

Neutrinos Have Mass: BNL Helps Place New Piece in Neutrino Puzzle

Neutrinos — tiny, subatomic particles that are electrically neutral and generally pass like ghosts through all matter — are now known to have mass.

The June 5th announcement from the Super-Kamiokande Collaboration (SKC) in Japan has the scientific community taking notice worldwide.

At “Neutrino ’98,” the international conference held June 4-9, in Takayama, Japan, SKC’s 120 physicists from 23 institutions, including former BNL Director Maurice Goldhaber of the Physics Department, reported strong evidence for their conclusion that, of the three known forms of the neutrino—the electron, muon and as-yet-unobserved tau neutrinos — the muon neutrino can oscillate, or change into a tau neutrino.

Thus, according to the rules of quantum mechanics, neutrinos must have mass.

This long-sought finding has changed physics’ list of accepted properties of neutrinos, and this change has implications for what is called the Standard Model, which describes the structure of matter.

The SKC Experiment

Funded by the Japanese Ministry of Education, Science, Sports and Culture and the U.S. Department of Energy (DOE), the SKC experiment uses an enormous, 50,000-ton tank of highly purified water, sited about 1,000 meters underground in the Kamioka Mining and Smelting Company’s Mozumi Mine.

Goldhaber, who has just returned from Neutrino ’98, explained that the neutrinos measured in the experiment are formed when high-energy cosmic rays from deep space bombard the Earth’s atmosphere (see diagram). As a result, billions of “atmospheric neutrinos,” which travel at nearly the speed of light and can pass through solid objects without difficulty, constantly pass through every part of the Earth.

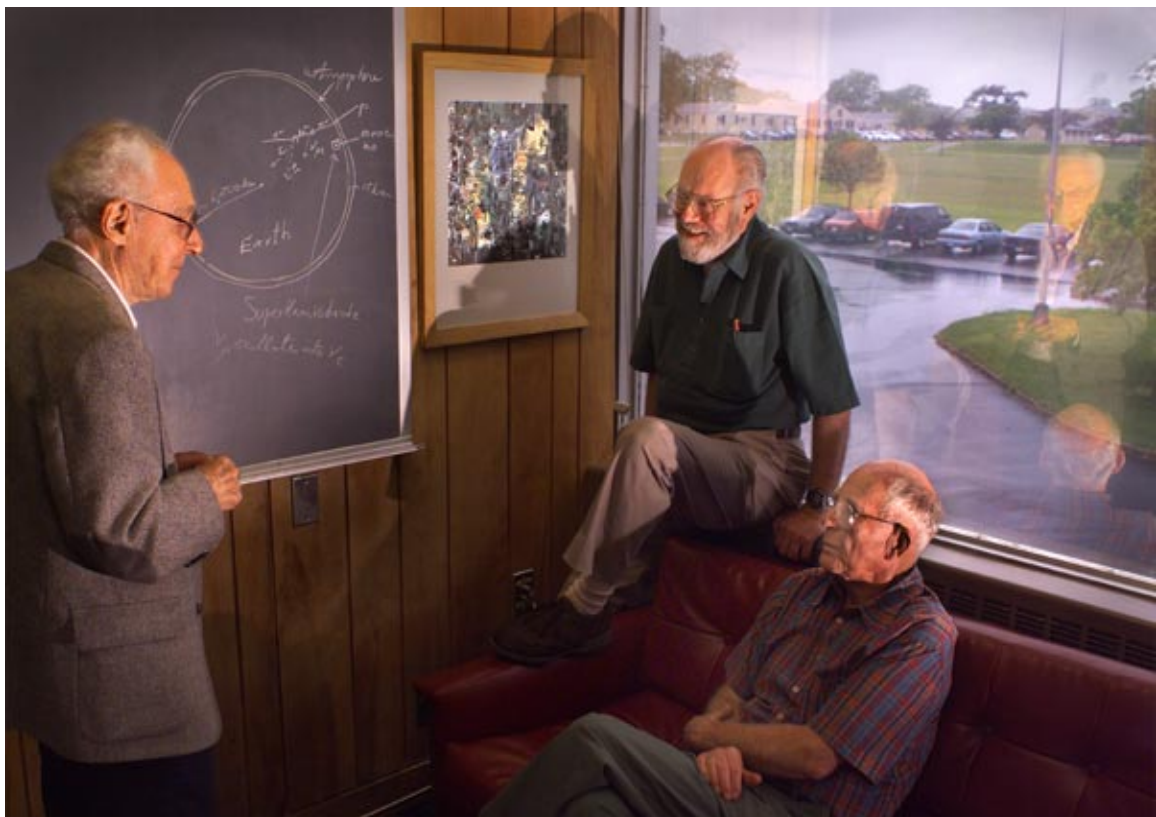
As they pass through the water in the SKC tank, a few interact with the water nuclei, producing muons or electrons, depending on the type of neutrino. These charged particles produce a cone-shaped signal of what is called Cherenkov light in a characteristic pattern that can be observed by the more than 13,000 photomultiplier tubes, which are light detectors that

