MOMENTUM

THE UNIVERSITY OF KANSAS DEPARTMENT OF PHYSICS AND ASTRONOMY

Undergraduate Natural Science Laboratory Teaching Center

The University of Kansas is widely recognized as a leading institution of higher learning in the State with significant strengths in its undergraduate and graduate programs in the natural sciences. However, the nature of science and science education have changed dramatically since 1954 when Malott Hall (laboratories in chemistry and physics) was constructed, and since the early 1980s when Lindley Hall (laboratories in geology) was renovated. In addition, the demand for basic biology courses has increased dramatically during the last decade and currently far outstrips the remodeled facilities of Haworth Hall completed in 1985. Unfortunately, many of the current undergraduate laboratory facilities on the Lawrence Campus, especially those in Malott and Lindley Halls, no longer provide laboratory spaces that meet modern standards for environmental health and safety, are not sufficiently accessible to the physically challenged, are woefully inadequate to carry out modern instrument-oriented laboratory science programs, and lack the flexibility to allow significant changes in the pedagogical approach to laboratory teaching methods.

In order to solve these problems and to provide laboratory facilities that will meet the needs of thousands of students in the College of Liberal Arts and Sciences for 30-50 years into the next century, the Departments of Physics and Astronomy, Chemistry, Biological Sciences, and Geology have proposed the addition of a modern Natural Sciences Laboratory Teaching Center east of and interconnected with Malott Hall. This facility would house all of the undergraduate laboratories for the Department of Chemistry and the Department of Physics and Astronomy, lower division laboratory courses in the Division of Biology, and lower division courses in the Department of Geology. In addition to laboratory space, the building would house small to medium-sized multimedia lecture/demonstration classrooms (to supplement larger rooms available in Budig Hall), student tutorial areas, computer commons, and a planetarium that would serve both undergraduate astronomy students and the public. A flexible environment would be featured in which project-oriented laboratory courses could be developed and interdisciplinary course activities would be encouraged.

The building plans include modern labs, some state-of-the-art lecture halls, lots of open space, and a planetarium. The total size of the project is estimated at 220,000 GSF (137,590 NSF) at a cost of $54,490,000 (escalated to the year 2000).

This proposal has gained the backing of Deans throughout the University. Drawings of the University's future building plans include its footprint next to Malott. The central administration has been talking about it, and a committee has been formed to look at the variety of ways of funding it, including a combination of State, Federal, and private funding.

Concept drawing of the Natural Science Laboratory Teaching Center. Malott is to the left.

A Letter from the Chairman

This year our newsletter is somewhat later than usual. In the past, the Office of University Relations has had major editorial responsibility in the publication of this work but this job has now shifted to our Department, and accounts for some of the changes you may notice in the format of the newsletter. The past year has been a full and rewarding one for us. I will focus on a few items in my introductory remarks but you can read about the various developments and activities relating to our Department in more detail as you peruse this newsletter.

Members of our Department have received a number of honors and awards. In Fall 1998 Professor Bruce Twarog received a Kemper Award in recognition of teaching excellence. These awards are generally given out in class at the beginning of the semester by a surprise visit from the Chancellor or the Provost. Unbeknownst to them, Bruce and his wife Barbara had traded classes. However, the day was saved when Barbara feigned illness and convinced Bruce to take her class, and Bruce was there to receive his surprise award. (Barbara could well be recognized for her performance at next year's Academy Awards ceremony.)

We are also very proud of the honors received by our students during the past year: in 1998 Adrienne Juett (Engineering Physics) and Gene Holland (Physics) received prestigious Goldwater Scholarships, and in 1999 Stuartt Corder (Physics and Astronomy) received a similar scholarship. Additional honors were bestowed on students at the Department's annual awards banquet last May, in recognition of their accomplishments. This is discussed in more detail elsewhere in the newsletter. Congratulations to them all!

During the past year we received the sad news that Professor Daniel S. Ling, Jr. passed away on August 21, 1998. Professor Ling received his PhD from the University of Michigan in theoretical nuclear physics in 1948 and came to KU that same year. He was a member of our Department until his formal retirement in 1993, with the last several years of this period spent on medical leave. Many will remember him as an excellent teacher and mentor who contributed greatly to their professional development. Further details on Dan Ling and his career at KU may be found elsewhere in the newsletter.

Changing demographics in the Department are reflected in recent faculty additions. Greg Hackman joined us in January 1999 as an assistant professor in experimental nuclear physics. Greg, together with Professor Steve Sanders, form the core of the nuclear physics group. In the coming academic year Linda Olafsen will join us as an assistant professor working in experimental condensed matter physics. This brings the total number of faculty in this research area to three (Judy Wu, Siyuan Han, and Linda Olafsen). In addition we will be joined by Jeffrey Olafsen (Linda's husband) who is also in experimental physics; he will be an assistant professor working in non-linear dynamics of granular systems. (This is the third husband-and-wife team in our Department.) A search is also underway for an assistant professor in atmospheric science with expertise in remote sensing. This latter search has not yet concluded as of the time of this writing.

In Fall 1998 Professor Robin Davis became the new Associate Chairman, replacing Frank Prosser who held that position since 1989. Frank Prosser retired in 1998 after serving 41 years at KU, and has set up a scholarship fund for the benefit of eligible undergraduates. The Francis W. Prosser Physics Scholarship Fund will provide a scholarship for a student majoring in Physics or Engineering Physics who has the best GPA at the end of the freshman year (with at least 30 hours of course-work and no more than 59 hours). This complements the Stranathan award, which is traditionally given to the physics major who has the most outstanding academic record at the end of his or her junior year.

We expect to have two of our faculty (Professors Adrian Melott and Alice Bean) on sabbatical leave next academic year. Adrian Melott plans to spend the fall 1999 semester at Carnegie Mellon University pursuing his research in cosmology. In particular he will work with the experimental cosmology group analyzing the Medium Deep Survey (out to about 2 billion light years) and studying X-ray properties of galaxy clusters. Alice Bean will spend the entire 1999-2000 academic year at Fermilab, working on the D0 experiment. As remarked in earlier newsletters, members of the high energy physics group are now actively working with the D0 collaboration at Fermilab (while continuing to maintain their involvement in the CLEO collaboration). During her sabbatical leave, Alice will focus her efforts on the D0 detector upgrade. The upgraded detector, together with improved Tevatron luminosity, will provide a powerful tool for studying top-quark physics and in searching for evidence of supersymmetry and a light Higgs boson.

Six years after lightning destroyed Hoch Auditorium a new building has risen from the ashes of the burnt-out site. The new building is named Budig Hall (after our last Chancellor), and it has been in use for over a year. It contains a 1000-seat lecture hall as well as other classrooms of lesser size. In addition to Budig Hall, the building also carries the inscription "Hoch Auditoria," providing some continuity with the original name. The building has all the latest audio-visual and computer facilities that greatly enhance its teaching function. It cost $22 million to build and its construction took two years longer than expected but it was well worth waiting for. The availability of these new well-equipped classrooms greatly facilitates the scheduling of classes with large enrollments.

This newsletter is, among other things, an instrument of communication between the Department and its alumni and friends. Our home page on the Internet (http://www.phsx.ukans.edu) also provides a great deal of information about our current activities, course offerings, and research programs. However, we are also interested in learning about you and important milestones in your lives; our newsletter can serve as an important conduit in passing this information on to others with whom you may have lost touch. If you know of alumni who are not receiving this newsletter please let us know and we will make sure they are placed on our mailing list. As often stated, we encourage and welcome personal visits from alumni and friends, so if you happen to be in our general area be sure to drop by and see us. Finally, I would like to thank you all for your continued interest in, and support of, the Department and its programs.

Ray Ammar
Chairman

STUDENT NEWS

Department Students Win Goldwater Scholarships

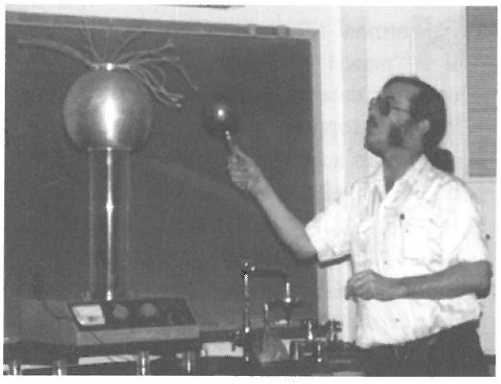
Undergraduate students in our department continue to excel in the prestigious Goldwater Scholarship competition. Two of our students won 1998 Goldwater awards, while one has recently been named a 1999 award winner. The Goldwater Scholarship is the leading national undergraduate scholarship in all fields of science and engineering, and it covers the cost of tuition fees, books, and room and board up to a maximum of $7500 per year. These students continue a strong tradition of success by departmental majors in the stiff competition for Goldwater Scholarships. Of the 35 individuals nominated by KU since 1988 (39 nominations because 4 students were nominated twice), 8 have been majors within the Department. Of these 8 students, 5 have been selected for scholarships at the national level, 3 within the last two years.

