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

PHYSICS

A UNIVERSITY EXEMPLARY DEPARTMENT

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'Nano' next big prefix

Imagine stuffing the entire contents of the Library of Congress into a box the size of a sugar cube, or sending a molecular robot through your bloodstream on a mission to wipe out cancer cells. Such are the more wild-eyed ideas being bandied about by researchers in the fuzzily defined but rapidly emerging field of nanoscience.

But while many scientists disregard such notions as mere pie-in-the-sky promises, members of the nation's scientific community are nearly unanimous in believing that nanoscience will soon yield other world-changing technological riches. According to scientists, "nano-" is the next great prefix, following on the heels of e- as in e-commerce and bio- as in biomedical technology.

"Nanotechnology is clearly the field of the future," said Dr. George Gruner of the University of California at Los Angeles earlier this week at a nanoscience mini-conference held at Virginia Tech.

"This is certainly an exciting time for those of us who work in the field, with explosive growth and all kinds of impressive achievements," echoed Virginia Tech physics professor Randy Heflin.

Nanoscience, roughly defined, is the study of particles no bigger than a billionth of a meter. It is, in short, the manipulation of molecules. The field embraces researchers from myriad disciplines - physics, chemistry, engineering and computing, for instance - and could lead to breakthroughs in areas as diverse as medicine, electronics, energy,

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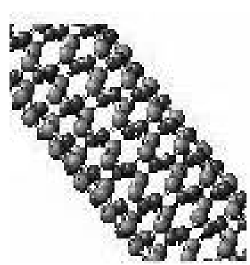
Mini-conference on Nanoscience/ Engineering

The Virginia Tech Mini-Conference on Nanoscience/Engineering, sponsored by the College of Arts and Sciences, the College of Engineering, and the Office of Research and Graduate Studies was held November 13-14, 2000.

The conference was designed to raise the awareness of scientists and engineers in Virginia to the interests that exist world wide in promoting synergism through collaboration among researchers in the field of nanoscience and engineering.



Presenters from the Virginia Tech Physics Department and their topics were Richard Zallen, "Spectroscopic Probes of Nano-crystal Size"; Randy Heflin, "Self-assembled Polymer and Fullerene Nanostructures for Optoelectronic Devices"; and Massimiliano Di Ventra, "Electronic Transport in Molecular Devices."

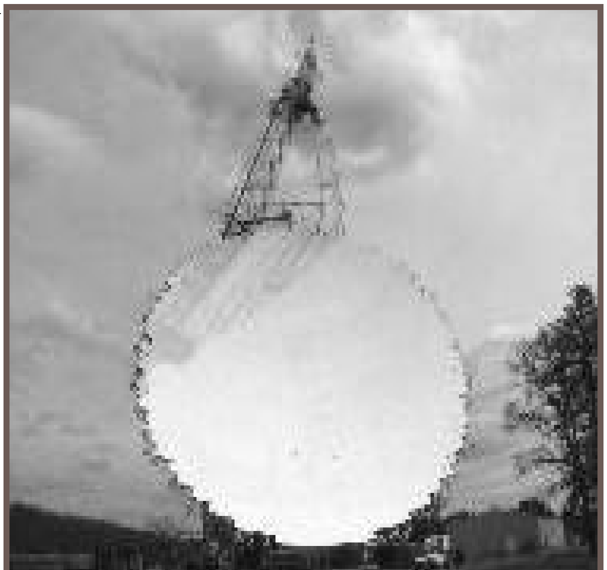
The Green Bank Telescope

by John Broderick

On a sunny day last August 28th hundreds of people gathered at the National Radio Astronomy Observatory at Green Bank, West Virginia to dedicate the Robert C. Byrd Green Bank Telescope (hereafter called by its affectionate nickname, the GBT). Sen. Byrd gave the keynote address at the dedication, preceded by remarks from the heads of NASA and the NSF. At the beginning of the dedication ceremony a rhythmic drumming noise could be heard — like someone beating a drum but not very musically. It turned out to be an audio display of a pulsar that the telescope was tracking. This was the same pulsar that had been observed during the "first light" observations for the telescope two nights earlier. This dedication ceremony culminated a 12-year quest for a new, state-of-the-art radio telescope to replace the one I broke (by accident) in November 1988.

