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ON TARGET

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# JLab Upgrade named near-term priority in DOE 20-year facility plan

## *Orbach visits Lab for On-Site Review*

**DOE unveils 20-year facility plan**

Jefferson Lab's 12 GeV (billion electron volt) Upgrade was among the 12 projects identified as near-term priorities when Energy Secretary Spencer Abraham outlined the Department of Energy's Office of Science 20-year facility plan on Nov. 10 in Washington, D.C. The plan prioritized a total of 28 projects, culled from the more than 50 projects over $50 million initially proposed, and includes new scientific facilities and upgrades to current facilities that will keep the United States on the leading edge of world-class science.

Jefferson Lab's Upgrade will double the existing energy of its electron beam to create a 12 GeV beam capable of providing much more precise data on the structure of protons and neutrons. Specifically, the upgrade will enable scientists to address one of the great mysteries of modern physics — the strong force — the mechanism that "confines" quarks together. New supercomputing studies indicate that force fields called "flux-tubes" may be responsible, and that exciting these flux-tubes should lead to the creation of never-before-seen particles.

"Upgrades to facilities, such as the Continuous Electron Beam Accelerator, would essentially create new facilities by applying advanced technology to

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Office of Science Director Ray Orbach (right) discusses JLab's science program with Larry Cardman, Associate Director of the Physics Division, during the Nov. 3 Department of Energy On-Site Review.

# DOE's 20-year plan unveiled; Office of Science Director visits JLab for Review...

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our current stock of powerful research machines," Secretary Abraham said during his comments at a National Press Club luncheon. "The upgrade to this accelerator…will double its power and apply advanced computing power to help us explain the properties of one of the strangest particles yet discovered — the quark."

"From the very large, with new pictures of how our universe evolved, to the very small with insights into the structure of the nucleus, the facilities we are proposing will secure American pre-eminence in science for the better part of the 21st century," he continued.

The next step in Jefferson Lab's 12 GeV Upgrade construction project will be receipt of Critical Decision Zero (CD0) approval from the Department of Energy's Office of Science.

To download a copy of the DOE 20-year facility plan, the text of Secretary Abraham's Nov. 10 speech, or information on JLab's 12 GeV Upgrade, visit www.jlab.org.

## On-Site Review Highlights

The Department of Energy, Office of Science Director Ray Orbach received briefings on Jefferson Lab's projects and heard about the Lab's planned 12 GeV Upgrade and long-range vision during his visit to the Lab on Nov. 3.

The On-Site Review agenda included discussions on the Lab's science program, on-going projects, the 12 GeV Upgrade and the Lab's forward vision — or long-range plan — out to 20 years.

Topics of interest to Orbach included Lab-wide safety, the status of on-going production work on Spallation Neutron Source cryomodules, the Lab's relationship with DOE, its Science Education program, and enhancing superconducting radiofrequency (srf) programmatic efforts at JLab. Lab leadership engaged in a lively discussion in addressing concerns about Lab safety, the loss of five weeks of science production due to Hurricane Isabel, and yield issues in cryomodule production.

At Orbach's request the meeting was held with a minimum of participants.

Lab Director Christoph Leemann said the review went well. Orbach was delighted with JLab's science program and that the Lab has a clear vision for the next 20 to 30 years. He expects excellence in all areas: safety, business systems and property management, and expects JLab to become second to none in the world in srf technology.

Dennis Kovar, Associate Director for the Office of Nuclear Physics (front row, left to right) listens to a briefing during the On-Site Review, along with Ray Orbach, Director of DOE's Office of Science; Jeffrey Salmon, Office of Science Chief of Staff and Jerry Draayer, President of the Southeastern Universities Research Association. JLab Director Christoph Leemann (back row, 2nd from right), is flanked by several members of Lab management who participated in the Department of Energy review.

# From the Director

Christoph Leemann
Jefferson Lab Director

*12 GeV is within reach; we must rededicate ourselves to excellence*

Dear Colleagues:

As 2003 comes to a close, I would like to express my appreciation to Lab staff and managers. During the year the JLab community has enjoyed tremendous achievements and faced difficult challenges together. Our collective steadfast efforts have convinced our stakeholders that we are an able partner and contributor to the advancement of an exciting national science agenda. I know that Jefferson Lab's position is strong, and our future, expressed in a clear vision, is as promising as it has ever been in the life of the institution.

A decade of planning for the Lab's future and a solid record of performance culminated in JLab's 12 GeV Upgrade making the list of near-term priorities in the Department of Energy's 20-year facility plan that Energy Secretary Spencer Abraham unveiled on November 10. DOE Office of Science Director, Dr. Ray Orbach, also expressed his confidence in the Laboratory during the November On-Site Review, and at the last NSAC (Nuclear Science Advisory Committee) meeting he characterized the Lab's scientific achievements as "superb." He endorsed the Lab's vision and nuclear physics program plans for the next two decades. Dr. Orbach challenged the Lab to build on our unique expertise in superconducting radiofrequency (srf) technology and to secure world leadership in this challenging technology. The development of such a plan is underway.

Through the collaborative efforts of JLab users and staff, the Lab is gaining wider recognition as a leader in nuclear physics research and our research results are becoming more visible in professional literature and the popular press. During 2003, 60 papers based on experiments conducted at JLab were published in peer-reviewed journals; and stories about both proton form factor and pentaquark research conducted at JLab received extensive coverage nationally and internationally, including *The New York Times* and *The Economist*.

