Spring 2003

# Cross Sections Spring 2003

Department of Physics and Astronomy

# Cross Sections

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Department of Physics & Astronomy

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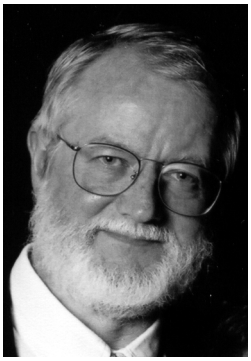
# A Message from the Department Head

**by Professor Soren Sorensen**

## *Physics Research on the UT Campus*



One of the main reasons I came to UT in 1985 was to take advantage of the research opportunities in East Tennessee. As a graduate student and post-doc I had traveled to many exciting places around the world in order to carry out my research, but I was ready to "settle down" and reduce the amount of "travel physics." Well, it did not go that way. Within a year I became involved with the Relativistic Heavy Ion program at CERN in Switzerland and spent 16 months in Geneva. And I was not the only UT physicist going somewhere else to do research. Nearly every experimentalist in the department was conducting his or her experiments outside of the UT campus. The solid state, atomic physics and nuclear physics groups did most of their experiments at ORNL and the high energy physicists were at Stanford and FermiLab.

Having strong on-campus research facilities is, however, vital for attracting top-notch students at both the graduate and undergraduate levels as well as for the freedom of our researchers to do exactly the right experiments at the right time without having to rely on Program Advisory Committees or the mercy of other collaborators. The department has therefore over the last five years worked aggressively to build up a strong on-campus research presence and today we are definitely seeing a lot of results from these efforts.

The condensed matter group has been particularly successful in creating a large equipment base in the Science and Engineering Research Facility (SERF), due in large part to the success of the Tennessee Advanced Materials Laboratory (TAML) under the direction of Professor Ward Plummer. TAML has been very aggressive in supporting large competitive startup packages for new faculty members. This has resulted in an exciting array of equipment on the third floor of SERF for the synthesis of advanced materials and their characterization. Pengcheng Dai's Floating Zone Furnace can produce large, ultra pure single crystals of oxides to be used for, among other things, high temperature superconductivity research. Additionally David Mandrus has a large set of furnaces for the synthesis of polycrystalline materials.

In order to study the magnetic properties of these samples of materials a SQID (Superconducting Quantum Interference Device) is being used, and to provide a large array of measurements of additional characteristics, like electric and thermal properties, a new Physical Property Measurement System (PPMS) is now available. For the creation of very pure and thin surfaces Hanno Weitering has recently acquired a state-of-the-art Molecular Beam Epitaxy (MBE) facility. In addition to its capability to create artificially layered structures, the MBE also contains an array of diagnostic tools for studying the surfaces. Many other instruments are available to our students and researchers as TAML facilities. All these instruments position UT well for the Spallation Neutron Source era soon to begin at ORNL. We can create, characterize and test many new materials prior to exposing them to the neutron beams at the SNS.

**"Having strong on-campus research facilities is . . . vital for . . . the freedom of our researchers to do exactly the right experiments at the right time."**

In the chemical physics program Bob Compton has several advanced lasers in his labs on the fourth and sixth floors. He and Bill Blass are performing a set

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# Honors Day 2003

In an unusual twist, Dr. Soren Sorensen and Dr. Pengcheng Dai walked away with the top graduate student awards at the annual honors day celebration on April 23. And although there is little doubt they were both stellar doctoral students at one time, they managed to claim these honors because their students were too busy running experiments to collect them.

Every spring the department recognizes top physics students for academic achievement, scholarly potential, excellence in research, and exceptional departmental service. This year saw the addition of 13 new physics honor society members and the acknowledgment of some outstanding students at both the undergraduate and graduate levels.

Gail Zasowski was the Outstanding First Year Student in Physics

The festivities began with the induction of students into Sigma Pi Sigma, the national physics honor society. Inducted were undergraduates **Richard Hatcher, Chad Mitchell, Joey Nicely, Jason Smith, Kip White** and graduate students **Kyungyuk Chae, Victor Chupryna, Anota Oluwatoyin Ijaduola, Zhanwen Ma, Richard Manley, John Meyer, Hyo-In Park, and Wesley Robertson**. Sigma Pi Sigma was founded in 1921 and includes more than 58,000 members. The society recognizes distinctive achievement and scholarship in physics.

The individual honors were awarded as follows:

The faculty chose **Gail Zasowski** as the Outstanding First Year Student for her exceptional performance during her first year of physics study. Gail has a university-wide 4.0 grade point average and is a member of the cosmic ray project sponsored by the Society of Physics Students.

The highest undergraduate honor, the Roseberry Award, went to **George Noid**. The award was named for Doug Roseberry, a stellar undergraduate student in the 1950s whose potential was cut short by his untimely death at age 23. This honor was established to recognize a student who exhibits Doug's insatiable curiosity about the natural world and his dedication to the department. George is planning to attend graduate school at Indiana University.

**James Wicker** was honored as the Outstanding Graduate Teaching Assistant, an award determined by the many students enrolled in the physics and astronomy labs. The awards committee said of James that he "has achieved outstanding evaluations from his students and has consistently shown extra effort in insuring the proper functioning of the labs under his guidance and under the guidance of others."

