

# News from abroad

## U. S. A.

### Policy for high-energy physics approved by the President

A booklet published in February for the U.S. Joint Committee on Atomic Energy\* included the text of the Atomic Energy Commission's proposals for the development of high-energy physics in America, covering the period 1965-1981, which have been submitted to Congress by President Johnson.

Among the specific plans presented are those for the construction of a 200-GeV proton synchrotron, to be completed before 1974, conversion of the Brookhaven AGS to a high-intensity machine, improvements at the Argonne ZGS, the construction of a high-energy electron-positron storage ring at the 20-GeV Stanford linear accelerator, the early construction of two or three large hydrogen bubble chambers, increased support for university high-energy physics groups, and intensive design studies for a proton accelerator of 600 to 1000 GeV energy to come into operation in 1980, with provision for the possible future addition of storage rings.

It is hoped to give further details of this report in the next issue of *CERN COURIER*.

### World's first experiment with colliding beams

Spectacular news came from Stanford University (U.S.A.) in March, when it was announced that on 1 February 1965 two electron beams travelling in opposite directions in a pair of intersecting storage rings had at last been made to collide.

The electrons in each beam had an energy of 300 MeV, so that when two of them met head-on their colliding energy was 600 MeV, equivalent to that of a 360 GeV electron hitting a stationary target.

This success, by a team of physicists from Stanford and Princeton Universities, marks the climax of six years

\* 'High-energy physics programme: report on national policy and background information', Washington, U.S. Government Printing Office, 55 cents.

answered are left unanswered or are neglected by lack of attention. The questions remain, they cannot be overlooked.

This different spirit will do most harm in the education of young scientists. The study of science is based upon a burning interest in fundamental problems. The attitude of students would be perverted if they were not constantly aware of a lively quest for the solution of the basic problems of science. Even the scientist who will devote his life to purely extensive research must be aware of the existence and the spirit of intensive research. The reason is that, even in the most extensive research, at every step there is always an intensive component: at each unsolved problem one must go back to some fundamental idea, one must try to see more of the essence of the problem. This is an attitude which can be fostered

of intensive work, the last three of which were years of frustrating problems that sometimes threatened to defeat the whole programme. During the last year in particular, after beams had been successfully stored in the rings, attempts to make them collide resulted in failure, except with relatively weak beams. Repercussions of this frustration were felt at CERN, where doubts were thrown on the feasibility of operating the proton storage rings proposed for the PS, in spite of the confident assurance by the designers that the unexplained electron effects were unlikely to occur to the same extent with the more energetic and less dense proton beams. The new results reflect an improvement of colliding beam operation to an extent that the collection of experimental data on the collision interactions could be started.

The Stanford storage rings are fed from the 'Mark III' linear accelerator, and electrons have been stored in the rings for periods as long as 35 hours. The beam current in each ring is about 0.03 ampères. One of the main experiments now proposed is a new, more severe test of the theory of quantum electrodynamics, made possible by the higher available energy which enables one to investigate 'objects' of smaller size.