We've hired a new Chief Scientist of international repute, Dr. Tony Thomas, who will bring added scientific strength to our world-class nuclear physics program and help us shape our future. Professor Thomas is an eminent theorist with enormous contributions in the field of hadronic physics, and with a keen understanding of the mutually supporting roles that experiment, theory, and computer simulation have to play.

Congressional support remains strong for JLab. We are delighted by the report language in the fiscal year 2004 Energy & Water Appropriation Bill that strongly supports both ongoing operations and the Upgrade.

Thanks to your competence, dedication and hard work, we have completed the year with an "outstanding" rating as measured by the metrics and peer reviews of our performance-based contract. JLab's SNS (Spallation Neutron Source) Team has delivered a number of cryomodules that meet or exceed specifications for the project and are implementing a plan to improve cavity production processes in order to meet the Lab's commitment for SNS on-time completion.

The accelerator recovery from Hurricane Isabel is progressing very well. The entire machine was brought back to 2 Kelvin in late October and efforts continue on rf tests for cavities and on bringing the beam to required specifications for scheduled experiments. The impact on the experimental program has been a schedule delay of several weeks, and plans are being put in place to fully recover the schedule over the next two years. The Accelerator Division made a tremendous effort over many weeks to get the machine back up to par and they deserve our sincere thanks.

Our Administration Division staff has done an admirable job in dealing with hurricane preparation as well as the storm's aftermath and in bringing the long-awaited CEBAF Center addition to fruition.

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# Seven years of physics with CEBAF

## *Symposium attendees review scientific results, accomplishments*

JLab's accelerator site

*by Douglas Higinbotham*
*Staff Scientist*

Jefferson Lab staff and users celebrated the first seven years of physics with the Continuous Electron Beam Accelerator Facility, CEBAF, during a symposium held this summer in conjunction with the JLab User Group meeting.

The unique design of this electron accelerator allows three experimental halls to be operated simultaneously with a total beam current of 200 uA (microamps) and a beam polarization of up to 80 percent. CEBAF has a user community of more than a thousand scientists from 187 institutions in 20 countries. As of summer 2003, 81 nuclear physics experiments have been completed with substantial data taken on 23 more. From the data obtained in these experiments, more than 250 refereed journal articles and 146 doctoral degrees have been awarded. For the near future, there are over 60 experiments planned and 128 more Ph.D. theses in progress.

To recognize and review the accomplishments of Jefferson Lab while also looking toward the future, the JLab User Group Board of Directors organized the symposium which was held June 11 through 13 and dedicated to the memory of Nathan Isgur, Jefferson Lab's first Chief Scientist. The meeting was divided into eight physics topics: nucleon form factors, few-body physics, reactions involving nuclei, strangeness production, structure functions, parity violation, deep exclusive reactions, and hadron spectroscopy. Each topic was presented by one experimentalist and one theorist.

The symposium began with presentations on the nucleon form factors given by Donal Day, University of Virginia, and John Ralston, University of Kansas. The nucleon form factors probe the electromagnetic structure of the proton and neutron. The presentations included discussion of the most referenced and surprising result from Jefferson Lab, that the proton's form factors do not follow an expected simple relation. While theorists have proposed different models to explain this result, the basic ingredient in almost all new models is the addition of relativistic effects.

From the discussion of the nucleon, the talks continued with presentations focusing on few-body systems, such as the deuteron and $^3$He (Helium 3), by Paul Ulmer, Old Dominion University, and Franz Gross, College of William and Mary. Typically for these experiments, the Jefferson Lab electron beam is used to knock out a proton from the few-body system or to probe it with elastic scattering. The expected yield of these experiments can be calculated exactly, assuming nucleons and mesons are the underlying particles. The presentations showed that even with beam energies of up to 5.7 GeV (billion electron volts), the electron scattering results are surprisingly well explained by the nucleon-meson models to distance scales of order 0.5 fm (femtometers). In contrast, experiments on deuteron photodisintegration, which probe even smaller distance scales, have revealed clear evidence of the limitations of the nucleon-meson models and of the onset of quark-gluon degrees of freedom.

For reactions involving nuclei, i.e. many-body systems such as oxygen and carbon, statistical methods in the context of the nucleon-meson picture are used to calculate the expected yields of the quasi-elastic reaction. Larry Weinstein, Old Dominion University, presented a talk titled "So Where Are the Quarks?" in which he showed that the nucleon-meson model describes even the highest momentum transfer Jefferson Lab data, while Misak Sargsian, Florida International University, spoke mostly of the future, when the quark-gluon nature of matter should become evident from experiments with a 12 GeV electron beam.

Reinhard Schumacher, Carnegie Mellon University, and Steve Cotanch, North Carolina State

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University, presented reactions involving strangeness production which includes the production of particles such as kaons. The presenters showed [at the time] new Jefferson Lab data confirming the Theta-plus particle as discovered by SPring-8 in Japan. This exotic particle is comprised of five quarks and has been dubbed the pentaquark. This had been described as the first observed nucleon resonance comprised of more than three valence quarks and has sparked international excitement. A Jefferson Lab experiment to further study this new particle has already been approved.

Keith Griffioen, College of William and Mary, and Wally Melnitchouk, Jefferson Lab, presented structure function experiments, which provide information on the quark and gluon structure of the nucleon. While CEBAF's beam energy is relatively low for this type of experiment, the high luminosity that is available has allowed many high precision structure function results to be produced. An interesting feature of the Jefferson Lab data is that if one scales the smooth deep inelastic cross section results from high energy physics to the kinematics, the scaled results will pass through the average of the resonant peaks of the JLab data.

This effect, known as duality, may lead to a better understanding of how the underlying quarks and gluons link to the nucleon-meson models.

