June 2001

ON TARGET

THOMAS JEFFERSON NATIONAL ACCELERATOR FACILITY • A DEPARTMENT OF ENERGY FACILITY

JLab property staff
needs your help with annual inventory

Into the machine
with Chris Curtis and the Alignment Group

In their own words
with JLab student turned staff member, Maud Baylac

Peninsula Fine Arts
Center thanks Lab for donation

Teasing clues from nature

Kaon experiment comes to successful end in Hall A

by James Schultz

Learning about building usually involves construction, not destruction of structures or machines. The universe, though, is a different case — at least, on a small scale. Without sifting through the debris generated from microscopic collisions in particle accelerators, gaining a better understanding of how the cosmos is constructed is nearly impossible.

Humans weren't present from the very beginning and so cannot see how everything got started. Nor is it possible or practical to recreate the actual conditions present just before the Big Bang. So physicists conduct their own studies, hoping to tease clues from Nature's tiniest creations, the subatomic building blocks known as quarks. In April, Jefferson Lab researchers concluded a Hall A experiment designed to look at some of the rarest subatomic particles known to exist: K-mesons, or kaons, and a kind of hybrid known as a hyperon.

"We've been studying how matter and antimatter are produced, and how they're distributed spatially," says experiment co-spokesperson Pete Markowitz, an assistant professor of physics at Florida International University. "When David Letterman throws things off tall buildings, everybody watches them crash to the ground and then looks at the pieces. We produce these particles, these pairs of strange quarks and strange antiquarks, and then sift through the pieces to find what we're looking for. We're interested in one particle in a billion — and it's hard to find. We're ultimately thinking backwards: How do such particles fit together? How were they created in the first place?"

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Enjoying the fruits of their labor, physicists take a break in the Hall A control room after completing the run of experiment E98-108. From left are collaborators Laird Kramer and Pete Markowitz, Florida International University; Ole Hansen, Physics Division; and Garth Huber, University of Regina, Canada.

Kaon experiment comes to successful end…

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Mesons are a class of particle that contain equal numbers of quarks and antiquarks (although not necessarily of the same type). When matter and identical antimatter meet, annihilation is instant and complete, with virtually complete conversion to energy (which is why antimatter is such a favorite fuel among science fiction writers; only relatively small amounts are needed to send spacecraft humming through space). Conversely, examination of how K mesons, or kaons, are created as a result of the internal interplay between quarks and antiquarks, should give invaluable insight into quark interaction.

Research and Consumer Products

Once a kaon is created, the remnants of its creation — particles known as hyperons, and in particular a hyperon variant called a "lambda" — are uniquely composed of quark matter: one strange, one up and one down quark. Examining the structure of these left-behind particles, as well as the behavior of electrons emitted during the course of multiple interactions, should allow physicists to take yet another large step on the way to understanding how matter came to be in the macroscopic world in the first place.

"This is fundamental research. It takes a long time for research like this to affect the price of bread in a grocery store," Markowitz contends. "But in the long run it will. It leads to a better understanding of Nature, which ultimately leads to practical benefits."

The digital products consumers enjoy today are the indirect results of physics experiments conducted in the first half of the 20th century. By laying the theoretical groundwork and then following up with studies that confirmed the particulars of quantum mechanics, researchers set the stage for the debut of the Information Age, the effects of which are still being experienced.

First proposed in late 1993, the Hall A experiment began on January 25 and ended April 26. Approximately 70 researchers from nine countries were involved. Two new detectors, to distinguish kaons from more prevalent pions and protons, were built at a cost of $100,000 each. According to Markowitz, he and his colleagues were quite pleased with experimental outcomes.

"We've had essentially no problems. It's been wildly successful," he says. "The detectors worked wonderfully and the JLab equipment was great. We've managed to get a large data set over a range of energies and angles. It let us really measure [kaon] behavior over a wide range."

A follow-on experiment, also in Hall A, is slated to begin this coming November. Most of the research team will be involved in the upcoming effort as well. Planning is well under way, with installation slated to begin early this fall.

"This first experiment succeeded for two reasons," Markowitz asserts. "First, it's because of all the hard work of dozens of people who attended to thousands of details. Second is the energy and quality of the [electron] beam, which allowed us to take measurements that otherwise would have been impossible.

