
PHYSICS & ASTRONOMY NEWS

*Published for Alumni and Friends of the Department
The University of North Carolina at Chapel Hill*

Winter 2004

Letter From the Chair



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Dear colleagues,

What do you like most about your job? We don't often think of this, beset as we are with more immediate and practical matters, but here in my final year as department chair, I have had occasion to ask this question of myself and to have others ask it of me. My predecessor, Tom Clegg, and my successor, Laurie McNeil, may reach other conclusions, but for me the very best part has been getting to know the faculty and staff much better, both personally and for what motivates them. As an astronomer working in a department of (mostly) physicists, and whose interests span an enormous range of research questions, this has been incredibly stimulating. I have not become expert or even a practitioner in any field beyond my own, but I've been better able to share the excitement and mysteries of my colleagues working in other fields. The intellectual curiosity level here is delicious. And this helps me in other ways, too: it's easier to work on behalf of others when you understand their visions and strengths. As for the staff, I always knew they were good, but I believe it takes a long-term and interactive working relationship with people to understand and appreciate their warmth and dedication. We have wonderful people here, folks, and I'm not alone in my opinions. I have read messages from department graduates who have found conditions elsewhere not as productive and positive. I am sure glad I did not have to leave to find that out, but could enjoy working with them week by week and year by year. So I am very happy that I've had this experience of getting to know my faculty and staff colleagues better, as well as people elsewhere on campus, to realize just what a remarkable place this is. (But between you and me, I am also looking forward to handing it over to Laurie.)

-Bruce Carney

Progress Made on New Science Complex



The view from the Chair's office of construction progress on the Science Complex.

There's a wonderful book by Richard Fariña called "Been Down So Long It Looks Like Up to Me", and the title and the mood of the book seem appropriate to everyone on the south side of Phillips Hall. Rock hammering and dynamiting do disturb one's equilibrium, but at least we are expecting the worst of it to be over soon. The excavation is about a month behind schedule because early dynamite blasts threatened our new Keck Laboratory's transmission electron microscopes, and Lu-Chang Qin was dismayed by their "safe mode" shutdown behavior, which requires a few days to counteract. And Yue Wu's high-field liquid helium-cooled magnet was at risk as well, so the strength of the blasts was reduced to avoid such damage. But while the amplitude of the noise and shock was abated, the integral under the curve promises to be about the same. The figure shows, literally, the "Chair's View" toward Venable Hall on a cold December day. The site is nearing its planned depth of 35 feet, necessary to properly anchor the building and enable good low-vibration laboratory space. Not much parking space left, is there?

And the costs? Well, when the bids were finally opened for the bulk of all the actual construction costs, and guess what? They were over budget, just like the first architect estimates, which were then exceeded by the contractor's estimate, and now

finally trumped by the actual bids. Let's hope there are no more cards to play. The Provost has been a steadfast ally throughout all these difficulties, and the University has once again (this makes three times now), found extra funding to enable us to build the building we need (and its companion next to the Wilson Library for Chemistry, which together constitute Phase I of the Science Complex construction).

So what's next? We expect that the excavation will be completed in March and that construction will begin shortly afterward. By this summer we should see the steel network emerging and about two years from now the building should be ready for occupancy. To remind everyone, there will be four new labs for Professors Qin, Tsui, Superfine, and Washburn, a glass-walled remote observing center on the classroom floor (astronomers in a fishbowl), and an introductory astronomy lab observing deck on the roof. The rest of the space will be occupied by Marine Sciences while Venable Hall is torn down and rebuilt, and by a new Institute for Advanced Materials, including new faculty, postdocs, and students working in a highly interdisciplinary environment. We hope that next year's newsletter has something reaching above ground level to show you.

Robert McMahan named Governor's Science Advisor



Bob McMahan

Bob McMahan, who has been a research faculty member of our department since 1989, has been named Senior Advisor to the Governor for Science and Technology and Executive Director of the North Carolina Board of Science and Technology. He is charged with taking the lead in science and technology policy at the state level. In this position he will serve as liaison between the Governor and the university system in science matters, and will play a similar role with technology Centers of Excellence such as the NC Biotechnology Center. He will work to define the strategic direction for science and technology policy in the state of North Carolina.

Bob's background uniquely suits him for this position. After receiving his BS from Duke in 1982, his Ph.D. in Physics from Dartmouth in 1986, and while a postdoc at the Harvard-Smithsonian Center for Astrophysics, he founded McMahan Research Laboratories. He moved the company to North Carolina in 1989, and sold it to a Swiss-based public corporation ten years later. Bob sub-

sequently became Executive Vice President of Engineering and Research & Development at GretagMacbeth, LLC, and then a Senior Technology Strategist for In-Q-Tel, the private venture capital arm of the CIA. Throughout this time he has maintained his appointment in our department, teaching astronomy and engaging in active research in large-scale motions of elliptical galaxies. These experiences have helped him understand the perspective both of the academic and the business communities.

Bob feels that it is very important that North Carolina have a person who will work persistently on the strategic issues involved in guiding the state's transition from an industrial to a knowledge-based economy. He particularly wants to work on improving the relationship of the university to the entrepreneurial community and to capital markets. He would like to optimize technology transfer and, where possible, to align university resources with the needs of entrepreneurs.

"I have been impressed with the level of engagement on these issues at high levels in the government in North Carolina," says Bob. He is looking forward to the opportunity to help the state "put the pieces together" and remain a leader in a very competitive environment. However, he intends to continue to participate in departmental activities, teaching astronomy and collaborating on research projects with his colleagues here. He says, "I think my appointment is indicative of how our department is perceived at high levels in the state." We are inclined to agree.