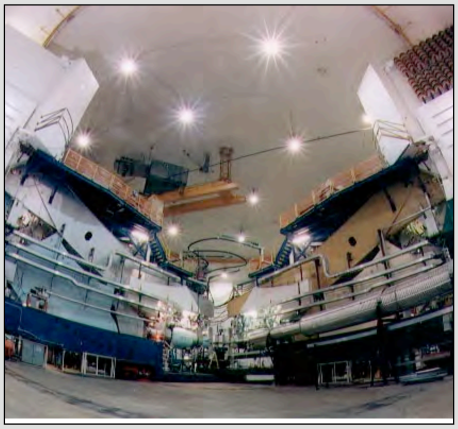
Krishna Kumar, University of Massachusetts, and Michael Ramsey-Musolf, California Institute of Technology, presented the parity violation experiments, where the strange quark distributions in the proton can be extracted by measuring the extremely small asymmetry in the elastic scattering of polarized electrons from an unpolarized proton target. One series of these experiments has already been completed at Jefferson Lab and several more are planned, including the G0 (G-Zero) and HAPPEX-II (Hall A Proton Parity Experiment) experiments scheduled for next year.

Deep exclusive reactions, experiments done in deep inelastic kinematics but where the detection of multiple particles allows the final state of the system to be determined, were presented by Michel Garçon, SPhN/Saclay (France), and Andrei Belitsky, University of Maryland. Generalized parton distribution models, which should enable a complete description of the nucleon's quark and gluon distributions to be extracted from this type of data, were presented along with the results from the HERMES (Germany) and Jefferson Lab deeply virtual Compton scattering experiments. The results indicate that generalized parton distributions can be extracted from this type of data. Several high-precision experiments are planned for the coming years.

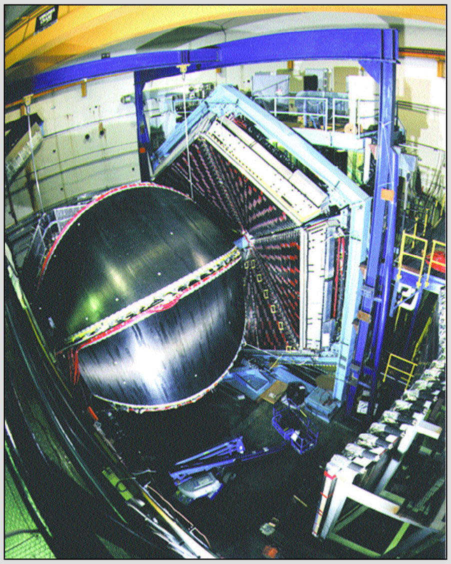
Steve Dytman, University of Pittsburgh, and Simon Capstick, Florida State University, presented the wealth of hadron spectroscopy data that is coming from Jefferson Lab. The analysis of the vast set of data produced by JLab on the nucleon resonances has only been partially completed but hints of new states are already emerging, while the work of doing a full partial-wave analysis of the data is getting underway.

Following the presentations, Larry Cardman, Jefferson Lab's Associate Director for Physics, presented the long-term outlook for the Lab. This talk focused primarily on upgrading CEBAF to a 12 GeV machine and building a fourth experimental hall. The higher energy would allow Jefferson Lab to continue its mission of mapping out the transition from the low-energy region where matter can be thought of as made of nucleons and mesons to the high-energy region that reveals the fundamental quark and gluon nature of matter.

Copies of these presentations can be found at www.jlab.org/div_dept/physics_division/talks/Users_meeting_2003.html.



Hall A



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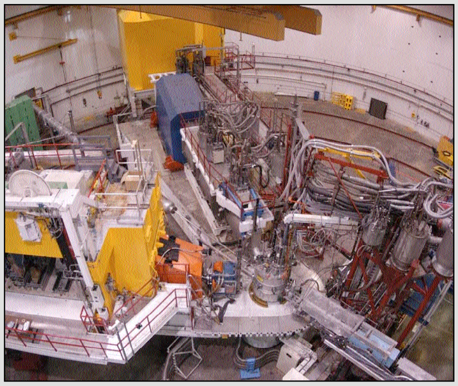

Hall C

# Detector Group update

## *New projects challenge, excite scientists*

*by James Schultz*

Concerned family members rush a potential heart-attack sufferer to a local emergency room. There, physicians hurry to ensure the patient doesn't go into full cardiac arrest. Using a portable imager to pinpoint blood flow through the heart, a cardiologist determines within minutes that there's a small blockage in one of the major vessels. A minimally invasive procedure is performed and the vessel is cleared. Within a day or so, the patient will be resting comfortably at home.

Thanks to the work of Jefferson Lab's Detector Group that scenario, or one like it, could soon be more common. Underwritten by the U.S. Army and in collaboration with the University of Florida, the Group is beginning development of a compact heart imager that can be quickly deployed and easily moved between such hospital areas as emergency departments and intensive care units. The Group will build and test the heart imager in stages, and although the work has only recently begun, the eventual practical results could prove dramatic.

"It's the most challenging project we've ever taken on," says Stan Majewski, Detector Group leader. "It will be incredibly gratifying if we're successful."

The $1.2 million, three-year heart-imager project is but one of several multiyear projects in which the Group is engaged. Two others involve application of small, portable breast imagers that make use of the positron emission mammography, or PEM, technique to detect cancerous breast lesions and help guide physicians in the taking of biopsies in hopes of identifying early-stage cancers. Another centers around gamma-ray detectors that could be used by neurologists to better monitor special radiation treatment of brain cancer. A fifth is concentrating on the development of a high-resolution gamma imager using single-photon emission-computed tomography, or SPECT, to reveal basic metabolic processes in small, unanesthetized animals.

