BROOKHAVEN BULLETIN
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BROOKHAVEN NATIONAL LABORATORY

RHIC Begins World's Highest Energy Heavy-Ion Collisions

On the evening of Monday, June 12, operators in the main control room of the Relativistic Heavy Ion Collider (RHIC) watched control displays anxiously as the beams circulating in the collider's twin rings appeared to be colliding.

"The atmosphere was tense and very exciting," said Thomas Roser, head of the Accelerator Division and run coordinator for RHIC's first collision run. "We were operating at nearly 30 billion electron volts (GeV) per nucleon, our target energy for first collisions,

"We are crossing into a new frontier of scientific inquiry."

and we knew the beams were crossing at the collider's intersection points. But we couldn't say for sure that we'd had collisions until we got definitive, corroborative evidence from the detectors."

All four of RHIC's detectors — BRAHMS, PHENIX, PHOBOS and STAR — were poised and ready to take data as the accelerator physicists began to steer the beams into collision, necessarily one detector at a time. The first spectacular images of particles streaming from a head-on collision point were produced by STAR shortly before 9 p.m. Data from PHOBOS indicated collisions at about 2 a.m. the next morning. It is easier to collide beams at these two collision points because the beams are wider than they are at BRAHMS and PHENIX, but work to produce collisions in all four detectors simultaneously is now continuing. PHENIX was seeing collisions as the Bulletin went to press (see image on page 3).

The collisions are great news to the thousands of physicists, engineers and support staff who have been working since 1991 to get RHIC up and running, and to physicists everywhere

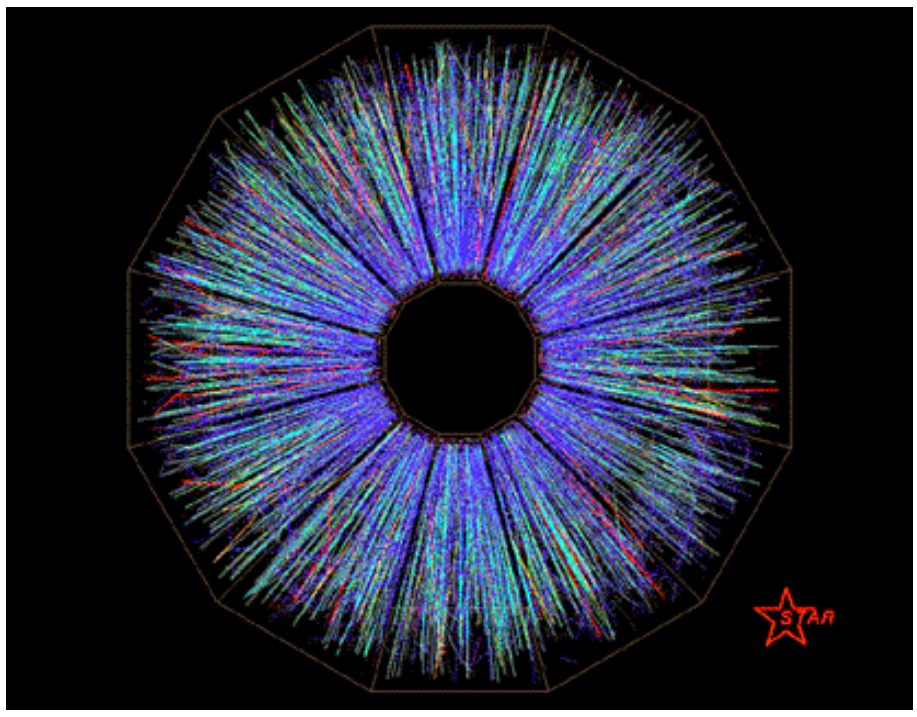
"Scientists from around the world will use this facility to answer some of the most basic questions about the properties of matter and the evolution of our universe."

who have been anticipating RHIC's debut. "These are the most spectacular subatomic collisions ever witnessed by humankind," said Satoshi Ozaki, Associate Laboratory Director for RHIC.

Said Laboratory Director John Marburger, "These first collisions prove that this machine can do what it was designed to do — produce the kinds of high-energy collisions necessary to further our understanding of the fundamental nature of matter. I extend my congratulations to everyone who worked on designing and commissioning this extraordinary machine, and look forward to the discoveries it will produce."