Marburger Discusses State of the Lab: Today, 11 a.m., 2 p.m.

Employees are invited to hear BNL Director John Marburger discuss the state of the Laboratory during two meetings today, June 19, in Berkner Hall: The first runs from 11 a.m. to noon, and the second from 2 to 3 p.m.

After Marburger’s presentations, employees will be able to ask questions and state their concerns.

Those who are unable to make either presentation may later watch a video of one of the meetings on the GLANCE kiosk in Berkner Hall or on WBNL at www.wbnl.bnl.gov.



In the Physics Department, three of BNL’s neutrino specialists (from left) Maurice Goldhaber, Gordon Danby and Ray Davis, discuss future neutrino experiments to follow up on the recent finding by the Super-Kamiokande Collaboration of strong evidence for neutrino mass.

Photo by
Roger
Stoutenburgh

cover the inside of the tank.

“The type of signal recorded allows us to distinguish between electron and muon neutrinos,” explained Goldhaber. “Their direction is also recorded, so we know whether the incoming neutrinos came down from the sky through the 15 kilometers of atmosphere or came from the other side of the Earth, traveling 12,000 kilometers to enter the tank from below.

“We found that more muon neutrinos arrive after the short journey than after the 12,000-kilometer journey,” continued Goldhaber. “The most plausible explanation is that, as they travel through the Earth, the muon-neutrinos probably oscillate into undetected tau neutrinos. The next effort is to detect neutral currents from the presumed tau neutrinos.”

History & Tradition

For Goldhaber to be involved in this historic experiment is a natural continuation of a long tradition of BNL neutrino research involving not only him but many of his colleagues.

While the neutrino was hypothesized in 1930 by Wolfgang Pauli, no neutrino was observed until 1956, when one was found by Frederick Reines and the late Clyde Cowan Jr.

In 1958, Goldhaber, Lee Grodzins, who was then a BNL postdoc and is now at the Massachusetts Institute of Technology, and BNL’s late Andy Sunyar made the Lab’s first major contribution to neutrino research: They performed a classic tabletop experiment that proved that neutrinos have negative helicity, meaning that they spin like left-handed screwballs.

This finding became a cornerstone in the development of weak interaction theory, which describes how particles decay.

The new finding means that neutrinos will not be “left-handed” under all circumstances, however. “Now that we know neutrinos have mass, one cannot talk of a specific helicity of a neutrino at rest, only of neutrinos as they are emitted in various decays,” commented Goldhaber.

Muon-Neutrino Discovery

BNL’s Alternating Gradient Synchrotron (AGS) then proved to be another fertile ground for neutrino studies.

