanics of supernovae.

Heger also studies very old stars, the so-called "population one" that formed 300 million years after the big bang. "This connects an old question to modern cosmology. How did the stars form?" To answer this question Heger matches abundance patterns of certain elements to models based on mass. With these "finger prints" physicists can tell a lot about the stars age, and how it formed. "With newer stars it's more difficult because contributions from later stars come into the mix." Heger explains that we could not say what generation the sun is because of those contributions.

In order to create his simulations, Heger works with theoretical models of what should be in the first generational stars. He says that University of Minnesota physicist Keith Olive is one of the pioneering experts at making those models. The models use known quantities such as the "initial mass function" a principal that states that a certain number of stars of each mass are being made at any given time. To test the model physicists try to match observations of modern stars with similar "finger prints."

Heger says that there is still a fair bit that is unknown about nuclear reaction rates. "There are 283 stable nuclei. We should know them all eventually. Even with unstable nuclei there are a finite number which is not impossible to understand." The more that is known about nuclei, physicists can provide additional checks on theory. Heger's work is expanding in new directions as computer modeling becomes more sophisticated. He has a student currently working on building multi-dimensional simulations—sure to yield "explosive" results.


Alex Schumann

Oriol Valls

Oriol T. Valls and students, Klaus Halterman and Paul Barsic, have been studying some unusual properties of nanostructures consisting of intercalated superconductor and ferromagnetic materials. Such structures are very interesting for a variety of technological (application to "spintronics") and scientific reasons. They exhibit what is called "proximity effects": the superconductivity leaks into the magnetic layers and the magnetism into the superconducting ones.

In the process of addressing some intriguing and puzzling recent experimental results, in which superconductivity was found to leak into a magnet over a distance very much longer than expected, investigators were led to speculate that this could happen if the Cooper pairs in the magnet had parallel spins, not anti-parallel. But this would violate the Pauli principle, one of the most fundamental laws in Physics: two fermions cannot be in the same state. Superconductors have zero electrical resistivity hence their name. This unusual property is known to be due to the electrons pairing up, forming so-called Cooper pairs. In nearly all of the known superconductors, the wave function of the electron pair is symmetric in space. The overall antisymmetry means then that the electrons must have their spins (proportional to their magnetic moments) pointing in opposite directions. If that were not the case, the Pauli principle would be violated. How can this be?

Professor Valls and his group found the answer. They managed to prove that there is after all a loophole which allows triplet (parallel spins) spatially symmetric Cooper pairs to exist in these nanostructures. The crucial trick is to look at the time dependence. It would not violate the Pauli principle if it turned out that the spin-symmetric state occurs with a time delay: one member of the Cooper pair has its spin parallel to its mate, but not at the same time, just a little later. Valls and his group showed through calculations that this state does exist in nanostructures and that it has the right properties to explain the experiments.

Class Notes

2005

Chad C. Geppert (B.S., Physics and Chemistry, 2005) I married Grace Liao in Taiwan in 2006. I worked for two years (from Taiwan) writing software for mass calibration laboratories. Our son, Isaiah, was born on May 9th, 2008. I am currently in graduate school in at the University of Minnesota. I love it. I guess I just could not get enough of Physics or Minnesota weather!

2003

Aron J. Cooper (BS, Astrophysics, 2003) I am working for Marshall Wace, an international hedge fund, as a quantitative analyst and portfolio manager. My wife Heather (also a University of Minnesota alum) and I have three kids Gideon (10), Lillian (3), Oliver (1).

2000

Neyda M. Abreu (B.S., Physics, 2000) I received my M. S. and Ph.D. (2007) in Planetary Science from the University of New Mexico. I am now an Assistant Professor at Penn State - Du Bois Campus. My research is in primitive chondritic meteorites.

Andrew D. Ferstl (Ph.D, Physics, 2000) I have been married to my wife Kerri for 14 years. We have two wonderful sons. I am currently an Associate Professor in the Physics Department at Winona State University. This is my ninth year. I teach classes and direct undergraduate research projects. I also work closely with two other University of Minnesota alums: **Nathan T. Moore** (Ph.D., Physics, 2006) and **Jennifer L. Anderson** (B.S. Physics, Astrophysics and Geophysics, 1998)**.** I am temporarily the Science Education Coordinator for the College of Science and Engineering.

Rupak K. Mahapatra (Ph.D., Physics, 2000) Following graduation, I became a postdoc at UC Santa Barbara doing research on Dark Matter search. I am now a faculty member in the Department of Physics at Texas A&M University.

Aaron M. McGowan (Ph.D., Physics, 2000) I am a Visiting Assistant Professor of Physics at Saint John Fisher College in Rochester, NY. I am continuing work in neutrino physics on MINOS through Argonne National Lab. I also work on MINERvA through a Visiting Scientist appointment at the University of Rochester. I live in Rochester with my wife, Sarah, who is a pediatrics resident.

1997

Laura E. McCullough (M.S., Physics, 1997) I am a tenured associate professor at the University of Wisconsin-Stout. I was recently elected chair of the physics department. My husband, Kelly McCullough, is a science fiction author who has published three novels with more forthcoming.

Thomas E. Wald (BS, Physics, 1997) I am currently pursuing a second bachelor's degree in Philosophy with a minor in German at University of Texas at Austin. I will finish in May, 2009. My primary interests are Philosophy of Mind and Philosophy of Science. I received my first scholarship for my studies this fall. I am single, but dating. My time is also filled with volunteer work to promote bicycling in Austin, TX. I am involved with the University of Texas Orange Bike Project, Bicycle Advisory Council, and the League of Bicycling Voters. I am also on the board of directors for the Wheatsville Co-op which is the only grocery store cooperative in Texas. The Twin Cities are lucky to have so many co-ops. I plan to return to my professional life as a web developer in fall 2009.

1980

Ardin Marschel (Ph.D, Physics, 1980; B.S., Physics, 1969) I am now a Supervising Patent Examiner at the U.S. Patent and Trademark Offices in the Pharmaceutical area of inventions after working previously in Private Industry in Genetic Engineering. I am married with four grandchildren. I am a tennis player. My favorite memory at the University of Minnesota was testing out a number of math and physics courses.

1979

Jeffrey J. Puschell (Ph.D., Astrophysics, 1979) I am a Principal Fellow for Raytheon Space and Airborne Systems in El Segundo, CA. I am an internationally recognized expert in the system engineering of space-based imaging and remote sensing systems. My graduate education, which balanced theoretical and hardware-related work, was excellent preparation for an ongoing successful 30-plus-year career in developing infrared and visible wavelength systems for operational and research applications. I have authored or co-authored more than 130 papers on a variety of research topics in astrophysics, space-based imaging and remote sensing and optical communication. I have been a leader in community service activities including Chair, External Advisory Board, Cooperative Remote Sensing Science and Technology Institute (CREST) at City College of New York; Chair, Technical Advisory Board for a major government classified program; panel member for the government's Tech 2025 technology future study and member of the U.S. Department of Commerce Emerging Technology and Research Advisory Committee. I have been an innovator in optical systems science and engineering for more than 25 years. My career includes a series of breakthroughs ranging from a method for estimating distance to the most distant known galaxies developed in 1982, described in a 1999 conference overview as "…pioneering even by today's standards…" to being technical lead for an impressive string of "firsts" including first autonomously operating LIDAR and first demonstration of laser communication with a submerged submarine. In July, I became Chief Scientist for the nation's highest priority operational environmental remote sensing system, NPOESS VIIRS, a space-based 22-band visible-infrared imaging spectroradiometer. My ongoing work with nanoantenna arrays promises to revolutionize imaging and remote sensing technology with electronically steerable imagers for ground, air and space platforms. My wife Dana and I live in Solvang and Hermosa Beach, CA. We have been married for more than 33 years. We have fond memories of our graduate school years in the Cities. We have three children: Ann, a former National Science Foundation Graduate Research Fellow, who is married and living in Munich, Germany; Brian, a computer science major at Santa Monica College; and Crystal, an anthropology student at Allan Hancock College. Back in graduate school, KSTP decided to cover the 1979 total solar eclipse and fly reporters and cameramen on their private plane up to Manitoba, they invited me to join them and to bring along a few colleagues and friends. See photo at left with Vincent Icke.

