Tracker and Calorimeter Based Veto Development

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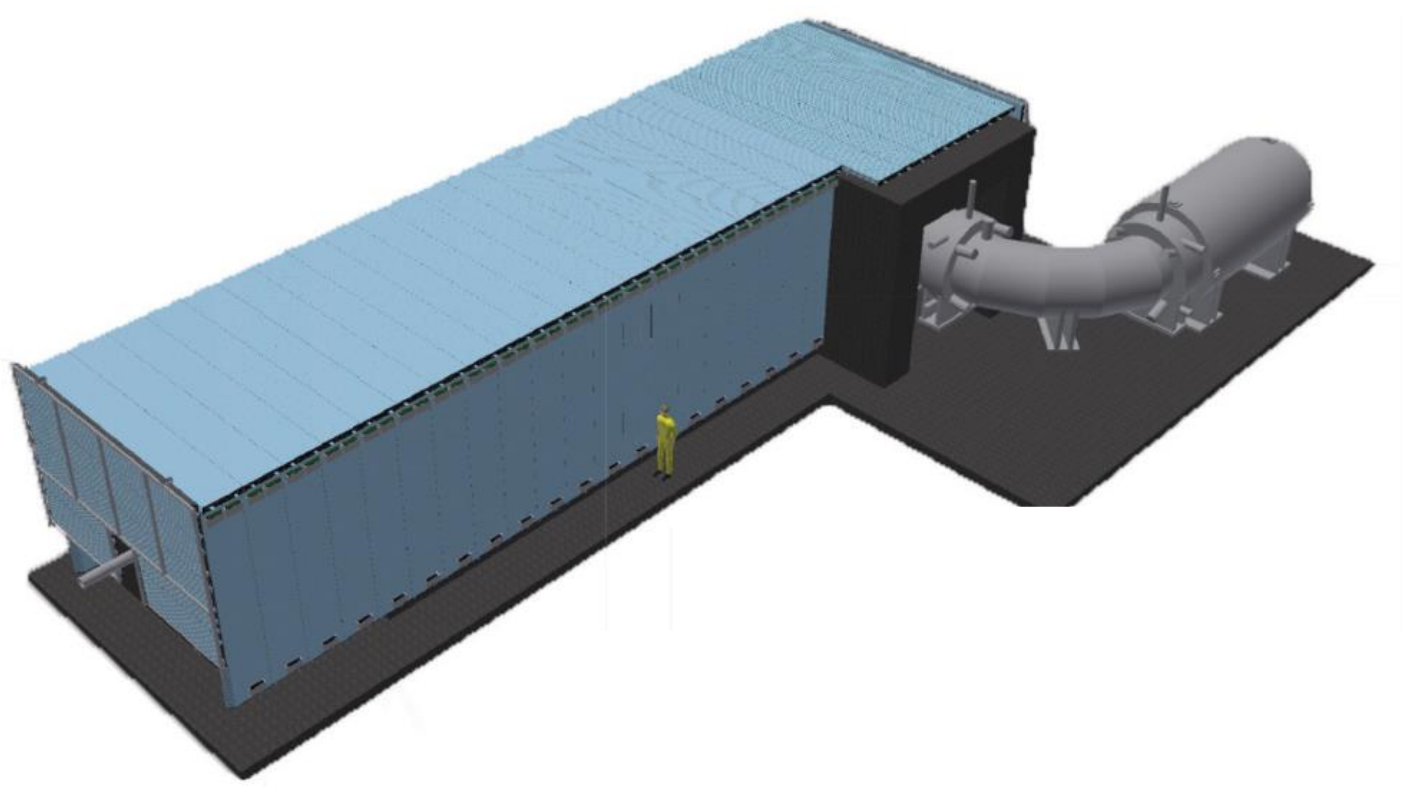
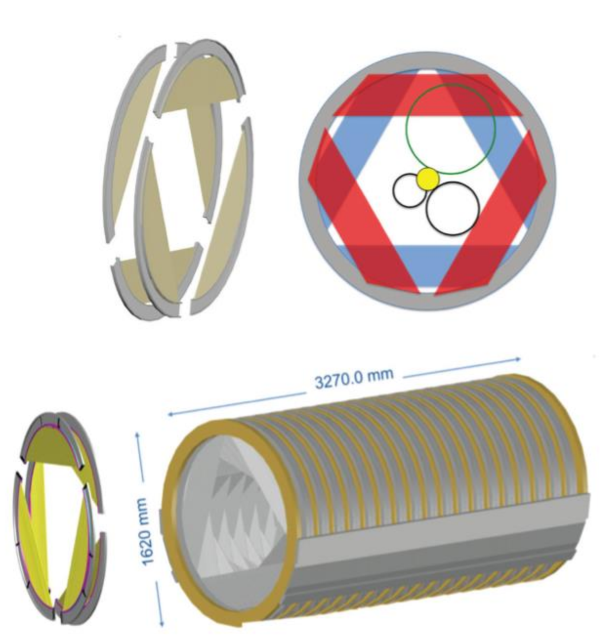
The Cosmic Ray Veto