The Paul H. Stelson Fellowship, which acknowledges the research contributions and potential of an accomplished graduate student, went to **Hye-Jung Kang**. She has already had three important publications, including one published in *Nature*. However, since she was at the National Institute of Standards and Technology working on an experiment, Dr. Dai accepted the fellowship in her stead. The Stelson Fellowship is named for Paul H. Stelson, former director of the physics division at Oak Ridge National Laboratory and an adjunct professor in the department for 25 years. This award, established by his family, continues Dr. Stelson's dedication to the mentoring and development of young scientists and also serves as an additional link between UT and ORNL.

Another long-distance winner was **Jason Newby**, recipient of the Fowler-Marion Outstanding Graduate Student Award. He was on shift at the PHENIX experiment at Brookhaven National Laboratory, so Dr. Sorensen stepped in to accept the honor on his behalf. Jason has an outstanding scholarly record in the classroom and in research, two criteria for this award.

One graduate student who **was** in attendance was **Rob Moore**, who was acknowledged as a Tennessee Advanced Materials Laboratory fellow. The TAML fellowships are designed to attract outstanding graduate students in the core departments of chemistry, chemical engineering, materials science

Guest Speaker Dr. Mark Littmann (left) chats with Professor Bill Bugg

## Whatever Happened To . . . ?

*Some of our past award winners and where they are now:*

Thomas Gadfort (Outstanding First Year Physics Student, 1998)
Physics Graduate Program, University of Washington

Ted Corcovilos (Roseberry Award, 1999)
Physics Graduate Program, Caltech

Lilia Woods (Fowler-Marion Award 1999)
National Research Council Postdoctoral Fellow, Naval Research Lab

Omar Zeidan (Stelson Fellowship, 2001)
Research Associate, University of Florida Cancer Center

and engineering, and physics and astronomy. Rob came to UT this past fall after finishing his master's degree at the University of Washington. He had previously served five years as a submarine officer in the U.S. Navy He is pursuing a doctoral degree in condensed matter physics.

The Robert W. Lide Citations recognize the hard work of students who lend their time and imagination to the maintenance and improvement of the undergraduate physics labs. The 2003 honorees were **Jason Smith** (Laboratory Development), **Stephen Wilson** (Laboratory Development), and **Olga Ovchinnikov** (Laboratory Leadership). These citations were named in honor of the late Dr. Robert Lide, a steadfast contributor to the undergraduate labs for many years, even after his retirement.

The students can give as good as they get, however, and for the third year in a row they presented a Teacher of the Year Award, sponsored by the Society of Physics Students. This year's honoree was **Dr. Jim Thompson**, who has now claimed the award twice.

Dr. Sorensen and Dr. Parks present Olga Ovchinnikov with a Lide Citation

The department invited **Dr. Mark Littmann**, Chair of Excellence in Science, Technology and Medical Writing in the College of Communication and Information, to give the honors day address. His remarks emphasized that scientists have both an opportunity and an obligation to communicate their work to a broader audience.

"The public knows how difficult science is," he told the assembly of students and faculty. "Scientists are, well, sort of magical," bringing the greater populace discoveries in DNA and superconductors.

"The public wants to share that sense of awe and wonder with you," he continued, accentuating the fact that in this new century science, technology and medicine will replace the geographic frontier as the new territory to be conquered.

"You," he told the group, "are in a position to tell that story."

Besides Dr. Littmann, other esteemed guests attending the celebration were retired physics professors **Ed Deeds**, **David King**, and **Ed Hart**; as well as physics Board of Visitors member **John Fox**. Representatives from the College of Arts and Sciences included **Dr. Lynn Champion**, Director of Academic Outreach; **Dr. Don Cox**, Associate Dean of Academic Programs; **Dr. Bill Dunne**, Interim Associate Dean of Research, Graduate Studies and Facilities; and **Dr. Susan Martin**, Associate Dean of Academic Personnel.

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of very interesting infrared absorption measurements of the light from the rising sun over the Smoky Mountains with a new ultra high resolution Fourier Transform Infrared Spectrometer. This sunlight is caught on the roof of SERF and channeled to the spectrometer on the sixth floor. Currently the high energy physicists are preparing for a new Liquid Scintillator Laboratory, and next year it is very likely that we will also start a lab in SERF for Digital Signal Processors to be used in nuclear physics experiments.

In the "dungeons" of the Nielsen Physics building we have recently cleaned up the old infrared spectroscopy room, which Geoff Greene will use to build a full-scale model of the cold neutron beam line at the Spallation Neutron Source. This project is likely to include several undergraduates. Even more undergraduate physics students are at the moment busy in another of the rooms on the first floor of Nielsen as part of an ambitious high school research and outreach project called TECOP (TEnnessee Cosmic ray Observatory Project), in which we will deploy cosmic ray detectors to 10 local high schools. These detectors will be built and operated by high school students and might eventually give us a measurement of the frequency of the most energetic cosmic rays.

I hope these examples will give you a feel for our ever-growing on-campus research. In particular, we are pleased with the strongly increased undergraduate research participation, since survey after survey has demonstrated that participating in research is one of the most important factors for undergraduate physics majors in judging the quality of a program.