Each of the projects is being funded in full or in part by monies provided by either the Department of Energy's Office of Biological and Environmental Research, the Army or the National Institutes of Health. Each of these imager-development efforts will continue for three to five years; as innovative technology of this kind requires time to devise, test and verify.

"If we want to have assured funding support, we have to be involved in more than one project at a time," Majewski says. "There's really no failure mode. Even in the worst case we end up with improved instruments. But we have no doubts that these devices will be useful. Some are actually already useful."

Whether used to diagnose maladies in the brain, heart or breast, all of these detectors owe their genesis to the expertise of the Detector Group members, developed as spin-offs of the sensitive gear used in the Lab's experimental halls to detect subatomic particles resulting from the collision of JLab's accelerated electron beam with a target material.

The Lab's scientists have adapted similar instrument concepts to sense the presence of trace amounts of injectable solutions containing slightly radioactive isotopes known as radiopharmaceuticals. One such radiopharmaceutical is fluorine-18 deoxyglucose, or FDG. As a harmless solution containing FDG circulates throughout the body, it tends to migrate to and accumulate in malignant cells because malignancy hungers for energy in the form of sugars to grow and spread. Once congregated in diseased tissues, the radiopharmaceuticals emit gamma rays, which are sensed by the detectors and then converted into electronic signals that can be rendered into a visible image. Depending on the kind of image processing employed, small tumors or other abnormalities usually reveal themselves as bright spots in the image.

In a series of clinical trials conducted at university hospitals and regional medical centers, the breast

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imagers developed by the Detector Group have proven exceptional performers, able to distinguish small tumors that otherwise would go unnoticed. Now, with one heart, one brain and two breast imagers at various stages of maturation, the Group's goal is to meet the competing requirements of practicality and cost, while retaining top-notch technical performance.

"We're getting into development of the most sophisticated instruments that we have ever built," Group leader Majewski explains. "These are complicated packages. Our challenge is to satisfy an array of specifications."

The Group has already "handed off" a market-ready version of one of its earliest detectors — a "gamma camera" licensed to the Newport News-based Dilon Technologies. The Dilon 6800 camera has completed successful clinical trials to indicate areas of hard-to-identify breast-cancer malignancies and received FDA (Food and Drug Administration) approval. The Dilon 6800 is smaller, mobile and more sensitive than larger, traditional nuclear-medicine diagnostic equipment, with an articulating arm and movable sensing plate that can be easily applied to the breast with little discomfort.

In the future, Lab-derived detector technology will be smaller, thinner and even more mobile, with detectors able to "see" at a much higher resolution. Results should improve even further as next-generation radiopharmaceuticals hit the market, enabling enhanced visual clarity. Ultimately, says Detector Group physicist and staff scientist Drew Weisenberger, the purpose is to make devices to preserve and protect human health.

"We want to make these detectors even better," Weisenberger asserts. "We want to do the [basic] science, and we also want to build these tools that can be useful to the medical community now."

JLab's Detector Group includes (front row, left to right) Brian Kross, Detector Technical Associate; Drew Weisenberger, Detector Systems Physicist; Stan Majewski, Detector Group Leader; Mark Smith, Biomedical Imaging Physicist; and (back row, l. to r.) Vladimir Popov, Imaging Detector Readout Specialist; Ben Welch, Imaging Detector Scientist; Carl Zorn, Detector Systems Physicist and Randy Wojcik, Detector Technical Associate.

# Detector Group update

## *Small-animal imaging project may better human health*

*by James Schultz*

In collaboration with Oak Ridge National Laboratory in Tennessee and Johns Hopkins University in Baltimore, instrumentation experts from Jefferson Lab's Detector Group are working to develop a small-animal imager that will reveal basic metabolic and physiological processes as unanesthetized animals move almost freely within a small enclosure. A major medium-term goal is to closely track the effects of a wide array of pharmaceuticals on living tissue.

For humans, one ultimate benefit of such a nuclear-medicine imager would be the ability of biomedical researchers to monitor, in real time, how newly developed medications disperse through the bloodstream to different organs. Eventually, the effects of gene therapy could likewise be monitored in response to differing treatments, to determine which work and which do not in animals, before clinical trials for humans are conducted. Nuclear-medicine studies of patients could also analyze individual reactions to medication, providing another tool in the ongoing evolution of the emerging field of personalized medicine.

"Our goal is to image the biodistribution of tracer molecules in living animals, or in human organs and tissues in order to better understand essential physiological processes," says Mark Smith, the biomedical-imaging physicist for JLab's Detector Group. "In the case of human patients the results can be used for diagnosis of disease."

The Lab's Detector Group is working on several projects that involve tracking radiopharmaceuticals, drugs that are "labeled" with atoms that decay to emit positrons or gamma-ray bursts that pinpoint pharmaceutical location. One such radiopharmaceutical is fluorine-18 deoxyglucose, or FDG, which is usually injected into the bloodstream. Typically FDG migrates to areas of greatest metabolic demand, such as cancerous cells, which use sugars and other nutrients to enlarge and spread. Adapting the particle-detector technologies used in physics experiments at JLab, Detector Group scientists are now working on the next generation of medical diagnostic gear that would detect and identify cancer in its earliest stages.