"Now that we know we can do this, we're going to take it to the next step. Next we're going to put these particles in a nucleus and produce matter that has never been built before. That will be a really challenging thing. And it will be a lot of fun."

Update

Spring Arts Festival

Xiaochao Zheng, flanked by her three ink drawings of Chinese women, won the People's Choice Award at this year's art festival. She is a Hall A physics student from MIT. Here she poses for a photo with her artwork and event organizer Joyce Miller, Physics Division. The art festival's Silent Auction raised $532 for the Peninsula Fine Arts Center.

Inventory time

Property staff needs your help to keep track of all that 'stuff'

It's inventory time at Jefferson Lab. That means the Lab's Property staff is working its way across the site in its annual effort to account for the several thousand pieces of mobile, high-cost equipment, tools and materials that are maintained on the Personal Property and Sensitive Property lists.

The Lab's capitalized Personal Property list — non-installed equipment costing more than $25,000 — currently includes 1,776 items valued at more than $30 million. And the Sensitive Property list — items prone to theft — holds another 6,906 items valued at nearly $9 million, according to Joan Campbell, JLab's Material Services coordinator.

"And that represents taxpayer dollars," she remarks, "which means all of that 'stuff' must be accounted for from the time of purchase to the time its is officially removed from the Lab's Property list."

In April, the Property staff of three — including Campbell — began the Lab's Personal and Sensitive Property inventories for Fiscal Year 2001. "The annual requirement is mandated by the Code of Federal Regulations. It specifies exactly how we must account for items that are on our Property Records," Campbell explains. The final inventory report is sent to the Department of Energy each October.

"We're about halfway through this year's inventory," Campbell adds. "It is progressing. It goes quickly and smoothly when everyone that has equipment assigned to them knows where each piece is physically located."

It also helps the Property team when each locked storage cabinet has a label affixed to the front with the name and phone number of the person responsible for that cabinet's contents. "If there's a cabinet, we have to inventory its contents," Campbell points out. "We encourage cabinet owners to be easily identifiable and to keep an inventory list of what is in their storage cabinets."

The Property team does a partial inventory of Personal and Sensitive Property each year; this year they will inventory about 75% of the items. Missing just one high-priced item on the list can make the entire report reflect poorly upon the Lab's ability to manage its resources, according to Campbell. SURA's contract with DOE includes inventory performance metrics requiring more than 99% of the property to be located during the inventory to achieve an outstanding rating. "And looking for one misplaced item can turn into the proverbial search for the needle in a haystack," she says, "tying up large amounts of time and effort."

Andre Hill checks a printer's identification number against his inventory list.

The Personal Property Procedures Manual, which is approved by JLab management and DOE, explains how Lab property must be handled and accounted for on site. "The manual was revised recently. It's very thorough," Campbell notes. "It covers just about every type of property situation — how to do a Loan Agreement, which is required when an item is taken off site and even how to handle international exports.

"Staff helps keep track of property as it's moved around site, or in and out of storage, by filling out a Property Movement Form that's available from the MIS Web page. But even informal e-mails are helpful," she continues.

The Material Services coordinator encourages everyone who signs for equipment, tools and materials to maintain an inventory list, know where items they've signed for are located or stored, who uses them, and if they are moved around. "By continually staying aware of the items you've signed for," Campbell says, "a person can avoid frustrating, time consuming searches during annual inventories."

Another suggestion is to "excess" property when it is removed from use in lieu of stashing it someplace. Then the excess property will be removed from the Lab's responsibility and will not need to be tracked down during inventory.

Staff members can access a listing of all property items assigned to them by going to the MIS Web page. Questions may be directed to Joan Campbell, ext. 7348, or Andre Hill, ext. 7688.

Editor's note: Non-installed or mobile equipment valued at more than $25,000 goes on the Personal Property list. Sensitive Property includes items of varying cost that are prone to theft. Neither listing includes installed equipment, which is valued at another $325 million for the Lab.

To access the JLab Property Manual go to the Plant Engineering Dept. Web page at www.jlab.org/serv/lab_biz.html. Under "Other Handy Links," select "Property Manual," then click on "Go."

