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THE MARKIII VERTEX CHAMBER AND PROTOTYPE TEST RESULTS*

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1. CHAMBER CONSTRUCTION AND PERFORMANCE

A vertex chamber has been constructed for use in the Mark III experiment. The chamber is positioned inside the current main drift chamber and will be used to trigger data collection, to aid in vertex reconstruction, and to improve the momentum resolution.

The vertex chamber consists of 640 thin-walled (100 μm thick) aluminised Mylar straws of 8 mm outer diameter, each having along its axis a 50 μm Au-plated tungsten sense wire, which is tensioned at 275 grams. The ends of the straws are fixed to 2.54 cm thick aluminum endplates, separated by 84 cm and epoxied to the beam pipe. The straws are arranged in 12 layers (4 axial, 4 stereo and 4 axial) at radii ranging from 5.4 cm to 13.0 cm. The chamber sits in a carbon fibre pressure vessel, sealed with a second set of endplates, allowing operation at pressures of up to 4 atm. The chamber signals, read out at one side through the same cables that provide the high voltage, are amplified by a factor of about 80 using fast (500 MHz) Avantek MSA-0135-22 RF amplifiers, discriminated and then fed into the trigger logic and time measuring electronics.

The chamber construction is completed and initial tests with cosmic rays, operating the chamber with argon/ethane (50:50) at 3 atm and at 3.9 kV, prove the ability to reconstruct tracks. Figure 1 shows the reconstruction of cosmic ray tracks with the first inner four layers connected. The radii of the darkened circles indicated in the figure correspond to the drift distances, as determined from the measured drift times, assuming a constant drift velocity of 50 μm / ns. Combining measured drift distances (d_i) from staggered tubes results in a triplet resolution of better than 50 μm.

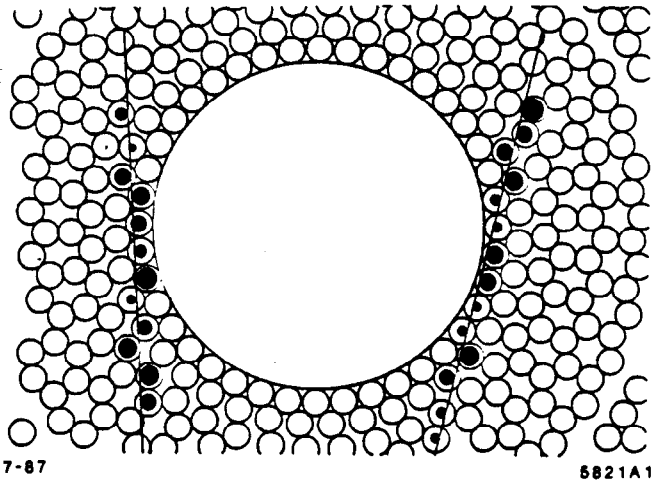

Fig. 1 : Reconstruction of cosmic ray tracks

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2. MATERIALS STUDIES

A study was undertaken to evaluate the potential effects on the straws of pressurised air, DME, argon/ethane (50/50 mixture) and argon/ethane (50:50) with a small (0.2%) percentage of water. One meter long samples of the aluminised Mylar straws, half with feedthroughs and half without, were placed in pressurised containers. Control samples were left exposed to the ambient temperature and pressure in our clean room. The straws weighed between 3 and 6 g, depending upon whether they contained Delrin feedthroughs. The accuracy of the measurement was 0.01 g. The lengths of those straws containing feedthroughs were measured to an accuracy of 0.25 mm.

After one month the samples were removed from the containers and remeasured. The relative weights of the samples exposed to DME increased by approximately 10^{-2} and the relative lengths increased by about 10^{-3}. No significant change was observed for the samples in other gases. We also noticed that the Delrin feedthroughs exposed to DME swelled.

3. PROTOTYPE TESTS

A prototype of the vertex chamber, with identical straw construction but different geometrical arrangement, was used to study the performance for various gases and pressures. Cosmic ray data from straw triplets, staggered by about ± 100 μm, were employed to calculate the single tube resolution σ. Figure 2 shows this resolution, obtained under different operating conditions. Including tracks at all radial and longitudinal positions, and without applying corrections as a function of the longitudinal position of the track, we obtain 30 μm spatial resolution for argon/ethane (50:50) at 4 atm and $\sigma = 35$ μm at 1 atm using Dimethyl ether (DME). Note that the DME resolution remains fairly constant over a broad range of operating voltages, in contrast to the argon/ethane result. Furthermore, the use of DME allowed to operate the prototype chamber at a very high gain of up to 10^8. The addition of small percentages of water (0.2% and 0.3%) to the argon/ethane mixture did not exhibit any changes in the resolution.

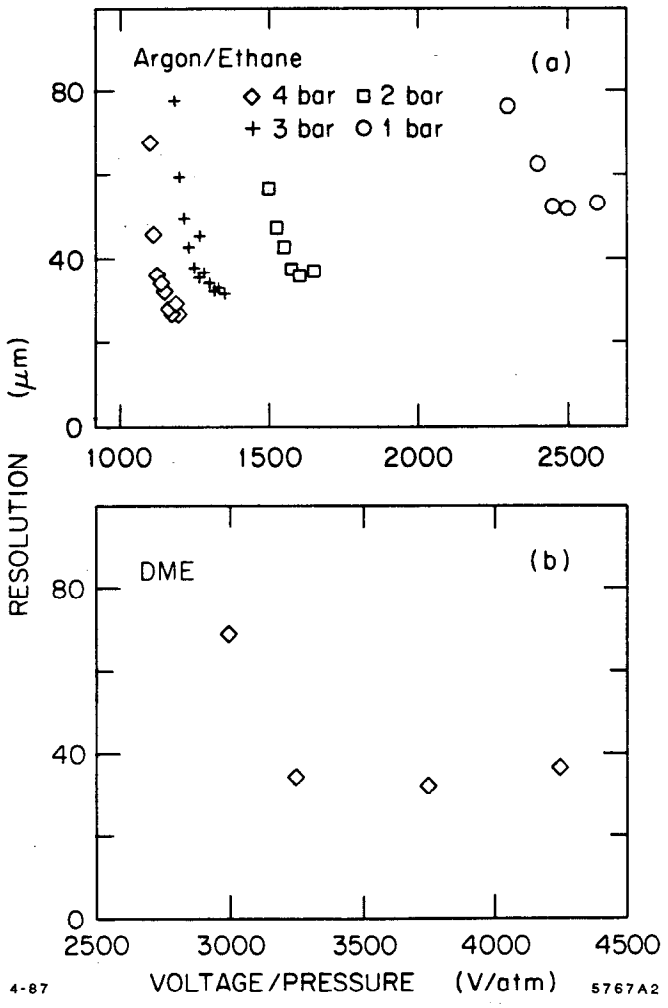

Fig.2: Single tube resolutions as a function of high voltage for a) argon/ethane (50:50) and b) Dimethyl ether.