At the AGS dedication, a friendly CERN rival joked with Goldhaber, who

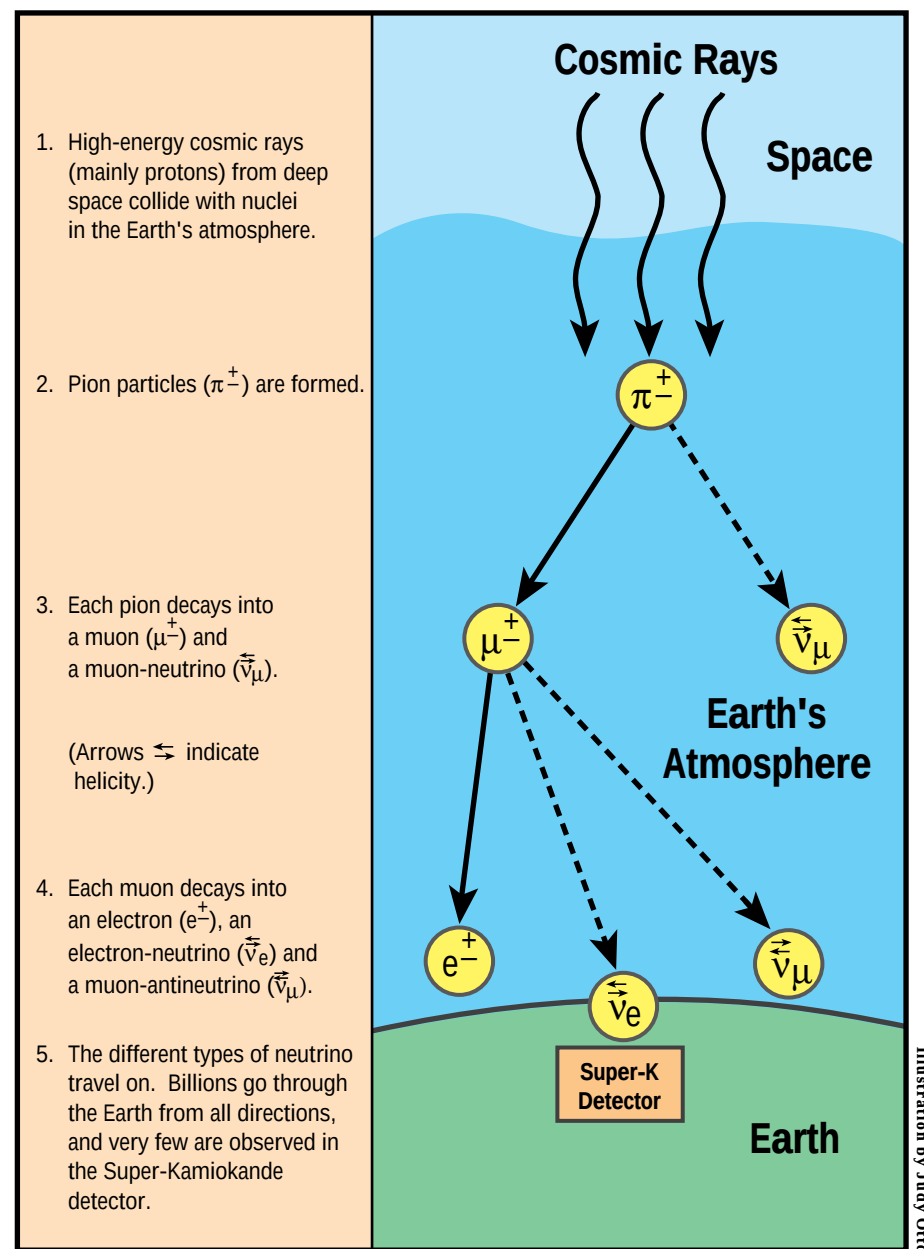
was then BNL Director, that CERN’s early start in operating its accelerator could result in their skimming the cream of the discoveries to be made. “Our boys at the AGS grew up on farms,” replied Goldhaber, “so they know how to milk a cow, and, when you milk a cow, you also get cream.”

In 1962, less than two years after the AGS reached its design energy of 30 billion electron volts (GeV), a Columbia University/BNL collaboration led by Melvin Schwartz, Leon Lederman and Jack Steinberger announced what was to be the 1988 Nobel-prize winning discovery of the

muon-neutrino.

This discovery was cited by the Nobel Committee for opening “entirely new opportunities for research into the innermost structure and dynamics of matter.” The experiment established the existence of different particle families and the fact that electrons and muons can be grouped together with their own neutrinos. This pair structure is one of the cornerstones of the modern lepton-quark theory of elementary physics.

