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A cylindrical μRGroove detector for the super tau-charm facility

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The Micro-Resistive Groove (μRGroove) is a single-stage MPGD featuring a groove amplification pattern. When developed into a cylindrical structure, it requires only two cylinders (electrodes) with independent support foams, offering advantages such as a simple structure, easy installation, and high mechanical strength. Additionally, the cathode of μRGroove can serve as a 1D readout strip (X-strip). With just one additional 1D readout (V-strip) located at the bottom of the amplification structure, 2D position resolution can be achieved. This geometry avoids the induced charge-sharing effect, increases the signal amplitude, and helps reduce the material budget. In this study, we present the design and production of the cylindrical μRGroove, with the first prototype having an effective area of 131 mm in diameter and 100 mm in length. This includes its detachable mechanical structure, low-mass type electrode design, vacuum gluing process, and reversible installation method. The total material budget of the sensitive area is ˜0.23% X0, and it can achieve an energy resolution of ˜26% and a maximum effective gain of ˜10000. The induced signal amplitudes on the X and V readout strips are roughly the same. Further beam test were conducted by 150GeV/C muons at the CERN-SPS beamline. Preliminary results show a detection efficiency >95% and a spatial resolution of <100μm for vertically incident particles. Results of μTPC mode and oblique incident particles are still under analysis. Due to its low mass, good spatial resolution, and high rate capability, the cylindrical μRGroove could be an ideal solution for the inner tracker in STCF experiments.

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