May 2001

ON TARGET

THOMAS JEFFERSON NATIONAL ACCELERATOR FACILITY • A DEPARTMENT OF ENERGY FACILITY

Welcome aboard!

Chattopadhyay takes over as new Accelerator Division Associate Director

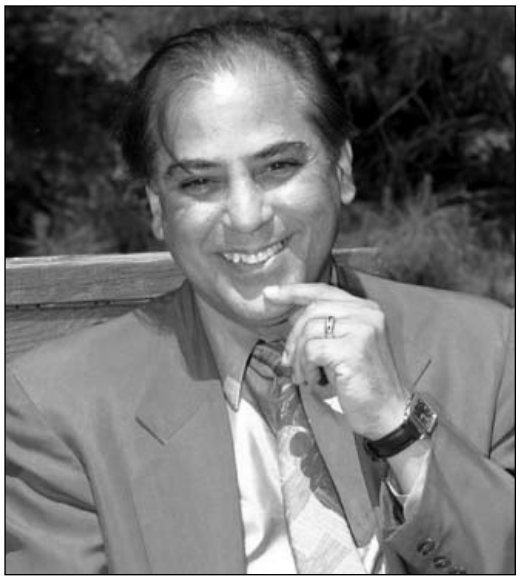
by James Schultz

Almost three decades after his arrival as a graduate student in northern California, Swapan Chattopadhyay is leaving the West Coast behind. Fortunately, Lawrence Berkeley National Laboratory's loss is Jefferson Lab's gain. A JLab search committee has chosen Chattopadhyay to fill the post of Associate Director for the Lab's Accelerator Division.

"I was at Berkeley for 27 years. At this point in my career I was looking for other opportunities and challenges," Chattopadhyay says. "It's quite evident from the attitudes of SURA, DOE and everyone here [at JLab] that they want this place to be a crown jewel. They are ready to walk that extra mile."

Chattopadhyay joined UC Berkeley in 1974 as a physics graduate student. Upon receiving his Ph.D. in physics in 1982, he spent two years at CERN as a scientific attaché. He then returned to work at Berkeley Lab, becoming group leader of the Exploratory Studies Group in 1987. Chattopadhyay was chief physicist for Berkeley's Advanced Light Source, from design in 1987 until commissioning in 1992. He also served as a major contributor to numerous national and international projects.

Together with Piermaria Oddone of Berkeley Lab, Chattopadhyay initiated and laid the accelerator-physics foundation for asymmetric-energy, electron-position colliders known as the B-factories, which led to the PEP-II collider at Stanford, as a joint Stanford Linear Accelerator Center, Lawrence Berkeley



National Laboratory and Lawrence Livermore National Laboratory project for studies of matter-antimatter asymmetry and charge-parity violation.

As a physicist with Berkeley's Accelerator and Fusion Research Division, Chattopadhyay established and became the director of the Center for Beam Physics (CBP) in December 1991. The CBP is a multidisciplinary research group of about 50 scientists and engineers whose mission is to study the production, manipulation, storage and control of particle and light beams and plasmas. Under Chattopadhyay's leadership, CBP researchers have been at the forefront of such scientific and technological breakthroughs as femtosecond X-ray generation for studies of ultrafast processes in nature, as well as laser plasma-beam interaction for all-optical particle generation and acceleration.

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Results presented at APS meeting

JLab uncovers distribution of charge, magnetization in proton

by Ben Stein
Sr. Science Writer, American Institute of Physics

The proton is the positively charged core of the hydrogen atom, the most abundant element in the universe. But mysteries still remain as to how the proton's building blocks combine to give the particle its electric and magnetic properties. An experiment conducted at Jefferson Lab last fall, and presented at the American Physical Society April meeting in Washington, D.C., showed for the first time that the distribution of electric charge in the proton is different from the magnetization distribution. This knowledge will help to develop a more sophisticated view of how the proton's building blocks interact with each other, and it helps to rule out some earlier ideas.

By firing electrons at protons and observing how they ricocheted or "scattered" from protons, researchers in the late 1950s discovered that the proton's electric charge and magnetization were spread out. This implied that the proton has a well-defined size of about 10-15 meters, or a millionth of a billionth of a meter. Researchers later realized that the proton, a building block of all atoms, was itself made of smaller building blocks, namely quarks, and the gluons that bind them together.

