BROOKHAVEN BULLETIN
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BROOKHAVEN NATIONAL LABORATORY

AGS — A Machine For All Seasons

Forty years ago, on July 29, 1960, the Alternating Gradient Synchrotron (AGS) became the world's most powerful synchrotron when it reached its design energy of 30 billion electron volts (GeV). Ever since, the AGS has facilitated extraordinary advances in the understanding of high-energy and nuclear physics, including three Nobel Prize winning experiments and many other major physics discoveries (see box on page 2).

The AGS has produced three Nobel Prize-winning experiments and many other major physics discoveries.

"For the past forty years, the AGS has been the constant at BNL in the evolution of experimental particle physics," says Derek Lowenstein, Chair of BNL's Collider-Accelerator Department. "Its impact on past scientific discoveries is likely to be mimicked in the future as it contributes to RHIC Nobel Prizes."

Originally the most powerful, the AGS became the most flexible accelerator in the world, able to deliver the most intense beams of protons, polarized protons — which are protons all spinning in the same direction — as well as beams of all ion species up to and including gold. It can also provide experiments with particle beams of uniform time-intensity distribution, and with beams of particles in bunches, or in single-bunch mode. Capable of producing beams containing $7x10^{13}$ protons per pulse, the AGS beam today is 10,000 times more intense than it was in 1960.

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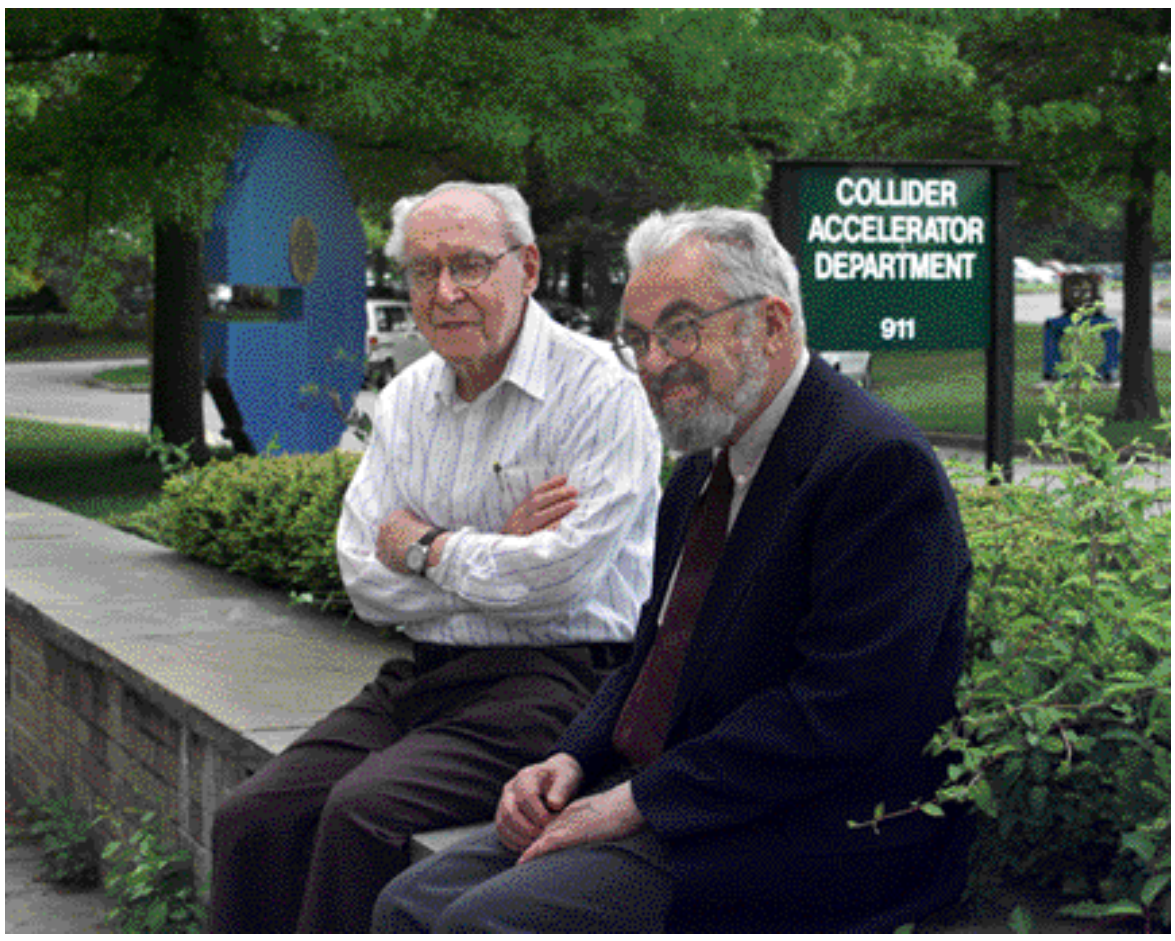
In the early years, AGS particle physics studies were restricted to