New Course on the Physics of Energy

Gerald Cecil has developed a new general education course for the department, "Energy, Sustainability, and Physical Principles." Physics 18 and its associated laboratory section 18L explore energy in its physical, technological, and social manifestations. In the lectures, students come to appreciate that our society expects to maintain its exponential growth, powered by

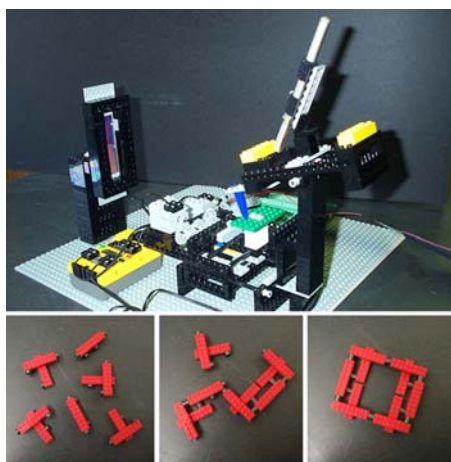
copious consumption of cheap energy. They learn that exponential growth always ends abruptly, that the energy supply is fast being constrained by technological and physical limits, and that prices, first of natural gas and then oil, may climb inexorably to many times their current cost over the next 10 years. The effect could be a profound and rapid change in the way we live, in particular greatly

New Course on the Physics of Energy (cont'd)

constricted mobility and dramatic improvements in energy efficiency. No other class at UNC addresses this fundamental issue on the sustainability of our civilization. Students write a class report that examines quantitatively how effectively another source, such as coal, nuclear fission, and solar (photovoltaic, thermal, and wind) power, can augment rapidly declining oil and natural gas. The feasibility of a “hydrogen economy,” rapid deployment of fusion reactors, and other proposed “technical fixes” are examined in this energy constricted near-future. Labs comprise quantitative

experiments to understand fundamental limits on energy efficiency, conversion between different energy forms, and some technical factors that limit fuel and solar cell performance in the real world. Students maintain a log of their own power consumption, suggest ways to improve their energy efficiency by “powering down,” and examine various lifestyle options for sustainability. The class enrolled 15 students in Fall 2003. We expect that its popularity will grow (as was the case with Physics 16, our “How Things Work” course).

New First-Year Seminar on Nanoscience



Top: Working Lego AFM model built by Brian Fuller, Bottom: Self-Assembling Lego-Magnet structure designed and built by first-year student Jeff Gragnolati

“Hand-crafting at the Nanoscale” is the latest addition to the first-year seminar program in our department. The course aims to introduce first year students to the nascent disciplines of nanoscience

and nanotechnology. Magnets and Velcro™ are used to represent forces between objects. For one model building project, the students were assigned to create a self-assembling system informed by their reading and in-class discussions on nanoscale self-assembly processes. The bottom three panels of the figure show a self-assembling Lego-magnet structure made by student Jeff Gragnolati. The top panel shows another model: the Lego atomic force microscope (AFM). This model helps students understand the AFM’s imaging and manipulation mechanisms and prepares them for real nano-manipulation experiments they perform toward the end of the semester using the nanoManipulator. Through in-class discussion and writing assignments, the students explore a variety of topics including nanomaterials, protein motors, molecular electronics, scanning probe microscopy as well as the coverage of nanotechnology in the popular press. The class discusses and debates the distinction between the genuine scientific and technological promise of this field and the hype and unrealistic fantasies of some nanotech promoters.

and nanotechnology. **Mike Falvo** received a Nanoscience Undergraduate Education grant from the NSF to support development of this course and he is teaching it to 11 students for the first time in Spring 2004 with assistance from graduate student **Brian Fuller**.

In this course, students study the unusual objects and properties of the nanoworld through class discussion, and hands-on activities that include model building projects as well as actual nanoscale experiments using an Atomic Force Microscope. For the model project activities, students construct models from molecular model kits, arts and crafts materials, Lego™ etc. to represent nano-systems

Through this range of learning activities, the course aims to provide the students with a general outline of the relevant scientific questions challenging nanoscience and an informed view of the technological outlook.

Protons and Neutrons Join Forces Upon Ludwig's Retirement



Ed Ludwig standing at left with his returning former doctoral students, from left to right in the order of their graduation: John McQueen, Bill McEver, John Wilkerson, Barry Burks, Roy Fauber, Kurt Fletcher, Tim Black, Mike Wood, and Brian Fisher. Other UNC/TUNL doctoral alumni attending were Jim Bowsher, Stephen Tonsfeldt, Robert Varner, and Kevin Veal.

When departmental nuclear groups' athletic teams have faced off annually for nearly two decades, Ed Ludwig has always led the *protons*' charge. They have challenged the *neutrons* in friendly, highly competitive early summer softball or tennis event that engaged UNC's faculty, post-docs, and graduate students working at the Triangle Universities Nuclear Lab.

Last summer, Ed "was benched" during a revised contest, when his former students and colleagues from both teams gathered to celebrate his retirement from 37 years of active teaching and TUNL research. By the time of his retirement last June after 36 years at UNC, Ed had directed more doctoral students (13) and more masters degree students (17) than any other Physics & Astronomy faculty member. Nine of these students joined a large number of their former TUNL colleagues who returned for the event.