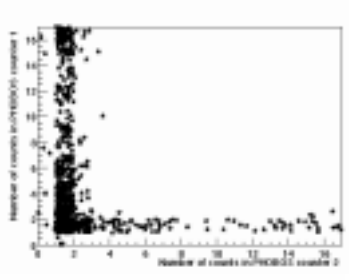
Unique Facility Looks Back in Time

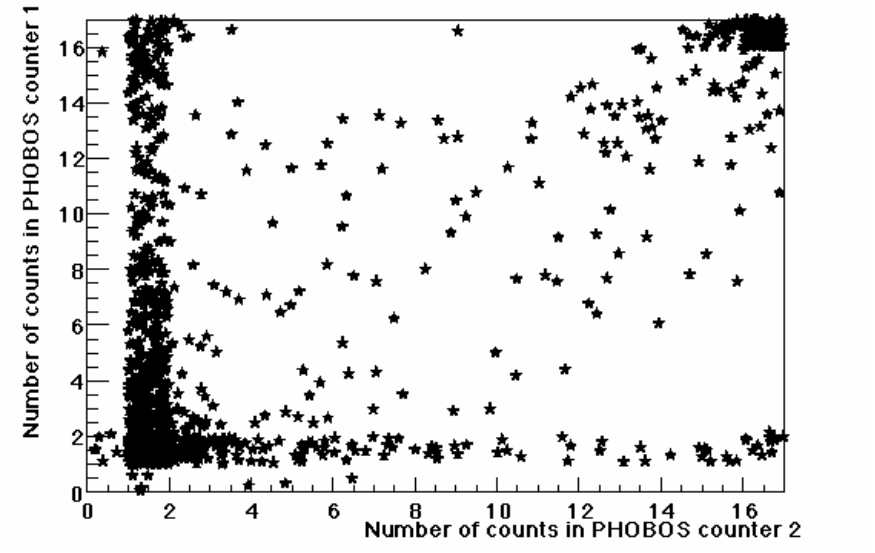
RHIC, made possible by sustained funding from DOE, is the world's newest and biggest particle accelerator for studies in nuclear physics. "We are crossing into a new frontier of scientific inquiry," said Energy Secretary Bill Richardson upon hearing of the first collisions. "Scientists from around the world will use this facility to answer some of the most basic questions about the properties of matter and the evolution of our universe."



A view of a RHIC collision seen in the STAR detector. "We knew immediately that we'd seen a true, beam-on-beam collision because all the particle tracks clearly originated at the center of the beam tube and sprayed out in all directions," said John Harris of Yale University and head of the STAR team. The symmetric pattern of particle tracks contrasts dramatically with so-called background events the team had witnessed, where collisions between ions and gas particles in the beam tube produce tracks going in only one direction.

These two plots are from PHOBOS, showing data taken in the early morning hours of June 13. The plot at right shows single gold beams interacting with material upstream of the detector. The plot below includes collision events, shown by the cluster of dots in the upper right corner. By the end of the day, PHOBOS had recorded over 1000 gold-on-





Roger Stoutenburgh

Celebrating the good news are Mike Butler, U.S. Department of Energy, Brookhaven Group; Derek Lowenstein, Collider-Accelerator Department Chair; Nicholas Samios, Physics Department and former BNL Director; and Satoshi Ozaki, Associate Laboratory Director for RHIC.

The high temperatures and densities should allow a soup-like plasma, a state of matter believed to have last existed millionths of a second after the Big Bang, when the universe first formed.

that make up protons and neutrons. The high temperatures and densities achieved in the collisions should, for a fleeting moment, allow the quarks and gluons to exist "freely" in a soup-like plasma, a state of matter that is believed to have last existed millionths of a second after the Big Bang, when the universe first formed.

"BNL is the only facility in the world where physicists can do this kind of research," Marburger said. Previous studies with lower-energy collisions at the CERN laboratory in Switzerland hinted at the existence of quark-gluon plasma (see Brookhaven Bulletin of February 11, 2000).

"New information from RHIC will consolidate many areas of cosmology that presently have only a speculative basis for understanding."

"But RHIC will produce far more definitive results and allow detailed studies of the quark-gluon plasma," Marburger said.

New State of Matter

"Detailed studies of the properties of the quark-gluon plasma — such as its temperature, energy and particle densities, and entropy — are essential to really understand and describe this unique form of matter," Ozaki said.

