

PHYSICS

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EXEMPLARY
DEPARTMENT

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Dr. Royce K.P. Zia
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Dr. John Simonetti
Associate Chair

Ms. Kim Dix
Dept. Business Manager

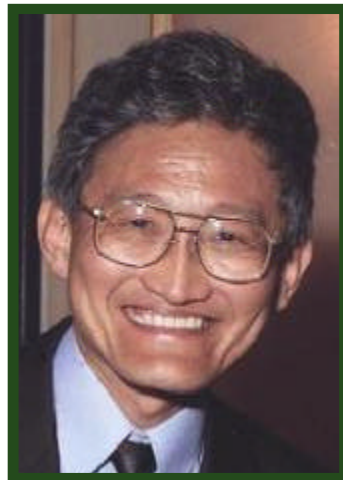
Ms. Deborah Cruise
Newsletter Editor



Quanta

A publication for the faculty, staff, students, alumni
& friends of the Virginia Tech Physics Department

New Chair heads Physics



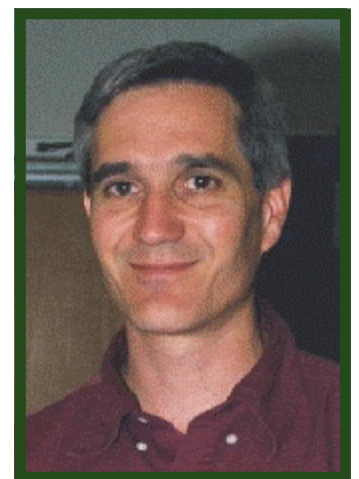
Royce K.P. Zia

In March of 2003, our previous Chair, Lay Nam Chang, took over the Deanship of the newly formed College of Science. John Ficenec and Jimmy Ritter kindly agreed to serve as the Interim Chair and Interim Associate Chair, respectively. I am honored that the Department elected me to succeed Lay Nam. At that time, I had planned a Study-Research Leave (also known as a “sabbatical”) for 2003-04. I am grateful to my colleagues for “keeping the home fires warm” until my return in July. At the start of this semester in August, with the unanimous support of the Department, John Simonetti graciously accepted my request to join me as the Associate Chair, beginning in January 2005.

Lay Nam and John left giant shoes to fill. In the past 12 months, 5 professors left the Department, including the 3 retirements portrayed in this Newsletter. On the positive side, we welcome 3 new professors –Giti Khodaparast, Rahul Kulkarni, and Raju Raghavan. (See pp. 6-7). A fourth, Hans Robinson, will join us in a few weeks. During 2005, we hope to add several more to our ranks. Our goal is to have at least 35 faculty members in the near future.

In addition to the faculty, there is another significant change. In September, we bid farewell to Rhonda Mitcham, who accepted an offer to work with the upper administration as a Business Practices Specialist. We are fortunate that Kim Dix was able to take over as our Business Manager in late October. Though less than two months passed since her arrival, Kim has already mastered the intricacies of her job. In the next Newsletter, you will find more about her.

There is lots of other exciting news, only some of which are reported in this letter. As John and I get over the “new ropes” phase, we hope to bring you a more complete picture of the Department. So, please stay tuned! For now, let me close by wishing you a joyous holiday season and hoping that you will join us in celebrating 2005 – declared by the United Nations as the International Year of Physics.



John Simonetti

- Royce K.P. Zia, Chair

Virginia Tech proposes national lab in Giles County

Article courtesy: Susan Truelove, Virginia Tech News, October 25, 2004

Virginia Tech believes that Giles County, 30 minutes from the university, would be the ideal site for the nation's next Deep Underground Science and Engineering Laboratory, and is submitting a proposal to the National Science Foundation to build a national laboratory 7,000 feet under Butt Mountain.

Project leader, Bruce Vogelaar in physics, Robert Bodnar in geosciences, and Matthew Mauldon in civil and environmental engineering are responding to the NSF request for proposals for a Deep Underground Science and Engineering Laboratory (DUSEL), where experiments in physics, geosciences, mining, geoengineering, and other areas could be carried out.

