Arts & Sciences

Spectrum

a Newsletter for Alumni and Friends of the Department of Physics & Astronomy at the University of Nebraska–Lincoln

No. 21 Spring 2001 Anthony F. Starace, Editor

NSF Funds Cosmic Ray Observatory Project (CROP)

Dan Claes flipped the toggle switch on the book-size black box and it immediately began producing tones, some high-pitched, some lower-pitched, sometimes several close together, sometimes spaced a few seconds apart.

What the University of Nebraska-Lincoln assistant professor of physics and astronomy was demonstrating was a cosmic ray detection device. The tones were the impacts of cosmic rays — protons and nuclei of light atoms, "little pieces of stars," Claes said — that constantly bombard Earth from all directions.

The detector is similar to those that he and **Greg Snow,** an associate professor of physics and astronomy at NU, hope to install at high schools across Nebraska in the next few years, thanks to a $1.34 million seed grant from the National Science Foundation.

The Cosmic Ray Observatory Project's goal is to install cosmic ray detectors at many of Nebraska's 314 high schools and link them via the Internet in what would be the geographically largest cosmic ray detection network anywhere. Each school's equipment would include a detector to register the impact and energy of cosmic rays, a Global Positioning System (GPS) device to record the exact time and place of the strikes, and a simple personal computer to keep track of the data and link it to other CROP sites.

A school's science classes will be able to set up their own experiments, but they will also be part of a much larger experiment coordinated by the University.

"In the typical high school science experiment, everything is canned, presented recipe-style and designed to be completed in a 45-minute period," said Claes, a former high school physics teacher. "The answer is sort of predictable, but here, they will actually be part of a long-term, ongoing experiment that, like any real research project, carries no guarantees. They'll learn a little bit about what scientists do, but more importantly, they'll come away with the impression that what scientists do is fun and interesting, and worth pursuing.

(From left to right) Dan Claes, Karl Richstatter, a junior science education major from Lincoln, and Greg Snow assemble one of the cosmic ray detection devices they hope to install at Nebraska high schools.

"They will be part of an integrated experiment and they will feel like they personally and their school are contributing real, live, useful data to a larger enterprise."

That larger enterprise will be an effort to learn more about two key features of cosmic rays that scientists don't understand — where they come from and how they achieve their high energies.

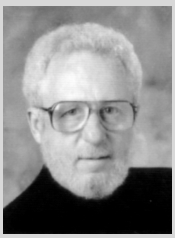
"Some primaries (single protons) carry the same energy as a driven hockey puck," Claes said. "There is no known phenomenon, not even the supernova explosion of a star, that we believe can drive a proton to that high an energy. Yet they exist, and we don't know where they come from."

When cosmic rays hit molecules in Earth's atmosphere, they create an avalanche of more particles called an 'air shower.' Those particles in turn initiate other collisions that make more

CROP *continued on page 3*

Heeger Wins Nobel Prize

Alan J. Heeger (B.S. 1957) shared the 2000 Nobel Prize in Chemistry with Alan MacDiarmid of the University of Pennsylvania and Hideki Shirakawa of Tsukuba University in Japan. The prize was awarded for their discovery that plastics can be made to conduct electricity, paving the way for numerous applications in displays and in electronics. Heeger (in Physics) and MacDiarmid (in Chemistry) were both at Penn in the 1970's studying the transition of insulators into conductors. On a visit to Japan, MacDiarmid met Shirakawa and invited him to join Heeger and himself at Penn for a year, during which time they made their discovery.



Alan J. Heeger

Conducting polymers are chain-like molecules with alternating single and double bonds. When the polymers are treated ("doped") with chemicals that either donate electrons or accept electrons (creating holes), the electrons or holes on the polymer can hop along the alternating bonds. In the original experiment, polyacetylene was doped with iodine vapor and the polymer's conductivity increased by seven orders of magnitude.

Currently, interest in conducting polymers is focused on their recently discovered electroluminescence, i.e., the ability to emit light. In 1990 Heeger founded a company, UNIAX Corp., to pursue display technology using electroluminescent polymers. In March

HEEGER *continued on page 3*

Spectrum
Physics & Astronomy

Letter from the Department Chair

As last year's *Spectrum* newsletter went to press, the Department was preparing for an Academic Program Review (APR). Such reviews are carried out every six years and include a comprehensive self-study of Department activities and duties, including teaching, research, and service. The APR provides a framework for assessing where the Department stands in the scientific and university communities and helps the Department to consider and modify its long-term goals. After our self-study was completed, a distinguished panel of scientists from other institutions was brought in to evaluate the self-study and to advise the Department on its long term planning. The Review Team was chaired by **Douglas Finnemore** (Distinguished Professor, Iowa State University), and included **Nora Berrah** (Western Michigan University), **Robert Hallock** (University of Massachusetts), **Kenneth Heller** (University of Minnesota), **P. Frazer Williams** (Electrical Engineering, UNL), and **W. James Lewis** (Mathematics/Statistics, UNL). Over a period of 2 + days (including April Fool's Day) the Review Team met with faculty, staff, students, and administrators to determine our strengths and weaknesses and to make specific recommendations regarding improving the Department and its programs.

> *"I am pleased to report that the outcomes of this APR were extremely positive. The Review Team noted the high morale of the faculty and staff, and suggested a number of changes in procedures that will help the Department run more smoothly."*

I am pleased to report that the outcomes of this APR were extremely positive. The Review Team noted the high morale of the faculty and staff, and suggested a number of changes in procedures that will help the Department run more smoothly. They also praised our strengths in condensed matter and materials physics (CMMP), in atomic, molecular, and optical physics (AMOP), and in our experimental high-energy physics (HEP) program, and further pointed out that the Department is uniquely strong in Physics Education and Outreach. The Review Team helped the Department realize that our Astronomy graduate program is not terribly effective. They recommended that, over time, resources currently allocated to the Astronomy graduate program be redistributed to CMMP, AMOP, and HEP.

Perhaps the most significant outcome of the APR was the acceptance by College and University administrators that the Department is facing a severe retirement problem, with 13 faculty members now age 62 or greater. While the Department has been alerting administrators to this problem for several years, it was the concern of the Review Team regarding this problem that had an effect. Specifically, the Review Team's report led Interim Dean Linda Pratt to invite Associate Vice Chancellor David Brinkerhoff, Vice Chancellor for Research Marsha Torr, and me to discuss how to handle the situation. This discussion led to an agreement that the Department should be permitted to hire approximately two new faculty per year for each of the next seven years. This was followed by approval to search for two new faculty members during the current academic year. Searches are currently underway to hire a new experimental atomic physicist and a condensed matter/materials theoretician, and we have already received many applications from excellent scientists. We will have a very full and exciting Spring Semester interviewing finalists for these positions. The Department wishes to thank Dean Pratt for her proactive role in the above events.

The hiring agreement, while very positive, will burden the Department in three ways: First, the Department may have to help fund, in the short term, some of the new faculty salaries. This can be done in several ways, including using "soft money" from large multidisciplinary research grants. We are quite hopeful that a new such grant will be announced in the next few weeks. If funded, this grant will provide salaries for two new faculty hires for four years. Second, hiring many new faculty requires the Department to find significant amounts of start-up funding. While difficult to do, this investment will pay major dividends in the future because of the inherent increase in our research capabilities the start-up funding will permit.

The third, and most difficult, problem we shall face is that of space. Over the past 15 years or so, the Department's plan has strived to increase its number of experimental faculty. In 1986, the Department had only eight active experimental physicists; in 2001, we have 13 active experimental physicists, and our theory effort is also larger, engaging more students and postdocs. During this time, the Department has undertaken many renovation projects of our facilities to obtain more useful laboratory and office space by converting underutilized spaces to these areas, but we have reached the limit of what can be done with our current space. New laboratory space is desperately needed if we are to continue to enhance our experimental research effort. We are now seeking funds to build an addition to Behlen Laboratory and possibly renovate Brace Laboratory. The addition would be called the Nanoscale Materials Research Building and would provide housing for the synthesis, fabrication, and study of new nanoscale materials, and for new faculty in this area. Some existing condensed matter research would also be moved into the new addition, freeing up space for more atomic physics research in Behlen. Preliminary plans call for a 20,000 square foot addition, which would provide space for about eight experimentalists and their students, as well as space for central fabrication/characterization facilities. Estimated cost is $5 M–$7 M. We are hoping that the addition can be built using some combination of university, NU Foundation, and federal funds, but funding sources have not yet been identified.

Among the spin-offs of the APR, I note that the major Department research groups (AMOP, CMMP, and HEP) were all specifically placed on the Arts and Sciences College "Priorities for Enhancement" list. In addition, Physics Education/Outreach may qualify under several separate categories. While placement on this list does not guarantee funds for enhancement, it does provide an additional argument for resources, and we expect that each group will grow even stronger in coming years.

CHAIR *continued on page 3*

CROP *continued from page 1*

and more particles. Eventually millions of particles are hitting Earth's surface.

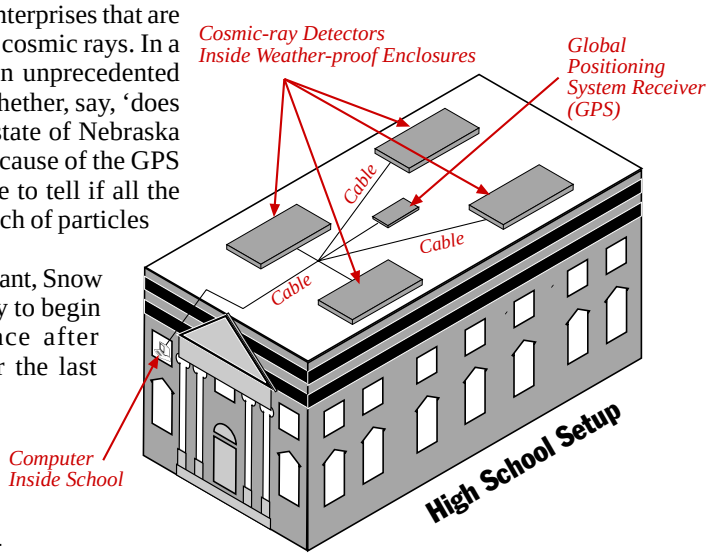
"The idea is that using a grid of detectors we can intercept a sample of those particles," Snow said. "Based on both counting the number of particles and looking at the relative arrival times of the particles, we can learn something about their original energy and the incident direction of the original particle — whether it's straight above or at an angle. By looking at this debris down on Earth you can sort of reconstruct information about the original particle.

"One of the nice features about our experiment is that the detectors are spread out over a much larger geographic region than any of the other major enterprises that are being mounted to study cosmic rays. In a certain way, we have an unprecedented sensitivity to judging whether, say, 'does an area the size of the state of Nebraska light up all at once?' Because of the GPS equipment we'll be able to tell if all the schools detect a big bunch of particles coincidentally."

Thanks to the NSF grant, Snow and Claes are now ready to begin putting CROP in place after brainstorming on it for the last three years. They will be able to fund summer workshops, stipends and expenses for high school teachers and students, a graduate student, a technician, undergraduates doing technical work and purchase of the GPS equipment and computers. They inherited the detectors free of charge from a completed cosmic ray project in Utah.

Snow said the goal after four years is to have a network of 20 to 30 schools in the Lincoln-Omaha area, plus at least one in each of the state's 19 Educational Service Units to serve as a hub for expanding in its region. The first group of high schools participating in CROP will include Lincoln Northeast, the Zoo School in Lincoln, Norfolk and Mount Michael Benedictine in Elkhorn.

by Tom Simons
University Public Relations



Proposed CROP detector system setup

HEEGER *continued from page 1*

2000 the company was acquired by DuPont.

In an interview with the *Daily Nebraskan* (October 23rd, 2000, page 3), Heeger said that UNL laid the foundation for his success in science. Owing to the few physics majors in the 1950s, Heeger said it was possible to have one-on-one interaction with faculty. He said Professor **Ted Jorgensen** in particular was influential. He taught Heeger beginning physics and it was this class which made Heeger switch his major from engineering to physics. Heeger said Jorgensen "really opened up modern physics to me."

Heeger is the Director of the Institute for Polymers and Organic Solids and a Professor of Physics at the University of California–Santa Barbara. He is a former Alfred P. Sloan Foundation Fellow and John Simon Guggenheim Fellow. He has authored over 500 scientific publications. He previously was awarded the American Physical Society's Oliver Buckley Prize (1983) for condensed matter physics and the Balzan Prize (1995) of the International Balzan Foundation (Switzerland) for outstanding contributions to the sciences. At the August 1999 UNL graduation ceremonies, Heeger was awarded an Honorary Doctor of Science degree.

CHAIR *continued from page 2*

Among other "big-ticket" items, I note that the **Greg Snow/Dan Claes** Cosmic Ray Observatory Project (CROP) was funded by the National Science Foundation in the amount of $1.34 M (see front page story), and preliminary indications are that the NSF may also fund the G K–12 proposal of **Diandra Leslie-Pelecky** in the amount of $1.4 M. Thus, we are anticipating that the Department will set a new record for annual funding this year.

As always, I want to thank you, our alumni and friends for your financial support. Over time, even small donations are really beneficial in improving our research stature and our high-quality teaching programs. A postage-paid card is included with this newsletter for this purpose, and for notifying the Department of career or address changes. At this time, let me also thank those of you who have corresponded with me this year. I have really enjoyed learning what our alums are doing and am amazed at the variety of careers they have undertaken. Perhaps the most striking news this past year was that **Alan Heeger** (B.S. 1957) was awarded the 2000 Nobel Prize in Chemistry (see front page story), but much other news about alumni is reported elsewhere in this issue. I encourage each of you to communicate your news to me by letter, e-mail (rkirby1@unl.edu), or phone. Enough alumni have told me how much they enjoy reading about their fellow classmates and other alums that I can assure you of interested readers. Best wishes until next year.

Sincerely,

Roger D. Kirby

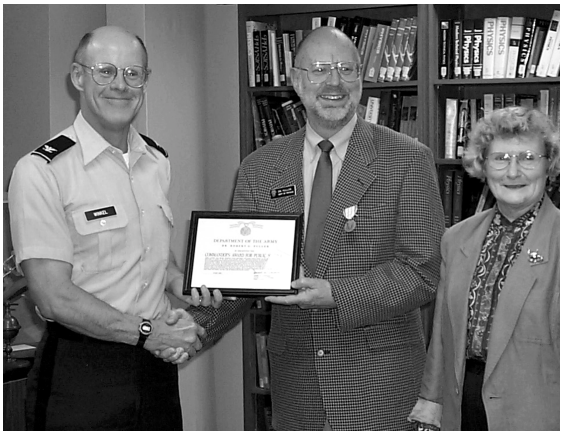
Roger D. Kirby
Professor and Chair

Fuller Cited by U.S. Military Academy

Professor **Robert G. Fuller** was awarded the Commander's Award for Public Service on 24 May 2000 at the United States Military Academy (USMA), West Point, New York. This award was presented by Colonel Raymond J. Winkel, Jr., Chair, Physics Department, USMA, at a public ceremony in Bartlett Hall.

