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A Technique for Local Desensitization of M.W.P.C.'s*

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ABSTRACT

A technique for deadening areas of multiwire proportional chambers is described. The technique, which has been in use for some time, makes use of ribbons of insulator laid across the wires.

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Occasionally it is necessary to desensitize an area of a multiwire proportional or drift chamber, usually because of a high particle flux through it. Methods reported in the literature have included thickening the wires by electrodeposition [1)], and plastic space-filling boxes capturing the wires [2)].

Such a requirement was faced when the SLAC Hybrid Facility (a 1 m. hydrogen bubble chamber with electronic tracking and identification equipment [3)]) was reassigned to a photon beam. The beam is derived by backscattering a 4.7 eV laser pulse from the 30 GeV SLED electron beam. The resulting gamma beam has a diameter of 3mm at the bubble chamber, an energy of 19.5 GeV, and an asymmetrical energy spread at half intensity points of about ± 1 GeV. The pulse width is about 60 ns at 10% intensity points.

It was intended to operate the P.W.C.s downstream of the bubble chamber with fluxes of 50-100 gammas per pulse, all within the coincidence gate of the electronics. This corresponds to the production of 20-40 electrons and positrons in the fabric upstream of the P.W.C.s, the majority of which spread into a vertical lamina in the 2.6T bubble chamber magnetic field. This electron-pair plane is effectively thickened by scattering and δ-ray formation. The latter is difficult to estimate because of the layout of material in the proportional chambers and the possibility of helical trajectories in the high and non uniform magnetic fields (2.2T and 0.9T) at two of the three packages of planes.

Because they fit into the exit aperture of the bubble chamber vacuum tank and magnet, the nine planes are of the type which minimizes the side frames to maximize the sensitive volume [4]. The wire tension load is supported by the stiff but light material which covers the whole surface area. In this case honeycomb material [5] was used. The honeycomb also provides the high voltage surfaces, 6.4mm away from the sense wire planes which used 20 μm wires 2mm apart. The wires of each plane were glued to one of the support/high voltage honeycomb plates at edge pieces over which the wires ran for typically 4.8mm (Fig. 1). Thus in a completed wire plane there is no access to the honeycomb side of the wires. The epoxy glue covering the wires is itself covered with 50 μm PTFE tape which acts as a bearing surface for a silicone rubber gasket.

Time and risk constraints made it necessary to find a deadening method for the electron pair plane which avoided machining of the proportional chamber fabric or rewiring the planes. At the same time the material close to the wires in the electron pair region should be minimized to reduce effects from local delta ray production and further pair production or Bremsstrahlung.

Two similar methods have been used. In the first, parallel lines of 50 μm diameter nylon monofilament, spaced from each other at 0.5 mm, were laid out under a few grams tension in a ribbon of the desired width. To prevent electrostatic repulsion, cross threads were glued on every 15 cm. The ribbon was then laid over the wire plane and its gasket bearing surface under 10 g tension per filament and glued to the outside of the frame. The nylon was glued to the sense wires every 30 cm for positional stability, and the distance from the sense wires to the ribbon was always less than 100 μm.

The gasket could be closed over the nylon filaments to give a good gas seal. However, even when a protective layer of 50 μm PTFE was used between the nylon and the gasket, there was a tendency for the squeezed nylon to deform, occasionally to the point of breaking. The resulting curled-up filament presumably affected the local efficiency but the detector was otherwise operative.

A more rugged, but slightly more massive, technique was to use a ribbon of 25 μm mylar, laid similarly over the wires. This was constrained to the wires not by glue but by mylar chevrons glued every 30 cm to the ribbons. The chevrons bridged the gap to the removable high voltage plane when the chamber was closed.

Using either technique, but particularly the latter, it is clearly possible to obtain a wide range of shapes for the dead area.

The edge of the deadened region is adequately sharp for most purposes. Measurements using a collimated source indicate a falloff from full efficiency to below 10^{-3} in 5 mm (Fig. 2). Efficiencies of 90% are achieved at 3 mm from the ribbon.