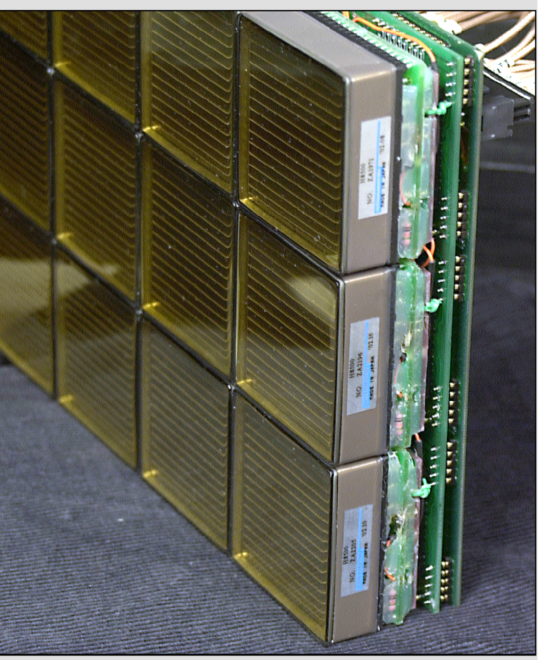
"The main goal would be to get better information so that patient treatment can be improved," Smith explains. "Suppose a person has cancer. Further suppose they have a PET [positron emission tomography] scan. [The images] would be a guide in helping the doctor determine whether to use surgery, chemotherapy, radiation therapy or some combination, depending on how the cancer has spread."

Currently, when doctors work with laboratory mice or other small animals, restraint through anesthesia affects the biodistribution and uptake mechanisms of radiopharmaceuticals. The imager that Smith and his colleagues are helping to create would enable a much clearer picture of metabolism as it occurs normally, without these complicating factors.

The resultant device will use a combination of Lab-developed gamma-ray detectors and single-photon emission-computed tomography, or SPECT, techniques to reconstruct three-dimensional images of radiotracer distribution. Researchers are examining which detector components and image-reconstruction processes would be best suited to produce images of the highest possible resolution and sensitivity.

"Imaging radiopharmaceuticals is not a brand-new technology," Smith points out. "Nuclear medicine has been around for 50 years. But with the current technology available for humans, it's difficult to get the resolution and sensitivity needed for small-animal imaging. That's what we're hoping to do."

The small-animal project, underwritten by the Department of Energy's Office of Biological and Environmental Research, proposed and led by Drew Weisenberger as a principal investigator, will first focus on brain imaging, since neurological function is of great interest to many researchers; and tracking the motion of a moving mouse head is a first step toward tracking whole-body motion. JLab recently filed a patent on technology derived from the venture. The first phase of the effort has taken two years and a second phase has recently begun.



The Group developed this detector, which is being used for a brain-imaging project at Duke University. Visible are the flat panel, position sensitive photomultiplier tubes.

# In Memoriam

## *JLab mourns loss of Steve Wells*

Steve Wells

Stephen Wells, 51, Jefferson Lab's computer hardware and telecommunications manager, died Oct. 10. He had been a member of the Laboratory and a key contributor in the Computer Center for 17 years.

He began working at the Lab in 1986, when he was hired to do network wiring for the VARC. As the workload grew Steve brought to the Lab people he'd worked with while a contract employee at the Naval Weapons Station. Randy Hartman was one such person.

From that point the projects came fast and furious. He designed the computer wiring for CEBAF Center. "It was an early accomplishment of his and one he was proud of," says Lyn, Steve's wife and Project Management staff member. "He worked nights and weekends making sure it was done correctly. If something was in his power to control, he made sure it worked."

He became operations manager for the Computer Center and oversaw the development of the data farm (silos). Meeting the Lab's demanding and growing hardware needs meant a constant juggling match to get the best possible equipment installed and working, while maintaining office space for Computer Center staff. Part of him was always thinking into the future. "He seemed ahead of his time," Lyn reflects. "He would see a problem or a need, and many times the solutions he envisioned hadn't been developed yet. Steve and the Computer Center staff would design and put something together that a year later could be bought."

Next came an overhaul of the Lab's site-wide network system. Steve and Mike Memory visualized a more advanced and capable system. They identified the network tools and management systems they needed and built a comprehensive system that was ahead of its time. Then he tackled network problems within the Applied Research Center (ARC) building.

Steve was integral to planning and development each time a new technology came to the Lab. "He was a behind-the-scenes guy," Lyn says. "When a new technology came to the Lab — with his electronics background — Steve became the go-to guy. If something was within his ability, he'd do it, and he constantly strived to get everything done correctly."

He brought wireless capabilities on site, visual messenger, the pager system, cell phones, teleconferencing, video conferencing, and SWIS TV (site-wide information system).

He understood the importance of communications for a facility like Jefferson Lab. "Many of us take for granted that our phones, pagers, cells and computer systems will always work, and as long as they work we don't think about the amount of effort that goes into making them work correctly" Lyn comments. "He loved working here. This was the perfect environment for him. When he was faced with a problem, he'd work it until he had a solution, and they weren't always conventional solutions. He was a pretty awesome guy."

"He loved being a Jefferson Lab ambassador," she adds. "When we traveled, he loved telling people where we worked and what he did and what the Lab was about. He was very proud of that."

"Steve was like family to me. He was a wonderful friend and a fantastic mentor," says Randy Hartman, Computer Center. "He was a meticulous professional and the group clown. I don't think a person could work with him and not learn from him. He was very meticulous and organized in the way he did things and that has been very helpful to me."

Randy is handling some of Steve's critical responsibilities and admits, "I still don't have it down, and I'm still discovering things he was taking care of. No one will ever fill his shoes."