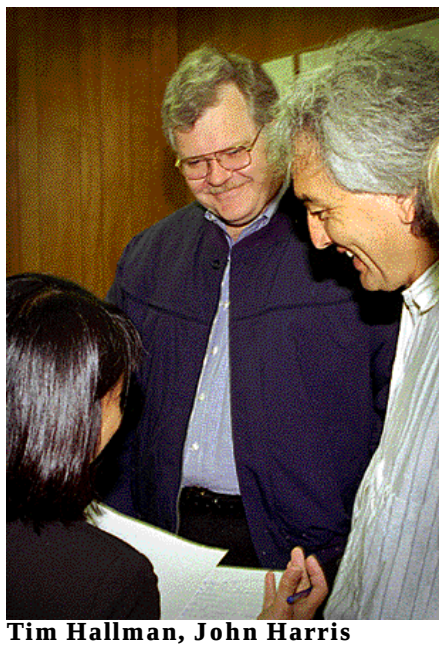
"The initiation of RHIC-era physics will be seen a decade hence as having initiated a set of investigations that shed important new light on the transition in our universe from a formless

(continued on page 2)

Derek Lowenstein, Eugene Raka

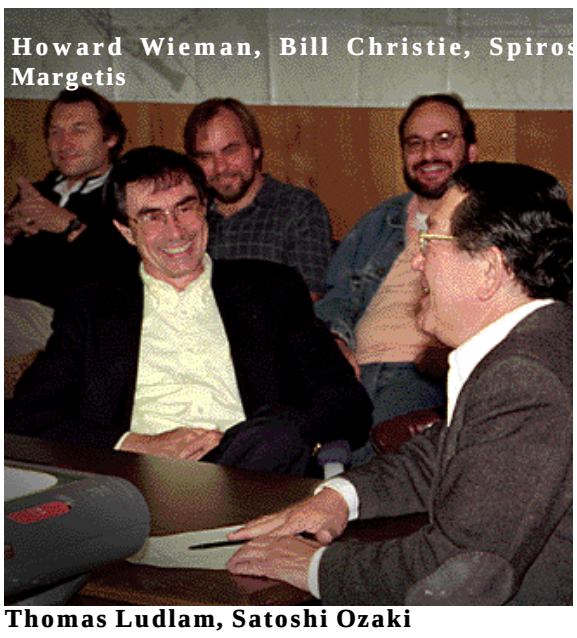
Thomas Roser, Fulvia Pilat, Satoshi Ozaki, Derek Lowenstein

Accelerator team shift meeting



Tim Hallman, John Harris

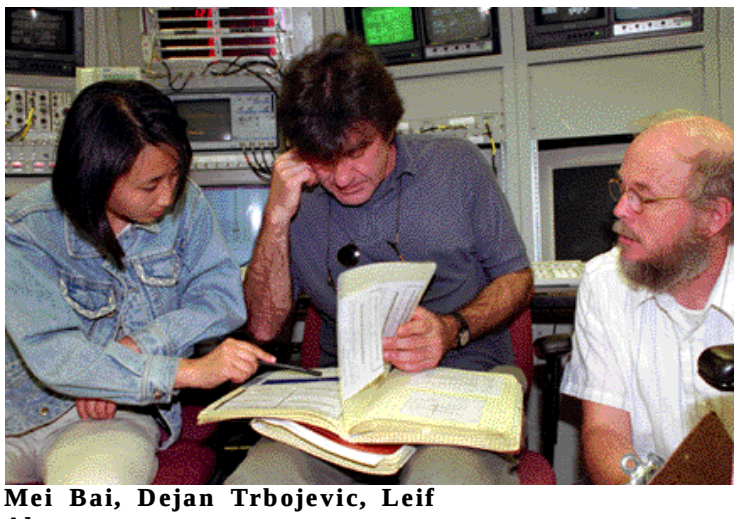
RHIC collisions



Howard Wieman, Bill Christie, Spiros Margetis

Thomas Ludlam, Satoshi Ozaki

Gunther Roland presents first collision data from PHOBOS



Mei Bai, Dejan Trbojevic, Leif Ahrens

Peter Cameron, Thomas Roser

Wit Busza, Nicholas Samios, Robert Birgeneau

RHIC Collisions *(cont'd)*

plasma of hot quarks and gluons to the dazzling diversity of matter that we see today, including ourselves," said Thomas Kirk, Associate Laboratory Director for High Energy and Nuclear Physics.

"The new information we get from RHIC will consolidate many areas of cosmology that presently have only a speculative basis for understanding," Kirk added.

Two Accelerators in One

RHIC's unique capabilities stem from its size and dual-ring design. Inside the underground accelerator tunnel are actually two separate accelerator rings, each 2.4 miles in circumference and together composed of some 1,740 superconducting magnets.

These magnets guide ions of gold atoms — gold nuclei that have been stripped of their electrons — around each of the circular rings in opposite directions at nearly the speed of light. The ions are then stored circulating in the rings at near light speed and allowed to collide at points where the two rings cross.

"The independent acceleration of two separate beams in the collider is what gives RHIC its unique ability to collide heavy ions with such high-energy impact," said Derek Lowenstein, Chairman of BNL's Collider-Accelerator Department.