Deadened in this way, the planes have operated for a year's data collection, aggregating about 10^7 minimum ionizing tracks per square centimetre across the dead regions, and in addition the effects of helical δ ray and soft compton electrons. Ribbons 2 cm wide in the first two plane packages and 4 cm wide in the downstream package have removed unwanted tracks sufficiently to allow satisfactory data collection at beam fluxes of up to 80 γ per pulse.

References

1. U. Hahn, W. Mohr, K. Moser, K. Rith, E. Schloesser, H. E. Stier, Nucl. Instr. Meth., 156 (1978) 211.

2. M. Edwards, Nucl. Instr. Meth., 156 (1978) 215.

3. J. Ballam, R. D. Watt, Ann. Rev. Nucl. Sci., 27 (1977) 75; R. C. Field, SHF Note 67, Dec. 1977, internal note of SLAC Group BC.

4. R. C. Field, SHF Note 62, Oct. 1977, internal note of SLAC Group BC.

5. Hexcel Corporation, Dublin, California 94566, USA.

Figure Captions

1. Isometric section of a P.W.C. half plane: (h) Honeycomb wall; (g) NEMA G10 end piece; (w) diagonal sense-wire plane; (s) gasket bearing surface; (m) Mylar desensitizing ribbon; (c) constraining chevron.

2. Efficiency across the desensitized region. The arrow indicates the position of the deadening ribbon, which was parallel to the 2 mm spaced sense wires.