# In their own words

## *With Erik Abkemeier, JLab's new Radiation Control Group Leader*

*as told to Judi Tull*

Although I was born in St Louis, my family moved to Chicago when I was seven, and I finished high school there. After receiving my Bachelor's degree in electrical engineering in 1988, I went to the Norfolk Naval Shipyard as a nuclear engineer in their test division.

In 1995, I transferred to the Naval Weapons Station at Yorktown to work in the radiological support office for the Naval Sea Systems Communications Detachment, where I was the radiation protection manager. Our role for the Navy was essentially the same as the Nuclear Regulatory Commission (NRC) for civilian facilities. Any kind of radiation use in the Navy or the Marine Corps fell under our control. If a permit was needed, they came to us, and we also did all the necessary inspections.

I traveled all over the world in that job and, although that sounds exciting, it can sure get old fast. We would fly in, do our work, then get back on a plane again for somewhere else. So I saw a lot of airports in places like Guam, Spain and Italy, but not a lot of tourist attractions.

I came to the Lab in July and now serve as the head of the Radiation Control Group.

The timing of this opportunity was great for me. I first met Bob May when I was taking on-site courses for my Master's in Health Physics at the Illinois Institute of Technology in Chicago. I later took an accelerator physics class at the U.S. Particle Accelerator School in Baton Rouge, Louisiana, and met Scott Schwann, who was then Bob's deputy. He was assisting a teacher with a class and mentioned that he was leaving the Lab. He suggested I contact Bob. By the time I got in touch with Bob, he was moving on to his current Accelerator Division position and I interviewed for his job.

I faced a challenging cultural shift when I came here and the work is much more fast-paced. At Jefferson Lab, there's a total attitude of problem solving and everyone just dives right in. Working with researchers from other countries is interesting too. Everyone brings a different background to the table. I told my wife, the first week I was here felt like I was working on the Apollo 13 mission — failure is definitely not an option!

This transition also came at a challenging time for RadCon, with the Department of Energy exploring the possibility of changing to NRC regulations. My past professional experience dealing with the NRC allowed me to add perspective and evaluate the resources needed for such a change. Shortly after I first arrived, the NRC came to JLab to have a look around, which was shortly followed by a visit from OSHA.

As soon as I came on board, I started meeting with the members of my group, going over reports and that sort of thing. Since each RadCon tech has his or her area of expertise, I rely very heavily on their abilities. All in all, I worked hard to hit the ground running.

In addition to my master's, I'm also a Licensed Professional Engineer in nuclear engineering and a Certified Health Physicist since 2001. This was particularly relevant to my position here, since all of the Radiation Control Group's work is in the realm of health physics. In March 2003, I also became a Certified Safety Professional.

I've lived in Newport News for nine years. My wife is a dentist, and we have two sons, who are seven and five. I played baseball in college and used to pitch semi-pro in the Eastern Shore league. I still play a little pick-up basketball, but I spend most of my spare time with my family.

# In their own words

*With Luminita Todor, JLab user, Theta-plus Search Group member*

*as told to Judi Tull*

I grew up in Bucharest, Romania, in Eastern Europe. My parents encouraged both my sister and me to do our best and gave us the freedom to do it. My father worked in a nuclear power plant and my mother, a Ph.D. in geography, did weather forecasting. They expected a lot from us, but they always praise rather than criticize.

I started to learn English in second grade, then studied French as well starting in fifth grade. In Romania, learning foreign languages is a common thread in the public education system. Another emphasis was on mathematics and the sciences. Even though math was my first love, I was fortunate enough in high school to take first place in the national physics competition. This sealed the decision to make physics my career. I've found my niche. Physics is not work for me; it's my passion. I enjoy learning more, doing more, understanding more.

I met my husband, Dorin, while we were both students in physics at the University of Bucharest. We always challenged each other. We were also graduate students at same time at Old Dominion University. His field of specialization is medical physics. As a graduate student, I benefited from the high-quality lessons I received from several members of JLab's Theory Group, and from my experience with the Old Dominion University Nuclear Experimental Group, including my thesis advisor, Charles Hyde-Wright. They had a big impact on my development.

I began working at Jefferson Lab with Hall A commissioning activities and data taking of the first experiments. Being part of the Lab team is a wonderful experience. It really is a melting pot of people from so many countries. I enjoy learning from the senior people and teaching the younger ones. What I've learned about all these different cultures is that we are much more alike than we are different. We are all citizens of the Earth, and members of this small world of nuclear physics. In 1999, I received the Luise Meyer-Schutzmeister Memorial Award, given nationally to a woman graduate physics student. This award was a real booster for me.

Being a grad student and having children was not easy. Our children, Horia and Alina, helped us a lot to keep focus and enjoy life besides work. Not only have Dorin and I found the opportunities to succeed here, but so have our children. They were fortunate to have amazing professors and get very high quality educations at both Norfolk Academy and the Governor's School in Richmond.

After we graduated in 2000, Dorin took a post-doc position at Memorial Sloan-Kettering in New York and I became a postdoctoral research associate with Carnegie Mellon University. I continued working at JLab but in Hall B. Our family's separation was harder than we had foreseen. Dorin didn't like being away from us, and the children missed their father, while I raced continuously to be a scientist and a mother.

The post-doc years were a time to mature as a scientist. I've been part of the Hall B Real-Photon working group. I went through all phases and projects from the drift chambers on call expert, g1c data-set calibration and [data] cooking, preparing the papers for publication, working on the frozen spin target experimental proposal and last but not least, being part of the Theta-plus search team. It was a challenge and opportunity to have my work coordinated by Reinhard Schumacher, a remarkable Carnegie Mellon professor and my post-doctoral supervisor.