Gordon Danby, AGS, who was the BNL member of this experiment, with
(continued on page 2)



How Atmospheric Neutrinos Arise

DAS Researchers Again Nationally Recognized For ‘Outstanding Environmental Achievement’



Michael Herbert

For the second consecutive year, Eugene Premuzic (left) and his research team in BNL’s Department of Applied Science have won a Certificate of Environmental Achievement for developing bacteria to clean up toxic wastes and recover valuable metals which are the by-products of geothermal energy generation. The natural heat found deep beneath the Earth’s surface, geothermal energy is used to heat homes and produce electricity in parts of the western U.S. and in several other countries in Asia and Europe. The BNL research on toxic waste-eating bacteria was one of 28 technologies recognized as an outstanding environmental achievement by the National Awards Council for Environmental Sustainability, a coalition of environmental, business and government organizations led by the environmental group Renew America. Brookhaven’s winning research will be included in the Renew America 1998 Environmental Success Index, a resource that lists over 1,600 outstanding environmental programs from around the country. With Premuzic, gathered around the pilot plant used to test the innovative technology at the Lab, is Raymond LaSala (second from left), U.S. Department of Energy’s Office of Conservation & Renewable Energy, Geothermal Technology Division, which funds the research. The rest of Premuzic’s team includes: (starting third from left) Mow Lin, Michael Bohenek, Richard Wilke, Lucy Shelenkova and Geeta Joshi-Tope. Not shown is team member Wei Min Zhou.

— Diane Greenberg

Neutrino Mass (cont'd)

technical responsibilities, vividly remembered the “great fun” of working with a handful of people and having had the opportunity to be “more than a spear carrier” in the experiment that employed the first successful accelerator-produced neutrino beam ever used in high-energy physics.

The Solar Puzzle

In commenting on the next great BNL contribution to neutrino science, Danby declared, “You started this whole business.”

The “you” to whom Danby referred is Ray Davis, now retired from BNL’s Chemistry Department.

Davis carried out *the* groundbreaking solar-neutrino experiment: Set up in 1967 in South Dakota’s Homestake Gold Mine, this experiment employed a hundred-thousand-gallon tank of dry-cleaning fluid about a mile under solid rock to measure neutrinos from the sun as a way to examine the sun’s energy-generation processes.

Startling results came from 18 years of data — the number of neutrinos detected was scarcely one-third of the solar neutrinos predicted by theory. The solar neutrino puzzle, as it was called, has intrigued physicists, chemists and astrophysicists ever since.

Recalled Davis, “We immediately planned a gallium experiment to confirm the chlorine result, and also, to measure the neutrinos created by the first reaction in the sun rather than the secondary solar fusion process we had measured.

He continued, “We developed all the chemistry, but we could not get the necessary funds. After I retired, I started working in a Russian gallium experiment using a different chemical process. Eventually, the Max Planck Institute found funds for the gallium experiment that we’d planned at BNL, so a largely European collaboration was formed to do an experiment in the

Gran Sasso Underground Laboratory in Italy. That was GALLEX.”

GALLEX Experiment

In 1986, with DOE funds to join the ten-institution GALLEX collaboration deep under the Italian Abruzzi mountains, a BNL team — led by Richard Hahn and including Keith Rowley, who was also part of the Homestake experiment; John Boger; and the now-retired Ray Stoenner and Gerhart Friedlander, all of Chemistry; and Joe Weneser, Physics Department — started out once again to measure solar neutrinos.

The GALLEX detector, which contains 30 metric tons of gallium in the form of a 100-ton gallium-chloride solution, produced results that made the puzzle more complex: Only 60 percent of the expected solar neutrinos were found.

As Hahn explained, “GALLEX was the first solar-neutrino experiment to observe the ‘pp’ neutrinos that are emitted in the main nuclear reaction that powers the sun. Our team did another landmark experiment to verify the gallium neutrino detector, exposing it to a known number of neutrinos from a chromium-51 source, the most intense radioactive neutrino source ever made. We observed as many neutrinos as we expected, showing that the shortfall of neutrinos observed from the sun was not from an experimental artifact.”

Both Hahn and Rowley were in Japan at Neutrino ’98, where the new SKC findings stirred much interest and anticipation of confirmation in future experiments. One of these is the Sudbury Neutrino Observatory (SNO) collaboration in Canada, in which BNL participates.