1975

Jeffrey R. Basford (Ph.D, Physics, 1975; M.S., Physics, 1969, B.S., Physics, 1965) After receiving my Ph.D. I went into the Peace Corps and the Vietnam-era army. After getting out of the army, the work prospects were limited. An overseas post-doctorate seemed less than alluring. I spent a year or so as a Washington, D.C. research and development consultant. I rapidly found that I was working too hard for the benefit of someone else and decided to attend medical school more

or less on a whim. I have been in the field ever since. I have worked at the Mayo Clinic since the early 1980s. I have done some research in central neurological rehabilitation and the effects of physical agents such as electromagnetic energy on the body. I am married and have three children. My youngest child is seven months old. My non-medical business is farming. Life is busy, but I still miss the lab and the chance to think.

1973

Donald W. Strecker (Ph.D, Physics, 1973; M.S., Physics,1969; B.S., Physics, 1965) Professor Edward P. Ney was my favorite instructor, mentor, advisor, and friend. His approach to physics; deriving the radius of a neutron star on the back of an old envelope, using half wavelength quantization, and the Heisenberg uncertainty principle, still amazes me and demonstrates his deep understanding of the principles of physics. In 1965, Ed took me on as a graduate student plotting data from his "Ney Ball" dim light photometer on the Ball Brothers Research Corporation (BBRC) satellite OSO-B2. In 1968, he was developing infrared (IR) astronomy at Minnesota. I joined the group. A 1971 IR expedition to Cerro Tololo InterAmerican Observatory in Chili with Ed was a memorable scientific and cultural experience. I also thank Professor John Williams who, in 1961-1962, made his introductory physics courses so interesting that I decided to major in physics. In 1973, I was a post-doc at NASA Ames Research Center doing airborne infrared astronomy. In 1978, I accepted a job at BBRC and moved to Longmont, CO. I retired earlier this year after thirty years at Ball as an infrared instrumentation systems engineer. I worked on several NASA infrared programs such as IRAS, NICMOS, SIRTF. Recently, I was the Ball systems engineer on the MIPS far-infrared instrument on SIRTF. Additionally, I worked in the new business arena in technology development, interacting with potential principal investigators, and by creating conceptual payload designs, costing, scheduling, and writing proposals. My wife, Patty (U of M, '66) and I have been married for thirty-five years. We have three daughters who are currently officers in the U.S. Army. Patty and I return to Minnesota quite often to visit friends and relatives and to maintain her family farm. The farm, in the southeast corner of Minnesota, has been in my wife's family for more than 150 years. My activities now include woodworking and improving the functionality of 1941 Farmall Model H and 1946 Farmall Model B tractors at the farm. Minnesota was an excellent training ground for an experimental physicist and for making the transition from research and academia to aerospace engineering and business.

1972

Richard A. Hendrickson (Ph.D., Physics, 1972, B.S., Physics, 1964;) My wife, Pauline, and I are both retired. We travel and play with our grandchildren. I do volunteer tutoring for high ability fifth and sixth graders at a local school. I switched from physics to computers and Fortran after graduate school. I worked for Cray Research for twelve years. I lived and worked in Belgium for three years (great beer!) I did consulting and software testing for twenty years. My most vivid, not exactly a favorite, memory is the day Kennedy was shot. My favorite memory was working in 42SB on Physics stuff as an undergraduate. It was my first exposure to real science. My favorite course was Russ Hobbie's Modern Physics class. The first time I saw hard math applied to something that you could not understand any other way. The two most interesting lecturers were probably Ed Ney and Bill Zimmerman. They had tremendous zeal. The most interesting graduate class was one by Paul Kellogg on General Relativity. It convinced me that I was not cut out to be a theoretical physicist. What little of the math I understood was beautiful, but it was too little.

1971

Matthew J. Cunningham (M.S., Physics, 1971, B.S., Physics, 1964;) I have one daughter and seven grandkids. I enjoy following developments in physics and astronomy. I play in our senior tennis league. In 1997, I retired from the City of Minneapolis as systems analyst and programmer. What a memorable time when Dr. Ney entered the lecture room carrying a suitcase with a heavy gyroscope revved up and hidden inside, and then he made a quick left turn! The students roared. It was wonderful to have a class (Classical Mechanics) taught by Dr. Nye. Later on, I was pleased to serve as his chief teaching assistant. Also, the wise and kind advice of Professor Gasiorowicz was extremely helpful.

1969

Fred Becchetti (Ph.D., Physics, 1969; M.S., Physics, 1968; B.S., Physics, 1965) I am married with two sons. I am a professor at the University of Michigan, Ann Arbor. My favorite memory from the University of Minnesota was taking night shifts on the nuclear accelerators with fellow graduate students, post-docs, and, occasionally, faculty – especially in the winter time. My advisor and others in the nuclear research group were great. As a physics undergraduate, I was wandering through the basement one day and noticed a room full of hundreds of lead-acid batteries. Next door, Professor Nier and others were making a precision mass measurement. Nier kindly stopped and explained what they were doing, and the purpose of all the batteries. The batteries provided the ultra-stable voltage sources needed for the experiment. I still remember how a well-known professor took time to explain his experiment to me. Now as a professor, I always try to involve undergraduate students in my own research.

Rufino H. Ibarra (Ph.D., Physics, 1969) After receiving my Ph.D., I went to England to do postdoctoral work at the University of Manchester from 1970-1973. I then joined the Physics Department at the University of the Philippines. I became full professor in 1979. I was at the University of the Philippines from 1973-1985. I had a chance to visit the Niels Bohr Institute in Copenhagen from 1976-1978 and the Max Planck Institute for Nuclear Physics in Heidelberg from 1982-1984. I am semi-retired. My wife, Odette, and I have one daughter. I have fond memories of the School of Physics and Astronomy. My favorite professors were Ben Bayman (my advisor), and William Zimmermann who taught freshman Quantum Mechanics.

Richard J. Seebach (B.S., Physics, 1969; M.S., Computer Science, 1972) I fondly remember my years at the University of Minnesota. Drs. Poppe and Brown were physics professors I enjoyed. Dr. Goldman was my undergraduate advisor! I was also a member of the marching and symphonic bands. I worked for Bell Labs, and then Lucent Technologies, in New Jersey from 1972 through 2003. I then taught high school mathematics for a few years. My wife and I are now retired. We will relocate to River Falls, WI next year to build our retirement home. We have two children and two grandchildren. I look forward to becoming involved with the I.T. and band alumni societies, and attending events on campus.

Gary H. Zeman (M.S., Physics, 1969) My education was interrupted by the draft for the Vietnam War. I joined the Navy and had a 20 year career as a U.S. Navy Radiation Health Officer. My wonderful wife Margaret was at my side through it all. The Navy sent me to complete a Sc.D. at the Johns Hopkins University in 1976. They gave me many challenging assignments and opportunities to use my physics education. After leaving the Navy in 1989, I spent a few years at Bell Labs in New Jersey, and at Lawrence Berkeley National Laboratory in Berkeley, CA.