In 1998, KU nominated four students, who all got awards. The two from our department are Gene Holland (physics) and Adrienne Juett (engineering physics). Adrienne's project with Prof. Besson was Detection of Cosmic Neutrinos in the Antarctic Ice.

Holland's work for Armstrong was to revise an elaborate set of computer programs and command procedures that they were using to process the Ulysses HISCALE data and make them work for the Advance Composition Explorer Energetic Proton and Alpha Monitor (EPAM) instrument. The EPAM instrument is the flight spare for the HISCALE instrument and thus is nominally identical. The problem is that the spacecraft system is completely different. Questions about the orientation, timing of data collection, reconciling this with the other (different instruments) on the ACE platform were difficult and exacting. Gene penetrated this problem all the way to the byte and millisecond level and rebuilt all of this in FORTRAN and DCL. He wrote excellent documentation of the revisions and worked tirelessly with the engineers at the Applied Physics Laboratory to get all of the parameters of the software correct.

In 1999, Stuartt Corder, an undergraduate major in Physics, Astronomy, and Math, is one of two KU students selected to receive a Goldwater Scholarship for 1999; four students were nominated for the award by KU. The 304 Goldwater Scholars nationwide were selected on the basis of academic merit from a field of 1181 math, science, and engineering students who were nominated by the faculties of colleges and universities nationwide.

Stuartt is a 3rd-year student from Olathe who plans on graduating in Spring 2001. He has done research to date in math with Prof. Bozenna Pasik-Duncan and is currently working with Prof. Bruce Twarog in Physics and Astronomy. His project is the computer simulation of the orbital motions of star clusters over the life of the Galaxy, taking into account the statistical effects of orbital diffusion and cluster dissolution. The goal is to test the impact of these processes on the relative abundance distribution of clusters versus field stars as a function of galactocentric distance.



Vince Reinert wows the kids at the Magic Show. (Above)

(Right)

A demonstration of the sinking of the Titanic at the 1999 Departmental show of Natural Magic

Student Awards , Honors, and Graduates

The Slosson award for graduate teaching assistants in Physics and Astronomy was given to Patrick Gorman, Michelle Leonard, and Ina Robertson.

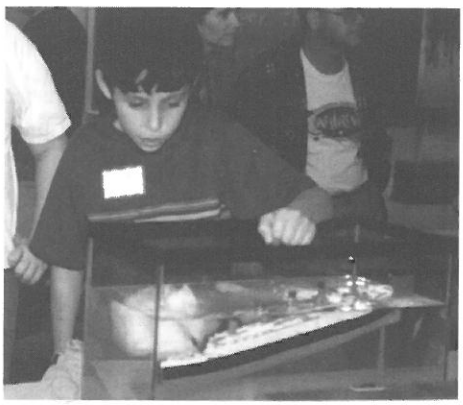
The outstanding teaching assistant award in Atmospheric Science was given to Wendy Elkins. The Stranathan Award, a senior-year scholarship based upon an outstanding record as a Physics undergraduate (selected in Summer 1997), went to Gene Holland and Adrienne Juett. The awards for Outstanding Graduating Senior in physics, engineering physics, and atmospheric science went to Gene Holland, Adrienne Juett and Kristine Zentimire.

Ms. Jounghun Lee won a University Dissertation Fellowship based on her innovative Ph.D. research with Prof. Shandarin.

Ahilleas Maurellis was granted his Ph.D. in 1998 and moved to Amsterdam to begin a job with the Institute for Atomic and Molecular Physics.

Alexei Nikitin was awarded a Ph.D. He elected to stay in Lawrence to work for Flint Hills Scientific, LLC.

Tolga Yalcinkaya successfully defended his Ph.D. thesis entitled Phase characterization and controlling transient chaos in deterministic flows in April 1998. Dr. Yalcinkaya is now a scientist with the Adcanced Research Division at the U.S. Sprint in Kansas City. He is working on analyzing the performance of large scale communication networks using computational models - the type of skill for which he was trained extensively while as a graduate student in the Chaos group.



Retired Professor Daniel Ling: 1924 - 1998

Daniel S. Ling Jr., who was a faculty member of the Department from 1948 to 1993, died at the age of 73 in Spokane, Washington on August 21, 1998.

Dan was born in Chicago, earned a B.S.E. at the University of Michigan in 1944, and M.S. at Michigan in 1945, and a Ph.D in theoretical physics from the University of Michigan in 1948. His dissertation was On the theory of Nuclear Angular Correlations. He came to KU in September 1948.

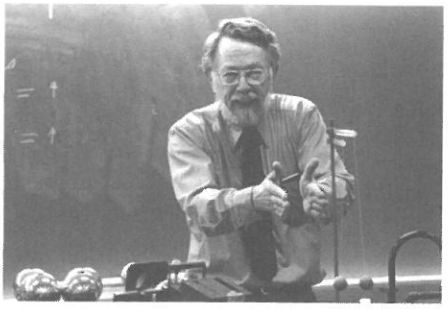
Dan was known for his lively and spirited lectures. Teaching was clearly his main academic interest. He was a HOPE Award nominee. Professor Emeritus Jack Davidson recalls that Dan had lots of good ideas for teaching physics, which is undoubtedly why he participated in an NSF-sponsored summer institute for college physics teachers in 1964. Professor Emeritus Bob Friauf, too, relates that Dan was best known as an outstanding teaching, who not only enjoyed it but was very good at talking through lucid explanations of all kinds of physics. Friauf adds, "He also had a strong feeling, perhaps old fashioned, that students should show respect and courtesy for the professor. For instance, if a student came to class at all, the student should be present on time, and should remain for the entire period. In recent years, when he was teacing Physics 114, he told me he was greatly distressed because only about one-third of the homework handed in by the class was ever picked by students."

As a mathematical physicist, he consulted with faculty in other departments in helping them solve their problems. These problems ranged from the flow of oil through beds of sand to the stressing and bending of battens, which are steel plates that help support structures. One of his two patents concerned the production of hydrogcarbon materials, while another one was on the use of Lamb waves in the ultrasonic testing of metal plates.

During 1957-1960, he consulted for a company in Colorado about a theory he had developed for the thermal initiation of explosive detonation.

Friauf also recounts that Dan was a good athlete and was an especially good fast softball pitcher. He also enjoyed skiing.

He moved to Spokane on medical leave in 1987 following diagnosis of cancer, and officially retired in 1993. He is survived by his daughter, Deborah Ling Stucky, Spokane; a son, David, Upper Saddle River, N.J.; a sister, Joanne Ling Moot, Bethesda, Md.; and six grandchildren. His wife of 38 years, Margaret, died in 1984.



Dan Ling discussing and demonstrating electrostatics

Herman Munczek Retires

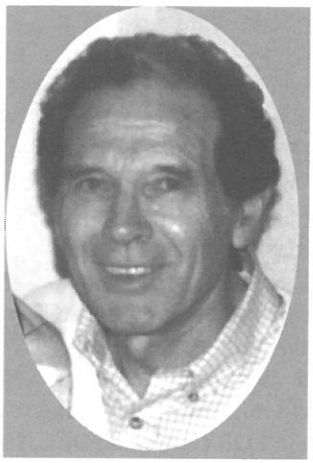
Herman Munczek has hung up the "pencil and paper" of his long teaching career in physics but says he "has not stopped being a physicist."

Herman's education was in Argentina. He actually began as an experimentalist, working on the properties of a new radioactive isotope of antimony. He says, though, that "After a little accident and learning what radiation could do to you, I quit experimental physics and became a theorist." After completing his doctorate in 1958, he went to the University of Rome on a postdoctoral fellowship—a time that he says was the most enjoyable of his career. "It was a period in which I was really initiated into theoretical particle physics. There were still colleagues and students of Fermi that were professors there, and there was a great atmosphere of collaboration." He got to know some American visitors, one of whom a few years later offered him a visiting position at Northwestern University. There Herman met Ray Ammar, Robin Davis, and Doug Mckay, all of whom also came to KU in the period 1969-71.

When asked what he feels are two of the most significant thing he's done in physics, he mentions the following. First is a clarification of the role of the path integral in describing the S-matrix in field theory and the role of certain quantities, like the propagator of particles and the connection with the Bethe-Salpeter equation, which describes bound states from the point of view of field theory. Much of this work was done with Doug McKay. Secondly, based on the previous research, and relatively recently, is the development of some new methods of calculating the bound states of quarks using the formalism mentioned above. This was done in collaboration with Pankaj Jain, a postdoc with the KU theory group, and was inspired by Herman's earlier work with Adolfo Nemirovsky (Ph.D. 1983).

He says that he misses the regular interaction with his colleagues and students. It has been, however, a very busy first year since retiring, with some travel, getting all his papers in order, and working on a few research ideas in physics.

He adds that the last 40 years have been a golden period of growth for physics at universities, and he wonders how it will change for students and faculty in the future.