I hope you are getting curious from this description of our on-campus activities and would like to see them in person, since I will be delighted to give you a tour. Just give me a call and we will roll out the "red carpet."

alumnus profile

## Space Wars and UNISOR:

# Leigh Harwood Recalls His Undergrad Days

Just for the record, Leigh Harwood didn't really program video games on the computer in Lee Riedinger's lab. At least that's his official response to Glenn Young's assertion in the last issue of *Cross Sections* that he added an early version of "Space Wars" to the PDP machine the nuclear physics group was using for research in the 1970s.

"Glenn gives me more credit than I'm due. That program came 'free' with the equipment," Dr. Harwood said laughing. "I was only doing programming for our new data acquisition system."

Dr. Harwood is a 1974 UT graduate with a bachelor's degree in physics. The son of a Baptist minister, he was born in Memphis but spent time in Virginia, Tennessee, and Missouri growing up.

"I'm nominally a Tennessean, but I had other influences," he said.

It was while attending grade school in Western Tennessee's Lake County that he decided he wanted to attend "the big UT" in Knoxville. His sister went to UT-Martin, but he set his sights on Knoxville with a major already settled on.

"I wanted to go into what I thought was atomic physics but would later find out was nuclear physics," he said.

As things worked out, Knoxville had another attraction for him.

"I was in a very small rural high school. The math and science was very limited. In the summer of 1969 I spent a couple of weeks with my sister who was working on a M.S. in microbiology at UT. During that visit I learned about the early admissions program. Those days in that program you could be admitted to UT without a high school diploma, provided your GPA and college boards met the right criteria. Fortunately, mine did and I was able to avoid 'wasting' another year in high school. The irony is that even though I have a Ph.D., I'm 'officially' a high school drop-out."

His introduction to the University, however, was not without its hiccups.

"I moved into Carrick Hall. It was somewhat intimidating; Presidential Complex housed more people than my home town."

Dr. Harwood also explained that the spelling of his first name often leads people to conclude that "Leigh" is a "she." During his first fall term at UT he received a nice letter on official University stationery in an official University envelope. It was from the Dean of Women.

Dr. Leigh Harwood

"I had been invited to pledge the freshman honors sorority," he said.

Although he thought that it would be a great joke to attend the sorority tea described in the invitation, he decided instead to go to the Dean of Women's Office, where he presented both his letter and his ID card.

"I think there's been a mistake," the receptionist said.

Life in physics, however, was a bit less complicated. Dr. Harwood worked with Lee Riedinger, Bob Lide, and Carrol Bingham through an independent study and as a work study student.

"I sort of double-dipped," he explained.

He was also one of only a handful of students pursuing physics.

"By about my sophomore year, but definitely by my junior year, there were only four of us left that started together as freshmen," he said. "There weren't many of us physics majors back in those days."

Though they may have been few in number, physics majors had the opportunity to work on major research projects. For Dr. Harwood, that opportunity presented itself in UNISOR, the University Isotope Separator at Oak Ridge. The project was established to enhance research on fundamental nuclear structure and involved 11 universities including Vanderbilt, Georgia Tech, and Furman.

"It was pretty exciting to be around in the early days of UNISOR," Dr. Harwood said. "Lee and Carrol did a lot to make the early days work. I got to be involved in very useful ways. That was my first time to be on the ground floor of something like that."

After graduating from Tennessee, Dr. Harwood headed to Florida State to continue his studies in experimental nuclear physics, earning a master's degree in 1977 and a Ph.D. in 1978.

"It was a great place to be a grad student," he said. "In a small lab like that you get involved in all aspects of doing the experiments from running machining parts for setups through running the accelerator to writing the data acquisition and analysis software. And THEN you get to work on your own data. The beaches were very nice too," he added with a laugh.

Next he went to Michigan State as a post-doc. Eventually he earned tenure there on the research staff.

"Around that time I decided to work on the cyclotron as opposed to doing experiments in nuclear physics," he said.

The National Superconducting Cyclotron Laboratory at Michigan State is home to two cyclotrons: the K500, which was the first cyclotron to a superconducting magnet; and the K1200, which Dr. Harwood helped design.

One of Dr. Harwood's projects at NSCL resulted in a technique for purifying beams of exotic nuclei.

"Back in 1980 we were planning the research program for the K800 (later

known as the K1200) cyclotron. We wanted to have beams of exotic nuclei that had only one 'species' in them and, at the same time, had a very narrow energy spread; we wanted to use those beams for collisions with targets and study the results. By putting together my experimental nuclear physics training with my ion optics knowledge, I came up with the idea of using a wedge-shaped energy degrader to decrease the energy spread," he explained.

"They use that scheme at NSCL now and also at GANIL in France. It will be used at RIA when it gets built" he said.

After nine years in Michigan, another opportunity arose that would send Dr. Harwood to his current post at the Thomas Jefferson National Accelerator Facility in Newport News, Virginia. He became a staff scientist at CEBAF, the Continuous Electron Beam Accelerator Facility.

"Here was this huge new facility," he said. "Not a new brick had been laid for it yet. There were a lot of ways I could contribute. When I got here I was a technical advisor to the project manager, who was also head of the engineering division. My first major management role was the transport system for the accelerator here, and there's 5K of it."

