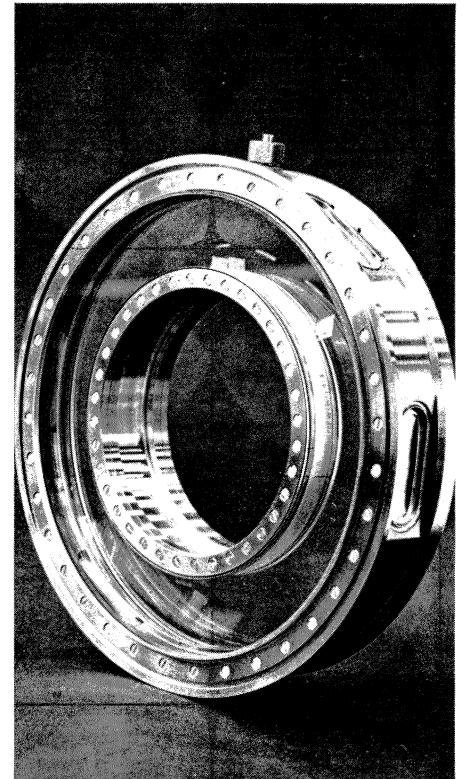
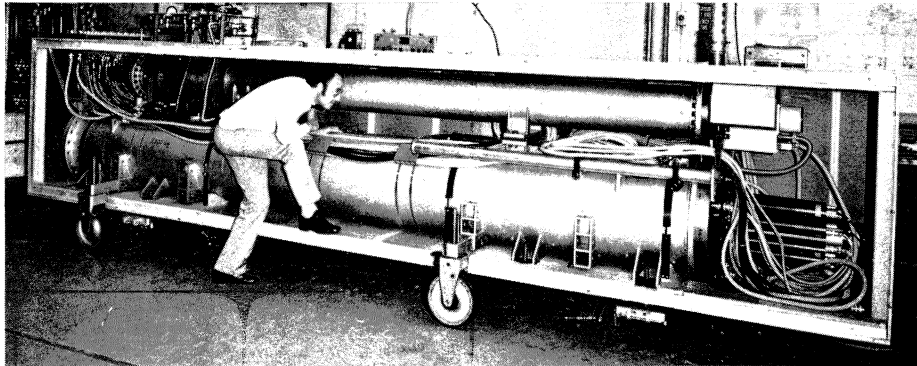


1. The DISC Cherenkov counter after its removal from the test beam. The large vessel of the counter is mounted on wheels and the photo-multipliers are located to the right in the photograph. On the top is a smaller tube housing a precision refractometer. The whole counter is thermally isolated in a foam-lined box.

2. The special chromatic corrector of the DISC counter is a triplet lens consisting of elements of fused silica and sodium chloride mounted in a barrel of invar.



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literally passes underneath the Franco-Swiss frontier, the important technological aspects will be highlighted, mention will be made of construction within strict budget limits to a fixed time schedule and of the measures to ensure environmental protection, etc.

DISC ready for Atlantic crossing

A high resolution differential Cherenkov counter, built by a combined team from Data Handling and Nuclear Physics Divisions has passed its beam tests at the CERN PS and is now being shipped to the National Accelerator Laboratory, Batavia.

The counter is of the 'DISC' type (described in vol. 12, page 234). It is 5.5 m long, uses a Cherenkov angle of 24.5 mrad and has a theoretical velocity resolution of 4×10^{-7} when filled with helium gas; this is sufficient to separate pions and kaons up to about 250 GeV/c and pions and protons up to about 500 GeV/c. When a high energy charged particle passes through the gas in the counter, a ring image of the Cherenkov light is focused onto a circular diaphragm. Light which passes through the annular opening in the diaphragm is detected by a coincidence arrangement of eight high quality photo-multipliers.

A set of special optics inside the counter corrects for chromatic and geometric aberrations in the light image. The chromatic corrector, consisting of a triplet lens of fused silica and sodium chloride elements, is adjustable in position along the axis of the counter so as to provide the best resolution over a wide range of beam momenta (for example, to detect anti-protons from 30 to 500 GeV/c) and a wide range of particle mass (for abundant particles and rarer particles such as hyperons, antideuteron, etc.).