Many particles have this substructure like the proton, but not all: for example electrons appear to behave like mathematical points, with no size at all. But the details of how quarks and gluons interact remain largely unknown. Jefferson Lab was built in part to study quark-gluon physics and their connection to larger composite objects such as protons.

In two recent Jefferson Lab experiments, researchers have learned some tantalizing new details of how electric charge and magnetization are distributed in the proton. Electricity and magnetism are closely intertwined, as any moving charged particle will generate a magnetic field. The proton's electric charge comes from its composite quarks, and all indications are that the quarks move inside the proton. In addition, quarks and gluons both have something called "spin," an inherent magnetism that has nothing to do with the motion of electrical charges but can be imagined as a built-in bar magnet. (A technical name for this bar magnet is "magnetic moment.") The term magnetization is used for the total magnetic field due to the currents from the moving charged quarks and the "bar magnets" of the quarks and gluons. Electrons too can be imagined to contain tiny bar magnets, even in the absence of any size; so electrons can be polarized, which is equivalent to lining up these tiny bar magnets so that they are pointing in the same direction.

The JLab experiments uncovered some intriguing differences in the way electric charge and magnetization are distributed in the proton. What makes the recent experiment at Jefferson Lab unique, compared to previous experiments, is that the most intense beam of polarized electrons ever produced was collided with a liquid hydrogen target cooled to only 20 degrees above absolute zero (-460 degrees F). The electron beam was of high energy, between 2000 and 6000 MeV (million volts). This is important because the higher the energy of the probe, the smaller the features that can be resolved. At these electron energies, physicists probe the quarks and gluons deep inside the proton itself. Moreover, by using a range of energies, the researchers are able to "map out" the proton's electric charge and magnetization distributions.

As an electron scattered from the target, it ejected a proton of large energy, (energy is conserved, even at this scale, and so the energy of the recoiling proton was equal to the energy loss suffered by the electron). The protons in the hydrogen target have a random polarization orientation, but after interacting with the polarized electrons, the recoiling protons become polarized themselves. With a specially developed detector called a proton polarimeter, the researchers measured the polarization of the recoiling proton.

From their measurements the researchers were able to determine a ratio of the electric charge distribution to the magnetization distribution at various depths inside the proton. They found that the electric charge is distributed over a larger distance in the proton compared to its magnetization.

These new data help to rule out some simple models of how quarks and gluons interact to give a proton its properties. This experiment provides one of the latest glimpses of the complex nature of the interaction between quarks and gluons, which are the constituents of the proton. As an example, these data show that the magnetization distribution is not generated by just the moving charges of the quarks, but that the spin of the quarks and gluons plays a significant role.

Editor's note: The results from the first part of these experiments were published in the Feb. 14, 2000, issue of "Physical Review Letters," Vol. 84, No. 7. The second part of these experiments ran from Nov. 5 through Dec. 19, 2000, in Hall A with that data being published in the near future. Referred to as GEP-II, the experiments were designed to learn more about the electric form factor of the proton. They were proposed by V. Punjabi, Norfolk State University; C.F. Perdrisat, the College of William and Mary; M.K. Jones, W&M and JLab; and E. Brash, University of Regina, Canada. Gilles Quemener, a graduate student at W&M, analyzed the first part of the experiment; Olivier Gayou, a graduate student at W&M and at the University Blaise Pascal, Aubiere, France, is writing a Ph.D. thesis based on the data. The experiments were made possible through the efforts of the Hall A collaboration; about 100 physicists participated in the preparation and data taking.

User survey speaks... JLab listens

by James Schultz

Snapshot of JLab's user community

Jefferson Lab's user community currently includes 1,697 researchers from 296 institutions. They represent 38 countries, and 31 states within the U.S. (including Washington, D.C.) More than 160 Ph.D. candidates are doing their experimental or theoretical research at the Lab.

Catch the June "OnTarget" for results from this spring's Experimental User Survey.

Live in the United States and it's likely you'll eventually be canvassed, polled or surveyed. Work at Jefferson Lab and your opinion will also be sought — and, unlike instant media surveys, the polling results will find direct application in the workplace.