Class Notes

I am now a Radiological Safety Officer at Argonne National Laboratory. I have spent the past couple years working on the radiation dose reconstruction and compensation program for the atomic veterans –– those 200,000+ military veterans who witnessed atomic tests between the years 1945 and 1962. It has been a satisfying experience to engage and, in some small measure help, improve the process to obtain the recognition and compensation the veterans deserve. I have many fond memories of the University of Minnesota in 1968-69. The war and the war protests on and off campus affected all of us in that age. A couple times the Administration Building (right next to the Tate Laboratory of Physics) was shut down due to sit-ins by protesters. Another memory was staying awake all night to start my car every hour when it was -25 degrees in the middle of January. But I did not mind that because I was up all night anyway working on Quantum Mechanics for Professor Stephen Gasiorowicz. He was beyond any doubt my favorite and toughest professor.

1968

Horst L Truestedt (M.S., Physics, 1968; B. Physics, 1968) I graduated in Physics from the University of Minnesota in 1968 after studying for eight years while working most of the time at 3M Corp. in physics research. I had my own lab at 3M. Management wanted me to move to one of the divisions. Many of my friends were starting to use computers more, so when IBM offered me a job in Rochester, MN, I decided to take the position. I started as a diagnostic engineer and ended my career after 30 years as a system architect with special focus on computer storage and interfaces. I started a consulting company at that time called TrueFocus, Inc. focusing on storage and high-speed interfaces (primarily Fibre Channel). My wife, Jeanne (B.S., Education) and I have two daughters and now five grandchildren (four boys and one princess who are 12 to five years old). I travel extensively with my work (in the first year that I retired from IBM, I was home the first week in January and then not for four successive days until Thanksgiving). In October, I made my third trip to Europe this year. I am giving the keynote speech at a storage conference in Vienna. My wife often travels with me. Together we have been around the world four times. We still enjoy seeing new things. Here is my web site: www.truestedt.org.

Daryl R. Tweeton (M.S., Physics, 1968; Ph.D., Physics, 1972) I have been married to my wife Jacqueline for 40 years. We have two daughters and one grandson. Our only son passed away in May, 2008. I worked at the U.S. Bureau of Mines in Minneapolis as a research physicist until 1996. I now have my own company, GeoTom, developing and selling software for geophysics. My favorite memory from the University of Minnesota was learning to run the Van de Graff particle accelerator in the nuclear physics laboratory. My favorite professor was my advisor, Carl Poppe. My favorite course was quantum mechanics.

1967

Carlos Avery (Ph.D., Physics, 1967; M.S. Physics, 1965; B.S., Physics, 1960) I began one of the best ten years of my life at the University of Minnesota in 1956. I won a prize in the high school state science fair that year for a "smoke tunnel" project. I was selected for a student research assistantship in Ben Lazan's affiliated Mechanics & Materials (M&M) Department. Then I took Edward Nye's sophomore physics course, and I decided physics was where I ought to be. I transferred, and was delighted to get Ed as my undergraduate advisor. He was a role model for me. He was my idea of a real physicist: smart as hell, funny (sometimes a bit risqué: e.g., his Lorentz Contraction limerick) and a true "character," with his red high-top sneakers, Marlboros, and Norwegian sweaters. Despite transferring, I kept my undergrad aero-related scholarship and the M&M job (full time in the summer, half-time during the school year), which enabled me to pay for my undergrad education. I stayed on at Minnesota for graduate work. I joined Alfred O. C. Nier's group in mass spectrometry, working on small mass-spec machines in Aerobee rockets to probe the composition of the upper atmosphere at 100-210 km altitude above White Sands Missile Range. I did my thesis work under Nier on atomic oxygen, measuring recombination coefficients of O on various surfaces-numbers necessary to make corrections to the readings of the spectrometer to account for surface losses in the instrument. I worked with **Jeff Hayden** (B.S., Physics, 1969), Charlie Tschetter and John Ristow on the devices and with **Al Hedin** (M.S., Physics, 1961; B.S., Physics, 1958) on developing a computer program to correct the telemetry data for these losses as well as the motion and orientation of the rocket as it spun and traversed its parabolic trajectory [See Hedin, Avery, Tschetter, JGR Vol 69 #21 (1 November 1964)]. As an experimental physics major and lab grunt, I learned some glass blowing, silver soldering, a smattering of electronics, how to work a lathe and milling machine. I also learned about keeping the liquid nitrogen traps filled to maintain high vacuum during long lab runs over several weeks at a stretch, necessitating never being away from the lab for more than 15 hours. The professional shop staff, "Buddy" Thorness, Don Schifferl, Herb Ballman [See Newsletter,#8, December 2007.], and Marvin Dynes, were lifesavers in helping me build my experimental apparatus. I passed my final oral exams in February 1967, and hosted the requisite "beer bust" for the department at Manning's up on Como Avenue. I then reported to the dream job I had in mind for the previous four years. When the "007" films hit the scene in the early 60s, I had daydreams about working in the CIA. I spotted a small ad in the *Scientific American*, advertising for physicists and engineers for the CIA. I hung on to that festering thought. I applied when the light at the end of my thesis tunnel was in sight. I accepted an analytic position and reported to work in March 1967. I stayed with "The Company" for 40+ years, retiring in January 2008. I said all that I will say about that job in a newsletter issue last year**.** After an 11-day "retirement," I went back to work as a contractor with CENTRA, where I plan to hang on at least another five years. The professors that had the most impact/influence on me and my career choice, who exposed me to much more than I comprehended or assimilated, were Ed Nye, Al Nier, Michael Sanders, Edward Hill, Donald Yennie, Walter "Cork" Johnson [Newsletter #9, July 2008], Norton Hintz, Karl Quisenberry, and (in the math department) Warren Loud and James Serrin. I had a great bunch of colleagues in my classes and in the labs: Jacque Hohlfelder, Gunnar Modin, Earl Kyle, Jay Benson, Richard Ries, **Richard Damerow** (Ph.D., Physics, 1963; M.S., Physics, 1960; B.S., Physics, 1958), **Arnold Dahm** (Ph.D., Physics, 1965), Fred Gillette, Chester Hwang, Dieter Krankowsky. I have fond memories of playing passable bridge with some of these guys in the basement MS lab at lunch. I found out that I really sucked at the game of "Go." What was really humbling, however, were the outstanding physics students who were a year after me or in some of my classes: **William Bardeen** (Ph. D., Physics, 1968) [I remember Bill would walk out of two-hour exams after an hour or so (with all answers right, of course) while the rest of us average folks hung on to the bitter end of the test period.] and **Stanley Brodsky** (Ph.D. Physics, 1964; B.S., Physics, 1961) [Brodsky and Bardeen were both winners of the Sakurai prize. Pretty impressive--and statistically interesting]**, George Gamota** Ph.D., Physics, 1963; B.S. Physics, 1961)**,** the Hager twins **Ralph Hager** (B.S., Physics, 1961, Deceased) and Richard (B.S., Math, 1961), **James Haijicek** (B.S. Physics, 1961 Deceased)**, Charles Reinert** (Ph.D., 1969; M.S., Physics, 1963; B.S., Physics, 1961).

Harold H. Burrows (M.S., Physics, 1967) I am married with three children and five grandchildren. I am now a financial consultant. My favorite memory from the University of Minnesota was the interaction with fellow grad school students.