The award citation reads:

"Dr. Robert G. Fuller is presented the Commander's Award for Public Service: During academic year 1999-2000, Professor Fuller performed outstanding service as the Visiting Professor in the Department of Physics at the United States Military Academy. Professor Fuller is an outstanding teacher, experienced educator, and superb scholar whose demonstrated mastery and innovative instructional methods contributed significantly to the Department's mission. His contributions to both the Departments of Physics and Mathematical Sciences interdisciplinary approaches will continue to influence program development long into the future. His insights and mentorship were especially important as USMA developed future curricula which included the use of laptop computers in the classroom and expanded interdisciplinary roles between mathematics and physics. His broad experience and outstanding communication skills played an important role in the development of the military faculty and in the conduct of the two-semester, introductory physics courses. Professor Fuller's exceptional service is in keeping with the highest traditions of the United States Army and reflects great credit upon himself, his family, and the United States Military Academy."



Left to right: Colonel Raymond Winkel, Professor Fuller, Margaret Fuller. Col. Winkel is congratulating Professor Fuller for his outstanding service after having presented him with the Commander's Award for Public Service.

Sartori is Lake Award Winner

Leo Sartori, professor emeritus of physics, received the James A. Lake Academic Freedom award from the Academic Senate on April 25.

Leo Sartori

Dermot Coyne, George Holmes Professor of Horticulture and chair of the Lake Award Nomination Committee, said Sartori had a long career as conciliator and advocate for faculty and academic freedom, based on deep regard for principle and careful consideration of facts, not popularity or self-interest.

Coyne said Sartori, a "wise and gentle scholar," constantly defended and promoted academic freedom in a variety of leadership roles and that Sartori, "made things better and clearer for us in our times."

In his address to the group, Sartori recounted how he taught his first class in 1952 and spent 27 years at UNL. During the 1950s, he said, the threat to academic freedom was external and involved loyalty oaths and "witch hunts" for Communists in academia. In the 1960s and '70s, the threat was the disruption of learning by anti-war demonstrators.

Sartori said it was frustrating for liberal anti-war faculty who despised the war, but also opposed the tactics of classroom occupation and campus violence, preferring methods such as teach-ins to persuade others to join the cause of peace.

Contemporary threats are less overtly dramatic, he argued, but no less important. The academic freedom of students sometimes appears to be in conflict with that of faculty, he noted. Faculty must be sensitive to student concerns, he said, but students

SARTORI *continued on page 7*

Farleigh Receives APPLAUSE Awards

On October 26th, 2000 faculty and staff surprised Electronics and Computer Specialist **Brian Farleigh,** a member of our Electronics Shop, by luring him into a classroom and giving him a hearty round of applause (and a citation, a $200 check, and various gift certificates).

Department Vice Chair Bill Campbell looks on as Brian Farleigh displays oversize copy of APPLAUSE Award check.

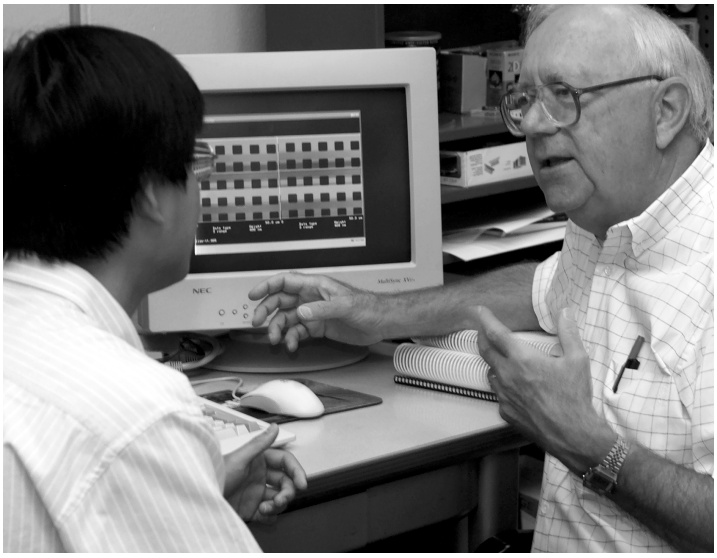
The APPLAUSE Program recognizes Managerial/Professional and Clerical/Tech/Service staff in the College of Arts & Sciences for their innovative ideas, their consistently outstanding performance, or their service above and beyond the call of duty. There are approximately two awards per month within the College. Farleigh had five nominations to receive the award.

These nominations state that "[Brian] is called upon constantly to assist all of our faculty and staff in many different ways and always does it with a smile and works very diligently to get the job done right the first time around... and he will check back to make sure you are satisfied... No task is too big or too small for Brian... he has gone above and beyond the call of duty on NUMEROUS occasions... a perfectionist in his job... The bottom line is that he is very dependable and will go out of his way to help... which makes him a great asset to both the Physics Department and the University...."

Subsequently, in December 2000, Farleigh was named as one of only six staff in the entire College to receive an Annual Applause Award (which was accompanied by another $200 check and more gift certificates and other items).

As reported in last year's *Spectrum* newsletter, in April 1999 Farleigh was awarded the Sigma Xi Support of Research Award.

UNL Researchers, Students Explore World of Nanoscale Technology



Professor David Sellmyer (right) talks with graduate student Hao Zeng at the Brace Physics Lab at the University of Nebraska-Lincoln. The monitor shows a nano-image of cobalt plutonium film.

Scientists at the University of Nebraska–Lincoln haven't gotten the world into a grain of sand yet. But they're working on it. In laboratories across the Lincoln campus, about a dozen faculty researchers and twice that many graduate and postdoctoral students are exploring one of the hottest frontiers of science—the world of nanoscale technology.

"The idea is we're able now to build structures where we're putting atoms and molecules together almost one-by-one, certainly layer-by-layer," said **David Sellmyer**, the George Holmes Distinguished Professor of Physics. Sellmyer also directs the Center for Materials Research and Analysis, a multidisciplinary umbrella under which most of the nanotechnology research at UNL has been done.

Center scientists work in a world measured in billionths of a meter. About four atoms can fit into a nanometer. The typical virus measures 100 nanometers across, a human hair about 10,000, a fine grain of sand could run into the hundreds of thousands. It's also a world predicted to produce the next industrial revolution and innumerable advances in areas ranging from computing to manufacturing and energy to medicine. "If I were asked for an area of science and engineering that will most likely produce the breakthroughs of tomorrow, I would point to nanoscale science and engineering," Neal Lane, the president's advisor for science and technology, told a congressional hearing recently.

> *To see a world in a grain of sand*
> *And a heaven in a wild flower,*
> *Hold infinity in the palm of your hand*
> *And eternity in an hour.*
>
> *— "Auguries of Innocence"*
> *William Blake*

Nanotechnology research has taken divergent paths in institutions around the world. At UNL, most of the work has focused on ways to store more and more information in smaller and smaller spaces, Sellmyer said. "We've really gotten focused on the design of these things in the last 10 years or so," he said. "I would probably say we have three or five groups that are on the hairy edge of doing something." Among their projects, Sellmyer and his colleagues have created new nanostructured magnetic thin films — putting ultrathin layer upon ultrathin layer of various materials, then studying the results. They also have worked with self-assembled arrays – making nanoscale pores in a layer of alumina, then filling the pores with various materials. Put in a magnetic material and you have "quantum dots." Dissolve the structure around the dots and they become nanowires. Layer materials in the pores — magnet, semiconductor, magnet — and you may have the foundation for a new type of computing in which information is stored not just with on-off signals but with intermediate signals as well.

Each project requires scientists from a variety of different fields, Sellmyer said. Chemists and physicists and electrical engineers and mechanical engineers join forces to study, explain, theorize and solve problems. With each new idea, the researchers first have to find out whether it's possible to translate theory into something concrete. "The problem of construction is a huge, huge problem," Sellmyer said. "Nowadays we're working so terribly hard on trying to synthesize these materials." Then they have to figure out what properties the new material has. What does it look like magnetically? Electronically? Can it stand up to heat? Cold? How long will it remain stable? And so forth. Predictions made based on larger-scale versions of the same material are not always helpful because nanoscale materials behave much differently. "You have to do physics studies on these to understand them before you can figure out what they can do," he said. That's the final step — seeing what use the new creation can be put to. Much of the work done at UNL appears to hold promise for information storage. Other work, like that on quantum computing, offers the hope of a vast leap in computing.

Visionaries in nanotechnology talk about increasing information storage abilities by 1,000-fold and fitting the entire contents of the Library of Congress into a device the size of a sugar cube. They also talk about creating nanocomputers to be the brains of nanorobots, tiny devices that could be used to clean hazardous wastes out of groundwater or released into the body to detect and kill cancer cells or put to work manufacturing products from the atom up. In addition, nanoscale devices could be used as sensors in a wide variety of fields. "This is all gee-whiz and far into the future," Sellmyer said, "but that's how science works."

With those visions in mind, President Clinton announced a National Nanotechnology Initiative in Spring 2000. He called for boosting national nanotechnology-related funding by $227 million — to a total of $497 million in

NANOSCALE *continued on page 6*

Research Highlight:

Discovery and Properties of Two-Dimensional Ferroelectrics

Professor **Stephen Ducharme** and his collaborators at the Institute of Crystallography of the Russian Academy of Sciences have made some fundamental advances in the physics of ferroelectrics. Ferroelectrics are non-conducting crystals which can exhibit a spontaneous electric polarization that can be reversed by application of an external electric field. They are named in analogy to ferromagnets. Ferroelectrics have electric dipoles which can align themselves within crystal domains. In a seminal paper in *Nature* [**391**, 874 (1998)], Ducharme and collaborators reported the discovery of "Two-Dimensional Ferroelectric Films." That is, they found that even an essentially two-dimensional thin film of ferroelectric material only two monolayers thick exhibited ferroelectric phase transitions with properties similar to those seen in bulk materials. This discovery occurred nearly 80 years after the discovery of three-dimensional ferroelectricity. It has been cited already as one of 30 "especially important and interesting problems in physics and astrophysics on the verge of the 21st century" in the April 1999 issue of *Physics Uspekhi* (the leading Russian physics review journal) by editor-in-chief, V. L. Ginzburg. Ginzburg subsequently invited Ducharme and collaborators to write a review of the work for *Uspekhi* [L. M. Blinov *et al*., "Two-Dimensional Ferroelectrics," *Physics Uspekhi* **170**, 243 (2000)].

> *"It has been cited already as one of 30 "especially important and interesting problems in physics and astrophysics on the verge of the 21st century" in the April 1999 issue of* Physics Uspekhi *(the leading Russian physics review journal) by editor-in-chief, V. L. Ginzburg."*

Recently Ducharme and collaborators succeeded in making the first measurements of the intrinsic coercive electric field in two-dimensional ferroelectrics. The coercive field is the field necessary to reverse the polarization of a ferroelectric crystal (or magnetization in a magnetic crystal). All previous measurements of the coercive field have measured the much smaller electric field values that are due to crystal defects, which break up ferroelectric domains. By working with thin film ferroelectrics, Ducharme and collaborators were able to greatly inhibit the influence of defects and measure the true intrinsic coercive field. This discovery, reported in the January 3rd, 2000 issue of *Physical Review Letters*, occurred more than 50 years after the intrinsic coercive field value was predicted by the seminal theory of ferroelectricity published in 1945 by V. L. Ginzburg.

Currently Ducharme's group has been advancing their in-house experimental capabilities. Their new fully-automated Langmuir-Blodgett (LB) deposition system (for making two-dimensional ferroelectric ultrathin polymer films) is installed and operating in Behlen 265B. Ducharme's group is one of only two groups in the world making two-dimensional ferroelectric films, the other being their collaborators in Moscow (who made the first such films in 1995). They have also pioneered a new technique of Pyroelectric Scanning Microscopy (PSM) for imaging the polarization state of ferroelectric films. The current resolution is 2 microns and it is expected that soon a resolution of less than 100 nm will be achieved using the CMRA's new near-field optical microscope.

Just as magnetic materials have been used for data storage and other applications, ultrathin film ferroelectric materials have numerous applications. Professors Ducharme, **Peter Dowben,** and **Shireen Adenwalla** were recently awarded a Nebraska Research Initiative (NRI) grant of $800,000 over 4 years to develop "Ultrathin Polymer Films for Microelectronic Devices." The devices include: high-energy capacitors for portable power, nonvolatile ferroelectric memories (RAM) for communication and information devices, uncooled sensors for broadband video and still imaging (i.e., not only in the visible, but also in the ultraviolet and infrared regions), acoustic transducers for ultrasound and sonar, and micro-electro-mechanical devices. Ducharme also recently received a National Science Foundation grant of $225,000 over 3 years for study of "High Performance Capacitors and Nonvolatile Random-Access Memories Based on Langmuir-Blodgett Films of Ferroelectric Polymers."

NANOSCALE *continued from page 5*

2000-01. The final funding total is not known yet because Congress is still working on its budget bills for the year. UNL researchers stand to get some of that money. University officials hired a Washington lobbying firm this year to work with federal officials, with money for nanotechnology research as one of the chief targets. The Department of Defense bill included $2.5 million for UNL research. That would add to the $6.5 million of external grant funding for the Center for Materials Research during the 1998-99 school year — some of which pays for nanotechnology research. This year's funding (i.e., 1999-2000) has not been totaled yet, Sellmyer said. The bulk of the money comes from the federal government, although IBM also funds one project. Sellmyer expects both private and government funding will grow — and with it UNL's nanotechnology research — as interest in the area picks up steam. "This idea of getting smaller and smaller has been around but it hasn't been until last year that everybody got interested," he said.

Check out these sites for more information on nanotechnology: www.unl.edu/cmra/ (UNL Center for Materials Research and Analysis); www.foresight.org (The Foresight Institute); www.nano.gov (National Nanotechnology Initiative).

by Martha Stoddard,
Lincoln Journal Star (27 July 2000)

Research Highlight:

AMO Synchrotron Group Installs VUV Quarter-Wave Retarder at the Advanced Light Source

How does one produce circularly polarized radiation given that you have a source of linearly polarized radiation? One answer is that you go to the many commercial catalogues and purchase a quarter wave plate. By placing the fast (slow) axis of the plate in the linear beam at an angle of 45° relative to the linear polarization axis, one obtains light of right (left) helicity.

This answer works well if the radiation is in the visible region of the spectrum. However, if it is in the 30-40 nm range one would not be able to find any material to build such a retarder. In addition, one would have to operate the system in vacuum since light in this wavelength region is strongly absorbed by air. This wavelength range is called the vacuum ultraviolet (VUV). For many reasons, the techniques used to build quarter-wave retarders in the visible range do not work in the VUV.

