

Last month at CERN

New external beam at the PS

Just over two years after the internal proton beam was first successfully ejected from CERN's 28-GeV proton synchrotron, a second, more complex ejection system has now been installed and successfully tested in the accelerator.

The original system ('fast ejection') gives a very short, intense pulse of protons, lasting about 2 millionths of a second on a target serving the South experimental hall. The new one, the result of intensive design, development and construction work over the past eighteen months, involving practically all the groups in the MPS Division, provides an external proton beam for the East experimental hall, with three widely different possibilities for the pulse duration.

Two of these possibilities arise from operation of the equipment as a 'resonant' ejection system (the principle of which was described in *CERN COURIER*, vol. 3, pp. 110-111, September 1963), when the accelerated protons circulating inside the synchrotron are 'gradually' spilled out into the external beam line to give either a long burst, at more or less constant intensity and lasting up to nearly one fifth of a second, or a much shorter burst of about a thousandth of a second, with each accelerator pulse. The longer, 200-ms, burst (known as 'slow ejection') is mainly suitable for experiments using counter and spark-chamber arrays for particle detection; the 1-ms burst ('quick ejection') will be used for bubble-chamber experiments requiring electrostatically separated beams of secondary particles. The third possibility is given by operation as a fast-ejection system, when the beam is sent out of the accelerator in an even shorter time, giving a 2.1-microsecond target burst suitable for bubble-chamber experiments requiring radiofrequency separators in the beam line. This method of operation is basically the same as that of the existing fast-ejection system, a selected number of bunches of circulating protons being ejected from the accelerator within the time taken for one revolution. At present, also, the two fast-ejection systems utilize the same kicker magnet, originally installed for the external beam in the South area.

The first tests on the resonant ejection system were made on 19 July and those with the fast system (carried out in collaboration with staff of the NPA Division) on 29 July, in each case using protons with a momentum of 19.2 GeV/c. Both methods, together with the first section of the external beam line and target system, worked well. Other tests were made at 12 GeV/c and 24.5 GeV/c and were equally successful. When focused on to the external target the fast-ejected beam had a cross-sectional diameter of less than 2 mm. The efficiency of the slow ejected beam was about 70% (that is, 70% of the protons circulating inside the accelerator were transferred to the external beam), which is a high value for a pulse as long as 200 ms.

During the tests a start was made on training the operators for the new beam facilities, in preparation for experiments scheduled for October: slow ejection into the e_2 beam line for proton-proton scattering experiments and fast ejection into the u_1 beam line, incorporating radio-frequency separators, for the 2-m liquid-hydrogen bubble chamber. In fact, one experiment was carried out almost immediately — a target exposure for the NP Division's Nuclear Chemistry Group.

PS shut-down

Installation of the East-area ejected beam was one of the most important of the major jobs carried out during the long shut-down of the synchrotron which lasted from the beginning of June until the middle of July.

In addition, in the East and North experimental halls especially, major changes were made concerning the experiments on the floor, most of the existing beam lines being dismantled and many new ones wholly or partly constructed. In the South hall the beam line for the muon storage ring was installed. Among other things, the CERN heavy-liquid bubble chamber was moved from the South hall to the North hall, following the end of the neutrino run, ready for a new experiment on the decay properties of positive K mesons. In fact, from the point of view of the MU group, responsible for all the beam and equipment changes, the shut-down

effectively began last Easter and will go on well into September. Practically all the experiments scheduled from July onwards are completely new, involving new experimental equipment, and even the liquid-hydrogen bubble chambers are using new beam lines.

Unfortunately it has not been possible to compile a full account of the work carried out during the PS shut-down period, but we hope to give further information on at least some aspects of it in subsequent issues of *CERN COURIER*.

May–July at the SC

During the three months May–July, four long experiments were in progress at different times at the synchro-cyclotron, together with a number of shorter ones. In parallel, as usual, various items of equipment and experimental arrangements were tested in preparation for forthcoming experiments.

At the beginning of May a series of experiments was carried out by the Health Physics Group, using the extracted proton beam. This was partly for shielding tests and radiation-dose measurements but also for biological irradiations on behalf of a number of institutes in Europe. The various experiments required a great deal of effort on the construction of the necessary shielding and on the precision alignment of the beam.