Herman Munczek

RESEARCH

Astronomy

How many papers end with the prosaic remark "more data are needed?" A 1997 paper by Twarog, Ashman and Anthony-Twarog considered evidence for a strange metal abundance discontinuity among the Milky Way's open clusters at a distance of 10 kiloparsecs from the center of the galaxy. Since more data really are needed, photometry in several clusters at critical distances and metal abundances has been gathered and is being analyzed. Astronomers at the University of Mexico's San Pedro Martir Observatory, including past sabbatical visitor, Bill Schuster, have contributed photoelectric data in some of the cluster fields to help calibrate CCD data collected at Kitt Peak and Cerro Tololo. Much of the summer of 1998 was spent plodding through CCD photometry, with the able assistance of undergraduates Stuartt Corder and Andrew Bricker.

While several cluster projects are still in the beginning stages of data collection and processing, several major efforts have seen completion in the past year with the publication of a metallicity calibration for the KU-developed photometric metallicity index based on the ultraviolet spectral features of ionized calcium. Nearing completion was the photometric study of hundreds of extremely metal-poor stars culled from the candidate list compiled by Tim Beers (Michigan State University) and co-workers. Twarog, Anthony-Twarog and undergrad A. Bricker also attacked a popular problem (the distance to the Magellanic Clouds) in a somewhat novel way, using HIPPARCOS parallaxes to calibrate isochrones for metallicities representative of the Milky Way anti-center clusters and the LMC.

Adjunct Assistant Professor Keith Ashman continues his work on globular cluster systems and the information they provide on the formation and evolution of galaxies. Globular clusters are dense, massive clusters of stars that are found around galaxies. With research student Jenna Burroughs (Baker University), Ashman has been looking for globular clusters in Hubble Space Telescope images of spiral galaxies. Although our own spiral galaxy, the Milky Way, has a well- studied globular cluster system, only a few other globular cluster systems around spirals have been investigated in any detail. Consequently, it is not currently clear what a typical globular cluster system around a spiral looks like. This severely hampers attempts to use globular clusters to investigate the galaxy formation process. Ashman and Burroughs will eventually look at twenty spiral galaxies observed with HST, thereby greatly improving current knowledge on these systems. Early results, including some obtained by Ashman with Kissler Patig (ESO), Zepf (Yale) and Freeman (MSSSO), indicate that the number of globular clusters around individual spiral galaxies is somewhat lower than previously thought.

Steve Shawl's textbook trials and tribulations described last year have turned out well. Shawl, and his co-authors, Bob Robbins and Bill Jefferys at the University of Texas, after nearly two years of work signed a contract in late August 1998 with a nationally recognized publisher to publish the fourth edition of their introductory textbook *Discovering Astronomy*. The publisher, Kendall/Hunt of Dubuque, Iowa, is small enough to be willing to try new ideas and take new chances, while large enough to know the textbook market well. While Kendall/Hunt has published astronomy lab manuals for years, they have never before published a nationally distributed astronomy textbook. To make the new edition available for the Fall 1999 semester required a tremendous effort in both the fall and spring semesters.

Atmospheric Science

The Atmospheric Science Program has made great strides during the past year along several fronts. A request to the College of Liberal Arts and Sciences by the Department of Physics and Astronomy to hire an additional faculty in the area of atmospheric remote sensing was approved and during Spring semester 1999, four candidates for this position visited the Department. During their visit, each candidate met with faculty and students in the Department, as well as presenting a research colloquium and teaching and undergraduate class.

On the research front, Professors Braaten and Tucker have been developing aviation weather research thrust, and have been developing collaborations with the KU Aerospace Engineering Department, the NOAA/NCEP Aviation Weather Center in Kansas City, the Center for Analysis and Prediction of Storms (CAPS) at the University of Oklahoma, and the Pleasant Hill, Missouri National Weather Service Office. To kick off this aviation weather initiative, Braaten organized and chaired a study conference, in the Kansas Union, which was focused on Aviation Weather Hazards. This conference was sponsored by the National Science Foundation [Experimental Program to Stimulate Competitive Research (NSF-EPSCoR] the Federal Aviation Administration Weather Research Program, and the U.S. Weather Research Program. Over 50 participants attended the conference representing universities, government research labs, federal funding agencies, and the aviation industry, including KU alumnus Randy Baker representing UPS Airlines. Our Aviation Weather Hazards web page (http://chinook.phsx.ukans.edu/~braaten/hazwx.html) provides important information about this new aviation weather collaboration, as well as detailed information about the topics discussed and the participants in attendance at the October study conference. Recently, a collaborative project between the National Weather Service forecast office in Pleasant Hill has been funded by the University Corporation for Atmospheric Research UCAR) for aviation related research.

Other research efforts in the Atmospheric Science program include a NASA funded project that involves analysis of surface meteorological and energy balance data from stations on the Greenland ice sheet to understand elevation changes on the Greenland ice sheet surface, which are measured using an aircraft-based, precision laser altimeter.

Condensed Matter Physics

The theme for Professor Judy Wu's group is thin film growth, characterization, and applications. The main thrust of the group has been developing high-quality Hg-based superconducting (Hg- HTS) thin films. Hg-HTSs, discovered in 1993, have the highest superconducting transition temperature among all existing superconductors (above 130K) and thus are very promising for various superconducting electronics. Wu's group, sponsored in part by NSF, DEPSCoR/AFOSR and BMDO [Ballistic Missile Defense Office] plays an important role in developing Hg-HTS thin film coating technologies to achieve large-area Hg-HTS wafers for

Continued on Page 6

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Condensed Matter Continued

microwave applications, thick Hg- HTS film on metals for superconducting tape applications, and ultra-thin Hg-HTS wafers for infrared detector applications. Wu's group is currently hosting four graduate students (A. Gapud, T. Aytug, Y.Y. Xie and R. Aga), one postdoctoral researcher (Dr. B.W. Kang) and two visiting scholars (Professors S.L. Yan and L. Fang). Extensive collaboration has been established with other groups including Professor Han's group at KU, Texas Center for Superconductivity, Sandia National lab, Oak Ridge National lab, Los Alamos National lab, US Army Research lab, US Air Force Research lab, and the MIT Lincoln laboratory.

Dr. B.W. Kang completed her Ph.D. thesis recently in Wu's group. Her work on mixed-state Hall effect won her a gold medal, one out of 14 nationally, in the student award at the Material Research Society annual fall meeting held in Boston in December 1998. Graduate student T. Aytug has been working at Oak Ridge National lab since January 1999 for his thesis research on buffer layers for superconducting tapes.

One of the research areas of Professor Siyuan Han and graduate student Yang Yu is quantum computing. It is considered one of the next century's scientific frontiers and has attracted extensive interest both from scientists and the general public. If the quantum computer can be built, it will be exponentially faster than any conventional computer in solving certain problems that were previously thought intractable. The most famous example is the factors of a large number, which is the corner stone of the modern encryption technology. Recently, Han received a three-year grant for nearly $350,000 from DEPSCoR/Air Force to conduct experiments on quantum computing using the superconducting quantum interference device, known as SQUID, as the fundamental building block. When compared to other approaches of actually realizing a quantum computer, SQUID has several distinct advantages. For instance, Han and his collaborators at SUNY Stony Brook have experimentally demonstrated that although SQUIDs are very different from atoms in almost every aspect, they are essentially artificial atoms. However, unlike a real atom whose energy level structure is nature given the energy levels of a SQUID can be designed and fabricated using integrated circuit technology, to suit specific applications such as quantum computing. The next goal is to create a macroscopic quantum coherent (MQC) state, known as the Schrodinger cat state, in SQUIDs. This requires the SQUIDs be cooled down to very low temperature to suppress thermal fluctuations, which are the source of errors. To achieve the required low temperature, Han and Yu received invaluable assistance from the Department machinists, Allen Hase and Bruce Janus, in completing the installation of a state-of-the-art Oxford Kelvinox 400 dilution refrigerator. In the first test it reached a temperature below 9 mK, that is less than 1% of a Kelvin above the absolute zero! Currently, Han and Yu are working on designing SQUID samples, setting up instruments, and developing computer Schrodinger cat state, in SQUIDs. This requires the SQUIDs be cooled down to very low temperature to suppress thermal fluctuations, which are the source of errors. To achieve the required low temperature, Han and Yu received invaluable assistance from the Department machinists, Allen Hase and Bruce Janus, in completing the installation of a state-of-the-art Oxford Kelvinox 400 dilution refrigerator. In the first test it reached a temperature below 9 mK, that is less than 1% of a Kelvin above the absolute zero! Currently, Han and Yu are working on designing SQUID samples, setting up instruments, and developing computer.

Cosmology

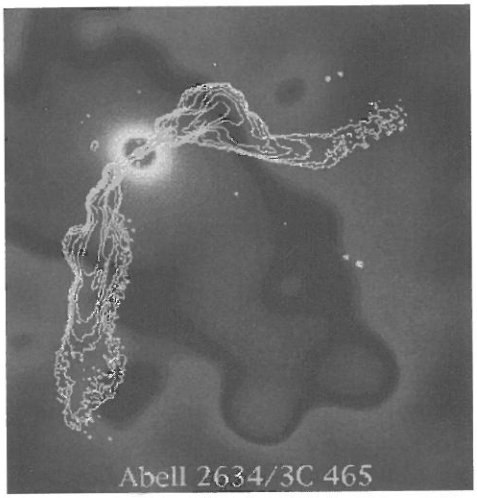
The KU cosmologists had an active research year. In addition to the presence of faculty (Hume Feldman, Adrian Melott, and Sergei Shandarin) and students, they were visited by Prof. Paul Shapiro of the University of Texas, who came to KU on a Big XII Fellowship. Shapiro was the first researcher from another institution to take advantage of this method to visit KU.