During the tests at CERN the detector was mounted in a 10 GeV/c pion beam (d 31) in the South Hall of the PS and was operating satisfactorily after only twenty hours. Precision alignment of the counter is not necessary since remote adjustment is possible. The detector is also insensitive to the temperature of its surroundings because temperature compensation is built into the design of the optics. However a stable temperature is required and this is achieved by thermally isolating the whole counter. The counter was filled with air for the tests and by setting the pressure with an interferometer it was possible to cross-calibrate the mean momentum of the beam to an accuracy of about 0.1%. The counter could then be set for the detection of particles of any given mass.

The figure shows some results taken during the test. The counting rate was

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recorded as the gas pressure was slowly increased. Peaks in the yield of particles correspond to electrons, muons and pions in the beam. The width of the peaks is determined by multiple scattering of the 10 GeV/c beam in the gas filling of the counter, but is not affected by the large divergence of the beam (about 5 mrad). The small bump on one side of the pion peak is not claimed as the discovery of a new kind of particle but is more likely to be some impurity (such as muons of 8 GeV/c) leaking into the beam.

These results indicate that the counter should perform to specification but to determine the ultimate velocity resolution will require a beam of much higher energy. For this, upon arrival at Batavia, it will be installed in the beam-line of the focusing spectrometer facility (NAL experiment 96). The experience gained will be useful for the design of future high resolution Cherenkov detectors for use both at NAL and at the CERN SPS.

Hunting for muons

For about a year now a Health Physics team at CERN has been busy with an unusual piece of equipment which has been touring around in the South Hall, in the car park behind BEBC and in the West Hall. The equipment is easily recognizable as consisting of scintillation counters but they have

3. The number of particles detected by the DISC counter plotted as a function of the gas pressure in the vessel. The width of the peaks is determined by multiple scattering of the low energy test beam by the gas filling of the counter.

The muon hunting telescope, which consists of three small scintillators fitted on a support bar. The two large scintillators in the foreground are the reference counters. The equipment is placed on top of the concrete blocks in order to find out whether the radiation rate at this height is greater than at ground level. The telescope can be moved around the site in the van which contains its associated electronics.

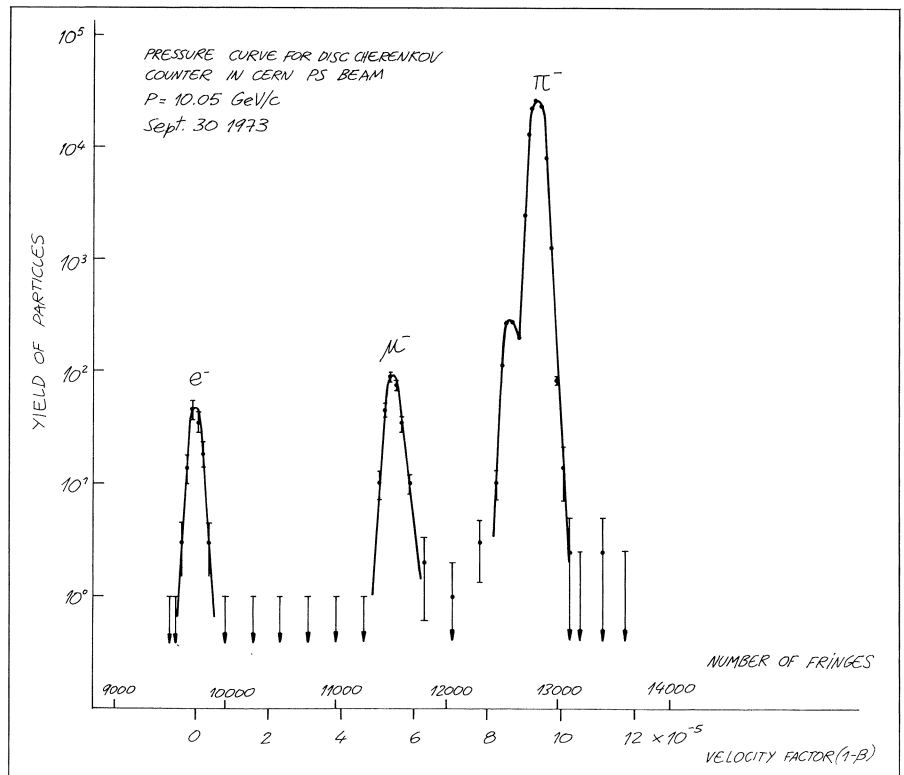
been set up outside the shielding walls, instead of inside in the usual experimental set-ups.