I didn't really break the old 300-foot telescope but an observing program of mine (along with two NRAO scientists) was running at the time of its demise. People have kidded me about breaking the 300-foot, and I tell them I'm proud to claim it. Proud because its collapse led to the replacement of a telescope built in 1962 costing $800,000, as a stopgap instrument to be used only until the 140-foot telescope construction was completed. This replacement telescope (the GBT) cost more than $75-million. Although its aperture is not significantly larger than the 300 foot (101 meters versus 92 meters), its new features are well worth the increased replacement cost — like wrecking an old Corvair and getting it replaced by a new Corvette.

The GBT will be able to observe at wavelengths shorter than 3 mm, whereas the 300-foot had trouble even with 6-cm wavelengths. (A good telescope has a reflecting surface at least16 times smoother than the observing wavelength; thus shorter wavelengths require more accurate surfaces.) The surface of the GBT can be kept accurate to such small tolerances by actuators that adjust the 2004 panels making up the surface, overcoming surface deformations caused by temperature, wind and gravity. Short wavelength capability is important because many molecules produce spectral lines in the millimeter-wavelength end of the radio band. Carbon monoxide (CO) is one of the most important of these molecules. CO shines brightly at a wavelength of 2.6 mm and is an effective tracer of the molecular hydrogen gas that makes up giant molecular clouds -- sites of star formation that can be up to a million times more massive than the sun. Molecular hydrogen is the most abundant molecule in the universe but is nearly invisible even though it is a hundred thousand times more abundant than CO. CO is so bright that it has been detected in quasars off on the other side of the universe. The GBT will be able to detect CO in many distant galaxies, helping us to better understand star formation in young galaxies, which themselves are still in the process of formation. We see these galaxies as they were long ago while still in their formation stage because their light has taken so long to get here.



GBT DISH - photo credits to **NRAO/AUI**

The GBT is fully steerable whereas the 300-foot was a meridian transit telescope; meaning that it could only look at the part of the sky which was transiting the meridian (the north-south line). Although the 300-foot could see any part of the sky above the southern horizon, it could only do so while that part transited the meridian. A weak source might not be detectable because of the short duration of the observation. The GBT will be able to track a radio source from horizon to horizon, if need be, to achieve the low noise levels necessary for detecting weak radio features.

An important new design feature of the telescope is its unblocked aperture; this is what makes it look so funny: like a giant erector-set big-bird. Signals from the sky are reflected to a focus placed off to the side of the dish, where they are collected, amplified and sent to the control room to be recorded and analyzed. As seen from the radio source the dish of the GBT has no obstructions in its wave path. Usually radio telescope "feeds" (the things that collect the incoming radio waves at the focal point) are placed directly

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Undergraduate Academic Advisor and Recruitment

Diane Walker-Green joined the Physics Department in February 2000, as the department undergraduate student advisor and recruitor. Diane has not only been an asset to the department, but to our current undergraduates as well. She has an excellent working relationship with the students and they come to her often for guidance. Join us in welcoming Diane as a member of our staff.

A personal statement: by Diane Walker-Green

I've had a very busy and exciting year. I've focused the recruiting portion of my duties on high school physics classes. In the past year I've visited 22 high schools, talking to physics, biology and chemistry students. My presentations include a suggestive list of high school courses that prepare a student to be strong in physics, combined with a little Hokie trivia, admissions information, and a heart to heart discussion on independence, maturing, and freedom that a student experiences when they first arrive on campus. I have also begun to build a working relationship with high schools that our current physics majors once attended. As a follow-up, each teacher receives a thank you note with a complimentary Virginia Tech promotional item, periodic updates on undergraduate information about the physics department and the departmental newsletter.

Even though I love to travel and meet prospective students, I have to admit that the part of my job I enjoy most is academic advising. As an advisor I follow the student's progress, as well as their course of study, and get to know them as a person. I not only get to talk with our students, but I listen to what they have to say. I encourage students to maintain an open line of communication. I sometimes serve as a liaison between faculty and students. When faculty members ask about a student for various reasons, I'm usually able to give them a little background information, as well as a progress report without ever pulling the students record.