The Fourth Great Plains cosmology workshop was held in May '98, at tended by researchers from Nebraska, Iowa, Missouri, as well as Colorado, England, New Mexico, and Hawaii (honorary Great Plains states).

Sergei Shandarin was on Sabbatical at the Theoretical Astrophysics Center in Copenhagen during Fall 1998. However, he also managed to visit Cardiff, Milan, Warsaw, and Toronto to present research talks. Adrian Melott spoke at a number of places, including Carnegie-Mellon University where he will return for a Sabbatical in fall 1999.

New work by Shandarin with student J. Lee has produced insights to the distribution function of the mass of objects formed in the Universe. The theory is a considerable improvement over its replacement, both in terms of realistic dynamics and agreement with computer simulations. It is expected to have a major impact on the understanding of cosmic structure and to place constraints on viable models.

Adrian Melott, with KU students Brian Wilhite (now a graduate student at U Chicago) and Michael Kaufman, and NATO Fellow Dmitri Novikov, unearthed persistent "superwinds" blowing along cosmic structures. The work has attracted considerable attention, including a 1/26/99 New York Times Article. The work shows that jets of plasma, which are thought to be ejected from enormous black holes in the centers of galaxy clusters, are blown by persistent winds. These winds appear to be aligned with superclusters, which are structures 100 times larger that are just beginning to form as they are separated from the cosmic flow.



RESEARCH

Experimental Particle Physics

The high energy particle physics group, comprising Professors Ray Ammar, Phil Baringer, Alice Bean, Dave Besson, Robin Davis, and Nowhan Kwak had another successful year in 1998. Ammar continued to lead the effort as Principal Investigator of the group's CLEO research program, using data collected at the Cornell Electron Storage Ring (CESR), in Ithaca, NY. In addition, Ammar, Baringer and Bean led parallel efforts at the D0 experiment just outside of Chicago. The latter experiment, sited at the expansive Fermi National Accelerator Laboratory in Batavia, IL, will become the focus of the group's research during the next five years.

Alice Bean, with undergraduates Pat Sterner and Brett Squire, and graduate student John Gardner, is heavily involved in the development of electronics for the high precision silicon detector to be installed in CLEO in 1999. The silicon detector is expected to be capable of measuring the location of particles that traverse it to within 1/100 of a millimeter, or about 1/5 the diameter of a human hair. Such detectors are among the most technologically sophisticated components of modern particle physics detectors. When not designing the CLEO-III software, Bean has also found time to do actual analysis of the data produced by the presently operating CLEO-II detector. Working in conjunction with graduate student Lin Zhou, Bean has published a paper on the production of protons in decays of heavy particles called B-mesons, which are copiously produced at CESR. The CLEO high-energy physics group was also fortunate enough to benefit from the contributions of talented undergraduates who recently jointed the group Peter Brabant, Matt Cervantes, Nathan DeLee, and Ben Marsh.

The particle physics group has, within the last year, substantially expanded its presence at the proton-antiproton accelerator at Fermilab, in Batavia, Illinois. This accelerator operates on the same principle as the CESR accelerator, but using protons and antiprotons rather than electrons and positrons as the matter-antimatter projectiles. Baringer has taken charge of the effort to integrate the Kansas group into the D0 experiment. The D0 detector is presently one of the two largest particle physics detectors operating in the United States. Recent work by the D0 group has included investigations of possible substructure in quarks — confirmation of such an observation would be perhaps the greatest high energy physics discovery in the last fifteen years. Experimental indications of such substructure have appeared within the last year and may be linked to the long-sought final unification of all of the forces known in nature. Other areas of study with D0 include precise measurements of the W boson mass, and searches for evidence of "supersymmetry". In the prevailing Big Bang model (the inflationary model), supersymmetry is required — verification of this model would certainly be a Nobel Prize winning discovery.

In conjunction with the particle physics group at Kansas State, Bean has secured a major position in the future upgrade program of the D0 detector. In recognition of her extensive hardware experience (particularly in the area of silicon detectors), she will coordinate the construction of the 200,000 channel central silicon tracking system. As part of this project, a Clean Room will be assembled in one of Bean's particle physics laboratories here at KU. To attract her to this project, Fermilab has also offered to pay half of her salary for the upcoming sabattical year, which Bean will take at the accelerator itself. As part of this cooperative arrangement, the Kansas State and Kansas groups will hold joint seminars and discuss the physics potential and opportunities on the D0 experiment. The KU particle physics theorists (Prof. Doug McKay and Prof. John Ralston) will play an active role in this physics program.

The D0 experiment has attracted graduate students Christina Hebert and Patricia Wagner (under Baringer's tutelage) and John Gardner (under Bean's tutelage) to this project. Undergraduates are also expected to play a key D0 role in the next year. Physics majors Michael Kaufmann and Bret Squire, and an Electrical Engineering student will all participate in the D0 upgrade project, under the direction of Professor Bean. Also precipitating on D0 is postdoctoral research associate Dr. Don Coppage, who moved from Cornell to Fermilab last July. Dr. Coppage is mainly working on the central preshower software with grad student Hebert and Prof. Baringer. This group is also doing Monte Carlo simulation of the detector response, calibration and alignment software, and offline data reconstruction.

The high-energy group is also involved in a speculative experiment to detect neutrinos. This experimental effort (called 'RICE', for 'Radio Ice Cerenkov Experiment') is based at the South Pole, and also includes KU theorists Doug McKay and John Ralston, who provided the original impetus at Kansas for the project. Graduate student Ilya Kravchenko visited the South Pole for a month during Dec. 98 — Jan. 99 to install and deploy new experimental hardware. Professor Bean has designed and directed the data acquisition electronics for this experiment. Undergraduates Dave Becker, Dave Schmitz, Ryan Dyer, Adrienne Juett have done most of the hardware testing and monitoring for this experiment. Undergraduate Anne Catlla has used data from Greenland to estimate the transparency of Antarctic ice to radio waves, while undergraduate Kelly Peterson has been searching for alternate sites for a neutrino detector experiment. Undergraduate Jon Stonger is working on extending the capabilities of an event display program for this project.

Dr. Chris Darling, formerly Prof. Bean's postdoctoral research associate, recently secured a position with the Microsoft Corporation in Seattle. He has been replaced at Cornell by Xin Zhou, formerly of Beijing.

Nonlinear Dynamics and Chaos

The chaos group continues forefront research on fundamentals and applications of chaos theory. At the present the group has two faculty members (Y.-C. Lai from Physics/Mathematics and D. Lerner from Mathematics), one post-doctoral fellow (R. Davidchack), five Ph.D. students, one Master student, and one undergraduate student. A junior faculty member, hired specifically in the area of Nonlinear Dynamics and Chaos by the Department of Mathematics, is expected to join the group in Fall 1999. The chaos group has maintained and strengthened

Continued on Page 8

RESEARCH

Chaos Continued

links with several leading groups in nonlinear sciences in the US and abroad. The group has stable federal funds from the National Science Foundation and the United States Air Force, and the group has continued to publish papers in highly selective refereed journals. In the past year, the group received over 100 scientific citations and was invited to give about a dozen lectures all over the world.

The Chaos group was the first to publish a series of papers on communicating with chaos — an area that has attracted much attention from both the scientific community and various funding agencies. They are now working closely with the Chaos group at the University of Maryland to establish a complete framework for chaotic communication systems theory based on dynamical encoding, in contrast to channel encoding utilized on most existing communication systems.

The Chaos group was among the first to address the question of the validity of mathematical modeling of physical systems, an issue that has attracted increasing attention from scientists and mathematicians. In several recent papers, they identified a general property of high-dimensional dynamical systems that obstructs deterministic modeling of the corresponding natural phenomena, no matter how accurate the model is. This result has deep implications to a variety of disciplines in which quantitative modeling is a common practice.

The Chaos group has started a collaboration with Prof. Siyuan Han, from the KU Condensed Matter group, on theoretical and experimental explorations of using solid-state devices for quantum computing.

Prof. Lai announced in June '99 that he was accepting a position at Arizona State University.

Nuclear Physics

The Nuclear Physics faculty are professors Greg Hackman and Steve Sanders. Hackman, who joined the faculty in January, brings a new perspective to the program with his strong background in gamma-ray spectroscopy studies.

The research activities of the group are split between preparations for the startup of the Relativistic Heavy-Ion Collider (RHIC) at Brookhaven National Laboratory and low-energy, heavy-ion reaction and structure studies being done at Argonne National Laboratory, the National Superconducting Cyclotron Facility, and elsewhere.