To access the Property Movement Form or to access the list of equipment assigned to you, go to the MIS Web page at https://mis.jlab.org/ and type "property" into the search drive. From the menu screen that appears, select from Property Search by Person, Property Search by Tag, and Property Transfer (Movement Form). Enter your username and password when prompted.

Into the machine

Alignment Group keeps physics research in line

by James Schultz

Young children are urged by those older and wiser to stay on the "straight and narrow." Jefferson Lab's continuous electron beam is under no such moral imperative. But like humans, there's a penalty for straying from the proscribed path. Deviations can have serious consequences: Were the beam not to squarely hit targets in the three experimental halls, researchers wouldn't be able to do much in the way of nuclear physics experiments.

On their own, the nearly 2,000 magnets that orient and steer the Lab's continuous electron beam can't keep electrons in line. That task falls to the Accelerator Division's Alignment Group, which must compensate for slight changes in elevation caused by the small but measurable curvature of the Earth that occurs even over the relatively small distance circumscribed by the near-one-mile-long underground track. Also affecting alignment are weather changes that cause metal parts to expand or contract, buildings settling into soil, the weight of fill dirt, new construction, and minuscule irregularities in poured concrete and other structural components.

In the macroscopic world, such deviations are relatively minor, on the order of less than one inch in any direction, and rarely affect performance in any significant way. In the world of quark-physics research, however, where beam-path differences shouldn't vary by more than a half-millimeter, looser standards would spell disaster.

"With a half-inch deviation, the physicists wouldn't be very happy and I'd be out of a job," says Chris Curtis, Alignment Group leader. "The beam would be hitting pipes and components and spraying radiation everywhere. You certainly couldn't get much physics done."

Ken Baggett (far right) and Steve Hardisty, Alignment Group, take a break while performing an elevation survey of the accelerator in February. The Alignment Group conducted a complete re-leveling of the accelerator; the last time the entire machine had been leveled was 1992-93. They then completed elevation surveys in each of the three halls, where they confirmed that Hall B has settled a total of 8 mm.

So the Alignment Group, like its colleagues in the world of land surveying, uses tried-and-true principles of geometry to calculate what's in line and what is not. Given the presence of hundreds of components and sub-components within the accelerator complex that must be adjusted, the job is more complicated than run-of-the-mill boundary surveying. A unique combination of gear is required to keep everything literally straight.

