

Last month at CERN

29th Session of Council

Delegates from the thirteen Member States of CERN met on 25 March for the 29th Session of Council, with Mr. J. H. Bannier (Netherlands) presiding.

This was a special meeting originally arranged in the hope that a decision could be made on the project for intersecting storage rings. In the event, this decision was not possible, but the meeting provided the occasion for a review of progress on the whole European future programme and of how it fitted in with similar ideas in other parts of the world, particularly with the comprehensive programme presented to Congress in the U.S.A.

Further details of this meeting are given on pp. 69-71 of this issue.

PS experiments in March

During the first period of March, the proton synchrotron was used mainly for counter experiments, although in the second week the 81-cm bubble chamber was also in use in the k_4 beam of the North hall. The accelerator was operated to give protons with a momentum of 19.2 GeV/c, with a target programme including a 300-millisecond 'long burst' on target o. 1 and a repetition rate of one pulse every 2.3 seconds.

Among the counter experiments, the **missing-mass spectrometer**, radically redesigned and incorporating many new components (including scintillation counters such as that illustrated in last month's issue) was used in an investigation of mesons with isotopic spin 1 and mass between 600 and 1100 MeV/c². The **CERN/Ivry group** took another 100 000 spark-chamber photographs, and in the **proton scattering experiment**, with sonic spark chambers and an on-line computer, 90 000 events were registered of scattering from lead and 68 000 of scattering from copper.

Continuing their investigation of antiproton-proton annihilation, the **Paple group** obtained another 35 000 spark-chamber photographs. After

news had been received of the observation in America of the antideuteron, they also spent a few hours investigating the occurrence of this 'antinucleus' in their m_4 beam. About 100 were detected, indicating a proportion of 1 antideuteron for every six thousand million negative pions.

As mentioned in last month's *CERN COURIER*, the **CERN 2-metre hydrogen bubble chamber** was brought into use during the second half of March, after testing and 'tuning' of the new **o_6 beam line**. Its operation was very satisfactory.

At the same time the **81-cm Saclay/Ecole Polytechnique bubble chamber** took 174 000 photographs of antiprotons stopped in deuterium, after taking 90 000 photographs of antiprotons in hydrogen the week previously. In fact it should be noted, as was announced during the March Council Session, that this chamber has now taken more than **5 million photographs** since it was put into operation at CERN in May 1961. The length of film involved is about 1500 km!

Another new bubble chamber

Effectively a new instrument, the enlarged **CERN heavy-liquid bubble chamber** had its first test runs during February. Studies of its operating characteristics were carried out during March and will be continued until the proposed antineutrino run in May. This chamber, which is normally filled with 1180 litres of freon, is at present the largest in the world, in terms of visible volume of liquid.

Also in preparation for the antineutrino run, the PS operators have been gaining experience in handling the fast-ejection system, which they are taking over from the designers in the NPA Division who have been operating it since its installation.

TV beam watching

External proton beams are, in fact, much in evidence in the work of the PS Division and a great deal is being done in preparation for the installation

of the first ejection system and proton beam line in the East area.

Particularly in the early stages of testing and operation, it will be necessary to observe the path of the external beam in order to facilitate correct adjustment. Both for ease of operation and because of radiation hazards, this observation will be made with the aid of a number of remotely controlled television cameras. This, of course, is not a new technique at CERN, but a completely new viewing system, of commercial manufacture apart from some of the switching systems, is being installed for the purpose. In the first half of March this system was subjected to a life test, to see how it would operate during the whole eleven days' running period of the accelerator.

Although the proton beam itself is quite invisible, its path will be shown by placing fluorescent screens in suitable positions, each screen lighting up where the particles pass through it, to give an indication of the position and 'shape' of the beam. This technique, the oldest known method of particle detection, has been allied to one of the newest 'industrial' TV systems to enable all the fluorescent screens to be viewed in the PS main control room.

One camera will look at the septum magnet that ejects the protons from the accelerator, two more will look at screens in the path of the beam, and a fourth will observe the external target at the end of the beam line. At present, arrangements are being made to view the beam ejected from section no. 58 of the synchrotron, but a similar system will be used for the later beam starting from section 62.

The television cameras are of particular interest, because of their small size and remote-control facilities. They are of a type that was developed for use inside nuclear reactors and other inaccessible places and have the advantage for CERN use that even the pre-amplifiers, as well as the other electronic components, can be placed away from the areas of high radiation intensity. The camera tube itself is shielded to some extent against radiation and the unit looks

something like a small telescope, 7.6 cm in diameter, 32 cm long and weighing 3.2 kg.

