Continuing development of compact MWPC detectors for TRINAT experiment

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Overview

The planned position sensitive multiwire proportional counter (MWPC) detectors, which will be replacing the double-sided Si-strip (DSSSD) ΔE-detectors making up part of the TRINAT experiment's current β telescope assembly, are approaching final assembly and their first characterization tests.

The current revision of the MWPC detectors incorporates onboard charge-sensitive shaping pre-amplifiers on its 40 position channels, 20 along each X/Y axis, and will occupy a smaller size footprint than the previous revision, with just 16 mm of height.

These new detectors will aid with the limiting systematics of energy loss and backscattering incurred by the DSSSDs. The current revision of the MWPC design is under assembly, and should be ready for testing within a month. Additionally, areas for potential design improvement have been noted throughout the past year, allowing for changes in future revisions.

MWPC circuit boards

After discussion with suppliers and several design revisions, the necessary printed circuit boards were fabricated (see Fig. 1). Conformal coating was applied to protect from arc discharges or leakages at the high voltages that the MWPC will need to operate at. Additionally, holes and slots were drilled in the boards to accommodate the bolts needed to hold the assembled detector together.

Fig. 1. MWPC circuit boards stacked to demonstrate overall form factor.

Anode wire assembly

To create the anode wires of the wire chamber detector, gold-coated tungsten wire of diameter 12.6 μm was strung across the channels of the detector using built-in guide hole vias to ensure alignment. The anode wires were given a consistent amount of tension using a suspended weight from the wire ends, and soldered on both sides of the board for a strong connection. Figure 2 shows these anode circuit boards.

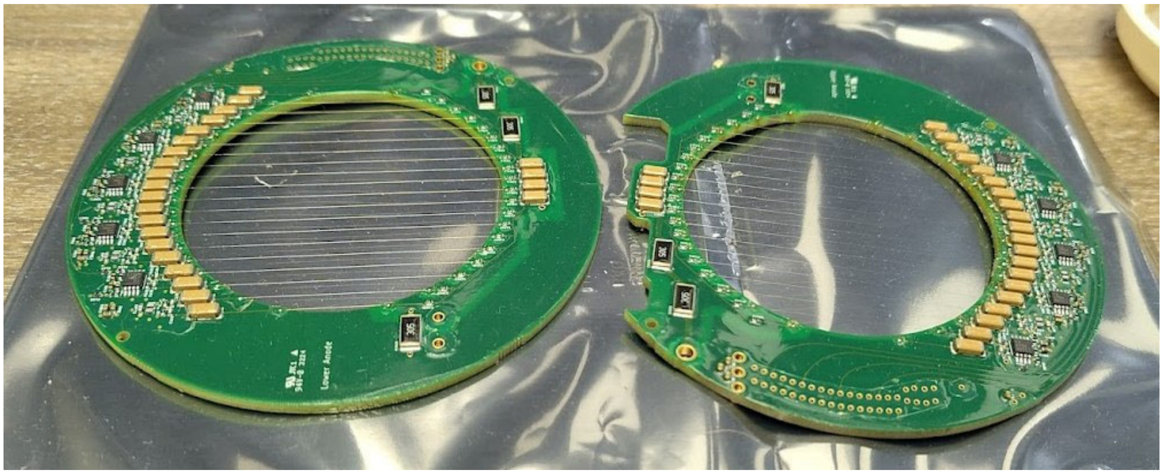

Fig. 2. Anode circuit boards with gold-coated tungsten wire strung to form anode wires.

Cathode assembly

Wire chamber cathodes were made with double-sided aluminized Mylar foil and attached with a silver-based conductive epoxy. This allows for flush attachment with a low-resistance electrical connection, without the need for additional reinforcement, which would increase the height of the detectors. The foil was kept stretched taut during gluing, and then carefully cut out afterward, to ensure a fully planar cathode.

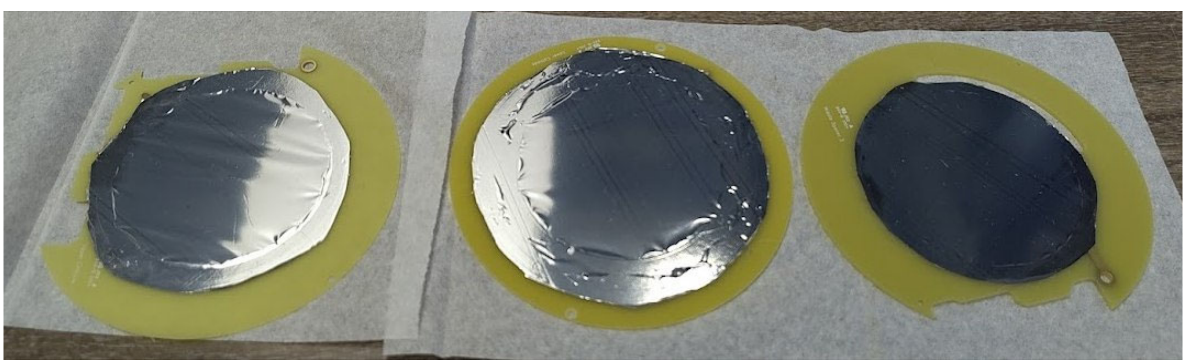

Fig. 3. Cathode boards with aluminized-Mylar planar cathodes.

Gas flow ports

Gas inlets and outlets were cut out of copper tubing of diameter 3 mm, and soldered directly to the board, to provide an electrical ground connection for the lower two cathodes. The ports can be easily swapped out with a soldering iron, to allow for differing lengths and shapes of tubing as needed. For example, to prevent excess pressure in the active area of the detectors, the inlet port will be crimped to increase flow resistance and limit the gas flow rate.

Spark discharge testing

To determine the tolerance of the sensitive detector electronics to currents induced by potential arc discharges within the active area of the detector, similar arc discharges were applied to test boards and amplifier performance was measured before and after testing. The amplifier electronics were determined to be more resistant to arc discharge when left floating with no path to a ground reference. Using this information, voltage limits can be determined for safe detector biasing, conditioning, and operation.