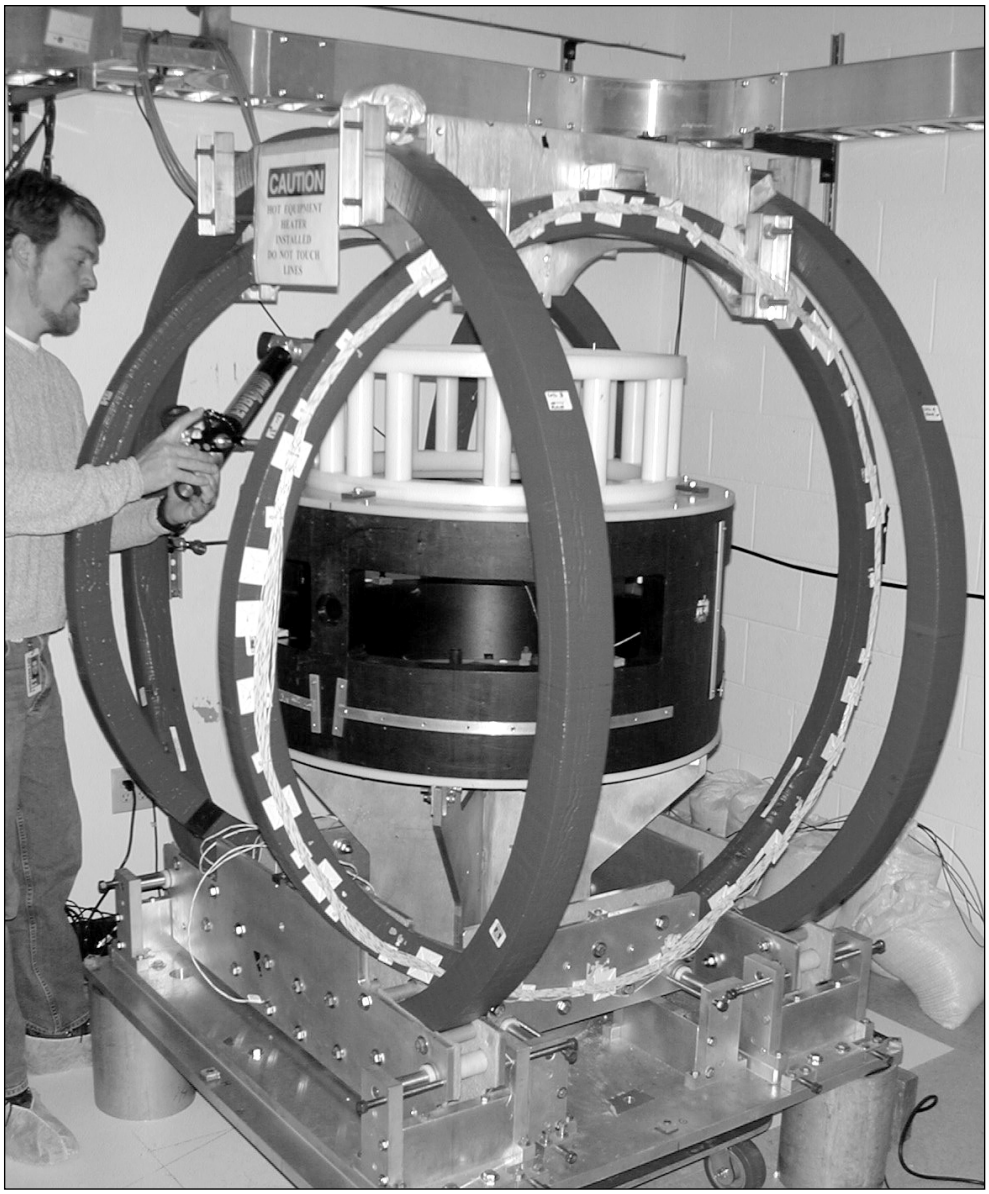
Keeping it on the Level

The group has developed a survey network of what Curtis and his group call "monuments," a series of 600 made-to-order machined cups in which sit half-spheres marked by bull's eyes. The position of the bull's eyes are measured by theodolites — essentially, a telescope with angle-reading capability — and by laser-based "mekometers," which measure location to an accuracy of one-tenth of a millimeter.

The group applies the principles of Euclidean geometry (the fact that the interior angles of triangles add up to 180 degrees) to deduce positions and make the necessary corrections. Since the monuments are located in a zigzag pattern throughout the accelerator complex, maximizing the number of triangulations that can be calculated, accuracy is thereby boosted.

Although the effect of the Earth's curvature is quite small, roughly on the order of one-half inch elevation change for a quarter mile of distance traveled, that curvature still must be taken into account in sending the electron beam in as straight a line as possible down the two tunnel linacs. Other, more local effects can be even greater, depending on the season, such as concrete swelling and contraction, water-table movement, and temperature-induced size fluctuations in metal parts.

Because the accelerator's steering magnets are installed on perpendicular rods called cartridge adjusters, with a range of 10 millimeters (roughly four-



Chris Gould, Alignment Group, uses a portable coordinate measuring machine (CMM) on the magnet coils of the Hall A helium 3 polarized target assembly. He is locating the center of the assembly to ensure exact placement of the target chamber.

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tenths of one inch), the Alignment Group can adjust position up and down, side-to-side and around in a circle. The Group has also written software that makes alignment faster and more accurate.

"We survey it, find out where it is and where it should be," Curtis says. "The software we've written calculates the difference. Then we move it until it's within the proper tolerance."

Once correctly positioned, the majority of magnets don't have to be moved often. The Group's major effort is concentrated in Halls A, B and C, where a revolving array of experiments requires near-constant adjustment. The Group is also involved in an ongoing process known as "fiducialization": placing monument-like bull's eyes on existing and new equipment in order to define their spatial location in the beamline.

"This is a rather specialized application of surveying. The principles are basically the same," Curtis explains. "You're measuring angles and distances and positions of things in three dimensions of space. On a [real-estate] boundary survey you have to worry about deviations of about a half-inch. Here we have to be at least 25 times more accurate than that."

Just how many measurements does it take?

Magnets in the accelerator are aligned using a two step process — initial alignment (before electrical and vacuum hookups), and final alignment. Two theodolites are used during the first step, and three during the second step. All references are shot in forward and reverse modes, and there are two to four fiducials (survey references) on each magnet.