The synchrotron group of **Orhan Yenen, Kenneth W. McLaughlin** and **Duane H. Jaecks** [who are in the Department's atomic, molecular, and optical (AMO) physics group] had a quarter wave retarder that operates in the VUV range built by the Physical Sciences Lab at the University of Wisconsin. It has since been installed on beamline 10.0.2 at the Advanced Light Source, a third generation synchrotron light source located at the Lawrence Berkeley National Laboratory. The basic principle of its operation is that the reflected components of light, which are parallel and perpendicular to the plane of incidence of a gold surface, undergo a relative phase shift that depends upon the angle of incidence and the energy of the radiation.

By employing a four-mirror, multiple-reflection system so that the angle of incidence of each mirror is near 70°, one is able to produce a transmitted beam with its two perpendicular components having equal amplitudes. In addition, they are 90° out of phase, producing circularly polarized radiation of a known helicity. The four mirrors can be synchronously rotated to change the angle of incidence as well as rotated about the axis of the linearly-polarized synchrotron beam. The entire system operates in a vacuum chamber at a pressure of 10^{-10} Torr. With this device **Orhan Yenen** has measured the degree of circular polarization produced by the apparatus to be greater than 99.7%. The procedure for carrying out the installation and characterization of the retarder represented an experiment in itself and took a significant amount of beam time.

According to the group, this is the only operational quarter-wave retarder in the world that produces circularly-polarized radiation over the continuous photon energy range of 10-60 eV that is dedicated to atomic physics research. The group has carried out three successful experimental runs at the Advanced Light Source in Berkeley using this retarder. Yenen will present an invited talk on the results at the 11th International Symposium on Polarization and Correlation in Electronic and Atomic Collisions, to be held in Rolla, MO in July 2001.

Using circularly polarized light in photoionization experiments is significant because it allows one to know the magnitude and direction of the total angular momentum absorbed by the atom. The one unit of photon angular momentum appears as orbital and spin angular momentum of the residual ion and the ionized electron. Using the concept of angular momentum sharing and partitioning, the Nebraska AMO Synchrotron group has been able to characterize and elucidate relativistic dynamics in multielectron systems. For details, see O. Yenen, K.W. McLaughlin, D.H. Jaecks, M.M. Sant'Anna, and E.A. Seddon, "Quantifying Relativistic Interactions from Angular Momentum Partitioning Measurements During Photoionization," *Physical Review Letters* (5 February 2001)

SARTORI *continued from page 4*

do not have an absolute right to avoid discomfort in a classroom, where thoughts and expression of ideas are paramount.

The conflict lies in a faculty member's right to a confrontational teaching style, for example, and a student's right to a classroom free of hostility, he said. A teaching style must sometimes give way to a student's right of expression, Sartori said, but careful consideration must be taken when making those decision.

Still, he said, he is troubled that students often have little or no voice in the grievance process and they need better representation.

He also voiced concern that promotion and tenure decisions might be hinging on an individual scholar's success at attracting external funding. Faculty must be free to choose their own areas of study and no one should be forced to chose a research course based on funding sources.

Prior to conferring the award upon Sartori, Richard Edwards, Senior Vice Chancellor for Academic Affairs, shared his thoughts on academic freedom with the senate.

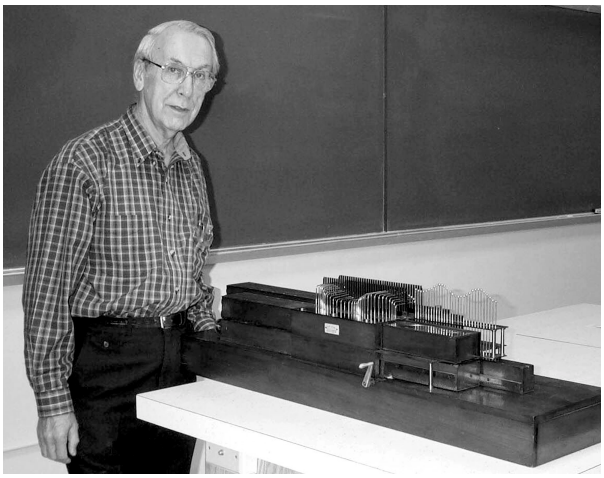
Edwards said he believed the most important reasons to defend academic freedom are that the quality and legitimacy of faculty research must be free from predetermined outcomes and that academic culture must be an environment of free inquiry.

He said academic freedom means an environment where faculty are supported for being outspoken, courageous and controversial, and where "probing, deep and sometimes troubling and even irksome questions can and should be asked."

The full transcript of Edwards's and Sartori's comments are available on the Academic Affairs Web site at http://www.unl.edu/svcaa/priorities.html.

Reprinted from *Scarlet* (4 May 2000)

The Treasure in Our Midst: Historic Scientific Instruments



M. Eugene Rudd displaying a wave machine from the 1920s used to demonstrate wave propagation and double refraction.

Historians of science recognize that the advance of science has depended not only on the creation of new ideas and concepts, but also on the development of instruments for research. Likewise, teachers and students know the value of apparatus for demonstrating physical principles. The importance of instruments has been recognized by the formation of a number of societies to promote their historical study. Some of these, such as the Scientific Instrument Society and the Antique Telescope Society publish journals regularly. A number of museums in Europe and the United States are devoted partly or entirely to scientific instruments, including several at universities.

Few of the people who attend classes or do research in Brace Laboratory realize that there is a treasure here in the Department; an historic treasure in the form of scientific instruments from generations past. Physics and astronomy courses were taught from the very beginning of the University of Nebraska in 1869 and research was carried on after DeWitt Bristol Brace founded the Department in 1888. Some of the equipment purchased for demonstration, laboratory, and research uses from those early times survives to this day and, along with more recent additions, forms a valuable collection illustrating late 19th and early 20th century physics.

These apparatuses collected dust in the attic and in cabinets and closets for many decades, and regrettably, some of them have been lost or cannibalized for other uses. In the 1970s Professor **Duane Jaecks** recognized the value of these instruments and with graduate student **Robert Maher** cleaned and refurbished several of the more spectacular ones. Recognizing the beauty of these instruments, Sheldon Gallery included some of them in an exhibition of historic scientific instruments in 1978. In 1998 I undertook to sort and clean a large number of them and I plan to make an inventory of the important items. Eventually, this inventory may be included in the Department web page and in an international on-line registry of historic scientific instruments being compiled by the History of Science Museum in Oxford, England.

Many of the instruments in the Department's collection that were purchased around the turn of the century were purchased from Europe's finest manufacturers. For example, William Thomson, later Lord Kelvin, invented many electrical measuring instruments that were manufactured by the Scottish businessman James White. These were the state of the art at the time and we are fortunate to have several in the collection. One, labeled "Sir William Thomson's Patent Electric Balance," is a somewhat complex current balance that has the original set of weights and two calibration charts signed by Thomson himself. The balance and a copy of one of the charts is in a display case on the second floor of Brace Lab.

> *"Some of the equipment purchased for demonstration, laboratory, and research uses from those early times survives to this day and, along with more recent additions, forms a valuable collection illustrating late 19th and early 20th century physics."*

Another example is a spectrometer made by Schmidt & Haensch of Germany specifically for use with a spectrophotometer invented by Brace. The spectrometer is in a display cabinet near the conference room and the spectrophotometer prism is in a cabinet across the hall from the mailroom.

American-made instruments are also part of the collection. About 1910 William Coolidge, working for General Electric, devised a kind of x-ray tube with a tungsten anode that brought x-rays out of the laboratory and into common use in industry and medicine. There is an early Coolidge tube in the collection.

Toward the end of the 1870s Henry Rowland at Johns Hopkins University built an engine for ruling concave gratings with unprecedented accuracy. He supplied gratings to most of the major spectroscopic laboratories in the world, thus revolutionizing the entire field of spectroscopy. We have several of his gratings including one of his six-inch models, the largest that he made.

D.B. Brace was deeply involved in the attempt to detect the ether drift and performed three highly sensitive experiments for this purpose. One of these, to detect the effect of ether drift on the double refraction of light as it traveled through glass or water, achieved a sensitivity of 1.3 parts per trillion! It was thus about 300 times more sensitive than the Michelson-Morley experiment and was probably the most sensitive experiment of any kind ever performed up to that time. Since it was published and widely quoted in Europe in 1904, it may have had an influence on Einstein in writing his famous relativity paper that was published the following year. While most of the parts of Brace's apparatus have been lost, we still have the original slab of glass that he used and the heliostat he used to direct sunlight through the apparatus.

At a time when it was unclear whether alternating or direct current would be used in distributing power in cities, Brace obtained a patent for a distribution system that could use either AC or DC. A device to demonstrate the relationship for students called "Weinhold's Rotating Field Apparatus" that would convert DC into AC is in a display cabinet near the stairway on the second floor of Behlen Laboratory.

These treasures in our midst are part of our scientific and Departmental heritage. It is hoped that a small museum can be created to preserve and display these instruments. But until then we will continue to show a few of them in hallway cabinets and try to preserve them for future generations.

by M. Eugene Rudd

Newton's Apple Tree Bears Fruit

Nine years after it was planted outside Behlen Laboratory, the cutting from Newton's famous apple tree has flourished and matured and in fall 2000 produced its first apples.

The first apples on the Newton's apple tree outside Behlen Laboratory.

The story of the tree was reported in the Fall 1991 issue of *Spectrum*. In brief, the tale begins with a retired Lincoln physician, **Edward Lyman**, and a retired UNL horticulturist, **Joseph Young**, who wondered what kind of tree it was from which Newton observed an apple fall to the ground. Their investigations took them to England, where a physicist at York University, **Professor Richard Keesing**, had already carefully researched the apple tree story and had actually located the tree at Newton's birthplace, Woolsthorpe Manor in Lincolnshire.

Lyman and Young took back with them a cutting from the tree (which had to be quarantined as per U.S. Department of Agriculture requirements). It was then grafted onto Nebraska rootstock (so that it would survive Nebraska winters) and was planted on April 4th, 1991 just south of the loading dock of Behlen Lab.

The tree is of the ancient cultivar, Flower of Kent. It supposedly will grow eventually to a height of 10-12 meters. The apples are pear-shaped and are smaller than apples generally produced today. For those interested in learning the history of Newton's tree, Professor Keesing has published an article on his research, "The History of Newton's Apple Tree," Contemporary Physics **39**, 377 (1998). Also, it is still possible to obtain a cutting of the tree. In fact York University in Toronto just planted a Newton's apple tree in October 1999; the cutting from England was grafted onto Canadian rootstock.

Beloved Beverly Beckoned to Bessey

Anyone who was a student or faculty member in our Department during the last quarter-century will remember **Beverly Wisehart**, the Physics Branch librarian. For 28 years she presided over our collection, taught new students and faculty about library use and procedures, and helped us all to locate things and use the library resources.

Beverly Wisehart

Now she has been transferred (as of January 12, 2001) to the Geology Branch library (in Bessey Hall). She had been spending part time there for several months, in preparation for the transfer. The Geology library is larger and more complicated than the Physics library, so Bev really has a bigger job. (But not bigger pay!)

During Bev's tenure here the library grew enormously, and this necessitated major moves and reorganizations several times. But Bev kept things going, with minimal disruption of service.

Bev was always cheerful and eager to help us. She knew, and communicated to us, how we could use the multitude of services that were available through the central library. She also did an excellent job of training her student assistants.

We will miss her, and certainly wish her the best of success in her new position. And at the same time we welcome her replacement, **Steve Sall.**

Dahlberg Presents Ruckman Lecture

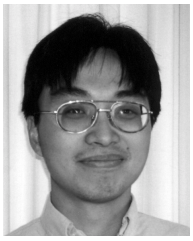
Professor E. Dan Dahlberg (University of Minnesota) was the Keynote Speaker at the annual Ruckman Lecture, held on November 7, 2000. **Jerry E. Ruckman** (B.S. 1962) has been a long-term supporter of the Department's activities, and income from his donations provides funding for our annual get-together with area high-school physics teachers. This year's Ruckman program included both high school and elementary school teachers, since the Department is now going to teach a physics course for future elementary and middle school teachers (headed by **Diandra Leslie-Pelecky** and **Vicki Plano-Clark**). Dahlberg, along with Pat Heller of the University of Minnesota, has developed a successful hands-on, inquiry-based course for future elementary school teachers.

Dahlberg's Ruckman address was entitled "Physics for Elementary School Teachers: The Good, the Bad, and the Ugly." Dahlberg began by emphasizing how important it is for physics departments to address the needs of this very important group of students. He encouraged physicists to familiarize themselves with existing materials and methods to avoid "re-creating the wheel." Dahlberg said that, as a magnetism researcher, he benefited greatly from collaborating with colleagues in the education department. Among the difficulties of implementing hands-on, inquiry-based classes, he noted that students aren't used to being asked to be active during class and faculty members are uncomfortable moving away from their traditional roles as lecturers. Also, students (as well as instructors) tend to get frustrated at the beginning of this course because of the emphasis on students' developing their understanding of concepts using their own background and language. Dahlberg ended by noting that he enjoyed very much teaching this course, and recommended that all physics classes should be taught using inquiry methods.

Department faculty members and their colleagues in K-12 education continued discussion over dinner at the Nebraska Union. A panel discussion allowed administrators, UNL faculty members in both Physics and Teachers' College, and teachers to share their impressions of the impact of the National and State Science Education Standards on current and future teachers. Special guests included Jim Woodland (Director of Science Education, Nebraska Department of Education) and Lois Mayo (Science Consultant, Lincoln Public Schools).

Liu Wins Folsom Doctoral Dissertation Award

Chien-Nan Liu (Ph.D. 1999) was awarded a 2000 Folsom Doctoral Dissertation Award by the Graduate College at the University of Nebraska-Lincoln (UNL) for his Ph.D. dissertation on "Photodetachment of Negative Ions with Two Active Electrons." During the 1999-2000 academic year UNL granted 251 Ph.D. degrees; only two Folsom Doctoral Dissertation Awards were given. Candidates for the award had to submit a 10-page abstract of their thesis and request letters of recommendation from dissertation supervisors and other faculty either at UNL or elsewhere. In order to decide among the finalists, the faculty selection committee asked outside experts in the field of each dissertation for independent evaluations of the thesis work. A plaque and a $1,000 check were presented at the Graduate College Awards Banquet on April 13th, 2000 to Liu's thesis supervisor, Professor **Anthony F. Starace,** as Liu was working as a postdoctoral research associate with Jan-Michael Rost at the Max Planck Institute on the Physics of Complex Systems in Dresden, Germany and could not attend. Starace also presented a 10-minute overview of the research Liu carried out which won him the award.