The equipment is a telescope for recording muons, which has been added to the large number of monitors that the Health Physics Group has around the CERN site for checking the radiation levels continuously. The standard monitors give an overall record of all radiation reaching them and the idea of developing the telescope arose when it was found that the radiation level on the car park behind the BEBC bubble chamber was higher (although not dangerously so) than was expected from neutrons alone. This higher dose could only be caused by muons, which can penetrate shielding much more easily than other particles (except for neutrinos). Neutrons make the biggest contribution to the dose rates measured on the CERN site but the contribution from muons predominate at certain points if the pions and kaons, generated by the interaction of the primary proton beam with a target, can travel the distance required for their decay into muons before meeting a shielding wall.

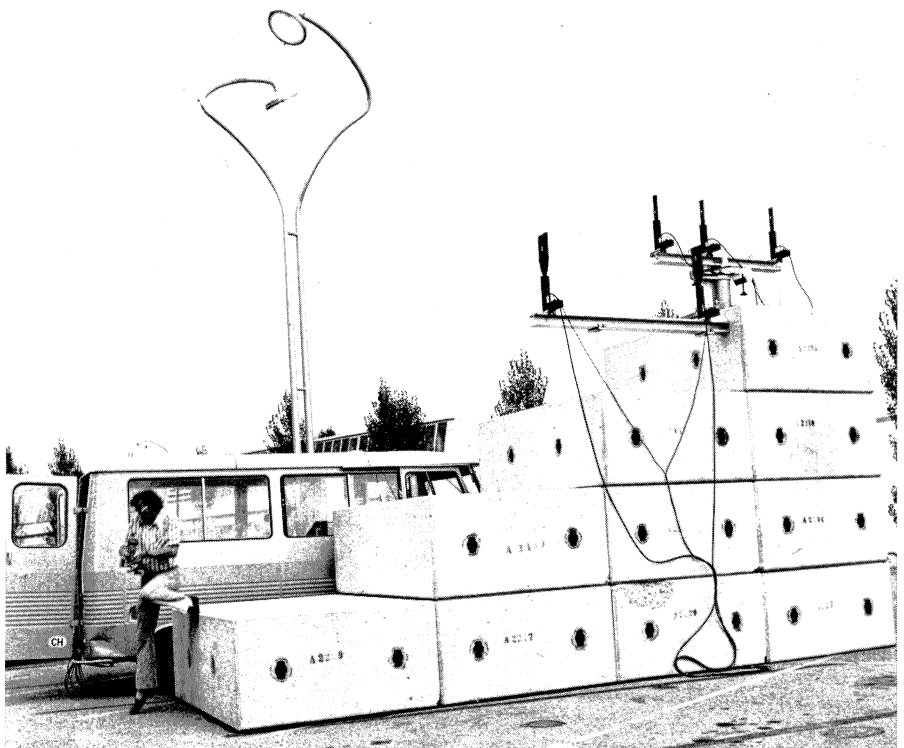
The telescope consists of a bar supporting three scintillation counters in triple coincidence. The bar can be set in either the horizontal or the vertical plane by means of two perpendicular pivots, which is how it earned the name of 'telescope'.

The pulses from the telescope are recorded and counted according to their amplitude by a 512-channel analyser. The various measurements are made with reference to two counters in coincidence arranged in a fixed position in the radiation field in order to take into account the intensity variations of the accelerator.

