



A note from the chair

After a very long journey, we are finally reaching the Promised Land of new laboratory and teaching space. Chapman Hall was dedicated on Nov. 18 with donor Max Chapman, Jr. in attendance. Located south of Phillips Hall where a parking lot used to be, it houses physics labs in low-vibration space in the sub-basement, an astronomy

remote observing room on the ground floor, and a rooftop deck for astronomy instruction. We share this lovely building with the Institute for Advanced Materials and the Department of Marine Sciences, and will gain additional space in it in a few years when a replacement for Venable Hall is built. So even those of us now suffering from “lab envy” can hope

for modern accommodations someday. Everywhere the halls are alive with the sounds of learning and discovery. Our enrollments are up, we have new colleagues and new research activities, and we are making efforts to enhance our introductory physics teaching. It’s a great time to be a member of this department!



Professor Laurie McNeil, department chair since 2004.

Nanotechnology cancer center awarded \$20 M

The National Cancer Institute has awarded UNC-Chapel Hill \$20 million to establish an interdisciplinary center for the study of nanotechnology in cancer research and treatment. The new Carolina Center of Cancer Nanotechnology Excellence, based in the Lineberger Comprehensive Cancer Center, will involve faculty in arts and sciences and medicine. The

program, one of seven institutions nationwide in the NCI Alliance for Nanotechnology in Cancer, will harness emerging developments in nanotechnology to improve cancer diagnostics, imaging and therapy and create new jobs in North Carolina.

The center has 6 main research projects. Five of those are led by faculty members

in the College of Arts and sciences. Otto Zhou leads a research team of 8 faculty members including Jianping Lu and colleagues from Radiology, Radiation Oncology, Cancer Biology and Biomedical Engineering to develop a carbon nanotube based field emission x-ray technology for early detection of cancer and for cancer treatment. The new

instrumentation under development including stationary micro-computed tomography scanner for in vivo imaging of small animal models for cancer research, digital tomosynthesis scanner for early detection of human breast cancer, and image guided radiation therapy system for small animals.

Virtual lung project awarded \$3.7 M

The Virtual Lung Project is a collaboration between 15 senior investigators at UNC to create a quantitative model of how the lung clears pathogens such as bacteria and viruses. Richard Superfine is

the principal investigator on the new 5-year, \$3.7 million grant awarded this summer by the NIH for the project. Key to the success of the project is understanding how cilia, 7-micron-long projections from the

lung cell layer, beat to produce fluid flow in the thin layer of viscoelastic mucus that lines the lung. Work in the Physics and Astronomy department includes measuring the forces exerted by individual cilia in

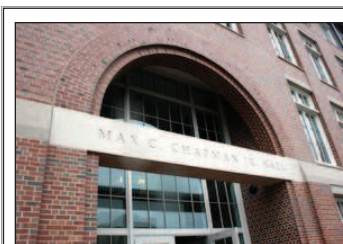
living cell cultures, measuring the fluid flow generated by beating cilia and understanding the complex viscoelastic properties of mucus.



Inside

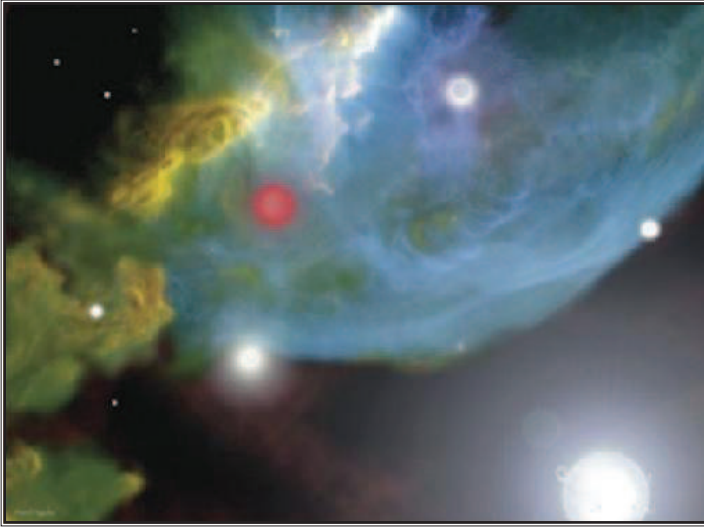
How Foamy is Spacetime
from Professor Jack Ng, page 2