The occasion also coincided conveniently in early June with TUNL's hosting the 250 attendees of Few-Body XVII, the triennial International Few-Body-Physics Conference. Because Ludwig's research long has emphasized the study of nuclear forces in few-nucleon systems, many other former TUNL students and international collaborators from Seattle, Oak Ridge, Los Alamos, Indiana, Lisbon, Tsukuba, Cologne, Pisa,

Erlangen, and Tübingen were all in town. They too gathered with local UNC and TUNL colleagues at the clubhouse of UNC's Faculty-Staff Recreation Association to reminisce and recall together the memorable, and often humorous aspects of Ed's TUNL career.

Proton and neutron team members competed with their stories and recollections of times with Ed and his colleagues at TUNL. John Wilkerson told everyone, for example, that it was Ed, and not he, who had locked the ignition keys inside the running rental car they were using while they were working together on an experiment at Berkeley. Former students revealed during the evening that their team association for the annual *protons vs. neutrons* "grudge" match had not, as the faculty had believed, been chosen randomly. Rather, students organizing annual team membership used "natural selection" to assure that the *protons* largely consisted of those who, like Ed, were always "highly charged" to win, while the 'neutral' *neutrons* usually could not care less whether they won or not.

At least for this one evening, the *protons* and *neutrons* collaborated to assure that Ed was the big winner, and all together enjoyed a catered dinner of substantially finer fare than the usual burgers, hot dogs, and watermelon which caps off the annual athletic event.

Carolyn Cox Retires after 30 Years of Service to the Department



Carolyn Cox

Carolyn Bynum Cox retired after 30 years of service in our Department. Carolyn is a lifelong resident of Goldston, NC. She graduated from J. S. Waters High School and Sanford Business College and worked in the Chatham County School System for five years before coming to UNC. She joined our departmental staff in 1973 as a typist in the Central Office and retired last summer after having served for more than a decade as the Department's Graduate Affairs Coordinator.

In the 1980s, she became our departmental guru overseeing faculty travel advances and reimbursements. When our faculty traveled, Carolyn was responsible for obtaining their cash advances and for the accuracy of their final expense accounting. There is hardly a more troublesome responsibility for a departmental staff member than this one. Faculty are known procrastinators, so they don't always obey the rules. They would rush in on Monday and say, "Carolyn, I'm leaving for a conference in Germany this Friday, and I really need money before I go." Never mind that the University required that such requests be made a month in advance!! Somehow, time after time, Carolyn would use her charm and connections to squeeze the system and get travel money before the guilty party left town. Students and faculty probably became even worse procrastinators because of Carolyn's effectiveness.

A few weeks later the traveler would return with stories of the voyage. And then Carolyn would often wait and wait and wait, for the final recordkeeping of the trip which was required to satisfy the University's auditor. One week, two weeks, sometimes a month would pass, with no records appearing. Carolyn would nudge with reminders, gentle at first, then more and more scolding and stern. Some faculty would finally come through with bits of paper which had a few numbers scrawled on them and were, for example, reputed receipts from some German Gasthof. Carolyn laborously figured out on what day the expense occurred, converted the figures to US dollars, and made all the receipts justify what the traveler said was spent.

But, there were the regular few forgetful faculty who would never respond to Carolyn's pleading and scolding. For them, there was only one solution. Carolyn kept a big red plastic bat in her office, and when it was really needed, she would pull it out and charge into the faculty member's office and demand accounting for the trip which had faded from the faculty member's memory. Few needed to be subjected to that treatment more than once.

Carolyn's later duties included dealing with all the problems graduate students could generate (and there are many). In addition to whatever was in her formal job description Carolyn advised graduate students on many issues of life (and love), sharing her wisdom and compassion with those in need. She also coordinated our graduate admission process, corresponding with hundreds of applicants each year, arranging for campus visits of prospective graduate students, and serving as a contact person for all those with questions and problems.

Upon her retirement Carolyn is looking forward to traveling, relaxing, returning to Shaw Divinity School, ministering to the sick and shut-in persons in nursing homes and caring for her ninety-seven year old mother.

New Faculty and Staff



Laura Mersini

We are delighted to announce that we have hired a new assistant professor, **Laura Mersini**. Laura comes to us from Syracuse University, where she has been a postdoc. Her undergraduate degree is from the Univ. of Tirana in her native Albania, and she was awarded a PhD in 2000 by the Univ. of Wisconsin-Milwaukee. She is a theoretical cosmologist, interested in inflation, gravity and quantum fields in curved space, the nature of dark energy, string-inspired models of the cosmos, higher-dimension braneworlds, and transplanckian physics. Laura's arrival marks the beginning of a planned enhancement of our theoretical physics efforts, an effort that will continue for several years with the addition of several more new colleagues.

We should note that it is a sign of the times that although Laura was offered, and accepted, a tenure-track assistant professor position; due to visa complexities we have had to appoint her temporarily as a visiting assistant professor while we work out a new visa for her. (This problem is not confined to new faculty. One of our graduate students has been trapped in her native Spain for three months after a visit home, and another is stuck in China.)



Sherril Bowman

Sherril Bowman is our new Research Services Administrator, in charge of proposal facilitation and visa assistance for international scholars. She replaces Matthew Sears, who departed to become a public school teacher. Sherril holds a business degree from the Univ. of Arkansas at Fayetteville, and has strong interests in environmental issues. These interests lead her to spend her free time doing environmental volunteer work - creek monitoring, invasive plant removal, trail maintenance and everyone's favorite — picking up trash.



