CERN

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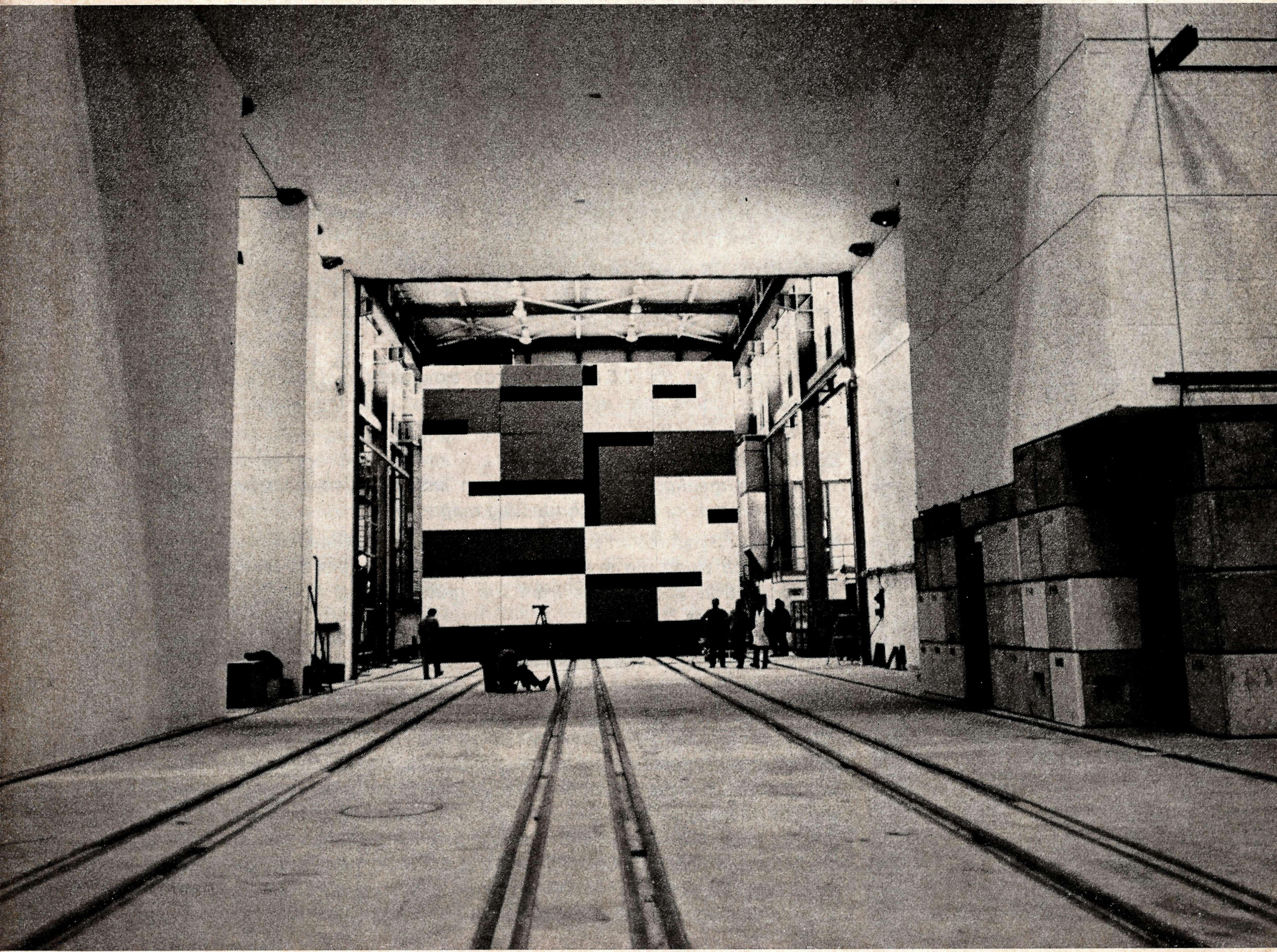

CERN, the European Organization for Nuclear Research, was established in 1954 to '... provide for collaboration among European States in nuclear research of a pure scientific and fundamental character, and in research essentially related thereto'. It acts as a European centre and co-ordinator of research, theoretical and experimental, in the field of sub-nuclear physics. This branch of science is concerned with the fundamental questions of the basic laws governing the structure of matter. The Organization has its seat at Meyrin near Geneva in Switzerland. There are two adjoining Laboratories known as CERN Laboratory I and CERN Laboratory II.

CERN Laboratory I has existed since 1954. Its experimental programme is based on the use of two proton accelerators — a 600 MeV synchro-cyclotron (SC) and a 28 GeV synchrotron (PS). Large intersecting storage rings (ISR), are fed with protons from the PS for experiments with colliding beams. Scientists from many European Universities as well as from CERN itself take part in the experiments and it is estimated that some 1200 physicists draw research material from CERN.

The CERN Laboratory I site covers about 80 hectares almost equally divided on either side of the frontier between France and Switzerland. The staff totals about 3000 people and, in addition, there are about 850 Fellows and Visiting Scientists. Twelve European countries contribute, in proportion to their net national income, to the CERN Laboratory I budget, which totals 371.4 million Swiss francs in 1972.

The CERN Laboratory II was authorized by ten European countries in 1971. A 'super proton synchrotron' (SPS), capable of a peak energy of hundreds of GeV, is being constructed. CERN Laboratory II also spans the Franco-Swiss frontier with 412 hectares in France and 68 hectares in Switzerland. Its budget for 1972 is 95 million Swiss francs and the staff will total about 300 people by the end of the year.

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Cover photograph : Not a view inside the Tate Gallery but a view inside Hall I4 of the Intersecting Storage Rings. The Hall is divided from an annexe, where the 'Split Field Magnet' (scheduled to be installed at intersection I4) will be built, by a thick concrete shielding wall. The wall can roll back on rails to allow the magnet through and to extend the area available to experimental equipment. At the instigation of M. Bron panels of colour were used to enliven the appearance of this large flat surface. The two cultures meet on a shielding wall. (CERN 281.1.72)

CERN News

Stacking laminations for the 1 m model of a B2 type magnet for the SPS. This model (and a B1 type which is also under construction) is being used for careful magnetic measurements to ensure that the required field configuration and precision can be achieved.

CERN 31.2.72

SPS progress

A few items from Laboratory II where the move to actual hardware for the accelerator to produce energies of several hundred GeV is well under way. Civil engineering work has started in the site itself, across the road from CERN Laboratory I ; magnet models are being produced ; the design report has been published.

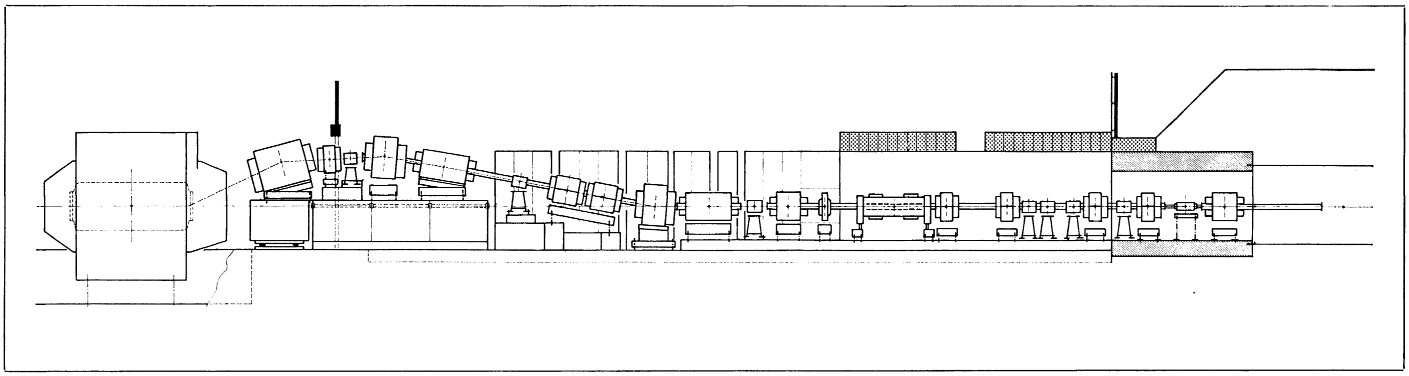
The first site operations to get under way were the excavations for the main buildings and assembly hall which will be ready for occupation at the beginning of 1973. Serious work has now begun on the main ring. Two 40 m deep access shafts are being dug : PP1, is number one of the six permanent access shafts equally spaced around the ring just inside the circumference while the so-called PGC is directly over the beam injection tunnel, TT10. The PP1 shaft will be 5 m diameter and will provide the access into the main ring through which the boring machine will be lowered. The PGC shaft, is 8.80 m diameter and it will be down this shaft that the various parts of the train which follows the boring machine will be lowered to be assembled down below, there to begin the 7 kilometre crawl around the ring. The train including the precast concrete slabs erection system will be of the order of 100 m in length. From this same shaft, the tunnel spoil will be evacuated and dumped with other spoil on the site used during the ISR excavations.

Work has also begun on the construction of the tunnel which will house the ejected beam line to the North experimental areas. As this is a tunnel which slopes progressively down from near ground level to the main ring depth, it is being excavated from the exit end and will terminate in a large cavern where the ejection systems are located. This tunnel which will be used only in the second stage of the project is bored now so as to be able to excavate in time the enlarged section.

By the end of February a 1 m model of a B2 type bending magnet is scheduled for completion. The cores were built from steel left over from ISR magnet construction and the coils were manufactured in the Laboratory I main workshop. A B1 model, also 1 m long, will be ready mid-March so that magnetic measurements can be carried out on both types.

Full-scale models (about 6 m long) are also to be built by mid-year particularly to check construction techniques. For these models, B2 laminations are being stamped by an outside manufacturer and B1 laminations are being machined at CERN. A touch of trans-Atlantic collaboration has entered in here — a stacking table has been borrowed from Batavia through the good offices of the NAL Business Manager, P.J. Readon. The table has been modified to match the SPS magnet profile. NAL has also lent two tanks for impregnating the magnets.

When the decision to construct the SPS was taken at the CERN Council meeting on 19 February 1971, Laboratory II was required to produce the design report of the machine within a year. This design report, which has the title 'The 300 GeV Programme' and the document number CERN 1050, was issued mid-February. Both English and French editions are being made available. It supercedes the pre-decision report ('A Design of the European 300 GeV Research Facilities', document number MC/60). Copies are being widely distributed to libraries, other accelerator Laboratories, etc.



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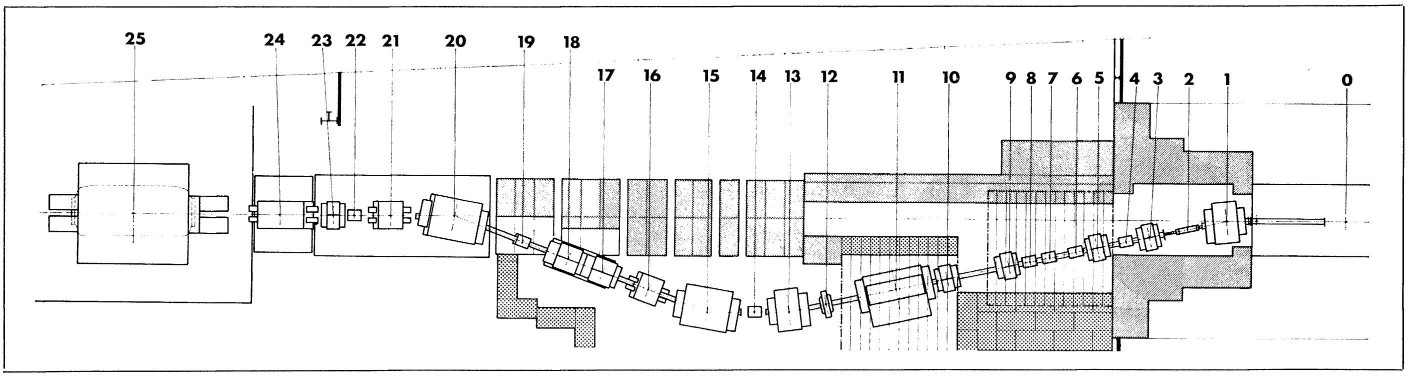


2.

