

## Milestones at Three of Brookhaven's 'Big Machines'



### Relativistic Heavy Ion Collider Successful Grumman-BNL Partnership Produces First Industrial RHIC Quadrupole

In the magnet testing area of Bldg. 902, Rich Meier makes the final checks on the first industry-built quadrupole for RHIC, before mounting it for testing at very low temperatures.

Photos on this page by Roger Stoutenburgh

Friday, April 8, marked an important milestone in the construction of the Lab's Relativistic Heavy Ion Collider (RHIC) — Grumman Aerospace Corporation delivered RHIC's first quadrupole magnet to be made by industry.

The quadrupole, which was the first superconducting accelerator magnet Grumman has built, is also the first of 432 such magnets that the company will produce for RHIC.

Once at BNL, the quadrupole underwent a series of tests, culminating in a successful two-day test at its operating temperature of 4.35 kelvins, 4.35 degrees above absolute zero. Not only did the magnet operate successfully at its design current of 5 thousand amperes (kA), but it also had a reserve of

over 50 percent before it quenched — lost its superconductivity and became resistant to electricity.

In addition, the total field strength of the quadrupole and its non-quadrupole components, measured over the full operating range of 0.5 kA to 5 kA, proved suitable for RHIC.

"The tests show that this magnet's performance has exceeded our expectations," said Satoshi Ozaki, RHIC Project Head. "Congratulations are due to Grumman for hitting the bull's-eye on their very first magnet."

Although a RHIC quadrupole is only 1.2 meters (not quite 4 feet) long, with an outside diameter of 26.7 centimeters (10.5 inches), it weighs 355 kilograms (782 pounds). When the magnet is operating, a magnetic field in its 8-centimeter bore focuses the beam particles as they speed to the next magnet in the ring.

The magnet was designed and developed by RHIC's Magnet Division, with eight prototypes being constructed at BNL about a year ago. In 1992, Grumman won a \$6-million contract to build 432 quadrupoles for RHIC, and, since then, a considerable technology-transfer effort has been ongoing between Grumman and the Lab.

"Part of the transfer was physical — BNL supplied the superconducting cable, the computer-driven magnet-coil winder and some other items," said Douglas Fisher, RHIC's project manager for the Grumman contracts. "The rest was to train Grumman engineers and technicians in the magnet-construction technology we've built up at BNL over the past decade." This task was handled by Michael Anerella, RHIC project engineer and the principal point of contact between BNL and Grumman.

To smooth the transition process, Grumman staff visited BNL to observe (continued on page 2)

## Alternating Gradient Synchrotron Siberian Snakes Rescue Polarized Protons

In 1984, polarized protons — all spinning in the same direction — first began circulating in BNL's Alternating Gradient Synchrotron (AGS). Since then, to maintain this uniform polarization, an elaborate and labor-intensive series of adjustments has been required for each polarized proton run.

But that fine-tuning became obsolete as of April 4, with the first test of a partial "Siberian snake" installed at the AGS. With this large magnet in place, the polarized proton beam was accelerated to an energy of 12 billion electron volts (GeV) with no depolarization. Without the snake, however, no polarization survived.

Invented by Siberian scientists Y.S. Derbenev and A. M. Kondratenko, and aptly named by AUI Distinguished Scientist emeritus Ernest Courant, Siberian snakes cause a polarized proton (continued on page 3)



In the Alternating Gradient Synchrotron (AGS) control room, Haixin Huang (left, seated) from Indiana University joins Thomas Roser (right, seated) and Larry Ratner, both from the AGS Department, to adjust the current for a test of the partial Siberian snake.

## National Synchrotron Light Source Structural Biology Extension Now Under Construction

For structural biology researchers who study the molecules of life using x-rays at the National Synchrotron Light Source (NSLS), time is of the essence. The crystals they grow are temperamental things, often with short life spans and a tendency to break down soon after the high-intensity probes hit them.