Management Award
Donna Braxton, page 4



Max C. Chapman Jr. Hall, part of the Carolina Physical Science Complex, opened its doors this fall. Chapman Hall has classrooms and labs for science departments including physics and astronomy.

Distant Burst Detected



Gamma Ray Burst

Dr. Daniel Reichart of UNC along with students Josh Haislip, Melissa Nysewander, Chelsea MacLeod, and Justin Kirschbrown discovered the most distant explosion yet known, a gamma-ray burst from the edge of the visible universe, using NASA's Swift satellite and UNC's SOAR and PROMPT telescopes. This powerful burst was detected September 4, 2005 and marks the death of a massive star and the birth of a black hole. It comes from an era soon after stars and galaxies first formed, about 900 million years after

the Big Bang.

Reichart's findings appeared in *Nature* in March. Scientists measure cosmic distances via redshift, the extent to which light is "shifted" toward the red, or lower-energy, part of the electromagnetic spectrum during the light's long journey across the universe. The greater the distance, the higher the redshift. The September 4 burst, named GRB 050904, has a redshift of 6.29, which translates to a distance of 12.8 billion light-years from Earth. The universe is thought to be 13.7 billion years old.

How Foamy is Spacetime?

Maybe not as foamy as some scientists thought, as a fresh look at a quasar first observed in 1998 by the Hubble Space Telescope (HST) shows. The idea that space is composed of ever-changing arrangements of bubbles, called spacetime foam, dates back to the 1960s. On a small (Planck) scale, foamy bubbles result from the uncertainty principle. Further, many physicists believe that some model of quantum foam must exist in any theory of quantum gravity, which unites quantum mechanics and general relativity. "The detection of spacetime foam will give us a glimpse of the ultimate structure of spacetime," said UNC Physics and Astronomy professor Y.

Jack Ng. "The observational results may also point physicists to the correct theory of quantum gravity."

Ng and his colleagues, W.A. Christiansen and H. Van Dam compared two spacetime foam models known as the holographic model and the random-walk model. The former model enables a less-turbulent spacetime while the latter model involves greater fluctuations. The team chose to analyze the quasar-like object PKS1413 + 135 to search for an Airy ring because the presence of a ring limits the amount of light scattering that could be caused by spacetime foam. The quasar is about 4 billion light years away from the Milky Way, allowing the physicists

to accumulate the tiny effects of the fluctuations over a huge distance. The HST's high-resolution image of the Airy ring surrounding the quasar ruled out the random-walk model, but lacked sufficient resolution to test the holographic model. Telescopes currently being built could capture even higher-resolution images for future studies. "In the next few years, interferometers - such as the Very Large Telescope Interferometer in Chile - could test the holographic model by observing more-distant quasars with their large apertures and long baselines," said Christiansen.

However, observationally ruling out the random-walk model, coupled with restrictions from computational phys-

ics, already has repercussions on the matter of spacetime. Because ordinary matter only contains an amount of information dense enough to map out spacetime at a level consistent with the random-walk model, the physicists' work strongly hints at the existence of dark matter and dark energy, independent of the evidence from recent cosmological observations.

Related news: Spacetime foam is linked to the physics of black holes and quantum computation. The article "Black Hole Computers" by Ng and S. Lloyd of MIT will appear in *Scientific American's* special edition on black holes, on sale in March 2007.