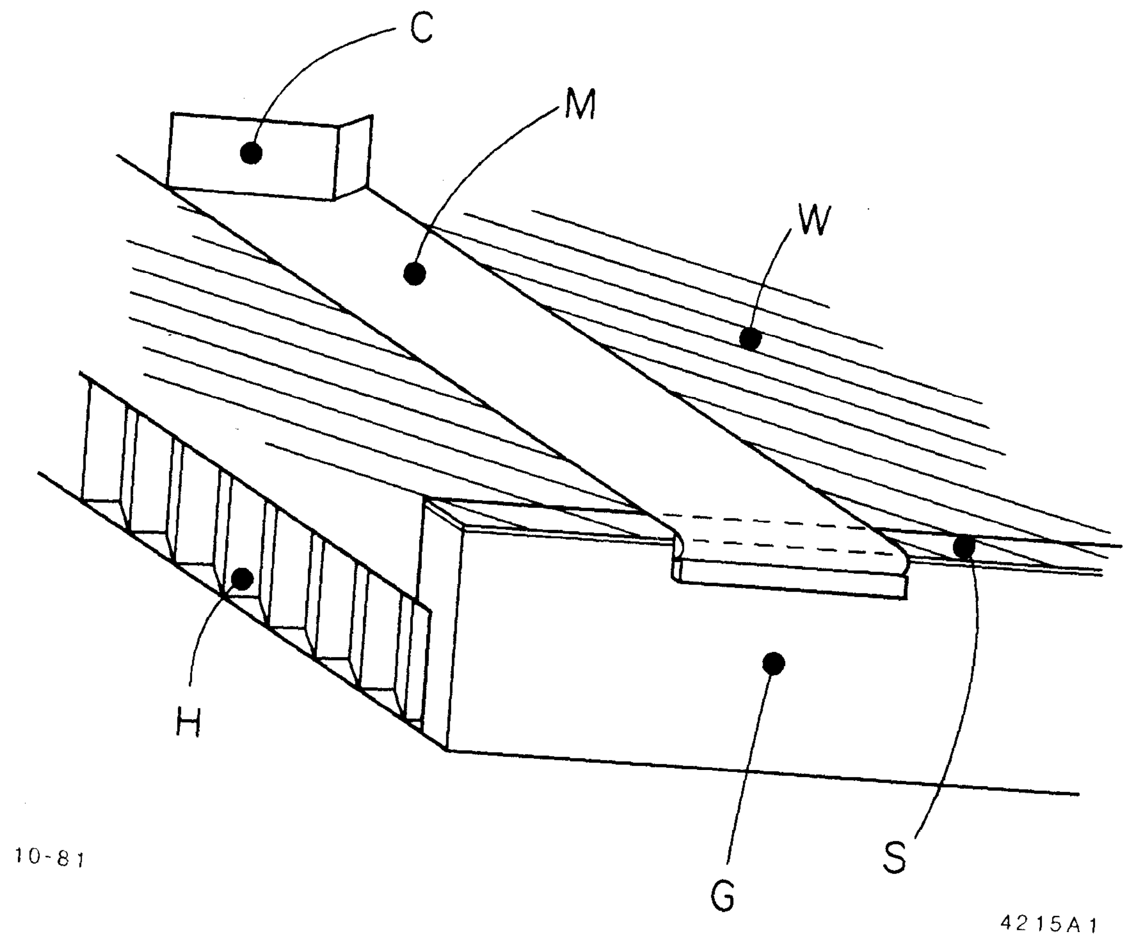
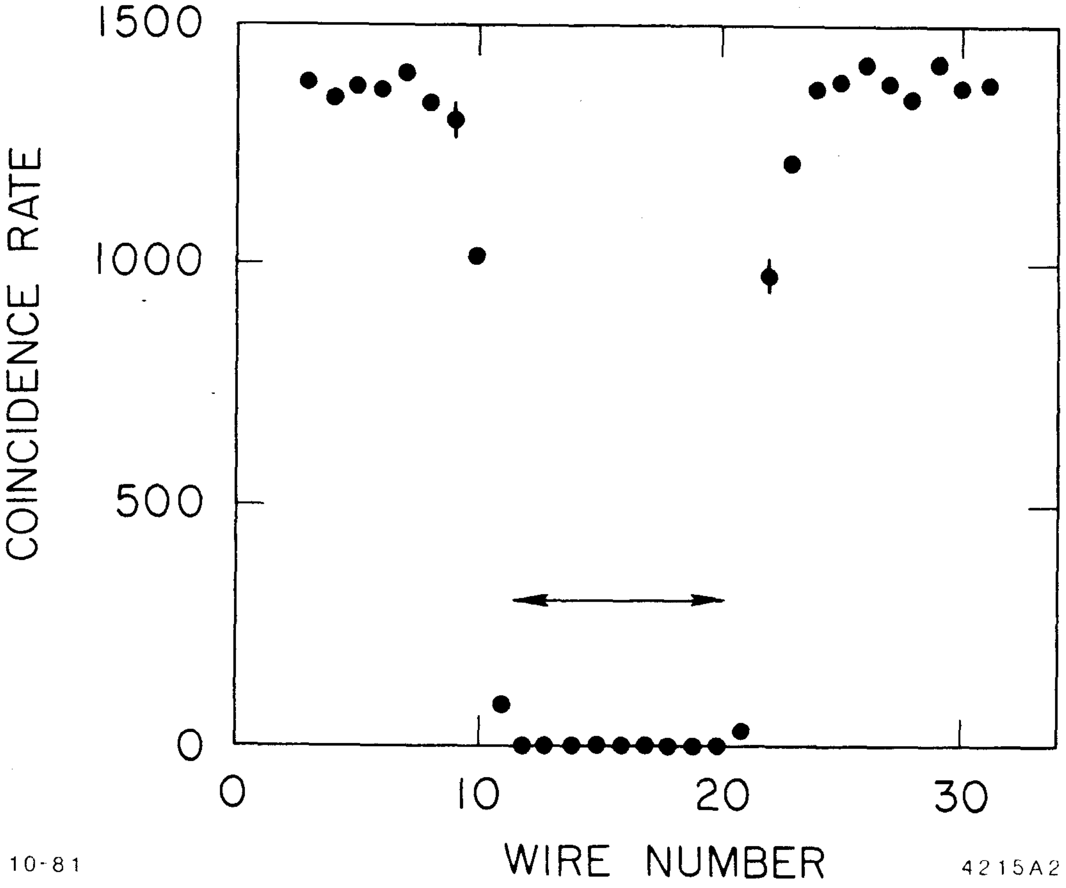


Fig. 1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COINCIDENCE RATE
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WIRE NUMBER
10-81
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Fig. 2