Right now, those crystals are prepared in labs in Bldg. 463, then transported to the NSLS with great care. But, by this fall, BNL and guest researchers will not have to make that risky trip. Construction began April 14 on a project that will add laboratory and office space to the NSLS, Bldg. 725.

The structural biology addition, which will wrap around the building from Technology Street to Brookhaven Avenue and span beamlines X6 to

X12, will house eight labs and a conference room for structural biologists who use NSLS beam lines. The project's contractors, Bass & D'Alessandro of Hicksville, expect to complete the 6,300-square-foot addition, which was designed by Ehasz Giacalone Associates of Garden City, by the end of October.

"This addition will allow us to build on the strengths of our structural biology programs, both within the Laboratory and in the user community," commented BNL Deputy Director Martin Blume. "It is especially important to have this kind of extra laboratory space for the structural biology beam lines because of the necessity to create some samples immediately before they are studied."

The construction of the facility is (continued on page 2)



As NSLS users look on at the April 14 groundbreaking, ceremonial shovels get broken in by: (left to right) Ove Dyling, Plant Engineering Division; NSLS Users Executive Committee Chairman Johnny Kirkland, Naval Research Laboratory; Denis McWhan, Chairman, NSLS Department; BNL Deputy Director Martin Blume; William Studier, Chairman, Biology Department; and Robert J. Bass, Bass & D'Alessandro.

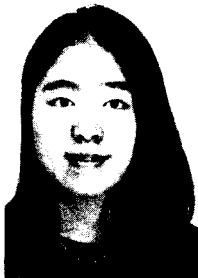
## AUI Scholarships Are Sweet for 16 Seniors

In the 29th year of the program, 16 sons and daughters of BNL employees have been awarded AUI Trustee Scholarships. Each AUI Scholar is a high school senior who will receive \$2,500 per year for up to four years of study at the college or university of his or her choice.

The winners were chosen from among 60 applicants. Selection was done by an independent committee appointed by the College Scholarship Service of Princeton, New Jersey, which administers the program for Associated Universities, Inc. (AUI).



**Alan Abola**, son of Agnes Abola, Alternating Gradient Synchrotron Department, and Enrique Abola, Chemistry Department, lives in Middle Island and goes to Longwood High School. He will major in physics, engineering or computational science at Harvard University or Stanford University.



**Yizhi Meng**, daughter of Wuzheng Meng, Alternating Gradient Synchrotron Department, lives in Setauket and goes to Ward Melville High School. She will major in mathematics at Cornell University, the University of Chicago or the State University of New York at Binghamton.



**Felisa Brunschwig** is the daughter of Bruce Brunschwig, Chemistry Department. She lives in Bellport and attends Bellport High School. Accepted by Brandeis University, Occidental College, the University of Rochester and Tufts University, she is as yet undecided on her major.

**Channie Neymotin** is the daughter of Lev Neymotin, Department of Advanced Technology. Residing in Plainview, she will graduate from the Torah Academy of Suffolk County, Commack. She will attend Harvard University or Yale University, to major in religious studies and liberal arts or science.



**Raman Ramakrishnan**, son of Venki Ramakrishnan, Biology Department, has been accepted at Harvard University, the Massachusetts Institute of Technology and Yale University, and he plans to major in the physical sciences or music. Living in East Patchogue, he goes to Bellport High School.



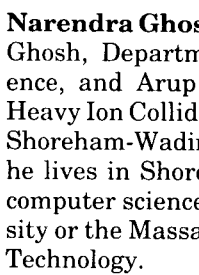
**Alan Feng**, son of N. Inan Feng, Biology Department, is a resident of Stony Brook. A senior at Ward Melville High School, he has been admitted to Cornell University, Georgetown University and the Massachusetts Institute of Technology. He will probably major in mathematics.



**Erin Ross** is the daughter of Tony Ross, Plant Engineering Division. A senior at Connetquot High School, she resides in Ronkonkoma. She has decided to attend Boston College, where she plans to major in psychology.