To convey a beam of antiprotons to the heavy liquid bubble chamber, Gargamelle, without disturbing unduly the carefully built shielding used in neutrino experiments, and to bring the beam into the chamber at the correct angle, a beam-line performing three dimensional contortions around the shielding has been built. (1) shows the view from the side and (2) the view from above. The indicated components are : 0 - beam target ; 1, 13, 15, 16, 20, 21 - bending magnets ; 2, 3, 5, 9, 10, 12, 17, 18, 23 - quadrupoles ; 4, 6, 7, 8, 14, 19, 22 - collimators : 11 - electrostatic separator ; 25 - Gargamelle itself.

Developments in developing

A building with a total area of some 1600 m² is going up behind the East Experimental Hall. About 1100 m² of its area will be used for a laboratory where all the developing of bubble chamber film will be carried out. It will be possible to deal there with around 8000 km of film a year.

CERN has had in action for some time a machine for developing film from the 2 m hydrogen chamber and the 81 cm hydrogen chamber (now in retirement), and a smaller one which was used for the 1.2 m heavy liquid chamber (now in retirement) and, temporarily, for the first film from the large heavy liquid chamber, Gargamelle. With the commissioning of Gargamelle and (soon) of the European hydrogen chamber, BEBC, it was decided, rather than to set up additional developing centres, to concentrate the work involved in dealing with film from all the chambers in one centre with improved equipment. (For example, the 'laboratory section' has a new very useful instrument known as a 'microdensitometer' for accurate measurement of film quality.)

Construction of the building began early in 1971, and the fitting-out stage has now been reached. The first stage consists of installing two machines, manufactured by Photomec, which have already been delivered and which will be used for the first time during this coming summer. They will be joined later by the machine already in use for the 2 m chamber film. There will then be equipment to process 35, 50 or 70 mm gauge film.

The new film development centre (known as Laboratory 27) has been designed to combine efficiency with safe working methods. It has storage space protected from heat for about one year's supply of film, developers, equipment for measuring and mixing the various chemicals, room where emulsion quality can be controlled, equipment for determining the right proportion of bath regenerator to give the best results for each type of film, etc. Since the atmosphere in many of the rooms is corrosive, the structural materials (concrete) and the materials used for the fittings were chosen with this in mind ; acid-resistant paints and coatings are widely used and there is a powerful ventilation system.

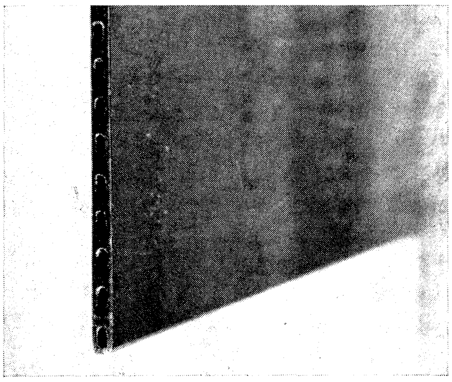
Antiprotons for Gargamelle

From April to July of this year, the heavy liquid bubble chamber, Gargamelle, will no longer be fed with neutrinos as it was during its first year of operation but with antiprotons with momenta of 1.6 and 2.6 GeV/c. Antiproton interactions in the chamber producing many neutral particles will be studied taking advantage of the heavy liquid's ability to 'materialize' neutral particles.

A beam to provide the antiprotons is now being installed in Hall 175. Based on the former beam m10 and known as beam m12, it has a single separation stage (2 m electrostatic separator with a gradient of 100 kV/cm over a 6 cm aperture) and will enable antiprotons with a momentum defined to within 0.5 % to be obtained.

As the particles must enter Gargamelle from above at an angle of 26° to the horizontal (in order to compensate for the effect of the chamber's fringe field on the low momentum particles) and since momentum separation takes place in the horizontal plane, the beam is being taken through some spectacular three dimensional contortions. In its last section four magnets, three quadrupoles and two collimators enable it to scale and skirt round the neutrino shielding. The beam axis climbs to 3.7 m above ground level.

A view of the thin septum magnet, one of the components of the SQUARE slow ejection system, fitted in straight section 85 of the PS. Its septum, shown enlarged on the left, is the first unit of such small thickness (1.5 mm) to be cooled by internal channels. It is made by a special method consisting of brazing together, side by side, cylindrical copper tubes which have been partially ground down to obtain the desired thickness. Excitation is provided by 5000 A pulses (120 A per mm^2) for 700 ms, giving a field of 0.2 T.



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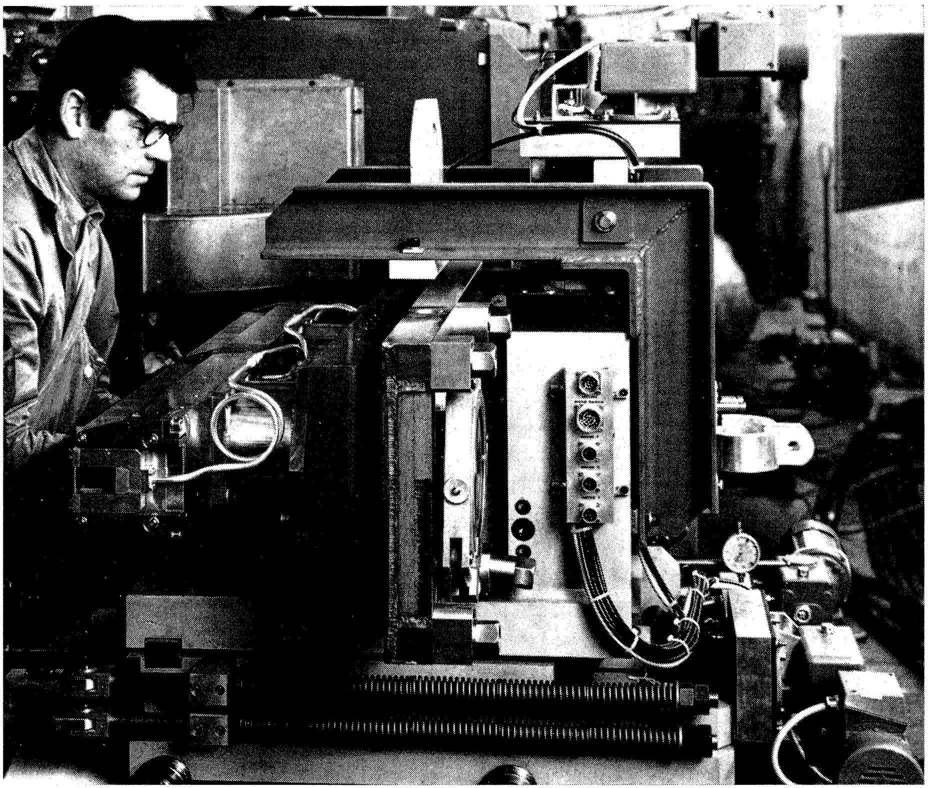

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At the same time, various modifications are being made to the neutrino shielding itself, mainly affecting its upstream section, which will in future consists of six sections of cast iron blocks separated by gaps of 0.3 m where muon detectors can be installed. The central mercury filled tube used previously will be taken out. The sections are made in such a way as to give a more homogeneous density, so that a more symmetrical muon flux will be obtained than was possible before. This new shielding will be ready about the end of August, at which time neutrino experiments will start again.

All SQUARE

With the commissioning of Omega due to take place in the summer of this year, the problem arises of the supply of particles to electronics experiments in three different areas: West Hall, East Hall and South Hall.

With the existing systems for using the accelerated protons, it is possible to supply only one slow ejected beam (feeding the East Hall) and, at the same time, to have only a small percentage of the beam on an internal target (feeding the South Hall). The arrangement will be replaced by a new system called SQUARE (Semi-QUAdrupole Resonant Extraction) which will give greater flexibility in supplying the three areas. The necessary units were installed during the recent annual PS shutdown.

The main components are: a nonlinear lens (semi-quadrupole) which is used to induce the 6⅓ resonance, an electrostatic septum located in straight section 83, a thin septum located in straight section 85, and septum magnets which complete the ejection into one or other of the experimental halls (one in straight section 16 to feed the West Hall, and the other in straight section 62 to feed the East Hall). Several dipoles and backleg windings on the main bending magnets will also be available to deform the beam orbit appropriately.

The improvement with SQUARE as compared with the previous ejection system concerns particularly the ability to share beam efficiently with internal targets. This type of operation was brought successfully into action at Brookhaven in 1969. Using the 6⅓ resonance to replace the integer resonance of the previous system makes possible much more efficient distribution of the PS beam between the ejection and the internal target. The targets receive up to 30 % of the beam (or even more, though then it is to the detriment of the ejection efficiency) without any corresponding losses in the machine. This was tested on the PS last year confirming the theoretical predictions. Previously, with the integer resonance, a number of protons about equal to that striking the target was lost inside the vacuum chamber when the beam was shared in this way. Such losses would have become prohibitive with the new intensities, which will soon be available from the machine, because of radiation damage and induced radioactivity.

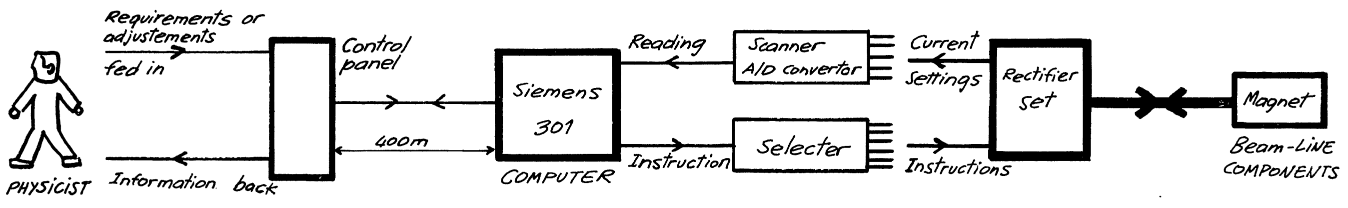
SQUARE includes two special septum magnets both of which involve new techniques. The first is an electrostatic septum 0.1 mm thick which was tried out in the PS ring in October last year (see vol. 11, page 320).

The second is a thin septum magnet in which the septum has been made in a novel way (see photographs) allowing efficient cooling of the septum in spite of its thickness of only 1.5 mm. In addition to these magnets there are two thick (6 mm) septum magnets to complete ejection to the West or East Hall. It is hoped to reduce the losses in the ejection process to a very low percentage.

Taming beams

The monitoring and control of multi-branched beam-lines distributing high energy particles among various experiments is an obvious area of application for a computer. A start in this direction at CERN has been made in the East Hall of the proton synchrotron using a Siemens 301.

The main beam-line components needing observation are the bending magnets and focusing lenses which



dictate the beam intensity and quality received by the physicists. The aim is to keep these parameters as close as possible to the required values. Before the computer came into use, the only means of checking performance consisted of making periodic 'manual' measurements of intensities in almost eighty different components in order to detect deviations or breakdowns. This task was performed by two people making a complete check every two hours. It was long and expensive and, of course, the possibility of error was always present.