Although the proposal is not due until January 10, 2005, members of the research team will meet with county officials Monday night to explain the project, since community support is part of the proposal.

"Research at the site would include study of deep outer space, the particles the sun and other stars send shooting through the earth, a protected environment and new technologies for creating pure supersensitive radiation sensors and pure fluids for semiconductors, the science for locating and wresting petroleum and minerals from the earth, how rocks clean up water and what we could learn from that process, how far under the earth life exists, and mining technologies that will extend our access to the earth's resources," said Bodnar.

Both the research process and research results would be shared. In addition to researchers, teachers and students would be able to use the Internet to observe or participate, "and we'll have tours for groups such as high school science teachers," Bodnar said.

"The university is fully behind the pursuit of this ambitious research project," said Fenwick.

"We are studying rare events so we need an environment without background radiation. At the Earth's surface, cosmic rays are always present. Deep underground, this radiation is reduced to the point that you can see rare events. We will place huge detectors thousands of feet underground so that cosmic radiation is filtered out by rock and dirt and we can learn the properties of elementary particles."

- Bruce Vogelaar, Associate Professor -

The proposal, due January 10, will propose a specific site for the deep mine, a conceptual design of the infrastructure necessary, identification of an initial suite of experiments, and the vision for a longer-term (30 year) program. The NSF will select three to five proposals and provide up to \$500,000 to each for six months to create detailed technical designs. The final selection will probably be made in late 2005 or early 2006, and construction would begin in 2008 and could take four years. NSF funding would pay for construction and scientific equipment. Once the facility is completed, additional research support on the order of \$200 million over 30 years would come from sponsors interested in specific projects.

Vogelaar, associate professor of physics, explains why physicists want to go deep underground. "We are studying rare events so we need an environment without background radiation. At the Earth's surface, cosmic rays are always present. Deep underground, this radiation is reduced to the point that you can see rare events. We will place huge detectors thousands of feet underground so that cosmic radiation is filtered out by rock and dirt and we can learn the properties of elementary particles."

New areas of research for a deep underground lab

The first deep underground mine in the world was the Homestake gold mine in South Dakota, where Raymond Davis of the University of Pennsylvania made discoveries about the universe in the 1960s. Subsequently, Masatoshi

- see "National Lab" pg 4-

Virginia Tech alum, astronaut, discusses space travel

Article courtesy: Sally Harris, Virginia Tech News, September 13, 2004

He has traveled 7.8 million miles. He has experienced 16 sunrises and sunsets a day. He has floated around like a helium balloon, unshackled by gravity. And now he has turned the focus of his work on the moon and Mars and beyond.

Roger Crouch, senior scientist for the International Space Station (ISS), an astronaut on two scientific missions of the Space Shuttle Columbia, and a Virginia Tech alumnus, will launch the first of the College of Science's Distinguished Lecture Series. His talk, "Vision for Space Exploration," which will include the role the ISS will play in that vision, will be at 5:30 p.m. Wednesday, Sept. 29, in 3100 Torgersen Hall; and a reception will follow in 1100.

Space travel exacts a toll on human bodies, and because the vision includes trips to Mars — which will take about three years — Crouch will talk about what space travel is like, what happens when gravity no longer exerts its pull, and how that would be a problem on a Mars trip. He will discuss the types of research being done on the ISS to avoid or minimize these kinds of problems.

The vision Crouch will discuss includes using the moon as a steppingstone for going farther out into the solar system. The plan is to get back to the moon by 2016 to 2020, and to Mars after 2030. "The program now is ... research that will allow us

to fulfill this vision," Crouch said.

That includes figuring out a way to recycle water and air so people can survive on Mars, Crouch said. It also includes the search for "new nuclear or solar — or even far-out things such as anti-matter — rocket motors," he said. "Currently, we are limited to takeoff when Mars and the Earth are closest together. When they are most separated, it takes about 22 minutes at the speed of light for a message to get from Earth to Mars. This requires autonomous medical care, or diagnostic and treatment capabilities. It will also include a suit to allow the astronauts to function on the surface of the moon or Mars, including shielding them from radiation exposure or, in the case of accidental exposure, developing a way for their DNA to heal itself without mutating. "We want to be able to predict the onset of illness and prevent it," he said.