New Faculty

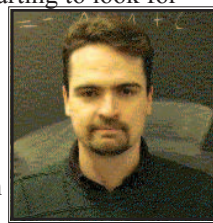
The Department of Physics and Astronomy and the Institute for Advanced Materials are pleased to welcome a new fac-



Professor René López

ulty member, **Dr. René López**, who began his appointment this past July. Dr. López's research interests include the interaction of light with matter and more specifically the optical properties of smart materials. One of his goals is to develop a strong research group in the area of Nanoscale Optical Materials and in doing

so, he is starting to look for students who share his interests and desire to join him in this scientific effort.



Professor Reyco Henning

Dr. Reyco Henning just arrived in

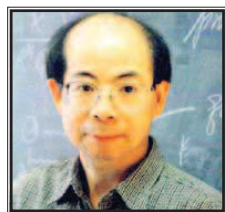
Chapel Hill this January to join our Department as an Assistant Professor. His research involves experiments that probe the fundamental properties of matter and its origins by searching for rare and exotic processes, in particular the direct detection of WIMP dark matter and neutrinoless double-beta decay.

Professors win prestigious awards



Professor Chris Clemens, Hettleman Prize recipient

- » Chris Clemens received the 2005 Phillip and Ruth Hettleman Prize for Artistic and Scholarly Achievement by Young Faculty on Sept. 16, 2006.
- » Associate professor Clemens was recognized for his work with SOAR and his ability to design state-of-the-art instruments with a modest budget.
- » Clemens has been a member of the faculty since 1998 and is the director of the Goodman Laboratory.



Professor Jack Ng, William C. Friday Award recipient

- » Jack Ng received the William C. Friday/Class of 1986 Award for Excellence in Teaching.
- » Professor Ng was recognized for his teaching style distinguished by clarity, thoroughness and humor.
- » “What I liked most about his class was the way he integrated stories and anecdotes about physicists into his lectures...making things a lot more interesting,” a student said of Ng.

John Hernandez retires after 40 years

Professor John . Hernandez retired in 2006 after 40 years of service in the Physics and Astronomy Department. Hernandez, born in Madrid, Spain, joined the department in 1966, obtained tenure in 1972, and was promoted to Professor in 1977. His research interests include theoretical condensed matter physics, statistical physics, electronic proper-

ties of disordered materials, metal-nonmetal and liquid-vapor transitions in metal-atom fluids, light particle localization in fluids.

John will still be around Phillips Hall for three years as he continues to teach during his “phased retirement.” Here we thank John for his significant contributions to the department and wish him only the

best in the years to come. Of course, we would love to visit John and his wife Marisa at the beach in Fuengirola (Malaga), Spain, when he is not teaching in Chapel Hill. Thank you, John!



Professor John Hernandez

Honors and awards

Astrophysics graduate students Rachel Rosen and Jane Moran have been awarded dissertation completion fellowships by the Graduate School. These non-service awards support doctoral students engaged in research and writing toward the completion of their dissertations. Rachel Rosen’s dissertation concerns models of the structure of pulsars. Jane Moran’s concerns polarimetry of gamma-ray bursts.

One of our undergraduate majors, Helen



Helen Chappell

Chappell, was inducted into Phi Beta Kappa in a ceremony on April 10. Congratulations to Helen!

Undergraduate physics major Andrew Fuller graduated on May 14, 2006 with Highest Honors. His honors thesis is entitled “Electrical Control of Ferromagnetism in Doped Magnetic Semiconductor Heterostructures,” and he conducted the research under the supervision of Prof. Frank Tsui. Andrew is also the win-



Andrew Fuller

ner of the Shearin Award for the Outstanding Senior Physics Major.