The Heat was On

Getting all the systems working together to detect collisions was no easy task. As Ozaki put it, "First you have to learn to crawl, then walk, run and climb before you can reach the summit."

Through late May and early June, RHIC operators labored through those early steps. "In a machine as complicated as this, anything that isn't working quite right can cause a delay," said Roser. There were struggles to get the beam circulating under stable conditions in both rings, and to get the detectors up and running at the same time.

"We had every system working as expected," said Thomas Ludlam, Deputy Associate Laboratory Director for High Energy and Nuclear Physics. "It was just a question of getting everything working together in concert."

The weather wasn't exactly helpful, either. High temperatures over the weekend of June 10 and 11 required adjustments in cooling systems. The scientists were also concerned about thunderstorms Sunday night because of possible power dips, which can interrupt the collider's operation.

But in the end, "the teams at the main control room worked in coordination with the four experiments to get long intervals of stable beam and capture the elusive first events," Ludlam said.

The first collisions took place with beam energies of about 30 billion electron volts (GeV) per nucleon (proton or neutron) — four times more energetic than the collisions at CERN. Soon, the team will accelerate the beams to 66 GeV each, the goal energy for this summer's research run, and eventually to 100 GeV per beam — resulting in collisions approximately ten times more energetic than those at CERN.

Particle Pressure Cooker

With all that energy concentrated in a space about the size of an atomic nucleus, the colliding ions, for a tiny fraction of a second, will reach a tem-

(continued on page 3)

Photos on this page by Roger Stoutenburgh.

RHIC Collisions

(cont'd)

perature one hundred thousand times hotter than the core of the sun — hot enough to "melt" the ions into their component quarks and gluons. By studying the data from millions of these high-energy collisions, RHIC scientists will be able to gather definitive evidence that quark-gluon plasma was formed, and begin to understand its properties.

Thousands of particles are emitted following each head-on collision. Sophisticated detectors — BRAHMS, PHENIX, PHOBOS and STAR — have been constructed at four of six collision points around the ring to gather and decipher the enormous volumes of data that are recorded regarding the properties of these emitted particles.

Scientists will be analyzing data collected by these detectors during continuous runs in the collider throughout the summer. The scientists anticipate releasing the first results from those analyses sometime at the beginning of next year.

Worldwide Collaboration

RHIC construction began in 1991 and was completed in 1999. Much of the work was done in collaboration with local industry, including the Northrop-Grumman Corporation, which manufactured many of the superconducting magnets at its Bethpage, New York, facility.

The experimental program was developed by nearly 1,000 scientific collaborators at nearly 100 research institutions representing 19 countries around the world.

Funded by the United States Department of Energy and constructed by Brookhaven Lab, the RHIC complex builds upon Brookhaven's preexisting chain of accelerators — the Tandem Van de Graaff accelerator, the Booster and the Alternating Gradient Synchrotron.

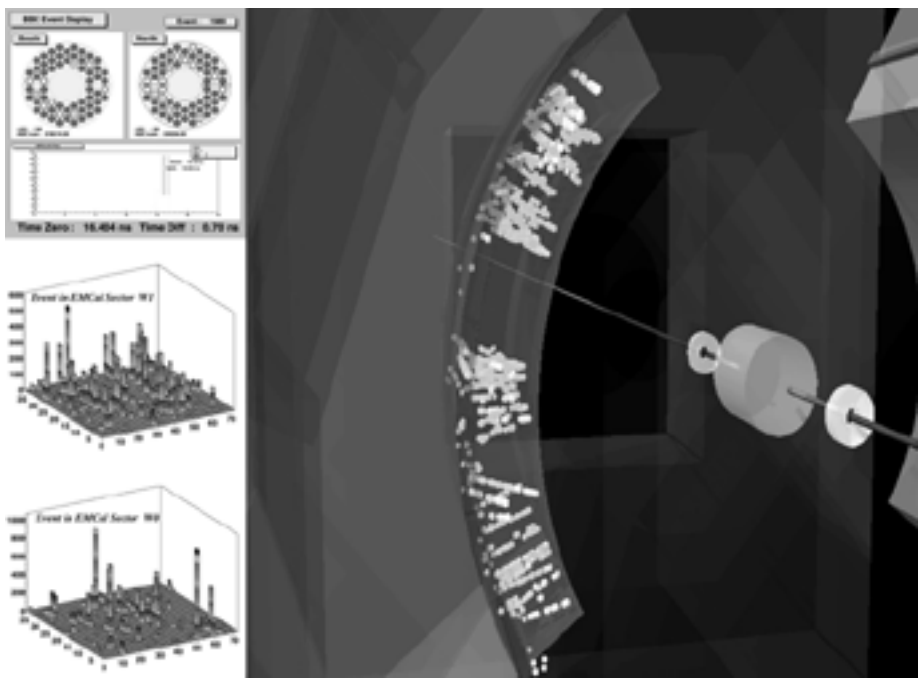
RHIC relies on these other machines to accelerate and inject ions into its collider rings at an energy of about 10 GeV per nucleon.