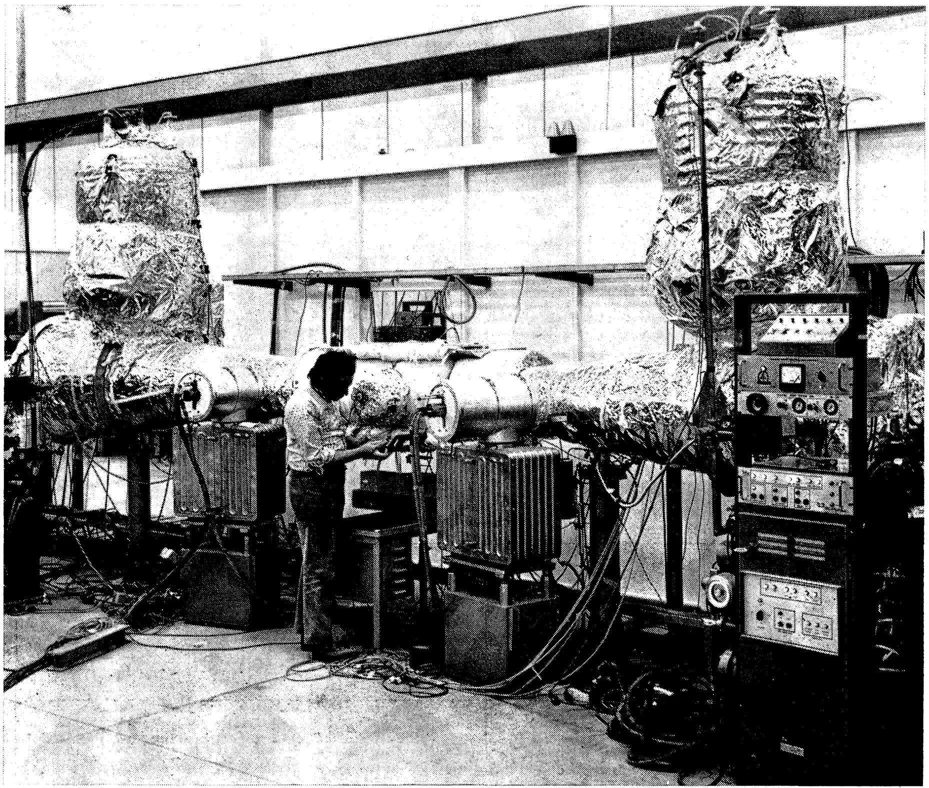
The first job given to the computer was to take over these checks, which are now printed out on tape by teleprinters in a form which can be used directly. At the same time, the teleprinter prints out the electrical power consumed by the various beam components (plus the 2 m chamber and Gargamelle) which represents a considerable proportion of the overall power consumption at CERN. It is thus possible, by extrapolation, to make precise power consumption forecasts which are passed on by the SB Division to the 'Services Industriels' of Geneva with the aim of obtaining optimum rates for the supply of electricity.

The computer's second task is to print out all the quantities which have fluctuated between two checks. It is thus possible to detect any abnormal operation, so that the physicists can omit, or correct, measurements made when the beams were out of adjustment.

After mastering this stage, the automatic control of beam-line components feeding the 2 m chamber was tackled. Here, it was necessary not only to make the analog nature of the power supply adjustments compatible with the digital character of the computer circuits, but also, for reasons of economy, to adapt the system to the existing installations (which had not been designed with computer control in mind) while limiting the number of analog to digital converters to a single unit. This restriction dictated the use of a centralized sweep system which, in turn, required continuous read-out of the current settings while a component was adjusted. This absorbs a high proportion of the computer's capacity during the read-out time, and thus only a small number of components can be monitored (thirty at most). This system is now being installed and work has progressed to the extent where it will be possible to use it when the 2 m chamber is started up again in May.

It is intended to use the same computer to monitor beam components in the South Hall and a similar method will be employed (periodic checks with results printed out on tape). In addition to the other advantages, this will save a six-man shift which will then be available for other work. Finally, an automatic monitoring network for the West Hall beam-lines is being developed. The components will be designed from the start for the digital system, avoiding the limitations experienced in the East Hall. Its commissioning is provisionally scheduled for the end of 1972.

Some parameters of the Siemens 301 computer being used in this work are : the central processor unit is a word-organized fixed-point processor with a word length of 24 bits. There is a 16 K corestore, a 1.6 μs cycle time and 23 priority levels. The channels and peripherals are — digital input and output (256 words of 24 bits, 15 μs per word), papertape reader (120 characters per second), papertape punch (30 characters per second), cardreader (120 characters per second) and typewriter (10 characters per second).



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A schematic representation of the computer system used to monitor and control beam-line components in the East Hall of the proton synchrotron. With the growing complexity of ejection systems and multi-branched beam distribution in the experimental areas, the use of computers to help in control is growing in importance. Beam-line components are now being built with this in mind.

PS Development Programme

A look at what might be needed in terms of development of the 28 GeV proton synchrotron so as to prepare it for its duties from 1976 onwards.

CERN is preparing a life of much greater variety for its accelerated protons in the future. If we look ahead to 1976, when the Super Proton Synchrotron (SPS) is scheduled to come into action, a proton emerging from the ion source will have the following possibilities confronting it.

It will travel down the linac acquiring an energy of 50 MeV. It will then be able to choose one out of the four rings of the Booster (synchrotron injector) where it will be accelerated to 800 MeV before being injected into the ring of the proton synchrotron (PS). (It could also skip the Booster and go direct to the PS ring if necessary.) Then the possibilities really open up. It can become involved in the PS experimental programme at energies up to 28 GeV by colliding with an internal target in the ring or by using one of several fast or slow ejection systems to travel into one of several experimental halls. Alternatively, if the proton has become very fond of going round and round, it can keep at it for possibly another day by choosing to go to one of the two rings of the Intersecting Storage Rings (ISR) for use in colliding beam experiments. And finally, if it aspires to higher energies, it can choose the route to the SPS for acceleration to hundreds of GeV and experiments at these energies.

Two units are common to all these possible manœuvres — the linac and ring of the 28 GeV proton synchrotron. Every single proton which will be used in a high energy physics experiment at CERN for perhaps decades to come will have been accelerated by the PS. This light-hearted introduction is simply to illustrate how vital for the future research at CERN is the performance and reliability of the PS.

It is in considering what attention to the PS will be needed to ensure that it becomes a good injector for the SPS, while continuing to be a reliable feed for the ISR and to sustain its own physics experiments, that the phrase 'PS Development Programme' has come into being. It should not be confused with the 'PS Improvement Programme'. The Improvement Programme was that series of additions and modifications to the PS, authorized by the CERN Council at the end of 1965 and now nearing completion of construction, which is greatly improving the performance of the machine (for example, higher repetition rate from a new power supply, higher intensity per pulse via the Booster) and its experimental facilities (for example, Gargamelle heavy liquid chamber, BEBC hydrogen chamber, Omega spectrometer).

A completely clean line cannot be drawn between the two, however, because quite a lot of the PS face-lift, implemented as part of the Improvement Programme, has gone towards preparing it for its future duties. Obviously, for example, before the SPS came on the scene the PS was being lined up to serve the ISR in addition to its own experiments.

What are the requirements?

In order to see what attention the PS will need we should start by asking what it will have to do.

The first new problem is that the beam characteristics required by the SPS are different from those required by the other users. It is intended to interlace feeding the SPS with feeding the normal PS physics programme. Thus the PS will have to be able to supply two different beams on alternate pulses. The SPS will require a beam at probably 10 GeV with as high an intensity as possible and with a small transverse emittance. Depending upon the method of transfer it may want some increase in momentum spread (to reduce debunching time in the SPS ring after bunch by

A new vacuum chamber was installed at intersection I-6 of the Intersecting Storage Rings at the end of January. It has been specially tailored to the requirements of the particular experiments at that intersection and has the form of a cylinder with cone-shaped ends rather than the customary 'X'. At the top and bottom of the central cylinder are two thin walls (800 × 300 × 0.2 mm) so that particles can escape almost unhindered in the vertical direction for the Aachen/CERN/Genoa/Turin experiment.
A second new feature is the use of two large cryogenic vacuum pumps (the vertical foil covered cylinders) built at CERN, which join forces with the already installed ion, turbo-molecular and titanium sublimation pumps, aiming to take the pressure down to 2 × 10^{-13} torr. This incredibly low value, a thousand times down on the average ISR pressure, will reduce to the minimum possible the background due to residual gas molecules for the CERN/Rome experiment. If this type of pump operates successfully, it may come into more general use on the ISR to help get rid of the pressure bumps (vol. 11, page 245) which seem a major limiting factor in achieving high stored beam intensities.

bunch transfer) or adiabatic debunching before transfer (in the case of continuous transfer). The beam characteristics demanded by the PS experimental programme are different, if not so stringent, and the peak energy can be up to 28 GeV.

However, the ISR does have very stringent beam requirements that the PS must also be capable of meeting (though the filling of the ISR will most likely always be concentrated in a separate period and, therefore, these beam conditions will not need to be interlaced with others in the same way). The ISR needs a small longitudinal emittance, high bunch density, etc. and could eventually achieve much higher stacked currents by making use of special tricks in filling the PS from the Booster (putting bunches from two Booster rings into one PS r.f. bucket).

How will the requirements be met ?

These varied requirements make necessary a much more thorough knowledge of beam behaviour in the PS, and, of course, a better ability to control that behaviour. A considerable amount of knowledge has obviously been acquired during the life of the PS, especially in recent years, but there are still areas of uncertainty. In particular, when the Booster begins to provide beams of up to 10^{13} protons per pulse, there may be many new effects appearing in the behaviour of beams in the PS rings. There will be detailed study of the higher intensity beam and such problems as arise will need analysis and then cure. Although we will slide over this topic, for fear of being submerged in specialized aspects of beam dynamics, it is vital for the future use of the machine and it involves a long list of subjects which need investigation.

In order for these investigations to be carried out the instrumentation for monitoring and control has to be improved. A long list of parameters which need to be studied, and of the monitors which currently seem most appropriate for each of the parameters, has been drawn up. The observation systems are being extended in accordance with this list and they are being linked to the PS control computer which will help in the acquisition and analysis of data. Attention is being given to the standardization of the monitors and their associated electronics (benefiting particularly from progress made during the building of the PS Booster) and also to further development of instrumentation of this type.

Beams to feed many users

In a few years time the likely arrangement of ejection systems and targets at the PS will be as follows :

1) Ejection from straight section 16 to the SPS. The components which will be required for this ejection obviously depend upon the chosen scheme — bunch by bunch transfer or continuous transfer. The former would require a fast kicker magnet with circuitry to apply twenty pulses in rapid succession and with very short rise and fall times for the field (techniques for achieving this are being developed — see vol. 10, page 310). The latter would require magnets and powering circuits to introduce a 'high beta section' in the PS and a thin electrostatic septum to peel the beam off down the ejection channel. Tests of both these schemes will be carried out in the course of 1972.

2) Down the same ejection channel will go the fast ejected beams for the ISR. The ejection system to achieve this has been in successful action for over a year now. The only new requirements could come about because of the need to retain, when high intensities are available, the quality of beam that the ISR likes.

3) Fast ejection from straight section 74 to feed the heavy liquid bubble chamber, Gargamelle, and the new muon storage ring to be used in a more refined g-2 experiment. This system already exists and has been used in the latest series of neutrino experiments with Gargamelle. The major change on fast ejection systems will be the installation of full aperture kickers to handle the more intense and wider beams. A system was tested last year giving 10^8 pulses without failure and orders are being placed with manufacturers.

4) Slow ejection to counter experiments in the East Hall has been in operation for many years. Now resonant ejection using the $6\frac{1}{3}$ resonance is being developed rather than the integer resonance previously used since sharing with internal targets will then be more efficient. Successful tests on this scheme were carried out in 1971. Components such as an electrostatic septum, thin magnetic septum and extractor magnet are being constructed. (See the article on SQUARE page 33.)

5) Fast ejection from straight section 58 to the 2 m chamber in the East Hall. This also is a system which has been in operation for many years.

6) One or two internal targets are likely to be still in use to provide beams for counter experiments in the South Hall. However, as machine intensity increases the problems that they bring of radiation damage and induced radioactivity could become much more troublesome and intensity limits will be set on the use of these targets.

The problems of reliability

In the complex mesh of rings (Booster, PS, ISR and SPS) that will make up the CERN accelerator complex in 1976, only the PS ring is old in the sense of having been built with 'old' techniques. It was, after all, the first alternating gradient proton synchrotron to operate in the world. The rings which surround it have incorporated newer construction techniques (some of them emerging from PS experience) and more reliable components, particularly with respect to radiation resistance. Also, by the time the SPS comes on the air, the PS is likely to have experienced well over a hundred million pulses and will have every right to feel old. Yet, ideally, it must sustain higher reliability than any of the other machines. If the Booster, ISR or SPS fails, physics programmes can still be kept moving. If the PS fails everything stops (with the possible exception of the ISR which can continue until it depletes the filling it has stored). Everything that is at GeV energies. The SC would still carry on.

However, good doctors have ensured that the PS does not feel as old as could be expected. It has received a large number of rejuvenating injections particularly in the context of the Improvement Programme. Thus most of the linac has been rebuilt to modern standards with the exception of the accelerating structure in the three linac tanks and their vacuum systems. Installation of ion pumps would improve reliability and their lower operating cost would pay for the capital investment over five years. The major concern at the linac is the long term reliability of the quadrupole focusing magnets in the drift tubes of the accelerating structure (particularly in Tank I).