CEBAF was designed to produce cw electron beams of up to 4 GeV for the study of quark structure in nuclei; the accelerator can produce beams with average power approaching 1 MW. On May 15, 1995, the accelerator reached "five pass", i.e., full design beam energy, status.

"That morning at 6:30 I said, 'I'm calling Hermann' (Hermann A. Grunder, who was then CEBAF Director and is now director of Argonne National Lab) and I officially notified our director that we were at full energy," Dr. Harwood said. "That was one of the most thrilling moments that I've had."

He has been a senior staff scientist since 1991 and has had varying roles, including managing the design, installation and commissioning of the 5 km long CEBAF beam transport system. He described it as "over 2000 magnets, 1800 power supplies, 5 km of vacuum system, plus all the support hardware and procedures."

Subsequently he was deputy head of accelerator engineering and deputy head of accelerator development.

"The accelerator development time gave me the opportunity to learn a lot about applied superconductivity, par-

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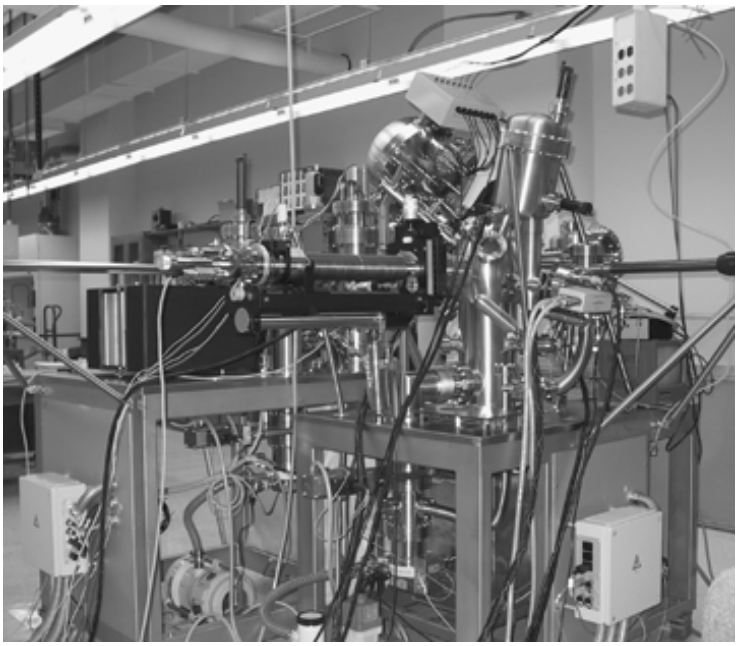
**research highlight**

# World-Class Research: Local Address



The new Omicron Multiprobe Molecular Beam Epitaxy in Dr. Hanno Weitering's lab in the SERF building

The Condensed Matter Experimental Group is slowly but surely turning the third floor of the Science and Engineering Research Facility into a world-class facility for creating and characterizing materials.

The addition of an Omicron Multiprobe Molecular Beam Epitaxy (MBE) system in November 2002 is the first of its kind at Tennessee. The system is capable of producing ultrahigh purity, artificially-layered materials with atomically abrupt interfaces and greatly enhances the university's competitiveness in fundamental *and* applied research on novel, low-dimensional materials, including thin film nanostructures. Dr. Hanno Weitering explained that the multiprobe system has all the necessary tools for the synthesis of thin films including thin film nanostructures, surface characterization (spectroscopy and microscopy), and in-situ electrical transport measurements. Thin films, which measure less than one micron thick, have applications covering the gamut from microelectronics to magnetic sensors, tailored materials, optics, and corrision protection.

The system is operated by Changgan Zeng (UT postdoc), An-Ping Lee (ORNL postdoc), and Murat Ozer (physics graduate student), under the supervision of Dr. Weitering. Present research projects involving the new instrumentation include the synthesis of ferromagnetic thin-film alloys for basic research on magnetism and spin diffusion in silicon-based semiconductors. Dr. Weitering explained that the successful integration of magnetic materials in silicon-based devices is predicted to revolutionize semiconductor- and information technology. Other projects involve electrical conductivity studies through novel quantum structures such as ultrathin metal films and atomic wire arrays.

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new faculty

See update on new particle, page 10

# Introducing Dr. Stefan Spanier

Stefan Spanier is trying to figure out how matter got the upper hand. Dr. Spanier, who joined the physics faculty in September 2002 as an assistant professor, is part of a collaborative effort pursuing a nagging problem in particle physics: the mystery of what happened to antimatter when the universe was born.

The universe is made up of common particles, collectively called matter. Every particle has a corresponding antiparticle with identical mass and spin but an opposite charge. These antiparticles are known as antimatter. Theory holds that when the Big Bang went off, equal parts of matter and antimatter were created.

The problem is that experimentation shows matter and antimatter will annihilate one another when they come into contact, with their energy reappearing as photons or other particle-antiparticle pairs. This means the universe should have disintegrated shortly after creation or contain equal amount of both in different places.

However, outside of the present research laboratories where it's created, there is no antimatter anywhere in the universe observed today. And so a mystery evolved: exactly what happened to favor matter in the battle with its antithesis?