"This moment represents the culmination of many years of hard work," said Ozaki, thanking everyone who has worked on RHIC. "Now all the pieces are in place to launch a new era for the study of nuclear matter."

For more information, see: http://www.rhic.bnl.gov/

For other physicists' comments, see: http://www.aip.org/releases/2000/rhic.html. —Karen McNulty

PHENIX Evidence of RHIC Collisions



Evidence of RHIC collisions was recorded in PHENIX on Thursday morning, June 15, after accelerator operators brought beams into collision in PHENIX. Signals were recorded simultaneously in seven detector subsystems: Zero-Degree Calorimeters, Beam-Beam Counters (BBC), Time-of-Flight Detectors, Pad-Chambers, Drift Chambers, Time Expansion Chambers and Electromagnetic Calorimeters (EMCal). The event display (right) shows tracks pointing to the collision. The BBC (upper left) confirms that the collision occurred near the center of the PHENIX detector system. The two EMCal displays (lower left) show the first measurements of transverse energy from RHIC collisions.

Equipment Demo

On Wednesday, June 21, from 10:30 a.m. to 1 p.m. in Berkner Hall, on-line office products vendor Corporate Express will sponsor a show of office products, with booths set up by vendors from 3M, ACCO, ESSELTE, SANFORD, and Corporate Express Furniture Department. All are invited.

Arrivals & Departures

Arrivals

Yan Guo ..... Biology
Rachel Inguanta ..... Physics
Erin L. Peters ..... Biology
Zane R. Price ..... Budget
Michael Thorn ..... Medical
Brett M. Viren ..... Physics
Denise E. White ..... Biology
Michelle L. Wilinski ..... Coll.-Accel.

Departures

Clay Carle ..... NSLS
Joseph M. Carraba ..... Cent. Shops
Marie-Christine Chung ..... Dir. Office
William J. Foyt ..... BIS
Ludwig Frey ..... Cent. Shops
Gerald L. Greenridge ..... Cent. Shops
Thomas Hanlon ..... Cent. Shops
Terry H. Harrison ..... NSLS
Walter F. Hulak ..... Cent. Shops
Steven W. Humphries .. Envir. Sciences
John T. Keane ..... NSLS
Christine King ..... Cent. Shops
William T. Kuhnle ..... Coll.-Accel.
Ruth Ann Lutz ..... Dir. Office
Ronald J. Orsini ..... Cent. Shops
Fred Rodriguez ..... Proc. & Prop. Mgt.
Yan Shi ..... Envir. Sciences
William P. Sims ..... Coll.-Accel.
Charles E. Spillett ..... Plant Eng.
William L. Stokes Jr. ..... Physics
William F. Stubler ..... DAT
Doris Terry ..... Budget
Alvin J. Vestal Jr. ..... Cent. Shops
Donna E. Vestal ..... Reactor
Gary M. Zukas ..... Reactor

BROOKHAVEN BULLETIN

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On the World Wide Web, the Brookhaven Bulletin is located at www.pubaf.bnl.gov/bulletin.html. A Weekly Calendar listing scientific and technical seminars and lectures is found at www.pubaf.bnl.gov/calendar.html.

BWIS Lecture

The Story of the Muon Told in Allegory

The muon, a particle in the lepton family whose relatives include the electron, but whose mass is 207 times that of this particular relation, is not only one of the many workaday particles studied at BNL and other laboratories around the world, but also one of the many intriguing characters found in the book *Muonic Rhapsody and Other Encounters.*

On Wednesday, June 21, at 4 p.m. in the Physics Seminar Room, Bldg. 510, the book's author, physicist Lali Chatterjee, will read excerpts from her work, which explores the lives and life-styles of elementary particles.

As Nobel laureate Leon Lederman wrote in the book's preface: "The story of the muon, told in allegory and metaphor, and with sheer poetic vision, can be viewed as a case study. That is, if one follows the argument, then one will learn a lot more about what scientists look for in their (reductionist) desire to understand the world in which we live."