It takes 150 to 300-plus measurements to align each magnet in the accelerator (step 2 alignment only). For the roughly 1,400 aligned magnets (not correctors) this totals in excess of 300,000 measurements. Magnet Stand alignment requires another (approximately) 40,000 observations, and bolt layout to position the stands adds another (nearly) 5,000 observations. It takes about 20,000 observations to establish the locations of the monuments in the survey network. And this doesn't include the fiducialization measurements required to define survey references on the components (15,000 observations for cryomodules alone).

To prevent error from creeping into their measurements, the Alignment Group calibrates their instruments to reduce errors, then takes measurements in a way to minimize or eliminate errors. For example, a theodolite is pointed at an object, then reversed and pointed again. (This constitutes "forward and reverse observations" referred to above.) The observational procedure provides redundant information, which serves as a check on the work. The group always shoots more than the minimum number of observations in order to define the location of theodolites and components. They shoot five, six, or more monuments to define the location of a theodolite, instead of the required three. And when the data taking is finished, they check through their notes and files to see if there were any problems, and any information sent out is checked by someone other than the data preparer.

All Alignment Group measurements are metric.

In their own words

Maud Baylac transitions from student to Lab staff member

as told to Judi Tull

Although I've only been a full-time staff member here at the Lab since January, I've worked here, off and on, since just before the HAPPEX experiment in 1998.

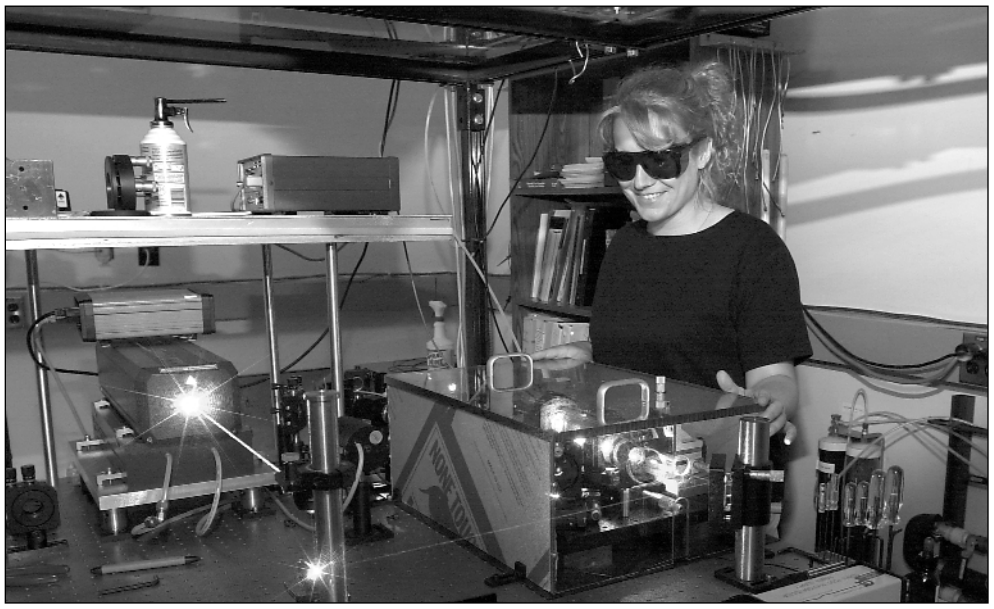
I came originally in connection with my Ph.D. thesis, which was for the measurement of electron beam polarization with the Hall A Compton Polarimeter. The work I do today as part of the Injector Group is far different.

I grew up in the French Alps, in Grenoble, the younger of two daughters. By the time I was in junior high school, I knew I wanted to work in science, and I thought that I would go into rocket physics or some aspect of space research. But when I was first introduced to sub-atomic physics during my second year of undergraduate work, I knew I'd found my niche. Understanding how the world works is just fascinating to me.

I came to the United States for the first time for my senior year of college. I was lucky enough to be accepted as part of an exchange student program at the University of California at Berkeley. Being there was quite an introduction to America! Berkeley's reputation as the home of free expression for young people is well deserved. And, the non-stop social life at Berkeley was intriguing and a welcome change from my college in France. There, the campus died at 6 o'clock when classes were over.