The particular responsibility of the Kansas Group at RHIC is to develop the multiplicity detector for the **B**road **R**ange **H**adron **M**agnetic **S**pectrometer (BRAHMS). This detector will supply a measure of the centrality of the collisions based on the number of charged particles emitted. For a central Au+Au collision at 100 GeV/nucleon in each beam, it is expected that ~ 16,000 charged articles will be emitted. By measuring the differential energy loss of the particles that pass through an array of Si strip detectors and plastic scintillator tiles arranged in two concentric barrels about the intersection vertex, it is possible to deduce the particle multiplicity on an event- by-event basis. The multiplicity measurement will be used to characterize the reactions in off- line analysis and will also be used to supply a first-level trigger to BRAHMS for downscaling the number of events written to tape based on particle multiplicity. Graduate students Hironori Ito and Patrick Delurgio are working on this project.

In a study involving a lower energy reaction, graduate student Andrew Dummer has finished his analysis of an experiment where evidence was sought for the conjectured ternary breakup of the ^{48}Cr nucleus. In reactions involving heavy ions, it is possible to create compound nuclei at high spin values. The ^{36}Ar+^{12}C reaction might lead to a highly elongated configuration of ^{48}Cr at high spins that corresponds to a linear arrangement of three, tightly-bound ^{16}O nuclei. Such a configuration would be expected to have a strong probability for decay to three ^{16}O particles. Dummer's work, however, suggests that the observed three-body decay of ^{48}Cr can be understood in terms of a sequential fission mechanism. Although this result furthers our general understanding of the fission process involving lighter nuclear system, it makes it unlikely that there will be a strong experimental signature for the ^{16}O chain configuration, should such a configuration exist.

In another low-energy reaction study, Professor Sanders traveled to Strasbourg, France to study the ^{6}Li+^{59}Co and ^{7}Li+^{59}Co fusion reactions. The goal of the experiment was to determine how the low binding energy of ^{6}Li might influence its fusion probability. Since one of the thrust areas of nuclear physics over the next decade is expected to involve reaction studies using radioactive beams, developing a systematic understanding of how the relative binding of the interacting particle influences reaction mechanisms is important. ^{6}Li is the least bound of the stable nuclei. By comparing its cross sections with those found using a more tightly bound ^{7}Li beam, it should be possible to determine how the stability of the beam particle influences fusion cross sections.

Along the lines of gamma-ray spectroscopy, Professor Hackman traveled to Chicago to participate in an "Unsafe Coulex" experiment. This was one experiment in an ongoing program in which heavy ion beams are directed upon targets of actinide elements. Previous experiments used ^{208}Pb beams at about 10-12% the speed of light on ^{248}Cm and various plutonium targets. At these energies, the beam is energetic enough so that in a head-on collision the beam and target would just barely touch, so that strong interactions are negligible. The most common reaction in these experiments is Coulomb excitation, where virtual photons from the ^{208}Pb field are absorbed by an actinide target nucleus, and the excited nucleus then decays by emitting real photons which are detected with the GAMMASPHERE facility. One of the highlights of these experiments has been evidence of static octupole deformation in ^{240}Pu, that is, that this particular nucleus may be pear-shaped. The experiment used a ^{209}Bi beam on a ^{232}Th target, first to study ^{232}Th itself, but also to explore whether or not it would be feasible to study new, short-lived isotopes by transferring a proton from the beam to the target. The cross-sections for these proton-transfer reactions should be

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two order of magnitudes lower than Coulex reactions; however, in the experiment, gamma rays from ^{233}Pa (which is ^{232}Th plus a proton) were in fact observed in coincidence with ^{208}Pb gamma rays (which is ^{209}Bi minus a proton). This demonstrates a technique that can be used for studying nuclei that have such short half- lives that you could never make a target out of them. Further studies along this line are being explored.

Space Physics

The year was full of changes for the space physics group. In July, Tom Armstrong and his students moved to the new offices of Fundamental Technologies, LLC, a computer consulting and service firm owned by Armstrong and his wife, and Jerry Manweiler (Ph.D. Physics 1997) and his wife. The familiar research efforts on Voyager, Ulysses, Galileo, Geotail, Cassini, and ACE continue at F.T., and a number of graduate and undergraduate students are employed there. Tizby Hunt-Ward, Program Assistant with the space physics group since 1985, now works half- time at F.T. for Armstrong and half-time in the department for Cravens. Fundamental Technologies' website is at www.ftecs.com.

Tom Cravens and his students continue their research on plasma interactions with non-magnetic solar system bodies. They are working on models of Titan's plasma environment and atmosphere in anticipation of the Cassini mission arrival at Saturn. Cravens is a team member for the Ion Neutral Mass Spectrometer (INMS) instrument on board that spacecraft. The Cassini orbiter instruments underwent a checkout in January 1999, and it appears to be in good health, as does the instrument with which Armstrong is associated.

Donors Hall of Fame

Many people over the years have thought about the Department of Physics and Astronomy through donations to the Department of Physics and Astronomy Development Fund and to the the Clyde W. Tombaugh Observatory Fund, and the Atmospheric Science fund. We wish to attempt to make up for our past failure to acknowledge this thoughtfulness by doing so below for gifts during the last 10 years or so, during which many of made continuing contributions, a goodly number of which have been anonymous:

Tombaugh Fund

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George R. Cole
Glenn E. & Barbara J. Conklin
Lockheed Martin Corporation
John P. & Mary R. Davidson

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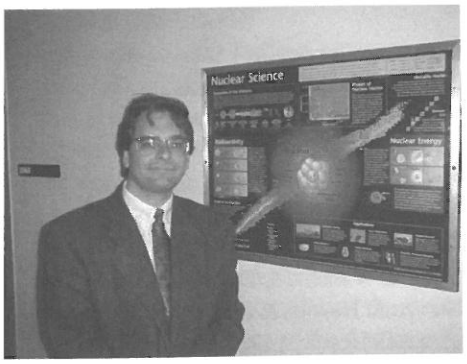
Frank W. Prosser Physics Scholarship Fund

Professor Emeritus Frank Prosser (B.A. 1950, MA, 1953, Ph.D. 1955) has made a major gift to the KU Endowment Association that will endow a scholarship for outstanding undergraduate students majoring in Physics or Engineering Physics.

The scholarship is for students who have completed at least 30 but less than 59 credits, and have declared a major in physics or engineering physics. The fund will provide $1000 per year.

Frank Prosser at the 1999 Annual Award Banquet

FACULTY NEWS



Greg Hackman joined the Physics and Astronomy Department in January of this year. His main research interest is in-beam gamma-ray spectroscopy as a means of studying nuclear structure, in particular the interplay between collective and single-particle behavior in heavy nuclei. Greg's prior experience includes post-doctoral appointments at Michigan State University's National Superconducting Cyclotron Laboratory and Argonne National Laboratory's Physics Division, graduate study in physics at McMaster University, and undergraduate study in engineering at University of Alberta. Greg's other interests include ballroom dancing, badminton, recreational bicycling, and camping with his wife Heather and dog Xena.

Keith Ashman continues to teach Math and Physics at Baker University, KS. He has recently accepted a full-time appointment at Baker beginning in the fall of this year.

Phil Baringer, **Adrian Melott**, and **Steve Shawl** attended the State Science Education Standards hearing in Topeka and spoke in favor of adoption of the State Science Education Standards, and in particular for retention of the material on evolution. A number of other faculty from KU and other Kansas institutions attended as well. This meeting was unusual in that it was attended by approximately 50 scientists, high school biology teachers, and one clergyman, all of whom spoke in favor of the adoption of the evolution portion of the science standards. Those who had been lobbying strongly against the teaching of evolution in favor of a Biblical explanation were not to be seen.

Dave Braaten hosted a workshop in October in the Kansas Union on Aviation Weather Hazards funded by NSF-EPSCoR, FAA Weather Research Program, and the U.S. Weather Research Program. Over 50 participants attended representing universities, government research labs, federal funding agencies, and the aviation industry.

Tom Cravens is currently serving as Secretary for the Aeronomy Section of the American Geophysical Union and helped plan the AGU Fall Meeting in San Francisco in December 1998. He will also be involved in the planning of the next 3 AGU meetings.

Tom Cravens and grad student Steve Ledvina attended the Fall American Geophysical Union Meeting in San Francisco in December. They presented a poster paper entitled "The interaction of Titan with the Saturnian magnetosphere."

Gisela Dreschhoff was elected Vice-President of the American Polar Society (APS) earlier this year. She attended the first APS Symposium at the Byrd Polar Research Center of the Ohio State University. She was invited to present a talk on "From Germany to the Polar Regions", recapitulating Germany's role in polar research since Carl Friedrich Gauss, and her involvement with the German government in Bonn to reestablish Germany's presence in Antarctica after World War II.

Robin Davis and Adrienne Juett

Hume Feldman continues to develop his Cosmology for Poets class as an honors section of Introductory Physics. The class has proven very popular with non-science students, and two of them have subsequently chosen to become physics majors.