My goals for the upcoming year are: 1) an undergraduate summer research program; 2) a summer camp for high school students; 3) establish a tutorial program that will be free for students who need tutoring; and 4) advanced placement certification workshop for high school teachers.

In closing, I'd like to thank the students, staff and faculty for their support, encouragement and suggestions. Your assistance has made my job very enjoyable.

(SPS) Hosts Zone Meeting

by Jerome Long

Representatives of SPS chapters in Zone 4 of the Society of Physics Students came to Blacksburg for a Zone Meeting on October 14, 2000. After Saturday morning coffee and doughnuts, the meeting opened with a keynote lecture on the Theory of Strings by Virginia Tech Physics Chairman Dr. Lay Nam Chang. The morning session of the meeting included short presentations of the results of undergraduate research participation. The afternoon session featured a tour of departmental laboratories and a panel of three Virginia Tech Physics alumni who have gone on to diverse and successful careers. The meeting concluded with a pizza party and informal conversation.

The Society of Physics Students is an affiliate of the American Institute of Physics and manages a membership of some 6,000 physics students in over 650 chapters on campuses throughout North America. Each chapter belongs to one of 18 zones with some 25 to 45 chapters in each zone. The chapters from a zone attempt to hold one or two zone meetings each year. The 40 plus chapters of Zone 4 are those from the colleges and universities of Maryland, Virginia and the District of Columbia. Zone meetings and other affairs within a zone are coordinated by an elected Zone Councilor. The current Zone 4 Councilor is Dr. Jerome R. Long , Chapter Advisor for Virginia Tech. The Virginia Tech chapter, with an active program and one of the largest national memberships, has been one of the 5% of chapters consistently designated as outstanding by the national organization. Individuals and groups within the chapter have won numerous awards and other national recognition.

Due to the large travel time between chapters of Eastern Maryland and those of Western Virginia, Zone 4 attempts to have two annual meetings with a western meeting in the Fall and an eastern meeting in the Spring. Despite that long distance, the October 14 western meeting in Blacksburg drew attendees from Maryland's Towson University and tidewater Virginia's Hampton University. The Saturday morning session of student presentations included two contributions from each of those institutions. As one might expect, several students from the Virginia Tech chapter made presentations. The Spring meeting for Zone 4 was held at Towson University on March 31, 2001, and included participants from Virginia Tech.

Perhaps the most unusual of the features of the October 14 meeting was the panel of alumni on Saturday afternoon. The three alumni panelists were Ms. Noel Heiks ('92), Mr. Robin Clark, Esq. ('94) and Mr. Eric Carlson ('95). Each panelist gave a short presentation of the nature of

