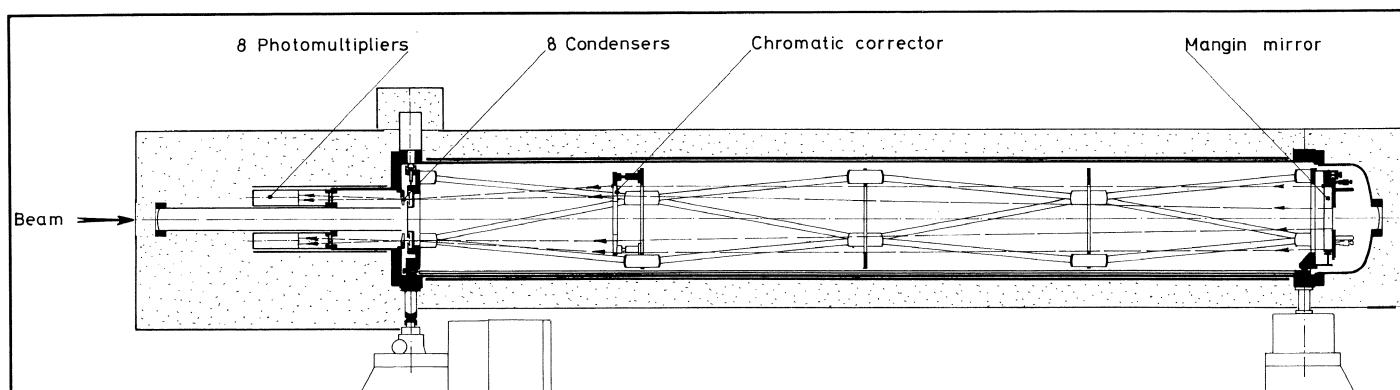


Diagram of the new type of Cherenkov counter developed for use at the SPS which has recently been successfully tested at the PS. Light emitted at an angle by particles in the beam is reflected by the mirror and focused on a ring shaped aperture which allows it through to photomultipliers.



seemed unacceptable when ten such counters were called for in the experimental programme of the SPS. C. Bovet therefore took a fresh look at the problem. The aim was to simplify the design so as to cut costs while still achieving acceptable results.

The first simplification was to limit the abilities of the counters to cover only the energy ranges that they will confront. Thus there will be two types — one for the West experimental hall to cover the energy range 15 to 150 GeV for particles generated by protons of up to 200 GeV which is the maximum energy usable in the hall, and one for the North experimental hall to cover the energy range 60 to 340 GeV for particles generated by protons of up to 400 GeV, which is the maximum energy of the machine. In each case the optical system is optimized for the top energy rather than being adaptable over a wide energy range. This should still give acceptable performance down to the lowest energy.

The second simplification is to use the same mechanical construction for the two types so that the counters will be transferable between the experimental halls with a change of the optical elements. Helium will be used in the North type and nitrogen in the West type.

The refractive index of the gas also appears in the equations which give the particle velocities. To avoid using a refractometer to measure the index,

it is obtained simply by pressure and temperature measurements. Great care has to be taken to ensure an even temperature along the 6 m length of the counter. It is built of iron in an aluminium coating insulated by a polyurethane jacket and achieves temperature uniformity to better than 0.1°C .

The trickiest component is the optical system which should bring the light to the same ring focus where an aperture in a diaphragm allows it through to eight photomultipliers. To collect all the light, the optical system has to have chromatic correction so that, regardless of wavelength, photons emitted by a given particle will come to the same radius at the diaphragm. In the previous design a most elegant corrector was incorporated involving a triple lens with fused silica and sodium chloride elements. Unfortunately no firm was prepared to tackle its manufacture. It was therefore decided for the new counters to divide the corrector putting one lens directly onto the mirror which reflects the Cherenkov light. This can be made in industry and leaves a fairly simple quartz lens along the counter to complete the correction. R. Wilson of the European Southern Observatory gave considerable assistance in the design of the optics.

The first Cherenkov Differential counter with Achromatic Ring focus, CEDAR, built following the ideas

discussed above, was recently tested in a beam at the proton synchrotron. It demonstrated clear separation of electrons, muons, pions and kaons as the pressure was varied up to eight atmospheres (higher pressure would have been needed to see protons). A NORD-10 computer was used to vary the gas pressure and to measure it. The computer also controlled the opening of the diaphragm in steps of $20\text{ }\mu\text{m}$ and the alignment of the counter in the beam in steps of $2\text{ }\mu\text{rad}$.