In the synchrotron ring, the vacuum system will be completely rebuilt by the end of 1972 with sputter ion pumps and with metal seals replacing the original rubber ones. There will also be better monitoring of the vacuum and easier methods of access to the chamber. The r.f. accelerating system is being progressively renewed with the installation of a series of new cavities built with modern techniques (most of the active components removed from the ring) which should ensure many years of reliable service (though there remain some potential problems associated with the acceleration of beams of high intensity). The new magnet power supply will have some minor modifications to improve its reliability (it may also be called upon to provide 'flat-tops' as long as 1 s) and the old power supply is being kept as a spare so that it could come into action within two days in the event of a major failure of the new power supply.

The big worry on the PS is the magnet system. It is already necessary to replace or recondition the bending magnets which have been in radiation hot spots. When higher intensities are accelerated with possibly increased radiation levels, will the combination of radiation damage and general ageing cause the whole system to deteriorate rapidly ? Is it necessary to rebuild the bending magnets for the whole ring ? A working party has been set up to study this and other aspects of long term operation of the PS. Already the correction magnets in the ring and their power supplies are to be replaced, particularly because their design is space consuming. Modern, more compact versions which will give greater flexibility and reliability are to be built ; the rotating generators (after over ten years of service are being replaced by static supplies using semi-conductor components which did not exist when the PS was built).

Developing computer control

It will be obvious from the long list of uses of accelerated beams from the PS in coming years and the complex interlaced sequences that the machine will be called upon to perform, that operation of the machine will become an even more intricate task. It will be necessary to lean still more heavily on the use of the control computer.

This subject is still under study but some preliminary conclusions have emerged. The control system will involve the use of several computers, the main one being the IBM 1800 in the PS control room. When satellite computers are acquired to shoulder some of the burden, the main computer should have sufficient capacity to meet the foreseeable requirements. If necessary, the present core store could be extended from 40 K to 64 K and faster disks could be used. A final decision on the long-term suitability of the IBM will be taken about the end of 1972 when some more experience has been gained with the use of display consoles.

The decisions on the satellite computers (number, type and scope) have not yet been taken but various 'sub-systems' are being studied. Obviously, in view of the more important role of the control computer, more attention has to be paid to making PS components accessible to the computer, in terms of acquisition of component data and monitoring of beam behaviour, and to making the components capable of adjustment via the computer to establish the optimum settings.

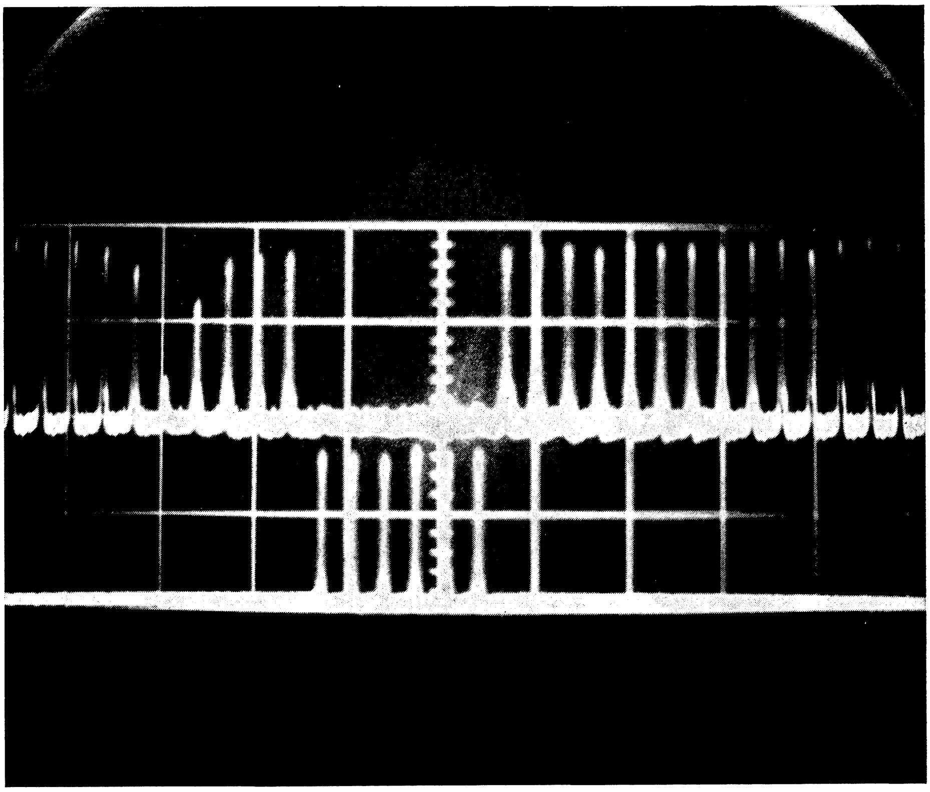
The 28 GeV proton synchrotron has already been running for as long as anyone could reasonably have expected when it was first turned on. Yet, far from losing interest for the machine builders, it is still capable of development involving some fascinating accelerator physics. This is vitally necessary to ensure that it fulfils its key role in the CERN experimental programme for decades to come.

Around the Laboratories

SERPUKHOV
Fast ejection works first time

On 5 February at 3.00 h the button was pressed at the 76 GeV proton synchrotron at Serpukhov to send beam out of the machine via the fast ejection system designed and built by CERN. At this first attempt, a fluorescent screen placed outside the exit window lit up with a beam spot just 1.5 cm to the right of the cross at the centre of the screen. Two shots later the spot was centred on the cross but, to rub in the success, it was later found that the screen position was 1.5 cm off centre to the left!

This achievement crowned three years of research and development at CERN in the group led by B. Kuiper followed by three months installation and testing at the Institute for High Energy Physics at Serpukhov. The provision of the fast ejection system by CERN is in the context of the CERN-Serpukhov collaboration (see vol. 7, page 123) and a detailed description of the system can be found in vol. 11, page 212. On the night of first operation the fast kicker was powered by 2 GW for 1 μs and sent the beam through two septum magnets then out into air beyond a beam-exit window where it could be monitored by a fluorescent screen and a beam current transformer. The system was first set up to operate on the decay part of the accelerator cycle, in other words it was pulsing but at a time when accelerated beam was not orbiting the ring. Simple adjustment then slid it into the right timing position to eject beam. After the excitement of watching a dozen ejections hit the screen came the excitement of the popping of a dozen champagne corks as Soviet and CERN scientists celebrated their great success.



This oscilloscope photograph demonstrates the performance of the fast ejection system brought into operation at Serpukhov at the beginning of the month. The top trace is taken from a beam current transformer in the ring and records the orbiting bunches of accelerated protons (normally thirty in all) one turn after ejection. The lower trace is taken from a beam current transformer outside the exit window of the ejection system and records six ejected bunches. A superficial glance indicates that the height (i.e. the intensity) of the ejected bunches is virtually identical with the height of the orbiting bunches and hence that the system is operating with very high efficiency (over 90 %).

The ejection was operated with precision and comfortably within its capabilities (the full aperture kicker magnet, for example, was powered at only 70 % of its maximum excitation). From the information provided by beam current transformers in the ring and beyond the exit window the ejection efficiency was calculated as about 95 %. After the break for celebrations it was decided to try to take the ejected beam through the beam transport system, also designed and built by CERN in the group led by B. Langeseth, to the target position. By 10.00 h, after slight adjustments to two focusing lenses to optimize conditions, the ejected beam was steered and focused accurately onto a screen just in front of the target. The spot size was a few millimetres and this can easily be further improved. The precision of the fast ejection and the beam transport system can best be underlined by reporting that after the tests there was no significant induced radioactivity recorded either from the septum magnets or from the beam-line components.

PRINCETON
Struggling on

The Princeton Pennsylvania Accelerator is still in action but the Laboratory is having to take even more drastic measures in order to try to stay alive. An assurance of $ 450 000 from the National Science Foundation was reversed under pressure from the Office of Management and Budget and the Laboratory is struggling on with an additional grant of $ 100 000 from the Fannie E. Rippel Foundation. In the hope of ensuring further support the synchrotron operating time is being trimmed down to 1200 hours per year with 21 rather than 31 staff so as to bring annual operating costs to $ 0.5 M.

*

Late news : In the first week of February the AGS broke through the previous intensity barrier in the days of the 50 MeV linac. The latest peak intensity we heard was 4.2×10^{12} *protons per pulse and going up.*

* *

Late late news : The Batavia synchrotron has operated at over 100 GeV and the first physics experiments have started. On Friday, February 11 using single bunch injection from the Booster (out of the 12 which will be used in full operation) the beam was accelerated, with a rise time of less than 2 s, to 100.4 GeV and operation in this mode continued for an hour. At a lower energy, p-p scattering experiments were then started. The power supplies are now being got ready so as to be able to try for the design target of 200 GeV. More details in our next issue.

The research programme with heavy ions is continuing and the demand for beam time over the next few years is far in excess of what the revised operating schedule can support. Already over 4000 hours per year have been requested for the next three years. Nitrogen ion intensities have reached 3×10^7 particles per second following vacuum improvements which have brought the pressure as low as 6×10^{-8} torr in the synchrotron ring.

In December some tests were carried out on the acceleration of neon ions. In a few days of running, beam intensities were brought to 10^4 neon ions per second and a peak energy of 8.5 GeV was achieved. More neon tests and the acceleration of argon ions are scheduled.

Since the first acceleration of nitrogen ions in July of last year (see vol. 11, page 251) a research programme involving a wide variety of disciplines has been mounted. Within six months over twenty experiments were performed and as many new proposals are on the table. They concern aspects of biology, physics, and radiation chemistry and involve about 70 scientists from 30 research centres. Obviously, the almost unique beams available from the PPA are attracting a lot of attention.

BROOKHAVEN AGS performance *

Most elements of the 'Conversion Project' at the 33 GeV Alternating Gradient Synchrotron were completed during a long shutdown last summer and the machine team are now working to realize the full potential of the new components. The Conversion Project has many features in common with the Improvement Programme at the CERN PS and is designed to improve the accelerator performance and the range of its experimental facilities.

After the addition of a new power supply to give faster pulse rates the second step to higher accelerated beam intensity has been the installation of a 200 MeV linac to give higher injection energy. The new linac began feeding the synchrotron ring in September 1971 but without extensive testing beforehand. With the linac in action it has proved difficult to increase the accelerated beam intensity which remains at about 2×10^{12} particles per pulse.

The linac generally runs with beam currents up to 50 mA rather than the design figure of 100 mA. Higher linac intensity introduces beam-loading problems and increases the momentum spread. The debuncher, which will help correct the momentum spread, is probably still several months away. Problem areas are the control of the pre-injector energy with intense beams, beam matching into the linac, focusing quadrupole current control, beam loading compensation in the cavities and the r.f. system modulator stage.

A lot of beam is lost at injection and orbit studies are under way. The multi-turn stacking efficiency (11 turn stacking) captures about a third of the beam and better beam emittance from the linac would improve this. Adiabatic trapping with the r.f. (see vol. 10, page 355) has been tried, but without conclusive sign of higher efficiency.