Chien-Nan Liu

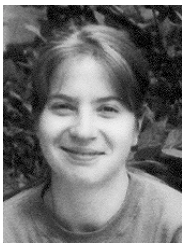
Liu's doctoral research concerns photodetachment of negative ions with excitation of the atom. The photodetachment spectrum of a negative ion typically has many features, all of which relate to doubly-excited atomic states or to excitation threshold phenomena. Negative ions have the advantage that the spectrum is not obscured by one-electron Rydberg spectra.

Obtaining the photodetachment partial cross sections is numerically very intensive and requires powerful workstations. But Liu's work is significant in that the results were analyzed in great detail so that all major features were identified and characterized. Comparisons were also made of spectra from different negative ions having similar electronic structures. But the most significant result of Liu's was in discovering an analytical theoretical explanation for the experimentally observed fact that resonance profiles in different partial cross sections sometimes mirror one another, i.e., in one partial cross section the resonance may appear as a peak and in another as a window. When the partial cross sections are added to obtain the total cross section, little trace of the resonance may be observed because of the cancellation of the peak feature by the window feature in the different partial cross sections.

Liu came to UNL from National Chiao Tung University in Taiwan in 1993. He was awarded a Maude Hammond Fling Fellowship at UNL in 1996, and was inducted as a full member of the Society of Sigma Xi in 1999. Following his year in Dresden, in November 2000 Liu moved to Kansas State University in Manhattan, where he is a postdoctoral research associate with Chii-Dong Lin.

Borca Wins American Vacuum Society Graduate Research Award

Graduate student **Camelia Borca** was one of 8 graduate students selected in a national competition for a 2000 Graduate Research Award by the American Vacuum Society (AVS). The award was presented at the AVS Awards Assembly, held on October 6th, 2000, during the 47th International Symposium of the AVS in Boston. The Award serves "to recognize and encourage excellence in graduate studies in the sciences and technologies of interest to the American Vacuum Society."



Camelia Borca

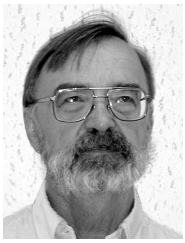
These fields include physics, chemistry, and various branches of engineering. The award consists of a $1,000 cash prize, a certificate, and travel expenses to attend the International Symposium.

Borca is doing her graduate thesis research under the supervision of Professor **Peter Dowben** in the general area of surface physics. The AVS award recognizes her research on the surfaces of half-metallic ferromagnets. This work is significant because half-metallic ferromagnets (which are metallic in one spin direction and insulating in the other spin direction) are potentially a key to successful development of spin-electronics. These materials have potentially 100% spin polarization. However, Camelia has been able to show that the surfaces of two classes of such materials are very fragile and that 100% spin polarization devices are <u>not</u> possible. Her study involved a very large number of techniques to obtain its results.

The AVS is a member society of the American Institute of Physics. It "promotes communication, dissemination of knowledge, recommended practices, research, and education in the use of vacuum and other controlled environments to develop new materials, process technology, devices and related understanding of material properties for the betterment of humanity." The AVS has 6,000 members worldwide.

Anspaugh Wins AIAA Award

Bruce E. Anspaugh (Ph.D. 1965) was named the winner of the 2000 Aerospace Power Systems Award by the American Institute of Aeronautics and Astronautics in July 2000 at the Riviera Hotel in Las Vegas, NV.



Bruce E. Anspaugh

The award is presented for a significant contribution in the broad field of aerospace power systems, specifically as related to the application of engineering science and systems engineering to the production, storage, distribution, and processing of aerospace power.

The award citation reads: "For career achievements in theoretical and empirical space solar cell radiation characterization and the generation of high altitude calibration standards for the aerospace community".

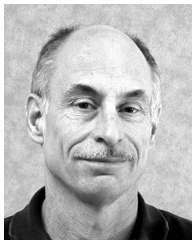
Anspaugh's balloon-flight activities received mention in the News Focus section of the July 28, 2000 issue of the journal *Science*.

Anspaugh was a Ph.D. student of Professor **Edgar A. Pearlstein,** and his dissertation topic was the study of radiation damage in copper. He has

ANSPAUGH *continued on page 14*

Sorensen Named Distinguished Professor

Christopher M. Sorensen (B.S. 1969) has been named a University Distinguished Professor of Physics at Kansas State University. There are currently only 21 Distinguished Professors in all Departments on the Kansas State University campus. Thus selection for this honor is highly competitive. Among the important factors in selection are an international reputation and a record of significant scholarly accomplishments. Sorensen has an outstanding record in research, working in many different areas of condensed matter physics. His most recent research includes the study of aggregation kinetics in aerosols and the chemical synthesis and study of metallic nanoparticles. His static and dynamic light scattering studies have shown that the aggregation kinetics is robust because the aggregates can move either ballistically or via two types of diffusion (depending on the size of the aggregate relative to the mean free path of the medium's molecules). Sorensen also uses chemical methods to synthesize nanoparticles (1 – 10 nm in diameter) of materials such as Co, Au, and $Cd_{1-x}Mn_xS$. The philosophy of this work is that clever synthesis creates new materials with potentially novel physical properties. Nanoparticles have novel properties for two reasons: there is quantum confinement of the electrons, and there is a large fraction of atoms on the surface. This latter property allows Sorensen's group to control the physical properties of the nanoparticles by attaching ligating molecules to their surfaces. Sorensen's current research also involves self assembly of nanoparticles into ordered 2-D and 3-D arrays or supercrystals, techniques which may have significant applications in future nanotechnologies.



Christopher M. Sorensen

While an undergraduate at UNL, Sorensen carried out research with Professor **Robert Katz,** whom he found to be a very inspiring research mentor. He remembers greatly the excitement associated with the search for the magnetic monopole and the great working relationship that he established with **Edward Kobetich** (Ph.D. 1968), who was then a graduate student in the Department. Sorensen was lavish in his praise for the education he obtained at UNL, saying that it really set the stage for his future accomplishments. In addition to his research experiences, he mentioned particularly the carefully crafted courses of Professors **M. Eugene Rudd, Edgar Pearlstein,** and **Duane Jaecks.** Following graduation from UNL and a period in the U.S. military, Sorensen received M.S. and Ph.D. degrees from the University of Colorado. He has been at Kansas State University since 1977.

Stenberg Comes Close to Winning U.S. Senate Race

Nebraska Attorney General **Donald B. Stenberg** (B.S. 1970) did better than the pre-election polls indicated, narrowly losing his race against former Governor Ben Nelson for the U.S. Senate seat being vacated by Nebraska Senator Bob Kerrey. Stenberg is currently in his third term as attorney general. In the May 2000 Republican primary election he won half the votes in a field of 6 contenders for the open senate seat.

Donald B. Stenberg

Stenberg was born in 1948 in David City, but grew up in Tekamah, where he was the valedictorian of his high school class in 1966. He enrolled at the University of Nebraska-Lincoln, where in 1970 he received his Bachelor's degree in physics with minors in math and chemistry. At UNL he was a half-mile runner on the track team. Upon graduation, he was one of 18 applicants selected for Harvard's joint Law/MBA program. He returned to Lincoln to establish a law practice and began running for public office in 1976. He joined the staff of Governor Charles Thone in 1980, serving as Director of the Nebraska Public Policy Office and the Department of Administrative Services. His first electoral success came in 1990, when he won the race for attorney general on a generally "tough-on-crime" platform.

Stuart O. Nelson Named Winner of ASAE Engineering Award

The American Society of Agricultural Engineers (ASAE) has named **Stuart O. Nelson** (M.A. 1954) winner of the McCormick Case Gold Medal Award for the year 2000. Nelson was presented the award at a banquet held Tuesday, July 11, during the ASAE Annual International Meeting currently being held in Milwaukee, Wisconsin.

The McCormick Case Gold Medal Award is one of ASAE's most prestigious awards. It is given in recognition of exceptional and meritorious engineering achievement in agriculture.

Nelson is a research agricultural engineer at the USDA-ARS Russell Research Center in Athens, Georgia. He is internationally recognized for his pioneering research on the dielectric properties of grain, seed, fruits, vegetables, insects, and other materials, and for agricultural applications of radio-frequency and microwave energy. His work has been vital to the development of grain moisture measurement technology in the protection of grain from spoilage and in maintaining the quality of stored grain and processed grain products.

Nelson has received four patents for various applications of devices that sense moisture content in grain, seed, and nuts and that sense the masses of such objects using radio frequency and microwave measurements. He has written seven book chapters and more than 220 articles in more than 30 different refereed technical journals. Nelson was elected to the National Academy of Engineering, and is a Fellow of the International Microwave Power Institute, Institute of Electrical and Electronics Engineers, and ASAE.

The American Society of Agricultural Engineers is a professional and technical organization dedicated to the advancement of engineering applicable to agricultural, food, and biological systems. Founded in 1907 and headquartered in St. Joseph, Michigan, ASAE comprises 9,000 members representing more than 90 countries.

Barrett Recalls Student Days in the 1950s

Editor's Note: William A. Barrett (B.S. 1952, M.S. 1953) recently wrote to Department Chair Roger D. Kirby about his student days in the Department. Barrett describes what seems like an idyllic time exploring physics. We reprint the letter for the interest it may hold for alumni and others.

William Barrett

Dear Roger:

You asked about an update on my activities. It's very nice of you to ask. I haven't earned any Nobel Prizes lately that I can recall, but I've had a really interesting and intellectually profitable career. It's included stints at several industrial laboratories, and teaching at two universities and a college. I've also earned about a half dozen patents, one of which actually found its way into a Bell telephone switching system for several years. You can find more details on my San Jose State University (SJSU) Web site (*http://www.engr.sjsu.edu/wbarrett/*). I'm an "adjunct professor" at SJSU, in the computer engineering program. That of course means I have no tenure, but I'm essentially on the verge of retirement. I've had an interest in electronics and [hardware] since my undergraduate days at UNL, and that later grew into an interest in software.

In fact, I've really only had one *formal* course in electronics, and that was taught by a graduate student in physics, in 1949. I've forgotten his name, but I'm really indebted to him and that little 3-credit hour course. He just started out by teaching us the Laplace transform as a way of working out the step and pulse response behavior of electronic devices, then went on to describe lots of interesting and useful electronics applications in physics. At that time, the transistor had only just been invented, so the course focused on vacuum tube electronics. The textbook was by Elmore and Sands, part of the MIT Radiation Lab series that came out after WWII. The book was very practical, with lots of circuits in it, including simple counters, wide bandwidth pulse amplifiers, and even a basic oscilloscope. A 0.1 microsecond rise time was a big accomplishment then, and required a lot of tubes connected together to form a pair of LC delay lines, something called a "chain amplifier." Of course, most of that technology was developed for use at Los Alamos to study nuclear reactions. It later found its way into very profitable products made by Tektronix and Hewlett-Packard.

The lab in that course, such as it was, consisted of poking around a dusty storehouse full of surplus electronics parts, evidently fed to the universities in the aftermath of the war. I liked the course so much that I spent a lot of spare time analyzing various kinds of RC circuits. I recall being particularly taken with DC amplifiers using coupled pairs of vacuum tubes. My close friend **Chris E. Kuyatt** (B.S. 1952, M.S. 1953, Ph.D. 1960) was in my class. Chris earned his Ph.D. under **Ted Jorgensen,** then went on to the National Bureau of Standards for a distinguished career. I understand that he's featured on their wall of honor of distinguished scientists. Chris passed away two years ago. Another close friend was **Arthur J. Meyerott** (B.S. 1952, M.S. 1953). Art was very skilled in mechanical and electronic systems, and went on to Los Alamos for a summer with me. I lost track of him after graduating, and I've often wondered what became of him.

> *"The lab in that course, such as it was, consisted of poking around a dusty storehouse full of surplus electronics parts, evidently fed to the universities in the aftermath of the war."*

I was fortunate to have been taken under the wing of Professor Jorgensen, who was developing a Cockroft-Walton accelerator in Brace Lab. I recall designing and building a high voltage regulator. It was based on a galvanometer, of all things, the only instrument considered sensitive enough to handle the very weak currents that could be pulled off the accelerator. Of course, its mirror angle was detected through a light beam and a split photocell. The photocell signal was amplified and used to drive a magnetic amplifier. A pretty crazy way to regulate the accelerator, but it worked, and helped in getting the ion collision experiments under control. **Charles J. Cook** (M.A. 1950, Ph.D. 1953) and **Emerson Jones** (Ph.D. 1953) were doing their Ph.D.'s with Jorgensen at the time, and came up with the basic ideas for the regulator. Prior to my automation, the system was driven by a high-voltage rectifier system run through a large Variac directly off the power mains. As the AC voltage moved up and down, so did the accelerator voltage, contributing a large scatter to the measurements. It was driving Cook and Jones crazy, so they asked me to concoct a regulator.

I also recall having the lab to myself for a whole summer, with the power shut down so that I could trace out the crazy quilt of wiring that had grown up into it. There were many power supply and signal cross talk problems. Cook and Jones were frustrated in not having an accurate schematic of the system. So they asked me to put one together, and after a month of hard work, I produced an accurate drawing on a large sheet of paper.

Of course, there were formal coursework labs for us as well. Professor **T. T. Smith** taught us the principles of electricity. His lectures were quite elegant and neatly packaged. He used one small room on the second floor with a blackboard on the end wall. However, the end wall was broken by a building support in the front-right corner. Someone had covered that with blackboard surfacing, too, so T.T. would start his lecture in the upper left corner of the blackboard, writing down and to the right as he went. Toward the end of the hour, he had covered the main board, then polished off his lecture with several equations that just neatly fit into the little extension panel on the right! It's as though his notes just wouldn't work in any other room, because the blackboards weren't quite the right shape.

T.T. particularly loved bridges of all kinds, and spent half the semester describing various DC and AC bridges. Thus the lab involved mostly putting together bridges using galvanometers as the sensitive component. Since I

BARRETT *continued on page 13*

BARRETT *continued from page 12*

had some electronics, I suggested to him that I try using a cathode-coupled pair of tubes as the detector, amplifying the signal so that an ordinary meter could be used to balance the bridge. He was intrigued with my idea, but he had to confess to me privately that he knew nothing about vacuum tubes or electronics. In fact, he admitted that he once purchased a little radio kit which he spent many hours working on at home, and he never got it to work. I appreciated his honesty and assured him that his little secret was safe with me.

I think I worked with Art Meyerott on that project. Smith let us use a corner of his office, and we built up a really spread-out bridge with about 4 tubes and lots of hookup wiring. We designed an AC bridge, and used a pair of Army headphones to listen to the balance signal. It worked reasonably well, after we figured out how to get rid of all the 60 Hz noise. I also recall very distinctly hearing a local AM radio station come through the headphones. I couldn't believe it, but then Art realized that one of the connections was a little rusty and was apparently demodulating the broadcast signal, crystalwise. Our wiring was large enough to be a good antenna. We learned something about the importance of shielding from that experience.