SNO in Canada

Hahn, Rowley and Boger are the BNL members of the new SNO experiment, which is nearing the start of taking data. In SNO, 1,000 tons of heavy water — worth \$300 million —

BNL Unites to Fight “Millenium Bug”

Tick...Tick...Tick... That’s the sound of the countdown that every computer owner now knows to fear — the countdown to the year 2000.

Because many computers, software packages and microchip-driven devices are programmed to represent the current year in two digits, not four, the turning of the new year on December 31, 1999 may make them think that the clocks have been turned back a century — to 1900! And the consequences of that could range from calculation errors to complete failure.

The problem is often referred to as the Year 2000, or “Y2K” problem, though others prefer to call it the “millenium bug.”

With more than 5,000 computers and countless other electronic systems, BNL might seem to be a prime candidate to catch a bad case of the millenium bug. But a new group brought together by BNL Deputy Director for Operations Thomas Sheridan is getting ready to vaccinate as many devices as possible against this terrible “disease.”

Each department, division and office has selected at least one computer-savvy person to work on the problem. Each representative will survey his or her own organization for potential Y2K problems. Then, working with the Computing & Communications Division’s Stuart Kern, Tom Schlagel and others, they will use proven software and other fixes to address the problems they find. The group will exchange information via e-mail and the World Wide Web to keep current as issues arise.

The group hopes to complete the task before the Department of Energy’s March 1999 deadline — in plenty of time to beat the December 31 rush.

“So, if your organization’s millenium bug-fighter appears at your office or work area looking for computers or electronic devices to examine and fix, give them all the cooperation you can, and don’t try to fix anything on your own,” said Sheridan. “The life you save may be your own computer’s.”

— Kara Villamil

Inside Info

John Shanklin, a biochemist in the Biology Department, was selected by the *Village Beacon-Record* as the Man of the Year in Science for 1997.

In an article last December 31, the North Shore publication recognized Shanklin as one of the BNL scientists who “have quietly gone about their work and continued to turn out world-class science. . . .”

The paper noted, “Shanklin’s work focuses on a process called desaturation, a series of chemical reactions in plants in which an enzyme called desaturase changes saturated fats — the ‘bad’ fat — into unsaturated fats. . . . Shanklin’s work could eventually

allow scientists to create ‘designer’ plants whose oils have special characteristics . . . and has implications for many industries which depend on saturated plant oils.”

John Shanklin took his B.Sc. in biology from the University of Lancaster, England, in 1981, then went to the University of Wisconsin-Madison for his 1984 M.Sc. in forestry and his 1988 Ph.D. in horticulture.

Shanklin joined BNL in 1992. In November 1997, he received a Presidential Early Career Award, as well as a Young Scientist Award from the U.S. Department of Energy.

are used in a deep mine in Canada to detect solar neutrinos.

Said Hahn, “While the SKC provides strong evidence for atmospheric neutrino oscillations of muon neutrinos at GeV energies, SNO aims to provide direct evidence for solar neutrino oscillations, of electron neutrinos at MeV [million-electron-volt] energies. We hope to show that electron neutrinos, which are the only kind emitted by the Sun, have been converted into the other neutrino types on their way to Earth.”

IMB and Supernova 1987A

Prior to GALLEX, an amazing neutrino event, the arrival of neutrinos signaling the start of the supernova SN1987A, was observed at the Kamioka and IMB underground proton experiments, within the same ten seconds. The event was particularly interesting at the Lab because Goldhaber was the BNL part of the IMB collaboration which also involved the University of California, Irvine, and the University of Michigan and BNL.

The IMB and Kamioka data showing that the group of neutrinos from SN1987A arrived in such a short period meant that there was little spread in velocities. This suggests a good upper limit for a neutrino mass on the order of about ten electron volts.

“The few observed neutrinos from this event, in their numbers and energies and coming from the deepest heart of the exploding star, confirmed our predicted scenario for this supernova

and helped confirm theories about the nature of supernova explosions,” said Sidney Kahana, Physics Department.

“It cannot be emphasized enough that neutrino astrophysics as a discipline began with the work of Ray Davis and his collaborators,” Kahana continued. “Astrophysicists have been provided with data from Davis’s work and other experiments using the Sun as a source of neutrinos, from the IMB and Kamioka experiments, which are both looking at atmospheric neutrinos, and from the still more distant source, the stellar explosion some 160,000 light years away in the Large Magellanic Cloud source of neutrinos.