Brendan B. Godfrey (B.S., Physics, 1967) I am a member of the Senior Executive Service, and Director, Air Force Office of Scientific Research in Arlington, VA. I guide the management of the entire basic research investment for the U.S. Air Force. I lead a staff of 200 scientists, engineers and administrators, and foreign technology offices in London and Tokyo. I was an Air Force lieutenant at Kirtland Air Force Base, N.M., from 1970 to 1972, performing research in computational plasma physics. I began my civilian career in 1972 at the Los Alamos National Laboratory, N.M., where I was responsible for establishing the intense particle beam research program. I left Los Alamos in 1979 to manage and conduct intense microwave and particle beam research at Mission Research Corp., becoming their Vice President and Regional Manager in 1987. In 1989, I returned as an Air Force civilian as Chief Scientist of the Air Force Weapons Laboratory at Kirtland AFB. My later assignments included Director of Advanced Weapons and Survivability at Kirtland's Phillips Laboratory; Director of the Armstrong Laboratory at Brooks AFB, Texas; and Director of Plans and Program at the Air Force Research Laboratory at Wright-Patterson AFB, Ohio. Prior to my current assignment, I was Deputy Director of the 311th Human Systems Wing, Brooks City-Base, Texas.

Steven C. Gustafson (B.S., Physics, 1967) I went to graduate school at Duke University receiving a Ph.D. in physics in 1974 with a dissertation in the microwave spectroscopy area. In the middle of graduate school, I was drafted and spent two years in the Army, including a year in Vietnam. A more delightful experience was my marriage in 1970. In 1974, I moved to Ohio, where I spent the next 24 years at the University of Dayton in the electro-optics area. In 1998, I joined the faculty of the Air Force Institute of Technology, where I now teach graduate students and conduct research in the pattern recognition area. The photo shows my two sons, both of whom are engineers (one mechanical and one electrical working in San Francisco and Seattle), my oldest son's wife, and my lovely wife, who was recently Dean of the Business School at the University of Dayton. I also like to ride my bicycle. This summer I rode 200 miles with my son from Seattle to Vancouver.

Frank T. Mabley (B.S., Physics, 1967) I married my college sweetheart and we have two daughters. I took up acting in 1998. I have done lots of plays, a few ads and some bad movies. I was with NASA for 3½ years. I then became a sex educator for Planned Parenthood while attending law school. I have been an attorney with my own firm since 1974. www.mableylaw.com.

Jonathan F. Ormes (Ph.D., Physics, 1967) I am married to my wife Janet (University of Minnesota alum). We have two children and four grandchildren. From 1967 to 2004 I was an astrophysicist for NASA. I served as the director of Space Science from 2000 to 2004 as well as Research Professor of Physics and Astronomy and Director of Denver Research Institute. My favorite memory from the University was walking past the lobster tank to a lab in the basement of the physics building.

Robert A. Stryk (Ph.D., Physics,1967; M.S., Physics, 1962; B., Physics 1959) I was the last person to use the Van de Graff accelerator whose large tank still sits behind the Physics building. Thank you, Office of Naval Research. I have been married three times. I am currently widowed. I have three children, seven grandchildren and one great-grandson. I worked at Honeywell on the ultra-violet flame detector. I was the co-inventor (with three others) of the ionizing type smoke detector. I set up real-time data acquisition with a minicomputer. I advised divisions on local vs. corporate computer usage until inexpensive computers made local the obvious best choice. I became the principal code developer for a mechanical simulation computer program which included plastic flow and material failure. Over 20 years it went from four boxes of cards in FORTRAN IV to 100,000+ lines of Fortran 98. I became an employee of Alliant Techsystems in 1990 when Alliant was split from Honeywell. I retired in 2002, but was hired as a part-time employee for continuing code development and organization at Southwest Research Institute. My hobby of long-distance running was thwarted by a hip replacement. I am currently playing the bass clarinet in the Minnesota State Band. I am still fascinated by physics and the many diverse insights that continue to be found such as those given at the Wednesday Physics Colloquium. My current contribution is running BOINC on my home computers. I gratefully remember having the opportunity to develop my thesis using grand classic equipment and clever things made locally by our own machine shop (thanks Buddy Thornes) and glassblower. I was enhanced by great discussions with other graduate students and Professors Morris Blair, Walter Johnson, Al Nier and many others.

Francis M. Tam (M.S., Physics, 1967) I have been married to my wife, Margaret, for thirty years and we have three children. My favorite memories from the University of Minnesota are dining out with **Brian Sabo** (B.S., Physics, 1958; M.S., Physics, 1963; Ph.D., Physics, 1973) and Lawrence Lee of Mechanical Engineering. C.N. Wall, in charge of teaching assistants and labs, was a father figure role model for me.

1966

James J. MacKenzie (Ph.D., Physics, 1966; M.S., Physics, 1963) I married my wife Rhona in 1965. We have two sons. I was a postdoctoral researcher at Argonne National Lab and MIT. I then joined the Audubon Society. From 1977 to 1981 I was Senior Staff Member for Energy at the President's Council on Environmental Quality. From 1981-1986, I was a member of the Union of Concerned Scientists. I served as Senior Staff at the World Resources Institute from 1986-2004. My favorite memory is when I was at a Minneapolis Symphony concert in the top balcony at Northrop Auditorium. A young woman came in and saw that her seat had been taken, and I offered her the one next to me. That is how I met my wife. My favorite professor was Ian Richards. He was a math professor. He never carried notes. He would walk in and say, "Here is where we left off."

James B. Mehl (Ph.D., Physics, 1966; M.S., Physics, 1964; B.S., Physics, 1961) I am married with two adult sons, two grandsons and one grand-daughter. Attached is a photo of my wife Joan and myself in the Cinque Terre area. I am retired from an academic career of teaching, research, and administration. I continue to do research from my home office. We live on Orcas Island in Puget Sound. Our house is in a small inland forest where we walk daily. My research activities evolved from experimental low- temperature physics to the application of acoustic and electromagnetic waves in precision measurements of thermophysical

properties of gases. More recently I have used lab initio potentials for helium and hydrogen gases to calculate the virial coefficients, viscosities, and thermal conductivities using quantum statistical mechanics. Since moving to the island I have only done computational work. My favorite professors were Bill Zimmermann and Lew Nosanow who were always clear; both showed by example that "hard" calculations could be done. Mike Sanders introduction to quantum mechanics was inspiring. I remember how he enthusiastically described papers and books from the German and French literature, which he apparently read with ease.

Paul A. Nyhuis (M.S., Physics, 1966) I married my wife Gayle in 1964. We have two daughters and three granddaughters. I am in excellent health. I still enjoy hiking, biking, and cross-country skiing. I taught physics and mathematics at Concordia College in St Paul from 1964-1970. From 1970-2000, I taught physics, astronomy, mathematics, engineering at Inver Hills Community College. I have been serving as Congregational Care Pastor at Crossroads Church in Cottage Grove since 2001. My job includes visiting people in hospitals, nursing homes, jails, doing some counseling, and managing a large benevolence program. My favorite course at the University was a Modern Physics sequence taught by my favorite professor, Russell Hobbie.

Lauren M. Peterson (B.S., Physics, 1966) I am married and have three children. I enjoy bicycling, swimming, and playing hockey and tennis. I have been doing basic and applied research in optics, remote sensing, and laser radar and quantum optics for 36 years for General Dynamics. I was an Adjunct Professor of EECS and University of Michigan for 25 years. I always enjoyed and looked forward to IT days when faculty and grad students came up with great games and demonstrations. I still remember doing second sound experiment in superfluid liquid helium in senior lab. My favorite professors were Robert Pepin, Morris Blair, Jake Waddington and Joe Valasek. I now teach many of those same courses. I will say that I would rather take an exam in physics than create or grade one.