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2001-2002 Award Winners

Alice Estes Martin Scholarship
Alma Robinson

Col. Nelson Carey Brown Memorial Scholarship
Jennifer Beard

Daniel C. & Delia F. Grant Endowed Scholarship
Anubav Vasudevan
Jerome Mettetal

Frank Leigh Robeson Scholarship
James Roberts, Seth Smith

H.Y. Loh Award
Josh King

Hugh D. Ussery Scholarship
Larry Cook

Robert C. Richardson Scholarship
Rafael Hipilito

Robert P. Hamilton Prize
Beth Reid

Theodore E. Leinhardt Scholarship
Zachary Lewis

Webster & Sara Schoene Richardson Memorial Scholarship
Christopher Graziul

C.H. Wan Scholarship
Anubav Vasudevan

Ray F. Tipsword Graduate Scholarship
Robert J. Astalos

Jamie Dunn Award
Thomas J. Bullard

The Green Bank Telescope

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in front of the dish. The feeds are held there by feed-support legs that make the dish, as seen from the radio source, appear to be blocked by an X-shaped obstruction. Although this obstruction doesn't remove much signal (the blocking area of the feed-support legs is much smaller than the total area of the dish), what happens is that signals from other directions of the sky can scatter, reflect or diffract into the feeds and contaminate the observation. The detected signal comes not just from the direction in which the telescope is pointing but also from other points in the sky. These contaminating signals, called sidelobes, form a four-point star, a familiar sight in astronomical photographs. Sidelobes aren't too much of a problem for optical astronomy, but they can be particularly troublesome when mapping the wide-scale distribution of spectral-line-emitting gas like neutral hydrogen. Strong signals from a cloud of gas in a nearby part of the sky can get scattered into the feed and overwhelm the weak signal coming from the location being observed. The GBT will not have this problem. Another useful property of an unblocked aperture is the absence of standing waves, which contaminate the baseline of spectral-line observations. These standing waves, which are amplified by multiple reflections between the dish and the feed, produce a wavy baseline in the plot of line strength versus observing frequency. The peaks and troughs of this undulating baseline can mask the presence of weak, broadened spectral lines. Because multiple reflections do not occur with an off-axis focus, the problem is neatly avoided.

GBT STRUCTURE- photo credits to **NRAO/AUI**

Currently the NRAO is accepting "Early Science" proposals while the testing of the telescope and the installation of new receivers proceed. Longer wavelength observations will get the first crack at the telescope. Once the complicated servo-system needed to maintain the high surface accuracy is working, the usable wave-lengths will begin to shrink. Our own Prof. Brian Dennison will be among these early users. He will collaborate with NRAO scientists (including Physics Department alumnus, Toney Minter) to try to make the first detection of a very broad fine-structure line of atomic hydrogen. Without the flat baseline capability of the GBT this project could not be done.

Tech astronomers have always had a close connection with this nearby observatory, and with the GBT on line this connection will continue and perhaps even grow closer.

Student News

Graduate student, Mark F. Makela, Department of Physics was selected to attend the 51st Meeting of Nobel Laureates. Mark is currently working with Prof. Bruce Vogelaar. Congratulations, Mark!

Physics Research Reports

New and on-going initiatives

Theoretical physicist shows single molecule can be transistor

The problem: Smaller, more powerful microprocessors require squeezing more transistors into a single chip—but there's a limit.

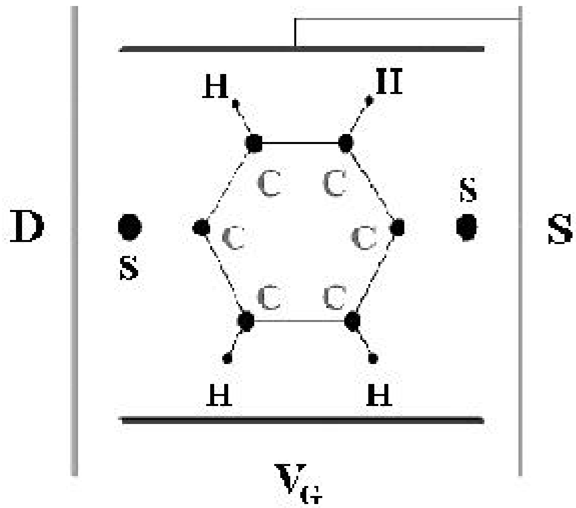
Transistors switch current on and off and amplify current. In existing transistors, this is done by applying voltage to a gate electrode between the input (source) and output (drain) electrodes. More transistors in a single chip means more computational speed. Presently, a single chip can hold up to about 50 million transistors, but leakage and tunneling are already a problem. Stray current (leakage) causes crossed signals, and electrons by-passing gate fields (tunneling) prevents current amplification.

The solution may be molecular electronics. "We can use molecules as transistors, switches, and memory devices," said Massimiliano Di Ventra, who joined the physics faculty at Virginia Tech this summer.

"We want to integrate billions of molecules into a single chip," he said. "We will have this technology probably in 15 to 20 years."

Di Ventra is a theoretical physicist whose research focus is to understand how molecular electronic devices work. He studies how a specific molecule will behave under current flow. "I inject current into the molecule to see if it can work like a transistor, a switching device, and the like." Last spring, he demonstrated that a benzene molecule can work as a transistor (published in the June 5, 2000 issue of *Applied Physics Letters*), acting not only as a switch but also as an amplifier.