Dr. Spanier is working with the BaBar experiment at the Stanford Linear Accelerator (SLAC) to answer that question. Using a particle accelerator two miles long, scientists hurl pieces of matter and antimatter at each other to recreate the Big Bang. They generate millions of *B* particles and their corresponding antiparticles (*B*-Bar) and measure their decay products with the BaBar detector.

"The main goal is to really find some asymmetry in the behavior between matter and antimatter," Dr. Spanier said.

That asymmetry is thought to be from an effect called CP violation, which has to do with why particles and antiparticles are not mirror images of one another.

"You create matter and antimatter, always, in the same amount," Dr. Spanier explained.

"If they do something different, they violate some basic fundamental symmetries: this is the CP."

The theory is that matter perhaps decays more readily into particles than antimatter decays into antiparticles and hence matter "outnumbers" antimatter.

A deeper understanding of this problem could play a role in redefining particle theory.

"We have this so-called Standard Model," Dr. Spanier explained. "Everything measured so far fits well into some 'big picture.' One could believe that we are at the end of the story, we know how things work."

Challenging the model, however, is a key component of his research. In July 2002, he presented a new measurement of CP violation at the 31st International Conference on High Energy Physics, held in Amsterdam. A second group, the Belle collaboration from Japan's High Energy Accelerator Research Organization, presented similar results.

"We measured something different than the model predicts," Dr. Spanier said. "There was a same effect. The effect was strong enough to be published. The effect is not yet strong enough so that the world has already proof of results in our field to pick it up and say, 'hey, there's the first signs of new physics.'"

If these results hold over time and further experimentation, however, Dr. Spanier said, "there must be some new particles bringing us closer to an explanation why we have an excess of matter with antimatter here on earth."

He explained that "the presented analyses are in fact just the start of the second mission of the BaBar experiment. The experiment so far has demonstrated the presence of CP violation in the *B*-meson system with very high precision, so nobody would doubt that anymore. The size of the effect, though, is in astonishing close agreement with the Standard Model. Now the question is, on the other hand, the effect is so small it cannot really explain everything at this point."

Dr. Stefan Spanier

With CP violation measurements one is already sensitive to effects caused by potential new particles.

"The effects are well observable but small because we are looking at such low energies as compared to the Big Bang," Dr. Spanier said. "CP violation is influenced by particles which we explicitly may create and observe only at high energies."

More powerful accelerators are needed to reach this energy scale. One such instrument is the Large Hadron Collider at CERN, the European Organization for Nuclear Research. Scheduled for completion in 2007, the LHC will use advanced superconducting magnet and accelerator technologies to hunt for signals of new particles. A large electron-positron Linear Collider for precision studies of their properties, possibly located in the U.S., is presently in discussion among particle physicists. Experiments such as BaBar can, in the meantime, provide constraints about where to look for new particles and forces. A corresponding feature of

these experiments is the advance in computing power they encourage.

"Because these effects are so small, you need a lot of computing and data storage," Dr. Spanier said. "What we have presently in our experiment is the world's largest database. We just discovered, very unexpectedly, a new light particle, because other experiments never looked before in a certain corner of their dataset or could not afford to store the information at all. There was a very significant peak not picked up at all."

With the large number of collaborators involved (BaBar involves 550 physicists from 72 institutions) good communications are an absolute necessity.

"SLAC has [a] connection to the fastest data transfers around the earth," Dr. Spanier said. In fact, they reached a certified data transfer speed record in February, sending 6.7 gigabytes in 58 seconds from Sunnyvale, California, to Amsterdam.

Dr. Spanier has 20 new computers in the Science and Engineering Research Facility and hopes, in time, to put together 60 more. They will be high-performance, high-speed machines, all linked together for internal communication. The electronic workshop of the physics department and a graduate student are working with him to set up the networking and clusters that will keep Dr. Spanier's experimental data organized. Systems such as this feed into the next generation of computing; a decentralized grid design that aggregates a pool of computing power to be accessed on an as-needed basis. A broker machine distributes the data for analysis and sends the results back to the researcher. Of course, with the future potential of commercial interest, Dr. Spanier said, "what is called a broker may turn into a real broker."

Since joining the faculty last fall, Dr. Spanier has been preoccupied with setting up his computing system on campus while maintaining his research interests at SLAC. He has also been involving other physics faculty in BaBar.

He is also getting involved in undergraduate physics education. Dr. Spanier is teaching Physics 102: How Things Work, to explain the basic principles of physics to non-physics majors and demonstrate how they fit into everyday life. He is also involved in TECOP (the TEnnessee Cosmic ray Observation Project), a research endeavor initiated by the Society of Physics Students.

Another asset to the University is that his wife Mahalaxmi Krishnamurthy, is a post-doc in physics working with the FOCUS collaboration at Fermilab. She also provides analysis support for the BaBar experiment.

Dr. Spanier is a graduate of the Johannes Gutenberg University in Mainz, Germany, having earned his diploma in physics in 1991 and his Ph.D. in 1994. He was awarded a CERN fellowship and worked as a post-doc at the University of Zürich from 1994 until 1998. From there he went to SLAC as a research associate before coming to UT last year.

Dr. Spanier said he has now been able to enjoy "the Alps in Geneva, the coast in California, and the Smoky Mountains in Tennessee."