**Rakesh Singh** is the son of Om Singh, National Synchrotron Light Source Department. He lives in Coram and goes to St. Anthony's High School in Huntington. To be a pediatrician, he will major in biological science at Cornell University, Columbia University or Tufts University.



**Narendra Ghosh** is the son of Vinita Ghosh, Department of Applied Science, and Arup Ghosh, Relativistic Heavy Ion Collider Project. Attending Shoreham-Wading River High School, he lives in Shoreham. He will study computer science at Harvard University or the Massachusetts Institute of Technology.



**Marsha Harris** is the daughter of Vincent Harris, Relativistic Heavy Ion Collider Project. To undertake a pre-medical course of study, she plans to attend New York University, Syracuse University or the University of Massachusetts. A resident of Jamaica, Queens, she is a senior at the August Martin High School.



**Carolyn Lee**, daughter of Tom Lee, Department of Applied Science, is a resident of Bayside, Queens, and she goes to Stuyvesant High School, Manhattan. She will probably major in biological science at either Yale University or the Massachusetts Institute of Technology.



**Dennis Lee** is the son of Yin-Nan Lee, Department of Applied Science. He has been accepted at Cornell University and Brown University, and he will probably major in engineering. A resident of East Setauket, he attends the Ward Melville High School.



**Angela Lu** is the daughter of Ming-Shih Lu, Department of Advanced Technology. Currently living in Miller Place, she will be graduated from Miller Place High School. To study the biological sciences, she will attend The Johns Hopkins University.



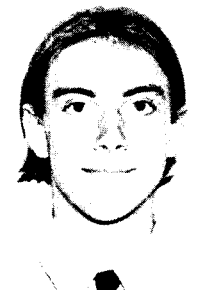
**George Williams**, son of Gwyn Williams, National Synchrotron Light Source Department, lives in Port Jefferson and attends the Earl L. Vandermeulen High School. He will study computer science at Cardiff University, Wales; Imperial College, England; or Pennsylvania State University.



**Karen Swyler**, daughter of Karl Swyler, Office of Educational Programs, lives in Sound Beach and attends Miller Place High School. To pursue her dual interests of arts and science, she will major in ceramics, with a strong minor in biology, at the New York State College of Ceramics at Alfred University.



**Joane Taneus** is the daughter of Roger Taneus, Reactor Division, and she will probably major in marketing at the University of Virginia or Yale University, after her graduation from St. Anthony's High School in Huntington. She is a resident of Coram.



## Technology Teachers To Convene at BNL

About 300 technology teachers from all over the state will gather to talk shop at BNL during the 31st annual spring conference of the New York State Technology Education Association, April 28-30.

"We're hosting this conference for the first time to help promote the importance of technology education and the conference theme, which is making connections between technology, science and math," said Karl Swyler, manager of BNL's Office of Educational Programs (OEP). "With supervisory concurrence and if space permits, Lab employees may attend any of the conference workshops and stop by the vendor displays."

Fifty workshops will be offered in subjects as diverse as "Model Rocket Building — Solid Rocket Fuel and Carbon Dioxide" and "Computer Graphics and Multimedia."

Almost 30 vendors will be on hand to demonstrate the latest in technology — from wind tunnels to robotics — from noon to 4:30 p.m. on April 28, and from 9 a.m. to noon on April 29. A shuttle bus will run from Berkner Hall to the exhibits in the Brookhaven Center.

Employees who eat at the Cafeteria should note that conferees will be dining there for breakfast each conference day, and for lunch on Friday, April 29, beginning at 1:15 p.m.

For workshop and other information, call OEP at Ext. 5849.

## Aerial View of Eclipse

To view the upcoming solar eclipse, the Brookhaven Flying Club plans a trip tentatively scheduled for mid-day on Tuesday, May 10. Weather permitting, club members will fly one or more aircraft approximately 100 miles north to view the eclipse's totality.

Since seats may be available for nonmembers, those interested in an aerial view may contact Dave Adler, Ext. 2686, or E-mail [adler@bnl.gov](mailto:adler@bnl.gov).