Nature columnist Philip Ball hailed the work in a "Science Update" article titled "Painless Gain" (*Nature*, June 2, 2000).



Benzene molecule as transistor

The transistor 's role as an amplifier is critical to ensure that signals remain strong as they pass from place to place. "So far, obtaining gain from a single-molecule device has been a big stumbling block for molecular electronics," Ball wrote. "Now Massimiliano Di Ventra …and his colleagues have shown that this hurdle is, in principle at least, surmountable."

Benzene is a common molecule made up of six carbon atoms forming a hexagon on a plane. It is abundant and cheap to manufacture. Di Ventra, Sokrates Patelides, a colleague in physics and astronomy at Vanderbilt University, and Norton Lang of the IBM Research Division in New York, did a computer simulation of a benzene molecule between two electrodes (the source and the drain) and applied an electric field perpendicular to the molecule (the gate field).

In the theoretical simulation with the benzene ring molecule, the drain and source are two gold electrodes connected to the benzene molecule by sulfur atoms. The gate consists of two charged metal disks above and below the molecule and between the electrodes. The electrons flow from source to drain,but the gate field can be adjusted to control the electron flow.

For some voltage at the gate field an "electronic bridge" is formed between source and drain and electrons can tunnel across the molecule easily, allowing a large current flow. This electronic bridge is called "resonant-tunneling." Thus, the molecule acts as a switch, and the signal is amplified by the gate as in conventional field-effect transistors.

"Now, tunneling destroys chips if they are too crowded, but, with molecules we can use the phenomenon to our advantage," Di Ventra said. "We demonstrated that single molecules can do the same job as transistors. But these single elements need to be combined to form molecular chips. This is a major technological problem. It is like in the 1940's when the transistor was invented: It took 25 years before transistors could be put together in integrated circuits."

"The next step in molecular electronics is to develop molecular chips that will replace the ones we use in our computers," he said.

Thanks to Susan Trulove of the Spectrum for the contribution of this article.

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Physics Research Reports

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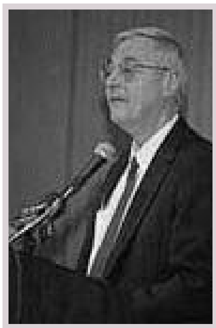
Carilion Biomedical Institute's Optical Sciences and Engineering Research (OSER) Center

Bill Spillman joined Virginia Tech in 1999 to be the Director of the Carilion Biomedical Institute's Optical Sciences and Engineering Research (OSER) Center. Prior to that, he was Director of Research and Chief Scientist at the BF Goodrich Aircraft Integrated Systems Division.



Just before coming to Tech, Bill spent 2 years working on so-called "smart" biomedical implants. He received his Ph.D. in experimental condensed matter physics in 1977 from Northeastern University in Boston and joined the physics department last year as an associate professor. He taught the Introduction to Biophysics course last fall and will be teaching it again in the fall of 2001.

His current research interests lie in biophysics and include smart biomedical implants, automated evolutionary system design, adaptive computational techniques, hyperspectral image processing using cellular automata, and complex adaptive systems. He is presently investigating the possibility of modeling the electro-static self-assembly process used in nanofabrication through the use of artificial life concepts. Bill is a fellow of the SPIE and last month was elected a Fellow and Charter Physicist of the Institute of Physics in the U.K. This June he will be chairing an SPIE conference on Complex Adaptive Structures.

The OSER Center which Bill directs was created from a partnership between the Carilion Health System, Tech and the University of Virginia. It has 3 goals: (1) to improve the research standing in the biomedical area of the partner universities, (2) to improve the health care of the region and the world, and (3) to create economic development in this region. OSER currently solicits and awards grants throughout the university of approximately $750K/year based on a call for proposals posted on the center website (www.OSER.vt.edu).

One of Bill's particular interests is to foster the development of a strong research base in biophysics at Tech. Biophysics is a new but rapidly growing interdisciplinary field where the mathematical rigor and physical insights of physics are applied to the complex adaptive systems of the living world. Bioinformatics is only one example of such activity. Bill would be happy to speak with anyone wishing to learn in more detail about OSER and its programs, as well as opportunities for support and research (wspillma@vt.edu).

