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A tile prototype of the Plastic Scintillation Detector for HERD based on long Printed Circuit Boards: design and test with ion beams at CNAO

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The Plastic Scintillation Detector (PSD) is one of the subdetectors of the HERD apparatus, planned to fly onboard the Chinese Space Station (CSS) in the second half of the 2020s to study high energy Cosmic Rays (CR).

The main requirements of the PSD are to provide online trigger for CR and online veto for gamma rays and to determine the charge of CR ions measuring the energy loss on five sides. Veto requires very high hermeticity as close as possible to 100%.

Rejection of backsplash particles produced from interaction in the calorimeter surrounded by the PSD required also precise timing.

The requisite of measuring CR charge for Z up to iron requires a large dynamic range that cannot be reached with a single read out chain.

With all those constrains we developed a prototype for testing with ion beams at CNAO (Centro Nazionale Adroterapia Oncologica).

The prototype consists of long (50 cm) Printed Circuit Board (PCB) each housing 5 tiles.

SiPMs of different sizes 5 of 3x3 mm² and 4 of 1x1 mm² mounted on the PCB reads out each tile on the wide side to guarantee uniformity of light collection.

Signals are extracted to one end of the PCB through lines inside the PCB avoiding cables.

Two long PCB can be electrically and mechanically joined to create a 100 cm long ladder with 10 tiles.

In addition the edges of the tiles are shaped such to overlap guaranteeing full hermeticity.

This configuration has been tested extensively with p and C beams at CNAO

at different energies such to mimic the energy loss of higher Z ions.

The full SiPM waveforms are acquired by a high frequency digital oscilloscope and stored for offline analysis.

Collaboration

HERD

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