I've had the opportunity to travel in this country — on both coasts and through the western states, and even Hawaii. But my favorite place was Bryce Canyon in Utah. There's nothing like it in Europe. That landscape is simply amazing.

Since I've lived here, I've been visiting Williamsburg, Yorktown, and Richmond. Last Christmas, my family came over and we went to New York City, where we spent New Year's Eve. Being in Manhattan for that was another incredible experience.



Maude Baylac prepares to open the cavity enclosure of a TiSapphire laser in the Source Lab located in the Experimental Equipment Laboratory. She's getting ready to optimize the laser's output power.

I returned to France after Berkeley, and did my graduate work at Universite Claude Bernard and Commissariat a L'Energie Atomique, Saclay. I started my thesis work in September 1997 and traveled back and forth between Newport News and Saclay for the next three years. I was fortunate to be involved with the installation, commissioning and first measurements from the Compton Polarimeter.

I've taken up residence at Buckroe Beach because I love living by the sea. I used to be a downhill skier, played squash and studied ballet, modern dance and jazz, but most of my recreational pastimes went by the wayside when it was time to start my thesis.

Although I did my early work in nuclear physics, I'm enjoying my work as an injector physicist. There is a lot for me to learn since I am now dealing with different aspects of physics, like optics or beam physics. Our goal is to produce a high quality electron beam — especially in terms of intensity and polarization — for JLab users.

When I worked with nuclear experiments, everything was done on a much larger scale. An experiment spans many years — from approval, to data taking and then analysis — and involves a great number of people.

Now, in the injector group, I have the opportunity to run my own tabletop experiments every day or so and I love that. I enjoy the work environment here, and the fact that I get to work with a lot of smart, experienced people. I do miss some of the daily experiences of living in France, especially the little streets and shops, the food and wine, but I have a number of co-workers who are here from France, and there is a feeling of community among us.

People sometimes ask me about being a woman in the science community. Science does not care whether you are a man or a woman. The bottom line is that we are all scientists. I feel strongly that girls should be encouraged more to go into the sciences, especially here in America. It will be a pity if young people don't come into this field. We would lose a lot of competence and that would be very sad for the future. Plus, there's a lot of fun stuff to do!

Milestones
for May 2001

Hello

Zopalla Brown, Internet Application Developer, Physics Division

Kris A. Burrows, Security & Services Section Manager, Administration Division

Douglas E. Curry, Electrical/Electronic Engineer, Accelerator Division

Gary E. Hays, Document Control Technician, Accelerator Division

Jessica M. Ledbetter, Web Developer, Physics Division

Gregory A. Sammons, Electro-Mechanical Technician, Physics Division

Goodbye

Deauna Brown, Employment Assistant, Administration Division

Deborah Lodding, Administrative Assistant, Accelerator Division

Paul Rutt, Electron Injector Scientist, Accelerator Division

Leslie Swindells, Administrative Assistant, Southeastern Universities Research Association

Congratulations

Jennifer Allen, Administration Division EH&S intern, has won a scholarship from the Greater Tidewater Chapter of the American Society of Safety Engineers. She is a graduate student at Old Dominion University, working toward her M.S. in Environmental Health with a concentration in Safety.

Vball enthusiasts seek help in finishing new court

Sand volleyball is coming to Jefferson Lab, according to Bob Welsh, Director of JLab's Student Affairs office. With assistance from Plant Engineering's Don Seeley and Ed Winslow, Welsh and a group of JLab graduate students have installed drainage pipes and spread the sand for a volleyball court. They are building it in the grassy area across the street from the parking lot on the east side of CEBAF Center.

Welsh received approval from the Director's Council to put the volleyball court in as a self-help project. Once completed, he says, the volleyball court will provide a much-needed recreation opportunity for the many students at the Lab. "Students are a vital part of the physics work going on here," he notes, "and quality-of-life issues impact them as much as the rest of us.

"We've poured the foundation for the net supports and installed the net," Welsh explains, "but, now we need some extra help. Soon we hope to start planting the perimeter around the court with Zoysia [grass] plugs. That will give us a nice, low-maintenance ground cover and control erosion. We'll need some volleyball-hungry volunteers to help plant the grass plugs and to help with the regular watering the grass will need for its first 6 weeks.