Biophysics is a new but rapidly growing interdisciplinary field where the mathematical rigor and physical insights of physics are applied to complex systems of the living world.

Prof. Royce Zia "Scientist in Residence"

At the invitation by Prof. Hans-Werner Diehl of the University of Essen (Germany) <http://www.theo-phys.uni-essen.de/tp/ags/diehl_dir/index.e.html>, Prof. Royce Zia spent 5 months (July-December, 2000) there as a "Scientist in Residence." With no specific duties, he was able to devote all of his time to research on statistical mechanics, especially for systems in non-equilibrium steady states. In addition to research and writing, he was able to travel around Europe, giving seminars/colloquia. His trip began with lecturing at the Eotvos School and Workshop on *Phase Separation in Physics, Chemistry, and Biology* <http://poe.elte.hu/~racz/eotvos.html>. Held at the Eotvos University (Budapest, Hungary), this combination of school and workshop is designed for advanced graduate students and postdoctoral research associates, focusing on the subject of pattern formation in a wide range of areas. Thereafter, Prof. Zia was based mainly in Essen, but, took this opportunity to visit his many friends and collaborators in a dozen institutions around Germany, Belgium, Denmark, England, and Holland.

'Nano'

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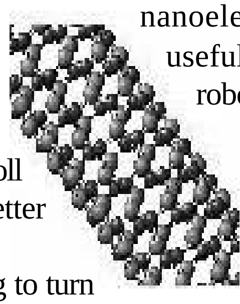
biotechnology, information technology, environmental science and agriculture.

To understand the different potentials of tweaking molecules, consider that Lucent Technologies and Oxford University have used nanoscience to create a tiny pair of tweezers composed completely of DNA strands, while Motorola Corp. is trying to find a way to use carbon nanotubes - sheets of carbon molecules rolled up the way you might roll up a newspaper - to create a better computer display screen.



Other scientists are working to turn a single molecule into an electric circuit, and some scientists are pondering ways atoms can be manipulated to one day create a "quantum computer" that can solve in one year problems that would take today's best computers billions of years to figure out.

So important is the nanoscience field that President Clinton announced a National Nanotechnology Initiative earlier this year and proposed $500 million in funding. [editors note: Initiative announced early 2000].

Research universities across the country, eyeing the federal funding, have intensified their work on nanotechnology and have begun offering more nano-related classes. Virginia Tech, looking to move ahead of other institutions, is considering the creation of an interdisciplinary Center for Self-Assembled Nanostructures and Devices.

The promises of nanoscience are only a few years away, said Stephen Turner, a physics professor at Cornell who spoke at Virginia Tech's nanoscience mini-conference. "We're trying to do things that are going to be used three or four years from now."

Alex Zettl, physics professor at the University of California at Berkeley, said research there on carbon nanotubes has yielded ways to build nanosprings, nano-bearings and nanoelectric switches, potentially useful if molecular engines and robots become reality.

Scientists say there are still problems to overcome and questions to answer, but the research conducted so far promises that manipulating molecules will produce incredible technological advances.

As Zettl said of his nanotube research: "It turns out all these things are working out better than we had a right to expect."

"We're trying to do things that are going to be used three or four years from now."
- Dr. Stephen Turner

New Faculty Members

Massimiliano Di Ventra - Massimiliano Di Ventra obtained his BS degree in Physics magna cum laude from the University of Trieste, Italy, in 1991 and his PhD in Physics from the Ecole Polytechnique Federale of Lausanne, Switzerland in 1997. The same year he moved to Vanderbilt University as Research Associate and in 1999 he became Research Assistant Professor in the same University. Since 1998 he has been Visiting Scientist at IBM T.J. Watson Research Center. In summer 2000 he was appointed Assistant Professor of Physics at Virginia Tech. His research focus is in first-principles atomistic simulations of electronic, optical, and transport properties of materials with special emphasis on wide-bandgap materials, biological systems and devices for Molecular Electronics applications. His work in molecular electronics has been featured twice in the journal Nature and other national and international journals. He has been invited to give more than thirty presentations at conferences, workshops and seminars at universities, national and industrial laboratories worldwide. He has also filed a patent on a novel processing for power-electronics applications.