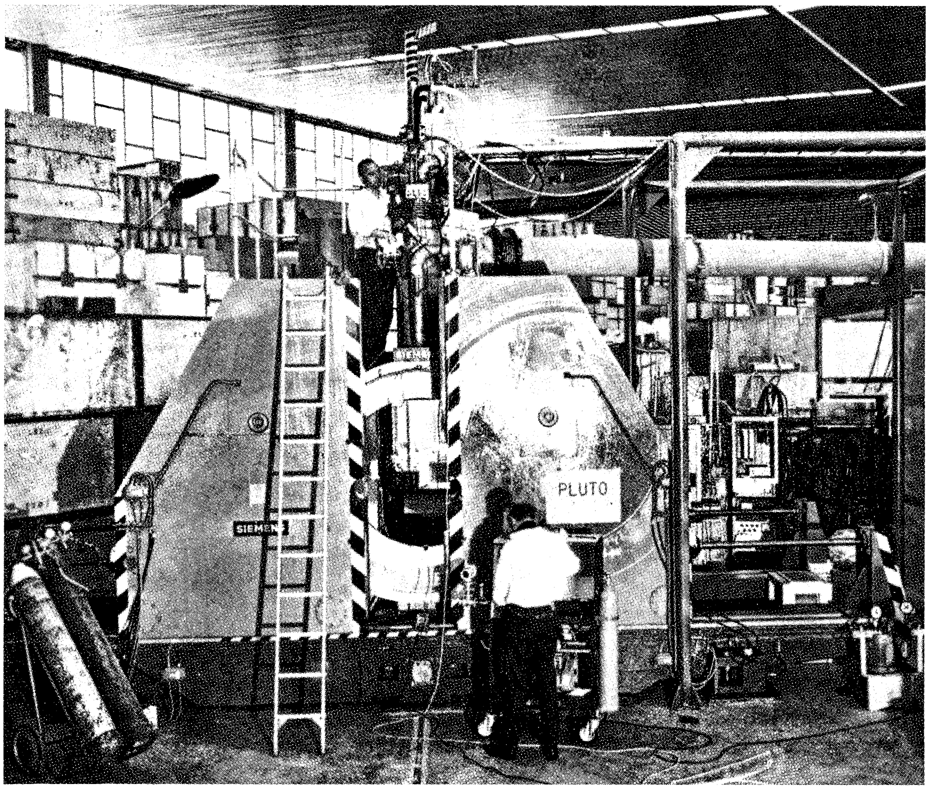
Improvement of the performance has been hampered by manpower problems and, of course, the requirement of sustaining the high energy physics programme rather than doing machine development. The present aim is to reach 5×10^{12} particles per pulse by mid-year and to push to the design goal of 10^{13} later.

More versatile use of the higher intensity beams will be possible both in terms of feeding a higher number of experimental positions and of sharing the accelerated protons in a variety of ways during a flat top which could last for 1 s. The slow ejected beam into the East Experimental Area now has three branches feeding target stations A, B and C. Simultaneous operation of the B and C stations should be available in a few months' time. A new fast ejected beam-line to feed the 7 foot bubble chamber in the North Experimental Area (particularly for neutrino experiments) is also ready for commissioning.

DESY Synchrotron and Storage Rings

An improvement programme has been under way for several years at the 7.5 GeV electron synchrotron at DESY. In particular it has been designed to increase the accelerated beam intensity, to achieve better quality of the ejected electron beams and photon beams and to improve machine reliability.

A major component of the move towards higher intensity is a new 400 MeV linac which replaces the original 40 MeV linac. It came routinely into action feeding the synchrotron in November last year and has increased the accelerated beam intensity by a factor of about four. The advantages of higher energy injection into an electron machine are different to those of a proton machine. With protons the higher injection energy raises the space charge limit so that the synchrotron ring can hold a more intense injected beam. With the DESY machine injecting at the higher energy means injecting into a field of 0.04 T rather than 0.004 T and the field configuration then needs much less correction. Also the rate of change of



The superconducting magnet, known as PLUTO, which will be used in the initial experimental programme at the DESY electron-positron storage rings. The magnet is 1.15 m long with an internal diameter of 1.4 m within which the interactions will take place and where detectors can be positioned. There are also apertures within the magnet itself for further detectors. The magnet field is 2.2 T.

(Photo DESY)

field is five times greater and the energy gain per turn is correspondingly higher giving smaller beam loading problems in the r.f. cavities. The final advantage of the new linac is that it is a more modern machine capable of higher intensities and of higher reliability in operation. It will also be used for the production of positron beams particularly for the storage rings.

The linac provides beam intensities of 100 to 150 mA and the beam transport and injection systems put this into the synchrotron ring with 100 % efficiency (as far as can be measured). However, after some 2000 turns the beam intensity begins to fall off as the beam blows up radially. Usually 30 to 40 mA can be reliably held as a good quality beam up to peak energies (60 mA has been observed but the beam was then unstable and could not be used efficiently onto targets). These intensities correspond to about 10^{13} accelerated electrons per second and compare with 10 mA prior to bringing the linac into action. Several experiments were ready to make use of the higher intensity just as soon as it was available.

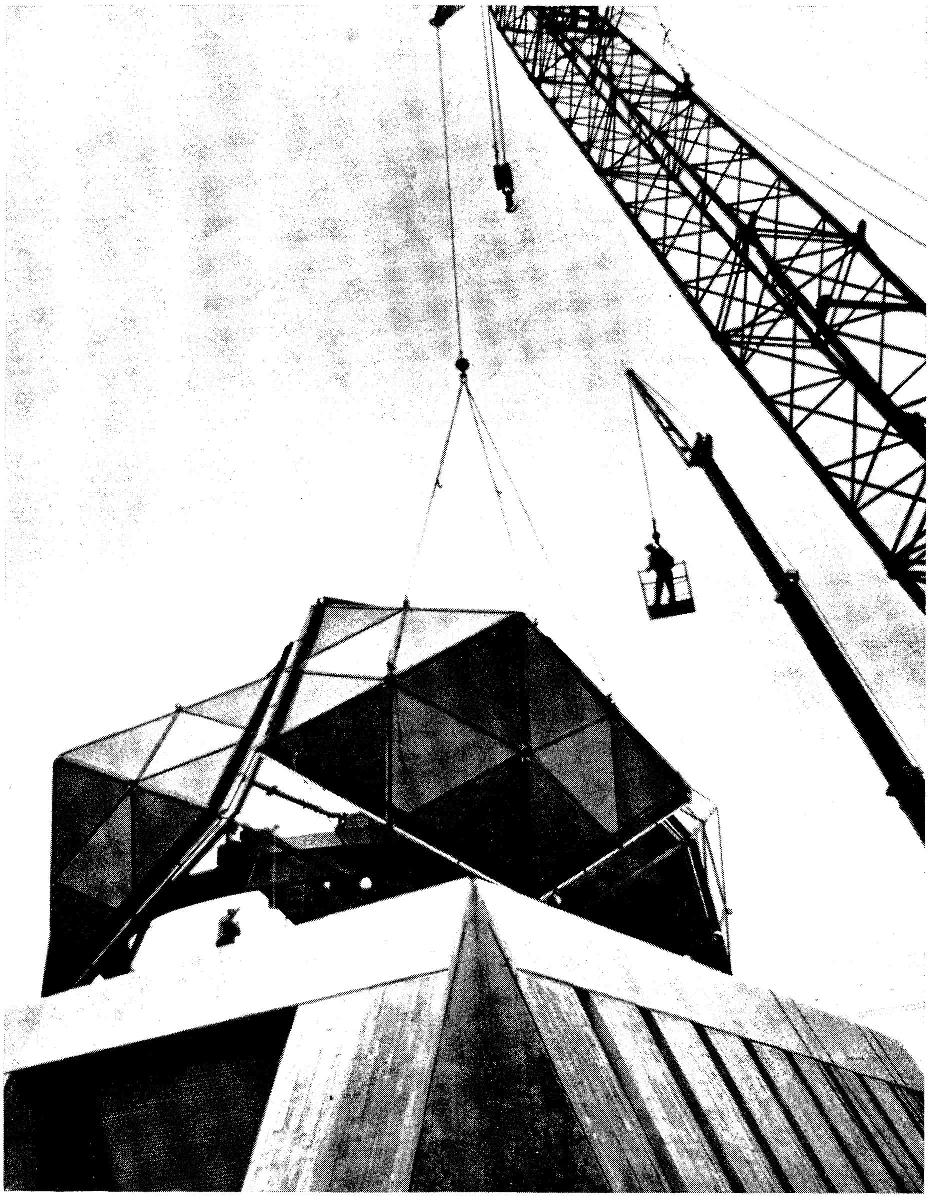
The cause of the beam blow-up is not clear. A likely source is interaction between the beam and the r.f. cavities where non-accelerating transmission modes could be excited and could be taking energy from the accelerating mode. (A short test with just one cavity in action did hold an 80 mA beam.) It will however need careful study before action is taken to push the beam intensity higher. There are already signs that the higher currents are increasing radiation damage (particularly to magnet coils) downstream of targets and this also has to be kept in mind before the next steps are taken. More use of ejected beams rather than internal targets is likely but this will bring its own problems in its wake.

Various other improvements in addition to the linac have been important in the context of preparing the machine for higher intensities. One of them we have reported before — the installation in 1968 of a new ceramic vacuum chamber. This has been a complete success. There is no significant change in pressure with either intensity or energy and the operating pressure of 5×10^{-8} torr has already meant that the new chamber has paid for itself since these pressures greatly prolong the life of the vacuum pumps.

The beams to experiments are being improved by several manœuvres. One is a better slow ejection system using a one-third resonance which has improved ejection efficiencies to over 80 % in agreement with theory (compared to 10 to 30 % with the previous regenerator septum system which also gave a poorer quality beam). Photon beam spill has been greatly improved by using a beam bump method (rather than changing r.f. amplitudes) to steer the electron beam onto the bremsstrahlung target in a precise way. A feedback system, with a photomultiplier as monitor, can control the application of the beam bump so as to achieve the desired spill form from the target. A flat-topping scheme is also being pursued which would be a great help in reducing background problems encountered in electronics experiments. At present the energy spread at the top of a magnet cycle remains within ± 0.25 % during about 0.9 ms. Usually something like 0.5 ms is used, though up to 1 ms is acceptable under favourable conditions. By modifying the magnet circuit it is hoped to achieve 3 to 4 ms 'flat-tops' where the same energy spread is retained.

One specialized ejection trick has been successfully applied at the synchrotron following an idea of G. Hemmie. The requirement was for single turn ejection to use the full beam in a 1 μs burst to yield a maximum intensity kaon beam for use in a bubble chamber experiment. The trick enables this to be achieved for a beam of any energy without the expense of very fast kickers. It involves the use, in combination, of the slow and fast ejection systems already installed. The components of the slow ejection system are used to change the working point of the machine as if for resonant ejection and the kicker of the fast ejection completes the single turn ejection system. This works with efficiencies of about 90 %.

Construction of the electron-positron storage rings, known as DORIS, has reached the stage where the buildings are essentially complete, the first machine components are being produced and the last major contracts have been placed. DORIS is the biggest of all the electron-positron



The geodesic dome topping the bubble chamber control building at NAL has recently been completed ; the photograph shows one of the last panels swinging into place. As reported before (vol. 11, page 102) these panels are constructed from discarded beverage cans bonded between layers of strong plastic following an idea by a NAL materials specialist. About 120 000 cans are now built into the roof.

(Photo USAEC)

storage ring projects. To recall its major features (for fuller descriptions see vol. 8, p. 289 and vol. 9, p. 145) : There will be two 'rings' one on top of the other, of oval shape (120 m and 60 m across) merging in two long straight sections where the beams can be collided at a crossing angle of 24 mrad. Most components are being designed for 4.5 GeV but r.f. power will be installed initially to cope with two 300 mA beams with an energy of 3.5 GeV. Electrons and positrons can be fed to DORIS direct from the new 400 MeV linac or at energies up to 2 GeV having passed via the synchrotron. A luminosity of 10^{32} cm^{-2} s^{-1} is eventually hoped for.

The outer structure of the buildings was completed last summer. The tunnels are already equipped with the cooling water pipes and the main cabling is being done this month. Support plates for the magnets are in position and the first production bending magnet was completed on 28 January. Previously, prototypes of the bending magnets, quadrupoles and of the difficult large aperture double quadrupole, which is one of the components producing the low beta section where the beams cross, had been built and measured. All the magnets are now ordered together with 26 power supply units and they should be completed by August 1973. Initially, however, although a full set of correction coils is being built into each magnet, power supplies for only half of the coils will be purchased.

Prototypes for the r.f. system were also constructed and six 250 kW units have been ordered. Vacuum chambers for the quadrupoles are also ordered and the rest of the chambers will be ordered next month. There has been a change in their design for the bending magnets. Instead of requiring a large bulbous projection protruding from the magnet gap in order to ensure sufficient pumping speed along the length of the chamber, there will be distributed ion pumps in the bending magnet field on one side of the chamber. On the other side, along two thirds of the bending length, will be a copper absorber for synchrotron radiation. The required pressures are 10^{-9} torr without the beams and 2×10^{-8} torr with the beams.