Dan Bock

Dan Bock has taken over for Carolyn Cox as Graduate Admissions Coordinator. A native of Cambridge, MA (where his mother is a city councilor and his father is an Emmy award-winning sound engineer), he still roots for the Red Sox and the Patriots. He has been a chess buff since his high school days on the chess team, and still plays competitively. He graduated from the University of Rochester in Economics, and was photography editor and news editor for the campus paper. Photography continues to interest him. Before coming to UNC he opened a coffee-house in Canton, OH with a friend and worked as a substitute teacher in Chapel Hill.

Student Goings and Comings

In May and December 2003 we sent a new flock of physics graduates out into the world. Of our A.B. graduates, **Anne Catherine Kruger** is at Woods Hole studying marine science, and **Courtney Pinard** is applying to graduate schools in neuroscience. Our B.S. graduates are also going in interesting directions. **Ken Varner** and **Deborah Sill** have gone the farthest afield: Ken is



Ken Varner

spending the year in Spain doing solar cell research (as noted elsewhere in this newsletter). Deborah is in Zurich working for a railway engineering firm that develops and tests safety standards. She will soon move to Berlin to begin an internship with the German Par-

Student Goings and Comings

liament and attend a semester at Humboldt University. She hopes to enter a graduate program in the history of science and science, technology and society in the fall. **Adam Crain** and **Matt Bayliss** are working here in our department with Chris Clemens (they will go to SOAR in Chile to support the commissioning of Chris' spectrometer in early summer) while waiting to hear from graduate schools. **Eric Olshan** has entered law school at Northwestern, **Jeff Milbourne** is pursuing a graduate degree at the UNC School of Education, **John Hobach** is working in a family business in Florida, and **Elaine Monbureau** is still here in Carrboro considering her options.

All of this year's M.S. graduates are pursuing PhD degrees here in our department. **Zejian Liu** and **Gongpu Zhao** are continuing to work with Lu-Chang Qin, as is **Yuanyuan Jia** with Yue Wu and **Guang Yang** with Otto Zhou. **Haken Deniz** is also continuing for his PhD, but is shifting to a different physics research field after completing his work with Rich Superfine.

Most of our PhD graduates have taken postdoctoral appointments. **Konstantin Bobkov** is in tomography at the Duke Medical School, **Alena Lieto** is at the Boston Biomedical Research Institute, **Les Fleming** is with the Army Research Office, **Doug Leonard** is at the Univ. of Alabama, **Mark Hannam** is at the Univ. of Texas at Brownsville, **Brian Fisher** is at NIST (though employed by Tulane), **Carrie Rowland** is at the Naval Research Laboratories, **Robert Runkle** is at

Pacific Northwest Laboratories, **Myoung Oh** is at Seoul National University, and **Calin Buia** has stayed close to home to work in our department with Paul Tiesinga. Others have taken faculty positions: **Kristi Concannon** is at King's College in PA, **James Dunn** is at Hampden-Sydney College in VA, and **Helio Leal** is at Appalachian State Univ. here in NC. **Gautam Trivedi** has bucked the trend and taken a job at a computer company in MA.

The Department welcomed seventeen new highly qualified graduate students last August. Fifteen received their undergraduate training in the US, at schools ranging from Tufts to North Texas, while new foreign students arrived from the University of Minnesota, New Mexico State, Bates College, and the Technische Universität in Graz, Austria.

A larger fraction of our newcomers garnered special awards this year than in any year in recent memory. Among them, **Jennifer Murray** of Florida State won a national multi-year Homeland Security Fellowship, and **Ben Evans** of Rhodes College was awarded one of the UNC Graduate School's competitive Merit Assistantships. Both **Vincent Touns** of LSU and **Brian Collins** of Gustavus Adolphus College received UNC Board of Governors' Awards, while **Chris Angell** from Georgia Tech received a Scholar of Tomorrow Fellowship from the UNC Graduate School. **Chris Lawyer** of Florida A&M holds an NSF Alliance for Graduate Education and the Professoriate (AGEP) Fellowship.

Faculty, Student and Staff Honors and Awards



Sean Washburn

The University gave well-deserved recognition to two of our faculty members this year by awarding them named professorships. **Sean Washburn** has been named Cary Boshamer Professor, a chair that was endowed by a member of the class of 1917 who later became a Trustee of the university. Mr. Boshamer was known as an aggressive tackle when he played on the football



Otto Zhou

team. **Otto Zhou** has been awarded a Lyle V. Jones professorship (which Sean formerly held), one of a number of professorships endowed by Margaret and Paul A. Johnston (class of 1950). The professorships are named for distinguished retired members of the faculty, in this case a professor of psychology.

Faculty, Student and Staff Honors and Awards (cont'd)

Others of our faculty have received a timely and well-deserved enhancement in their status. **Chris Clemens** and **Dmitri Khveshchenko** have been promoted to Associate Professor, with tenure, and **Yue Wu** has been promoted to Professor.

Louise Dolan has been selected to receive the Wellesley College Alumnae Achievement Award for 2004, an award that recognizes alumnae who have brought honor to themselves and to Wellesley College through their outstanding achievements. It is the the highest honor given to alumnae for excellence and distinction in their fields of endeavor. Previous recipients include Hillary Rodham Clinton, Madeleine Albright, NPR journalist Cokie Roberts, and opera singer Phyllis Curtin. Louise entered this distinguished company when the award was presented February 20, 2004.