We are pleased to welcome Dr. Spanier to the physics department at UT.

## SERF Equipment

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Another key element in the group's on-campus research efforts is the Crystal Growth Facility, co-managed by Drs. Pengcheng Dai and David Mandrus. These new labs in SERF house a NEC Machinery Corporation SC-2-MDH-11020 infrared (IR) image furnace; as well as seven Lindberg Box furnaces (four 1500 C, one 1700 C, two 1200 C), two 1100 C Mini-Mite Tube furnaces and one 1500 C Lindberg Tube furnace. The facility's IR image furnace is used to grow single crystals of transition metal oxides and other materials suitable for neutron scattering, transport and optical investigations.

More information on the facility is available on the Web at www.phys.utk.edu/taml/facilities/CrystGro.html.

## Alumnus Profile: Leigh Harwood

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ticularly its application to the cavities used for beam acceleration."

In addition, he was head of the beam physics and instrumentation department for two years.

"I just can't hold a job here," he said laughing.

Currently he is leading the project to double CEBAF's energy to 12 GeV.

"They asked me to lead that program," Dr. Harwood said. "I've been working on that for about three years now. The whole project, accelerator plus experimental system upgrades, will be around $200M. We're waiting now to get approval from the Department of Energy to proceed."

Occasionally he gets to do some technical work, but primarily it's budgets, meetings, and scheduling. He said that like the typical physicist, he comes in on Saturdays and spends a great deal of time on work, but he is not a man without other interests. At present scuba diving is his favorite distraction, a hobby he discovered during his undergraduate days.

In the past few years he has renewed his enthusiasm for the sport and traveled to Honduras, the Red Sea, and Micronesia (the south Pacific) to dive. He also finds time to play a little music, a little volleyball, and to volunteer with the Appalachian Trail Conference.

As for his UT days, that's an experience Dr. Harwood is quick to praise.

"I am grateful that I came to UT for school," he said. Of the three universities he has been affiliated with, he said that "UT was the most geared toward the positive welfare of the students."

From the financial aid office to the physics department, he said the people he met at Tennessee "always seemed genuinely interested and concerned about the students. We weren't just a number and a file."

Dr. Harwood has one son, Benjamin, who is a 21-year-old college student.

"He's a math major who wants to teach. Abstract algebra is his specialty. I'm proud to say that he's already had a paper published."

new faculty

# Dr. Yuri Efremenko: A Veteran Rookie

The title may be new, but the face is a familiar one. Dr. Yuri Efremenko, a veteran of the department's elementary particle research team, is the newest physicist in the UT/Oak Ridge National Laboratory Joint Faculty program. He shares a joint appointment between the physics department and the ORNL Physics Division.

A native of Moscow, Dr. Efremenko came to UT in 1992 as a research associate professor and has studied everything from possible upgrades for the Large Electron Positron Collider at CERN to quartz fiber calorimetry at the Stanford Linear Accelerator.

"In this country, first it was the supercollider in Texas," he said, recounting his diverse research experience, "then SLAC, [then] some local experiments."

While Dr. Efremenko has worked primarily with Dr. Bill Bugg and Dr. Yuri Kamychkov, he has also lent a hand to Drs. Soren Sorensen and Ken Read by working on the muon identifier for the PHENIX detector at Brookhaven.

Dr. Efremenko works with the undergraduate students involved in TECOP

"Actually, I'm still with PHENIX," he said.

More recently, however, he has been preoccupied with two other projects: KamLAND and ORLaND.

The Kamioka Liquid Scintillator Anti-Neutrino Detector in Japan, better known as KamLAND, is dedicated to the solar neutrino problem; that is, trying to determine why the sun and other sources of radioactive emissions produce only about one-third of the neutrinos they should as predicted by theory.

In December, the collaboration captured headlines in *The New York Times* as a result of a paper they submitted to *Physical Review Letters*. The paper proposed that some neutrinos, which come in three "flavors," actually change their identity as they approach the earth from the sun. The experimental work at KamLAND, based on the study of antineutrinos from nuclear reactors, also confirmed that neutrinos do in fact have a tiny bit of mass. This could redefine the Standard Model of physics.

Dr. Efremenko explained that UT's work with KamLAND consisted of refurbishing 600 photomultipliers (about one-third of the detectors used for the experiment) to get them calibrated and up to speed for data analysis.

"We continue to evaluate data . . . to provide more precise measurements," he said.

In present form KamLAND has about another two years, he added, "then we will consider an upgrade."

Researchers will strive to make the equipment more sensitive at lower energies to study terrestrial neutrinos while continuing their observation of solar neutrinos.

Aside from KamLAND, Dr. Efremenko was also co-spokesman of the ORLaND project (the Oak Ridge Laboratory for Neutrino Detection), a proposed underground facility to be built adjacent to the Spallation Neutron Source. The ORLaND project has evolved into a somewhat more modest endeavor, the SNS[2] (Supernova Neutrino Studies at the Spallation Neutron Source) to measure neutrino nuclear cross sections of astrophysical interest.

"I'm sort of in charge of this neutrino program," Dr. Efremenko said.