Beam measurement prototype units are being developed. One unusual instrument is a mode-locked laser giving pulses 10 ps long gating a Kerr cell (the bunches will be about 100 ps long). The technique was tested at the synchrotron at the beginning of February. The beam observation systems will be linked to a control computer which will have a very important role in the operation of the storage rings.

In preparation for the experimental programme one magnet detector system has already been produced. This is the superconducting magnet, known as PLUTO, which has an internal diameter of 1.4 m, 1.15 m long, and a field of 2.2 T (described in vol. 10, page 231). It was initially intended as a prototype for a bigger version but this is now unlikely to be built and other magnet detector systems are being studied for construction later. If all goes to schedule, commissioning of DORIS will begin at the end of 1973.

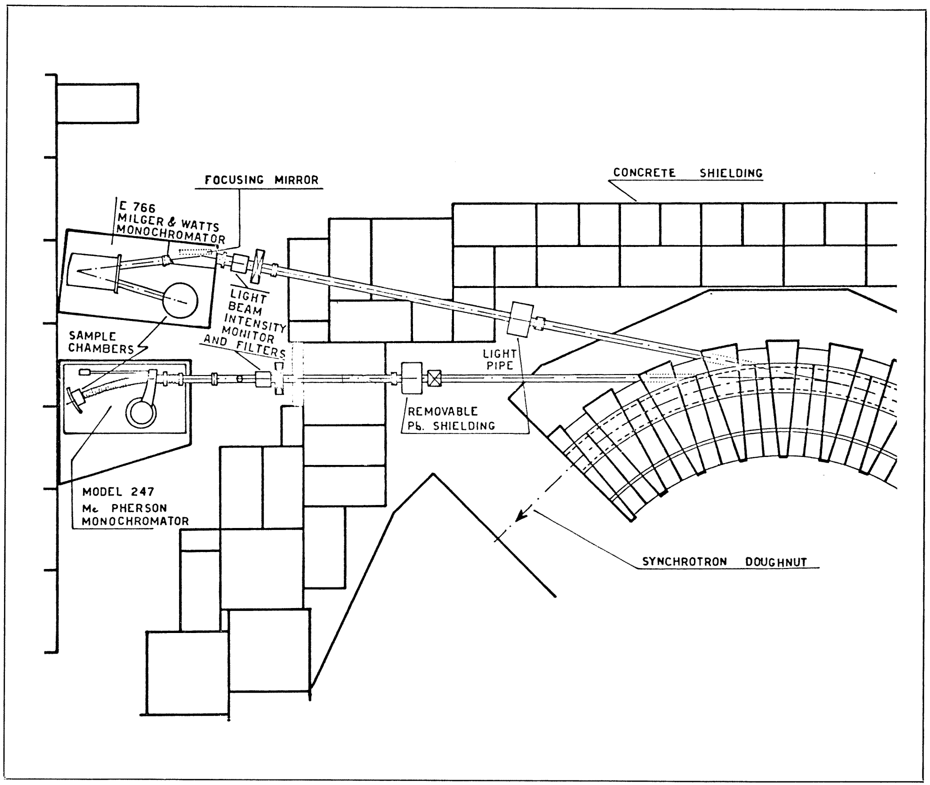
GESSS meetings

In January and February there were further meetings of the Group for European Superconducting Synchrotron Studies — a full GESSS meeting at Karlsruhe on 18 January and a Machine Design meeting in the first week of February at CERN.

The first brought together specialists from the three European Laboratories collaborating in this field

(Karlsruhe, Rutherford and Saclay) and representatives of CERN Laboratory II. Laboratory II is committed to assessing the possibility of incorporating superconducting magnets into the SPS machine lattice. For this reason only half a ring's worth of conventional magnets is being ordered initially and the decision to go superconducting or to continue conventional will be taken in about two years' time. All three collaborating Laboratories are attempting to produce pulsed superconducting magnets appropriate for a synchrotron and thoroughly tested by that time (each using different approaches on some aspects of the magnet design). Magnet specifications for the models being built in each Laboratory will be available soon and we will give more information when they are available.

The second meeting tackled more specifically the integration of superconducting magnets into a synchrotron. It is worth bringing out here that, although the beginning of 1974 is an extremely important decision date for superconducting magnets, a negative decision at that time would certainly not be the end of the road for such magnets. For example, in 1975 there will be decisions on magnets for the beam transport systems to take the highest energy beams from the SPS into the new North experimental area. Later on, more speculatively depending upon the sustained interest of the physics and a more buoyant financial situation, there will be decisions on improvements or conversion of the ISR and even of the further development of the SPS itself. The present work of GESSS, quite apart from its general importance in increasing our mastery of the phenomenon of superconductivity, is necessary to feed vital information into the balance pans for the time when all these decisions are taken.



1.

1. Diagram of the Frascati synchrotron radiation facility. On the right is the ring of the 1.1 GeV machine and emerging tangentially from the beam paths are two light pipes feeding several experiments. Synchrotron radiation facilities are attracting a lot of scientific interest. Daresbury are bringing a major unit into action at the 5 GeV NINA and DESY, with many years of experience with a facility at the 7.5 GeV machine, are to extend their facilities considerably. (We shall report on the work at both these other Laboratories in a coming issue.)

FRASCATI

Synchrotron radiation facility and experimental results

The radiation emitted by the electrons orbiting the 1.1 GeV electron synchrotron at the Frascati National Laboratory has been used for several years for research in molecular and solid state physics. This radiation is much more useful than conventional laboratory sources because of its strong intensity in the 5 to 2000 Å range and its high degree of polarization (about 70 %).

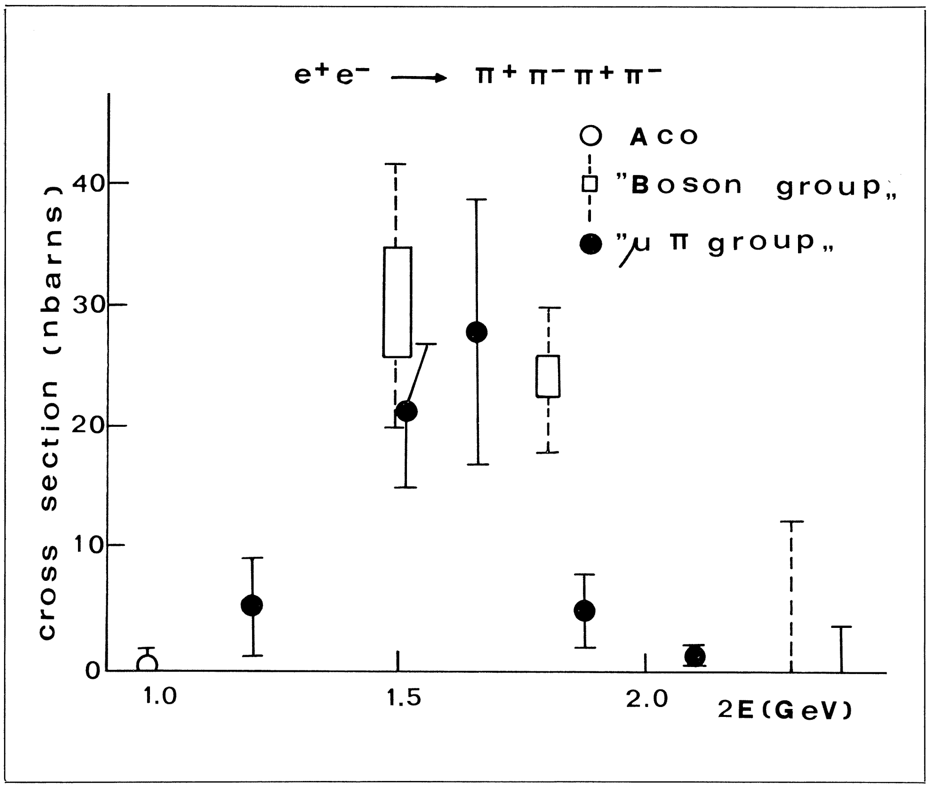
The problems which can be investigated in solid state physics change according to the spectral range of the synchrotron radiation. At small photon energies (below 40 eV) deep valence states are excited and therefore the optical spectra can be interpreted in terms of the conduction band density of states and/or of electron-hole interaction. At higher energies core states are excited and atom-like phenomena take place.

The experimental set up of the 'Solidi Roma' group is shown schematically in the figure. Using a grazing incidence monochromator and a near normal incidence monochromator, the 5 to 2000 Å range is covered with an energy resolution better than one in a thousand and also two experiments can be performed at the same time. The optical properties of layer structures, such as graphite and GaSe, are presently under investigation. The components of the dielectric tensor are obtained from the reflection and transmission spectra and it will be therefore possible to verify the validity of the two-dimensional model used in the band structure calculations.

Another problem of interest is the identification of the structures present in the high energy absorption thresholds of alkali halides. Better insight can be achieved under uniaxial stresses, which split degenerate levels. Such splittings are hardly detectable with absolute measurements and require either stress or wavelength modulation techniques.

The extreme ultraviolet region of the spectrum is also being used by a second group for atomic and molecular spectroscopy in high magnetic fields. In particular, spectral structures due to magnetic quantum levels in transitions from inner shells are being studied in the absorption spectra of various semi-conductors.

In order to achieve the high sensitivity necessary for performing such experiments (signals more than 70 db below the noise level must be recovered) techniques of modulation spectroscopy and phase detection are to be used. In particular, it will be necessary to achieve modulation of the applied magnetic field, which will



2.

2. *Results from the Adone storage ring indicate a resonance at around 1.6 GeV.*

be produced by a small superconducting magnet (about 4 T peak field). A superconducting solenoid has been designed, which should give a field modulation on small solid samples of the order of 80 % with a frequency of about 20 Hz. The whole experimental apparatus should be ready to be operated in the summer.

Since 1966 there has been a full programme of research at the electron synchrotron by a Frascati - Naples - Pavia - Rome collaboration using the bubble chamber technique to investigate single and double pion photoproduction on protons and neutrons up to 1 GeV. In 1971 the analysis of 750 000 pictures taken in deuterium was completed for the reaction

$$\gamma + n \rightarrow \pi^- + p$$

and interesting results were found concerning the following questions raised by the theoreticians :

a) The existence of an isotensor term in the electromagnetic current — comparison of the total cross-section in the first resonance region with that of π^+ photoproduction on protons, as proposed by M. Sands and G. Shaw, indicates an isotensor contribution of some 20 % ;

b) A possible T-violation in the electromagnetic interactions of hadrons — comparison of the cross-sections in the first resonance region with those of the inverse reaction as measured at Berkeley and CERN indicates a large T-violation ;

c) The photoexcitation of the Roper resonance (P_{11}) — behaviour of the total and differential cross-sections in the second resonance region can be interpreted assuming a large P_{11} resonant amplitude which agrees with the assignment of this resonance to an SU3 antidecuplet not foreseen by the quark-model.

In view of the great importance of the above questions a careful control of the present data is necessary, as well as new experimental results, both on the reaction studied and on the inverse one. Moreover, particular attention has to be given to the problem of extracting the cross-sections on free neutrons from the deuteron data.

Concerning the isotensor contribution to the electromagnetic current, in December 1971, 350 000 pictures were taken at Frascati with a maximum photon energy of 450 MeV in order to investigate particularly the first resonance region by obtaining a cleaner sample of events without double photoproduction contamination.

The 'μπ group' at the 1.5 GeV electron-positron storage ring, Adone, has observed a broad peak around 1.6 GeV total energy for the cross-section of the process $e^+e^- \rightarrow \pi^+\pi^-\pi^+\pi^-$ (see figure).