Early last year, Dorin found a position at the Medical College of Virginia and last summer we bought

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# Former BEAMS student revisits JLab

*Young man sets goal on career in science, technology*

*Photo Courtesy of NIST*

Thomas A. Pierce, Jr., a senior at Norfolk State University and a National Institute of Standards and Technology (NIST) intern, is a former BEAMS participant who recently returned to JLab to take part in a National Educators' Workshop as an invited research presenter.

The first groups of students to participate in Jefferson Lab's Becoming Enthusiastic About Math and Science (BEAMS) program are graduating from college and entering the workforce. Since the spring of 1991, more than 530 classes of sixth graders, many from Newport News' inner city schools have attended this innovative, week-long math and science immersion program developed by Jefferson Lab.

"I've often caught myself wondering how they are doing," says Stacy Ring, JLab Science Education technician. "Have the students benefited from the program? Did it help motivate them to do better in school or stimulate their interest in math and science? Did it raise their awareness of the many opportunities available to them?"

The question was raised Oct. 21 when more than 60 teachers and professors converged on Jefferson Lab as part of a National Educators' Workshop. A participant asked about the impact of BEAMS on its students and the response, "I was in BEAMS" came out of the throng.

The voice belonged to Thomas A. Pierce, Jr., a senior at Norfolk State University who will graduate with his Bachelor's degree in Computer Integrated Design Technology in December 2003. As a sixth grader at Huntington Middle School, Pierce attended BEAMS. He fondly recollects the thrown racquetball shattering after being frozen in liquid nitrogen, the blown-up balloon shriveling as it was dunked into the same cryogenic liquid, and the coordination it took to perform the Slow Bike Race. But even stronger are his memories of the "really great people" he met at JLab and the excitement of going someplace new.

"Everything here just seemed so exciting and fun. I really connected with it," he said.

"Taking learning outside the classroom adds another dimension of practicality and application, making it easier to relate with the real world," Pierce

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commented, "and BEAMS did that [for me]." On the other hand, he found the conventional classroom environment serious and strict, and at times, difficult.

He came back to Jefferson Lab for a BEAMS mentor experience in 9th grade, was a member of CHROME, the Cooperating Hampton Roads Organization for Minorities in Engineering, and participated in a variety of science and technology clubs and activities throughout middle and high school. He cited "a bunch of early experiences" for developing his interest in and desire to pursue math and science: BEAMS, his family's regular excursions to museums, building Lego models, and his mother giving him the book, "Tell Me How, Tell Me Why." He grew up asking questions and being encouraged to dig for answers.

Now this young man is on the brink of a challenging, high-tech career. He can already be proud of a resume dotted with impressive internships and research projects. He has conducted a broad range of metallurgical research for the National Institute of Standards and Technology (NIST), including metallography, Rockwell Hardness measurements, digital microscopy, heat treating, sample preparation, tensile testing, powder metallurgy, etching and engraving.

As an intern he's examined failed joint fractures between copper tubing, solder and the intermetallic layer, and the recrystallization and grain growth of aluminum alloy for tubular car frames. Pierce was a member of the World Trade Center investigative team to examine the steel beams that collapsed. He is listed among the authors of a 2002 collaborative research paper titled, "Instrumented Consolidation of Amorphous Powders," and most recently he performed research on bismuth that serves as a shielding material for a research reactor controlling spurious neutron scattering.

He is eyeing two research projects he hopes to pursue after he finishes his coursework in December, and plans on pursuing a Master's degree in materials science and engineering. "I'm not ready to rule anything out," Pierce said of possible career opportunities. He is intrigued with the integration of smart materials, the design of small components and quality control. He wants challenging, fulfilling research projects. "I want to make a difference but most of all, I want to be happy with my career choice," Pierce noted. "Money is not my primary driver."

What advice does he offer middle and high schoolers? "Take math and science classes seriously," he said. "I know math isn't always easy, but in a few years you will appreciate the effort you put into it. Challenge yourself; it may be uncomfortable at times but in the end it will be worth it."

"And try new things, if you don't at least try new things you'll never know what you can do," he continued. "Even if it doesn't turn out as planned, you will still have learned something just by trying. I was really nervous before I started my internships and research projects, but I decided to just jump head first into them. It was amazing! I've learned so much. I got over a lot of my nervousness and I deal with it much better now."

# In their own words with Luminita Todor...


Luminita Todor, JLab user and Theta-plus Search Group member, prepares the presentation for her Aug. 15 Physics Seminar on “The Pentaquark.”

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our first house near Richmond. During the last year I’ve commuted several days a week to continue my work here. Starting in August, I took a visiting faculty position at the University of Richmond to teach Introduction to Physics and Quantum Mechanics. I enjoy teaching and I find that if you are passionate about the subject and truly care, the students respond well.

I don’t know at this point what the future will have for me. It’s possible that I will get a permanent position next year at the University of Richmond, but this is an emotional roller coaster, being sort of in and sort of out. I hate things being temporary, and long for security. But this is reality in this field. Without passion, no one would do it.

*Editor’s note: The Luise Meyer-Schutzmeister Memorial Award was established in memory of nuclear physicist Luise Meyer-Schutzmeister, a Senior Physicist at Argonne National Laboratory. It is awarded annually to recognize nationally, an outstanding female graduate physics student.*

# Milestones
## for October 2003

### Hello

Antje Bruell, Hall C Physicist, Physics Division

Evgeny Epelbaum, Nathan Isgur Distinguished Fellow, Phy. Div.