When I studied optics, the course didn't have a formal lab, but I noticed a lot of optics gear gathering dust on the second floor, so I asked our instructor if Chris and I could try setting some of it up. I was particularly fascinated with the Michelson interferometer, and discovered one in the cabinet. So we followed the textbook, which pointed out that it's best to start with a sodium lamp, then go on to other monochromatic sources. Getting white fringes meant that the two paths were exactly matched, and that required considerable skill. Chris and I decided to go for white fringes. It meant first measuring the two paths as carefully as we could, with a pair of calipers, to try to see *any* fringes at all. It was then a matter of adjusting the mirror angles to expand the fringes, with sodium light, looking for the largest possible fringes. We discovered that just by pressing down on the base (a steel cylinder about 10 cm in diameter), we could shift the fringes a little one way or the other, which gave us clues on how to align the mirrors using the fine screws provided for that. We worked on getting circular fringes, which meant that the mirrors were parallel, then made their diameters larger and larger by sliding them along the base. Finally, when we achieved total blackout/whiteout, we discovered the white light fringes. We had the pleasure of demonstrating them to several amazed faculty members who claimed they hadn't seen that done for several years. That made all the physical optics theory come to life for us, and we ended up with a healthy appreciation for the scale of light wavelengths and the nature of interference. We also discovered that it's important to approach such a project with a plan and a good sense of theory that makes it possible to progress from one stage to the next.

I had almost no contact with interferometers until I joined the staff of Lasa Industries in 1986.

> *"At San Jose State, I'm responsible for a compiler construction course. We have an ever-increasing flood of students and not enough computer-skilled instructors, so there'll be plenty for me to do until they carry me out on a stretcher, I guess."*

Then it became obvious that we needed to install an interferometer to monitor the lateral position of an IC chip being patterned. I knew all about it, of course, and was also able to build in several corrective subsystems in the form of temperature and air pressure gauges and what not to achieve the highest possible precision. We later noticed an interference phenomenon in the optics system that seemed to permit us to achieve a good focus with our laser system. I was able to analyze that and explain the magnitudes of the fringes, etc. That led to a patent that I feel very good about, as it required some basic physical optics analyses to justify its equations and claims.

Professor Jorgensen also encouraged Chris and me to play with an oil drop apparatus that someone had made years previously. I think this was in connection with an upper division atomic physics course that he taught. So we studied up on it, fitted it up with a precision thermometer and air pressure gauge, calibrated the electric field and the microscope, measured the oil density carefully, then proceeded to tinker with individual drops moving up and down, under higher and lower fields. After careful measurements on several dozen oil drops, and some hand calculations, we were able to announce our estimate for the electron's charge. It was about 5% higher than the accepted value, and our experimental error was about 1%. But Jorgensen felt that we were right, after reviewing all the calibration procedures. About a year later, our experiment was repeated by someone else, and our measurement was confirmed. I don't think that little experiment ever found its way to the *Physical Review*, but it should have.

At San Jose State, I'm responsible for a compiler construction course. We have an ever-increasing flood of students and not enough computer-skilled instructors, so there'll be plenty for me to do until they carry me out on a stretcher, I guess. I'm also involved in a biometrics research program, part-time. It isn't funded this summer, but it looks like a major grant will be coming through this fall. In particular, I've been looking at the false rejection rate of an iris pattern-matching system, which appears to be a very good way of identifying people. You essentially use an ordinary video camera with a close-up lens to photograph someone's eye. The software is supposed to locate the pupil reliably, then perform a Gabor filtering on the iris patterns to yield a binary code. The basic work has been done by a Cambridge professor, John Daugman, and I've been investigating some of the issues that he didn't address in his patent.

None of my biometrics papers have been published in a journal, but they are available for interested parties through our biometrics web site. Since SJSU is essentially an undergraduate institution (no Ph.D., but B.S. and M.S. programs), it's difficult to keep any kind of research program alive. But I really don't care about that, and am basically having a good time doing things that I enjoy doing, and helping students to grow in the process.

Well, this has turned out to be a much longer letter than I had planned. That's the trouble with being an "old professor" and a good typist to boot. I think you should know that I regard my training at Brace lab with great fondness and affection, and I have no doubt that many other physics students feel the same way. Keep up the good work.

Yours sincerely,
William A. Barrett
2797 Lena Drive
San Jose, CA 95124

Brief Notes

- Senior Lecturer **C. Martin Gaskell** was one of 6 UNL faculty nominated for a 2000 Outstanding Educator Award by the Association of Students of the University of Nebraska (ASUN). ASUN presents two awards annually, one to a faculty member teaching a large enrollment class and one to a faculty member teaching a small enrollment class.

- Professor **Timothy J. Gay** and his *Football Physics* videos are capturing national attention. ABC News got the ball rolling last year when they came to UNL at the end of the 1999 football season to film a feature story for *World News Tonight with Peter Jennings* (http://www.abcnews.go.com/sections/science/DailyNews/football991115.html). This past season *People Magazine* ran a feature story on Gay titled "Field Theory" (12/4/00, page 97). Gay also appeared recently (26 January 2001) on the Discovery Channel to discuss the Super Bowl. In addition, Bill Waggoner of Metropolitan Community College in Omaha has received a grant to support a group of 8 community college physics faculty to do projects involving football physics. Gay's 60-second videos may be viewed on his web page (http://physics.unl.edu/football.html). They are in the QuickTime video format.

- Professor **Kam-Ching Leung** has been hosting a number of Chinese astronomers at UNL lately. In May 2000, Qingyao Liu and Yulan Yang of Yunnan Astronomical Observatory visited. Then, in August, Huisong Tan of that observatory also visited. In November Zongyun Li of Nanjing University paid a visit. Leung also recently served as co-editor of the book *Stellar Astrophysics* (Kluwer, Dordrecht/Boston/London, 2000).

- George Holmes Distinguished University Professor **David J. Sellmyer** has been elected Vice Chairman of the American Physical Society Topical Group on Magnetism and Its Applications (GMAG). He becomes Chair of GMAG next year.

Aylesworth Speaks at Recognition Luncheon

Kevin Aylesworth (M.S. 1986, Ph.D. 1989) spoke at the May 4, 2000 Recognition Luncheon to 1999-2000 Department graduates, faculty, staff, and current students. Aylesworth is currently the Senior Program Officer for the National Research Council's Center for Science, Mathematics, and Engineering Education in Washington, D.C. He did his doctoral work with Professor **David J. Sellmyer** on the magnetic and structural properties of permanent magnetic films. Regarding his experiences at UNL, he noted the thrill of working in the lab (with fellow student Dave Billesbach) to make the new high temperature superconductors shortly after their discovery was announced. Upon graduation he became a National Research Council Postdoctoral Associate, working at the Naval Research Lab in Washington, D.C. Since then, however, his career has taken many non-traditional turns, which Aylesworth focused upon in his remarks preceding his formal presentation.

Kevin Aylesworth

Aylesworth is probably best known as the founder of the *Young Scientists' Network*, which was formed to provide reliable and realistic information about the job market for recent physics graduates. He co-authored (together with Sheila Tobias and Daryl E. Chubin) the book, *Rethinking Science as a Career: Perceptions and Realities in the Physical Sciences* (Research Corp, Tucson, AZ, 1995). While engaged in that, he held a variety of positions in the 1990's, including working as a science consultant and paralegal in a Cambridge, MA law office; as the owner/entrepreneur of *Aylesworth Technical Services*; as an American Physical Society (APS) Congressional Fellow in the office of Iowa Senator Tom Harkin dealing with issues relating to defense, the environment, and energy; and as the assistant to the Director of APS's Education and Outreach Programs. The point of his remarks on his career was that there were many paths open to physics Ph.D.'s besides the obvious ones.

Aylesworth's formal presentation to graduates on his current work was entitled, "Engaging the Scientist Inside Every Child: A Physicist's View on Improving Elementary Science Education." He began by citing a recent experiment in which students graduating from Harvard were asked to explain the origin of the Earth's seasons and it was found they could not. Aylesworth noted this was symptomatic of the scientific illiteracy of the American public. The reasons, he stated, were not related to amounts of homework, time spent in class, time spent watching TV, or time spent on after school jobs. It is due to the broad but shallow science texts that are mandated by textbook selection committees in some of the largest states in America, which then determine the kinds of books which publishers make generally available. Since Sputnik, he noted, there has been a tension between reforms aiming to train more American scientists and those aiming to educate the American public generally. The current reform wave is more focused on how children learn and seeks to give everyone an appreciation for science by involving children in active learning experiences. He noted that children like the new, hands-on ways of learning science in contrast to the older textbook-based approaches.

ANSPAUGH *continued from page 10*

been a member of the scientific staff at the Jet Propulsion Laboratory (JPL) since 1964, where he has worked on a number of issues related to radiation damage in space environments.

In his early days at JPL, the Mariner IV spacecraft was already on its way to Mars when newly-obtained radio-astronomy data indicated that Mars had a strong magnetic field, suggesting that there might be trapped radiation belts there.

This led to a flurry of activity at JPL to test critical subsystems of the spacecraft for susceptibility to radiation-induced effects. Since these initial efforts more than three decades ago, Anspaugh and his co-workers have carried out a huge variety of ground-based and high-altitude (37,000 m) balloon-flight measurements on the interaction of radiation with solar cells of various kinds. His research has led to significant recognition from the aerospace community, including the prestigious Aerospace Power Systems Award mentioned above.

We Heard That...

- **Abrahamson, Dean E.** (M.A. 1958), Humphrey Institute, Public Affairs, University of Minnesota, 301 19th Avenue S, Minneapolis MN 55455, has written a *Viewpoint* article in *APS News* (October 2000) on "So You Want to be a Critic." The article provides advice for being an effective critic of established policy or dogma. It is "based on lessons learned from my 30 years of personal experience doing public education work regarding atomic energy." Dean is Professor Emeritus at the University of Minnesota and Visiting Professor at the Institute of Physics and Technical Physics, Chalmers Technical University in Göteberg, Sweden.
- **Agrawal, Bishan S.** (M.S. 1973, Ph.D. 1974), 85 Rockwell Circle, Marlboro, NJ 07746, is a Senior Systems Engineer with Telcordia Technologies, Inc. in Princeton, NJ.
- **Anderson, Terry L.** (M.S. 1971, Ph.D. 1975), 24 Hill Street, Bernardsville, NJ 07924-2707, is with Lucent Technologies in Warren, NJ.
- **Backhaus, Scott N.** (B.S. 1990), 4627 Ridgeway, Los Alamos, NM 87544, is the Reines Fellow at Los Alamos National Laboratory in Los Alamos, NM. He recently co-authored an article on "The Power of Sound" in *American Scientist* (November/December 2000). The article argues that "sound waves in 'thermoacoustic' engines and refrigerators can replace the pistons and cranks that are typically built into such machinery."
- **Bao, Minqi** (M.S. 1992, Ph.D. 1995), 25 Metro Dr., Suite 100, San Jose, CA 95110, has moved to the San Jose office of Platform Computing, Inc. as a Senior Systems Engineer. He says "I was the 30th employee when I joined the company [in Toronto] 4 years ago. We have more than 300 employees worldwide now." An IPO is expected for the company soon.
- **Brace, Russell** "Rusty" W., Dewitt Bristol Brace's grandson, read the David Cahan/M. Eugene Rudd biography of D. B. Brace while on a cruise between Bora Bora and Tahiti. He reports being "entranced" by the story and amazed by D. B. Brace's many accomplishments. He is purchasing many copies of the book to give to other members of the Brace clan.
- **Bruegman, Otto** (B.S. 1984, M.S. 1987), 2203 Huntfield Ct., Gambrills, MD 21054, is now an Executive Vice President at International Technology Management, an aerospace engineering firm in Crofton, MD.
- **Camp, Howard Alan** (B.S. 1999), 911 Colorado St., Manhattan, KS 66502, is a graduate student in atomic physics at Kansas State University.
- **Costello, James M.** (M.S. 1963, Ph.D. 1967), 5408 CR 250, Durango, CO 81301, is now retired.
- **Dau, Donald E.** (M.A. 1950), 1450 18th Avenue, Apt. B17, Rock Island, IL 61201-4364, started working for the U.S. Department of Defense in January 1951 in the Quality Control field and has been retired since September 1995.
- **Fickler, Debra J. Cleveland** (B.S. 1988), 12525 Grandview Drive, Huntley, IL 60142, is an Attorney at Law with a specialty in patent and trademark matters with Fitch, Even, Tabin & Flannery in Chicago, IL.
- **Gallagher III, John S.** (former visiting faculty member), 3309 Heathendell Lane, Madison, WI 53713, is a Professor of Astronomy at the University of Wisconsin-Madison.
- **Goonesekera, Arosha** (Ph.D. 1998), 2070 Latham St., #3, Mountain View, CA 94040-2125, has accepted a position with Nanometrics, Inc., of Sunnyvale, CA. He is working in their optical metrology R&D group, which employs other UNL graduates (mainly from the EE department).
- **Groebner, Andrew T.** (B.S. 1989), 14109 Huckelberry Lane, Silver Springs, MD 20906, works in the Engineering and Software Services Department of the Space Telescope Science Institute (STScI) in Silver Springs, MD. STScI is the astronomical research center responsible for operating the Hubble Space Telescope as an international observatory.
- **Heller, William T.** (B.S. 1993), 3000 Trinity Dr. #12, Los Alamos, NM 87544, finished his Ph.D. in 1999 at Rice University in Biophysics is now a postdoctoral researcher at Los Alamos National Laboratory.
- **Hollman, Kyle** (B.S. 1988), 4564 Hunt Club Dr. #2A, Ypsilanti, MI 48197-9079, is a Research Fellow in the Biomedical Engineering Department at the University of Michigan.
- **Huang, Keh-Ning** (former postdoctoral research associate), Institute for Atomic and Molecular Science, Academic Sinica, P.O. Box 23-166, Taipei, Taiwan 106, R.O.C., co-chaired the Fourth Asian International Seminar on Atomic and Molecular Physics, 13-18 October 2000, in Taipei.
- **James, Helen** (B.S. 1965, Ph.D. 1975), 1702 First Avenue, Nebraska City, NE 68410, is an Emeritus Professor of Chemistry at Weber State University, Ogden, UT.
- **Jensvold, Angela** (M.S. 1996), 2332 Portland St., Los Angeles, CA 90007-1916, writes: "I'm teaching H.S. physics and math now. I teach Advanced Studies Physics and Math Investigations. It has been a real learning experience." She says she works more hours than anyone she knows and gets paid the least.
- **Jewell, Travis** (Current undergraduate major), PO Box 273, Cairo, NE 68824, was the subject last year of a feature story in the *Grand Island Independent* (8/25/2000). The article describes his research project as a senior at Grand Island H.S. to build a telescope. The telescope contains an 8 inch mirror which Jewell polished at UNL using tree pitch and cesium oxide. Sr. Lecturer C. Martin Gaskell advised Jewell on the requisite procedures. Eight different and successively finer "grits" were used to grind the mirror. Jewell brought the 66 inch long telescope with him when he enrolled at UNL last fall.
- **Katkanant, Vanvilai** (M.S. 1979, Ph.D. 1983) has become Chair of the Physics Department at California State University, Fresno, CA.
- **Lewis, Michael** (B.S. 1992) has been a postdoctoral researcher at the National Institutes of Health since receiving his Ph.D. in Physics from the University of Michigan. At Michigan, he specialized in scanning probe microscopy studies of biological systems.
- **McFee, Ronald W.** (M.A. 1966, Ph.D. 1971), 425 Pruit Avenue, White Rock, NM 87544. "I live in the White Rock section of Los

WE HEARD THAT *continued on page 16*

WE HEARD THAT *continued from page 15*

Alamos County which was undamaged by the recent fire. I was, however, forced to evacuate for 3 days beginning May 11th… I have not been back to Lincoln very often since I left UNL in 1971. I did stop in during the summer of 1986 and saw a few people including Professor Dan Schlitt. Nevertheless, I am surprised by how few people from the UN Physics Department I have seen in the last 29 years. The only person with which I have even infrequent dealings is David Crandall, who is a career civil servant in the DOE. Please give my regards to anyone [who still remembers me]."