Astronomer **Dan Reichart** has had a very good year. He won one of the nation's most prestigious astronomy honors, the Robert J. Trumpler Award of the Astronomical Society of the Pacific. This award is made to a recent Ph.D. degree recipient whose research is considered unusually important to astronomy. It recognizes his thesis, "which significantly enhanced knowledge in the field of gamma ray bursts and opened up important new areas of research," according to the Society. Previously, this thesis won the Carl Sagan Outstanding Teacher Award at the University of Chicago. As if that weren't enough, Dan also won the 2003 Ernest F. Fullam Award of Dudley Observatory, the purpose of which is "to provide encouragement and support for an innovative research project in astronomy or astrophysics." Dan's project involves three fully-automated, robotic telescopes that will chase gamma-ray bursts (GRBs) at the Pisgah Astronomical Research Institute (PARI), a not-for-profit radio and optical observatory in the western mountains of North Carolina (<http://www.pari.edu>).

Paul Frampton was honored recently at the Coral Gables Conference in High Energy Physics



Gerard 'tHooft, Sheldon Glashow, and Paul Frampton

and Cosmology. The meeting was held this past December, and the first two days were dedicated to Paul's contributions in honor of his 60th birthday. The conference was well attended, and included three Nobel Laureates (Sheldon Glashow, Gerard 'tHooft, and Martinus Veltman) whom Paul knows well. Speakers included Paul's former postdoc and frequent collaborator Tom Kephart (Vanderbilt), UNC colleague Y. Jack Ng, Alan Guth (MIT), Pham Quang Hung (UVA-Charlottesville), Holger Nielsen (Niels Bohr Institute, Copenhagen) and Mark Wise (Caltech). Two of Paul's former students attended:



Duane Deardorff

Marcelo Ubriaco from Puerto Rico and Otto Kong from Taiwan; and former postdocs Osamu Yasuda and Tadashi Yoshikawa made the trip from Japan.

Our teaching efforts have also achieved recognition. At the summer meeting of the American Association of Physics Teachers in Madison, WI, Director of Undergraduate Laboratories **Duane Deardorff** displayed a simple manometer for measuring lung pressure, and it received one of 4 awards for the Low-Cost Apparatus Competition. Duane has added this device to our demonstration equipment, noting that it is of particular interest to the many life science students who take introductory physics.

Within the university, other faculty have been making their mark. **Dmitri Khveshchenko** has been awarded one of the 2003 Phillip and Ruth

Faculty and Student and Staff Honors and Awards

Hettleman Prizes for scholarly achievements by young faculty at UNC.

Our students have also been widely recognized. Undergraduate physics major **Joshua Carter** won a Goldwater Scholarship, a highly competitive and prestigious scholarship that goes to outstanding sophomores and juniors, “to encourage outstanding students to pursue careers in mathematics, the natural sciences, or engineering and to foster excellence in those fields.” No more than 300 of these are awarded nationally each year, and Josh is one of three UNC winners. **Ken Varner** was inducted into the Order of the Golden Fleece and the Order of the Grail-Valkyries. These undergraduate-run honor societies recognize individuals who have made long-lasting and extraordinary contributions to the University community and academic climate through excellence in scholarship, dynamic leadership, and innovative service. To top his year off, Ken was selected as one of three Leonard M. Rieser Science, Technology, and Global Security Fellows for 2003. The fellowship is administered out of the Bulletin of Atomic Scientists and is funded by the Educational Foundation for Nuclear Science. The fellowship will fund his research on “New concepts in high efficiency industrial solar cells” during this academic year at the Solar Energy Institute of Madrid, Spain.

Senior undergraduate major **John Hobach** won both our Paul E. Shearin Outstanding Senior Award, given to the senior majoring in physics who is most outstanding on the criteria of scholarship, scientific insight and professional seriousness; and the Archibald Henderson Prize in Mathematics, given to the UNC undergraduate with a high degree of mathematical ability and the greatest promise of originality in the field.

Undergraduate majors **Craig Baden**, **Joshua Carter**, **David Doll**, and **Stephen Weinman** were

among the 96 students inducted into Φ BK in April 2003, and **Vadas Gintautas** and **Matthew V. Greco** were inducted in November 2003. The requirement for inductance is that seniors must have a quality point average of at least 3.750. Note that a grade of A- earns 3.7 quality points, so these requirements represent outstanding achievement. Only 1% of Carolina juniors and seniors receive this honor every year.



Celeste Yeates

Undergraduates were not the only students who were recognized for their excellence. Graduate student **Celeste Yeates** was selected by the faculty as the winner of the 2003 Outstanding TA award. Celeste was honored for her excellent work as an Astronomy 31 TA. She gave birth to a baby boy within days of being selected for this honor.



Mercedes Lopez Morales

Graduate student **Mercedes Lopez Morales** has won a Society of Fellows Dissertation Completion Fellowship for 2003-2004. These fellowships support the most promising doctoral candidates at the University of North Carolina at Chapel Hill in the final phase of completing their dissertations. Some students also received recognition by organizations outside the university: **Lorenza Levy** garnered a new 3-year Harriet G. Jenkins pre-doctoral fellowship from NASA, **Yuan Cheng** won the first prize in a regional health physics meeting in the summer with a cash award for his research on field emission x-ray, and **Les Fleming** won a National Research Council postdoctoral fellowship.

Our staff were not overlooked, either. Our System Administrator **Stephen Joyce** won a 2003 IT Award for “outstanding information technology support.”