(continued on page 2)



Roger Stoutenburgh D0220600

Looking forward to the next frontier of physics are Maurice Goldhaber (left) and Ernest Courant, who combined have spent approximately 100 years at the Lab, spanning the time of the Cosmotron (see C-shaped Cosmotron magnet back, left) through the innovation of the Alternating Gradient Synchrotron (AGS), to BNL's latest world-record smasher, the Relativistic Heavy Ion Collider, now administered with the AGS in the new Collider-Accelerator Department.

If you can't do two things together, you just do one after the other — that's all there is to it!"

Ernest Courant, Distinguished Scientist emeritus, was describing how he came to think of the strong-focusing principle that he, together with M. Stanley Livingston and Hartland Snyder, codiscovered in 1952.

Also known as alternating gradient focusing, this principle was a breakthrough in accelerator design. At BNL, it resulted in the construction of the extremely successful Alternating Gradient Synchrotron (AGS), which achieved its design energy 40 years ago, on July 29, 1960 (see accompanying story, left).

In previous circular accelerators, such as BNL's Cosmotron, particles had been guided around the ring by a magnetic field made by outward-facing magnets. The magnets bent the particles' trajectories and at the same time weakly focused them both horizontally and vertically. The particles' energy could only be increased by enlarging the ring with wider magnets, requiring far more steel — at great cost — to make the larger number of magnets.

But Courant and his colleagues calculated that energy could be increased dramatically with much smaller magnets if the particles were strongly focused first vertically,

(continued on page 2)

RHIC Fest — A Gold-Gold Success

The weather held off and the food and other refreshments held out to make RHIC Fest 2000 a smashing success. Hundreds of Lab employees, collaborators, visitors, and friends gathered outside Berkner Hall on Friday, July 14, to celebrate the Relativistic Heavy Ion Collider's (RHIC's) first collisions of two beams of gold ions.

"This is a very important occasion for Brookhaven National Laboratory," said Satoshi Ozaki, Associate Laboratory Director for RHIC, who hosted the party along with Lab Director John Marburger. "It represents the culmination of many, many years of effort," he said, thanking the entire Laboratory for its support for RHIC.

"Everyone here has contributed in ways you may not even have suspected," said Marburger, echoing this sentiment and marveling at the coordinated effort it took for all four detectors to be ready to take data at first collisions. "I expect the physics that comes from this machine to be just as spectacular," he added.

Former Laboratory Director Nicholas Samios acknowledged that that will be the fun part. "What a great young team we have to operate this machine. It is their task to bring it even further," he said, looking forward to the collaboration among experimentalists and theorists.

"We have at least 20 years of physics to go, and hopefully a couple of Nobel Prizes," added Derek Lowenstein, Collider-Accelerator Department Chair.

Michael Holland, DOE Brookhaven Group, said "the Department is extremely excited about RHIC." He presented awards for excellence in partnership to Thomas Ludlam, Deputy Associate Laboratory Director for High Energy and Nuclear Physics, and Michael Harrison, who heads the Superconducting Magnet Division, who each again congratulated and thanked the entire Lab team for contributing to RHIC's success.

The speeches concluded with an invitation from Ozaki for everyone to "go back to drinking and eating" — and as you can see in the accompanying photos, they did! — Karen McNulty

CN7-187-00

CN7-226-00

Derek Lowenstein, Andy McNearny

CN7-231-00

John Searing, Michael Holland

CN7-178-

All party photos by Michael Herbert

Bill Weng, John Marburger, Nicholas Samios, Satoshi Ozaki

AGS Machine *(cont'd)*

those using internal targets — where particle beams were directed at a target inside the confines of the accelerator. Scientists would study particles as they were liberated from the target.