- **Moore, Donald C.** (B.A. 1942; former faculty) is retired and living in Sequim, WA. Since receiving a Ph.D. in physics from the University of California at Berkeley, he has had a long and interesting career involving both technical work in the oil industry and faculty/administrative positions at various universities. Dr. Moore is currently enjoying retirement on the Olympic Peninsula, where he is helping the Seattle Baroque Orchestra develop a Dbase4 database of their music programs and members.
- **Nafis, Suraiya** (Ph.D. 1987) is with Celeritek Corporation in San Jose, CA. She writes: "I left Nebraska at the end of 1994 and have kind of forgotten about life in snow! On the car radio I heard that this year the snow is more severe back in Lincoln. Lots of activities are going on in the fab, which is expanding. It is hard to find qualified people but we are not as picky as universities are when hiring people because hiring and firing is much easier here. We are buying new equipment… My job is to develop new processes, improve existing ones and do statistical process control. I take care of the Plasma Etching tools, Plasma Nitride deposition tools, e-beam evaporators, dry photoresist strippers, and gold plating baths. My responsibilities are much more than those of the other engineers. Our fab works very hard to meet its target because we know if a company misses its [earnings] target, it gets severely punished on Wall Street. I like my job and am not stressed out…"
- **Niva, Gordon D.** (M.S. 1975, Ph.D. 1975), 32 High Bluff, Laguna Niguel, CA 92677, is a Program Manager with Boeing Corp.
- **Pan, Cheng** (former postdoctoral research associate), 1 Seagrave Rd, Cambridge, MA 02140, has joined Basis Technology, Inc. of Cambridge, MA. Basis Technology is a private software service company specializing in re-engineering software for international markets. It has special expertise in Asian language information processing.
- **Reed, Kennedy** (Ph.D. 1978), 793 Canterbury Ave., Livermore, CA 94550-6225, is a member of the American Physical Society's Committee on International Scientific Affairs (CISA). His work for CISA was featured in *APS News* (August/September 2000). Reed accompanied Samuel Adjepong, a physicist and the vice chancellor of the University of Cape Coast in Ghana, West Africa, to visit several U.S. institutions and agencies in order to establish scientific links.
- **Reilly, Kevin** (M.S. 1962), 304 N. Burbank Drive, Bluff Park, AL 35226, is employed at the University of Alabama - Birmingham.
- **Schneider, Donald** (B.S. 1976) is now on the faculty at Penn State and reports that he has met some success in Happy Valley creating a Penn Staters for Nebraska chapter. Each fall he informs his class that the difficulty of the exams depends on the outcome of Big Red games; he doubts that there are any more fervent Cornhusker Fans anywhere than on the weekends before exams. Seriously, this is what he tells his students.
- **Serra, Efren** (M.S. 1994), 4349 Renaissance Dr. #7-217, San Jose, CA 95134-1552, works at Sun Microsystems, Inc., Palo Alto, CA. His e-mail is [efren.serra@eng.sun.com] and he writes that he enrolled in a six-evening course at UC-Berkeley last summer on "Embedded Systems," namely, the software embedded in micro computer-controllers in all sorts of common household devices.
- **Shermer, Russ** (B.S. 1984, M.S. 1986), 4206 Yew Pt., Eagan, MN 55122, is a founder and Chief Technical Officer of Site Metrics [*www.site-metrics.com*].
- **Simperman, Roy F.** (M.S. 1965), 5609 80th Avenue SE, Mercer Island, WA 98040, is Chairman & CEO of Semaphore Corp.
- **Snodgrass, Thomas G.** (B.S. 1991), 25354 Cedar Lane, New Prague, MN 56071, is now a Senior Technology Development Engineer with Cypress Semiconductors in Minneapolis, MN.
- **Teays, Terry J.** (Ph.D. 1986), 8811 Magnolia Dr., Lanham Seabrook, MD 20706, is employed by Computer Sciences Corp. as a Senior Principal Scientist. He is in his 4th year as the Chief of the Education Branch at the Space Telescope Science Institute where he leads the education activities for the Hubble Space Telescope. He also manages the education forum for NASA's Origins Program.
- **Wadewitz, Scott** (M.S. 1998) is a Systems Engineer at Gatan, Inc. where he is responsible for installation of electron microscopy components and systems. Scott is based in Pleasanton, CA, but travels around the country to university and industrial research laboratories. He recently installed some components in the Electron Microscopy Facility housed in the Beadle Center for Biotechnology at UNL.
- **Williams, Lynda Jeanne** (former graduate student) is currently an instructor at San Francisco State University. She gave an interview to the *New York Times* on September 19th, 2000 on her performances at scientific conferences as "The Physics Chanteuse" [*www.nytimes.com/2000/09/19/science/19CONV.html*]. Her mixed-media vaudeville act is derived from themes in contemporary physics and has proved quite popular with scientists. She even was invited to perform recently at Caltech for the 60th birthday celebration of Professor Kip Thorne, the pioneer of black hole and gravity wave detection.
- **Winder, Dale R.** (M.A. 1954), 1430 W. Oak, Fort Collins, CO 80521, has been retired for several years from the Physics Department of Colorado State University. Prior to Dale's retirement he studied and became a Graduate Gemologist and did appraisals and jewelry creations for several years. He and his wife, Kathleen, travel a lot in their retirement years.
- **Woeher, Sarah** (B.S. 1999), 11477 Mayfield Rd #418, Cleveland, OH 44106, is in the Ph.D. program in biophysics and bioengineering at Case Western Reserve University, Cleveland, OH. She reports that it has been challenging so far, but she and husband Mark (a Ph.D. student in neuromechanics at CWRU) are adapting to graduate school.

Acknowledgments

The Department is very grateful to the following individuals and corporations for their new and continuing financial contributions during the period 1 November 1999—31 December 2000. These contributions have been made in support of major items of capital equipment, an endowed professorship, graduate fellowships, undergraduate scholarships, and invited lectures as well as for unrestricted purposes. Those who have not been contacted by one of the University of Nebraska Foundation's telephone campaigns or who might be considering an additional tax-deductible gift to us should note that we have the following general accounts at the UN Foundation.

1.) **Physics & Astronomy Development Fund** (for unrestricted gifts) (Account No. 2557.0)
2.) **Physics & Astronomy Lecture Endowment Fund** (Account No. 3321.0)
3.) **Physics & Astronomy Scholarship Endowment Fund** (Account No. 3303.0)

Contributions to any of these may be made conveniently using the contribution card and return envelope enclosed with the mailing of this newsletter. Checks should be made payable to the University of Nebraska Foundation and should indicate for which account the money is intended. Those contributors whose employers have a matching gift program should indicate this.

Bishan Agrawal (M.S. 1973, Ph.D. 1974)
Terry L. Anderson (M.S. 1971, Ph.D. 1975)
Kevin D. Aylesworth (M.S. 1986, Ph.D. 1989)
Ball Corporation
Minqi Bao (M.S. 1992, Ph.D. 1995)
William A. Barrett, Jr. (B.S. 1952, M.S. 1953)
The Boeing Company
Larry L. Boyer (M.S. 1968, Ph.D. 1970)
Blaine D. Bryan (B.S. 1960)
James M. Bunch (M.S. 1963, Ph.D. 1967)
William L. Burmester (B.S. 1973, M.S. 1975)
Louis J. Caplan (M.S. 1964, Ph.D. 1975)
Donald E. Dau (M.A. 1950)
Paul O. Davey (Ph.D. 1964)
Debra Jean Fickler (B.S. 1988)
Paul Finkler
John W. Flocken (M.S. 1964, Ph.D. 1969)
FMC Foundation
Robert G. Fuller
Thomas E. Furtak (B.S. 1971)
John S. Gallagher III
David M. Gray (B.S. 1977)
Andrew T. Groebner (B.S. 1989)
Burt H. Hartzell (B.A. 1939)
Maurice R. Hawthorne (B.S. 1964)
Alan J. Heeger (B.S. 1957, HDS 1999)
Kyle W. Hollman (B.S. 1988)
Gary M. Hoover (B.S. 1961)
Keh-Ning Huang
IBM
Sitaram S. Jaswal
Vanvilai Katkanant (M.S. 1979, Ph.D. 1983)
David W. Keifer (B.S. 1968)
Roger D. Kirby
Rebecca Richards Kortum (B.S. 1985)
Byron L. Krauter (B.S. 1976)
Wilma Carol Marcy LaBelle (B.S. 1955)
William J. Lannan (M.A. 1956)
Michael K. Lewis (B.S. 1992)
Robert Linderholm
Robert L. Maher (M.S. 1975, Ph.D. 1980)
Ronald W. McFee (M.A. 1966, Ph.D. 1971)
Ronald H. McKnight (M.S. 1964, Ph.D. 1970)
Donald C. Moore (B.A. 1942)
Suraiya Nafis (M.S. 1984, Ph.D. 1987)
Gordon Niva (M.S. 1975, Ph.D. 1975)
Phillips Petroleum Foundation, Inc.
Kevin D. Reilly (M.S. 1962)
Jerry E. Ruckman (B.S. 1962)
M. Eugene Rudd (Ph.D. 1962)
James J. Schmidt (B.S. 1956, M.S. 1957)
Theodore J. Schuldt, Jr. (B.A. 1959, M.A. 1961)
David J. Sellmyer
Roy F. Simperman (M.S. 1965)
Anthony F. Starace
Telcordia Technologies
Terry Teays (Ph.D. 1986)
Alan B. Tveten (M.A. 1959)
Dale R. Winder (M.A. 1954)

Thank you very much!

For more information about the Department of Physics and Astronomy, visit our Web Site at: **http://physics.unl.edu/**

Arts & Sciences

The Record

a Documentary Record of Facts and Figures for the Department of Physics & Astronomy at the University of Nebraska–Lincoln

No. 21 Spring 2001 Roger D. Kirby, Editor

1999-2000 Degree Recipients

Bachelor of Science

Jonathan W. Bullis (Dec. 1999) is working in Lincoln and plans to apply to graduate programs in Astronomy.

Howard A. Camp (Dec. 1999) is in the atomic physics graduate program at Kansas State.

Benjamin F. Hudson (Dec. 1999) is in the physics graduate program at the University of Wisconsin-Madison.

Jeremy A. Potter (Dec. 1999) is in the B.S. program in Mechanical Engineering at UNL.

Sarah M. Woehrer (Dec. 1999) is in the biophysics graduate program at Case Western Reserve University, Cleveland, OH.

Christina M. Lund (May 2000) is in the medical physics graduate program at the University of Chicago.

Matthew A. Poulsen (May 2000) is in the M.S. program in physics at UNL, working under the supervision of Professor Stephen Ducharme.

Michael P. Roth (May 2000) is in the M.D. program at the University of Nebraska Medical Center in Omaha.

Jennifer L. Webster (May 2000) is working as a Field Engineer with Schlumberger Corp., New Orleans, LA.

Master of Science

Takashi Komesu (Aug. 1999) is a physics Ph.D. student at UNL working under the supervision of Professor Peter Dowben.

Camelia N. Borca (Dec. 1999) is a physics Ph.D. student at UNL working under the supervision of Professor Peter Dowben.

Yu Feng (May 2000) is working as an actuary for Aegon USA, Inc. in Louisville, KY.

Doctor of Philosophy

Chien-Nan Liu (Aug. 1999) worked as a postdoctoral research associate in the Max Planck Institute on the Physics of Complex Systems in Dresden, Germany, for one year and is now working as a postdoctoral research associate at Kansas State University in Manhattan, KS.

Mingjun Yu (Dec. 1999) is in research and development at Max Media Corp. in San Jose, CA.

Robyn Wilde (May 2000) is currently a physics instructor at Western Wyoming Community College, Rock Springs, WY, and from May 2001 will be a postdoctoral research associate at the University of Oklahoma in Norman.