The rest of the month was occupied mainly by three of the long experiments that are continuing at the SC: measurement of the x-rays produced by muon capture in atoms, search for the disintegration of the neutral pion into three gamma rays, and investigation of muon capture in a target of high-pressure hydrogen gas.

During June and July a fourth experiment was begun and completed, the beam line having been set up during the preceding month. This experiment, carried out by a combined team from CERN and the French laboratories at Saclay and Orsay, was on the scattering of 600-MeV polarized protons from a polarized-proton target. The target was the same as that used in previous experiments at the SC and

PS and described in *CERN COURIER* last December (vol. 4, p. 168). It was bombarded by protons polarized by scattering from a small carbon target. The beam line guiding the protons to and from this target and enabling protons of either 'spin up' or 'spin down' to be selected consisted of sixteen independent elements and was the most complex ever used at the SC. A photograph of the detection equipment, together with some information on its mode of operation, appears on p. 121 of this issue.

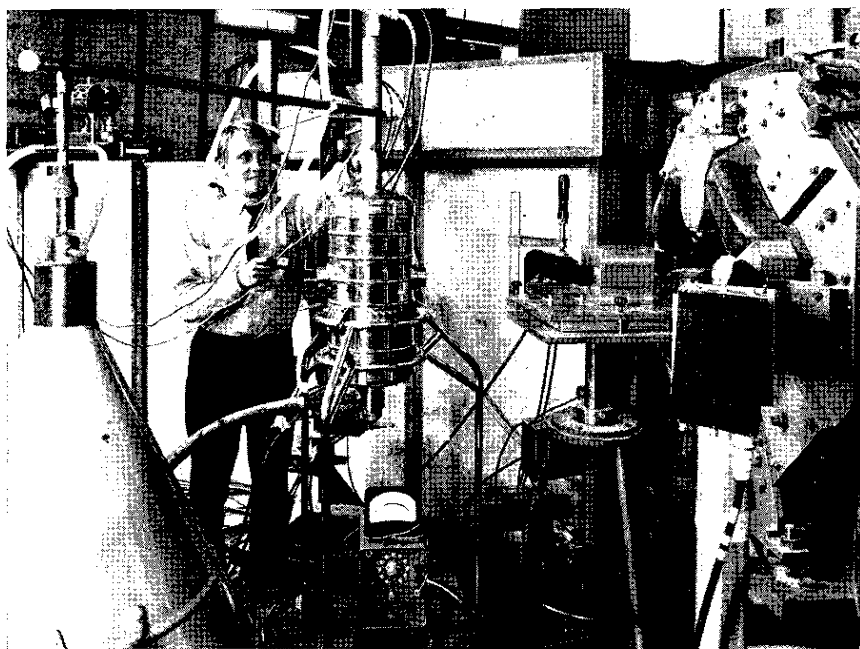
During May the position of the magnetic extraction channel for the external proton beam was changed, in accordance with prior calculations, to obtain a considerable increase in the extraction efficiency. The beam-measuring system was also recalibrated, to give a more accurate reading. Some 5×10^{11} protons per second can now be obtained in the external beam.

Also in the period under review, many members of the MSC Division moved into their new quarters in the buildings constructed in the area between the SC control room and the Main Workshop. For example, much of the equipment used by the New Projects Group was moved into the newly finished hall where the cyclotron model will be set up. The SC workshop was also among the sections to be transferred.

Superconducting magnet used in emulsion experiment at the SC

One of the shorter experiments at the SC in May was of particular interest since it involved the use for the first time at CERN of a superconducting magnet. The aim of the experiment, which was carried out by a group from the Particle Physics Department of the 'Centre de Recherches Nucléaires' at Strasbourg, was to study the mechanism of double charge exchange, π^+ changing to π^- , in light nuclei forming part of nuclear emulsions or added to them. The superconducting magnet, giving a magnetic field of 42 000 gauss yet still very easy to handle, permitted a good distinction to be made between the positive and negative pions of high energy.

