A Low Mass Straw Tube Tracker for the Mu2e Experiment

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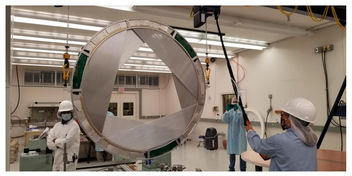
Tracker Construction

The Mu2e tracker will search for 105 MeV conversion electrons from $\mu^- Al \rightarrow e^- Al$ interaction.

- Main detection element of the Mu2e experiment.
- Low mass tracker using straw drift tubes running ArCO2(80/20).
- 25 μm Tungsten wire as the anode.
- 21600 x 5 mm OD metalized 15 μm thick walled Mylar straws;
  - Inner coat provides cathode.
  - Outer coat provides shielding and reduces leaks.
- Highly segmented -> 36 planes -> each made from 6 panels.
- Momentum resolution < 180 keV/c.

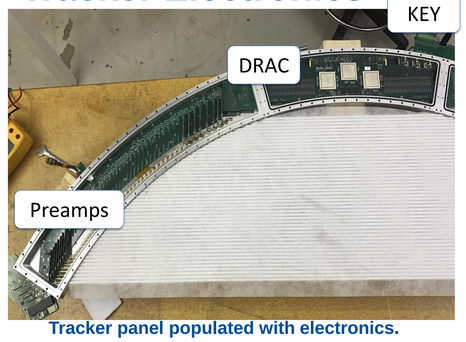
Tracker straw and CO2 leak test.

Tracker panel construction in U. of Min.

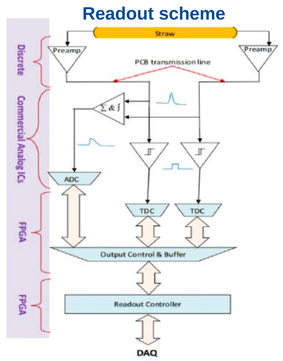


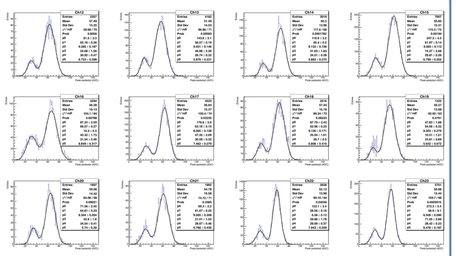
Completed plane in FNAL and final tracker with 36 planes.

Tracker Electronics



Tracker panel populated with electronics.





Fe-55 spectrum for panel # 16.

Electronics are installed within detector volume.

- Both straw ends are terminated with preamps that reads the signal in pairs.
- DRAC(Digital Readout and Controller) houses FPGA's and ADC's.
- Key board houses the optical links for data as well as LV.

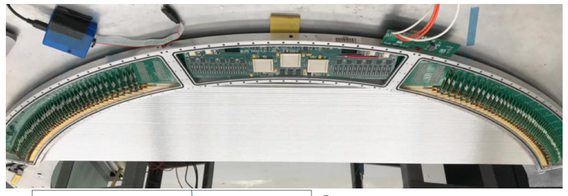
TDC;

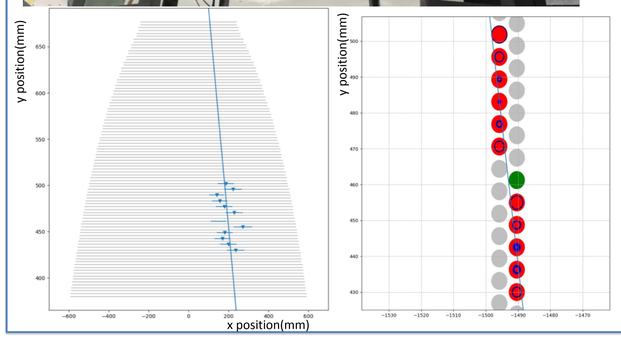
- Time division to locate hit position.
- Longitudinal resolution of 4 cm.
- Individual threshold crossings are digitized.
- Coincidences within 40 ns are kept.

ADC;

- Digitized analog sum of both ends @ 50MS/s.
- Get pre and post samples in case of a coincidence.
- Form hits and send to DAQ.

Cosmic ray track for a single vertically aligned tracker panel.

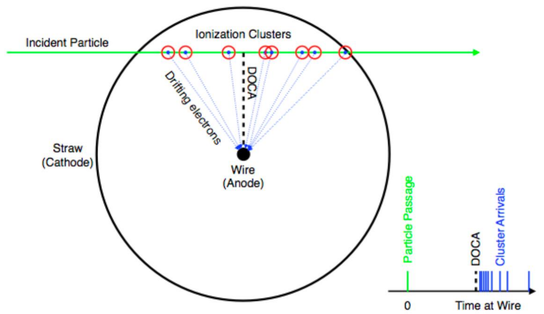




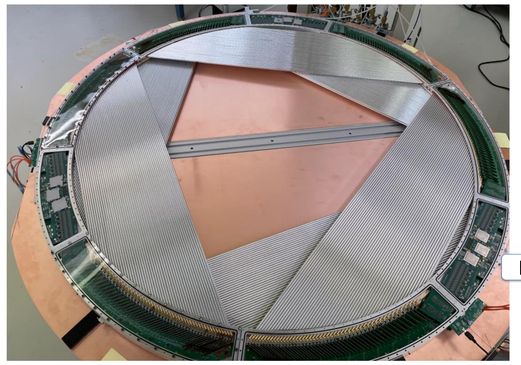
Cosmic rays with production panel

A tracker panel was placed vertically for this cosmic ray test.

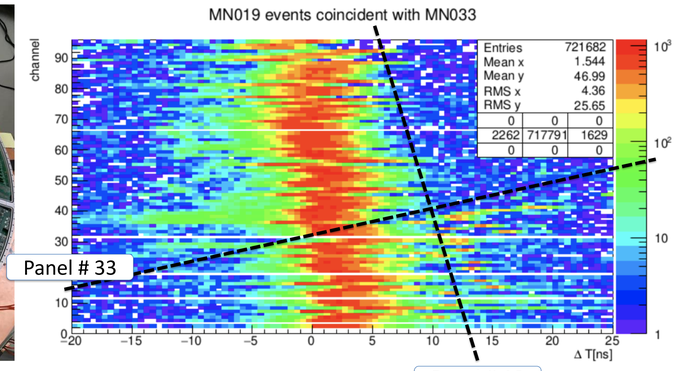
- DOCA(distance of closes approach) is determined to compute drift time.



Vertical Slice Test of a production tracker plane



VST plane with production electronics.



VST plane was the first plane to be constructed and populated with electronics. It is under commissioning and testing since Jan-21.

- Readout through optical fibers and readout controllers using Tracker DAQ.
- VST electronics cooled with a ¼" copper tube installed around the plane running water at 20 C. Actual tracker will use SUVA coolant.
- Cosmic ray coincidences are read with 500 triggers per panel & run.

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