“The cosmos, as a source of neutrinos and other particles for experiments will probably play an increasingly important role in the future, especially in light of the difficulty of funding larger accelerators,” he added.

Interestingly, Goldhaber’s long acquaintance with atmospheric neutrinos started in 1954, on a visit to Reines and Cowan at Los Alamos, when Goldhaber was wondering whether the proton could decay.

“They were recording atmospheric neutrinos using a large scintillating counter, and we decided to look for proton decay in a parasitic experiment. Now, much later, the IMB, Kamioka and Super-Kamiokande detectors, built mainly for proton-decay studies, have made symbiotic atmospheric neutrino experiments possible. Things go around,” he concluded.

— Liz Seubert

Sitar Concert Next Saturday

Original and nationally known music will be presented on the sitar by Indian composer Rash Behari Datta, during a concert sponsored by the BERA Indo-American Association.

The concert will take place on Saturday, June 27, at 3 p.m. in Berkner Hall, and all are invited to attend. Tickets, at \$10 per person, may be purchased at the door.

Called the lute of India, the sitar is a stringed instrument, having a long, broad, fretted neck; two resonators made from gourds; seven main strings; and 13 sympathetic strings.

An All India Radio orchestra composer and music director, Rash Behari Datta has also provided music for documentary films, TV series and stage. He has represented his country as part of cultural delegations to different parts of the world.

Addition

In last week's story on the NSLS Annual Users' Meeting (see page one of the Brookhaven Bulletin of June 12, 1998), one of the names of the members of the organizing committee was inadvertently omitted: That member is John Hill of BNL's Physics Department.

Equipment Demo

Next Friday, June 26, from 11 a.m. to 2 p.m. in Berkner Hall, L&M Associates will display and demonstrate equipment from several of the manufacturers that it represents, including Keithley Instruments, Xantrex, Behlman, Trompeter, IOtech and more.

Instruments that will be on hand include: DMMs, electrometers, switching systems, precision ac sources, interconnects and more.

Software Demo

On Tuesday, June 23, from 10 a.m. to noon in the seminar room of the Computing & Communications Division, Bldg. 515.

Algor's finite element-analysis and mechanical event-simulation software will be demonstrated. This mechanical event-simulation software features nonlinear capabilities and an interface with CAD.

In addition, Algor's Superdraw III, a geometry control center, and Algor's Hexagen, an automatic FEA solid-meshing tool, will be discussed. For more information, call Chris Neuberger, Ext. 4160.

BROOKHAVEN BULLETIN

Published weekly
by the Public Affairs Office
for the employees of
BROOKHAVEN NATIONAL LABORATORY

ANITA COHEN, Editor
MARSHA BELFORD, Assistant Editor

Bldg. 134, P.O. Box 5000
Upton NY 11973-5000
Tel. (516) 344-2345; Fax (516) 344-3368

World Wide Web:
<http://www.pubaf.bnl.gov/bulletin.html>

The Brookhaven Bulletin is printed on paper containing at least 50 percent recycled materials, with 10 percent post-consumer waste. It can be recycled.



Where's Waldo?

BNL 50 Human Formation: Official T-Shirt Now on Sale



Where were you at high noon on Monday, December 15, 1997?

Were you on the field next to BNL Police Headquarters having your picture taken by photographer Roger Stoutenburgh who was 100 feet off the ground on the catwalk surrounding the water tower?

If so, then you not only made BNL history during the Lab's 50th anniversary year, but you also made the cover of the Brookhaven Bulletin on December 19, 1997 — and now you have made it onto the front of a T-shirt, which is now on sale at the BERA store.

To get your 100-percent cotton, limited-edition, one-size-fits-most, extra-large T-shirt with the picture of you and 1,000 of your closest coworkers, bring \$10 per T-shirt to Berkner Hall, Tuesday through Friday, 9 a.m. to 1:30 p.m.

