COLLÈGE DE FRANCE

1530

Laboratoire de Physique Corpusculaire
11, Place Marcelin-Berthelot, 75231 Paris CEDEX 05 - 325 62 11

FLEXIBLE GEOMETRY HODOSCOPE USING
PROPORTIONAL CHAMBER CATHODE READ-OUT

C. AUBRET, A. DE BELLEFON, P. BENOIT, J.M. BRUNET, G. TRISTRAM
COLLEGE DE FRANCE PARIS

L.P.C. 78/03

Work supported by the I.N2.P3.

ABSTRACT

The construction of a cathode read-out proportional chamber, used as a low mass hodoscope is described. Results on efficiency, time resolution and space resolution are shown. The associative logic, which permits the use of the chamber as a coplanarity chamber is briefly presented.

RESUME

La construction d'une chambre proportionnelle à lecture cathodique, destinée à être utilisée comme hodoscope est décrite ici. Les résultats des mesures d'efficacité, de résolution en temps et de résolution spaciale sont présentés. La logique associée permettant d'utiliser la chambre comme un trigger de coplanarité est brièvement résumée.

I/ INTRODUCTION

A cathode read-out proportional chamber has been studied and built in the L.P.C. laboratory of the Collège de France. This detector, installed in Ω spectrometer magnetic field, must be set in an intensive beam coming from S.P.S. accelerator at C.E.R.N. (1). The division of the cathode plane into segments of almost arbitrary shape allows a much greater flexibility in the choich of the geometry than a usual scintillator hodoscope when, as for us, a resolving time larger than 50 nsec can be tolerated (2).

Because of the intensive beam, it was necessary to get inefficient the part of the chamber which is in the beam (to increase the life time of the chamber) (3).

In this article we present results of testing the final chamber with a test pattern on the cathodic plane.

II/ DESCRIPTION OF THE CHAMBER

The useful dimensions of the chamber are $120 \times 120 cm^2$. The MWPC uses 20 μm gold-plated tungsten wires with a 4 mm wire spacing and 5 mm cathode to anode gap. The anode wires are bussed together to positive high voltage while the cathode foils are at ground potential. One of the cathode planes is continous whereas the other one has the desired segmented geometry.

They are made of mylar sheets (50 μm thick) painted with graphite spray. For painting the sector plane, a mask is used to grant the insulation between the different sectors. On the other side of the mylar support one can find the same design but covered with a coach of silver paint. A pine hole is done through the mylar, by the graphite side to get a clean surface in front of the anode wires, in order to have the ground potential on the graphite sectors.

The read-out wires are glued with silver paint on each sectors on the outer side of the mylar foil, as shown on fig. 1.

In this chamber the 4 mm wire spacing does not allow the use of freon in the gas mixture that will consist of 76 % Argon, 20 % Isobutane and 4 % isopropylic alcohol.

The measurements were performed using the electrons from a Ru^{106} source collimated to approximately 5 mm diameter by the use of two scintillators counters.

Every sector of the cathode plane was connected to a eight channel amplifier board fixed on the chamber. Fast outputs of the amplifiers were put in coincidence with the two counters to monitor the efficiency of each sector. An overall efficiency was made by putting all the channels together in coincidence with the trigger counters. For this test the cathodic plane was divided into 19 sectors as it is shown on fig. 2 On the middle, a circular sector was managed and put at a positive high voltage (800 - 1000 V) in order to get a strong inefficiency on the way of the beam.

III/ EXPERIMENTAL RESULTS

A - Time resolution

To measure the time resolution, the source was centered in a sector which was found to have a good efficiency. The chamber logic output width was fixed at 20 nsec and the counter gate pulse width was varied. Delay curves for various gate widths are shown on fig. 3 for a 200 μV amplifier threshold. We can see that a total efficiency results from a gate width less than 50 nsec. When the width of the chamber logic pulse is taken into account, a time resolution of about 60 nsec is measured for the chamber.