Based on feedback given during a recent survey sent to roughly 1,000 User Group members, the number of computers in the second-story atrium of CEBAF Center was quadrupled and after-business-hours access to Trailer City was expedited by conversion from a key-lock to an electronic-access system. Other user concerns, from safety training to the quality of cafeteria food, were also addressed.

Haiyan Gao, assistant professor of physics at the Massachusetts Institute of Technology and JLab User Group Board of Directors member has primary responsibility in the area of user quality of life. According to Gao, canvassing opinion on the Lab's working environment is particularly valuable for managers, who can fine-tune administrative processes to better serve the Lab-wide community. "Quality of life" is no mere slogan when describing visiting scientists' ability to obtain required space or equipment for their physics research with a minimum of fuss and bother.

"People work long hours. That work can be stressful," Gao says. "Because they're here for a certain period of time, users want to work as efficiently as possible. No one wants to waste time. So quality of the work life is an issue."

According to the survey, close to 90 percent of respondents said they enjoyed working at the Lab, while 94 percent found the scientific staff "knowledgeable and helpful." Staff was generally credited with making life easier for users in most matters administrative. "People's responses were generally very positive," Gao says. "Especially from graduate students. It's a great place for them to work. There's a lot going on."

Problems Being Addressed

Two major, perennial issues confronting new arrivals have been training and badging. In the past, users have complained of a cumbersome process that was too confusing and time-consuming. The Lab has listened to those concerns, according to this latest survey, and has implemented streamlined procedures that have been more favorably received.

"Two of my graduate students arrived in January and a couple of days later were 'official,'" Gao says. "They got their badges without any problem. If you make everything convenient and straightforward, it makes the process efficient for everybody."

The area that elicited the most concern on the survey was Trailer City, wherein cramped offices and noisy heating and air conditioning equipment make work difficult for many. Nearly a third of respondents said that Trailer City office space interfered with their productivity. No immediate solution is likely, Gao points out, but Lab managers are acutely aware of the problem and are seeking solutions for it.

"A survey is a uniform way to collect information," Gao contends. "It is important for us to sample opinions. We need the feedback to make the Lab a better place for users to work."

Haiyan Gao, a member of JLab's User Group Board of Directors, was responsible for the User Quality of Life Survey.

Lab's SNS involvement accelerates

R&D activities reach halfway point; SRF technology at forefront

by James Schultz

At the halfway point of a 24-month research-and-development program, Jefferson Lab is staying on track and on schedule as a principal contributor to a major new DOE Basic Energy Sciences research installation scheduled for completion by 2006.

JLab is part of a team of federal laboratories — including Argonne, Brookhaven, Lawrence Berkeley, Los Alamos and Oak Ridge — collaborating in the design, engineering and construction of the $1 billion-plus Spallation Neutron Source (SNS) in Oak Ridge, Tenn. The SNS will provide the most intense pulsed-neutron beams in the world for scientific research and industrial development.

"We're on schedule and on cost," says Warren Funk, JLab's SNS project services manager. "There have been some hiccups, but we've worked around them. The Lab is meeting its commitments."

JLab's responsibility is to engineer and assemble SNS cryomodules on site in Newport News and to oversee the installation and initial operation of cryomodules and helium refrigeration equipment at Oak Ridge. As at JLab, superconducting radiofrequency (SRF) techniques and advanced cryomodule design will be incorporated within the SNS accelerator complex to enable low-cost, high-efficiency operation. The first of several prototype six-cell cavities has achieved acceptable performance in vertical test. Components for the first prototype cryomodule are expected to begin arriving at JLab in the late summer.

"In terms of production SRF, JLab has a unique capability in the United States," Funk points out. "As the advantages of SRF have become more apparent, we've been asked to participate in more and more of these kinds of projects. We're able to build on other labs' experience around the world, plus our own, to meet the project requirements."

Recently, the SNS project has suffered from cost pressures in non-accelerator areas, leading to design changes; most notably, reduced beam power on target, to restore an acceptable level of project contingency. Three fewer cryomodules will be incorporated: 23 versus 26 in the original design. Construction of a planned SRF facility has also been deferred, perhaps indefinitely, depending on future cost experience.