Hume Feldman appeared for an hour long live interview for KJHK radio talking about cosmology in general and PHSX 112 in particular. He got rave reviews from all those who listened.

Hume Feldman and **Adrian Melott** were both invited speakers at the AAPT meeting in Lincoln Nebraska. They focused on cosmology concepts for high school physics.

Hume Feldman organized and was master of ceremonies for a Cosmology Jamboree for Bishop Seabury Academy in Lawrence. The entire student population read the book *The Whole Shebang* by Timothy Ferris, and organized discussion groups and shows on cosmology.

Hume Feldman was an invited speaker at the Pritzker Workshop on Inflationary Cosmology in Chicago. He spoke on the Bullseye Effect, which is a concept largely developed at KU. It deals with the tendency of redshift surveys (maps of the universe with velocity used to measure distance) to show structures that wrap around an observer, as a kind of illusion. The strength of this illusion can be used as an indicator of the force of gravity, and therefore the amount of mass in the Universe.

Ying-Cheng Lai is sponsoring the Beowulf project - to build up a supercomputer with 16 DEC-Alpha 533MH PUS for parallel processing. The peak performance of Beowulf will be about 1 Gflops, and it will be one of the most powerful machines on campus for high-performance scientific computing.

Doug McKay visited the Little Apple from Oct. 5 thru 17 as a guest of Tim Bolton in the K-State high-energy physics program. The visit was sponsored by KU, which was happy to get rid of him for two weeks, under the Big XII Faculty Fellowship Program. Doug gave several lectures to the high energy physics special topics

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class and presented a high energy physics seminar "Using D0 and CDF SUSY search data to bound masses of exotic quarks".

Adrian Melott continues to develop his elementary school cosmology curriculum. He spoke about his experiences to a packed house at Ecumenical Christian Ministries near KU.

Adrian Melott presented the joint physics and astronomy colloquium at Carnegie-Mellon University and the University of Pittsburgh entitled "The Bulls-Eye Effect as a Probe of the Mass Density of the Universe." He also presented the Astrophysics seminar "Cluster Winds Blow Along Supercluster Axes" at the University of Florida in Gainesville.

Adrian Melott gave the weekly Theoretical Astrophysics Seminar at Fermi National Accelerator Laboratory in November titled "Cluster Winds Blow along Supercluster Axes".

The January 26 issue of the New York Times contained an extensive article on the large-scale structure of the Universe. Nearly half of it was devoted to an account of the evidence for "superwinds" recently published by **Adrian Melott** and others.

The American Physical Society meeting in Columbus last April featured participation by KU cosmologists as well as alumni. Prof. Melott was an invited speaker at the workshop "The Five Fundamental Parameters of Cosmology" held in conjunction with the meeting.

Sergei Shandarin visited Osservatorio Astronomico di Brera in Milan and Merate (Italy) and presented a colloquium on "Morphology of the Large-Scale Structure." He also went to Copernicus Astronomical Center in Warsaw, Poland, where he gave talks on "Morphology of the Large-Scale Structure" and "Cosmic Mass Function and Large-Scale Biasing." The same presentation was made at the Theoretical Astrophysics Center, Copenhagen, Denmark. Continuing his tour of northerly climes, he visited Canadian Institute for Theoretical Astrophysics (CITA) in Toronto, Canada.

Sergei Shandarin and Adrian Melott have purchased a pair of HP C240's. These feature the fastest single floating-point processor on the market, 1.5Gb of RAM each, with each sitting on about 90Gb of disk. Getting ready to use Internet 2!

Steve Shawl has been named to a task force to investigate the formation of an electronic astronomy education journal. He will be one of three representatives of the American Astronomical Society, and will work with representatives from the Astronomical Society of the Pacific, and the American Association of Physics Teachers (AAPT).

Steve Shawl attended a strategic planning retreat for the Education Office of the American Astronomical Society. He was the only non-member of the Education Board to attend this meeting of some 10 people at the Space Telescope Science Institute.

Steve Shawl was a member of the organizing committee for the symposium on the teaching of undergraduate astronomy held by the Astronomical Society Society of the Pacific in Albequerque in June. He was a member of a panel discussing "The Ideal Introductory Astronomy Course" and another panel on "Astronomy Lecture Demonstrations." Finally, he contributed a paper titled "Learning Styles in Introductory Astronomy Classes." The meeting was attended by some 130 college astronomy teachers from across the country, Mexico, and Australia. Funding for his attendance was provided by the Kansas Space Grant Consortium.

Jack Shi has visited the Brookhaven National Laboratory and gave a talk at the RHIC Colloquium on "Global Compensation of Magnetic Field Errors with Minimization of Nonlinearity in Poincare Section Map".

Faculty Awards and Honors

Bruce Twarog received a Kemper award in recognition of teaching excellence. Twenty awards were provided. Winners are notified when the Provost and other administrators (and the new media) appear without warning in their classroom. Unfortunately, the Administration did not know that Bruce had changed classes with his wife, Barbara! However, Barbara had been notified about it so that a ruse could be devised for Bruce to be there! The award includes $5,000.

Steve Shawl was presented with the Department's Undergraduate Teaching Award at the May 1999 Department Awards Banquet.

Tom Armstrong and Tom Cravens have each received a NASA Group Achievement Award for their work on the Cassini mission.

Tom Cravens is the Secretary of the Space and Aeronomy Section of the American Geophysics Union. The December meeting was the first meeting he has organized; he claims it went reasonably well and no one tried to lynch him.

Professor Emeritus John P. (Jack) Davidson, past Chair of this Department, put "his money where his mouth is" by running for one of the five seats on the State Board of Education. The State Board has been politically deadlocked, and Jack, running as a democrat, hoped to break that stalemate. However, his republican opponent won. Still wanting to make a significant contribution to education, he then ran for the Lawrence School Board and won a four year position there.

Gisela Dreschhoff was an invited speaker, together with astronaut Wally Schirra and five other scientists and explorers, at the Explorers Club (Northern California Chapter) annual dinner in San Francisco. Her talk 'From the Moon to the Sun via Antarctica and Greenland' was a summary of her work with Edward J. Zeller during the last 30 years, first in the Apollo Program and later in the polar regions.

Among various invited lectures, **Ying-Cheng Lai** was invited to give a plenary lecture on Chaos Theory at the first Overseas Chinese Physicist Association (OCPA) Conference before the 1999 APS March meeting in Atlanta. The participants of this OCPA Conference included five Nobel laureates.

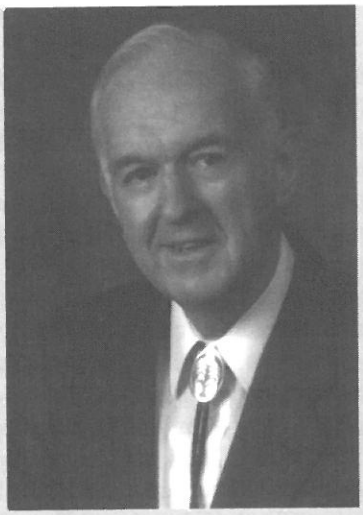
FEATURE STORY

MID-20TH CENTURY PHYSICS AND ASTRONOMY AT KU

Our department has had a wonderful lot of students and faculty over the years. Many - physics majors and astronomy majors, undergraduate and graduate students - have gone on to distinguished careers in research, teaching, administration, government, and industry. With this issue of Momentum, we are inaugurating what we hope will be an annual story by one of our alumni who has contributed to science and society in his/her own way, with a physics/astronomy background from KU as the unifying theme.

Dr. Henry Horak was both a student and a professor at KU. His career includes physics, astronomy, and meteorology. His student years at KU were from 1938-1940 for the bachelors and from 1946-47 for a masters. Graduate study at the University of Chicago in 1947 was under S. Chandrasekhar, who was awarded the Nobel prize in physics in 1983. Completing his Ph.D. in 1950, he then joined his early mentor, Wyman Storer, at KU as an assistant professor. In 1957, he migrated to the Southwest to become part of the Los Alamos National Labs.

The editor of this newsletter, starting as a first semester graduate student at the University of Texas, began hearing wonderful stories over the years from a number of scientists who were taught by Henry Horak at KU. I decided, therefore,



to begin the series with him. Since I had never met him, I asked one of his ex-students, Dr. Jack Hills, to make the initial approach; I'm indebted to Jack for doing so. What resulted is an article that will certainly appeal to the astronomy alumni, but others should also find it both interesting and absorbing. You will see that KU physics and astronomy alumni have, indeed, made substantial contributions over the years.

Dr. Horak clearly got in to what he was writing!The end result is more than 50 pages single spaced! Therefore, in *Momentum* we are presenting a few excerpts that, we hope, will make you want to read more. The rest has been placed (along with photographs) on the Department's web site. Anyone who does not have web access and would like a copy should notify us and a copy can be made.

Excerpts....

