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FOR HIGH ENERGY HEAVY ION EXPERIMENTS TPC 4π DETECTOR "DIOGENE". WHAT POSSIBILITIES AND WHAT PHYSICS?

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"Diogene" is the name of a 4π solid angle detector, based on a Time Projection Chamber (TPC), designed to perform exclusive measurements of charged particles emitted in central collisions of relativistic heavy ions.

Exclusive measurements of all charged particles emitted in central collisions of relativistic heavy ions are becoming more and more necessary in this field of nuclear physics in order to answer some crucial questions such as : what is the degree of compression achieved in these collisions? what is the behaviour of nuclear matter at high degree of excitation as well as compression? the possibility of handling high multiplicities up to 40 or 60 ; a momentum measurement of all particles, with not too bad a resolution, up to about 1.5 GeV/c ; a good particle identification between $\pi^{\pm}$,p,d,t...

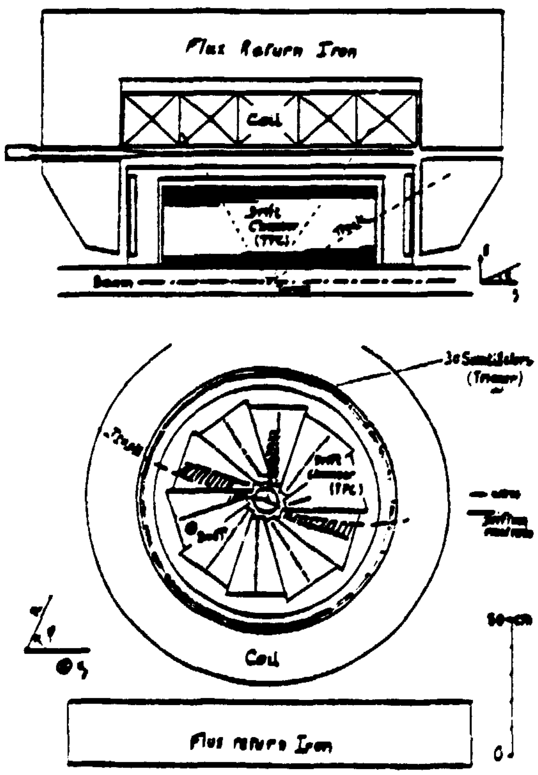

Fig. 1 - Two views of the "Diogene" detector : a) upper part of a radial cut in the vertical plane. b) cut through the target perpendicular to the beam axis.

A schematic drawing of the whole detector is shown on Fig. 1. The internal detector, a TPC working in a 1 Tesla magnetic field, can be triggered on central collisions by requiring a high multiplicity in the lateral trigger system consisting of 30 plastic scintillators. The size has 80 cm in length, 70 cm in diameter, and 10 sectors with 16 sense wires in each one. The magnetic field has been raised from 0.5 to 1 Tesla, which required to change the gas mixture to (Ar + C_3H_8).

Expected performances. The TPC covers about 80 % of the full 4π steradian solid angle, at polar angles θ between 25 and 150 degrees. "Diogène" can handle large charged particle multiplicities, up to at least 40, the absolute maximum being 80.

Two multiwire proportional chambers are placed upstream and downstream of the TPC in order to measure the multiplicity of particles emitted forward and backward. A plastic wall is also being designed to detect and identify, by means of time of flight and energy loss measurements, particles emitted in a very narrow forward cone and going through the hole the iron yoke.

Test results. A sector was built, mounted and tested over this year with beam of π,p and α particles. With 4 atmospheres pressure in the chamber (Fig. 2) the detection thresholds are the following : 20 MeV pions and 50 MeV per nucleon nuclear fragments.

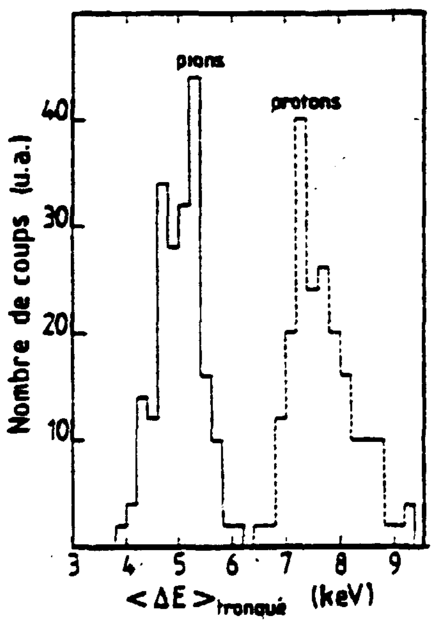

Fig. 2 - Pion proton identification at 1 GeV/c momentum of mean energy loss with 4 atm. gas pressure.

The 10 sectors of final detector will be built, mounted and tested all over next year. On the whole TPC should be ready for full operation at the end of 1981. We hope have also at LNS (Saturne II) next year a beam of C, N, O, Ne, Ar from 50 MeV at 1 GeV per nucleon.

A big effort is needed during the next year in order to find the best global variables, that one can measure with such a detector, and could contain information about the dynamics of central collisions between relativistic heavy ions. The aim is of course to answer some crucial questions such that : is there any kind of equilibration, thermal or even chemical? is there any evidence for collective effects predicted by hydrodynamical calculations? what is the equation of state of nuclear matter?