1965

Darwin H. Throne (M.S., Physics, 1965) I got married in 1965. We had two sons. I divorced in 1980. I married Sandy Smith in 1987. I have lived in the Slicon Valley area since 1965. I traveled extensively to about 15 countries around the world. Both of my sons are married, living in Silicon Valley, and are involved in high tech business. My personal interests include tennis, skiing, golf, cycling, backpacking, photography, theater and listening to classical music. I have served on several business and community boards and commissions over the years. I worked for Hewlett Packard Co for ten years on atomic frequency standards and other electronic products. I founded Handar, a remote data acquisition company in 1976 which was sold to TSI in St Paul in 1986. I founded several other startup companies in various fields. I am currently working on a new startup (and hopefully the last), Cirgon in the home entertainment industry with an emphasis on photography. I taught a graduate course on entrepreneurship in the School of Engineering Management at Santa Clara University for three years from 1992-1995, based on a book I co-authored entitled "Managing High Tech Startups." My favorite memory at the University was working in the high altitude physics lab for John Winckler. The combination of physics and electrical engineering was fascinating. My favorite professor was Ed Ney. My favorite course was particle physics.

David S. Hanson (M.S., Physics, 1965; B.S., Physics, 1961) I have been married to my wife Catherine since 1962. We have three children, Elizabeth, Mark, and Eileen. We have four grandsons. Since retiring in 2005, we spend the winter at home in Sarasota, FL, and divide our time in the summer between White Bear Lake, and a cabin on Fortune Lake in the Michigan UP. Tennis is a year round activity. In February and March 2008, we vacationed in France and Italy, and finished with a cruise around the Mediterranean. We visited the Pacific Northwest on Amtrak recently, and plan to use the train again to visit Williamsburg, VA this fall. Retirement is great and life is good. After leaving the University, we moved to Ann Arbor for an engineering position with Bendix Aerospace. This was when LandSat was current, and Bendix had built the ground data processing station at Goddard. I was working to develop an aerial remote sensing capability to supplement satellite data. We had the corporate plane equipped with two imaging line scanners (IR and multi-spectral, i.e. several bands in the visible and near IR), and an aerial survey camera. The scanner data was tape recorded and processed in the MIRIA lab, the development of which was my first job. This was lots of fun. We flew jobs all over the country. The best was a forest inventory project on the west slope of the Sierras for a timber company Bendix had acquired. This was ultimately unproductive and Bendix went out of that business. We returned to Minnesota to work on an aerial survey capability for a land surveyor who wanted to expand into photogrammetric mapping, followed by development work in digital photogrammetry at Control Data. This evolved to the development of a reconnaissance system for the Defense Department where I worked with two major subcontractors to deliver imaging sensors for the prime system, ATARS. When this program was cancelled before completion (a huge disappointment), I continued in the defense industry, working with many different subcontractors to deliver systems for inertial guidance, radar tracking, and other specialized devices. I retired from United Defense (now BAE Systems) in 2005. I am loving retirement. I can not call this a favorite memory, but it is certainly the most remembered. One day in 1963, **Jim Mehl** (Ph.D., Physics, 1966) came into one of the teaching labs on the second floor and told me the president had been shot. John Winckler and Ed Ney, who taught my first two undergraduate courses, were my favorite professors. I transferred to physics from the Forestry School. Winckler and Ney's courses were my introduction to the School of Physics.

Charles D. "Chuck" Swanson (B.S., Physics, 1965) My wife, Sue, and I enjoy traveling, especially to visit our daughters in San Francisco and Washington D.C. We also like music, reading and spending time at our cabin. In 2000, I joined the teaching faculty of the Computer Science Department at the University. This followed 25 years of supercomputing at Control Data and Cray Research. My favorite memory was listening to Russell Hobbie lecture on quantum mechanics just after hearing about John Kennedy's assassination. It was a scary time! James Mentz's lectures on mechanics were difficult yet interesting.

1964

James S. Sarp (B.S., Physics, 1964) I got married in 1972 and have one son. My activities outside of work include: Chairman of Worship Technology (lights, videos, and sound) at a local church, and working at a local food pantry driving trucks for pick-up and delivery. From 1967 to 1971 I was an officer in USAF. My favorite assignment was at USAP Global Weather. Currently, I am working for United Space Alliance supporting NASA doing astronaut training. As a student, I had a part-time job in the physics laboratory working for Dr. James Earl flying high-altitude balloons for research using cloud chambers. My favorite professor was John Winckler. My favorite course was a lecture/lab sequence studying the physics of vacuum tubes and transistors.

Dennis W. Whitson (M.S., Physics, 1964) I was married in 1961. I have three daughters, one son and five grandchildren. I have taken cruises to Alaska, Panama Canal, Egypt, and London, England. I worked for thirty-four years at Indiana University in the Department of Physics

and Astronomy. I worked two years as a Research Associate at Wright Patterson Research. My favorite memory was the great teaching at the University. My favorite class was modern physics.

1962

Tung H. Jeong (Ph.D, Physics, 1962) My wife Anna and I have three children and two grandchildren. From 1963-66 I worked in the summer at Oak Ridge National Laboratories. From 1972-1997, I served as Director for Center for Photonics Studies at Lake Forest College, where I am currently Professor Emeritus. My honors include Robert Millikan Medal, American Association of Physics Teachers; Thomas Alva Edison Lectureship, National Science Teachers' Association; CNN Interview; Fellow: Optical Society of America appointed Traveling Lecturer; Honorary Professor of Physics: Beijing Normal University, Kunming University; Progress Medal Award, Photographic Society of America for contributions to three-dimensional imaging; Life Time Achievement Award, International Holographic Manufacturers' Association; Keynote speaker at the annual international conference of the International Hologram manufacturers' Association in 2005, in China; Co-Chair Seventh Lake Forest International Symposium on Display Holography at St. Asaph, North Wales. My hobbies include windsurfing, skiing, reading and violin. My favorite memory from the University was operating the proton linear accelerator.

Roger I. Johnson (B.S., Physics, 1962) I have been married to my wife Vicki for 45 years. We have two sons. We have three grandchildren whose sporting escapades we enjoy immensely. After earning a Master of Arts Degree in Teaching from Harvard's Graduate School of Education, I taught physics in publically supported institutions for two years in Connecticut, one year in the New York State College and University System, and then 35 years in the Minnesota State College and University System (MNSCU). Along the way I completed certificate programs in Astrophysics at the University of Rochester, Nuclear Engineering at the University of Missouri at Rolla, and doctoral work in Educational Administration at the University of Minnesota. I never lost the lust for learning! I left MNSCU in 2000. I did part-time adjunct teaching at Northwestern College in Roseville, MN. I finally retired in 2005. I taught calculus-based physics and engineering courses, but filled a full-time position with astronomy, algebra-based physics, and physics for nurses, physics for ultrasonographers, and physics for people who do not generally like physics, but needed an elective. It was a joyous experience teaching the subjects I loved. I have several fond memories from my time as an undergraduate: helping build nearly 200 electronic circuits used to count cosmic ray particles and launching them on balloon flights, following the telemetric transmission of data to ground receivers was a joy that was preparative for graduate school and remunerative for someone who needed to work his way through school. Being the secretary, then president of the University's Student Section of the American Institute of Physics familiarized me with most of the faculty. Arranging for the faculty to give talks to our Club was great fun. I simultaneously served on the IT Engineering Council, as a student representative from the Department of Physics. I was a ChemE major as a freshman; but one quarter of Physics with George Freier and I was hooked. Dr. Freier made physics come alive and made so much sense to me, that I changed majors. His blackboard artwork and general delivery and prowess at demonstrations were mesmerizing. I emulated his style as best I could in my own physics teaching career. Dr. William Zimmerman was a professor who captured my attention. He was one who added the gift of rhetorical injection and a rational flow of ideas to his development of theory and problem solutions that I found particularly exciting and useful in my own teaching. Finally, I found in Dr. Walter Johnson's Senior Lab a love for following through with detailed experiments that was far more enlightening than the dry freshman laboratories. He showed me the now obvious connection between theory and experiment that every physics student needs to admire about the subject. I have always regarded my education at the SPA as superior, and I have never regretted one moment, one course, or one professor. The academic strength of the University has always been a "shoulder to lean on" even as I taught at other colleges in Minnesota.