Lali Chatterjee, Ph.D., is a professor of physics & astronomy at Cumberland University and a guest scientist in the Physics Division of Oak Ridge National Laboratory. A member of the Oak Ridge Laboratory Neutrino Detector Collaboration, Chatterjee works on neutrino-induced electroweak processes and has published on various aspects of the physics at the Relativistic Heavy Ion Collider. Her book, The Incredible Life Styles of Subatomic Particles, will be published by Kendall Hall in the fall.

Chatterjee's lecture is sponsored by Brookhaven Women in Science (BWIS), and all are invited to attend. To join the speaker at a noon discussion in the cafeteria on Tuesday, June 20, and/or to have dinner off site with the speaker after her talk on the 21st, contact Stephanie Lamontagne, Ext. 7141 or stephl@bnl.gov.

Pianofest, 6/21

For the 12th year, Pianofest, a group of prize-winning young artists coached by festival director Paul Schenly and other master teachers, will bring the finest in piano classical music to BNL, in a concert on Wednesday, June 21, at noon in Berkner Hall.

In residence at Southampton College, where it presents recitals on Mondays in July at 4 p.m., Pianofest includes among its faculty Yoheved Kaplinsky, head of the Juilliard School's piano department, Daniel Shapiro of the Cleveland Institute of Music — who performed at BNL last season — and Arie Vardi, who teaches in Israel and Germany. The program will be presented with commentary by Paul Schenly. Noon recitals are free, informal, and open to all.

BNL and USB Offer Courses of Interest

On the Lab's Site

If ten or more enroll in each class, two mechanical engineering classes will be offered on site during the fall semester by the State University of New York at Stony Brook (USB). The course are:

• **MEC 631A Cryogenic Engineering:** (3 credits) covers the basic principles of cryogenic engineering and implementing cryogenic applications in high-energy physics research. Topics include refrigeration for labs and superconducting magnets. Prerequisites include thermodynamics, heat and mass transfer, and fluid mechanics courses.

• **MEC 631B Cryogenic Safety:** (2 credits) covers general safety issues in designing and handling cryogens and cryogenic systems, operational hazards and procedures, and safety codes. Topics also include requirements for handling combustible gases such as oxygen, hydrogen and LNG.

The classes will be offered on two evenings per week over 15 weeks. For more information, go to http://snap1.c-ad.gov/cryogenics/. If you are interested, contact Marilyn Pandorf, Ext. 5251.

At Stony Brook

During the fall semester, BNL's Ed Kaplan is teaching EST 595 Principles of Environmental Systems Analysis, one of several evening courses of interest to environmental professionals offered by the Department of Technology & Society in USB's College of Engineering & Applied Science.

For more information on this and the other courses within the graduate curriculum in environmental and waste management and/or on the 30-degree master's program in that field, contact the Department of Technology & Society, 632-8765.

BERA Bridge Club Game Schedule

The BERA Bridge Club runs a duplicate bridge game approximately every other week. This summer's schedule is as follows: June 22, July 13 and 27, August 10 and 24. Additional games are being considered.

All games start at 7:15 p.m. on Thursday evenings, in the Cafeteria. If you need a partner, let us know. For more information, call Morris Strongson, Ext. 4192.

Computing Corner

The following PC training classes are scheduled for July and August:

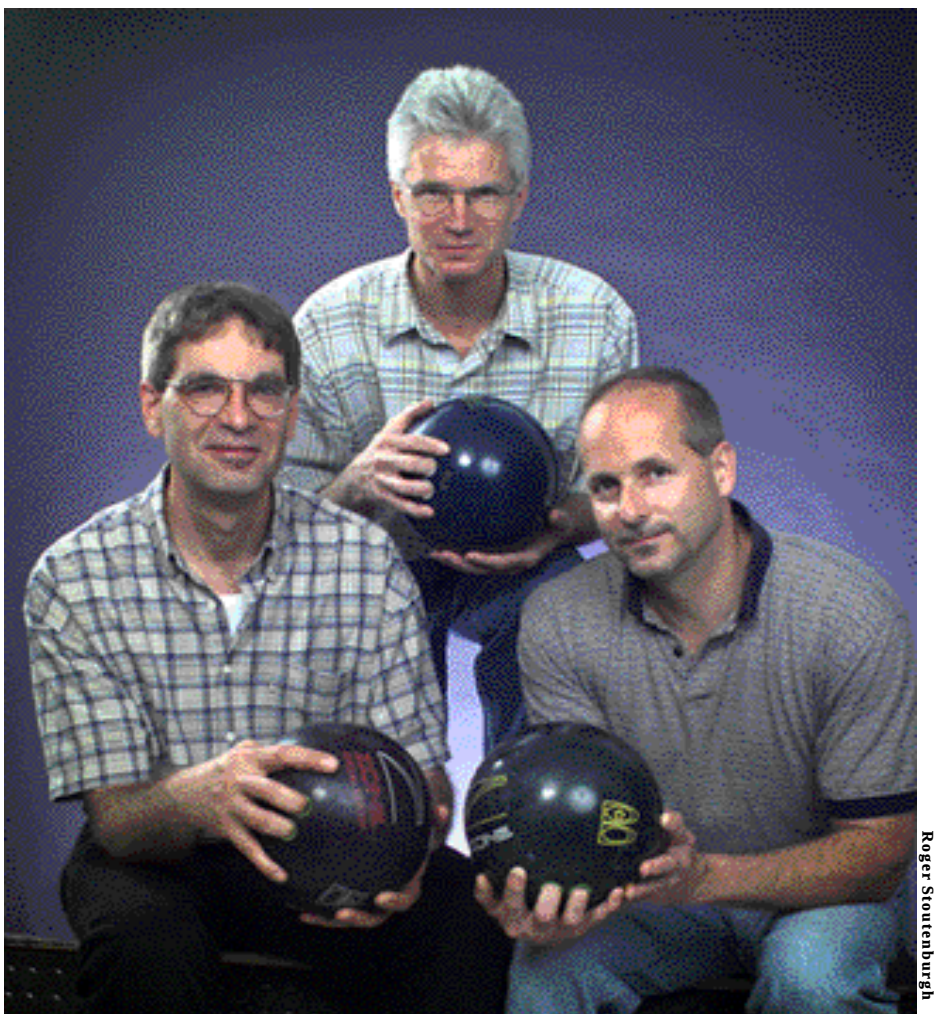
date	class	level
7/11-12 (2-day)	Access	intermediate
7/13	HTML	introduction
7/10-14 (5-day)	**LabView	
7/17-21 (5-day)	**LabView	
7/17-19 (3-day)	**Linux System Administration	
7/18	Outlook	
7/19	Front Page 2000	beginner
7/20	PowerPoint	intermediate
7/26 & 27	Project	beginner
7/31-8/4 (5-day)	**Linux Internals	

**To register for these classes or for more information, contact Pam Mansfield, Ext. 7286 or pam@bnl.gov. To register for all other classes or to request future classes, submit a training request form and an ILR for the appropriate amount to Mansfield, Bldg. 515. Classes are scheduled based on the number of requests received. See the Information Technology Division (ITD) training page at www.itd.bnl.gov/bnl/training/ for registration information and course schedules.

JAVA Programming

ITD has scheduled a five-day JAVA programming class from August 21-25. The class will meet in the Bldg. 515 training room, 9 a.m.-4:30 p.m. The fee is $1,275 per student. To register, send an ILR to Mansfield, Bldg. 515, by June 26.

1999-2000 BNL Bowling Champions



Roger Stoutenburgh

In the BNL Red & Green men's bowling league, the five guys making up a team that Was 4 Guys dumped the Portsiders overboard in winning the annual championship. The three of the five in the picture above are: (back) Fred Wahlert, (front, from left) Tom Dilgen and John McCaffrey. Missing from the picture: Scott Berg and Manual Grau.

In the BNL Purple & White mixed bowling league, blood proved thicker than water, as was demonstrated by the Kin Pins' winning the annual championship over the Bud Attitudes. The kin making up the Pins are: Ed Meier, Mary Grace Meier, Terry Meier, Tim Meier, and Ann Wynkoop and Pete Wynkoop. (Apparently, a family reunion prevented their being present for the picture.)

After a break for the summer, the BNL Bowling League resumes play in September. The mixed league bowls everyone over in Rocky Point on Thursdays, while the men's league knocks the pins down in Port Jefferson. For more information, call Debbie Keating, Ext. 3888.

BERA Book Fair

On Thursday and Friday, June 29 & 30, from 10 a.m. to 3 p.m., BERA will sponsor a Book Fair in Berkner Hall lobby, featuring fun reading ranging from children's stories to cookbooks to *New York Times* best-sellers.

These new, hardcover books will be sold at a 50 to 70 percent reduction. They will be in stock, ready for immediate purchase at the fair. Some gift items will also be available. Credit cards and checks will be accepted.

At the fair, you may fill out a coupon to be in a drawing for a book of your choice. For more information, call Andrea Dehler, Ext. 3347, or M. Kay Dellimore, Ext. 2873.

Amateur Radio

The BERA Amateur Radio Club will next meet at noon on Thursday, June 22, in Room D of Berkner Hall. On the agenda will be preparations for the upcoming Field Day. All Lab members, guests and licensed amateur-radio operators are invited to attend. The Field Day exercise will begin at 2 p.m. on Saturday, June 24, and run through 2 p.m. on Sunday, June 25. All are invited to attend. For more information, call Chris Neuberger, Ext. 4160.