I began writing this mini-history at the request of Dr. Steve Shawl, who is now the senior astronomer at Kansas University. The intention was to compile a short summary of the activities of the K.U. Astronomy Department and its students during the mid-twentieth century, from about 1935 when Dr. Storer joined the faculty, through World War II, and from 1950 through 1967, when I was also a member of the faculty. I left K.U. in late 1967 to join the Los Alamos Scientific Laboratory in New Mexico, where I retired in 1989. It appeared at first sight a simple enough task to write a short mini-history, but it soon became apparent that I required more data than my memory could alone provide; after all, I'm 79 years old, and it has been thirty-one years since I taught my last class at K.U. But on second thought, there were modern techniques that I might utilize, namely, e-mail and the internet, both accessible via my computer. So, I compiled a name list of fifteen or so former graduate students, and sent them e-mail messages at their addresses given, for the most part, in the 1997 Membership Directory of the American Astronomical Society. The response was very encouraging; so much so, that I felt obligated to expand the original mini-history into a more substantial document describing some further adventures of these same students after they left K.U. Writing such a quasi-historical document is quite different from putting together the kind of technical paper with which I was familiar, and I often struggled with the wording. Furthermore I could foresee that problems of information accuracy were going to arise that might not be readily solved; therefore, I sent to each of my respondents a short list of questions to which, fortunately, they all replied, again proving "If you want answers, go to a busy person." It was then possible for me to write out several paragraphs for each former student comprised of a sort of melding of his information with my own notes and memories. Often I was able to quote directly from him. In this fashion I was able to proceed without worrying too much about accuracy, although the dates of events still gave some trouble.

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Dr. Max Dresden was a new member of the Physics Department in 1946, and taught a number of courses on theoretical physics; while I was writing this, the notice of his death on October 29,1997 appeared in Physics Today, June 1998, p. 90, where it is stated that he had been the thesis adviser to more than sixty Ph.D. students (this is truly a remarkable accomplishment). Without doubt he gave the best lectures in physics that I was ever privileged to attend, and I took quite a few of his courses the next two years. I had hoped to take relativity, but it wasn't offered in those years, so instead enrolled in differential geometry and tensor analysis from Dr. P.O. Bell of the Mathematics Department. Also, I took orbit computation (of an asteroid or comet) from Dr. Storer, and started to compute my first orbit. We used a textbook by Dr. R.T.Crawford that was saturated with trigonometric transformations, and of course we performed the calculations using logarithms. I was able to follow the formulas, but had difficulty with the logic behind them. During the summer I did some sober thinking, and decided to apply vector analysis. Things started making sense, and fairly soon I acquired an active rather than a passive understanding of the basic con-

FEATURE STORY

Excerpts Continued

cepts. This, in turn, led to my M.A. thesis on Vector Methods Applied to the Theory of Orbits, which I completed the following school year. It also became possible for me to calculate an orbit in about six to eight hours (this was speedy for those days), and I calculated three orbits as examples to be included in the thesis. While I admit that some of this speed could be attributed to my new understanding of the subject, yet most was caused by my being able to use the new Monroe mechanical calculator that Dr. Storer had acquired via the Physics Department (it cost $1500; quite expensive for those days). I cheerfully abandoned logarithms as my main calculation tool.

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I remember the very first day (September, 1950) that I taught the elementary course in descriptive astronomy, known formally as Descriptive Astronomy 12. The class numbered about thirty. Such a course is not easy to teach (especially the first time), because the concepts are quite new to most of the students; another part of the difficulty is clarifying old ideas that are imperfectly understood. My first astronomy question posed to the class was simply: "Which way is 'up'?" As I recall, none of the students could answer that question correctly; I'm sure this irritated some of them, because of the implication that "they were so dumb that they didn't know which way was up!" Thereafter I used this same question to commence every beginning class that I taught.

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Sometime during the mid-fifties George Gamov, the well known Russian nuclear physicist, visited K.U. and gave a talk concerning the origin of the universe about which he'd written a very popular and best selling book. There was a large expectant audience in one of the lecture halls. Gamov turned out to be quite an extravert, and very humorous. He began by saying that the evolution of the universe reminded him of a pregnant woman, that is, they both are expanding...(he paused)..., and furthermore the most interesting things happened at the very beginning. The audience warmed up to that line, I must say. At the end of his performance he received copious applause, and then willingly answered questions from the audience.

****

On occasion he [Chandrasekhar] would tease me for being a political conservative, because he had become a naturalized U.S. citizen and prided himself (and his wife, Lalitha) in being stalwarts of the democratic party. I in turn prodded him, and whenever feasible would invite him to give a colloquium at K.U. But at first to no avail. Later, I mentioned that I had grown up in Kansas City, and that it is only a short distance to Independence, Mo., where President Truman lived and a new library recently constructed in his honor. The next time I brought up the subject of the possible colloquium, he said he would do it provided I could arrange a visit with Truman for him and Lalitha! [Editor's note: the rest of the story is lots of fun!].

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In the 1950's another revolution began that was essential to the success of the space age, not to mention almost everything else in the world, viz., the development of the digital computer. One of the first commercially available was sold by IBM (International Business Machines), and labelled the IBM-650. K.U. obtained one of these in the late 1950's. It was placed in one of the basement rooms of Strong Hall, and so much heat was generated by the numerous vacuum tube components that air conditioners occupied every available window. Program instructions and data were fed nto the computer via punched cards, and the results also came out as punched cards. I fully expected all the professors to be lined up competing, if not fighting, for the opportunity to use the computer, but that didn't happen. But some of us were delighted to have the new machine, such as the Petroleum Engineering Department (which was primarily responsible for persuading the University into obtaining it), an entomologist, a botanist, and a handful of others including an astronomer (me!). Even most of the members of the Mathematics Department seemed to ignore the machine, probably because they primarily did research in "pure" mathematics. Of course the students loved it, and we faculty members who wanted to compute had to compete with them !

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Now let us go on to another, and non-legal, case: one afternoon (I was working away at my desk) Dr. Storer received a visitor who had written a book at least an inch thick recommending that the value of Pi (3.14159265...) be changed to the integer 3, and wanted an evaluation of his concept. Storer accepted the challenge to convince the individual that such a change would not be feasible, and spent some time in the process. I had other things to do! and disappeared somewhere, but the two, plus a student, were still at it when I returned later; perhaps, though, Storer succeeded thereby in suppressing a best seller.

And while speaking of best sellers, Brook Sandford in his e-mail to me mentions the visit to K.U. of *Immanual Velikovsky*, probably in 1965, who was the author of a best selling book called *Worlds in Collision*. I only vaguely recall this visit, but I do remember Otto Struve, during a lecture at Yerkes on comets, saying in no uncertain terms that the book wasn't worth reading, and would mislead the nonscientific readers. In recent years there has been a review of it in one of the books, *Broca's Brain*, by the late Carl Sagan. Brook further reports that although there was a sizeable audience who attended the Velikovsky talk, only Dr. Storer and Dr. Wiseman (physics) responded critically to the presentation. It must have taken a certain amount of bravery to interrupt the speaker, since no formal rebuttal time had been allotted. Brook further makes the point that scientists cannot afford to ignore those who, for whatever purpose, advocate such pseudo-science, and that this lack of response is one of the important factors contributing to the "dumbing down" of education in America. It's a rough road to respond regularly to those who stretch the truth, and most scientists just don't have the time to do a thorough job; if Velikovsky were alive today, I can imagine his publishing an updated version of his book including photos of the Shoemaker-Levy comet's collision with Jupiter and saying "I told you so."

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In my own situation as a teacher I've been approached by well meaning parents who tactfully would enquire whether astronomy was being taught 'properly' to their children at K.U., the implication being that "creationism" should be given equal weight to "evolution." I would respond that one of the competing theories

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Alumni e-mail addresses on Web

If you would like to have your e-mail address placed on the Department web site, please contact either solwa@ukans.edu or shawl@ukans.edu. The department's web address is http://www.phsx.ukans.edu

John Beacom (B.S.1991) is an honorary postdoctoral fellow at Cal Tech, working in nuclear astrophysics.

Ed Bell (Ph.D. Physics, 1989) has recently been promoted to Chief Scientist with Raytheon ITSS and is still hard at work at the National Space Science Data Center at NASA's Goddard Space Flight Center, a contract which was recently renewed for the third time. Although Ed has spent most of his time the last few years making data and information from NSSDC available over the internet (using perl, Java, and just about anything else), he'll be spending some time over the next two years doing research again as he is also a Co-I on a recently won NASA JSDAP grant (comparing Galileo and Voyager data).

Hillary Bull (B.S. physics 1998) has taken a research position with the Sprint Corp. in Kansas City, Missouri.

Humberto Campins (B.S. astronomy 1977) has made a career shift in leaving a full professorship at the University of Florida to be a program officer at Research Corporation in Tucson. As the only astronomer at Research Corporation, he will represent Research Corporation on the Science Advisory Committee of the LBT, or Large Binocular Telescope project in Arizona, which will be completed in 2002-2003. He will continue his research on comets at the University of Arizona's Lunar and Planetary Laboratory, where he has a Senior Research Scientist appointment. With one day per week dedicated to research, he's hoping he'll actually produce more research than ever.

Don Coppage (Ph.D.) moved from Cornell to Fermilab last July.

