AGS EXPERIMENTAL PROGRAM

The Brookhaven Alternating Gradient Synchrotron was first put into operation in the summer of 1960. After a period of tuning up, the experimental program utilizing this accelerator began in the fall. At this time it seems appropriate to review the present status of the AGS and some of the experiments which have been carried out.

As an aid to the design of succeeding experiments, the first experiments done at the AGS were in the nature of surveys to determine the numbers of various types of particles emanating from the internal targets. One method employed stacks of photographic emulsions in order to detect and count protons scattered, or "diffracted" at a very small angle from a target. Another type of survey done used Cerenkov counters to measure the yield of secondary particles from a target. (A Cerenkov counter is a device which can distinguish slight differences in velocity of particles traveling near the speed of light.) In this way it was possible to determine how many pi mesons, K mesons, and anti-protons, as well as protons, came from the target with energies from 3 to 10 Bev. These elementary particles are of great interest in high energy physics and the numbers produced are collated with theoretical predictions.

Besides the surveys on particles emerging at small angles to the AGS beam, another group of researchers has examined the production of various particles at larger angles. Identification of a particle type in this case was accomplished by a direct measure of the time required by the particle to traverse a known distance between two detectors.

This past spring, the BNL 20-inch hydrogen bubble chamber was set up at the AGS for survey runs, and beams of secondary particles at various energies were conducted into it. By studying the tracks which were produced, events such as the production (in liquid hydrogen) of K-meson pairs and new neutral particles were studied or searched for. This same bubble chamber run also provided an opportunity for some groups to test devices which will be valuable in identifying tracks in the chamber in future experiments.

A primary experiment at the AGS which was recently completed was the measurement of the "total cross sections" for interactions of particles (protons, anti-protons, $pi^{\pm}$ mesons, and K^{+} mesons) when they impinge on a stationary target proton. By "cross section" is meant the effective size of the target proton as seen by an incoming particle. Measurements of these cross sections for different types of incident particles will be helpful in testing various theories concerning the interaction of elementary particles.

In the next few months, two primary experiments will be undertaken. The first will utilize equipment which has been set up to pass a beam of practically pure anti-protons into the 20-inch bubble chamber to study the annihilation of the anti-proton by the ordinary protons in the liquid hydrogen; and, also, to study the strange particles produced by a proton-anti-proton reaction. The second experiment will involve neutrinos which are massless, chargeless particles and very difficult to detect. An attempt will be made to settle the important theoretical question of whether there are one or two distinct types of neutrinos.

DEDICATION AGENDA

Participants in the International Conference on High Energy Accelerators, representatives of universities and governments, from both home and abroad, and AGS staff are attending AGS dedication ceremonies today. Dr. Leland J. Haworth, member of the Atomic Energy Commission, will deliver the main address. Other speakers will be Dr. M. Goldhaber, Director of BNL; Mr. E.L. Van Horn, Manager of the Brookhaven Office of the A.E.C.; Dr. I.I. Rabi, President of Associated Universities, Inc.; and Dr. G.K. Green, Chairman of the Accelerator Department. Following the ceremonies, guests will tour the AGS facilities.

MILESTONES IN THE CONSTRUCTION OF THE AGS

SUMMER 1952	Concept of strong focusing principle.
AUGUST 1953	Proposal made to the U.S Atomic Energy Commission.
JANUARY 1954	Authorization and funds allotted by Atomic Energy Commission.
LATE 1955	Construction of service building started.
DECEMBER 1955	Beam in electron analogue accelerated to 5 Mev.
JANUARY 1956	Digging started for circular trench to house magnet tunnel.
NOVEMBER 1956	Staff moved into new service building.
MARCH 1958	First magnets delivered.
NOVEMBER 1958	Motor generator set delivered.
MAY 1959	First beam accelerated by Cockcroft-Walton generator. Last magnets delivered.
APRIL 13, 1960	Linac proton beam accelerated to 50 Mev for first time.
MAY 17, 1960	50 Mev proton beam injected into synchrotron and successfully completed one turn around the ring.
MAY 26, 1960	Beam injected into synchrotron and successfully spiraled around ring approximately 100 times without r-f acceleration.
JULY 22, 1960	First attempt at appreciable acceleration resulted in occasional pulses to phase transition at a few Bev.
JULY 29, 1960	Beam consistently passed through phase transition and was accelerated to above 30 Bev.