Softball

Results reported as of June 12

League E1		League M1	
Cobras	4-1	Gour-Mets	5-0
Magnuts	4-1	Happy Hour	4-1
Cleen Sweep	3-2	OER Wellheads	1-4
Blue Jays	2-3	Stingrays	0-5
Phoubars	2-3		
Scram	0-5	League M2	
League E2		Here for the Beer	2-0
Gas House Gorillas	4-1	Odd Sox	1-1
Hammerheads	4-1	Skeleton Crew	1-1
Rockets	4-1	Ten Samurai	0-2
CCD	2-3	League E3	
Hy Tech	2-3	Bombers	4-1
Mesocyclones	2-3	Sure Fire	3-2
Lights Out	1-4	Medical	2-3
Phase Out	1-4	Sultans of Swat	1-4

Internet: <http://www.l2ball.bera.bnl.gov/>

BERA Bus Trips

There are still seats available on the following two BERA bus trips. Buses will leave from the Brookhaven Center, with a pickup at Exit 63 LIE, if necessary. The per-person costs include admission and round-trip bus transportation.

- **Atlantic City, Saturday, July 18:** \$23, with casino-hotel and coin package to be announced.
- **Six Flags/Great Adventure, Saturday, August 8:** \$45. Take the family on the Batman Ride, the Right Stuff - MACH 1 Adventure, the Great American Scream Machine, the Viper and Skull Mountain indoor roller coaster, or to see a water and stunt show.

Make paid reservations first-come, first-served, at the BERA Sales Office, Tuesday-Friday, 9 a.m.-1:30 p.m. For more information, call Andrea Dehler, Ext. 3347, or M. Kay Dellimore, Ext. 2873.

Amateur Radio

The BERA Amateur Radio Club will host a field day on Saturday and Sunday, June 27 & 28, at the gazabo near the softball fields.

The event will start at 2 p.m. Saturday and run for 24 hours, ending on Sunday at 2 p.m. This is a national competition, and all employees and guests are welcome.

The meeting to finalize plans will be held in Room C, Berkner Hall, on Thursday, June 25, at noon. For more information, call Chris Neuberger, Ext. 4160, or Nick Franco, Ext. 5467.

Attn. Computer Users: Hackers at Work

Within the past three weeks, there have been many instances of outside hackers' gaining access to BNL computers.

If you are a user or systems administrator of any Unix system at the Lab, including Linux, then be sure to read the descriptions of these incidents: Go to the Computing & Communications Division's home page on the World Wide Web: <http://www.ccd.bnl.gov>. Click on security, then click on current events.

You will find tips on how to prevent your own account from being compromised, as well as advice for system administrators.

Contact Stuart Kern, Ext. 4711, if you have any questions.

Computer Training

The JAVA training class organized by the Computing & Communications Division (CCD) is filled and registration is closed. The class will meet in the CCD seminar room, Bldg. 515, from 10 a.m. to noon on July 7, 9, 21, 23, 28 and 30.

Textbooks are available in the CCD Documentation Store and must be picked up before the first class. Do not come to the class if you are not registered for it.

For more information e-mail Pam Mansfield at pam@bnl.gov.

Arrivals & Departures

Arrivals

Jennifer A. Kozak AGS

Departures

Patricia C. Kriss Applied Science
Susan G. Yan Chemistry

SCOPE Course for Teachers

Radiation: It's Elementary

SCOPE, the Superintendents Cooperative Organization for the Promotion of Education, is a non-profit organization providing courses for teachers and other support to school districts in New York State.

One summer SCOPE course offerings this year is "Radiation: It's Elementary," which will be taught on site by four BNLers: Arland Carsten, Alan Kuehner, Kathleen McIntyre and Dolores O'Connor.

They will present basic lectures on the properties of natural radiation, give tours of Lab facilities to show how radiation is used in research, offer demonstrations on how to measure radiation, and outline lesson plans for classroom use.

The intended audience for this new course is elementary school teachers. The course will be offered in three sessions, July 21-23, from 9 a.m. to 3 p.m.

For more information, contact Janet Tempel, Ext. 4049. To register, contact SCOPE, 360-0800.

Last Day for Books

Today, June 19, is the last day of the annual BERA spring book fair — so, rush to Berkner Hall between 10 a.m. and 3 p.m. to browse or buy *The New York Times* bestsellers, cookbooks, children's books and other quality hardbacks offered there at discounted prices. For more information, call Andrea Dehler, Ext. 3347, or M. Kay Dellimore, Ext. 2873.