Today, the AGS particle beam is delivered onto targets outside the AGS. The tremendous advances in accelerator technology enable particles to be injected into the two RHIC rings where they are accelerated and then brought into collision at the four RHIC experiments.

The AGS is capable of running seven to nine experiments simultaneously, while four or five other experiments are setting up. In addition to the four RHIC experiments, seven experiments are currently running at the AGS.

The future of the AGS looks as interesting as its past. On the horizon is RHIC 2, for which the AGS beam will supply more bunches of beam as part of the upgrade to provide 40 times more collisions. Lowenstein explains that following this upgrade, "experiments that used to take a year to collect data, would only take a week." The AGS will also be a major player in a possible future eRHIC facility, in which electrons will collide with ions. Also, in a plan for a future muon collider to be constructed at BNL, the AGS serves as the producer of the muon particle beam.

"The AGS is the perfect testbed to learn how to manipulate and accelerate high-power proton beams," says Lowenstein. "Having served science for the past 40 years and proposed experiments for quite a few more, by the time this is over, the AGS will be eligible to collect Social Security."

— John Galvin

AGS Highlights

1962 — The muon-neutrino, discovered by a Columbia/BNL group led by Leon Lederman, Melvin Schwartz, and Jack Steinberger, who all received the 1988 Nobel Prize in physics.

1964 — CP violation, discovered by James Cronin and Val Fitch, both then of Princeton University. They were awarded the 1980 Nobel Prize in physics.

1964 — The Omega-minus particle, observed by a BNL team led by Nicholas Samios, then head of the Physics Department's Omega Group.

1974 — The J/psi particle, discovered by a BNL/Massachusetts Institute of Technology (MIT) team headed by Samuel Ting of MIT. Ting shared the 1976 Nobel Prize in physics with Burton Richter, who found the particle simultaneously at the Stanford Linear Accelerator Center.

1975 — The charmed baryon, charmed lambda, observed by a BNL team led by Nicholas Samios, then head of the Physics Department's Omega Group.

1997 — Evidence of the first exotic meson particle by a team of 51 scientists from BNL, Northwestern University, Renesselaer Polytechnic Institute, the University of Massachusetts, Dartmouth College, and Russia's Institute for High Energy Physics and Moscow State University.

1997 — Discovery of the rare kaon decay, K^+ meson decaying to a pion and two neutrinos, by an international team of 50 BNL researchers with scientists from Canada's TRIUMF Laboratory, the University of Alberta, Japan's KEK Laboratory and Osaka University, and Princeton University.

— J.G.

AGS: Strong Focus on Future *(cont'd)*

then horizontally. They achieved this by arranging the magnets so that their field gradients faced alternatively inward, then outward around the ring. It turned out that this idea had been proposed earlier and sent to California by Nick Christofilos in Greece, but his innovation had gone unrecognized and

". . . on the border between light and dark, where no complete set of guiding principles is as yet established."

was then forgotten. Later, he was invited to BNL and worked here for a time.

The practicality of the principle was demonstrated in 1954 with Cornell University's 1.3 billion electron volt (GeV) electron accelerator, and in 1959, well before the AGS was finished, with the 25-GeV Proton Synchrotron at CERN, the European particle physics laboratory in Switzerland.

On May 17, 1960, a 50-million electron volt (MeV) beam completed one turn around the AGS ring. In July that year, the 30-GeV design energy was reached and even surpassed.

"But," Courant recalled, "although we were all very excited by how quickly things were going, we were a little disappointed that we'd been scooped by CERN."

One reason that BNL had fallen behind was by building an electron analog before starting construction on the AGS, Courant said.

The analog was designed to explore what is called the transition energy, a potentially serious problem with the synchronization behavior. The analog could also give information on nonlinear resonances which might affect the orbit stability of the particles as they circled the AGS ring.

"These resonances were not a big problem, but it was good to know what was happening," Courant said. "Using the analog, we found that the transition problem could be overcome. We also found out a lot about higher-order resonances that we hadn't expected, and we confirmed that we could go forward with the design as planned. So the delay was worth it."