In the PS East area, only the cameras will be inside the synchrotron tunnel, the pre-amplifiers and camera-control units being outside in the so-called East-ejection building. Two television monitors with 20-cm screens will be installed in the main control room, with means for selecting the view shown by any one of the cameras. The sensitivity of the cameras is such that pictures of normal contrast can be obtained with an illumination of only 10 lux — about the same as that of a reasonably well-lit street at night.

Again intended primarily for the new ejection system, though it also has more general uses, an instrument has been designed by the PS Radio-frequency Group to enable electronic measurements to be made at precisely determined times in the PS cycle. Called a **cascade counter**, it has two inputs, the first of which is connected to the standard timing pulses of the PS and the second to pulses controlled by the signal to be measured. Counting begins automatically after a certain number of pulses have entered the first input, the number being preset to give the required time delay between the start of the whole operation and the taking of any particular measurement.

Nuclear-structure experiment at the SC

As described in last month's issue, the installation of the new slow-ejection equipment in the synchrocyclotron created some difficulties, but the first week of tests after putting the accelerator back into operation showed that it had been worth while. Overall beam intensities up to 60% of that of the fast-ejected beam were obtained, with a duty cycle of 30%; that is protons were available in the external beam for a third of each machine cycle. The new inflector magnet for the muon channel was also tested during this time and shown to provide many possibilities for new beams.

One of the experiments resumed during March was that in which 'muonic x-rays' are studied in order to gain information on the structure of various nuclei. In this experiment, negative muons (produced by the SC muon channel) are slowed down in a target consisting of the material to be investigated, say tungsten. When the muon is nearly at rest it comes under the influence of a tungsten nucleus and orbits around it in much the same way as an ordinary atomic electron. From the outer orbit it drops down into successively lower orbits until finally it either decays or is captured into the nucleus. As the muon changes from one orbit to another it emits radiation, in exactly

the same way as an electron dropping from orbit to orbit in an excited atom. The energy of each quantum of radiation is equal to the energy difference between the two orbits, and in the case of the muon these energies are in the range of about 1 to 6 MeV. The various energies of these x-rays are characteristic of the atoms in the target (analogous to the optical line spectra in the case of electrons), and since the muon orbits lie much closer to the nucleus, or sometimes even in the nucleus, the energies of the x-rays are very sensitive to the distribution of the nuclear electric charge. Study of the x-ray spectra thus gives information firstly on the charge distribution of spherical nuclei, which is expressed as a nuclear radius and a 'skin thickness' (the way in which the charge decreases at the edge of the nucleus), and secondly on any quadrupole (that is, non-spherical) structure of the nucleus.

Precise measurement of the x-ray energies is very difficult, requiring a sensitive, energy-dependent, stable detector together with extreme stability in the associated electronic equipment. In the experiment at CERN, carried out by a group comprising CERN physicists and those of a Dutch visiting team, a new technique, only recently developed, is being used, in which the detector is a lithium-drifted germanium crystal. This kind of crystal, in the same 'family' as crystal diodes and transistors, consists of germanium in which a precisely controlled amount of lithium has been introduced in a particular manner. It is an extremely sensitive x-ray detector, giving much higher energy resolution than previously possible (only about 3 eV is needed to produce an electron/hole pair in the crystal, compared to about 300 eV for each photoelectron in a sodiumiodide/photo-multiplier combination), but requires great skill in its production.

The results of measurements obtained between October 1964 and January 1965, on nuclei of gold, lead, bismuth, tungsten and uranium, were published last February*. The run now in progress is being carried out with a new, larger detector (2.5 cm square and 6 mm thick), produced especially for this purpose in the

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The spreading of the laboratory atmosphere into more traditional fields is exemplified by this photograph, which shows part of the computer installation in CERN's Finance Division. This computer is used primarily for all accounting concerned with salaries, but can also deal with stock records and the compilation of statistics and general accounting work. Information is fed into the computer by means of punched paper tape and the results of the calculations are printed automatically on each person's account sheet, which appears in the central console. Mrs. L. Oldrati is at the console in the photograph. The account sheets also have magnetic tracks and the information they hold can be extracted by the account reader, seen in the cabinet behind E. Luchmann.