Dr. Yuri Efremenko

ORLaND would take advantage of the sheer number of neutrinos the SNS will produce on a relatively "fixed" schedule. The Spallation Neutron Source will include a liquid-mercury target for bombardment by beams of protons. When protons interact with the mercury atoms in the target, neutrons are formed, but so are pions, which decay into a neutrino and a muon. The muon then decays into one electron and two neutrinos. The SNS will produce about $10^{15}$ neutrinos per second from the decay of stopped pions. A powerful research advantage for ORLaND is that the SNS will produce neutrinos in pulses with a much more predictable schedule than the sun or reactors, making observations much easier.

Dr. Bugg explained that "because of the exciting potential for neutrino physics at SNS, Yuri proposed and organized an ingenious experiment to study processes that could lead to backgrounds at stopped pion facilities like SNS. Yuri's experiment, managed by a small group of physicists at UT,

ORNL, and TRIUMF in Canada, was carried out at the TRIUMF accelerator." (TRIUMF is Canada's National Laboratory for Particle and Nuclear Physics.)

The experiment involved a search for decay of stopped negative pi mesons in low Z target materials used to produce neutrons and therefore has been dubbed "pi in the water" as opposed to "pi in the sky." The results of the experiment indicate that SNS will be a very clean neutrino source.

Another responsibility for Dr. Efremenko is his work with TECOP, the TEnnessee Cosmic ray Observation Project. He is serving as technical director of the undergraduate research endeavor, which involves a collaboration between UT physics majors and high schools to build a network of detectors to capture cosmic ray information and a system to analyze the data.

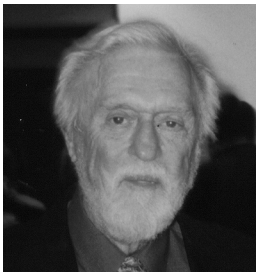
Dr. Efremenko said he has divided the students into groups based on their capabilities and the project's goals, and at the end he will bring them all together to work together on a cohesive result.

"They're learning," he said. "There are a lot of things to do."

Dr. Efremenko earned his master's degree in 1982 at Moscow Engineering Physics University (MIPI) and finished his Ph.D. in 1990 at the Institute for Theoretical and Experimental Physics (ITEP) in Moscow. The author of more than 140 publications, he spent one year as a guest scientist at CEBAF (the Continuous Electron Beam Accelerator Facility) in Virginia before coming to UT. His appointment as a faculty member this past fall is a welcome addition to the department.

## A Scholar and a Gentleman

# Professor Ed Harris (1924-2003)



Dr. Ed Harris

On February 1, 2003, the physics department lost a friend, a scholar, and a gentleman when Dr. Ed Harris passed away after a brief illness. He was 78 years old.

Edward Grant Harris was born March 10, 1924, in Morristown, Tennessee. At age 18 he enlisted in the U.S. Army Air Corps and served as a WWII radar operator on a B-24 bomber in the 5th Air Force, Pacific Theater. He completed his military service in 1945 and returned to Tennessee, where he earned a bachelor's degree in electrical engineering at UT in 1948. He followed that with a master's degree in physics two years later, and finally a Ph.D. in physics in 1953. He spent four years with the Naval Research Laboratory before returning to UT in 1957 as an assistant professor of physics.

Among the places Dr. Harris traveled and worked during his illustrious career were the University of California Radiation Laboratory at Livermore; the Atomic Energy Research Establishment Laboratory at Harwell, England; the Laboratoria Gas Ionizatti in Frascati, Italy; the John J. Hopkins Laboratory in La Jolla, California and the Scottish Universities Summer School of Plasma Physics in New Battle Abbey, Scotland. He was an active member of the physics faculty until 1975, when he became a professor emeritus. That same year he also became a Benford Foundation Distinguished Professor of Physics.

Dr. Harris was a renowned scholar whose books became permanent fixtures on the physics landscape. *A Pedestrian Approach to Quantum Field Theory* was first published in 1972 and was translated into German in 1975. *Introduction to Modern Theoretical Physics (Vol. 1: Classical Physics; Vol. 2: Quantum Theory and Statistical Physics)* was published in 1975; Volume Two was later translated into Chinese.

The importance of his work and his gift for teaching were summed up by Dr. Junichiro Fukai, a former student of Dr. Harris who is now an associate professor of physics at Auburn University.

"Dr. Harris was an extraordinary teacher in every way," he wrote. "[He] was my thesis advisor guiding me in theoretical plasma physics for my Ph.D. He always presented a difficult subject in a very comprehensive fashion. All of our classmates were amazed and inspired in his rather quiet lectures. We respected him greatly. His two-volume book of Modern Theoretical Physics has served us as a bible of physics. Dr. Harris guided us through unselfish advice, camaraderie, and warm hospitality. I was very much inspired by his eternal sprit of inquiry in physics. I will miss him greatly."

A tribute to his scholarly influence is the fact that although Dr. Harris took credit for only 44 publications, four of them alone have garnered 808 citations.

Dr. Harris was a fellow of the American Physics Society and a member of the American Association of Physics Teachers, the American Association for the Advancement of Science, and the Federation of American Scientists. He served as a consultant to the Thermonuclear Division at Oak Ridge National Laboratory for 20 years and was a member of the Scientific Advisory Board of the Dystonia Medical Research Foundation. He also supervised a total of 17 Ph.D. students.