Crouch started working for NASA after graduating from Tennessee Tech University in 1962, then completed a master's and a Ph.D. at Virginia Tech in 1968 and 1971, respectively. He realized his dream of space travel on the first Microgravity Science Laboratory mission in 1997, a mission cut short by fuel-cell problems. His was the first crew of astronauts to take a mission back into space when they returned that July to complete the research projects from around the world that would show scientists how



Astronaut Roger Crouch

- photo credit: NASA -

materials behaved when gravity was not an influence. Now he works with the scientists aboard the ISS and gives talks such as this to inform the public about NASA's work.

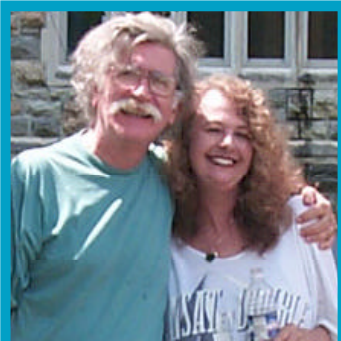
Tennessee Tech recently named him its Frederick L. Culp Professor of Physics, named after a professor who encouraged him when he was an insecure student. A TTU news release quoted Culp as saying, "Roger's personality was like Clark Kent's and his achievements like Superman's."

Crouch was lead scientist of the Microgravity Space and Applications Division from 1985 to 1996. He has conducted various research, ranging from electronic devices for remote sensing, to heat-shield protection for reentry space vehicles. He has earned numerous awards, including Virginia Tech's Distinguished Alumni Achievement award, TTU's Distinguished

- see "Crouch" pg 7 -

Three professors honored as professor emeritus

The title of emeritus may be conferred on retired professors and associate professors, administrative officers, librarians, and exceptional staff members who have given exemplary service to the university and who are specially recommended to the board of visitors by Virginia Tech President Charles W. Steger. Nominated individuals who are approved by the board of visitors receive an emeritus certificate from the university.



**John Broderick
with wife Sandy**

John J. Broderick, professor of physics in the College of Science at Virginia Tech, was conferred with the title “professor emeritus,” August 2004.

A member of the Virginia Tech faculty since 1974, Broderick developed and taught several astronomy courses to undergraduate students with science and engineering majors as well as non-science majors. He also established a radio astronomy research program at Virginia Tech with approximately 80 publications associated with his

- see “Emeritus” pg 5-

National Lab

continued from page 2

Koshiba of the University of Tokyo used a lead-zinc mine near Tokyo in the 1980s. Both scientists received the Nobel in Physics in 2002. Now, there are deep underground laboratories in locations around the world, but only limited options within the United States. Approximately seven sites are competing to be the next deep underground laboratory in the United States.

A condition of the new site is that it offers opportunities for research in fields in addition to physics. Scientists from several universities formed the EarthLab steering committee and identified research in geosciences, geoengineering, geomicrobiology, environment, hydrology, and mining technologies that would be advanced by a deep underground lab.

“Giles County is ideal because the site offers geological features unique among the seven known sites competing for the lab,” said Bodnar, University distinguished Professor in Geosciences at Virginia Tech and project spokesman. The limestone formations are typical of much of the earth’s rock where petroleum and minerals are found, and although these resources do not exist in Giles, study of the rock’s characteristics deep underground will advance exploration. Meanwhile, engineers are interested in fracture properties at depth and in hydrogeology, particularly as it relates to the fracture system and thrust faults, Mauldon said.

Engineers also have questions about the design of subsurface space and tunnels at great depth. “DUSEL provides an opportunity to use remote sensing methods such as seismic tomography to make inferences about the characteristics of the rock mass adjacent to the underground lab, then to verify those predictions with core drilling or further excavation,” Mauldon said.

The DUSEL will also allow engineers to develop technologies and a better understanding of how to develop tunnels and caverns at that depth. “Through experimentation, observation, and monitoring in a DUSEL in sedimentary rocks, the geoengineering research community will have an extraordinary opportunity to learn about engineering characteristics of a layered rock mass,” Mauldon said. “The knowledge gained will facilitate well-planned development of subsurface space to benefit society.”

