

The 8th International Conference on Micro Pattern Gaseous Detectors (MPGD2024)



Contribution ID: 72

Type: **not specified**

9. Performance study of 400mmx400mm and 600mmx600mm micromegas track detectors using cosmic rays

Tuesday 15 October 2024 17:17 (4 minutes)

The large area and high spatial resolution of particle detection are important aspects in the research and application of MPGD. Currently, there is no satisfactory technological solution to address these challenges, particularly in achieving long-term stable, high-resolution readout of large area detectors, and managing high irradiation background and counter rates. In this study, we utilized the thermal bonding method for manufacturing Micromegas detectors and conducted production and research on large area Micromegas detectors ranging from 400mmx400mm to 600mmx600mm in size. Several large area Micromegas detectors have been successfully developed, and a cosmic ray test system has been established. Using this system, we developed an alignment algorithm and investigated the position resolution, detection efficiency through performance testing, and micro-TPC reconstruction. A new alignment algorithm for plate detectors based on MillepedeII was developed using this system, effectively addressing the convergence issue of traditional algorithms in the rotation alignment of the x/y direction. The results of the cosmic ray test demonstrate that the detection efficiency of the 400mmx400mm thermal bonding Micromegas detector exceeds 95%, with a position resolution of approximately 130 micrometers. The position resolution of micro-TPC reconstruction is approximately 160 micrometers for particles with incident angles greater than 20 degrees. This paper covers the manufacturing of large area Micromegas detectors, cosmic ray testing, and data analysis methods.

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Session Classification: Poster Session