Renato Higa, Post Doctoral Fellow, Phy. Div.

### Goodbye

John Brawley, Senior Associate/Coordinator, Accel. Div.

Sanford Roman, Accelerator Operator, Accel. Div.

## *CERN collaboration announces evidence for new five-quark particle*

The NA49 collaboration at CERN's Super Proton Synchrotron (SPS) accelerator recently announced experimental evidence for another member of the five-quark exotic baryon family known as "pentaquarks."

The new pentaquark, called Xi-minus-minus ($\Xi^{--}$), is heavier than the Theta-plus ($\Theta^{+}$) that has been spotted at four facilities to date: SPring-8 in Japan, ITEP in Russia, Jefferson Lab in the United States and ELSA in Germany. Like the $\Theta^{+}$, the existence of the new exotic baryon was predicted by Russian theorists Dmitri Diakonov, Victor Petrov and Maxim Polyakov as part of an anti-decuplet of five-quark resonances.

Diakonov *et al*. predicted the $\Xi^{--}$ exotic baryon with strangeness S=-2, isospin I=3/2 and a quark content of two down quarks, two strange quarks and an up antiquark ($dds s\bar{u}$), at a mass of about 2.070 GeV (billion electron volts) and narrow width of 0.040 GeV.

On Oct. 8, the NA49 collaboration announced evidence of a peak in the $\Xi^{-}\pi^{-}$ invariant mass spectrum at 1.82 GeV having a width below the detector resolution. (See http://arxiv.org/abs/hep-ex/0310014). They estimate that their signal is 4.0 standard deviations above background.

Similar to Jefferson Lab's CLAS detector in Hall B, the NA49 detector is a large-acceptance detector, enabling scientists to track multiple particle events at once. The NA49 data sample began with around 6.5 million events from proton-proton collisions, which they eventually whittled down to 36 $\Xi^{--}$ events by systematically cutting away data related to other particle events not of interest.

The collaboration recently submitted a letter-of-intent to extend the proton-proton collision data in NA49 during 2004. They estimate that with detector upgrades, three months of running would give them four times more events than their present data sample.

## *Lab's 1-day United Way campaign gathers over $50K in donations*

One hundred seventy-one individuals from Jefferson Lab filled out contribution forms during the Lab's 2003 United Way campaign. Including anonymous cash donations, the Lab raised $50,669.07 during this year's fundraising campaign.

JLab's United Way campaign coordinator, Christine Hummel, calls this year's one-day event a great success and thanks all of the volunteers who helped make the day possible and everyone who filled out a contribution form or made a cash donation.

## Hall C continues proton research

Eight university students from the U.S., Canada and France spent their summer making cables, building a cable rack and hanging cables for a new calorimeter that will help JLab researchers peer deeper inside the proton. For many of the students, this was their first visit to the Lab. And many hope to return soon.

"We are building a large solid-angle calorimeter for electron detection in the next phase of $G_{Ep}$ measurements," says Vina Punjabi, Norfolk State University. Experiment E01-109 in Hall C will measure the electric form factor of the proton — written as $G_{Ep}$ — a quantity that describes the distribution of electric charge in the proton.

The experiment extends the Lab's successful investigations into charge and current distributions in the proton to a higher momentum transfer ($Q^2$) of 9 GeV (billion electron volts). Charles Perdrisat, College of William & Mary, explains that at higher $Q^2$, a lot of "junk" goes on in the background, with few real events. The new calorimeter will provide the large solid-angle and high resolution required to find the data of interest.

"With the students working on this," says Punjabi. "We are hoping that the next phase of $G_{Ep}$ will happen in the later half of 2005."

Pictured here with their supervisors, Punjabi and Perdrisat, are: (front row, left to right) Vina Punjabi; Juan Carlos Cornejo, California State University at Los Angeles; Charles Perdrisat; John Gillespie, William & Mary; Blake Leverington, University of Regina in Saskatchewan, Canada, and (back row, l. to r.) Jeremy Chen, William & Mary; Henry Lovelace, Norfolk State University; Olivier Despin, Université Joseph Fourier in Grenoble, France; Celia Blain, Université Joseph Fourier; and Dan Mazur, University of Regina.

# From the Director...

*Continued from page 3*

After much hard work, funding for the Free-Electron Laser is looking better than it has in years; and the upgraded machine achieved first light this summer. After dealing with the effects of the hurricane, staff members brought the FEL on line in late November, lased over Thanksgiving weekend and are now preparing for their 10-kilowatt run.

Ensuring a safe working environment remains of highest priority at the Lab and a key responsibility for each manager and staff member. Recent accidents and near misses demonstrate that we can and must do more to protect one another and ourselves in the workplace. I ask each one of you to be fully informed of safety requirements and to remain alert when performing the task at hand. Colleagues are expected to speak up and/or intervene should they observe an unsafe practice. We will pay great attention and make a dedicated effort in the coming months to address needed improvements in Electrical Safety, Materials Handling and Personal Protective Equipment.

There is much to celebrate and be proud of at Jefferson Lab. We have an important and recognized mission, today and in the decades ahead, and a good team of capable and hard working people. As always there will be scientific, technical and business challenges to face and funding will be extremely competitive. Yet, I believe we have the potential to achieve great things together. Thank you for stepping up to the task, and I wish you and your loved ones a joyous New Year.


*Dec. 25, 26, 31 and Jan. 1: Holidays*

*Dec. 29, 30 and Jan. 2 Shutdown Days*

ON TARGET

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