And life scientists will be able to study microorganisms to help determine the temperature and chemical limits for life. “An underground lab will allow us to study such organisms in a natural setting, rather than a simulated lab environment. We will also study the roll of microbes in mineral growth and weathering,” Bodnar said.

Who will participate?

“The expertise to use such a facility does not come from one place. We will only succeed if we have support from researchers across the country,” said Bodnar. “We are inviting researchers from all over the country to visit and consider doing research here. It is critical that our team includes leading researchers in these fields from throughout the United States.”

People from all over the world will have the opportunity to see beautiful Giles County when they participate in research that is advancing science in numerous fields and benefiting humanity.

For further information go to: <http://www.phys.vt.edu/~kimballton>.

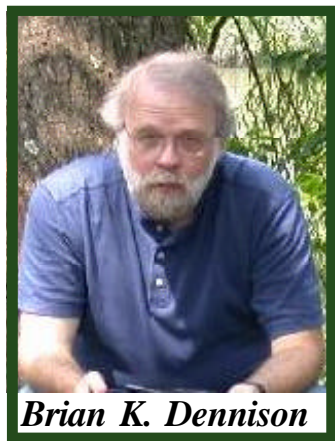
Emeritus

continued from page 4

work. In addition to his teaching and research, Broderick responded to numerous questions related to astronomy from the general public, and participated in several astronomy outreach programs for the broader community.

Broderick is a member of the International Astronomical Union, International Scientific Radio Union, and the American Astronomical Society. He received his bachelor's degree from Penn State University, and a master's degree and Ph.D. from Brandeis University. ⚙

Brian K. Dennison, professor of physics in the College of Science at Virginia Tech, was conferred with the title "professor emeritus," August 2004.



Brian K. Dennison

A member of the Virginia Tech faculty since 1977, Dennison developed and taught astronomy laboratories to numerous non-science as well as science and engineering undergraduates, and taught a wide variety of undergraduate and graduate lecture courses covering both astronomy and physics. He developed an astronomy concentration (which eventually became an astronomy minor), and served as the adviser for students in that course of study. Dennison led several outreach activities and organized astronomy programs to the surrounding community

and to visitors at Mountain Lake Hotel and Conference Center and the Horton Center. He received his Ph.D. from Cornell University. ⚙

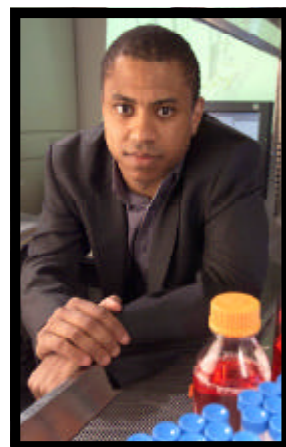
John R. Ficenec, professor of physics in the College of Science at Virginia Tech, was conferred with the title "professor emeritus," June 2004.



John R. Ficenec

A member of the Virginia Tech faculty for 36 years, Ficenec has served as associate head, acting head, associate chair, and interim chair of the Physics Department. He made important contributions in the research of experimental elementary particles physics, specifically, the investigations of multiplicity distributions in high-energy collisions, the production of exotic baryons and mesons, and the search for the elusive magnetic monopoles, collaborating with a global array of physicists at Brookhaven National Laboratory, Fermi National Accelerator Laboratory, and Thomas-Jefferson National Accelerator Facility. He authored 81 publications, co-edited a book, and gave numerous presentations at both national and international conferences. Ficenec received his Ph.D. from the University of Illinois. ⚙

Physics alum is top Young Innovator and winner of Black Enterprise's Rising Star Award



Colin Hill, a 1996 graduate of Virginia Tech's department of physics, named to the 2004 list of the world's 100 top Young Innovators by Technology Review, MIT's Magazine of Innovation.

Hill also won the Black Enterprise's Rising Star Award, which recognizes an individual under the age of 35 whose outstanding skills, professionalism, and perseverance establish him as a future business leader.

Hill is the CEO and co-founder of Gene Network Sciences (GNS), a company which uses biological and chemical data to create robust computer models of cell function and human biology.