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 complete 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>.

The following vacancies are exempt from the Director's hiring freeze.

SCIENTIFIC RECRUITMENT - Doctorate usually required. Candidates may apply directly to the department representative named.

MKBO1. POSTDOCTORAL RESEARCH ASSOCIATE - To develop the three-beam phasing method for macromolecular crystallography. Will assist in the operation of synchrotron x-ray beam lines, and the supervision and teaching of visitors. Will have approximately 25 percent of time for independent or collaborative research. Requires a Ph.D. in physics, extensive experience in the use of multiple-beam phasing in macromolecular crystallography and the software involved, and with synchrotron x-ray research. Preferred skills include: teaching experience, mechanical and electronic experimentation (design and construction of apparatus), writing of software and operating-system maintenance. Under the direction of R. Sweet. Biology Department.

MKBO3. POSTDOCTORAL RESEARCH ASSOCIATE - To join a program to develop a multi-processor computer cluster optimized to the needs of a suite of x-ray beam lines at the National Synchrotron Light Source. Will assist in the installation and reduction to operation of a multi-layer monochromator for an x-ray beam line, and in the operation of synchrotron x-ray beam lines; and supervise and teach visitors. Requires a Ph.D. in physics, extensive experience in x-ray diffraction, synchrotron x-ray research, and some knowledge of x-ray optics and use of software for diffraction research. Preferred skills include: experience in mechanical and electronic experimentation (design and construction of apparatus) and experience in small-molecule crystallography. Under the direction of M. Capel. Biology Department.

MK7644/7645. POSTDOCTORAL RESEARCH ASSOCIATE/ASSISTANT PHYSICIST - To work with the ATLAS Group, which is taking a lead role for the Lab in the ATLAS experiment at CERN, with major responsibilities for the liquid-argon calorimeter, the cathode strip muon chambers, physics analysis and simulation. Should have a Ph.D. in physics, training in experimental particle physics and extensive experience in a major particle-physics experiment. Those with more experience could be considered for an assistant physicist appointment. Under the direction of H.A. Gordon. Physics Department.

MK7485. POSTDOCTORAL RESEARCH ASSOCIATE/ASSISTANT PHYSICIST - With strong background in silicon-detector development and Ph.D. in physics, to work in the Silicon Detector Group, which is involved in an effort to build a vertex tracker (SVT) for the RHIC accelerator using 6x6 cm² drift detectors. Responsibilities will include working on SVT-related issues such as hybrid electronics/detector integration, ladder testing and evaluation and installation of the SVT. Involvement in ongoing research projects developing x-ray detectors and evaluating rad-hard silicon, as well as LHC silicon pixel efforts, will be encouraged. Proficiency in C and LabView is a plus. Candidates with more experience could be considered for an assistant physicist appointment. Under the direction of V. Radeka. Instrumentation Division.

LABORATORY RECRUITMENT - Opportunities for Laboratory employees.

DD7643. SECRETARIAL POSITION - (part-time) Requires an AAS degree in secretarial science, or equivalent experience, good communication skills and knowledge of Lab policies and procedures. Proficiency required with word processing, preferably Microsoft Word; experience with the IPAP system highly desirable. Knowledge of e-mail, WWW, and Latex for typing and editing technical papers also desirable. Duties will include: arranging conferences and meetings, coordinating domestic and foreign travel and housing for visitors, providing support for the international collaborations E8666 and BRAHMS, preparing collaborator appointments, maintaining filing, preparing and distributing collaboration reports, maintaining collaborator and publication lists, and performing some library functions. Physics Department.

OPEN RECRUITMENT - Opportunities for Laboratory employees and outside candidates.

MK7420. SCIENTIFIC ASSOCIATE POSITION - Requires an MS in physics or nuclear chemistry, knowledge of C, C++, several years' experience building and programming a real-time data-acquisition system for

a modern high-energy or nuclear physics experiment, and experience with VME hardware. Familiarity with ROOT data analysis framework, VxWorks and TCL/TK desirable. Will be responsible for building and managing the data-acquisition system for the PHOBOS experiment at RHIC. Chemistry Department.