## F. R. of GERMANY - DESY

### Accelerator running regularly

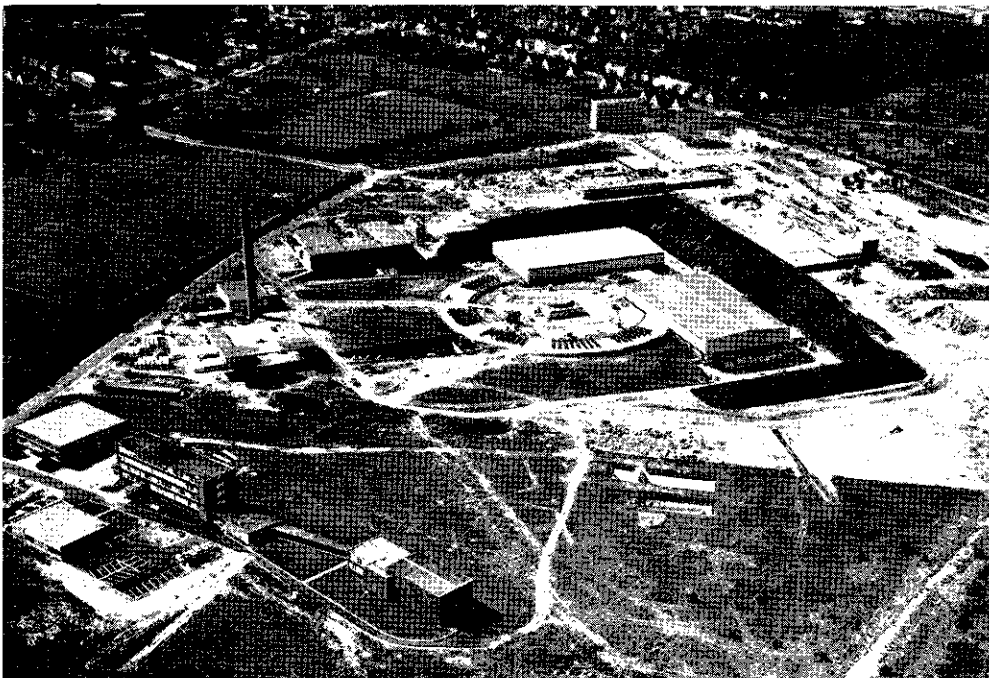
News from the 'Deutsches Elektronen-Synchrotron' (DESY) at Hamburg (Federal Republic of Germany) in March was that the accelerator was running on a regular weekly schedule of 96 hours, from 11 p.m. each Monday to 11 p.m. Friday. About 50% of the time was being used for experimental physics (with counters and a bubble chamber) and about 30% for experiments and development work with the accelerator itself, some 20% still being lost because of technical difficulties.

This machine, as well as the similar one (Cambridge Electron Accelerator) in the U.S.A., produces the world's

and maintained only if intensive and extensive research have an equal standing in the scientific community. There is one broad front in science and each part of it must be pushed forward with full vigour.

We find strong support today for space technology, which may allow us to explore the unknown parts of the solar system. Exploration of the unknown was always a strong component of human endeavour in our modern civilization. But it must go together, as it always did, with another equally strong component: the explanation of the unknown in whatever form it faces us.

In the beginning of the 16th century, when the scientific era began, Magellan performed the first trip around the earth. But also in the same period Copernicus published his work on the motion of the planets ●



Aerial view of the DESY Laboratory, at the time of the inauguration of the electron synchrotron last November. The shape of the accelerator (which is 2.5 m underground) can be seen clearly in the centre of the picture, with the main control room at the centre of the ring and two large experimental halls tangential to it. In the left foreground are the buildings of the II Institute for Experimental Physics of the University of Hamburg.

highest energy electrons. It is now just over a year since the first accelerated beam was obtained\*, and the intensity at the present maximum energy of 6 GeV is about  $2 \times 10^{10}$  electrons per pulse. At the usual operating energy of 4-5 GeV, the intensity is  $10^{11}$  electrons per pulse, or more (corresponding to an instantaneous beam current of about 20 mA). With a repetition rate of 50 pulses per second, this means that the number of electrons normally delivered by the machine is  $5 \times 10^{12}$  per second.

The accelerator was officially inaugurated on 12 November last, by the Federal Republic's Minister for Scientific Research, Hans Lenz, at a ceremony attended by some 400 guests from all parts of the world, including a number from CERN. Like the CERN PS, DESY is a circular machine, using the strong-focusing principle of magnetic guidance for the accelerated particles. The ring has a diameter of 100 metres (half that of the CERN PS) and there are 48 magnets with 16 acceleration cavities. Electrons are injected from a 40-MeV linear accelerator. The cost, altogether 110 million DM, was met largely by the city of Hamburg (17 million) and the Federal Republic (83 million), but a timely gift of 10 million DM from the Volkswagen Foundation also enabled a delay in the completion of the accelerator to be avoided. The head of the DESY Laboratory is Prof. Willibald Jentschke, who was born and educated in Vienna and worked for some years after the war in the U.S.A., before returning to Europe to become Director of the Physics Department of the University of Hamburg with which DESY is associated. Prof. Jentschke is also a Member of CERN's Scientific Policy Committee and a Delegate of Germany to the Council.