David C. Look (M.S., Physics, 1962, B.S., Physics, 1960) I have been married for 40 years to my wife Rita. We have two children and three grandchildren. We travel all over the world (China/Korea/Japan in 2007), mostly giving lectures on ZnO research. I am very active in Baptist church activities; as well as music, biking, tennis, volleyball, hiking (recently climbed Half Dome in Yosemite National Park). I am the Director, Semiconductor Research Center, Wright State University, and researcher at the Materials Directorate, Air Force Research Laboratory, funded by AFRL and also NSF, AFOSR, DOE, and ARO. My professional dream is an efficient solid-state white lighting from crystalline ZnO (that's right, the nose powder), saving the USA $150B per year in power costs by 2025. I organized the First International Workshop on ZnO in Dayton, 1999, and have participated in many other similar ZnO-based meetings since then. My favorite memory was skipping research and going to the Student Union to play pool and ping pong with fellow grad students **Dennis Barnaal** (Ph.D., Physics, 1965, M.S., Physics, 1962, B.S. Physics, 1958) and **Jan Northby** (Ph.D., Physics, 1965) whenever Professor Lowe was away. My least favorite memory was making a stupid mistake and blowing up a very expensive vacuum-tube voltmeter during early in my M.S. research. I avoided the lab for a week or two to give Professor Lowe time to cool off. My favorite professor and course (as I remember) was Professor James Werntz, "Thermodynamics, Statistical Mechanics, and Theories of the Structure of Matter". Professor Werntz was by far the best instructor I ever had in undergraduate or graduate training, anytime, anywhere. He was truly a wonderful teacher.

1961

Earle Kyle (B.S., Physics, 1961) The latest news is that I have been asked to help Carnegie Mellon University's Team Astrobotic compete in the $20 million Google Lunar X-Prize. My son is finishing his senior year there and is also helping the team. Since I helped design the Apollo spaceships that took men to the Moon, it is great fun for me to help this team land a private robot near the Apollo 11 site and transmit pictures back to Earth. We plan to launch in May of 2010. I owe my exciting aerospace career to the University's Cosmic Ray Research Lab where I helped design part of the Orbiting Solar Observatory satellite.

Richard Rue (B.S., Physics, 1961) My wife and I are world travelers. I enjoy skiing and photography. I have been restoring antique clocks, cameras, pianos, harpsichords, classical keyboards and church organs for forty years. I was a physics instructor in Ridgecrest, CA and at Pacific University in Forest Grove, OR. I was a physicist at Naval Warfare Center (NWC) -China Lake, CA. I am currently an optometrist in Banney Lake, WA. I have two patents at NWC related to guidance of drama aircraft. My favorite memory at the University was monitoring early passages of Sputnik, Graduation Day and passing advanced calculus.

Athanasois "Tom" Patitsas (MS, Physics, 1961; BS, E.E., 1958) Many years have passed since I found myself in a large first year classroom in Tate Lab of Physics in September of 1954. My command of the English language was minimal. I had to work in the kitchen of one

of the fraternities. The boys there had a terrible time trying to pronounce my name, so when I decided to adopt the name, Tom, they all jumped with joy and relief. After a couple of lectures, I approached Dr. George Freier, the lecturer, and I said that I have a problem, since my English was not adequate to follow his presentation. He smiled and said, "That is a problem alright. You come and see me whenever possible." During the seven years that followed, Dr. Freier was my mentor and advisor. I appreciated his perseverance and intellectual honesty in his effort to understand some of the physical phenomena around us, such as the electric field on the surface of the earth. During the 1970s, while teaching physics at Laurentian University in Sudbury, Ontario, CA, I did computations on the scattering of the sun's rays by water droplets, in connection with the phenomenon of the rainbow. Since 1990, and especially after my retirement in 1996, I have been involved with the understanding of the phenomena of the singing sands and booming sand dunes. In the former case, a pleasant sound is emitted, with frequency of about 600 Hz, when certain beach sands are stepped on or impacted by a rod. In the latter case, a droning sound is emitted, with frequency of about 100 Hz, when sand masses avalanche down the slope of a sand mountain. The results of this study are summarized in a manuscript recently completed that will be published soon in, Scientific Journals International. It can be accessed through Google by the title, "Singing sands, musical grains and booming sand dunes" http://www.scientificjournals.org/journals2008/articles/1404.pdf. Last June, I had the opportunity to meet my son, Steve at Quebec City during the annual meeting of the Canadian Association of Physicists. Steve is a professor of Physics at the University of Lethbridge, Alberta, Canada.

1960

Arthur F. Hayes (M.S., Physics, 1960; B.S., Physics and E.E. 1956;) I am retired. My wife Jacqueline and I have been married for 54 years. We have two sons and three grandsons. We are avid choreographed ballroom dancers and are active in our church. We do a lot of choreographed ballroom dancing and are parliamentarians for the International Choreographed Ballroom Dance Association (ICBDA), website http://icbda.com/. We have our own website http://www.we-dance.info/ where we show dance videos with choreography instructions for dancers to view and learn dances. I am Clerk of Session for the First Presbyterian Church in Plant City and I am on the Board of Trustees for the Presbytery of Tampa Bay. After graduation, I started my 34-year career at Honeywell as an Evaluation Engineer. I retired as a Project Engineer. My most notable achievement was the co-invention of the "Hot Line Gun Sight" for fighter aircraft with Robert Schultz, another University of Minnesota graduate. We received a patent for it in 1973, patent number 3,716,696, "Projectile Stream Display Apparatus". Industrial publication "Aviation Week" published an article describing its operation in their August 17, 1970 issue. I received the Honeywell Sweat Award for this achievement in 1970. Over my career at Honeywell, I worked on navigation, fire control, marine and space systems. The last five years I was a Project Engineer at the Honeywell Systems and Research Center. One of my projects was the development of Honeywell systems for the Space Defense System Initiative, more commonly known as "Star Wars". I retired from Honeywell in 1990. I accepted a position as a Church Business Administrator at the First Presbyterian Church in Bellevue, WA. I refer to this second career as moving from near space to outer space. I retired from this position in 2000. We moved to Florida. My favorite memory has to be the times I spent dating Jacquie, going to football games, watching Paul Giel run up and down the field, hockey games watching Ken Yackel at Williams Arena, and studying in the Engineering Library. After Jacquie and I were married, we moved to the student housing on the Saint Paul campus. We had close friends there and enjoyed many happy times. On several occasions, I had the pleasure of sitting next to Dr. Alfred Nier as we traveled on the intercampus trolley. My favorite physics courses and professors were modern physics from Alfred Nier and George Freier, mathematical physics from Edward Hill and electronics from Morris Blair. My favorite course was in the EE 261-263 Problems Electromagnetism from William Shepherd. We met in the conference room next to his office. He assigned us problems to work on and present to the class. My greatest intellectual experience was the derivation of the relationship of energy to mass from Einstein's theory of Special Relativity and the derivation of the velocity of light from Maxwell's equations.