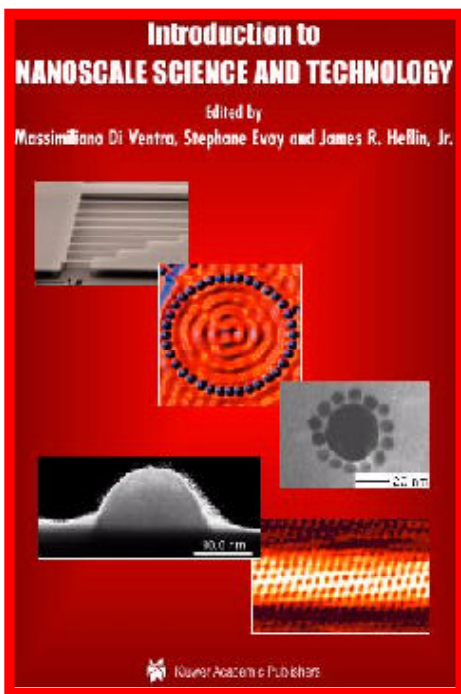
He credits his success to years of hands-on-experience and a strong background in computational physics and systems biology, which has allowed him to develop a strategic roadmap that makes his company a forerunner in the industry.

Hill readily acknowledges the support he received at Virginia Tech, and gives thanks to his advisors, Royce Zia and Beate Schmittmann, with whom he did his first research in complex systems and chaos theory. ⚙

Introduction to Nanoscale Science and Technology

Excerpts from: Susan Truelove, *Virginia Tech News*, July 16, 2004

Introduction to Nanoscale Science and Technology, has just been released by Kluwer Academic Publishers (www.wkap.nl/prod/b/1-4020-7720-3). The book was created by **James R.**



Heflin Jr. of the **Virginia Tech Department of Physics**, Stephane Evoy of the University of Pennsylvania Department of Electrical and Systems Engineering, and Massimiliano Di Ventra of the University of California at San Diego Department of Physics.

The textbook consists of 23 chapters in seven sections, beginning with the fundamentals, how to make and characterize nanoscale materials and an overview of the new classes of materials. The authors describe the top-down approach, or lithography, as “similar to the work of a sculptor carving a face from a block of marble.” On the other hand, the bottom-up approach is the assembly of individual atoms and molecules to form complex systems.

The second section of the textbook looks at the new materials that have become the building blocks of nanotechnology – the hollow carbon

molecules called fullerenes and nanotubes; nanocomposite materials designed to display the properties of their minute components; and collections of small numbers of atoms with altered electronic and optical properties, called quantum dots.

The remaining five sections describe applications. “A major goal of nanotechnology is to develop materials and devices that outperform existing technologies,” the editors explain in the text’s introduction. Thus, there is a section on electronics. Nanotechnology means smaller and faster microelectronic devices with individual molecules built as electronic components and even single electron transistors.

A section on nanoscale magnetic systems looks at quantum computing and magnetic storage. A section on nanoelectromechanical systems examines nanomachined mechanical structures and single-chip systems that can sense, compute, and communicate. A section on photonic materials reviews inorganic semiconductor systems and looks ahead to organic, self-assembled materials with a range of applications, such as improved solar cells, modulators for communication systems, and flexible flat panel displays.

The final section provides an overview of nanoscale biological systems, including those that aim to replicate the function of natural structures, membranes, and fluids. Structures for bone growth, implants that won’t be rejected, and biomolecular motors to replicate natural mechanical activity are examples.

Each chapter provides an overview, with examples selected for educational value and written in a manner accessible to both science and engineering disciplines.

The textbook avoids jargon and overly-technical terms. All of the chapters have end-of-chapter questions. In most cases these relate directly to the content of the chapter while other questions require the student to look at reference material or beyond for answers. Instructors can find the solutions on a password-protected website.

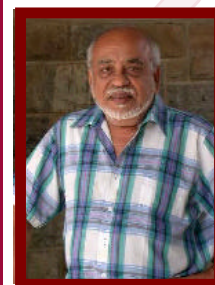
To keep the cost down, the book is in

black and white. But copies of all the figures – most of them in color – are included in PowerPoint files on a CD that accompanies each copy of the book.