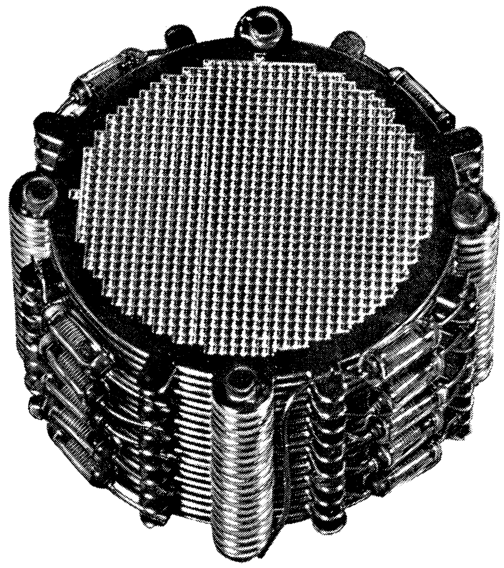
The result, based on thirty-one well identified events, can be interpreted in terms of a new heavy meson having the same quantum number as the rho meson, a mass of 1.6 GeV/c^2 and a width of 0.35 GeV. Such an interpretation, which has been recently discussed on theoretical grounds by A. Bramon and M. Greco, coincides with the one suggested by M. Davier et al. as a possible explanation of their results on the photoproduction of four charged pions ($\gamma p \rightarrow \pi^+\pi^-\pi^+\pi^- p$) at the Stanford linear accelerator.

The energy dependence of the cross-section has been confirmed by independent measurements of the same quantity by the 'Boson group' at Adone, for a total energy larger than 1.5 GeV. It is also in agreement with the measurement carried out at the Orsay storage ring, ACO, for a total energy 0.99 GeV.

Conference announcements

The Sixth International Cyclotron Conference will be held at the University of British Columbia, Vancouver, Canada (where the TRIUMF cyclotron is under construction) on 18-21 July 1972. It will cover recent developments in the design and operation of cyclotrons, including isochronous machines and synchro-cyclotrons. Further information may be obtained from N. Brearley, TRIUMF, University of British Columbia, Vancouver 8, B. C., Canada.

The Second International Conference on Ion Sources will be held at Vienna, Austria, on 11-16 September 1972. Further information may be obtained from Dr. H. Winter, II. Institut für Experimentalphysik der Technischen Hochschule Wien, 1040 Vienna, Karlsplatz 13.



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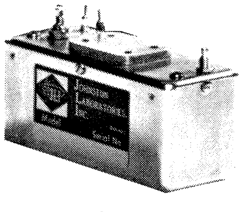

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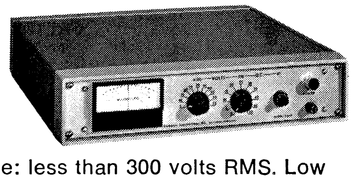

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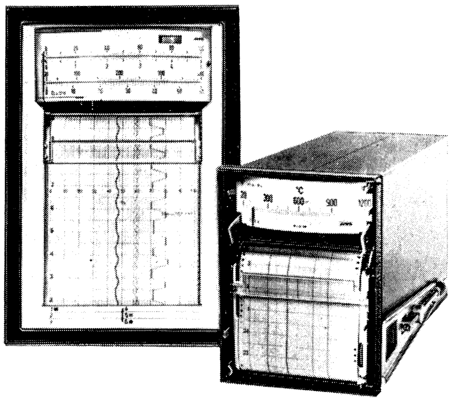

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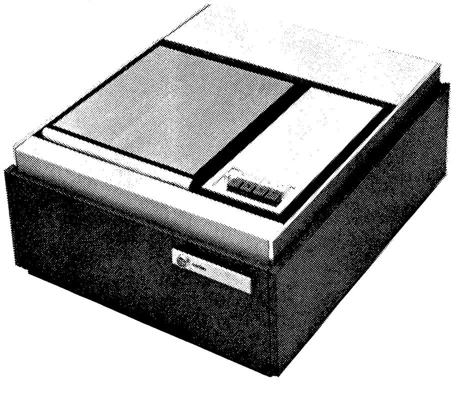

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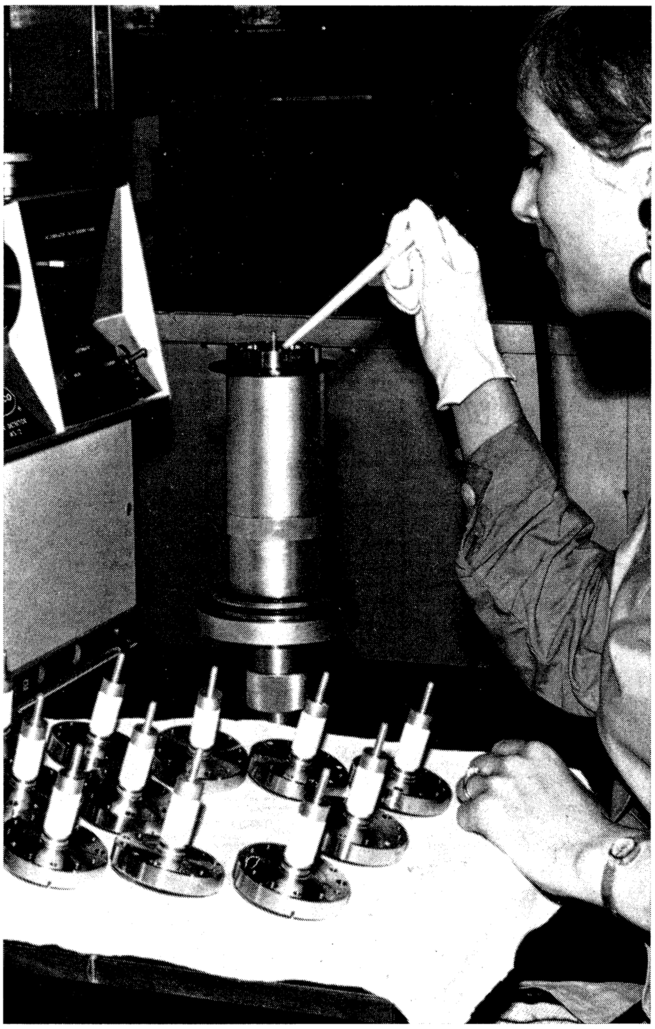

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Radômes, fenêtres électromagnétiques
Pièces en oxyde de Béryllium « BEROXYD »
POUDRES abrasives et pour projection

Desmarquest et C. E. C. S.A.

LDC 1804

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Zone Industrielle N° 1
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Téléphone : 33-05-95
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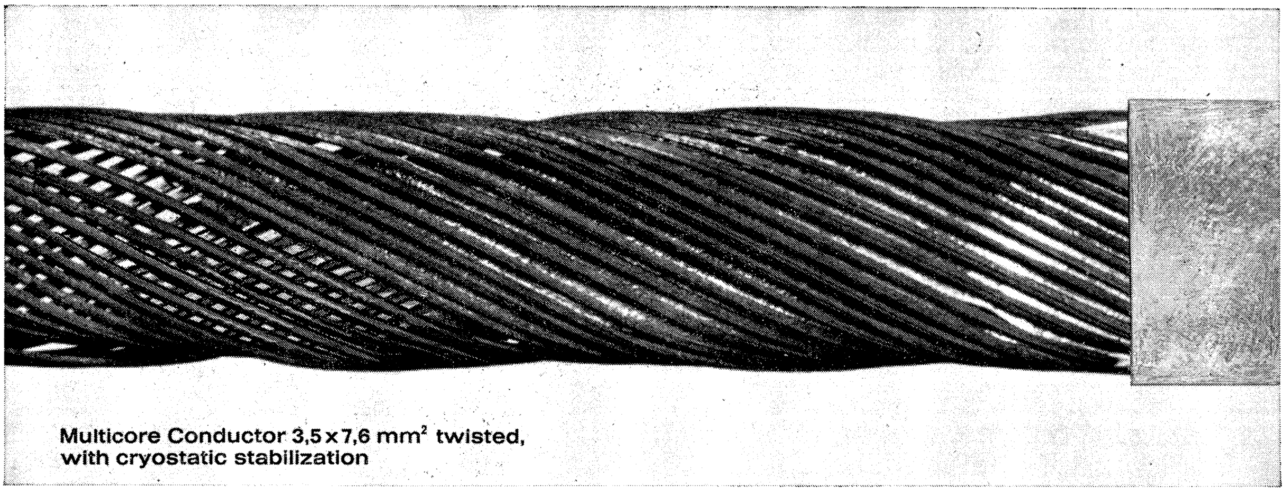
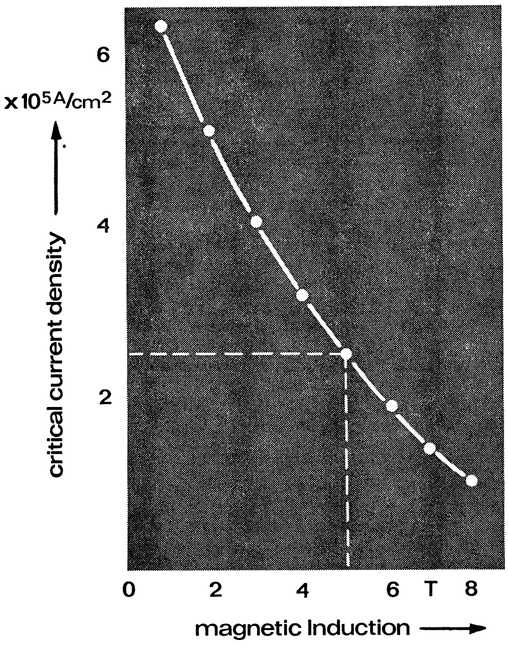
VAC
VACUUMSCHMELZE



Multicore Conductor 3,5 x 7,6 mm² twisted, with cryostatic stabilization

NbTi based alloy High Field Superconductor

VACRYFLUX 5001®



Application: Magnets both of big volume and on laboratory scale

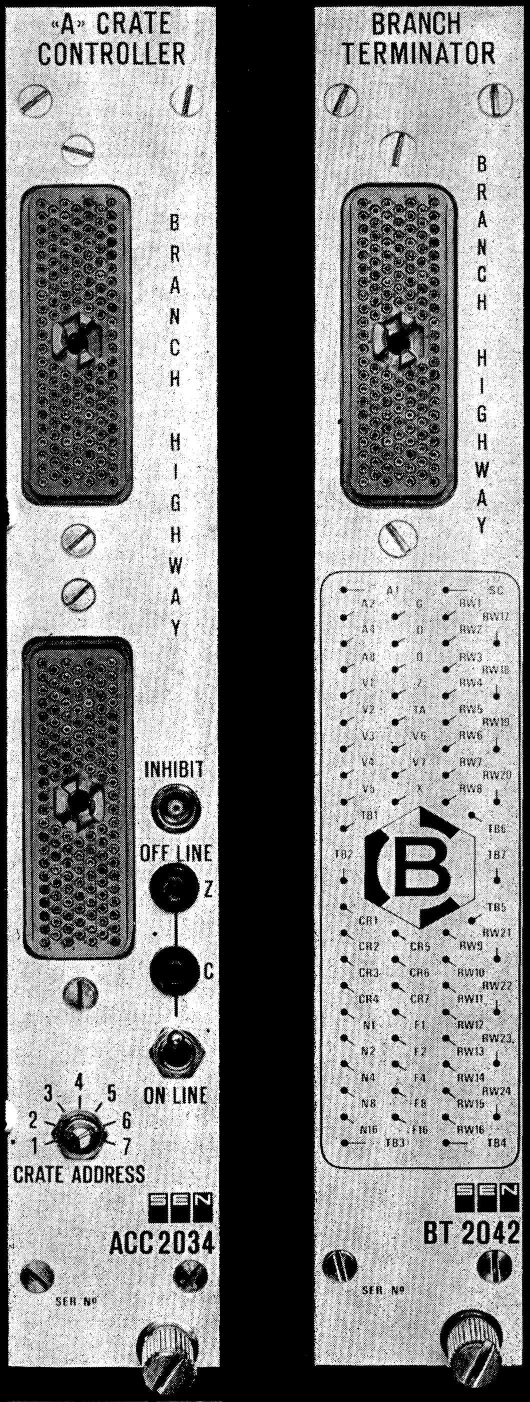
Single core conductors for magnets of high homogeneity (critical current density about 2-2,5 x 10^5 A/cm² at 5 T)

Multicore conductors containing 30 to 250 twisted superconducting strands, various degrees of stabilization, cross section circular or rectangular (diameter of superconducting cores: 0,1-0,2 mm)

Filament conductors containing 60 to about 1000 twisted superconducting strands, intrinsically stable (critical currents varying from 100 to 2000 A at 5 T)

VACUUMSCHMELZE GMBH · 645 HANAU

SEN CAMAC



The «A» CRATE CONTROLLER with the new ESONE specs and CERN option is already available.