AGS DESIGN SPECIFICATIONS

Type of particles	Protons
Energy	30 + billion electron volts
Pulse rate	20 per minute
Output	$\sim 10^{10}$ protons per pulse
MAGNET	
Focusing type	Alternating gradient
Mean radius	421.5 ft.
Sectors, number	240
Field at injection	121 gauss
Field, maximum	13,000 gauss
Power input, maximum	33,000 kilowatts
Rise time	1.2 seconds
Weight	Steel - 4000 tons; copper - 400 tons
APERTURE	
Width	6 inches
Height	2.7 inches
SHIELDING	Earth and concrete
INJECTION SYSTEM	
Type	Linear Accelerator
Energy	50 Mev
Injector output	3 milliamperes
ACCELERATION SYSTEM	
Frequency	1.4 to 4.5 megacycles per second
Accelerating cavities	12
Energy gain, average	90 Kev per turn

the Bulletin Board

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DEDICATION OF BROOKHAVEN ALTERNATING GRADIENT SYNCHROTRON

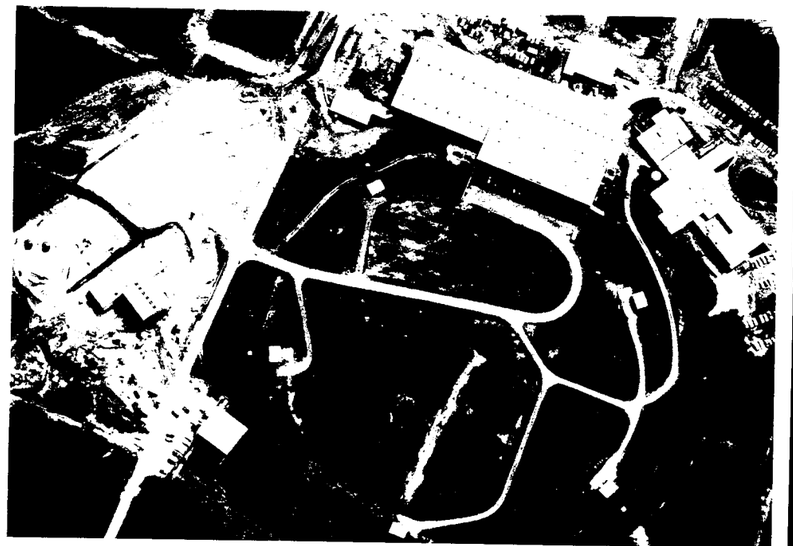
The world's largest and most powerful particle accelerator, the Alternating Gradient Synchrotron, is to be dedicated today here at Brookhaven National Laboratory.

The dedicatory address will be delivered by Dr. Leland J. Haworth, member of the Atomic Energy Commission. Dr. Haworth, who was Director of the Laboratory from 1948 until his appointment as a Commissioner last April, has given vigorous leadership to the AGS project from its inception. He served as Chairman of the Accelerator Development Department, which was responsible for the design and construction of the AGS, until November, 1959, when the present Chairman, Dr. G.K. Green, was appointed to that position.

The dedication ceremonies follow the 1961 International Conference on High Energy Accelerators, held in New York City and Brookhaven from September 6 through 12. The Conference, sponsored jointly by the International Union for Pure and Applied Physics, the U.S. Atomic Energy Commission, and Associated Universities, Inc., has been attended by over 200 of the world's outstanding scientists in the field of high energy accelerators.

Construction of the AGS, which includes 240 magnets placed in a ring-shaped, 18-foot square tunnel one-half mile in circumference, was started in late 1955, following several years of preliminary design work. The total cost of this highly complex AEC research facility, including a 63,000 square foot service and laboratory building, and an 83,000 square foot experimental building, is approximately $32,000,000. Following the completion of the AGS in early 1960, it underwent a period of testing; the first acceleration trials were made on July 22, and protons were first accelerated to an energy of 30 billion electron volts on July 29. Since that date, the AGS has been improved, auxiliary equipment has been installed, and the research program begun. The machine can now deliver a peak energy of 33 Bev. Its normal operating energy is 30 Bev, at which level it can deliver a pulse every 2.4 seconds. The pulse rate can be increased to 1.6 seconds at 20 Bev, and 0.8 seconds at 10 Bev. An intensity of 3×10^{11} (3 followed by 11 zeros) protons per pulse was reached within a year of initial operation.

The experimental use of the AGS represents an important step forward in USAEC-sponsored studies of nuclear forces and the properties of sub-nuclear particles. It is enabling scientists in the United States to study nuclear interactions at energies about five times greater than ever before possible in this country. Since 1954, the most powerful accelerator in the U.S. has been the 6.2-Bev Bevatron at the University of California's Lawrence Radiation Laboratory. With a machine in the 30-Bev range, physicists at Brookhaven expect to learn more about the many kinds of particles, such as mesons and hyperons, and the various "anti-particles."