Despite this setback, improvements in cryomodule performance could mitigate the worst of the beam-energy-reduction modifications. Rather than a 50-percent impairment, the Lab's SRF and engineering prowess should enable the SNS accelerator to operate at 80 percent of its design level. There are

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Chattopadhyay takes over as Accelerator Division AD…

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At Jefferson Lab, Chattopadhyay will oversee all accelerator operations, research and development, the Lab's applied-superconductivity and superconducting radiofrequency research and development efforts, its cryogenics and engineering programs and the Free Electron Laser (FEL) program.

"JLab has excellent scientists, staff, and a unique technology base," he says. "But I think we can do more. I think JLab has a real shot at achieving major scientific breakthroughs deserving the highest recognition in science."

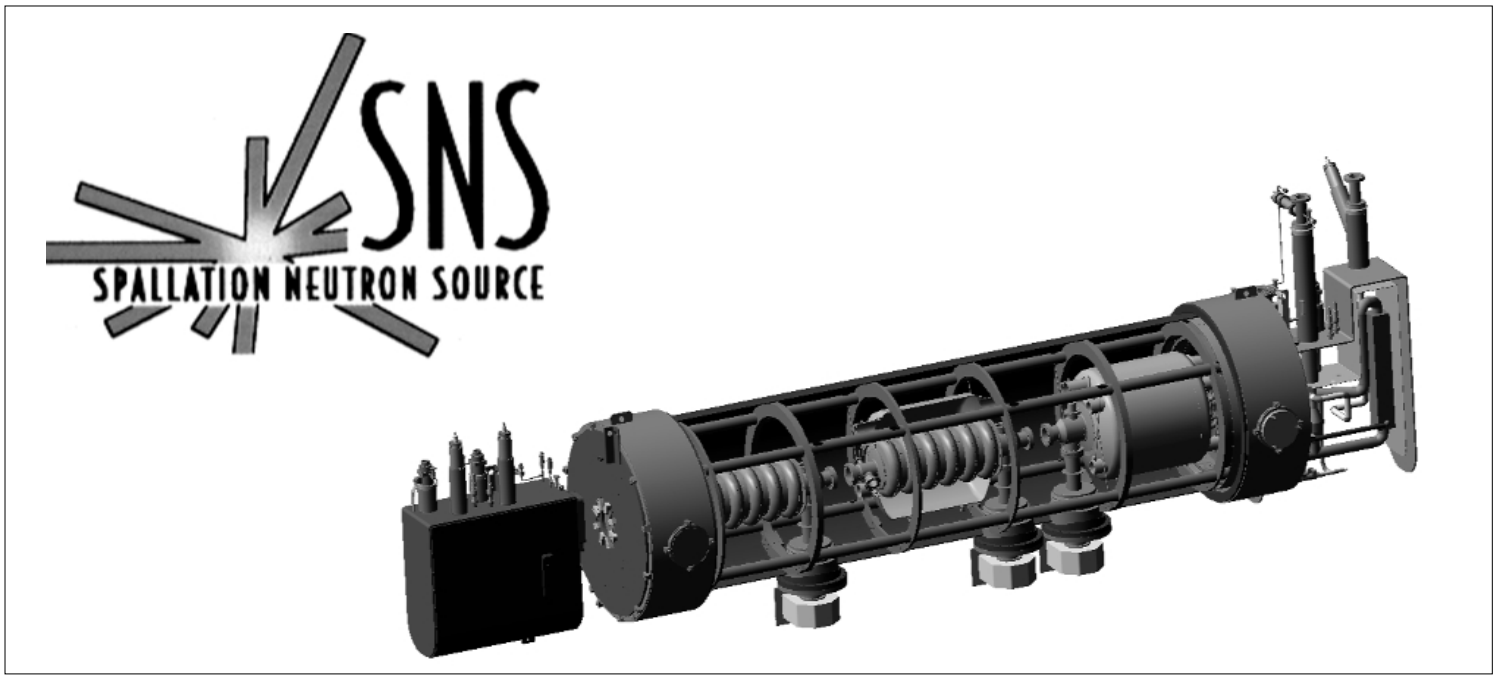
Chattopadhyay aims to solidly put the Lab on the international map, pointing to the proposed 12 GeV upgrade, a concurrent lattice quantum chromodynamics (QCD) theory effort, and the Lab's ability to produce coherent, powerful and ultrashort — measured in one-quadrillionth of a second or faster — pulses of light of all colors in the visible range and beyond for various fundamental studies in basic and applied sciences.