Physics major Joshua LaRocque also graduated with Highest Honors in December 2005. He conducted research under the supervision of Nikolay Dokholyan of the Department of Biochemistry & Biophysics, and his thesis was entitled “Direct Observation of Protein Folding, Aggregation, and a Prion-Like



Joshua LaRocque

May 2006 Graduates

PhD. In Physics

Michele Arzano
Sreeja Asokan
Matthew Fleener
Eric Harley
Hyooungki Park
William Shively
Jennifer Weinberg-Wolf
Celeste Yeates
Gongpu Zhao

M.S. in Physics

Eliza Osenbaugh-Stewart

B.S. in Physics

Matthew Aitken
Adam Brooks
Adam Cottrell
Andrew Fuller
Matthew Grames
Justin Kirschbrown
Chelsea MacLeod
Andrew Myers

B.A. in Physics

Eric Hirsh*
Markita Landry
Jacob G. Vincent

*Eric graduated in December 2006.

Conformational Conversion.”

Undergraduate physics major Joshua Haislip has been awarded the 2006 Vanderbilt Prize for Undergraduate Research in Physics and Astronomy. The prize, which includes an award of \$1000, was presented at a banquet at Vanderbilt University in June. Congratulations to Josh!



Joshua Haislip (third from right) accepting the 2006 Vanderbilt Prize

Staff News

New Staff Hires

Jennifer Dunn joined our outstanding staff in June as the new graduate affairs coordinator. After studying at Virginia Tech Jennifer came to UNC-CH to work. Jennifer assists with the graduate student application process for the department. Working with Barbara Szilvay and several professors to coordinate graduate student program affairs

ensures that work is “always exciting!”

In addition, we are equally as happy to welcome Cassandra Houston to the physics and astronomy department staff! Cassandra joined the team in September as the new research services administrator and works with proposal writing and processing. We are glad that Cassandra decided to move all the way from Washington State to work with us.



Department manager, Donna Braxton (right) received the 2006 Excellence in Management Award. Braxton was also recognized in 1999 for her outstanding managerial skills.

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We Heard From...

I hope you don't find this strange, but I've attached my CV. I feel really privileged that I've been able to continue in physics as a researcher and teacher. I've done way more than I ever expected, and visited places and met people that I'll never forget. I guess what I'm most proud of is the number of different countries represented by my various collaborators: 13! The list is Austria, Australia, China, France, Greece, India, Israel, Japan, Mexico, New Zealand, Sweden, United Kingdom, and the good ole USA. You might be intrigued by my basic area of research: General Relativistic Superfluids and Superconductors! That's such a strange combination of physics that I still feel a bit uncomfortable writing it down. However,

our best description of neutron stars is that they have superfluids/superconductors in their outer cores. I just love this odd combination of fundamental microphysics and gravitation. Can you believe NSF is also paying me to pursue this?!? Kinda strange, but I'm not going to question it.

*Greg Comer, PhD
Class of 1990*

I am a 1956 Graduate of the Department of Astronomy and Physics (BS Physics) under Dr. Shearin, Dr. Palmatier, Dr. Straley et al. I am also a NASA retiree, living in Merritt Island, FL. Please see Key Word NSS-ISDC 2005 for recent event to share with the Department (click on Speech

“Benefits of Space Exploration”). Please see also web site www.hearagain.org.

*Adam M. Kissiah, Jr.
Class of 1956*

I was at UNC in 72-76 and got a BS in Physics. I have just left NASA (Goddard) after 19 years, and have accepted a position as professor at the University of Michigan in the Atmospheric, Oceanic, and Space Science Department. <http://aoss.engin.umich.edu/go/?id1=10&id2=1&id3=48>

*Ricky Root
Class of 1976*

Bum-Hoon Lee, a Chapel Hill postdoc (with Prof. Paul

Frampton) 1989-90, has been appointed to direct a science research center supported by Korean science ministry with a billion Won (about US \$1M) for each of the next nine years to support theoretical physics research in Korean universities.

Jennifer Scott (class of '94) and Craig Snyder (class of '95) were married on May 29, 2004. The couple met in Dr. McNeil's advanced physics lab.



Jennifer Scott and Craig Snyder