After preliminary tests at Saclay, using the 3-GeV proton synchrotron 'Saturne', the equipment was brought to CERN and used on 14 and 15 May in a pure beam of 70-MeV positive



This photograph shows the compact nature of the special cryostat containing the superconducting magnet for the emulsion experiment of the Strasbourg group, as mounted in the neutron room of the synchro-cyclotron at CERN. The incident pion beam comes through the quadrupole focusing magnet at the right, is collimated by the pile of lead bricks and is detected by the small plastic scintillation counter immediately to their left. In the left foreground is the liquid-helium container for continuous replenishment of the liquid in the cryostat.

pions from the SC, at an intensity of about 100 pions per square centimetre. Basically the apparatus consisted of a light cryostat, of original design having a clear space in the middle into which stacks of nuclear emulsions (4 cm x 9 cm x 2 cm) could be placed, in free air, uncooled. Inside the cryostat was the coil of the electromagnet, constructed in two parts, of niobium-zirconium wire, surrounded by liquid helium with no other cooling jacket. The cryostat and coil complete weighed about forty kilogrammes; the d.c. generator, giving a regulated output of 200 A at 6 V, weighed some 150 kg. The whole equipment, in contrast to a conventional magnet and power supply of similar performance, was easily moved and was in fact brought to CERN in a light van.

During the experiment, after the initial cooling down of the coil, the average consumption of liquid helium was between 1 and 2 litres per hour, the vapour being collected for re-use, and the system was in operation for about twelve hours with the magnetic field constant to one part in a thousand.

According to the group that carried out the experiment, the size of such an enclosure for emulsion stacks or other techniques of detection is limited only by the present cost of superconducting wire. The value of the magnetic field is limited by the

critical field of the superconducting material, but by using more favourable materials, such as niobium-tantalum alloy or niobium-tin, there is a hope of exceeding 100 000 gauss over quite a large volume in the near future. This would obviously offer a very

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PARTICLES AND SELCITRAP

In the December, 1964, issue of CERN COURIER we published a short contribution in German on the subject of antiparticles. As a result we have received the following comment — from John Sykes, of the Atomic Energy Establishment at Harwell, U.K. — which seems particularly appropriate in view of the recent discovery of 'compound' antiparticles in the form of antideuteron.

WHAT MATTER ?

Cheer up ! for somewhere, off the map
By many and many a parsec
The stsitneics at their NREC
Are closely studying selcitrapp.

After a long noitirutrap
(almost sisenegonehtrap)
They too have reached a pihnsrentrap
To do research on selcitrapp.

And in their Reiruoc, mayhap,
They're writing gloomy articles
About these awful **particles**
That spoil their world of selcitrapp.

either for chemical, biological, medical or agricultural research, or for sterilizing food.

The various chapters deal briefly but clearly with the following subjects: nuclear reactors (with the exception of very powerful ones or those used for military purposes); high-intensity isotopic radiation sources; Van de Graaff accelerators; electrostatic-cylinder generators; resonant-transformer electron-beam generators; powerful sources for industrial irradiation; and linear accelerators. Technical details concerning installation in a laboratory, as well as capital and operating costs of the equipment, are given for each type.

A chapter is included on radiation protection in the laboratory and in industrial plants, and another (very short) on measuring energy and neutron fluxes.

The book is obviously a practical one, intended to serve as a guide for those wishing to instal radiation sources of a certain power for research, clinical or industrial purposes. It consists of 268 richly illustrated pages covering the various types of equipment and their installation, and there is a wealth of diagrams and tables. The bibliography, which is given separately for each chapter, has been brought up to about 1961.

Antonio Pasinetti

Last month at CERN (cont.)

promising technique for experimental physicists, from the points of view of both ease of transport and ease of operation.

Annual General Meeting of CERN Staff Association

On Wednesday 2 June the Main Auditorium at CERN was well filled for this year's Annual General Meeting of the Staff Association. Representatives from the Staff Council of the United Nations were also present and messages were received from the Staff Associations of the World Health Organization and the International Telecommunications Union, who were unable to send observers.

A summary of the activities of the previous year was given by Dr. G. Vanderhaeghe, the retiring Chairman of the Association, and both this report and the financial report were unanimously approved by the meeting. An important task of the Committee had been to make a careful examination of the **Statutes of the Association**, in the light of experience since it was set up and of the growth and consequent changes that have taken place in CERN as a whole. As a result, a completely revised set of Statutes had been produced and circulated before the meeting. These were adopted in principal, but a committee is to be charged with their final drafting, in the two official languages of the Organization, before final submission to the members of the Staff Association for approval.