Faculty and Student Activities and Accomplishments



Frank Tsui

As usual, our faculty have been busy, and their work has received outside attention. **Frank Tsui**'s work on a novel Ge-based magnetic heterojunction diode was highlighted by the Materials Research Society in the September 2003 issue of *MRS Bulletin*. The work described there was published in *Applied Physics Letters* in August. Frank also co-organized the 2nd Japan-US Workshop on Combinatorial Materials Science and Technology held in December 2002, and was the Editor for the Proceedings that were published in *Applied Surface Science*.

Other members of the condensed matter physics group have received external recognition for their work, but of another kind. **Otto Zhou** and **Jian Ping Lu** were issued an U.S. Patent on the new field emission x-ray technology that they have developed, which is based on carbon nanotubes. And the work that **Jie Tang** (adjunct faculty and visitor from the National Institute of Materials Science in Japan) has performed at UNC, in which she fabricated CNT fibrils by dielectrophoresis, was widely reported in the newspapers in Japan and published in *Advanced Materials*.

The work of other faculty members has also been noted in the popular press. Research by **Jack Ng**, **Wayne Christiansen**, and **Henk van Dam** on quantum gravity physics, published in *Astrophysical Journal Letters* in July 2003, was previewed in *The Economist* magazine (UK) in March and in the German newspaper *Frankfurter Allgemeine Sonntagszeitung* in April. Unfortunately, only Jack's name was mentioned in the article in *The Economist*, and the reporter mistook 10^{15} (a thousand trillion) as a million. Wayne, Henk

and Jack concluded that the Hubble Space Telescope observation cannot be used to rule out Planck-scale physics in quantum gravity. This story was subsequently hailed as one of the top 100 science stories of 2003 by *Discover* magazine, and was featured on the cover of the January 2004 issue.

We also note that one should never throw away one's dissertation, because it may find some use somewhere someday. After gathering dust on a shelf for twenty-eight years, a portion of **Jack Ng**'s Ph.D. thesis that dealt with polarized electron-electron scattering was used in the recent Moller Asymmetry Probe experiment at Stanford Linear Accelerator Center to measure parity violation in Moller scattering, thereby measuring accurately the weak (i.e. Weinberg) angle in electroweak unification.

Bruce Carney has been elected chair of the Board of Directors of the International Gemini Observatory, a seven-nation partnership that operates two 8-meter telescopes, one in Chile and one in Hawaii. This means more frequent flyer miles for Bruce. He is also now the Vice President of the SOAR Telescope Board of Directors (see elsewhere in this newsletter for an update on SOAR).

Russell Taylor has been invited to be a visiting professor at the University of Hamburg in the Faculty of Informatics from March through July. He will be teaching a course on "Visualization and Experiment Control for nanoManipulation" and leading student research projects to develop new techniques.

We are at an exciting time when precision measurements, sophisticated computation and theory from the basic sciences can have profound impact on biomedical science. **Rich Superfine**, together with researchers from Applied Mathematics, Computer Science, Chemistry, Biochemistry and Biophysics, and the Cystic Fibrosis Center as well as

Activities and Accomplishments (cont.)

our own department, have formed the *Virtual Lung Project*. Their goal is to integrate theory, computation and experiment to create a comprehensive simulation of a basic function of the lung, the clearance of infecting bacteria. The failure of cilia-induced fluid flow in the lungs happens in genetic diseases such as Cystic Fibrosis, and in lungs damaged from smoking or pollutants. The consequences are deadly. It is a fascinating problem that includes challenges ranging from the hydrodynamics of thick viscous fluids, polymer theory, single molecule measurements of molecular motors, and mathematical modeling of biochemical feedback loops. It is all part of a new field called Systems Biology, and someday soon they hope to be able to test new drugs and therapies out in the computer to predict what will work best in the patient.

Adjunct faculty member **Richard Hammond** chaired a session in Alternate Theories of Gravity at the Tenth Marcel Grossman meeting in Rio de Janeiro in July 2003, and gave invited presentations at the Ultrahigh & High Intensity Laser Workshop held in June at the University of Michigan and the Optical Society of America's Topical Group on Wave in Random and Periodic Media in Tucson in October.

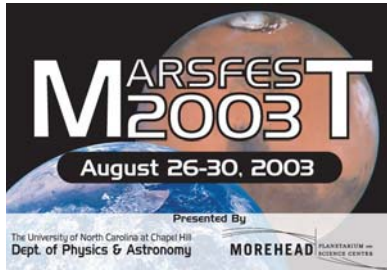
Our students are also engaged in new adventures. Twelve UNC students are participating this year in the TransAtlantic Science Student Exchange Program (TASSEP), which sends undergraduate science students to study abroad (mostly in Europe). This is more than any other US university is sending. Of these, four are physics majors. **David Doll** and **Nathan Wilson** are at Université Joseph Fourier in Grenoble, France; **David Moschler** is at the University of Glasgow, where

he is studying both physics and music (he is majoring in both); and (as noted above) **Ken Varner** is at the Solar Energy Institute of Madrid, Spain.

Undergraduate **Charles Olbert** was the first author on a paper published in *Astrophysical Journal Letters* in July 2003. His co-authors were adjunct faculty member (and former North Carolina School of Science and Mathematics teacher) **Jonathan Keohane** and scientists from Cal Tech, Goddard Space Flight Center, NRAO, NCSU, and the Univ. of Manitoba. Five of our undergraduate students gave presentations at the annual campus Celebration of Undergraduate Research in April 2003. They were **Ben Wilde** (a Computer Science student working with Rich Superfine), **Vadas Gintautas**, **Rohit Prakash**, **David Moschler**, and **Courtney Pinard**. Their topics ranged from three-dimensional atomic force microscopes to diffraction analysis of fine powders to biological application of carbon nanotubes to stellar spectra to cortical neurons.