AGS Dedication

In a July 1960 statement made as the AGS began operation, Leland Haworth, BNL Director at the time, congratulated Ken Green, John Blewett, and the entire staff of the Accelerator Development Department for their work. He gave special congratulations to Courant, Snyder, and Livingston, "whose brilliant concept of strong focusing has once more proved its great utility."

Taking over as BNL Director on July 1, 1961, was Maurice Goldhaber, now Distinguished Scientist emeritus. From September 6-12, the Lab hosted the 1961 International Conference on High Energy Accelerators in New York City and at the Lab. Immediately following the conference, the AGS dedication ceremony was held.

Goldhaber had just returned from a celebration in Manchester, England, for the fiftieth anniversary of the discovery of the nucleus by Ernest Rutherford. On the return flight, Goldhaber wrote the talk he was to give at the AGS dedication: "Why High Energy Physics?" which was later published in the December 1961 *Physics Today*.

Not strangely, Goldhaber's words on the science lying ahead at the AGS are relevant today in the new age of the AGS's mighty spin-off partner, the Relativistic Heavy Ion Collider (RHIC). RHIC was built, as all accelerators have been since 1954, using the strong-focusing principle.

In his talk, Goldhaber described experimentalists, eager to work on the new machine "on the border between light and dark, where no complete set of guiding principles is as yet established."

"Research with these machines is a great adventure."

"Today, the border between light and dark has moved to questions of nuclear structure, of the structure of elementary particles, and of the forces between them," he also noted.

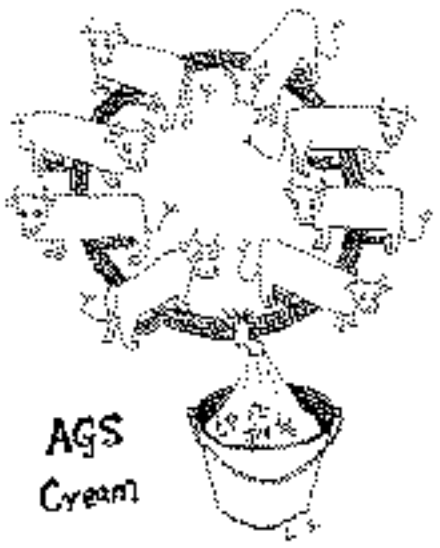
"Research with these machines is a great adventure; it leads us nearer to the heart of the particles of which we all are built. To think of something more exciting is difficult," he concluded.

Another remark made by Goldhaber at the AGS dedication recalls a CERN scientist who somewhat unwisely sympathized with the new BNL Director over CERN's having completed their sister machine first. "We'll get all the cream," said the visitor.

Goldhaber remembers perfectly the spirit of his reply. "Many of our physicists and engineers grew up on farms and know how to milk cows — and when you get milk, you also get cream," he said.

The cream of scientific discovery that the AGS has provided and is still providing is vital to world physics. Now, Courant, Goldhaber, and the scientific community worldwide look forward to heavy cream from RHIC.

— Liz Seubert



Maurice Goldhaber's AGS cream story inspired Liz Seubert to draw this cartoon showing a muon neutrino, CP violation, omega minus, and a J/psi floating to the top of the milk yield of a ring of alternating cows.

Road Closed

From Wednesday, August 9, through Friday, August 11, Brookhaven Avenue will be closed in both directions in front of the Information Technology Division, Bldg. 515, due to underground steam line repairs.

GLOBE@BNL

BERA's gay and lesbian club, GLOBE@BNL, will hold its monthly meeting on Friday, August 11. For more information and the meeting's location, call Mike Loftus, Ext. 2960, or Chris Gardner, Ext. 4537, or go to the club's web page at http://homestead.juno.com/bnlglobe/files/home.html.

Environmental Stewardship Policy Awareness

BNL's Environmental Management System (EMS) is being audited during July-October. All Lab employees should be prepared to answer questions that auditors might ask.

This is the fourth in a five-part series to help you understand how BNL's EMS policy commitments apply to you and to give sample questions and answers that you should be prepared to answer. Your answers should be specific to your own work.

Policy: BNL is committed to an aggressive cleanup of existing environmental problems.

Q: How do you support the cleanup effort of the Laboratory?