The general idea of the equipment was approved in March 1971 and it was tested during 1972. During this time, the conditions in which the equipment is truly selective to muons



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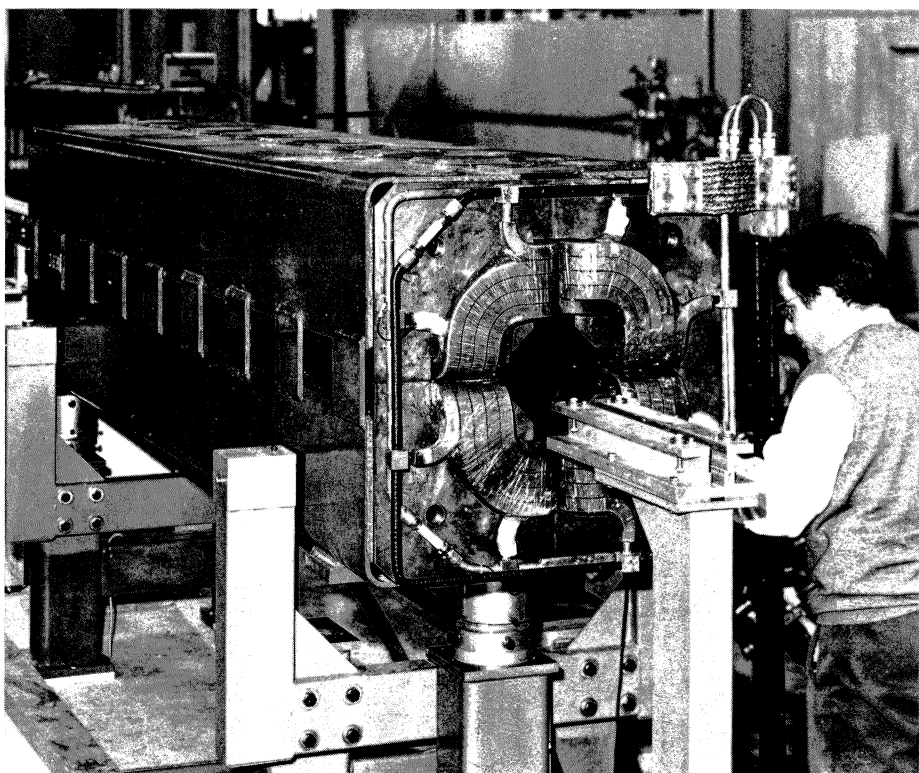
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With some relief 'the mole' bored its way into the gallery of straight section 3 of the SPS on the night of 1-2 October. Since it was last seen in straight-section 2, mid-June, it had run into pockets of gas (methane and carbon monoxide) which delayed tunnelling for a week while extra ventilation was installed. The mole has about 2300 m behind it and is likely to be half-way around the ring by the end of the year.

The first production quadrupole for the SPS reached CERN at the end of September. Half-cores for the bending magnets are mounting up in the large assembly Hall and coils for the bending magnets are arriving, though at a somewhat slower rhythm. In the November and December issues we will be covering progress in SPS construction in more detail.



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were determined and its sensitivity to the direction and to the intensity of a muon source was found. The telescope proved to be a high precision instrument.

In theory it is always possible to estimate the muon doses which are likely to be met outside the experimental halls but the calculations are often found to be inexact because of their complexity. In fact, it is necessary to take into precise account all the obstacles in the paths of the particles and the difficulty of such a procedure will be appreciated when one has passed through the chicanes formed by the blocks of concrete, lead and iron which abound in the experimental halls. The telescope makes it possible to locate the muon sources exactly and to check the theoretical calculations relating to intensities. The aim is to reduce the dose rates recorded on the site, either by making it possible to stop the pions and kaons before they decay into muons or by determining the precise points at which the shielding must be reinforced.

This muon telescope will be improved further. It operates very well when the PS is operating with slow ejection of the accelerated beam but the associated electronic equipment is too slow when the PS operates with fast ejection. The Health Physics team is investigating ways of improving the equipment so as to be able to record muons during the extremely short time taken for a single PS bunch to pass.