## NSLS Addition

(cont'd)

expected to cost \$1.8 million, funds appropriated from the U.S. Department of Energy's (DOE) Office of Health and Environmental Research budget.

Blume commented that the NSLS project is just one part of long-term plans to expand the structural biology program. "It will help us serve anticipated new users as well as our existing community, who use not only the Light Source but also the High Flux Beam Reactor and BNL's electron microscope facilities, as well as contributing to the Protein Data Bank," he added.

— Kara Villamil

## RHIC Magnet

(cont'd)

the construction of the final RHIC research and development magnets. And, since last November, a total of 44 RHIC Magnet Division staff members have made 168 trips to Grumman's Bethpage facility to assist in the training for this effort and a much larger companion effort to build 373 dipole magnets each 9.7 meters long.

"This success is the fruit of the technical competence we have at Brookhaven," Ozaki observed.

Bernie Cody, Grumman's project manager for the quadrupole, agreed that the key to this success has been the combination of two areas of expertise — BNL's magnet design and development, and Grumman's long experience in the techniques of mass production. "The result is an excellent working partnership," said Fisher.

— Liz Seubert

## Weight Management Group Forming to Meet on Site

A group for employees interested in managing their weight using nutritional and behavior-modification principles is being formed. Sponsored by the Health Promotion Program of the Occupational Medicine Clinic, the group will be run by registered dietitian Lydia Genovese, who holds a master's of science in nutrition from

Hunter College and is an adjunct instructor in the diet technician program of Suffolk Community College.

The group will focus on losing weight and body fat without being on a diet, by examining lifestyles, targeting goals, improving nutrition and acquiring healthier eating habits gradually. Exercise will also be an

important component of the program.

The group will meet for six Mondays, noon to 1 p.m., starting May 9, and it is limited to 12 people. The cost per person is \$90, payable at the first session. To register, first-come, first-served, contact Health Promotion Specialist Mary Wood, Ext. 5923, as soon as possible.

## Siberian Snake (cont'd)

ton beam to wriggle like a snake. A partial snake makes a polarized proton beam easier to achieve at the AGS, while a group of full snakes opens up new possibilities for experiments involving polarized proton collisions at BNL's Relativistic Heavy Ion Collider (RHIC), now under construction

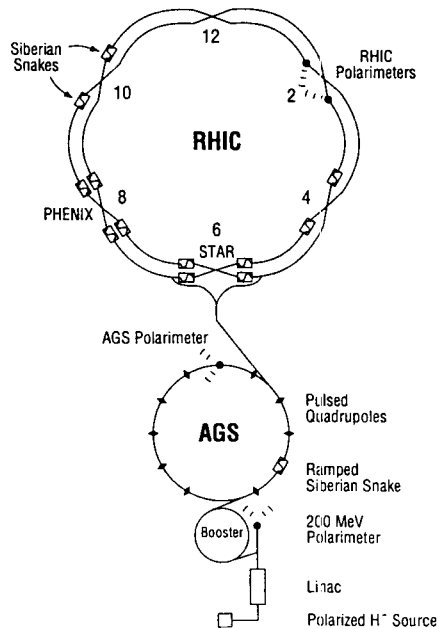
Polarized-proton experiments measure spin effects in high-energy reactions. But, at the AGS, to keep the protons polarized, 94 small dipole magnets in the accelerator's ring have had to be adjusted 40 times during a one-second acceleration period. Otherwise, the protons were kicked off their vertical axis by an accumulation of horizontal magnetic fields.

### From Theory to Practice

The theory of using a partial Siberian snake to overcome the problem of depolarization at the AGS was first published by Thomas Roser, AGS Department, in 1988. Larry Ratner, AGS, together with S. Y. Lee of Indiana University, made the initial proposal to try it out. That resulted in this month's test of a partial snake by a collaboration of researchers from BNL, Indiana and Argonne National Laboratory.

The partial snake is a 2.5 meter-long solenoid, an electrically energized coil of insulated copper wire that produces a magnetic field of almost 2 tesla's, pointing along the beam of polarized protons.