We produce also a Branch Terminator and a Branch Highway cable of many lengths.

ACC 2034 «A» Crate Controller
BH 2037 Branch Highway cable
BT 2042 Branch Terminator

Outstanding features

- Only one printed circuit board (increases fiability and keeps down price) facilitates test and maintenance
- the second dataway connector is independent of the first, allowing easy plugging into the crate
- synchronous logic (timing accuracy)
- CAMAC cycle is not disturbed by parasite pulses
- Master clock started by the branch driver and controlled by the Hold-Line (CERN option)
- Variable frequency clock with only one adjustment
- CAMAC cycle typical 1 μs
- complete decoding of functions and subaddresses
- x-response for each function decoded in the Crate Controller

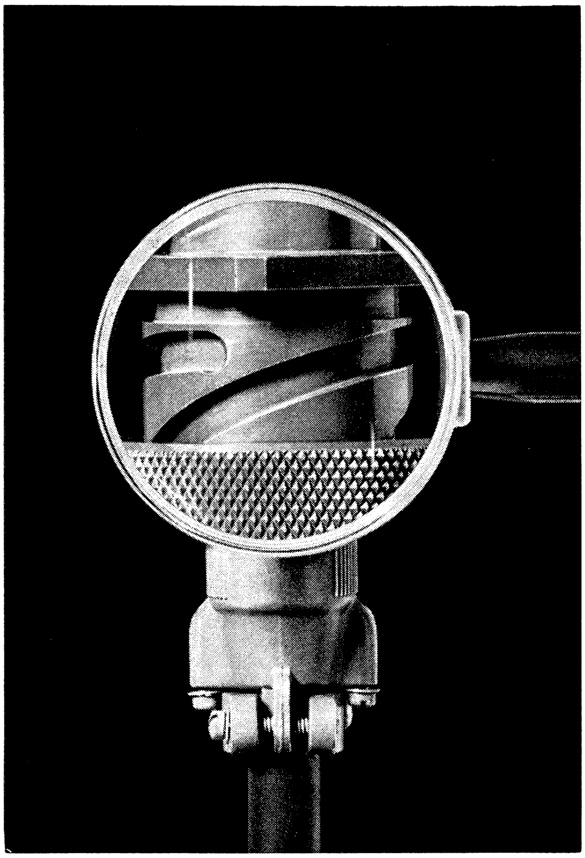
SEN ELECTRONIQUE

Ask for more information

31, av. Ernest-Pictet - 1211 GENEVA 13 - SWITZERLAND - Tel. (022) 44 29 40

Denmark: J. FJERBAEK i/s, Ingenior, M. AF I - Hoeghsmindevej 23 - 2820 Gentofte/Copenhagen
France: ORTEC SARL - 2, quai du Parc - F-94 Saint-Maur
Germany, Benelux: SEN Elektronik - Haidbrook 23, Postfach 223 - D-2 Wedel/Hmb.
Italy: ORTEC-Italia SRL - Via Monte Suello 19 - 20133 Milano
South Africa: DENBIGH SMITH & PHILLIPS LTD. - Honiton Road 33 - Plumstead, Cape
Sweden: POLYAMP AB - Toppvägen 20 - 17500 Jakobsberg
U. K.: ORTEC LTD. - Dalroad Industrial Estate - Dallow Road - Luton Lu11su/Beds.
U.S.A., Canada: EG&G/ORTEC - 100 Midland Road - Oak Ridge, Tenn. 37830

CANNON



This MS connector offers you more than a MIL-C-5015 connector...

... because of his bayonet coupling which offers you the advantages of fast connecting and disconnecting. This connector is completely sealed to withstand moisture condensation, vibration, corona and flashover caused by altitude environments. It is available as mounting receptacle, straight plug or 90° angle plug in about 100 different contact arrangements.

Please contact us for further details or ask for a shortfrom catalogue.

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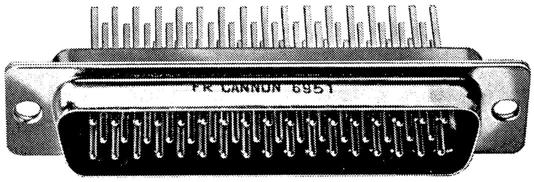
CANNON

D Subminiature rectangular connectors



D Subminiature rectangular connectors are designed for applications where space and weight are prime considerations. They accommodate a great number of circuits in relation to their size and weight and are especially suited for aircraft, missile and ground support systems. Although designed essentially for rack/panel applications, D series connectors may be adapted for cable attachment by accessory junction shells (shields) with integral clamps. D subminiature connectors have a maximum of 50 contacts in the D series and 100 contacts in the Double Density D series.

Combination arrangements, with provisions for coaxial, power, and/or high voltage contacts, and printed circuit terminations are also available. The versatility of the D Subminiature line is enhanced by the variety of insulating materials and finishes, as well as by the complete line of accessories.

Please contact us for further details or ask for a shortform catalogue.

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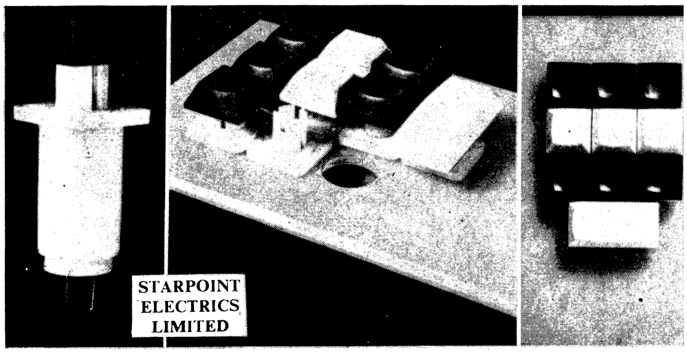
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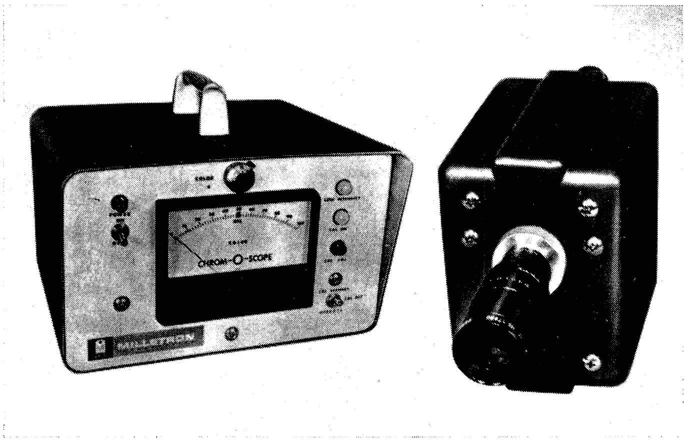


Pyromètre optique automatique bichromatique «Therm-o-scope»

Ce pyromètre appelé plus communément pyromètre à deux couleurs permet de s'affranchir des délicats paramètres que présente une cible dans toute mesure optique, notamment en ce qui concerne sa géométrie, son émittance, son pouvoir émissif ; il en est de même de la transmittance des différents écrans situés entre la cible et l'élément détecteur.

IZART S. A.

Siège social et Direction générale :
27, avenue Saint-Laurent
91 - **ORSAY** Tél. 928 42 39
Atelier : Tél. 355 62 54

Caractéristiques particulières :

La température minimum mesurée est de 815° C, température maximum 3520° C.

L'indication en température est affichée sur un galvanomètre.

Le principe de diaphragme asservi donne une graduation linéaire. Parallèlement une sortie analogique ajustable pour enregistrement ou régulation de 0 à 500 mV est systématiquement prévue ainsi qu'un réglage du temps de réponse.

Temps de réponse réel pour un échelon de 99,9 % de l'étendue totale d'échelle : 100 millisecondes.

La sensibilité ramenée à l'étendue totale d'échelle est meilleure que 0,3° C.

Un réétalonnage à déclenchement manuel ou automatique sur un étalon interne (filament de tugstène) est prévu.

Un système optique de visée permet une mise au point de 15 cm à l'infini.

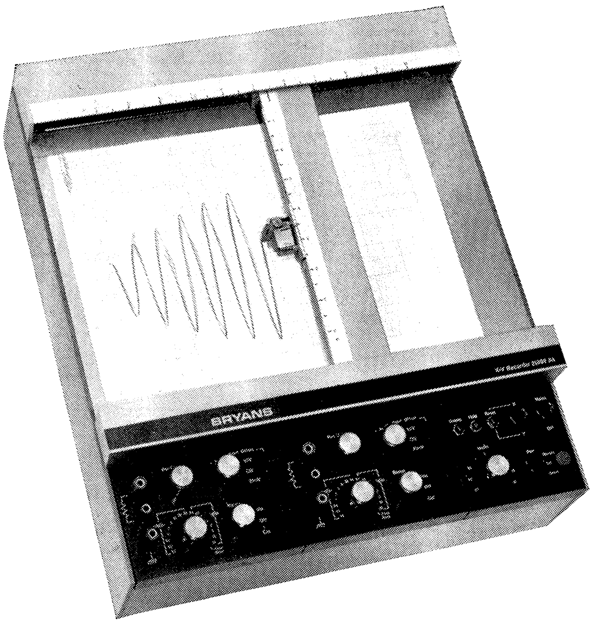
Le rapport de visée est : $\frac{1}{125}$.

Un astucieux dispositif d'alarme lumineuse ou sonore prévient toute fausse mesure (écran opaque aux longueurs d'ondes choisies, énergie rayonnée insuffisante, rapport de visée incorrect, etc.).

Utilisation :

En laboratoire toutes les applications peuvent être envisagées. Les industries du verre et du ciment ont résolu de nombreux problèmes par l'usage du « THERM-O-SCOPE » insensible aux écrans de fumée et à la présence de flamme. Les écrans de verre et de quartz n'introduisent plus d'erreur.

Cet appareil apporte enfin une solution définitive à de nombreux problèmes de mesure optique de température.


BRYANS

Une entreprise en expansion

Qui sommes-nous ? Cii, Compagnie Internationale pour l'Informatique, une entreprise privée industrielle dont les principaux actionnaires s'appellent Thomson, CGE et Schneider. Nous exerçons une activité dont on ne voit guère la fin dans le monde moderne. Nos objectifs en tiennent compte, et nous les atteignons.

Notre catalogue comprend dès maintenant une ligne continue d'ordinateurs universels (de Iris 45 à Iris 80). Avec elle, nous couvrons tous les domaines de l'informatique, depuis la gestion de l'entreprise moyenne jusqu'aux plus gros travaux scientifiques. Et la sortie du mini-ordinateur Mitra 15 nous a permis de confirmer notre rang de leader européen pour les applications industrielles.

Nous avons déjà installé plus de 700 systèmes : une première étape. Pour franchir la deuxième, nous agrandissons de moitié notre Usine de Toulouse, nous recrutons nombre d'ingénieurs (ils sont déjà 1600), nous donnons, pour nos clients, une nouvelle dimension à notre Ecole de formation, nous ouvrons des Délégations commerciales dans chaque métropole régionale et nous ne cessons d'étendre notre Réseau de maintenance.

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- High input sensitivity (0.25 pC/count or 1.0 pC/count) eliminates need for additional amplifiers.
- Flexible system-oriented features include generation of two status commands, Q response suppression for empty modules, and provision for compacting data from adjacent modules into 16-bit words.

LRS

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A substantial advance in fast-pulse ADC capability, the new Model 2248 *Multi-ADC* permits use of analog-to-digital converters for both measurement and monitoring purposes to an extent not previously practical. Now, ADC cost becomes low compared to the existing per-channel investment in counter assembly, associated electronics, hardware.

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- Particle identification using dE/dx counters.
- Improving time resolution from slow scintillators by correcting for counter risetime.
- Tagging data with time-to-height converter outputs.
- Recording particle position using a long scintillator and two phototubes.
- Monitoring gas threshold Čerenkov counters.
- Debugging or monitoring proportional chambers.

For full details on the Model 2248 Multi-ADC or on other instruments in our integrated line of high-performance NIM and CAMAC modules, contact *Alan Michalowski,* Sales Manager, LRS Particle Physics Division, or your local LRS Sales Office.

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