The accomplishments of our students do not stop at the undergraduate level. **Jenny Xue** and **Asiri Ediriwickrema**, rising seniors at North Carolina School of Science and Math in Durham, worked with Jon Engel this past June and July to understand whether and how the heaviest elements are made in supernova explosions. They used a network code to simulate nucleosynthesis, examining how the final distribution of elements depended on a few key reaction rates. Jenny and Asiri presented their results as a poster at a special session for undergraduates at the APS Division of Nuclear Physics meeting in Tucson in October. Of the many students at the session, they were the only ones still in high school.

MARSFEST Event Draws Media Attention



In August 2003 our department teamed up with the Morehead Planetarium and Science Center and local amateur astronomy groups to allow the community to view Mars at its closest point to the Earth in 60,000 years. The Morehead 24-inch telescope was opened up and pointed toward the red planet for 5 consecutive nights, allowing over 700 curious citizens to view such features as the polar ice caps and dark surface regions. For all those who could not obtain a free ticket up to the dome, members of the Chapel Hill Astronomical and Observational Society (CHAOS) and the Raleigh Astronomy Club (RAC) had smaller telescopes set up near the sundial in front of the planetarium, where people waited patiently in 30-minute lines to catch a glimpse of the planet. In addition, the Morehead

planetarium and science center ran special programs highlighting Mars every night.

The week-long MARSFEST event was shown on the local affiliates of NBC, CBS, and ABC news, and stories were printed in the *News & Observer*, *Herald Sun*, *Chapel Hill News*, and *Daily Tar Heel* newspapers. Visitors were all very pleased at the opportunity to view Mars at Morehead, and they were equally impressed by the SOAR remote observing room, which was opened for tours throughout the week. The great success of the MARSFEST was only possible because of the help of so many students and faculty. Over 16 graduate and undergraduate students and 6 astronomy faculty members volunteered their time to help out, along with over a dozen amateur astronomers and numerous volunteers from the Planetarium and Science Center. Mars won't be this close to the Earth again for another 284 years... hopefully MARSFEST 2287 will be as successful as MARSFEST 2003!

KamLAND at UNC

Roger Wendell, a graduate student 2/26/04

While $10^{15} \text{m}^{-2} \text{s}^{-1}$ neutrinos pass through each one of us, most of which lack the common courtesy to stop and interact, many wonder about the utility in studying these standard model wallflowers. Indeed the purpose of the KamLAND detector is to bring the strange properties of these particles into the limelight by studying the antineutrino output from 20 Japanese nuclear reactors. Because antineutrinos interact so rarely, rejecting competing backgrounds is important for observing these reactions, and is the primary focus of TUNL physicists. More than simple rejection, we are interested in position information of passing muons to provide tight limits on the possibility of spurious signals from spallation neutrons. KamLAND's water Cerenkov veto detector allows for high tagging efficiency using a small number of phototubes by sectioning groups of these detectors in volumes bounded by reflective Tyvek®

surfaces. However, with the possibility of multiple photon reflections, one loses concrete information about the position of the photon at creation by the time it reaches a phototube. Our recent work focuses on studying the veto efficiency with Monte Carlo simulation, and writing algorithms to track background muons using real and simulated data.

To get these real data, each collaborator takes shifts, which result in a 12-hour travel experience across the Pacific for residents of NC. Of course, the opportunity to speak and learn Japanese abounds as 30% of our collaboration is Japanese, and shifts are taken in the confines of a control room beneath 1km of limestone in a decommissioned Japanese zinc mine. This, together with a diet of bento, sushi and ramen, allowed physicists toiling over careful analysis to confirm the Large Mixing Angle solution to the solar neutrino problem.

Opening Our Eyes on the Universe



The final stages of construction of SOAR: the primary mirror in its supporting cell (with 120 activate supports). The arrival of the first (of several) trucks carrying the optics and support structures at the SOAR dome.

In the late 1980s, as Morris Davis was retiring, Wayne Christiansen and Bruce Carney hatched an insane scheme that UNC should build a world-class telescope to study the southern hemisphere. It turned out that (a) they were not the only crazy people in the world; and (b) that maybe they weren't so crazy after all. The US National Optical Astronomy Observatory joined UNC's effort early on, and we were later joined by the CNPq, the Brazilian equivalent of NSF, and by Michigan State University. If we weren't crazy when the project began, our wits steadily unraveled as the budget climbed and the delays in the polishing of the optics stretched into years. But now the end of construction and the beginning of science are near: the primary, secondary, and tertiary mirrors, plus their support structures and associated electronics, reached the summit of Cerro Pachon on January 12, 2004. By the time you read this, the telescope will be completely assembled, with "first light" in early March. We will be watching through webcams inside the dome. Commissioning will start shortly thereafter, including trials of our temporary remote observing room over at Morehead Observatory. We hope to begin at least partial routine science observations by this fall. And oh yes, we plan a party: the

formal dedication will be on Saturday, April 17, and will probably be webcast. A special "pre-dedication" for UNC only will be held at the Morehead Planetarium on Friday, April 16. As a reminder, UNC will receive 61 nights of observing time per year. Stay tuned using www.soartelelescope.org.