Honors

1999-2000 Fellowships and Traineeships

Thomas Koch, *Graduate Research Traineeship*
Rebecca Lindell-Adrian, *Graduate Research Traineeship*
Deborah Williams, *Regents Tuition Fellowship*
Hao Zeng, *IBM Graduate Fellowship*

1999-2000 Scholarships

Brigitte Gregg, *U.S. Harkson Scholarship*
Owen King, *Physics and Astronomy Scholarship*
Christina M. Lund, *U.S. Harkson Scholarship*
Bradley Peterson, *Joel Stebbins Fund Scholarship*
Jonathan Reyes, *Joel Stebbins Fund Scholarship*
Seth A. Root, *John E. Almy Scholarship*
Michael P. Roth, *Henry H. Marvin Memorial Scholarship*
Gary Ruplinger, *Ed Hirsch Scholarship*
Lucas Sabalka, *Henry H. Marvin Memorial Scholarship*

College of Arts and Sciences Annual APPLAUSE Award

Brian Farleigh

UNL Parents Teaching Award

Herman Batelaan
C. Martin Gaskell
Timothy J. Gay
Kevin M. Lee
Gregory R. Snow

2000 Distinguished Graduate Teaching Assistant Award

Timothy Reece

2000 Distinguished Undergraduate Teaching Assistant Award

Jennifer L. Webster

1999-2000 Society of Physics Students Officers

Alex Kieckhafer, President
Chad Petersen, Vice President
Omid Zehtab, Secretary/Treasurer

Faculty Professional Activities

In addition to service on Department, College and University-Wide committees, during 1999-2000 a number of the faculty were active in local, national and international professional activities, as follows:

Clifford Bettis: Secretary, Physics Instructional Resource Association

Daniel Claes: Judge at Lincoln Public Schools/Pfizer Science Fair

Peter Dowben: Center for Advanced Microstructure and Devices Advisory Board, LSU; Session Chair at 44th Annual MMM Conference

Stephen Ducharme: Chair and Proceedings Editor for the Conference on Organic Photorefractive Materials (July 1999), Denver

Ilya I. Fabrikant: Chair of the International Symposium on Electron-Molecule Collisions and Swarms (July 2001), Lincoln NE

Timothy J. Gay: APS DAMOP Secretary Treasurer; APS DAMOP Program Committee (ex officio); GEC Executive/Program Committee; NRC Committee on Atomic, Molecular, and Optical Physics (CAMOS)

John R. Hardy: Consultant, Army Research Laboratory; Consultant, Naval Research Laboratory

Duane H. Jaecks: Users Executive Committee of the Advanced Light Source, Berkeley, CA

Diandra Leslie-Pelecky: Member, American Physical Society Committee on Careers and Professional Development; APS Representative to the AIP Advisory Committee on Career Services

Kam-Ching Leung: American Astronomical Society, Chrétien International Award Committee (Member); *Chinese Astronomy and Astrophysics* (Pergramon Press: Oxford), Editorial Board; International Astronomical Union, *Information Bulletin on Variable Stars*, Editorial Board; United Nations Working Group on Astronomical Facilities in the Pacific Rim; Hong Kong Astrophysical Society (Vice President); Co-Chair of Scientific Organizing Committee, Pacific Rim Conference on Stellar Astrophysics (August 1999), Hong Kong; Science Advisor, Hong Kong Science Museum and Hong Kong Space Museum

Edward G. Schmidt: Coordinator, *Archives of Unpublished Variable Star Observations*, International Astronomical Union

David J. Sellmyer: International Organizing Committee, Magneto-Optical Recording International Symposium (1999) Monterey, CA; Executive Committee of APS Group on Magnetism and its Applications (Member); Chair of Nominating Committee, APS-GMAG; MMM Intermag Conference, San Francisco (Session Chair); Honorary Member of the Academic Committee, State Key Laboratory of Magnetism, Institute of Physics, Chinese Academy of Sciences; Member, Nebraska State EPSCoR Committee; Member, EPSCoR Grants Committee; Member, Governor's Science and Technology Planning Committee

Gregory R. Snow: Fermilab Users Executive Committee (Chairman); Session Chair at International Europhysics Conference on High Energy Physics (July 1999), Finland; NSF Proposal Review Panel for GK-12 Program

Anthony F. Starace: UNL Faculty Representative, Federal Demonstration Partnership, National Research Council; Committee of Visitors, Physics Division, National Science Foundation; Associate Editor, *Reviews of Modern Physics*

2000-2001 Visiting Staff Members

Visiting Professors this year are **Neil Boag** (Ph.D. 1980, Bristol) working with Peter A. Dowben, **Sam Cipolla** (Ph.D. 1969, Purdue), **Vladimir Fridkin** (Ph.D. 1965, Russian Academy of Sciences) working with Stephen Ducharme, and **Nikolai L. Manakov** (D.Sc. 1979, Leningrad State U., Russia) working with Anthony F. Starace.

Visiting Associate Professors **Mikhail Chibisov** (Ph.D. 1967, Kurchatou Institute, Russia) working with Ilya Fabrikant, and **Jianjun Liu** (Ph.D. 1994, Jilin U., P.R. China) working with John R. Hardy.

Visiting Assistant Professor **Rochelle Ondracek** (Ph.D. 1994, Johns Hopkins) working with David J. Sellmyer.

Adjunct Professor **Ronald H. Ono** (Ph.D. 1983, SUNY at Stony Brook) working with Sy-Hwang Liou.

Research Assistant Professors **Shireen Adenwalla** (Ph.D. 1989, Northwestern), **Imaddin Al-Omari** (Ph.D. 1996, UNL) working with David J. Sellmyer, **Renat Sabiryanov** (Ph.D. 1993, Institute of Chemistry of Solids, Ekaterinburg, Russia) working with Sitaram Jaswal, **Ralph Skomski** (Ph.D. 1991, Dresden) working with David J. Sellmyer, and **Orhan Yenen** (Ph.D. 1986, UNL) working with Duane H. Jaecks.

Postdoctoral Research Associates **Mircea Chirpara** (Ph.D. 1987, Institute of Atomic Physics, Bucharest, Romania) working with Shireen Adenwalla and David J. Sellmyer, **Gerard Lagmago-Kamta** (Ph.D. 1999, National University of Benin, West Africa) working with Anthony F. Starace, **You Qiang** (Ph.D. 1997, U. Freiburg, Germany) working with David J. Sellmyer, **Mark Rosenberry** (Ph.D. 2000, U. Michigan) working with Timothy J. Gay, **Andrei Sokolov** (Ph.D. 1996, Moscow State U.) working with Bernard Doudin, **Alexander Sorokin** (Ph.D. 1997, Institute of Crystallography, Russian Academy of Sciences) working with Stephen Ducharme, **Hong Tang** (Ph.D. 1996, Institute of Metal Research, Academia Sinica, P.R. China) working with David J. Sellmyer, **Minglang Yan** (Ph.D. 1992, Lanzhou U., P.R. China) working with David J. Sellmyer, **Lanping Yue** (Ph.D. 1995, Chinese Academy of Science, P.R. China) working with Diandra Leslie-Pelecky, and **Min Zheng** (Ph.D. 1997, Institute of Physics, Chinese Academy of Sciences, P.R. China) working with Roger D. Kirby and David J. Sellmyer.

Senior Lecturer **C. Martin Gaskell** (Ph.D. 1981, U. California).

Lecturers **Hurol Aslan** (Ph.D. 1994, Purdue) and **Kevin M. Lee** (Ph.D. 1997, UNL).

1999 Fall Semester Colloquia

September 2
Professor Michael Cavagnero, University of Kentucky
"The Interferometric Manipulation of Chemical Bonds"

September 9
Professor Robert Averback, University of Illinois
"The Properties of Nanoclusters on Surfaces"

September 16
Dr. Mathias Schubert, University of Nebraska-Lincoln (EE) and University of Leipzig
"Ellipsometric Studies of Some Interesting Optical Media"

September 23
Dr. Peter W. Milloni, Los Alamos National Laboratory
"The Quantum Vacuum"

September 30
Professor Raymond Flannery, Georgia Institute of Technology
"Recombination: Its Role from the Big Bang, in Astrophysics, in Aeronomy and in the New State of Matter"

October 7
Dr. David Pappas, National Institute of Science and Technology
"Spin-Flop Transitions and Magnetic Nanostructures"

October 14
Dr. Ron Ray, Fermi National Accelerator Laboratory
"Studies to Understand the Origin of CP Violation: The KTeV Experiment at Fermilab"

October 21
Professor Philip H. Bucksbaum, University of Michigan
"Quantum Wave Packets Sculpting"

October 28
Professor Steve Cohn, University of Nebraska-Lincoln (Math and Statistics)
"Convection Diffusion Equations and Contaminant Flow"

November 4
Professor Ronald E. Taam, Northwestern University
"Common Envelope Evolution of Binary Star Systems"

November 11
Professor Gregory R. Snow, University of Nebraska-Lincoln
"Search for Antiproton Decay at the Fermilab Antiproton Accumulator"

November 18
Professor Paul D. Burrow, University of Nebraska-Lincoln
"Exploring Empty Orbitals with Electron Scattering: The Dissociative Attachment Process"

December 2
Professor Xiao Zeng, University of Nebraska-Lincoln (Chemistry)
"Computational Studies of Phase Transitions and Nanotribology"

2000 Spring Semester Colloquia

January 13
Professor Anthony F. Starace, University of Nebraska-Lincoln
"Control of Intense Laser-Atom Processes with Strong Static Fields"

February 10
Professor Peter Dowben, University of Nebraska-Lincoln
"Does Spin-Electronics Have a Future at Nebraska?"

February 24
Professor Mark A. Johnson, Yale University
"Spectroscopic Studies of Vibrationally-Mediated Slow Electron Capture"

March 7
Sharon Begley, Senior Editor, Newsweek
"English, Please: Why Science Doesn't Get Better Press, What Scientists Can Do To Change That, and Does It Matter Anyway?"

March 9
Professor Jack Bass, Michigan State University
"Giant Magnetoresistance in Metallic Magnetic Multilayers: Why It's Better to do it Perpendicularly"

March 20
Professor Beth Ann Thacker, Texas Tech University
"A Study of the Nature of Students' Models of Microscopic Processes in the Context of Modern Physics Experiments"

March 30
Professor Eric Schiff, Syracuse University
"Electronics in Tortured Topologies: Nanoporous Titania and Silicon"

April 6
Professor Michael Weissman, University of Illinois-Urbana/Champaign
"1/f Noise in Magnetic Systems"

April 13
Professor David Landau, University of Georgia
"Exploring New Frontiers in Science with Computer Simulations"

April 20
Professor Philip E. Wigen, Ohio State University
"High Resolution Scanning Probe Ferromagnetic Resonance Force Microscopy"

The Record
Physics & Astronomy

1999 Faculty Publications

Astronomy and Astrophysics

C.M. Gaskell, "Broad Line Regions—a Final Examination" in *Structure and Kinematics of Quasar Broad Line Regions,* Ed. by **C.M. Gaskell,** W.N. Brandt, M. Dietrich, D. Dultzin-Hacyan, and M. Eracleous, San Francisco: Astronomical Society of the Pacific, 423 (1999).

C.M. Gaskell, and S.A. Snedden, "The Optical Case for a Disk Component of BLR Emission" in *Structure and Kinematics of Quasar Broad Line Regions,* Ed. by **C.M. Gaskell,** W.N. Brandt, M. Dietrich, D. Dultzin-Hacyan, and M. Eracleous, San Francisco: Astronomical Society of the Pacific, 157 (1999).

S.A. Snedden and **C.M. Gaskell,** "An Analysis of the Velocity Dependence of BLR Emission Line Ratios from HST and Optical Data" in *Structure and Kinematics of Quasar Broad Line Regions,* Ed. by **C.M. Gaskell,** W.N. Brandt, M. Dietrich, D. Dultzin-Hacyan, and M. Eracleous, San Francisco: Astronomical Society of the Pacific, 25 (1999).

C.M. Gaskell, W.N. Brandt, M. Dietrich, D. Dultzin-Hacyan, and M. Eracleous (editors), *Structure and Kinematics of Quasar Broad Line Regions* (San Francisco: Astronomical Society of the Pacific, 1999).

S.A. Snedden and **C.M. Gaskell,** "The Effect of Abundance Variations on Estimates of the Densities of Broad Line Region Clouds in Quasars," Astrophysics Journal (Letters) **521,** L91 (1999).

Atomic, Molecular and Optical Physics

S.J. Buckman, D.T. Alle, M.J. Brennan, **P.D. Burrow,** J.C. Gibson, R.J. Gulley, M. Jacka, D.S. Newman, A.R.P. Rau, J.P. Sullivan, and K.W. Trantham, "Role of Negative Ion Resonances in Electron Scattering from Atoms and Molecules," Australian Journal of Physics **52,** 473 (1999).

C.-M. Teodorescu, D. Gavel, J. Choi, D. Pugmire, **P.A. Dowben,** N. Fominykh, A.A. Pavlychev, and E. Rühl, "Inner Shell Excitation and Fragmentation of Sulfur Aggregates," Journal of Electron Spectroscopy and Related Phenomena **101-103,** 193 (1999).

I.I. Fabrikant and R.S. Wilde, "Evidence of Virtual Dipole-Supported States in Electron Scattering by Methyl Chloride," Journal of Physics B **32,** 235 (1999).

R.S. Wilde, **G.A. Gallup,** and **I.I. Fabrikant,** "Semiempirical R.-Matrix Theory of Low Energy Electron—CF_3Cl Inelastic Scattering," Journal of Physics B **32,** 663 (1999).

A. Schramm, **I.I. Fabrikant,** J.M. Weber, E. Leber, M.-W. Ruf, and H. Hotop, "Vibrational Resonance and Threshold Effects in Inelastic Electron Collisions with Methyl Iodide Molecules," Journal of Physics B **32,** 2153 (1999).

H. Batelaan, A.S. Green, B.A. Hitt, and **T.J. Gay,** "An Optically-Pumped Electron Spin Filter," Physical Review Letters **82,** 4216 (1999).

B.G. Birdsey, H.M. Al-Khateeb, M.E. Johnston, T.C. Bowen, **T.J. Gay,** V. Zeman, and K. Bartschat, "Near-Threshold Measurement of Integrated Stokes Parameters for Kr Excited by Polarized Electrons," Physical Review A **60,** 1046 (1999).

H.M. Al-Khateeb, B.G. Birdsey, T.C. Bowen, A.S. Green, M.E. Johnston, and **T.J. Gay,** "A Simplified GaAs Polarized Electron Source," Review Scientific Instrumentation **70,** 3882 (1999).

Y.-K. Kim and **M.E. Rudd,** "Theory for Ionization of Molecules by Electrons," Comments on Atomic and Molecular Physics **34,** 309 (1999).

C.-N. Liu and **A.F. Starace,** "Mirroring Behavior of Partial Photodetachment and Photoionization Cross Sections in the Neighborhood of a Resonance," Physical Review A **59,** R1731 (1999).

C.-N. Liu and **A.F. Starace,** "Photodetachment of Na^-," Physical Review A **59,** 3643 (1999).

D.B. Milošević and **A.F. Starace,** "Phase Control of X-ray—Atom Scattering in the Presence of a Bichromatic Laser Field," Journal of Physics B **32,** 1831 (1999).

D.B. Milošević and **A.F. Starace,** "Magnetic-Field-Induced Intensity Revivals in Harmonic Generation," Physical Review Letters **82,** 2653 (1999).

N.L. Manakov, V.D. Ovsiannikov, and **A.F. Starace,** "DC Field-Induced, Phase and Polarization Control of Interference Between One- and Two-Photon Ionization Amplitudes," Physical Review Letters **82,** 4791 (1999).

D.B. Milošević and **A.F. Starace,** "Intensity Dependence of Plateau Structures in Laser-Assisted, X-ray—Atom Scattering Processes," Physical Review A **60,** 3943 (1999).

D.B. Milošević and **A.F. Starace,** "High-Order Harmonic Generation in Magnetic and Parallel Magnetic and Electric Fields," Physical Review A **60,** 3160 (1999).

C.-N. Liu and **A.F. Starace,** "Photodetachment of He^- in the Vicinity of the He^* (n = 3,4, and 5) Thresholds," Physical Review A **60,** 4647 (1999).

Condensed Matter Physics

V. Scarani, **B. Doudin,** J.-P. Ansermet, "The Microstructure of Electrodeposited Cobalt-Based Nanowires and its Effect on Their Magnetic and Transport Properties," Journal of Magnetism and Magnetic Materials **205,** 241 (1999).