Caren Hagner - Caren Hagner obtained her PhD in Physics from the "Technische Universität München" (TUM), Germany in 1995 were she participated in an experiment searching for neutrino decays at a nuclear power reactor in Bugey (France). She was awarded the prize for best thesis of the year at TUM. She then received a Marie-Curie Fellowship and was Research Associate at the "Commisariat à l'Énergie Atomique" in Saclay (France), where she participated in the NOMAD neutrino oscillation experiment at CERN (Geneva, Switzerland). In 1997 she joined the BOREXINO group, a solar neutrino experiment at the Gran Sasso Underground Laboratory in Italy, at the "Technische Universität München" as Research Associate. She was a member of the Astroparticle Physics Center in Munich focusing on Dark Matter Search. In January 2001 she moved to Virginia Tech where she was appointed Assistant Professor. Her work in experimental particle physics has been focused on Neutrino Physics. It covers a large variety of detection techniques (from wire chambers to ultra-low radioactivity liquid scintillator detectors) and neutrino energies (low energy reactor neutrinos, solar neutrinos, supernova neutrinos and high energy neutrinos from accelerators). At Virginia Tech she will join the group of the BELLE experiment at KEK(Japan) where B-Physics and CP-Violation are studied.

Physics Department Retreat

by John Ficenec

The department held a retreat on September 22-23, 2001, at Mountain Lake Resort, Mountain Lake, Virginia, with 85% of the faculty in attendance. The secluded and colorful surroundings provided an uplifting environment, free of the usual interruptions on campus. The retreat format consisted of breakout sessions with small-group discussions, followed by group reports and discussions among all participants.

The first discussion was focused on long-term research interests and the number of faculty required to have an impact in each research area. Initiation of new re-search directions such as nano-science, bioscience, and quantum computing; reconfiguration of current programs in astrophysics and theoretical mesoscopic physics; and consolidation of our base programs in astronomy, particle physics, and condensed-matter/optics were discussed. A general consensus was reached on new faculty hires for the next several years in order to position the department with the proper mix of applied and fundamental research.

The second discussion was focused on the teaching and outreach mission of the department. Service courses and the role of technology in these courses; the number and types of undergraduate and and graduate courses to better serve the needs of BS/BA, MS, and PhD graduates; retention of undergraduate majors; and the level of expanded off-campus course offerings and outreach to serve the needs of non-traditional students and the public at large were discussed. Several suggestions surfaced in these discussions which are being examined in more detail with a goal of implementation.

An opportunity to engage in less physics-focused conversation was provided by a cocktail hour, dinner, and sleep-over for faculty, staff, and their significant others. The astronomy group provided the participants with a tour of the observatory or a keystone-cop film clip of the CCD-equipped telescope proposal and construction process. An enjoyable time was had by all, with a renewed sense of a commonly-held direction for the department.

SPS Zone Meeting

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their work. The presentations were followed by open discussion between panelists and with the audience. Ms. Heiks is currently Vice President for Sales and Marketing with HALEOS, Inc. Robin Clark is a patents attorney with the firm of Hunton & Williams. Eric Carlson is a staff scientist at HyTech Research Corp. The Society of Physics Students is very grateful to these persons for giving of their Saturday time to participate freely in this exchange.

"DID YOU KNOW??"

There are many different ways to give to your favorite programs at Virginia Tech, including the Department of Physics. Most people know about making cash donations, but there are other methods to give that may better suit your financial situation. You may be surprised to learn what kinds of gifts Virginia Tech accepts, and how you can avoid some taxes you thought you would have to pay. For more information about giving stock, receiving income in exchange for your gift or making a donation through your estate plans, please contact Connie Talbott, the Director of Development for the College of Arts & Sciences, or one of our gift planning professionals at (800) 533-1144.

Article written by Kevin Weekly, Assoc. Director of Planned Giving, University Develoment.

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