In an assessment of operations Chattopadhyay provided to the search committee, he cited JLab's involvement in the Spallation Neutron Source (SNS) as the kind of project that plays to the Lab's strengths in superconducting radiofrequency (SRF) technology. It's an area in which he feels the Lab should remain active, even to the extent of pursuing other SRF projects in this country and abroad, such as the international TeV-Energy Superconducting Linear Accelerator (TESLA) project. Chattopadhyay also sees the FEL program as a means of further diversifying JLab's basic and applied-science portfolio.

"We're trying to 'grow' a complementary set of users — biologists, chemists and solid-state physicists who would come here to do a kind of science they couldn't do elsewhere," Chattopadhyay says. "It diversifies the Lab and utilizes our core technologies. It puts us on the scientific landscape with a broad base. Remember that we're still young and thus far — with the exception of the FEL — primarily a single-purpose lab known for nuclear physics research."

Chattopadhyay eventually would like to boost the Lab's funding, as well as establish two Centers of Excellence: a Center for Advanced Studies of Accelerators and an Institute for Superconducting Radiofrequency Electrodynamics to push the frontier of the Lab's core competencies in particle and light beam dynamics and superconducting radiofrequency technology.

Editor's note: Berkeley Laboratory's "Currents" newspaper writer Lynn Yarris contributed to this story.



JLab's proposed cryomodule design for the Spallation Neutron Source.

Lab's SNS involvement accelerates...

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no absolute guarantees, Funk says, but a reasonable expectation of success given the expected enhancements.

"It's very gratifying to find that your piece of the technology puzzle allows the project to successfully cope with external pressures," he says. "But we all realize there's an awful lot of work that remains to be done. We're buckling down to get it done.

"Even given these constraints, the SNS will be successful. In my opinion, it's simply too important to be allowed to fail. And we [at JLab] know how to make it succeed."

The Lab's role in SNS cryomodule design and construction will enable personnel to enlarge skill sets necessary for the next phase of the Lab's own expansion. A planned JLab accelerator upgrade to 12 billion electron volts, or 12 GeV, will require the installation of redesigned cryomodules. Each upgraded unit will have a capacity more than double present levels. Other improvements will include more robust magnetic shielding and a tuner control substantially more efficient than current versions.

The aggregate effort of JLab employees, both permanent and contract, full- and part-time, reassigned to SNS activities from other JLab-specific duties or brought on especially for SNS, is equivalent to 50 full time employees. Additional staff, consisting of SNS employees who will come to JLab to learn about cryomodule assembly and operation as part of the technology transfer component of the collaboration, will be added as the Lab's involvement peaks.

Even though Lab managers had been involved in informal discussions early on, JLab's formal involvement in the SNS project dates back only to the summer of 1999, when discussions outlined the Lab's envisioned participation. "This is not so much a technical challenge as it is a management challenge: How do you keep an extremely fast-track project on track?" posits Claus Rode, Director of Projects of the Accelerator Division and the Lab's senior team leader for the SNS project. "We're doing the R and D in two years and production in slightly more than two years. By comparison, we started CEBAF in 1985 and electron beam was available to researchers in 1994. The SNS program is playing out in an extremely short period."

When the SNS facility is complete, researchers will be able to obtain detailed snapshots of material structure and stop-action images of molecules in motion. Similar to a flashing strobe light providing high-speed illumination of an object, the SNS will produce pulses of neutrons every 17 milliseconds, with more than 10 times more neutrons than are produced at the most powerful pulsed-neutron sources currently available. Neutrons from the SNS beam will scatter from a target material in a way that reveals that material's structure and properties.

SNS funding is being provided by the U.S. Department of Energy's Office of Science, Basic Energy Sciences Division, with $8 million in additional monies coming from the state of Tennessee. Final siting at Oak Ridge was approved in June 1999, and groundbreaking occurred six months later, on December 15.