B - Efficiency

We need an uniform efficiency across the entire cathode plane. Plateau curves for various amplifier thresholds are shown on fig. 4 for a 50 nsec gate width. The efficiency depends on the separation between sectors since the electric field can be perturbed by polarization charges on the mylar. It is possible to find an efficiency larger than 99 % if the distance between sectors is less than 2 mm by moving the high voltage. The chamber efficiency was found uniform across the entire cathode plane, thus there was no difference in efficiency between strips running parallel or perpendicular to the anode wires.

C - Space resolution

The space resolution between two sectors depends on the distance between the sectors and the high voltage on the anode wires. To get a good efficiency a sufficient high voltage is needed, at the expense of a larger space resolution as shown in fig. 5.

IV/ ASSOCIATIVE LOGIC

For trigger purpose, we need azimuthal correlations between sectors in order to use the chamber as a coplanarity chamber. The complexity of the reaction studied ($\pi^- p \longrightarrow \Lambda^\circ K^\circ$) and the cross-talk between sectors do not allow a simple correlation and a more sophisticated (but fast and flexible) logic is needed.

With the output of the n sectors of the chamber, a n bit word is built. By Monte-Carlo, we know the N possible words for our experiment. The logic using a hash-coding method, compare the experimental word with this N words and we know if the event has the desired configuration.

The hash-coding method permits to resolve this problem in a very short time (less than 200 nsec) and it is very easy to modify the list of the possible configurations (4).

V/ CONCLUSIONS

The results presented above show that the chamber is good for trigger purposes. Time resolution of approximatively 60 nsec and uniform efficiency of greater than 99 % can be achieved, while the overlapping between two sectors is less than 10 mm.

The main advantage remains the flexibility and the simplicity of construction of the cathodic plane. These qualities make such a chamber a practical alternative when space limitation occurs or when different geometries are needed.

REFERENCES

(1) A de BELLEFON, P. BILLOIR, J.M. BRUNET, J. SIAUD, G. TRISTRAM, A. VOLTE, J. VRANA, P. SONDEREGGER. CERN/SPSC/76-30/P.67 (1976)

(2) M. DAVIER, M.G.D. GILCHRIESE, D.W.G.S. LEITH SLAC - PUB - 1581 (1975)

(3) F. SAULI CERN 77 - 09 (1977)

(4) A. de BELLEFON, F. BOURGEOIS, G. SCHULER, C. AUBRET, P. BENOIT, P. BILLOIR, J.M. BRUNET, G. TRISTRAM. CERN/EF 77-1 (1977)

FIGURE CAPTIONS.