"It is a 'bring your own ball' volleyball court," he says. "As few as four and as many as 12 may use the court at a time. The volleyball court is available for games during daylight hours on a first-come, first-served basis. It will be great to have the court available for after-work and weekend games."

The court is accessible to all graduate and undergraduate students at the Lab, as well as JLab employees. Call Welsh at ext. 7583 or e-mail welsh@jlab.org for more information or to help with grass planting and/or watering.

Local council recognizes Lab for minority support

The Tidewater Regional Minority Purchasing Council (TRMPC) recently recognized Jefferson Lab during the council's monthly "Power Breakfast" meeting. TRMPC cited JLab as an outstanding corporate member and for its "exemplary commitment to the minority business community."

In a congratulatory letter to Danny Lloyd, JLab's Purchasing and Small Business Manager, TRMPC Executive Director Wendell Braxton complimented the Lab's unwavering support of TRMPC projects. He applauded the Lab for consistently providing leadership in creating procurement opportunities for minority entrepreneurs.

Lab tops goal; biggest turnout ever for Red Cross blood drive

Kathy Crosby, Medical Services secretary, sends out a "huge thank you" to everyone who helped with or volunteered for the Red Cross blood drive on May 17. "It was our most successful blood drive to date," she reports. "The blood drive ran from 10 a.m. to 4 p.m., but at 3:30 we had to start turning away donors because the Red Cross staff ran out of supplies."

One hundred and two people signed up. The Red Cross collected 89 productive units, which topped the Lab's goal of 65 units for the day, and five individuals were first-time donors, Crosby adds.

She reminds everyone that the next blood drive will be Oct. 10 and urges everyone at the Lab to participate. "The American Red Cross has been experiencing a 4 percent decrease in donated units and an 8 percent increase in demand, over the last several months," she points out. "That kind of math doesn't work and there are so many ways we can help turn this picture around.

"Give the gift of life and show your support for this worthy cause," she says. "Put it on your calendar, we'll need donors, greeters and 'bloodhounds' to help recruit and schedule donors." Donors are asked to schedule an appointment so adequate Red Cross staff and volunteers will be able to maintain a smooth-running operation.

For more information about the October blood drive, contact Vicki Barnett at ext. 6269 or e-mail vbarnett@jlab.org.

At a Glance

Calendar of JLab activities and events

June 4–Aug. 10: Energy Research Undergraduate Laboratory Fellowship (ERULF) program.
June 11–29: Hampton University Graduate Studies (HUGS) 2001 program.
June 15: Deadline for signing up and paying for Family Baseball Game outing (at CEBAF Center front desk).
June 18–Aug. 10: High School Summer Honors Internship Program (SHIP).
June 18: Deadline for questions & comments concerning SURA's Request for Proposals (RFP) to participate in a SURA-sponsored Scintimammography Initiative. Submit questions/comments to jmullin@sura.org.
June 20–22: Annual JLab User Group meeting.
June 25: DMV mobile unit visits Lab.
June 25–29: Pickup your tickets for Family Baseball Game outing (at CEBAF Center front desk).
June 29: Dosimetry badge exchange. Be sure your TLD is in its assigned place in the badge rack before leaving work.
June 30: JLab Family Baseball Night at War Memorial Stadium.
June 30: Deadline for submitting proposals to SURA in response to its Request for Proposals regarding the SURA-sponsored Scintimammography Initiative. RFP format available on Web page.
July 9–Aug. 2: Physics Enrichment for Science Teachers (PEST) program.
July 10: Safety Eyeglass Truck on site from 9 a.m.– noon. Get your Purchase Requisitions in now. Call Estelle Seeley, ext. 7238 for more information.
July 23: DMV mobile unit visits Lab.
Aug. 27: DMV mobile unit visits Lab.
Sept. 16–21: 9th International Conference on the Structure of Baryons at Jefferson Lab.
Sept. 24: DMV mobile unit visits Lab.

*To add an event or activity to the calendar, e-mail magaldi@jlab.org. For additional, or the most current, information, visit the "At a Glance" calendar on the JLab News Web page at www.jlab.org/news/. * Events flagged with an asterisk (*) have an accompanying story in this issue of "On Target."*

ON TARGET

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