Meanwhile, on another continent, the Southern African Large Telescope is progressing on schedule. Eighteen of the 96 segments that will constitute the 11-meter primary mirror have arrived, and the building and telescope support structure are essentially complete. You can follow progress at www.salt.ac.za. A party this year for SOAR and, we hope, a party for SALT the following year. We will receive 9 or 10 nights of observing per year on SALT when regular operations begin, perhaps in 2006.

Finally, turning our attention back to Chile, we will soon begin construction of an array of small robotic telescopes whose primary purpose will be rapid photometric studies of gamma-ray bursts. Collectively referred to as PROMPT (the Prompt Remote Optical Monitoring Photometric Telescopes), they should be able to receive signals from the new gamma-ray burst satellite SWIFT directly, and without our intervention, be on target and estimating photometric redshifts within tens of seconds. The most interesting bursts will turn SOAR into a "target of opportunity" telescope as we quickly bring the imagers and spectrographs to bear on some of the most luminous and most distant objects in the Universe, but which remain bright enough for such study only briefly. When not following GRBs or supernovae, PROMPT will be undertaking more normal research programs, including synoptic observations of eclipsing or pulsating stars. The remote observing center in the new building now under construction should become a very busy and exciting place!

Author Bob Park visits UNC

On April 21, Dr. Robert Park visited our department. Dr. Park is a Professor of Physics at the University of Maryland, and is also the head of the Office of Public Affairs of the American Physical Society. In that capacity, he monitors government affairs related to science, and writes the frequently-controversial electronic column “What’s New” (www.aps.org/WN). He is the author of the book *Voodoo Science*, which was used as the primary textbook for a First-Year Seminar entitled “You Don’t Have to Be a Rocket Scientist,” taught by

Prof. Ed Samulski of the Chemistry Department. Prof. Park participated in a brown-bag lunch in the Dept. of Physics and Astronomy, and attended Prof. Samulski’s class and held discussions with the students. In the evening he gave a public lecture, “The Seven Warning Signs of Voodoo Science.” The lecture was well attended by members of both the University community and the public at large (including a few people who appeared to be believers in voodoo science!).

Astronomer Vera Rubin Visits UNC



NGC 4650A, observed by the Hubble Space Telescope. Note the nearly orthogonal rotating disks.

Image courtesy of NASA and the Space Telescope Science Institute.

Dr. Vera Rubin of the Carnegie Institution of Washington visited the Department and the University November 17 and 18 of 2003. Vera is best known for her work on the rotation curves of disk galaxies and her observations that they don’t show “Keplerian fall off” at large radii, which implies galactic masses increasing with radius despite the lack of any evidence of such behavior from the luminous matter. In other words, her work pointed to the existence of dark matter. She has been honored many times and in many ways, including the award of the Medal of Science by President Clinton in 1993, the Gold Medal of the British Royal Astronomical Society

(the first woman so honored since Caroline Herschel in 1828), and election to the elite Pontifical Academy of Sciences. Her visit proved to students, faculty, and the general public that she is also a warm and wonderful person.

Vera stayed very busy here. On Monday she met with a “Women in Science” class taught through the Curriculum in Women’s Studies, had lunch with our graduate students, and gave the Department’s regular colloquium. On Tuesday she visited the Business School for a videoconference with students at four high schools scattered around the state, had lunch with the Senior Associate Dean for Science and members of his Women in Science committee, enjoyed tea and cookies with the Department’s undergraduate and graduate students, and capped off her visit that evening with the Chancellor’s Science Lecture on “Bright Beacons and Dark Mysteries of the Universe”. Despite mediocre weather and being held on a weeknight, Hill Hall was almost full, meaning the audience included at least five hundred people. She answered many questions after her talk, and the visibility of physics and astronomy (and the Department thereof) was raised considerably.

All the comments during and following her visit were enthusiastic, and as a consequence of the Tuesday lunch, the Dean’s office may take some concrete pro-active actions on behalf of increasing the number of women faculty members in the sciences.

Undergraduate Students Contribute to New Stellar Library

Jim Rose has been involved in a long-term Indo-US collaboration that recently completed work on an unprecedented database of stellar spectra using the Coude Feed telescope at the Kitt Peak National Observatory outside Tucson, AZ. This multi-year collaboration, involving astronomers at UNC, at the National Optical Astronomy Observatory (NOAO), and at the Inter-University Center for Astronomy and Astrophysics in Pune, India and the University of Delhia in Delhi, India, has been designed to provide a unique “library” of the spectra of stars, covering a large range in wavelength at good spectral resolution. Altogether, they acquired nearly 7000 spectra of 1273 individual stars. These spectra can be used as templates, or building blocks, in studies of the evolution of galaxies, as well as for many other purposes. Thus this spectral library,

which has been made publicly available in an archive at NOAO, should be a major asset to the astronomical community for many years to come. A large amount of the actual observing for the project was carried out by 6 UNC graduate students and 3 UNC undergraduate students. In fact, the last two observing runs that resulted in the completion of the spectral library were carried out by UNC undergraduate students **Lauren Johnson**, **David Moschler**, and **Jesse Richuso**, who carried out most of these observations on their own. A paper describing the spectral database has been accepted for publication in the June issue of the *Astrophysical Journal Supplements*. All of the spectra, and information about them, are now publicly available at the URL: <http://www.noao.edu/cflib>

Physics and Astronomy News

Published for the Friends and Alumni of the Department
The University of North Carolina

Winter 2003

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