1 A schematic representation of the cathodic plane.

2 Pattern of the test plane.

3 Chamber delay curves.

4 Chamber plateau curves for two amplifier threshold.

5 Spatial response curves for two neighbouring sectors.

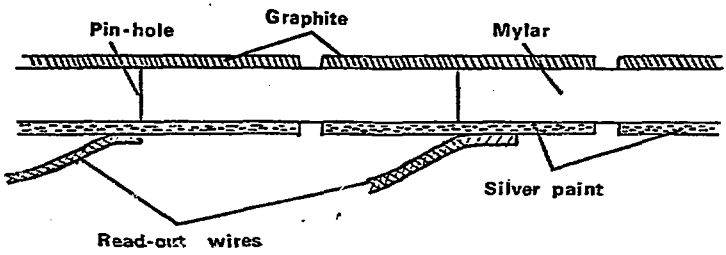

Pin-hole
Graphite
Mylar
Silver paint
Read-out wires

Fig. 1

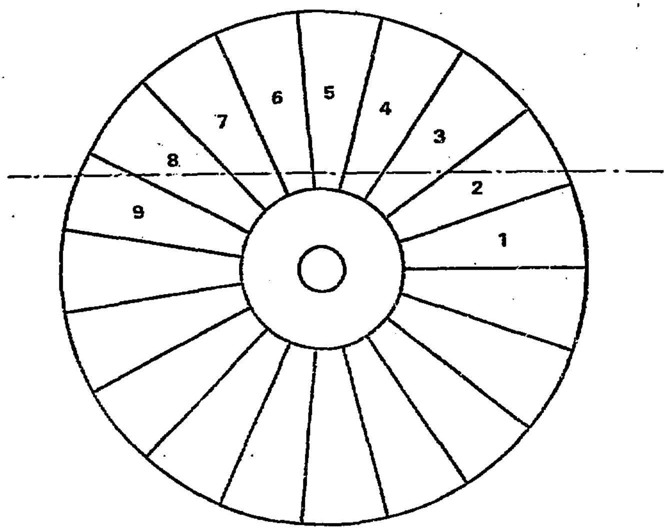

6
5
4
7
3
8
2
9
1

Fig. 2

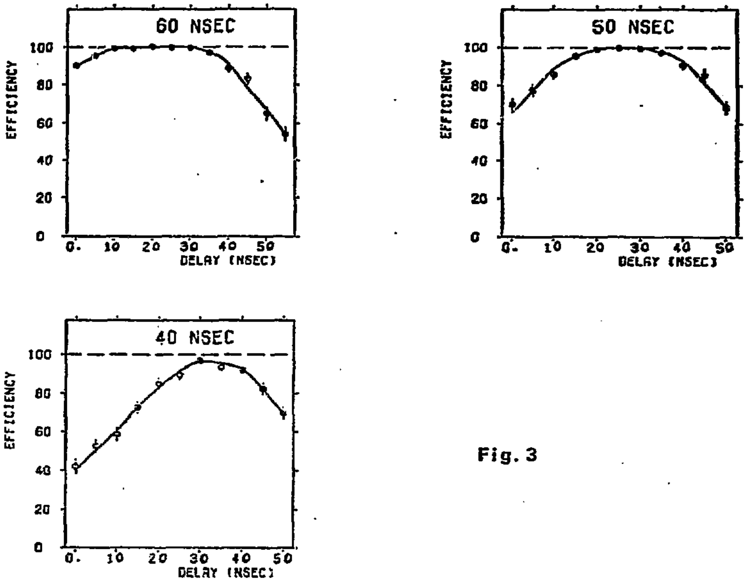
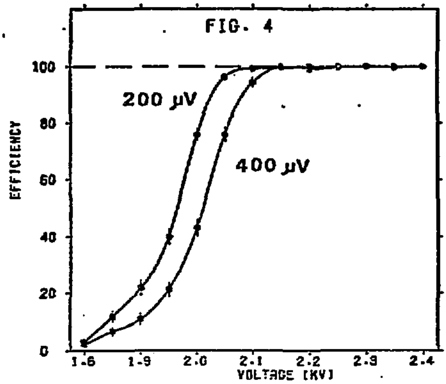
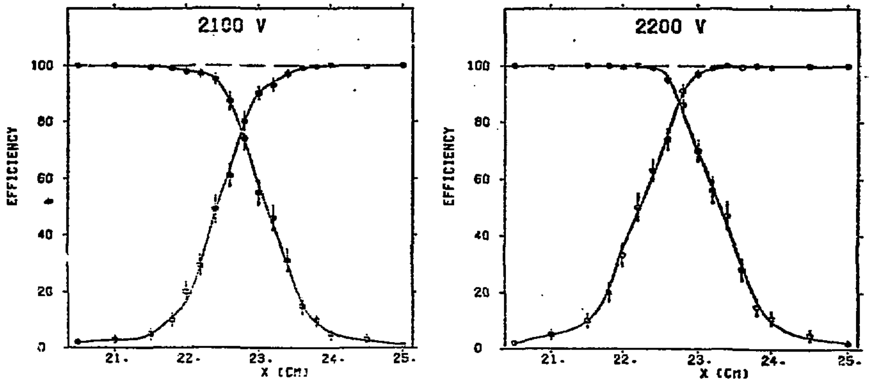

60 NSEC
50 NSEC
40 NSEC
EFFICIENCY
DELAY (NSEC)
0
20
40
60
80
100
10
30
50

Fig. 3



200 µV
400 µV
EFFICIENCY
VOLTAGE [KV]

FIG. 4



2100 V
2200 V
EFFICIENCY
X [CM]

Fig.5