Philip J. Nistler (B.S., Physics, 1960) I have been married to my wife Toni for 45 years. We have four children and three grandchildren. I spent eight years at Univac doing research on various ferrite components, and developing a radiation hardened device for monitoring nuclear weapons. After Univac, I spent 29 years with Honeywell. The first 11 years were spent doing digital design, including the design and system testing of the Space Shuttle Main Engine Controller Assembly. The last 18 years at Honeywell were spent in engineering management leading the design and development of various commercial aviation products. I have been retired for 12 years. I am thoroughly enjoying the retirement phase of my life. I spend spring and fall farming in southwest Minnesota. In January and February, I hike in Kauai. The remainder of the year is spent traveling, playing tennis, skiing, biking, gardening and enjoying the grandchildren. I also volunteer my time for Habitat for Humanity. My favorite professor was J. Morris Blair. In the 1980s, I had the honor of hiring him as a consultant to help my design team during the development of a new fuel densitometer.

Mervine Rosen (Ph.D., Physics, 1960) I am married and have two children and six grandchildren. I spent a very enjoyable post-doc year at Nihom University in Tokyo, where I also picked up a great interest in Japanese. Culture and religion have stayed with me for many years. Upon returning I went to the Naval Research Lab in Washington D.C. I live in Virginia. I have been active in my local community and temples. They had an electron linac at NRL. I worked for a number of years on the scattering from mol electro excitation of nuclei. When the navy stopped supporting nuclear physics, I branched out into a number of fields: the use of particle and laser beams on metal surfaces to change their properties, film growth on surfaces using particle beams using molecular dynamics coder, radiation transport in nuclear reactors and its effect on reactor walls, etc. In the early days of SOI, we looked at the effectiveness of various weapons beams against not yet designed Soviet ICBMs. In the early 90's I got involved in the determination of the optical properties of semiconductor quantum dots. I retired in 2001.

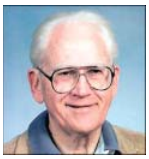
Donald W. Vierimaa (formerly Wieriman) (B.S., Physics, 1960) I

was raised in Minneapolis, and I graduated in 1956 from North High. The most challenging and interesting course was thermodynamics. A favorite memory is of a math instructor dressed in a sport jacket and tennis shoes writing equations on the board and then walking out the door, peering down the hall and then without a word continuing writing equations. Upon graduating, I took the Rose Bowl train to Los Angeles and watched the number one Gophers lose to the University of Washington. Apparently the Gophers playing in a bowl game is a once in a lifetime event. I worked for North American Aviation, Boeing, and McDonnell-Douglas in the aerospace industry in the areas of thermal dynamics, vacuum technology, cryogenics, and testing. I married my wife Geraldine in November, 1967. We lived in Cape Canaveral, Florida where we saw rockets launched more than once a week. I saw a Saturn V rocket launched

from the reviewing stand. My wife and I decided to take a six month trip around the world in 1969 before we settled down. Upon return, the aerospace industry had collapsed. I worked one term as a high school teacher in math and shop in rural Virginia. I found a job as a manager of a McDonalds in Washington, D.C. I then worked for the Association of American Railroads and Truck Trailer Manufacturers Association. I retired as Vice President of Engineering on January 1, 2000. My wife died of pancreatic cancer on June 6, 2000. I participate in a number of singles groups. I am president of a ski club for skiers over 50 years of age. Our oldest skier is 89 years old. My pastimes include hiking, biking, boating, skiing, dancing, concerts, travel, and friends and family. I have one son and four grandchildren who live nearby. I have been in every state and every continent except Australia. I frequently return to Minnesota to visit friends and cousins. I returned in August from a four day, 132 mile bike ride in Quebec where the oldest biker was 80. In December I plan to visit Antarctica with two friends. I inherited the family homestead farm (woods and swamp) in Palo, MN. It looks like it will be a century more before it yields to development. People kid me because I took a four hour guided tour of Embarrass, MN. I found that I could still take the mail boat tour of Lake Vermillion just as I did when I was 12 years old. The boat I took then is now an antique. I have a 1966 aluminum boat with a 1966 100-hp Johnson and a 1967 Sunbeam Tiger II that needs to be restored. I need to be restored as well. I am lucky, however, I only take Lipitor and Viagra and am lucky to have the opportunity. That's the news from Woebegone East where all the men exaggerate, the women believe them, and the children have two families.

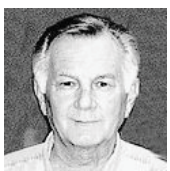
In Memoriam

Richard S. Claassen (Ph.D, '50) died June 16, 2008 at age 86. Known as "Dick", he was born in Ithaca, NY. He worked for 31 years at the Research Organization of Sandia National Laboratories in Albuquerque, NM. He was appointed a Vice President in 1982 and named Director of Sandia's sister laboratory in Livermore, CA. He also worked as a consultant for government science agencies, professional associations, and two universities for developing material science programs in their engineering departments. After retirement, he continued his consulting role. During World War II, he spent two years in development work for the Manhattan Engineering District on the "atomic bomb project." He is survived by his wife and three children.



August R. Hanson (B.S. '42) died on June 18, 2008 in Apple Valley, MN at age 90. He was born in Minneapolis, MN in 1917. August taught Aeronautical Engineering at the University of Minnesota. In the late 1960s, he started a manufacturer's rep business partnership, GII Sales. After retirement, August was Vice President of QuestStar Medical, Inc. He is survived by daughter, a son, a grandson, three step-grandchildren and seven step great-grandchildren.

David I. Norman, (B.S. Physics '62; Ph.D, Geology '76), 67, passed away on May 5, 2008 in Ghana, Africa. He was born in 1940 in Willmar, MN. He served in the Peace Corps from 1966 to 1968. He married his wife, Mary, in 1976. They spent 1976 - 1978 in Norway before settling down in Socorro, NM. He was a professor at New Mexico Tech from 1978 until his death. David is survived by his wife of 32 years, a son, two daughters.



George M. Satovich (M.S., Physics '72) 66, died October 7, 2008. George was born in Crosby-Ironton, MN. He worked at Raytheon where he headed a research group developing rocket technology (a life long dream) and cutting edge chip technology used by Motorola. He later returned to Minnesota to work as a components engineer for Control Data. He then started his own companies, NES and Cardio Systems. He was a key designer of the Bio-Medicus / Medtronic blood pump which, some 25 years later, is still recognized as the finest blood pump in use today. He later developed a cutting edge heart rate monitor endorsed by the Minnesota Heart Institute. The monitor was also used in training by the elite Minnesota athlete, Greg Lemond. In addition to working on many NASA and government military projects, George also developed the world's number one electronic toy, sold by Mattel, three years in a row. The toys were a series of remote controlled vehicles using sound and voice recognition technology. He is survived by two wives, three daughters, a son and six grandchildren.

Hugo D. Wahlquist (B.S. '53) died June 14 at age 78 years. Hugo received a BS in physics in 1953 from the University of Minnesota. He received a MS in astronomy from Caltech in 1954. While never losing his passion for the stars, Hugo developed a deep love of Einstein's theories of relativity and worked tirelessly with great joy in the pursuit of the elusive gravity waves Einstein's theories predict throughout his career in mathematical physics. He published over 60 refereed research papers, created the "Wahlquist Solution" to Einstein's relativity equations for a "Finite Body of Rotating Perfect Fluid." He had an international reputation for work in soliton theory, general relativity and differential geometry, and cosmology. He also did experimental work, using the IUE spacecraft to observe quasars and led the search for low-frequency gravitational waves using the Cassini interplanetary spacecraft. He worked at the Jet Propulsion Laboratory, beginning in 1956. He was a Senior Research Scientist at JPL until his retirement in 1996. He is survived by his lifemate, three daughters and grandchildren.