An important organizational change adopted in the new Statutes was that in future, instead of the separately elected Committee and Chairman, there will be an elected Staff Council, which will itself elect an Executive Committee, including a Chairman, from

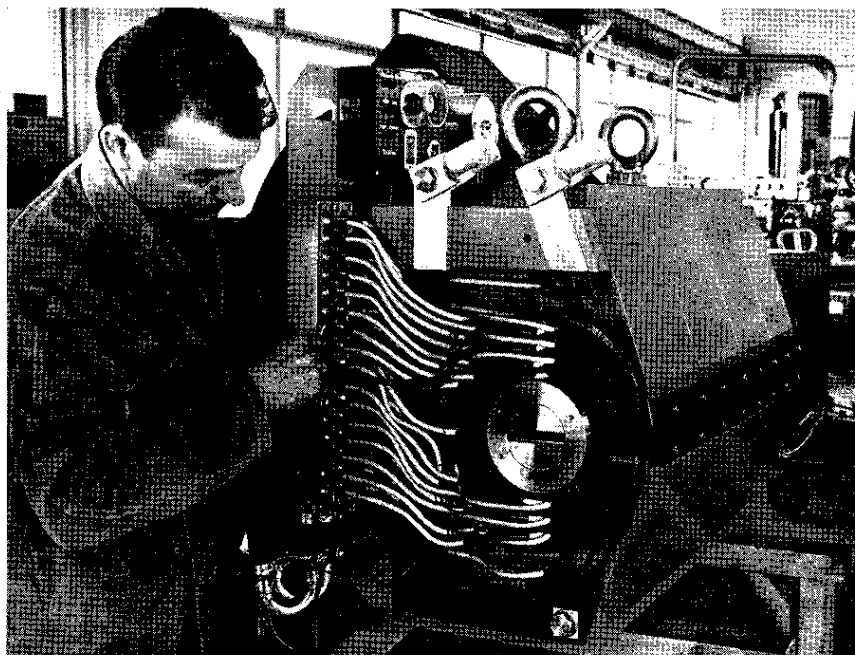
among its own members. Moreover, to provide continuity, only half the Council will retire each year, each member being elected for a 2-year period. Among other things discussed at the meeting, the previous Committee's proposals for new electoral groups for the election of the Council were approved unanimously. The proposal to maintain annual subscriptions on a voluntary basis and at the previous levels (Fr. 5.— for grades 2 to 5, Fr. 10.— for grades 6 to 9 and Fr. 15.— for grades 10 to 14) was also approved, after

various other suggestions had been put forward.

In the elections that took place later in the month, 44 members were appointed to the Council, with 32 deputies. The **Executive Committee** has been appointed as follows:

Pierre Lazeyras	President
Jacques Gioria	Vice-president
Aldo Michelini	Vice-president
Joan Rice	Secretary
Claude Degrange	Treasurer
Eugénie Iseli	Journal

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Because particles such as protons, pions and kaons can be guided from one place to another and 'sorted' in momentum by magnetic fields, in much the same way as light can be sent from place to place (and 'sorted' into different colours) by means of prisms and lenses, the design and construction of suitable electromagnets plays a large part in the technology of sub-nuclear physics. In this photograph, Antoine Magouriotis, of CERN's TC Division, is seen with a new magnet (TC 15) developed in the Division and now installed at the beginning of the m_s beam line which provides antiprotons, pions or kaons for the 81-cm Saclay/Ecole Polytechnique (Paris) hydrogen bubble chamber. It is this magnet which directs the particles away from the synchrotron towards the next magnet in the beam line. It is small, so that it can be fitted close in to the target, and powerful since it has to bend the particles as soon as possible in the direction of the bubble chamber. The distance between the poles is 21 mm and the pole length 840 mm (effective length 870 mm). A field of 21 300 gauss is produced, using a total current through the coils of 800A with a current density of 50A/mm². This exceptionally high value is obtained by using an advanced system of cooling for the coils, and the connecting pipes for the many parallel circuits are clearly seen in the photograph; it is of interest to compare the thickness of the bus bars carrying the current to and from the coils with the thickness of the coil conductor itself.