#### Liquid-hydrogen bubble chamber

A day or two before the inauguration of the accelerator, the first photographs were obtained with the

Laboratory's 80-cm liquid-hydrogen bubble chamber, and the first 'production' run began in February, in an experiment on the interaction of high-energy gamma rays with protons. This chamber is a particularly striking example of the 'team work' of high-energy physics, as it was projected by a joint group of physicists from Institutes in Aachen, Bonn, Hamburg, Heidelberg and Munich and built by a mixed team of German and French physicists and technicians at the French centre of Saclay. Among the physicists associated with the use of the chamber for experiments are a number who were previously at CERN.

The design of the chamber follows closely that of the 81-cm Saclay chamber at CERN, with a hydrogen volume of 128 litres (an oval cylinder 80 cm  $\times$  40 cm  $\times$  40 cm deep), but the cycling time is much faster. Taking pictures at the rate of two per second, the instrument consumes film at the rate of 1 km per hour. Shortly before its first run began, the chamber was officially inaugurated, on 18 February 1965, by Prof. F. Perrin, High Commissioner for Atomic Energy in France, who is also a Member of CERN's Scientific Policy Committee and a Delegate to the Council.

## U.K. - RUTHERFORD LAB.

#### Accident to Nimrod

At about 11 p.m. on the night of Sunday 21 February a serious mechanical accident occurred on the power supply for the magnet of the 7-GeV proton synchrotron 'Nimrod'. As a result, operation of the accelerator and its already overcrowded physics programme has been brought to a halt.

As with other synchrotrons, the magnetic field rises to a maximum and falls again with each pulse of the accelerator, and the corresponding surges of current

\* See, for example, CERN COURIER, vol. 4, p. 78, June 1964.

are too large for the magnet coils to be fed directly from the public electricity supply. Instead, at Nimrod, a twin motor-alternator-flywheel set mounted on one long shaft is used as a 'buffer' between the supply and the magnet. The two motors are driven from the supply, the alternators provide (through rectifiers) the magnet current, and the flywheels increase the rotating mass and help to store energy between each pulse. Although the whole system rotates continuously at about 1000 revolutions per minute it slows down by about 4% when current flows into the magnet and speeds up again when current flows back at the end of each pulse.

The rotor of each alternator is of 'salient-pole' design, with six poles running the length of the machine (over 3 metres) and keyed into the rotor body by a dove-tail joint. As a result of the tremendous stresses set up by the alternate slowing down and speeding up, every 2 seconds or less, of the system, one of these dove-tail joints fractured, allowing the end plate to move outwards under centrifugal force and to tear into the surrounding stator.

It is estimated that the alternator will take about eight months to repair. There is a chance that the accelerator will be able to run with the remaining alternator during this time, with a repetition rate of one pulse every 5 or 6 seconds instead of every 2 seconds, but this will depend on the results of detailed investigations into the cause of the failure, and elimination of the possibility that a similar accident could occur again. At the time of writing (end of March) the results of these investigations were still unknown.

Before the breakdown, the accelerator had been running well, with beam currents of around  $1.5 \times 10^{12}$  protons per pulse as routine.

Among the experiments recently completed, two are perhaps of particular interest. One of these used a polarized-proton target, of a somewhat different design to the one at CERN, to measure the parity of some of the 'resonances' obtained in the scattering of pions by protons. The other was an investigation of the decay of the  $K^0_2$  meson into two pions, using sonic spark chambers as detectors and kaons with an energy less than that used at CERN but still higher than that used at Brookhaven. Like the CERN physicists, the group that carried out this experiment obtained almost exactly the same number of decays (relative to other charged modes), as in the original Brookhaven experiment, serving to underline the fact that the effect, whatever it is, that violates the CP-invariance rule is independent of the energy of the kaons.