* H.L. Acker, G. Backenstoss, C. Daum, J.C. Sens, S.A. de Wit: Measurements and analysis of muonic x-ray spectra in the spherical nuclei Au, Pb and Bi and the deformed nuclei W and U, Physics Letters, vol. 14, pp. 317-320, 15 February 1965.

undertaking, apart from its obvious administrative difficulties, would not even be scientifically advantageous because the research needs of the numerous scientific groups could not be met by a single accelerator. For the 600-GeV to 1000-GeV machine the outlook is rather different. The greater expense provides a stronger need for wider collaboration and the longer time scale provides more opportunity for it to come about. Nevertheless, the report concludes that vigorous design and engineering effort should be exerted independently by U.S. scientists so that such an accelerator could become reality in 15-20 years, whether as an international project or as a national one.

The question of collaboration in the use of accelerators, rather than in their construction and operation, is of a different order and very much easier. Considerable encouragement is given in the report to the interchange of scientists between the various laboratories existing or expected to come into operation in the next year or two.

U. K. — RUTHERFORD LAB.

End of N.I.R.N.S.

Among the changes brought about by the new British Government, in office since last October, have been the setting up of a 'Science Research Council' and the consequent dissolution of the National Institute for Research in Nuclear Science (N.I.R.N.S.). The National Institute was set up in 1957 to provide facilities on a national scale, financed by the Government, for the use of universities and other bodies interested in nuclear science. Its first laboratory was the Rutherford High Energy Laboratory at Chilton, Berkshire, equipped with a 50-MeV proton linear accelerator and the 7-GeV proton synchrotron 'Nimrod'. A second, the Daresbury Nuclear Physics Laboratory, in Cheshire, is being built round a 4-GeV electron synchrotron 'Nina' and has a former physicist of CERN's SC Division, Dr. A. W. Merrison, as its Director. The Atlas Computer Laboratory also belonged to N.I.R.N.S., but since 1st April, when the changeover took place, all three laboratories come under the control of the Science Research Council, which has a much broader responsibility than N.I.R.N.S., embracing such fields as

space research and astronomy as well as nuclear and sub-nuclear physics. The Science Research Council will also be the main U.K. agency for supporting CERN. Like the older Agricultural Research Council and Medical Research Council and a new Natural Environment Research Council, it comes under the Ministry of Education and Science. Its chairman is Sir Harry Melville who, as secretary of the Department of Scientific and Industrial Research, has been a British Delegate to the CERN Council for the last few years; one of the eleven other members is Prof. C. F. Powell, member and past chairman of CERN's Scientific Policy Committee.

Honour for Director of Rutherford Laboratory

The Director of the Rutherford Laboratory Dr. T. G. Pickavance, has been made a Commander of the British Empire and received the insignia of this Order from H.M. the Queen at Buckingham Palace on 18 March.

The Nimrod power supply

Further news about the damaged power supply for 'Nimrod'* became available on 2 April. Investigation has confirmed that the failure was due to metal fatigue, and it appears that certain stress-concentration effects had not been sufficiently appreciated in the design. As a result both alternators will have to be modified before satisfactory long-term operation can be resumed, but it is still hoped to operate the accelerator with the remaining motor-alternator set for a limited time. At the beginning of April, this alternator had been fitted with stress-recording instruments and was being run to check the conclusion about the fracture in the damaged one**.

If the experimental programme is resumed on a limited scale, some experiments already planned will collect less data than originally foreseen and others will take longer to complete. Offers of assistance with accelerator time have also been received by the Rutherford Laboratory from a number of other high-energy physics laboratories, including CERN ●

* As reported in CERN COURIER, vol. 5, pp. 58-59, April 1965.

** Early in May it was learned that similar fatigue cracks had been discovered in the rotor of the second alternator, so that this rotor also has to be returned to the manufacturer for rebuilding. As a result, even half-speed operation of the accelerator is not expected to be possible before September.

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University of Basle, and better electronic apparatus. Already, more detail has been revealed in the uranium and tungsten spectra and new data have been obtained on the quadrupole structure of the plutonium nucleus.

German Parliamentary Committee visits CERN

A visit lasting part of one afternoon and most of the next day was paid to

CERN on 16 and 17 March, 1965, by members of the 'Bundestagsausschuss für Atomkernenergie und Wasserwirtschaft' (Parliamentary Committee for Nuclear Energy and Water Supplies) of the Federal Republic of Germany. The guests were welcomed on the first afternoon by the Director General, Prof. V. F. Weisskopf, who spoke to them on the part played by CERN in the field of sub-nuclear research. During their tour of the Laboratory

the following day, the members of the Committee saw various aspects of the proton synchrotron and its experimental areas, the 2-metre bubble chamber, methods of measuring bubble-chamber photographs and the computers. Before leaving, they were given an idea of the future projects proposed for high-energy physics research in Europe and had an opportunity to discuss them with some of the people concerned ●