

Getting colder

In August (page 225) we reported the bringing into operation of a polarized proton target of volume 45 cm^3 working at 0.55 K which was an important advance in the development of these targets. It now looks as if the development can be carried further with the testing of a new refrigerator using a 10 cm^3 sample which can be maintained at a temperature of less than 0.05 K . This is a step not only towards obtaining higher rates of polarization but also towards realizing 'frozen spin' targets which could allow particles emerging from collisions to be detected over almost 4π solid angle.

The refrigerator, built by T. O. Niinikoski of the Technical University of Helsinki in collaboration with the CERN Polarized Targets Group, is based on the principle of He^3/He^4 dilution. It was designed for integration in a Roubeau-type pre-cooler producing a temperature of 1.04 K . In other words, it had to be housed in a cylindrical space of 3.9 cm diameter. This very compact structure was made possible by using sintered copper heat exchangers, which are only slightly sensitive to the Foucault currents caused by rapid variations in the magnetic field.

Furthermore, the use of high speed pumps ($250 \text{ m}^3/\text{h}$) gives a cooling power which is without doubt the greatest ever reached for such low

temperatures — it was possible to maintain the 10 cm^3 sample at 0.03 K under normal operating conditions and to sustain temperatures as low as 0.022 K .

The next stage involves polarization measurements of various substances at these temperatures. The final aim, however, is to perfect 15 cm long targets intended for the large aperture magnet in the East Hall or for use with the Omega spectrometer.

In order to derive the maximum amount of information from these spectrometers, it is desirable to be able to analyze the particles leaving the target at any angle. However, with the targets built so far, working on the principle of dynamic polarization, it was necessary to have a very homogeneous and intense magnetic field, which meant poles coming very close to the target and reducing the solid angle over which observations could be made.

The lower the temperature, the longer the relaxation time, i.e. the longer it takes for the polarized protons to revert to a completely disorientated state. But the inertia of the spins at very low temperatures is such that their orientation is maintained even if the necessary conditions for dynamic polarization are no longer ensured. Thus it is possible to maintain prolonged polarization even if the magnetic field ceases to have the intensity and the homogeneity necessary

A photograph of the dilution refrigerator built at the Technical University of Helsinki to achieve very low temperatures (0.05 K range) for use with polarized targets. A) mixer chamber, B) heat exchangers, C) counterflow heat exchanger, D) vacuum jacket flange, E) still, F) vacuum jacket pumping tube, G) condenser, H) gas heat exchanger, I) pumping head flange, J) ^3He inlet tube.

The graph shows the cooling power available in the mixer chamber as a function of the temperature.

for creating the effect. This is a 'frozen spin' target. It is hoped that, once placed in Omega's 1.5 T field, the target will be able to maintain its polarization for several days at a temperature of 0.06 K .

Work on frozen spin targets being carried out at the Rutherford Laboratory (where different conditions make it possible to use a 3 T holding field) was briefly mentioned in the last issue (page 330).

HYBUC Rapid cycling

The small hydrogen bubble chamber, HYBUC, has just added another remarkable feature to its list of properties in becoming the first rapid cycling chamber to operate at CERN. The chamber is designed particularly for experiments on hyperons and it was at the beginning of December, in the course of the third test run