Kurt Dominik (B.S.1992) has launched his own company, Ascension Consulting, in Lee Summit, MO. He writes that he is still a computer nut and does not have a cool pasttime and is currently involved in a project with Sprint. Most of his work is still with legacy systems and the demand is very strong, so to keep up with current trends, he is also doing some internet based Java work for a start-up company in Lee's Summit. He and his wife Laura have no kids and two miniature daushunds.

Bradley Denton (B.A. astronomy 1980), who also majored in English (and obtained an MA in English from KU in 1984), is a successful science fiction writer. In fact, he won the John W. Campbell Memorial Award for the best science fiction novel of 1991 (for *Buddy Holly Is Alive and Well on Ganymede*) and his book *Blackburn* was a finalist for the 1993 Bram Stoker Award. He and his wife, Barbara, live outside Austin. Interested readers might look at the web site: http://www.sff.net/people/bradley.denton/index.htp

Rebecca C. Ashley Dorward (B.A. Physics 1972) is working as an historical consultant from her home in Aurora, Colorado. She completed an M.A. in history in 1998.

Mark Everett (B.S. astronomy 1991) has a post-doc position in infrared astronomy at the University of Wyoming.

Steven Hawley (B.A. physics and astronomy 1973) is scheduled for (or flew) his fourth Space Shuttle Flight on STS 93, which will launch the Chandra X-ray Observatory. The launch date is currently July 20. Steve previously launched the Hubble Space Telescope and was involved in one Hubble repair mission.

Jack Hills (MA astronomy 1967), who has been a deputy group-leader in the Astrophysics Group of the Theoretical Division at Los Alamos for the past 15 years, is the Chairman of the Division on Dynamical Astronomy in the American Astronomical Society.

James Holliday (B.S. Physics 1998) is presently continuing his CLEO research with the KU group while stationed at Cornell.

Mike Holmes (Ph.D. Physics, 1987) is at Edwards Air Force Base, California. He is working with a team, SOTV (Solar Orbit Transfer Vehicle), that is developing a space propulsion system that uses solar thermal energy as a power source. SOTV acts as a third stage and once in orbit will deploy inflatable concentrators to focus sunlight into an absorber. Hydrogen picks up thermal energy from the absorber and expands out a nozzle to get thrust. The benefit to this approach is that the propellant does not have to be the product of a reaction. Hydrogen is therefore used because it is very light and has a high molecular velocity which maximizes dP. The bottom line is that SOTV type propulsion can double the payload of conventional rockets. It is hoped that SOTV will fly in 2003. Mike runs a ground test lab for SOTV technology and also does optical modeling of the inflatable concentrators. He writes that it's just like plasma physics but the particles don't interact with each other and they don't stick to things.

Mona Kessel (Ph.D. Physics, 1986) (currently of NASA Goddard Space Flight Center) is still involved with Cluster, a largely ESA mission of four spacecraft orbiting Earth in a tetrahedron pattern to obtain 3D measurements - now called Cluster II since the first set of ours blew up a few years ago on the first Ariane 5 launch. She travels to Europe several times a year to participate in team meetings, workshops, or general science meetings. This past summer in Maryland, she worked with a couple of 9th grade teachers to create lesson plans based on Sun-Earth connection research using current data. The plan is to make these lesson plans available on the WWW to any teachers who want to work them into the curriculum - but first they must be tested and evaluated.

Over the last 18 months **Bob Kessel** (Ph.D. Physics, 1986) moved back into technical work within NRL's Naval Center for Space Technology after a stint as a trainee bureaucrat. Initially, the work involved experimental measurements and numerical simulations for satellite laser ranging optical systems. More recently, the bulk of his tasking has switched to the development of the ground data and sensor systems for a hyperspectral remote sensing satellite program called NEMO. As time has been available away from the program

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responsibilities, he has produced a few applied optics publications based on the SLR work and conference presentations on behavioral dynamics.

Sergei Kotov, who started with the KU particle physics group in 1993, took postdoctoral research positions at CERN.

Ilya Kravchenko, who also began in 1993, took a postdoctoral research position with MIT beginning in February, 1999.

Jounghun Lee received her Ph.D, this spring. She has accepted a postdoctoral fellowship in Taiwan. She was supported by a Dissertation Fellowship her last year at KU, and graduated with honors.

Jay Lindgren (Ph.D. Physics, 1994) moved to North Carolina in 1998 where he works for Duke Solutions. He is responsible for developing and managing financial products that are integrated into DukeSolutions' total energy solutions. His activities are coordinated with the product development group, the structured transactions group and the pricing desk. Currently Jay is working on weather derivatives, electric power interruption insurance, and other electric power and natural gas risk management products. Jay also writes that he and his wife had a baby boy in February, who joins their 20 month old daughter.

Angie Linn (B.S. Physics & astronomy with Distinction 1996) is active in research at Ohio State University. She writes, "the whole astrophysics/cosmology group here is great. It's a lot of fun, because its a fairly large but very friendly community. I did some work on primordial nucleosynthesis this summer and fall (we were trying out a new statistical method to try to get a better estimate of the primordial ^{4}He abundance, but it didn't work—the method was faulty.) This coming summer I am planning on working with Dr. David Weinberg up in the astronomy department on an as yet undetermined project having something to do with Lyman alpha forests. I think that'll be fun. It'll be nice to get back to LSS type stuff again."

Achille Maurellis (Ph.D. Physics 1998) has left for Amsterdam, The Netherlands where he has a postdoctoral position at the FOM-Instituut voor Atoom-en Molecuulfysika. He was recently awarded a comprehensive Marie Curie Environment and Climate grant by the European Commission for a proposal entitled "Interfacing GOME (Global Ozone Monitoring Experiment) data with aeronomical models and laboratory photophysics". He will be working on both the computational and the laboratory aspects of analysis of satellite measurements of Earth's airglow and its application to the study of Earth's ionosphere.

Jenny Pauls (Ph.D. Physics 1998) and **Bryce Kuhlman** (M.S. 1997 from some engineering department or other!) were married in May and are living in Phoenix, AZ. Jenny is teaching physics part-time at Chandler-Gilbert Community College (with good prospects of becoming full-time as they rapidly expand their campus). Bryce is working as a systems engineer at Motorola.

Daryl W. Preston (Ph.D. Physics 1970), who is a professor physics and California State University in Hayward, has been elected to Fellowship of the American Physical Society.

Fred Rollins, Jr (B.S. Physics 1950, MS Physics 1952) is now retired and living in Overland Park, Kansas.

Amar Ray (Ph.D. Physics 1997), who has been with US Sprint since he left KU in 1996, received a promotion recently.

Ed Sion (B.A. Astronomy 1968; MA astronomy 1969) , a professor of astronomy at Villanova University, is a scientific editor for the *Astrophysical Journal*, the most prestigious international journal in astronomy and astrophysics.

Russell Stutz (B.S. Physics 1998) left Lawrence for the Air Force on March 15.

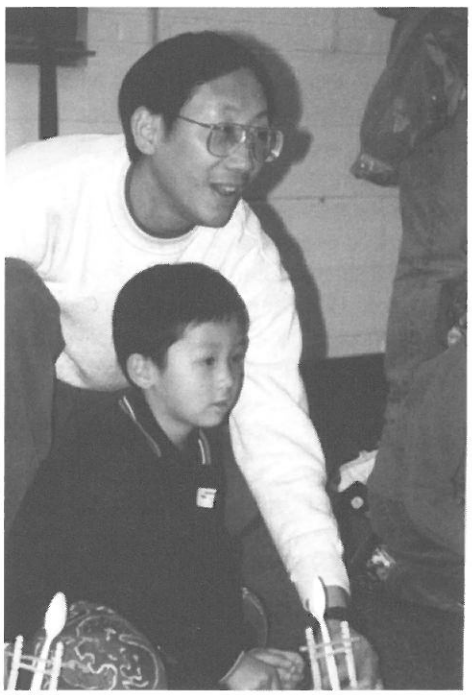
Jeremy Tinker (B.S. Physics and Astronomy 1996) is in the Peace Corps in Ghana, teaching High School level physics and chemistry for the next two years.

Francis Vitt (Ph.D. Physics, 1997), employed by Sterling Software, was promoted in October 1998 to software engineer and relocated from Colorado to Bellevue, Nebraska. He works in the Advanced Weather Systems division on space weather projects such the analysis and prediction of the near-Earth space environment conditions, which are controlled by Sun-Earth interactions. Some of the projects he is involved with include the prediction of currents in electrical power grids induced by auroral and geomagnetic storms, and the analysis of communication satellite disruptions associated with near Earth space environment events.

Brian Wilhite (B.S. physics, 1998) is now a graduate student at the University of Chicago.

Alan Wiseman (B.S. Physics, 1981) is moving from the University of Chicago Relativity Group to the University of Wisconsin-Milwaukee Physics Department. He will be joining the faculty as a Visiting Assistant Professor.

Lin Zhou (Ph.D. 1998) took a postdoctoral research position with Cornell University following his graduation in August of 1998.



Professor Jack Shi and son at the Magic Show learning about atomic energy levels!