The Chinese Space Station

HERD will be located on the CSS.

The Plastic Scintillator Detector

The correlation between the signal amplitude and the Birks’ law is well fitted with a Birks’ law:

$$A = P_0 \frac{\Delta E_{th}(Z^2)^{\alpha}}{\Delta E_{th}(Z^2)^{\beta}}$$

The 2019-2020 results proved the concept of using low energy (p,C) ions to provide energy losses as large as high-Z high energy ions. Saturation in light production following Birks’ law was confirmed and its parameters measured.

Beam Test 2021: the long PCB

A new design of the tile is required to satisfy the requirements:
- full hermeticity (no dead space between tiles)
- mechanical support for the tile structure
- uniformity of response on tile surface
- two readout channels per tile with low-high gains to match the broad dynamic range in energy loss from proton to iron and beyond

Possible solution: long Printed Circuit Board (PCB) 50 cm long (to be extended to 100 cm) hosting 5 tile 10x10x0.5 cm² each. Two sets of SiPMs located on the wide face to avoid dead space between tiles.

One set, 3x3 mm² with large gain, the other 1.3x1.3 mm² with low gain. SiPM are located to guarantee a good light collection uniformity for both sets.

We put under test at CNAO a long PCB with 2 adjacent tiles.

CNAO provides low energy ion beams (p,C) compared to high-Z high energy ions

Energy loss of ions

Possible solution: long Printed Circuit Board (PCB) 50 cm long (to be extended to 100 cm) hosting 5 tile 10x10x0.5 cm² each. Two sets of SiPMs located on the wide face to avoid dead space between tiles.

One set, 3x3 mm² with large gain, the other 1.3x1.3 mm² with low gain. SiPM are located to guarantee a good light collection uniformity for both sets.

Beam Test 2019-2020

Test scintillator tile (EJ200) 10 cmx10 cmx0.5 cm² each by 5 SiPMs 3x3 mm², (opposite sides) in parallel

The PCB 50 cm long is designed to house 5 tile 10x10x0.5 cm² each by 5 SiPMs 3x3 mm² connected in parallel. Two sets of SiPMs connected in parallel (low gain) and by 4 1.3x1.3 mm² connected in parallel (low gain), signals are routed to the connectors (left side below). Two of these PCB can be ganged together to form a 1 m long PCB with 10 tiles.

Conclusions

Prototypes of the HERO PSD have been tested with ion beams at CNAO. Saturation effects in scintillator are measured. The principle of long PCB read out is proved. Amplitude measurements in low-high gain channels correspond to the expectations. The time resolution is adequate for the requirements of the experiment.

Preliminary