## U. S. S. R. - DUBNA

### New Director of the Laboratory

An interchange of positions has taken place at the Joint Institute for Nuclear Research (J.I.N.R.) at Dubna (U.S.S.R.), where Prof. Dimitry I. Blokhintsev has given up his post as Director of the Institute to become head of its Laboratory of Theoretical Physics and Prof. Nikolai N. Bogolyubov, formerly head of the Laboratory of

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Theoretical Physics, has been appointed Director of the Institute.

Prof. Blokhintsev had been Director since the founding of the Institute in 1956. Before then he worked at the Physics Institute of the U.S.S.R. Academy of Sciences and directed the construction of the first nuclear power plant, put into operation in the Soviet Union in 1954, although his interests are primarily in the field of theoretical physics. He was made professor in the University of Moscow in 1936, at the age of 28, and has contributed especially to the theories of phosphorescence, fluorescence and semi-conductors.

Prof. Bogolyubov had led the Laboratory of Theoretical Physics since 1956, as well as being in charge of the Department of Theoretical Physics of the V. A. Stehlov Mathematics Institute of the U.S.S.R. Academy of Sciences. Previously he was chairman of other Departments in the Academy of Sciences as well as at the Universities of Moscow and Kiev. He is a theoretical physicist who has made many contributions to the subject, often of a basic nature, particularly in the fields of analysis, function theory, differential equations, theory of vibration, theory of stability and quantum field theory.

Both physicists are well known also outside Russia and Prof. Bogolyubov, like CERN's Director General Prof. V. F. Weisskopf, has participated in the 'Pugwash' movement, of science and world affairs, for many years.

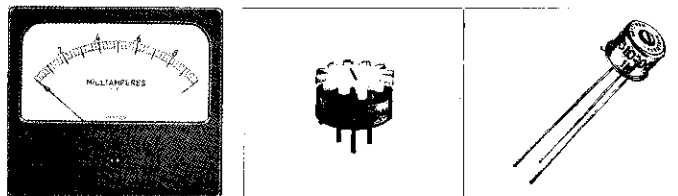
#### 10-GeV accelerator operation

In a seminar given at CERN on 23 March, Dr. J. V. Chuvilo, Deputy Director of the Laboratory for High Energy Physics at J.I.N.R., gave an outline of the experimental facilities and experiments in progress round the 10-GeV synchrophasotron (synchrotron). The accelerator gives an internal proton beam of intensity  $1.2 \times 10^{11}$  protons/pulse, with a repetition rate of 1 pulse every 9 seconds at the highest energy. Instead of the 14-day cycle used at the CERN PS, the synchrophasotron has a more complex schedule of 57 days: 12 on, 2 off; 12 on, 2 off; 21 on, 8 off. With one long shut-down of about a month, there are about 5000 hours of running time available for physics experiments each year.

The accelerator has two experimental halls, and among the experiments recently completed or currently in progress are bubble-chamber runs on particle 'resonances', using incident pions; pion-proton and proton-proton scattering, with emulsions, spark-chambers or a cloud chamber as detectors; and investigations on the various 'normal' decay modes of the  $K^0_2$  meson. As at CERN, some of these experiments are carried out by visiting teams from the universities of the Institute's member states.

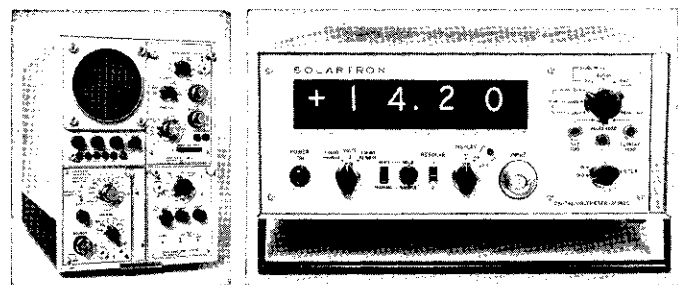
In addition to a 40-cm liquid-hydrogen bubble chamber, the Institute now has a 1-metre hydrogen chamber, on which the first tests were carried out last December. This chamber, which is housed in a separate building some way from the accelerator, is now being prepared for its first experiment, in a beam of negative pions. The Institute also has a xenon bubble chamber, 55 cm  $\times$  27 cm  $\times$  18 cm, a 1-metre propane chamber, and a 2-metre propane chamber (volume 220 cm  $\times$  70 cm  $\times$  40 cm), though the latter is not yet fully operational ●