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One of the regular Conference sessions at the Barbizon-Plaza Theatre.

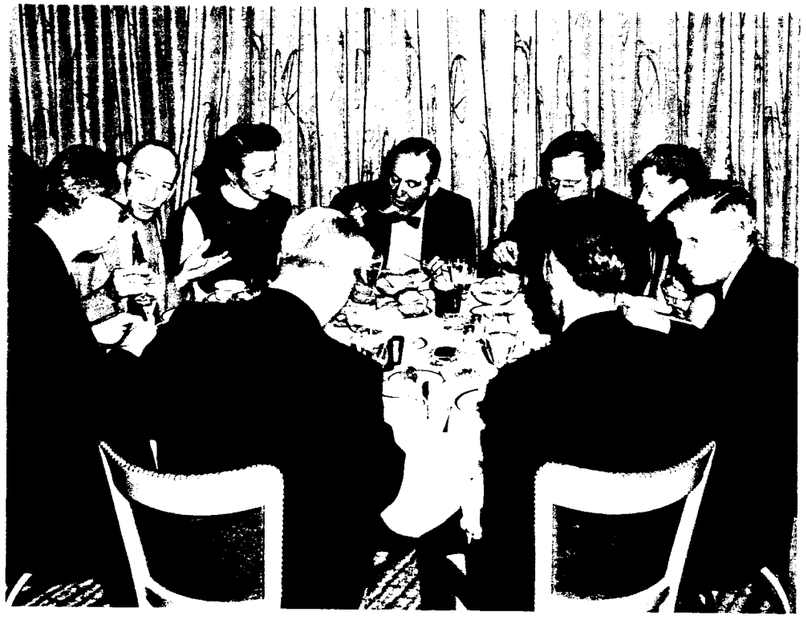

Table at a Conference banquet. S. Goudsmit of BNL, who delivered the after dinner speech is seated at the center of the picture facing the camera. Starting with Dr. Goudsmit, the following persons are seated counter clockwise around the table: Mrs. G.K. Green, G.K. Green, BNL, U.S.A.; S.D. Winter, Saclay, France; L.C.L. Yuan, BNL, U.S.A.; J.B. Adams, CERN; J.P. Blewett, BNL, U.S.A.; M.H. Blewett, BNL, U.S.A.; and M.G.N. Hine, CERN.

THE 1961 BROOKHAVEN INTERNATIONAL CONFERENCE ON HIGH ENERGY ACCELERATORS

Involved in a lively discussion at the welcoming party are Commissioner L. J. Haworth, U.S.A.E.C., E. D. Courant, BNL and K. Brown, Stanford.

Brookhaven was host during the past week to the 1961 International Accelerator Conference. The Conference was opened by G.K. Green of BNL, the Conference Chairman, on Wednesday, September 6, at the Barbizon-Plaza Hotel in New York City. Dr. Green welcomed the more than 175 scientists who had come from fifteen different countries and expressed regret that an expected group of accelerator experts from the USSR were unable to attend. He introduced the Secretary of the Conference, C.E. Falk of BNL, and the Conference Proceedings Editor, M.H. Blewett of BNL. The Conference then started with its regular sessions which covered discussions of the present and future role of high energy accelerators in particle physics, operating characteristics of new accelerators such as the CERN 28 Bev and the BNL 33 Bev alternating gradient synchrotrons, high energy linear accelerators, reviews of studies exploring the feasibility of building accelerators of still higher energies and intensities, storage rings, fixed field alternating gradient synchrotrons, etc. The Conference moved from New York to Brookhaven on Sunday, September 10, and sessions were resumed at the BNL Theatre on the next day. The meetings ended on Tuesday, September 12.

The session Chairman's table. Seen from left to right are: L.C. Teng, Argonne, U.S.A.; T.G. Pickavance, Rutherford Laboratory, United Kingdom, Chairman of Session IV; M.G. White, Princeton, U.S.A.; C.E. Falk, BNL, U.S.A.; and W.K.H. Panofsky, Stanford, U.S.A.

Conference participants line up for coffee at one of the regularly scheduled breaks in the formal sessions. Seen from left to right are I.F. Quercia, Frascati, Italy; S. Suwa, University of Tokyo, Japan; T. Collins, Cambridge Electron Accelerator, U.S.A.; G. Corazza, Frascati, Italy; and F.T. Cole, MURA, U.S.A.