"Using a polarimeter designed by George Mahler, from the RHIC Project, and our collaborators from Argonne, we were able to measure polarization



very accurately, and we found that the partial snake did its job well," said Roser. "We are planning additional tests at higher energies, and our ultimate goal is to test the snake at the full operational energy of 25 GeV by January 1995."

Roser added, "I'd like to thank all my collaborators for making this test a success, in particular, James Alessi and Ahovi Kponou, both from the AGS, who ran the polarized ion sources at the Linac; Yousef Makdisi, RHIC Project, who helped to operate the polarimeter; Haixin Huang, Indiana, and Leif Ahrens and Gerry Bunce, AGS, who helped make the test go smoothly."

### How the Snake Works

"When hit by a horizontal magnetic

**Polarized protons start with hydrogen gas stripped of its electrons in BNL's polarized negative hydrogen (H<sup>-</sup>) source. The particles are accelerated through progressively larger accelerators — the Linac, the Booster, the Alternating Gradient Synchrotron and, by the end of the decade, the Relativistic Heavy Ion Collider (RHIC). The ramped Siberian snake at the AGS keeps the protons polarized, as will the four snakes in RHIC at the 4 o'clock and 10 o'clock positions. The S's at RHIC's detectors PHENIX and STAR represent spin rotators.**

force, the polarized protons precess, or wobble, similar to the way a spinning top wobbles when it is kicked from the side," explained Roser. "When the frequency of the horizontal magnetic force is the same as the polarized protons' precessing frequency, the effect of the repeated kicks accumulates and completely depolarizes the protons. This happens 40 times during the one second it takes to accelerate the polarized protons to 25 GeV, and, until now, has required 40 adjustments."

To overcome this, the partial snake performs a clever trick: It rotates the spin of the polarized protons by nine degrees away from the vertical axis at each revolution around the AGS, so the kicks on one turn cannot accumulate with the kicks on the next turn. In fact, after 20 turns around the accelerator, the kicks cancel themselves.

Explained Roser, "It is as though the top were kicked from opposite directions — the force from one kick cancels the other, keeping it stable."

For RHIC experiments, polarized protons will be accelerated at the AGS before moving on to RHIC's two rings, where they will accelerate up to 250 GeV per beam, colliding at an energy of 500 GeV. When RHIC is completed before the end of the decade, it will be the only high-energy accelerator in the world in which polarized protons will be able to collide.

In RHIC's 3.8-kilometer circular tunnel, the effect of the horizontal magnetic fields will be much stronger than in the AGS. To counteract this, two Siberian snakes will be installed in each of the two accelerator rings of the collider to prevent depolarization.

"These full Siberian snakes will flip the polarized protons' vertical axis a complete 180 degrees at each turn around RHIC," said Roser, "and the horizontal magnetic forces will cancel themselves at every other turn."

The RHIC Siberian snakes are being designed in the Magnet Division of the RHIC Project, with input from Ernest Courant, RHIC; Alfredo Luccio, AGS; and Yuri Shatunov, from the Budker Institute of Nuclear Physics, Novosibirsk, Russia.

With the snakes in place in RHIC, an international team of physicists, including BNL researchers, plans to probe the spin structure of polarized protons and investigate the fundamental forces that affect elementary particles when they collide.

Thus, the team hopes to gain greater insight into quantum chromodynamics, the theory that explains the interactions of quarks and gluons — the elementary particles from which polarized protons are formed.

— Diane Greenberg



**Professional Secretaries Week\* — April 24-30**  
**Professional Secretaries Day\* — April 27**

\*Created by PSI in 1952 to recognize secretarial achievements and to show the tremendous potential of the secretarial career.

## IBEW Meeting

Local 2230, IBEW, will hold its regular monthly meeting on Monday, April 25, at 6 p.m. in the Knights of Columbus Hall, Railroad Avenue, Patchogue.

The agenda includes regular business, committee reports and the president's report.