A: One way I help is by maintaining ownership of chemicals and radioactive materials from the time of purchase until final disposition, either through exchange via the Chemical Management System, proper disposal, or return to my home institution. My organization is also pursuing corrective actions on legacy problems identified during the Facility Review Project.

Q: What is your responsibility if a spill or inadvertent release to the environment occurs?

A: I report the spill by calling Ext. 2222, and then notify my supervisor and ESH staff. The Lab has a team of emergency responders who control and contain the release, and coordinate the cleanup activities. Also, BNL's Environmental Restoration program identifies, treats or removes, and monitors the historical contamination on site.

More details on BNL's Environmental Restoration initiatives can be found on their web page, http://www.oer.dir.bnl.gov/ or by contacting Ken White, Ext. 4423.

Advanced Technology Next Summer Sunday

Visit BNL's Energy Efficiency and Conservation Division on Sunday, August 6, and hear presentations on technologies that have been developed at the Lab. These will include combustion heating technology, geothermal technology, and energy efficiency programs. Visitors will also learn about innovative fuel cells sited at BNL, which produce both electric power and heat.

Summer Sunday Tours continue with guided bus tours of the Lab site which run throughout the day. The Whiz Bang Science Show, a lively, interactive demonstration of basic scientific principles, will be presented four times between 10 a.m. and 3 p.m. The Camp Upton Historical Collection, located in the Camp Upton chapel, displays the history of the BNL site during its pre-Lab days as a U.S. Army camp during World Wars I and II.

Organized by BNL's Museum Programs of the Community Relations Office, BNL Summer Sunday tours run from 10 a.m. to 3 p.m., but visitors must arrive before 3 p.m. The tours are free, open to the public, and no reservations are required.

Hospitality News

All the Lab community is invited to take part in these activities:

Welcome Coffee, Tuesdays

Every Tuesday, 10-11:30 a.m., coffee is offered in the Recreation Building lounge. Newcomers are invited to find out about life at the Lab and make new friends.

New York City Day Trip, 8/13

On Sunday, August 13, at 9 a.m., a bus bound for Manhattan will leave from the Lollipop House in the apartment area. Students, facility users, guests, employees and families are welcome. The cost is $10 per adult, $5 children 2-12 (under 2, free). To reserve, call Mimi Luccio 821-1435.

Bronx Zoo Trip, 9/16

On Saturday, September 16, children and families may join a trip for the traditional day at the Zoo. The bus will leave from the Lollipop House at 9 a.m. and will leave the Zoo at 5 p.m.

Details are posted in the Laundry Room in the apartment area and in the Recreation Building. For more information, call Hospitality Chair Mimi Luccio, 821-1435, or, on site, call Vicky Chang, Ext. 1053.

Arrivals & Departures

Arrivals

Ian Ballantyne ..... Info. Tech.
Ila G. Campbell ..... C-A
Hucheng Chen ..... Physics
John G. Guercio ..... C-A
Ao Lin ..... Chemistry
Sharadha Sambasivan ..... Biology
Alexander Undrus ..... Physics

Departures

John Castro ..... Plant Eng.
William C. Elliott ..... Biology
Carmen Falkenbach ..... EENS
Lawrence Johnson ..... Plant Eng.
Paul A. Kessler ..... Info. Tech.
H. Ronald Manning ..... Fin. & Admin.
Jullie Pan ..... Medical
Joan D. Perullo ..... Staff Services
Jonathan B. Sanborn ..... N&NS
Edwin Taylor ..... Info. Tech.
Igor Triger ..... Reactor

America Online

Some BNL employees and retirees have recently reported having sporadic difficulty in sending or receiving e-mail from America Online accounts. This is not the result of any mail configurations on the BNL end. If you have trouble sending or receiving from America Online, contact them directly.

People sending e-mail through America Online receive an error message as follows:

- <someuser@bnl.gov>... Deferred: address already in use
- Message could not be delivered for 1 day.
- Message will be deleted from queue.

The "address already in use" message is due to a problem on the machine trying to deliver the e-mail, in this case, America Online.

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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.

Invitation!

Visit the Summer Student Poster Session on Thursday, August 10. Posters presented by BNL's summer students will be on view in Berkner Hall lobby, 10 a.m.-2 p.m.