More work space

Test Lab gets 12,000 sq. ft. of new work space for SNS project

by Judi Tull

Construction crews working on the new addition to the Test Lab (Building 58) are racing toward a July completion date. The project is the culmination of more than a year's worth of planning and designing, and represents the largest in-house project undertaken since completion of the Free Electron Laser building.

Lab architect and design project manager, Christine Snetter, and a team of Plant Engineering Department engineers, had just four months to come up with a design and construction documents (full set of plans) for the $1.3 million, 12,000 square foot addition. The building will house new equipment, a shop and press area, a survey and alignment room, clean room, and welding area in addition to other work spaces. The Lab's participation in the $1.4 billion Spallation Neutron Source project in Oak Ridge, Tennessee, which will require specialized equipment to be installed in the addition, was the driving force and deadline-setter for the construction project.

Snetter started work on the addition in the spring of 2000, and it became all consuming. "I didn't have a summer last year," she commented. "It's always busy around here, but I lost track of the hours I was working on this one."

The addition presented a number of architectural challenges. Since its location is in a high-visibility spot, Snetter struggled to make the new work blend with the old, no easy feat since the existing building combines pre-cast concrete, brick and metal work.

"It's important to make an addition look like it belongs to the original building, and not something that's just been stuck to it," she said. Window trim on the addition will match the existing trim on Building 58, Snetter said. However, the old finish may look a bit duller than the new trim.

The project was made even more challenging because of the extensive building code regulations for additions, many of which deal with fire safety and employees' access to exits.

This photo of the Test Lab addition was shot after the frame was constructed. The shell is now enclosed.

An existing contract for drainage repairs on the road adjacent to the construction area added another dimension to the demands Snetter faced. "It was crucial that one construction project didn't encroach on the other, and we had to carefully define the work areas for the subcontractors," she explained.

The job was bid as a single project, but funding availability that changed along the way sent Snetter back to the drawing board mid-project, she said. One saving grace is that the interior spaces are large and open, and did not require lots of detail work.

Rebecca Yasky, facility maintenance and construction section manager, had come on board last fall, just before the Ritchie-Curbow Construction Co. of Newport News was given notification to proceed with construction on Oct. 20.

Yasky, who has almost two decades experience in construction management, praised the staff's ability to rise to the demands of seeing a large project through on such a tight schedule. For instance, Karen Congiu, the Lab's subcontracting officer for the project, got the paperwork moving on the front end, and Ed Winslow, who works on the daily inspections and coordination of the project, put together a Web site so Lab employees can be kept up to date on how construction work is progressing.

Incentives and damages were written into the contract to encourage getting the job done on time, she said. The contractor will receive a bonus for every day the project is completed ahead of schedule or will be assessed the same amount if it is late.

The Lab's emphasis on safety is also reflected in the contract, something that came as a pleasant surprise to Yasky. The contractor is rewarded for each month's work that shows no violations. "In all these years, I've never seen a contract done this way," she said.

"This project represents an investment in the future of the Lab. It will allow us to build the superconducting radiofrequency cryomodules for SNS," she commented.

The facility upgrade will also provide infrastructure for future projects including the Lab's proposed accelerator upgrade to 12 GeV (billion electron volts).

To watch construction progress from your IBM-compatible pc, go to www.jlab.org/serv/lab_biz.html and click on "Active Projects."

Milestones
for April 2001

Hello

David W. Green, Accelerator Operator, Accelerator Division

Dia T. Williams, Electronics Assembler/Technician, Physics Division

Goodbye

Maureen H. Davis, Payroll & Asset Mgmt. Supervisor, Administration Division

Sarah P. Freeman, User Liaison Secretary, Physics Division

Shannon W. Krause, Crew Chief, Accelerator Division

Deborah M. Melz, Document Control Operator, Accelerator Division

Education seeks mentors, projects for interns

Jefferson Lab's Science Education staff members are preparing for the annual High School Summer Honors Internship Program (SHIP) and they need your help, according to Leigh Ann Garza, Science Education Administrator.

More than a dozen high school students from across the state will be on site from June 18 - August 10, and they need both mentors and projects for their stay at the Lab. Anyone with a project, or project idea, that would be good for a high-achieving high school student or students, may contact Garza at ext. 7633 or e-mail her at harlow@jlab.org. Anyone interested in being a mentor for a student over the summer may also contact her. Student projects will be funded at no direct cost to a group's budget.