C. Beeli, **B. Doudin,** J.-P. Ansermet, P. Stadelmann, "Off-Axis Electron Holography of Single Ferromagnetic Nanowires," Materials Characterization **42,** 175 (1999).

C.N. Borca, R.-H. Cheng, and **P.A. Dowben,** The Influence of Patterning in Co and Co/Pd Multilayers Structures," *Polycrystalline Metal and Magnetic Thin Films,* Ed. By D. Laughlin, K.P. Rodbell, O. Thomas, and B. Zhang, Materials Research Society Symposium Proceedings **562,** 63-67 (1999).

T. Komesu, C. Waldfried, and **P.A. Dowben,** "The Unoccupied Band Structure of Strained Gadolinium," Journal of Vacuum Science Technology **A17,** 1319 (1999).

J. Choi, **P.A. Dowben,** C.N. Borca, S. Adenwalla, A.V. Bune, **S. Ducharme,** V.M. Fridkin, S.P. Palto, and N. Petukhova, "Evidence of Dynamic Jahn-Teller Distortions in Two-Dimensional Crystalline Molecular Films," Physical Review B **59,** 1819 (1999).

C. Waldfried, **P.A. Dowben,** O. Zeybek, T. Bertrams, and S.D. Barrett, "Structural Domain Growth of Strained Gadolinium on Mo(112)," Thin Solid Films **338,** 1-4 (1999).

C.N. Borca and **P.A. Dowben,** "The Influence of Patterning on Co/Pd Multilayer Structures," Journal of Magnetism and Magnetic Materials **198-199,** 258 (1999).

C.N. Borca, J. Choi, S. Adenwalla, **S. Ducharme, P.A. Dowben,** L. Robertson, V.M. Fridkin, S.P. Palto, and N. Petukhova, "The Influence of Dynamical

PUBLICATIONS *continued on page 22*

PUBLICATIONS *continued from page 22*

Scattering in Crystalline Poly(Vinylidene Fluoride-Trifluoroethylene) Copolymers," Applied Physics Letters **74,** 347 (1999).

J. Choi, J. Zhang, **S.-H. Liou, P.A. Dowben,** and E.W. Plummer, "The Surfaces of the Perovskite Manganites $La_{1-x}Ca_xMnO_3$," Physical Review B **59,** 13453 (1999).

T. Komesu, C. Waldfried, and **P.A. Dowben,** "The Origin of Enhanced Magnetization in Strained Gadolinium," Physics Letters A **256,** 81 (1999).

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C.N. Borca, R. Skomski, and **P.A. Dowben,** "Structure and Hysteresis of Patterned Soft-Magnetic Structures," Physica Status Solidi (a) **174,** R15-R16 (1999).

J.-L. Lin, H. Rauscher, A. Kirakosian, F.J. Himpsel, and **P.A. Dowben,** "Selective Adsorption of Metallocenes on Clean and Chemically Modified Si(111) Surface," Journal of Applied Physics **86,** 5492 (1999).

C.N. Borca, S. Adenwalla, J. Choi, P.T. Sprunger, **S. Ducharme,** L. Robertson, J. Liu, Matt Poulsen, V.M. Fridkin, H. You, and **P.A. Dowben,** "A Lattice Stiffening Transition in Copolymer Films of Vinylidene Fluoride (70%) with Trifluoroethylene (30%)," Physical Review Letters **83,** 4562 (1999).

A.V. Bune C. Zhu, **S. Ducharme,** I.M. Blinov, V.M. Fridkin, S.P. Palto, N. Petukhova, and S.G. Yudin, "Piezoelectric and Pyroelectric Properties of Ferroelectric Langmuir-Blodgett Films," Journal of Applied Physics **85,** 7869 (1999).

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R.F. Sabiryanov and **S.S. Jaswal,** "Magnons and Magnon-Phonon Interactions in Iron," Physical Review Letters **83,** 2062 (1999).

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S.H. Liou, S. Huang, E. Klimek, **R.D. Kirby,** and Y.D. Yao, "Enhancement of Coercivity in Nanometer-Size CoPt Crystallites," Journal of Applied Physics **85,** 4334 (1999).

H.Q. Li, R.H. Ono, L.R. Vale, D.A. Rudman, and **S.H. Liou,** "Interactions Between Bicrystal Josephson Junctions in a Multilayer Structure," IEEE Transactions on Applied Supercond. Vol. (1999).

S.H. Liou, "Comparison of Magnetic Images Using Point and Thin-Film Magnetic Force Microscopy Tips," IEEE Transactions on Magnetics **35,** 3989 (1999).

A. Gavrin, C. Sellers, and **S.H. Liou,** "Magnetic Domain Observation on Melt-Spun Nd-Fe-B Ribbons Using Magnetic Force Microscopy," *Advanced Hard and Soft Magnetic Materials,* Ed. by M. Coey, *et al*., Materials Research Society Symposium Proceedings **577,** 241 (1999).

X. Gao, J.A. Woollam, **R.D. Kirby, D.J. Sellmyer,** C.T. Tanaka, J. Nowak, and J.S. Moodera, "Dielectric Tensor for Magneto-Optic NiMnSb," Physical Review B **59,** 9965 (1999).

D.J. Sellmyer, M. Yu, and **R.D. Kirby,** "Nanostructured Magnetic Films for Extremely High Density Recording," Nanostructured Materials **12,** 1021 (1999).

M. Yu, Y. Liu, and **D.J. Sellmyer,** "Structural and Magnetic Properties of Nanocomposite Co:C Films," Journal of Applied Physics **85,** 4319 (1999).

J.P. Liu, Y. Liu, R. Skomski, and **D.J. Sellmyer,** "Magnetic Hardening In $SmCo_x$-Co Multilayers and Nanocomposites," Journal of Applied Physics **85,** 4812 (1999).

S. Bandyopadhyay, L. Menon, N. Kouklin, H. Zeng, and **D.J. Sellmyer,** "Electrochemically Self-Assembled Quantum-Dot Arrays," Journal of Electronic Materials **28,** 515 (1999).

R. Skomski, **R.D. Kirby,** and **D.J. Sellmyer,** "Activation Entropy, Activation Energy and Magnetic Viscosity," Journal of Applied Physics **85,** 5069 (1999).

Z.S. Shan, H. Zeng, M. Azarisooreh, K. Honardoost, Y. Liu and **D.J. Sellmyer,** "Effect of Layer Thickness on Orientation Distribution and Magnetic Properties of CoCrTa/Cr Films," Journal of Applied Physics **85,** 4310 (1999).

Y. Liu, J.P. Liu, and **D.J. Sellmyer,** Nanostructure of Exchange-Coupled Hard/Soft FePt Composite Films," Nanostructured Materials **12,** 1027 (1999).

J.P. Liu, Y. Liu, R. Skomski, and **D.J. Sellmyer,** "High Energy Products in Exchange-Coupled Nanocomposite Films," IEEE Transactions on Magnetics **35,** 3241 (1999).

Z.C. Zhong, V. Holmes, **P.A. Dowben,** and **D.J. Sellmyer,** "Selective Area Laser Induced Deposition of Metal Boride Thin Films," *Flat-Panel Displays and Sensors—Principles, Materials and Processes,* Ed. by F.R. Libsch, Materials Research Society Symposium Proceedings **558,** 115 (1999).

R. Skomski, J.P. Liu, and **D.J. Sellmyer,** "Quasicoherent Nucleation Mode in Two-Phase Nanomagnets," Physical Review B **60,** 7359 (1999).

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R. Skomski J.P. Liu, and **D.J. Sellmyer,** "Permanent Magnetism in Exchange-Coupled Nanocomposites," *Advanced Hard and Soft Magnetic Materials,* Ed. by M. Coey *et al*., Materials Research Society Symposium Proceedings **577,** 335 (1999), and **562,** 309 (1999).

High Energy Physics

B. Abbott, ...**D. Claes, G. Snow,** *et al*., "Determination of the Absolute Jet Energy Scale in the DØ Calorimeters," [DØ Collaboration], Nuclear Instruments and Methods in Physics Research A **424,** 352 (1999).

B. Abbott, ...**D. Claes, G. Snow,** *et al*., "The Dijet Mass Spectrum and a Search for Quark Compositeness in $\bar{p}p$ Collisions at $\sqrt{s}$=1.8 TeV," [DØ Collaboration], Physical Review Letters **82,** 2457 (1999).

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B. Abbott, ...**D. Claes, G. Snow,** *et al*., "Small Angle J/Psi Production in $\bar{p}p$ Collisions at $\sqrt{s}$=1.8 TeV," [DØ Collaboration], Physical Review Letters **82,** 35 (1999).

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B. Abbott, ...**D. Claes, G. Snow,** *et al*., "Search for Squarks and Gluinos in Single-Photon Events with Jets and Large Missing Transverse Energy in $\bar{p}p$ Collision at $\sqrt{s}$= 1.8 TeV," [DØ Collaboration], Physical Review Letters **82,** 29 (1999).

B. Abbott, ...**D. Claes, G. Snow,** *et al*., "Measurement of the Top Quark Pair Production Cross Section in $\bar{p}p$ Collisions Using Multijet Final States," Physical Review D **60,** 012001 (1999).

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Interdisciplinary Physics

Archaeometry

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Educational/History

M.E. Rudd, "Eise Eisinga and His Amazing Planetarium," Journal of the Antique Telescope Society **16,** 4-7 (1999).

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Physics Education

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Track Physics

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New Research Grants and Contracts

during the period 1 November 1999 – 31 October 2000 the following new and renewal grants and contracts were received by our faculty

Principal Investigator	Title (Source of Funds)	Amount ($)
Batelaan	The Kapitza-Dirac Effect: A Coherent Electron-Wave Beamsplitter (Research Corporation)	35,000
Batelaan/Starace/Sellmyer	Quantum Information Technology (NRI)	127,451
Claes/Snow	Fermilab Collaboration (Northern Illinois University)	76,100
Doudin	Electrodeposition of Ferromagnets in Organic Solvents (ACS)	12,500
Doudin	Single-Spin Electronics (NSF)	74,963
Doudin/Sellmyer	Magnetometry on Individual Nanometer-Sized Ferromagnet (NSF)	5,167
Dowben/Adenwalla	Boron-Carbide Thermal Neutron Detectors and Cameras (NRI)	66,000
Dowben/Liou/Adenwalla	The Metal-Nonmetal Transition in Magnetic Local Moment Systems (NSF)	118,955
Ducharme	Infrared Spectroscopic Ellipsometry (Woollam Co., Inc.)	38,964
Ducharme	High Performance Capacitors and Nonvolatile Memories from Langmuir-Blodgett Films of Ferroelectric Polymers (NSF)	87,833
Ducharme/Dowben/Adenwalla	Structure of Ferroelectric Polymers (ONR)	95,846
Ducharme/Dowben/Adenwalla	Ultrathin Polymer Films for Microelectronic Devices (NRI)	183,608
Fabrikant	Strong External in Decay and Photodetachment of Negative Ions (DOE)	35,782
Fabrikant	Collision Processes Involving Low-energy Electrons (NSF)	60,000
Gaskell	Quasers and Supermassive Black Holes (Space Telescope Science Institute)	4,862
Gay	Polarized Electron Physics NSF9732258 REU Supplement (NSF)	10,000
Gay	Polarized Electron Physics (NSF)	163,000
J. Hardy	Studies on the Microwave Optics of Ionic Molecular Solids (ARO)	110,000
Jaecks	ROA Supplement to NSF 9731869 (NSF)	13,000
Jaecks	Correlated Motion, Energy and Angular Momentum Partitioning in Multielectron and Massive Three Body-Coloumb-Interacting Quantum Systems in the Continuum (NSF)	180,000
Lee	Publishing Agreement (Harcourt Brace College)	1,250
Leslie-Pelecky	Metastable Phases in Chemical Synthesized Nanoparticles (American Chemical Society)	6,500
Leslie-Pelecky	A Pilot Program for Professional Development of K-8 Teachers in Physical Science (NE Coordinating Commission for Postsecondary Education)	10,414
Leslie-Pelecky	Career: Cluster-Assembled Magnetic Nanostructures (NSF)	80,000
Leslie-Pelecky/Ducharme	Research Experiences for Undergraduates in Nanostructured Materials (NSF)	63,000
Liou	Homologous-Series Superconductors and Multilayer Junctions (Midwest Superconductivity Consortium)	43,050
Liou/Kirby	High Temperature Stability of Magnetic Clusters (ARO)	77,500
Liou/Sabirianov	Magnetic Domains of Nanometer-Size Magnetic Features [DOD-DEPSCOR (ARO)]	90,000
Yi Liu	Digital Imaging System-Nanostructured Materials (NSF)	70,500
Sellmyer	Extremely High Density Recording (NSIC-EHDR)	22,500
Sellmyer	Fundamental and Magnetic-Hardening Studies of Nanocrystalline and Nanocomposite Magnets (DOE)	82,295
Sellmyer	Fundamental and Magnetic-Hardening Studies of Nanocrystalline and Nanocomposite (DOE)	85,000
Sellmyer	Advanced Magnets for Power Systems (ARO)	400,000
Sellmyer/ Doudin/ Dowben/Kirby/Liou	Nanoscale Materials for Information Technologies (NRI)	250,000
Sellmyer/Doudin/Leslie-Pelecky/Liou/Qiang	Development of a Cluster-Deposition System for Nanoscale Magnetic Materials (NSF)	40,000
Sellmyer/Jaswal/Leslie-Pelecky/Liu	Advanced High-Temperature Magnetic Materials (AFSOR)	99,538
Sellmyer/Kirby	IBM Fellowship-Hao Zeng (IBM)	21,504
Snow/Claes	Cosmic Ray Observatory Project (NSF)	327,990
Starace	International Request for NSF Award PHY-0070980 (NSF)	7,870
Starace	Coherent Control of Continuum Quantum Processes (NSF)	85,000
Starace	Dynamics of Few-Body Atomic Processes (DOE)	99,500
Supriyo/Liu/Sellmyer	Self Assembled Nanostructures (ARO)	25,406
Weymouth	Ponca Cemetery (Ponca Tribe of Nebraska)	1,100
Weymouth	Hopeton Earthworks, Ross Co, Ohio (Dept. of Interior, Natl. Park Service)	2,400
	Total	**$3,491,348**

AAPT – American Assoc. of Physics Teachers
ACS – American Chemical Society
AFOSR – Air Force Office of Scientific Research
ARO – Army Research Office
DOE – U.S. Department of Energy
EPSCoR – Experimental Program to Stimulate Competitive Research
IBM – International Business Machines
KC – Kalamazoo College
NRI – Nebraska Research Initiative
NSF – National Science Foundation
NSIC – National Storage Industry Consortium
ONR – Office of Naval Research