When only six of the eight photomultipliers were asked to record that light had passed through the ring aperture in the diaphragm, the efficiency in pion detection was 98% and the background away from the ring focus was down a factor of 10^{-5} compared to the signal given by pions. Overall, the agreement between the measurement and the calculated performance was excellent. (One slight worry about the number of light photons detected per beam particle was removed when it was found that the coatings on the optical elements had not received enough attention.) Six of these counters are now being prepared ready for the start of the SPS physics programme next year.

At the machines

We are accustomed to reporting new records achieved in the performance

Around the Laboratories

of the Intersecting Storage Rings (ISR) with regard to both the luminosity and intensity of the beams stored in the rings. Obviously, the further beyond the design figures that the peak performance is taken, the less spectacular, and harder to come by, are the subsequent improvements. Here are the record figures since our last review.

On 24 May, the luminosity recorded for 26 GeV beams was 1.5×10^{31} per cm^2 per s during a physics run, whilst the intensity in rings I and II was 21.2 and 24.8 A respectively. On 30 May, a record intensity of 32.5 A was achieved in ring II, with a 26 GeV beam and on 3 July an intensity of 31.5 A was recorded in ring I again with a beam energy of 26 GeV.

Operation continued until 25 July, when the storage rings were shut down for maintenance. They were due to be started up again on 27 August but, because of an incident in the vacuum system, this could not take place. There was an implosion of a titanium bicone which had just been installed at intersection I-7. It had successfully passed laboratory tests and an enquiry has been opened to determine the cause of the accident.

It is obviously accident time at CERN because the usual remarkable machine reliability was violated at the PS also shortly after the ISR incident. On the evening of 29 August, a fire broke out near the South Hall and damaged a distribution board connecting the electrical power supplies to the auxiliary magnets of the PS together with supply and control cables. Work started immediately to repair the damage but the PS is likely to be out of action for about three weeks. The delaying factor is not so much the direct fire damage but the fact that burning PVC insulation gave rise to hydrochloric acid, helped along by the water used to extinguish the fire, and the acid has penetrated everywhere.

ORSAY Flipping detector

Yet another novel way of detecting high energy charged particles has been thought up by A.K. Drukier and C. Valette of Orsay. They suggested that granules of materials in the superconducting state could be flipped normal by the energy deposited by a passing particle. Drukier went one further and suggested that transition radiation (a phenomenon first identified at Yerevan and studied in detail at Brookhaven) could do the flipping. The granules could thus both initiate the radiation and detect it. These ideas have been successfully tested by an Orsay/Brookhaven/DESY team on an electron beam at the DESY synchrotron.

Re-reading this opening paragraph brings home yet again how intercommunity. No doubt this is a comment that we could make about many of the topics that we cover but taking this particular one — An idea emerging at Orsay in France incorporates the results of work at Yerevan in Soviet Armenia and Brookhaven in the USA and is tested in a French/American/German collaboration (the American, L.C.L. Yuan, actually being temporarily based at CERN) on the synchrotron at Hamburg in the Federal Republic of Germany.

Transition radiation is produced when a charged particle travelling at relativistic energies crosses the boundary between two media of different refractive index. The radiation can be detected in the optical and X-ray region. It is not easy to measure this radiation since the materials used to produce it (such as closely spaced metal foils) tend to absorb the radiation themselves. The granule idea gets around the problem.

Type I superconductors, such as tin or indium are able to retain their

superconducting property beyond the critical conditions (temperature, and magnetic field) where they usually flip to the normal state. This is known as superheated superconductivity and, as with the supercooled liquid in a bubble chamber, the depositing of a comparatively small amount of energy is enough to flip the system normal.

The proposed new technique was tested by making a small target (3 mm diameter, 10 mm long) detector consisting of granules of tin (5 mm or 3.4 mm in diameter) embedded in paraffin wax. As a relativistic electron from the synchrotron crosses each metal-wax boundary, transition radiation is emitted and this radiation is then predominantly absorbed by other surrounding granules. It can be arranged that the energy deposited by the initial electron (about $1.25 \text{ keV}/\mu\text{m}$ in tin) is not enough to flip the granules while the photoelectrons from the transition radiation, depositing more energy (for example, $3 \text{ keV}/\mu\text{m}$ at 40 keV and $6 \text{ keV}/\mu\text{m}$ at 15 keV in tin), do flip the granules. This is achieved by adjusting the strength of the magnetic field applied at the detector, which adjusts the conditions at which the superconducting tin goes normal.

The number of granules affected due to transition radiation is a function of the 'gamma' of the high energy particle (which relates its mass to its rest mass). Measuring the number of granules which go normal determines gamma. One way of carrying out the measurement is to put the detector inside a coil which is part of a resonance circuit. As granules go normal they change the inductance of the coil (since in the superconducting state they exclude magnetic field) and the resonant frequency in the circuit changes accordingly.

The tests at DESY demonstrated that transition radiation does cause flipping. The threshold was set above