Send Garza a short description of the project and an explanation of what the student(s) would be doing. "We're hoping to attract a range of projects for the group," she says. "In addition to a variety of scientific interests, this year's group has students interested in electronics, engineering and computer science. Many of the students have well-developed computer programming skills. If you have an appropriate project or an idea for one, please get in touch with me by June 4, Garza asks.

This is the ninth year that the Lab has sponsored this program. More than 75 students applied for this year's 13 internships. For more information about the program contact Garza or Science Education program manager, Janet Tyler, ext. 7164.

Run-A-Round Results

This year's Run-A-Round was the largest ever, according to Becky Nevarez, Jefferson Lab Activities Group (JAG) chair. More than 480 employees and guests registered for the fun run and more than 420 people finished the race. Winners and finishing times are posted on the column closest to the information counter in the CEBAF Center lobby, and on the JAG Web page www.jlab.org/intralab/committees/jag/ (click on Archive).

The JLab Spirit Award, based on the number of participants and volunteers in each division, was won by the Director's Office with 83 percent participation. The Director's Award, based on "winners points," was won by the Physics Division. And, this year's winning T-shirt design — 2001 Physics Odyssey — was the team effort of Brian Kross, Physics; Jaynie Martz, Accelerator; Paul Hood, Physics; and Simon Taylor, Physics.

Guest Julia Clingenpeel, 77, mother of Mary Haga who works in the cafeteria, was the oldest Run-A-Round finisher.

"Congratulations to all of the award winners and each participant," Nevarez said. "Everyone is a winner! It was a great event and nice to see such a large turnout. A special thanks to all of the volunteers; without their support the JAG couldn't host these events!

Open House 2001

A scout has a hair-raising experience while touching a Van de Graaff generator during a static electricity demonstration at the Open House. The exhibit was in one of the Applied Research Center university tents set up in the CEBAF Center parking lot. More than 6,000 people attended the event.

2000 Gold Award

JLab earns recognition from HRSD

Jefferson Lab was one of 95 area agencies, industries or businesses to receive the 2000 Gold Award from the Hampton Roads Sanitation District recently.

On May 9, HRSD recognized area Industrial Wastewater Discharge Permit holders for their outstanding efforts during 2000. Ninety-five permit holders earned Gold Awards — meaning they had completed the year with a perfect compliance record — no administrative or technical violations.

"Maintaining the level of compliance necessary to qualify for one of these awards is quite an achievement — one in which each and every one of you can take pride, knowing that without your help, we could not meet the goals of HRSD's Industrial Waste pretreatment program. The environmental improvements that continue to be made in Hampton Roads are due in part to the continuing efforts of facilities such as yours," wrote Ronald E. Johnson, chief of Industrial Waste in his congratulatory letter to award winners.

Special thanks go to the Plant Engineering and Radiation Control staff members for their efforts in managing our permit requirements, says Lab EH&S Reporting Manager, Carter Ficklen.

Ficklen and Becky Nevarez, Radiation Control technician, accepted JLab's award during HRSD's 2000 Pretreatment Excellence & Pollution Prevention (P2) Awards luncheon.

At a Glance

Calendar of JLab activities and events

June 4: Energy Research Undergraduate Laboratory Fellowship (ERULF) program begins.
June 8–9: JLab's relay team participates in the American Cancer Society's annual Relay For Life at Todd Stadium, NN.
June 18: High School Summer Honors Internship Program (SHIP) begins.*
June 21–22: Annual JLab User Group meeting. There will be two workshops: Parity-Violating Electron Scattering (organized by Dave Mack and Mark Jones) and Searches for Exotic Mesons (organized by Gary Adams and Haiyan Gao). Winner of annual SURA/CEBAF Thesis prize to be announced.
June 25: DMV mobile unit visits Lab.
June 29: Dosimetry badge exchange. Be sure your TLD is in its assigned place in the badge rack before leaving work.
July 9: Physics Enrichment for Science Teachers (PEST) program begins.
July 23: DMV mobile unit visits Lab.
** Events flagged with an asterisk (*) have an accompanying story in this issue of "On Target."*

ON TARGET

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