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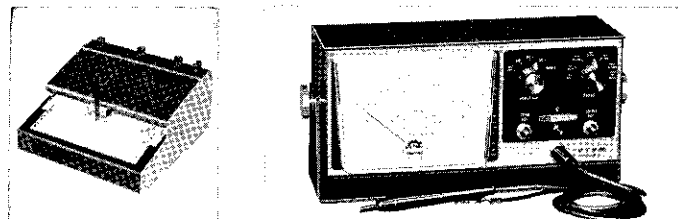
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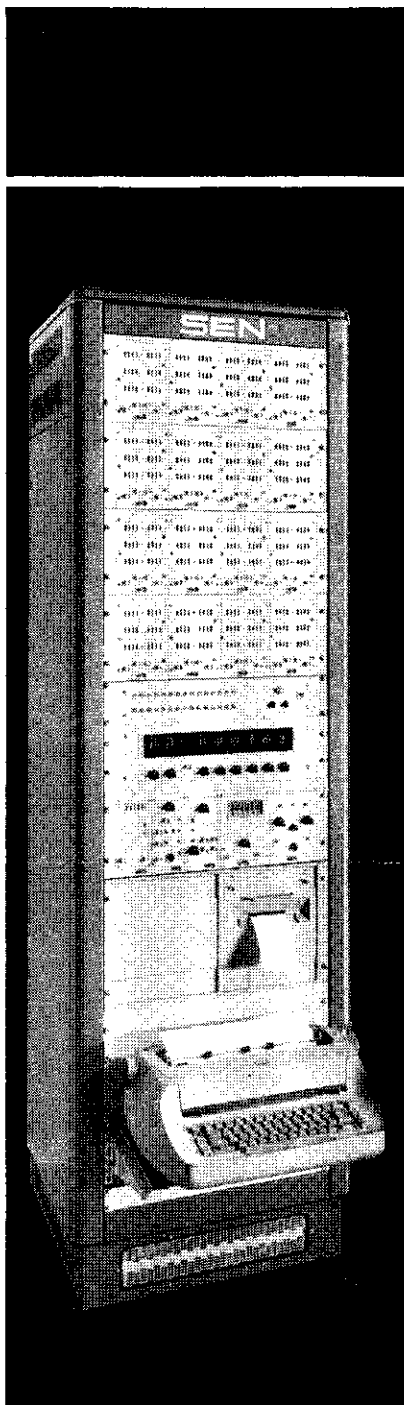
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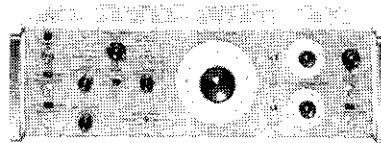
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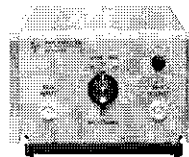
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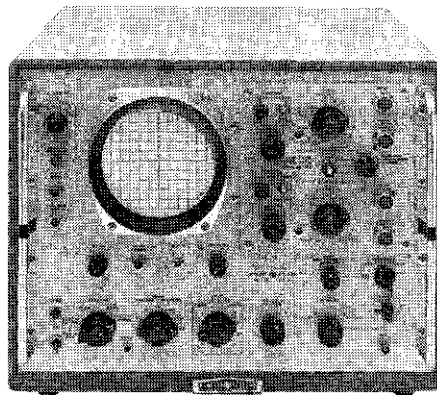
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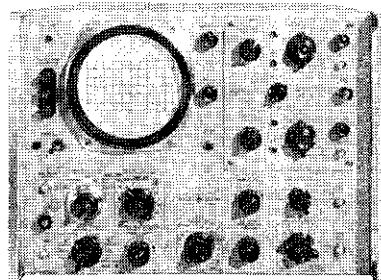
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