Correction:
Ronald Loren Keith died August 24, 2007, not 2008.

William Bardeen

(Ph.D., Physics, '68)

You came to Minnesota in 1962 after graduating from Cornell. What helped you decide to come to the University of Minnesota for your Ph.D.?
I was interested in joining the low temperature experimental physics group.

Who were your favorite professors?
Lew Nosanow who convinced me to switch to theoretical physics, Steve Gasiorowicz who taught me elementary particle physics and E.L. Hill, who taught me mathematical physics

Tell us about your Ph.D. experience?
Steve Gasiorowicz was my advisor. My thesis was titled "A covariant formulation of spin and representations of the local current algebra." This topic resulted from my interest in the spin structure of scattering amplitudes and the properties of amplitudes involving local currents. The best part of doing this research was being able to think deeply about difficult problems.

What were some of your favorite memories of your time while you were here?
Fellowship among the physics graduate students and their families, playing on the physics basketball team, enjoying the Minneapolis lakes with my family and friends.
Where did you go after completing your Ph.D.?
I was a postdoc at the new Institute for Theoretical Physics begun by C.N. Yang at SUNY- Stony Brook followed by a term as a member of the Institute for Advanced Studies in Princeton, NJ.

Tell us about your research projects.
I am the co-inventor of the theory of the axial vector current anomaly which is of foundational importance in modern theoretical physics. Stephen Adler and I developed the "non-renormalization theorem" (known as the Adler-Bardeen Theorem). I played a key role in the development of perturbation theory for quantum chromodynamics and dynamical approaches to electroweak symmetry breaking. Another of my main interests is quantum field theory and its application to the phenomena of elementary particle physics.

You joined the Fermi National Accelerator Laboratory in 1975. What influenced your decision to come to Fermilab?

at Fermilab in 1977

B.W. Lee, the Head of Theoretical Physics at Fermilab and colleague at the ITP at Stony Brook, convinced me that Fermilab would be an exciting place for physics where I could fully develop my research interests. I have been a member of the senior scientific staff at Fermilab and have served as Head of the Theoretical Physics Department. My research at Fermilab has covered many topics in theoretical particle physics, most notably the physical applications of perturbative quantum chromodynamics, the theory of the strong force, the analysis of gauge and gravitational anomalies, and the study of the dynamical mechanisms of electroweak symmetry breaking.

What was/is your favorite research project?
My early work on anomalies in quantum field theory, done while I was a member of the Institute for Advanced Studies, was exciting, and it has served as the foundation for much further research on the nonperturbative structure of quantum field theories.

What are your awards and honors?

I have received the J.J. Sakurai Prize of the American Physical Society (1996), a John S. Guggenheim Memorial Foundation Fellowship (1985), Senior Scientist Award of the Alexander von Humboldt Foundation, Alfred P. Sloan Foundation Fellowship. I am a Fellow of the American Physical Society (1984), and a Member of the National Academy of Sciences (1999). I received an Honorary Doctor of Science degree from the University of Minnesota in 2002. This is the highest award conferred by the University of Minnesota. I was recently elected as a Fellow of the American Academy of Arts and Sciences (2008).

Tell us about your family.

Marge and me at 2008 Nobel festivities

My wife Marge is Head of the Education Office at Fermilab. I have two grown children, Chuck, a computer engineer, who is now earning his P.hD. in Atmospheric Science, and Karen, who is a high school chemistry teacher.

What are your hobbies?
Genealogy and family history. The use of DNA to study early family connections.

John (left) and William Bardeen in 1945.

Kim Dockter
Director of External Relations

Why invest in the School of Physics and Astronomy?

Private philanthropy combined with public support allows us to attract top-notch faculty and students, and to secure state-of-the-art facilitates and equipment, which enable us to carry out our important missions of research and education. Our students and faculty are deeply appreciative of the generous support many alumni and friends of the department provide.

Dr. Jeffrey Basford (Ph.D., Physics '74) is one of the department's long-time supporters. In 1995 he endowed the Jeffrey Basford Scholarship, which provides support to undergraduate physics majors, and contributes to it annually. His gift was motivated by a deep appreciation for the support he received as a student in the physics department and out of a desire to "make student lives a little better and give them a feeling that their efforts are appreciated." Reflecting on his experience as a physics student, Dr. Basford says, "I found the work challenging, most of the professors helpful, my fellow students stimulating, and Dr. R. Pepin invariably cheerful and correct."

Dr. Basford has a diverse background that includes a Ph.D. in physics, teaching as a Peace Corps Volunteer, serving as a U.S. Army officer and a period of research and development consulting. He then attended medical school and completed residency training in Physical Medicine and Rehabilitation in 1981. Dr. Basford has been a member of the Department of Physical Medicine and Rehabilitation at the Mayo Clinic since 1982 where his clinical responsibilities and research interests have emphasized neurological rehabilitation and musculoskeletal pain. Dr. Basford's research has focused on central nervous system rehabilitation and the effects of physical agents such as electromagnetic energy on the body. He is currently Professor of Physical Medicine and Rehabilitation at Mayo, director of its NIH Rehabilitation Research Training Program and chair of his department's research committee.

"Life has been a little of a random walk. I am now in medicine, do some research and find that the approach and insights I gained in physics gives me ideas and a discipline that I think my colleagues sometimes lack," Dr. Basford said.

Can Zhang is the 2008-09 Jeffrey Basford Scholarship recipient. Can is a junior in the Physics program. The Basford Scholarship is covering his tuition. Can's dad influenced his decision to study physics. Can was good at math. He read stories about physics and was fascinated. He wanted to be a physicist. Can grew up in Wuhan, China (in the center of the country). He says it is like Minnesota. "The people there pay attention to education. Students there want to be good and keep up." Can came to the School of Physics and Astronomy at the University because the U.S. has the best physics research. He applied to three schools. Minnesota gave him a scholarship, so he came here. Can is working on research with Professor C. C. Huang on liquid crystals. His favorite professors at the University of Minnesota are C. C. Huang and Dan Cronin-Hennessy. Can likes working with C.C. Huang because C.C. is still excited about his liquid crystal research even after 20-30 years of work. He thinks that Professor Hennessey is a great teacher. He wants to be physics professor just like Dan. Can's future plans include working towards a Ph.D. in Physics. Can says his undergraduate work here has strengthened his determination. "You can have a good academic record, but doing research in physics is more than that, it is about doing things and collaborating. Even if you doing thing in the right way, but it will not guarantee you will get what you want. It takes patience to suffer the frustration."

The future of physics and astronomy at the University of Minnesota is as exciting as the past and your investment is essential to our ability to provide an excellent scientific education for students, create synergies between learning and research, and foster interdisciplinary collaborations in new areas of research. Please consider making a gift to support students, faculty, facilities, or for general operations. Your investment will yield important benefits to our state, nation, and world.

You can contact Kim Dockter by phone 612-626-9385 or email dockter@umn.edu

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Next issue: Focus on 1970s alumni

We will highlight our alum from the 1970s in the fall edition of the newsletter. 1970s alumni can expect a class notes mailing in February. Send your Class Notes responses by May 15, 2009 for inclusion in the next newsletter. We can not wait to hear from you!

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