## Let's Dance the Fox Trot and Mambo!

Sign up now for the beginners' fox trot and mambo dance lessons, which will begin on Wednesday, May 4, in

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## P-CAD Users

To hear a report on the International P-CAD User Group Conference, the P-CAD User Group will meet on Wednesday, April 27, from 10 a.m. to noon, in the seminar room, Bldg. 515.

For more information, call Pam Mansfield, Ext. 7286, or E-mail pam1@bnl.gov.

## Aerobic Dance

To stretch away those everyday aches and to build flexibility and cardiovascular fitness in time for softball and other summer activities, join the next 15-weeks of the Aerobic Dance Club's aerobics and/or stretch classes, starting the week of May 2 and ending the week of August 29.

The stretch class will be held every Monday in the Physics lounge, Bldg. 510, beginning May 2; the aerobic class will be held Tuesdays in the Recreation Bldg. in the on-site apartment area, starting May 3. Register at the first classes.

Each series costs \$35 per person. For more information, call Pat Flood, Ext. 7886, or digital beeper 4011.

the Physics lounge, Bldg. 510. Offered by the BNL Ballroom, Latin & Swing Dance Club, the class will be taught by 1993 Empire State Ballroom champions Giny Rae and Peter Sciarca.

The class will run from 6:30 to 7:30 p.m. for six to eight Wednesdays, depending on how many people sign up.

The cost is \$20 per person. BNL employees, retirees and those employed by on-site contractors, plus their spouses, dance partners, family and friends are welcome — especially men. Since even numbers of men and women will be enrolled, you don't need a partner to sign up.

For more information or to register, call Marsha Belford, club president, Ext. 5053.

## New CCD Capability: Voice Mail Form

With the Octel voice-mail system installed by the Telecom Services Sec-

## Amateur Radio

The Amateur Radio Club will next meet on Thursday, April 28, at noon in Room D, Berkner Hall.

All Lab employees, guests and licensed amateur-radio operators are invited to attend. For more information, contact Chris Neuberger, Ext. 4160, or Nick Franco, Ext. 5467.

tion of the Computing & Communications Division (CCD) last January, the equivalent of a paper form can be completed on voice mail, using the Octelforms application feature. One example of this is the special telephone line for reporting problems with purchased goods or services, described in last week's Bulletin. CCD helped set this line up so that a call to Ext. 3200 is equivalent to completing a paper form.

For more information on this capability, call Nick Pisco, CCD, Ext. 2000.

## Outreach Workshop

### An Affair to Remember . . .

With statistics ranging upward of 50 percent, the most accurate estimates of extramarital sex say that 21 percent of men and 16 percent of women have sexual relations outside of their marriages each year. Of these, some 6 percent engage in affairs lasting three months or longer.

According to the next Outreach speaker, clinical psychologist Don-David Lusterman, a good percentage of people involved in protracted affairs are suspected or eventually found out by their marriage partners — but, if handled properly, this discovery can either lead to "a better marriage or a better divorce."

Lusterman will discuss "Marital Infidelity: The Affair as Crisis and Opportunity" during the next Outreach workshop, on Tuesday, April 26, from noon to 1 p.m. in Berkner Hall. All are invited, and an audiotape of the talk will be available afterwards in the Research Library.

Before an affair, Lusterman will show, a marriage is usually anything but perfect, despite what the offended party may believe. According to the speaker, the key factor absent from marriages in which one or both partners stray is the couple's ability to solve problems together.

As the speaker will explain, the discovery that one's spouse is having an affair is a traumatic experience, and the person making the discovery feels like a victim. If the victim's rage is not acknowledged by the infidel, then the couple can never get beyond blaming each other — and winds up with an angry marriage or messy divorce.

Lusterman will also discuss such issues as the "other" man or woman and side-taking by family and friends.

Returning to BNL by popular demand, Don-David Lusterman, Ph.D., is a fellow of the American Psychological Association and the American Association of Marriage & Family Therapists. Having published widely on the subject of extramarital affairs, he is now coauthoring a book on the topic, and he has testified in court as an expert witness in the field.