Dr. Harris is survived by his wife, Sara Waldron Harris, and his daughter, Heather Ann Harris. Other family members include his sister-in-law Sarah Harris, nephew Grant Harris, niece and husband Peggy and Steve Mardosa and son Peter and brother-in-law Ralph F. Waldron.

# Physics Family News

## faculty

A subatomic particle, Ds (2317), debuted in April and two physics faculty members had something to say about it. The May 6 edition of the *Oak Ridger* describes the new particle as having a strange quark configuration, very small yet very stable with low mass. Scientists at the Stanford Linear Accelerator discovered Ds (2317), whose existence was announced April 28. Both **Professor Ted Barnes** and **Assistant Professor Stefan Spanier** were quoted in the *Oak Ridger* article. Dr. Barnes co-authored a paper hypothesizing that the new particle is really a molecule of quarks, but he explained to the newspaper that whether it's a multi-state quark or a new particle, it's certainly a surprise. Dr. Spanier was part of the BaBar collaboration working on the project. He said that UT has been involved with this work from the very beginning and will continue to do so. His new 20-computer setup will be part of that work. The article is available at the physics Web site (www.phys.utk.edu).

Congratulations to **Stefan and Maha Spanier** on the birth of their daughter, **Ishani Maria**, on May 12.

## staff

**Paul Lewis** was the U.S. Cellular/ WATE Channel 6 Educator of the Month for March. Paul directs both the astronomy outreach and observing programs as well as the Teachers Resource Distribution Center. A description of the program is available on the Channel 6 Web site at www.wate.com. Congratulations to our most recent graduates:

## students

Spring 2003: **Maria Fout,** B.S.**; Brian Irick,** B.S.**; James LePage,** B.S.**; Suphot Musiri**, Ph.D.; **George Noid**, B.S.; **Hyo-In Park,** M.S.**; John Pierce**, Ph.D.; **Sonali Shukla**, B.S.; **Shu-Jung Tang**, Ph.D.; **Alex Thesen**, Ph.D.

Fall 2002: **Anas Ababneh**, Ph.D.; **Luc Dessieux**, M.S.; **Eric Lingerfelt**, M.S.; **William Newton**, M.S.; **James J. Schiermeyer**, M.S.; **Malachi Schram**, M.S.; **Denise Story**, B.S.

The department was well represented at the January American Astronomical Society meeting in Seattle, in no small part thanks to the students. Graduate student **Reuben Budiardja** presented a poster on "Programming Wireless Handheld Devices for Applications in Teaching Astronomy," which explains how Dr. Mike Guidry's group has developed client/server programs that, among other capabilities, allows students to access a 700-question astronomy quiz database from a cell phone or PDA. His presentation featured hands-on demonstrations with real devices. The group was responsible for six posters at the meeting, which involved the work of current and former students **Bronson Messer**, **Eric Lingerfelt**, **Kyungyuk Chae**, **Suzanne Parete-Koon**, and **Erin McMahon**.

**Anton Naoumov** gave a talk at the SPS session of the American Physical Society March Meeting, held in Austin, Texas. His presentation, entitled, "Toward the Separation and Enantiomeric Excess of Chiral Carbon Nanotubes," described his research with Dr. Bob Compton and Dr. Ray Garrett.

Four physics majors are among the 23 students selected for internships in the UT/Oak Ridge National Laboratory Undergraduate Summer Research Program. They are **Joey Nicely**, **James Alsup**, **Scott Outten** and **Gail Zasowski**. The program, in its second year, provides a $2,000 stipend and tuition credit for two hours of directed study for each student and a $500 honorarium for the supervising faculty member. The Provost's Office and ORNL fund the program, which is designed to increase the participation of undergraduates in the university's research enterprise.

## alumni

Congratulations to **Sam Held** (M.S., 1999) and his wife Erica on the birth of their third son, **Timothy James Held**, born February 4, 2003. He joins older brothers Sammy and Charlie.

**David Witt** (B.S., Engineering Physics, 1995) is a Senior Health Data Analyst with CIGNA Healthcare in Chattanooga, where he works with custom database programming and analysis of the results.

**Dr. Ronald E. Goans** (B.S, Engineering Physics, 1968; M.S., Physics, 1969; Ph.D., Physics, 1974) is a Senior Medical Consultant with MJW Corporation and a Clinical Associate Professor at the Tulane University School of Public Health and Tropical Medicine. He earned his M.D. at the George Washington University School of Medicine. **Judy Winegar Goans** (B.S., Engineering Physics, 1971) is an attorney with Nathan Associates, Inc.

Players choose their teams for the annual physics softball game at the departmental picnic April 26.

# Thanks to our Donors!

The physics department is grateful for all gifts, both in general and those received during the Board of Visitors December 2002 development campaign. We would like to thank the following people for their generosity to our programs:

(Gifts forwarded from November 2002 through May 15, 2003)

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The artwork above is a drawing of the "Untitled" sculpture over the entrance of the Nielsen Physics Building. The sculpture was designed by Professor Philip Nichols of the Department of Art and is intended to convey the feeling of large and small masses, atoms, molecules, motions of charged particles in magnetic fields, and radiation emanating from nuclear disintegrations.

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