Because of the rapid evolution of the field, in three years, the book will have to be substantially updated to include the latest advances.”

Welcome new faculty

Raju Raghavan



was formerly a Distinguished Member of Bell Laboratories and joined Virginia Tech in the summer of 2004. He is an experimental physicist who has worked for

many years in the field of astroparticle physics, in particular, solar neutrino physics and astrophysics. Raju is a senior collaborator in the BOREXINO experiment at Gran Sasso, Italy (in which Virginia Tech scientists have been participating for many years). At Virginia Tech, Raju hopes to develop a neutrino group and a new experiment—LENS—aimed at observing neutrinos from the fundamental proton-proton reaction in the sun. This project is expected to be a seed experiment in the nearby Kimballton mine in anticipation of a diverse multi-disciplinary science program intended for the Virginia Tech based National Center DUSEL (Deep Underground Science & Engineering Lab) at Kimballton.

- see “Faculty” pg 7-

Crouch

continued from page 3

Alumnus award, and NASA's Exceptional Performance Award and Special Achievement Award. Crouch had a role in a PBS video on microgravity that received a 2003 Emmy.

The College of Science at Virginia Tech gives students a comprehensive foundation in the scientific method. Outstanding faculty members teach courses and conduct research in biology, chemistry, economics, geosciences, mathematics, physics, psychology, and statistics. The college is dedicated to fostering a research intensive environment and offers programs in nano-scale and biological sciences, information theory and science, and supports research centers—in areas such as biomedical



Photo credit: NASA

and public health sciences, and critical technology and applied science—that encompass other colleges at the university. The College of Science also houses programs in pre-medicine and scientific law.

Founded in 1872 as a land-grant college, Virginia Tech has grown to become among the largest universities in the Commonwealth of Virginia. Today, Virginia Tech's eight colleges are dedicated to putting knowledge to work through teaching, research, and outreach activities and to fulfilling its vision to be among the top research universities in the nation. At its 2,600-acre main campus located in Blacksburg and other campus centers in Northern Virginia, Southwest Virginia, Hampton Roads, Richmond, and Roanoke, Virginia Tech enrolls more than 28,000 full- and part-time undergraduate and graduate students from all 50 states and more than 100 countries in 180 academic degree programs. ⚙️

Faculty

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Giti A. Khodaparast



comes to us from Rice University in Houston, Texas, where she has worked as a Post-doctoral Research Associate since 2001.

Her Ph.D. in Physics is from the University of Oklahoma. She describes her research as focusing on understanding the quantum states and charge/spin dynamics in low-dimensional systems. She uses magneto-optical and time-resolved ultrafast spectroscopy to study materials such as semiconductor hetero-structures, magnetic semiconductors, and quantum dots. These research activities will develop concepts for new devices as well as elucidate the fundamental physics. The experimental facilities include a femtosecond near-infrared laser and cryogenic equipments. ⚙️

Rahul Kulkarni



comes to us from his position as a postdoctoral research scientist at NEC laboratories. Prior to his experience there, he earned an MS in Physics from the Indian Institute of Technology and a Ph.D. in the same field from The Ohio State University. Dr. Kulkarni


is currently working on a number of research projects, including experiments in quorum-sensing regulatory networks in bacteria, comparative genomics studies of small RNA regulation in bacteria, oscillations and sub-cellular localization of Min proteins in *E.coli*, protein misfolding and aggregation in prion disease incubation, structural and dynamical properties of networks. He is also working on an integrated analysis of biological networks and processes using computational modeling and bio-informatics. ⚙️

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- ◆ Through gift planning - charitable gifts that provide an income.
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To learn more on the different ways you can give, visit the Virginia Tech, Office of University Development - "Ways to Give" website at <http://www.givingto.vt.edu/>. However you choose to give, private giving contributes immeasurably to making Virginia Tech a world-class institution. Contributions are tax deductible as provided by law. 

*Thank you in advance,
Royce K.P. Zia, Chair*

By contributing to the education of physics, you contribute to the future for all!

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