Michael Herbert CN7-281-00

Roger Stoutenburgh CN7-268-00

DOE-sponsored programs for students are administered at BNL by the Office of Educational Programs (OEP). They include the ERULF (Energy Research Undergraduate Laboratory Fellowship) program and the Community College Institute (CCI) for Biotechnology, Environmental Science and Computing.

The photograph above shows this summer's ERULF students. They are undergraduates from colleges all over the country who have come to BNL for 10-week research internships, which are arranged by Louise Hanson, OEP (center row, right).

Also staying for 10 weeks at BNL are the CCI 2000 students, pictured at left with Y. Renee Flack (front, third from right), Educational Programs Administrator, and Glenn Williams (second from right), Enrichment Component Instructor. CCI was begun by DOE's Office of Science in 1999, with BNL designated as the lead laboratory because of the Lab's proactive history of programs coordinated with community colleges.

Dosimetry badges will be exchanged today, Friday, August 4. Therefore, please place your badge in its assigned rack space before leaving work today.

Classified Advertisements

OPEN RECRUITMENT – Opportunities for Laboratory Employees and Outside Candidates.

NS7219. WEB CONTENT EDITOR – (Reposting) Requires a bachelor's degree in an appropriate field, experience in Web site design and administration, knowledge and experience with HTML, web page editors (FrontPage, Dreamweaver), graphics programs (Fireworks, PhotoShop), and the MS Office Suite. Proven ability to meet deadlines, juggle simultaneous tasks and keep skills current is necessary; strong teamwork and interpersonal skills are essential. Experience with Active Server Pages, Javascript, XML, and other software associated with electronic publishing is desirable as is interest and facility in translating complex scientific and technical subject matter into attractive pages for a general audience. Will develop and maintain the content of Brookhaven's Web pages; create static pages and templates; and work with IT staff in establishing and maintaining a publication process. Media and Communications Office/Community Involvement, Government and Public Affairs.

DD8397. AUTO-TRUCK MECHANIC (Term Appointment) - Under minimum supervision, performs required repairs, maintenance, servicing and incidental operation of gasoline and diesel engine driven vehicles such as automobiles, trucks, trailers and material handling equipment. Performs limited welding, brazing and painting and other body and fender repair work in order to maintain vehicles in operating order. Uses and maintains all hand and portable tools, shop machines and equipment necessary to perform assigned work. Staff Services Division.

DD8603. SENIOR TOWER LINE PERSON – Under minimum supervision, installs, repairs, and maintains overhead and underground electrical distribution lines systems, equipment, controls and related devices, ordinarily of 2300 volts and over. Duties include rigging, electrical and mechanical work incidental to the installation, maintenance, and repair of equipment, wires, lines, instrument, and fabricated metal on structures such as meteorology towers, pile stack an water tower. Will other wise perform duties of Electrician A. Plant Engineering Division.


CN7-194-00

Eugene Raka, Julius Spiro


CN7-222-00

Rudy Alforque, Conrad Foerster, Payman Mortazavi, Tom Kim


CN7-242-00

Kevin Smith, Fulvia Pilat, Sanjee Abeytunge.


CN7-215-00

Mike Harrison, Mike Butler, Mike Schaeffer


CN7-190-00

Peter Paul, Tom Ludlam, Tom Kirk, Satoshi Ozaki, John Marburger


CN7-229-00

Seigfried Naase, Thomas Roser.


CN7-233-00

Phil Cerniglia, Jen Claudius, Todd Satogata, Angelika Drees


CN7-246-00

Woody Glenn, Jim Wishart, Morris Bullock, Joe Sheehan

Mei Bai, Vadim Ptitsyn, Steve Tepikian, Wolfram Fischer.


CN7-239-00

Doris Rueger, Satoshi Ozaki, Tom Ludlam, Susan White-DePace

Paul Sampson, Peter Ingrassia, Charlie Whalen, Keith Zeno.

BNL Celebrates First RHIC Collisions

RHIC

AGS


CN7-219-00

Sue Perino, Nelson Cause, and the Isotope Stompers

Back: Johannes Van Zeitjs, Bob Olsen, Joe Piacentino; front: Larry Hoff, Wolfram Fischer, Andreas Lehrah, Al Marusic.


CN7-244-00

Russell Wilkins Jr., Tom Johnson, James Williams


CN7-204-00


CN7-208-00

Pets and children were also welcome!