Give Blood Next Week

Appointments may still be made to donate blood during the next BNL Blood Drive, to be held on Monday and Tuesday, June 19 & 20, from 9:30 a.m. to 3 p.m. in the Brookhaven Center.

Those eligible to donate are people in good health between the ages of 17 and 76 who have not donated blood in the past 56 days.

To make an appointment, contact BNL Blood Drive Chair Susan Foster at Ext. 2888 or e-mail donateblood@bnl.gov. In your message, include your name, extension, and preferred time to donate.

Classified Advertisements

Placement Notices

The Lab's placement policy is to select the best-qualified candidate for an available position. Candidates are considered in the following order: (1) present employees within the department/division and/or appropriate bargaining unit, with preference for those within the immediate work group; (2) present employees within the Laboratory; and (3) outside applicants. In keeping with the Affirmative Action Plan, selections are made without regard to age, race, color, religion, national origin, sex, disability or veteran status. Each week, the Human Resources Division lists new placement notices, first, so employees may request consideration for themselves, and, second, for open recruitment. Because of the priority policy stated above, each listing does not necessarily represent an opportunity for all people. Except when operational needs require otherwise, positions will be open for one week after publication. For more information, contact the Employment Manager, Ext. 2882; call the JOBLINE, Ext. 7744 (344-7744), for a list of all job openings; use a TDD system to access job information by calling (516) 344-6018; or access current job openings on the World Wide Web at http://www.bnl.gov/JOBS/jobs.html.

LABORATORY RECRUITMENT – Opportunities for Laboratory Employees Only.

NS8839. QUALITY PROGRAM ENGINEER – (Part-time) Requires a bachelor's degree in a relevant field and at least ten years' experience in developing/implementing quality management programs in a fast-paced, customer-oriented environment. Experience with DOE Order 414.1 and/or 10 CFR 830.120 "Quality Assurance;" Process Improvement Team training and facilitation, conducting assessments; and Project Management is required. A working knowledge of Performance Based Management, as well as heavy customer relations experience is essential. ASQ certifications in auditing, engineering, and management is a plus. Responsibilities will include updating and prioritizing internal customer needs and expectations; working with the Training & Qualifications Office in the development and implementation of a value based quality training program; and assisting in the development of the new BNL customer-oriented Quality Program Office. Quality Program Office.

DD8844. SECRETARIAL POSITION - (term appointment) Requires an AAS in secretarial science or equivalent experience, good communication skills, knowledge of Laboratory policies and procedures, and proficiency with Microsoft Word, Microsoft Outlook, and PowerPoint. Experience with Peoplesoft (Web Req.), Excel, and BNL travel system required; knowledge of ATS or equivalent a plus. Must be creative, customer sensitive, and be able to handle multiple assignments. Duties include assisting in the development of a new customer-oriented Quality Office, as well as coordinating and maintaining services to operate a fast pace/performance based organization. Will develop and prepare quality related reports, monitor project milestones and budget commitments in support of various quality programs, and handle file maintenance and organization, as well as project meeting coordination. Will act as Training Coordinator, Document Records Coordinator, and Property Management Representative. Quality Program Office.

OPEN RECRUITMENT – Opportunities for Laboratory Employees and Outside Candidates.

MK8498. CHAIR, NONPROLIFERATION AND NATIONAL SECURITY DEPARTMENT – The Chair reports to the Associate Laboratory Director for Energy, Environment & National Security and is responsible for all administrative, budgetary, and personnel decisions within the Department. Requires a Ph.D. or equivalent experience in a relevant field and the ability to obtain and maintain a security clearance. Candidate must have a record of technical and/or managerial accomplishment in international safeguards, treaty negotiation and verification, arms control and nonproliferation and/or international collaborations for proliferation prevention and material security. In addition, a solid reputation in the U.S. and/or international nonproliferation and national security community and previous experience in program development is also required. Candidate should be able to present a clear vision of how the Department will grow during the next five years and maintain or improve its reputation in the international fields in which it is currently involved and exhibit excellent leadership and management skills, provide evidence of responsible fiscal management, and possess effective oral and written communication skills. Director's Office.

NS7913. PHYSICS ASSOCIATE POSITION – Requires a BS in physics or a related discipline with course work or equivalent experience in computer science. Will work on parallel computing algorithms for nuclear, high energy, and condensed matter physics, including accelerator design and parallel data manipulation. Center for Data Intensive Computing.