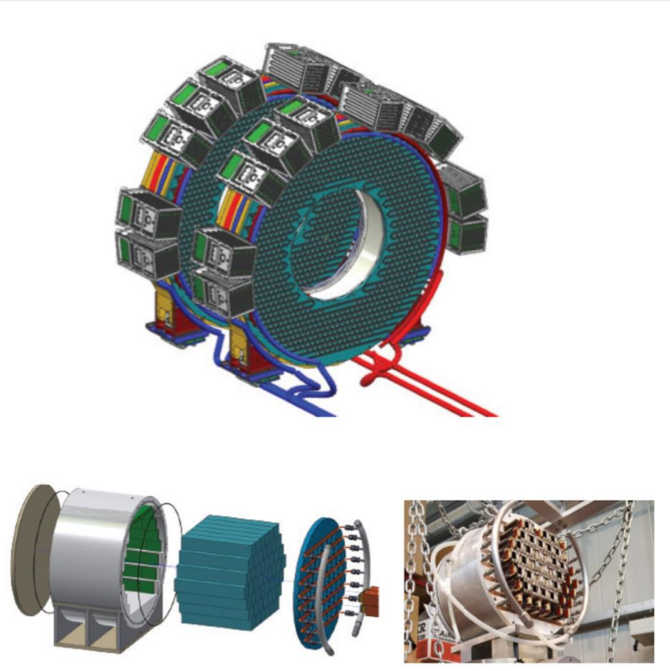
- Cosmic rays produce electrons that closely mimic the ~105 MeV conversion electron signal ~1/day.
- A cosmic ray veto will be constructed around the downstream side of the transport solenoid and the detector solenoid to detect these cosmic rays.
- It will be composed of four layers of scintillator strips separated by aluminum absorbers.
- It is designed to identify ~99.99% of all cosmic rays entering the detector so that any signals within ~125 ns of the cosmic ray can be ignored.



The cosmic ray veto system. It will enclose the detector solenoid and downstream half of the transport solenoid.



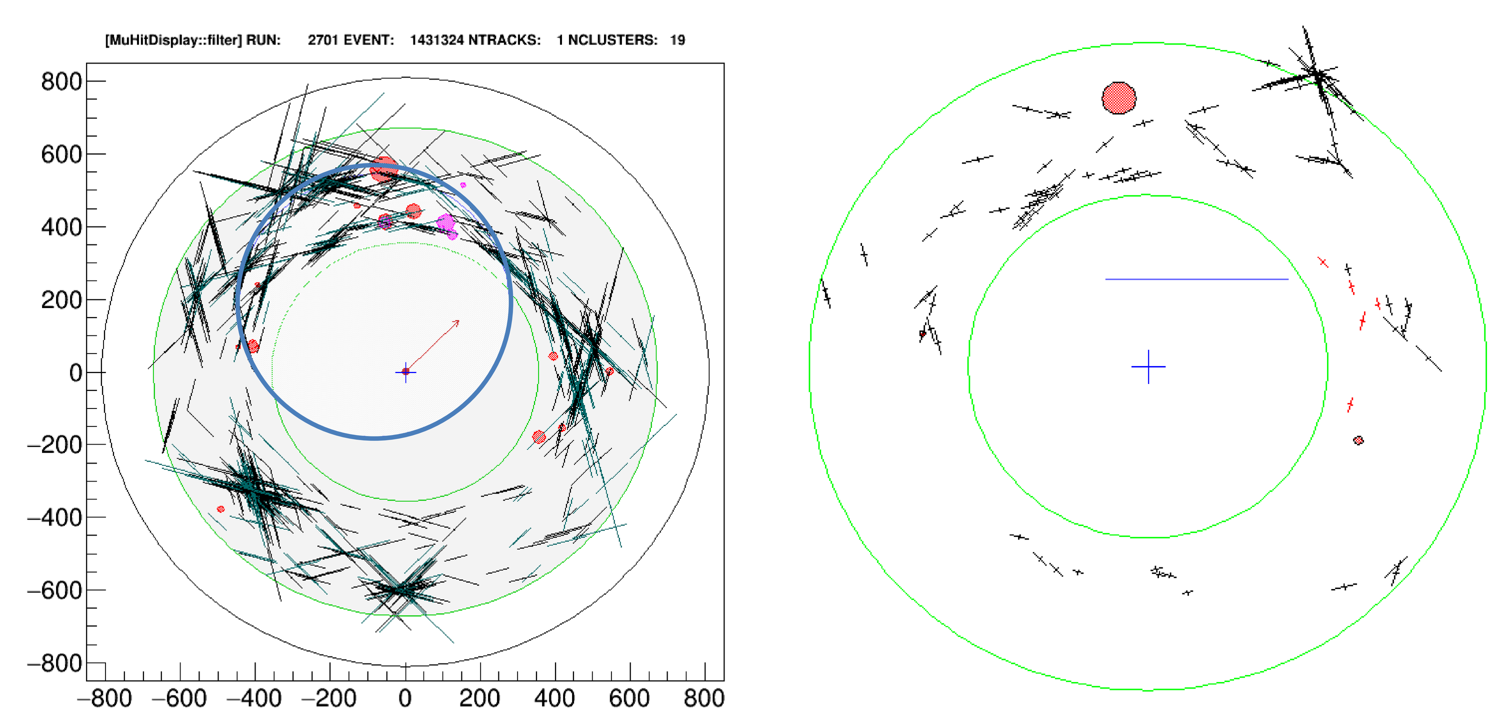
The tracking system. 96 straws form a panel, which covers 120 degrees. 3 panels for a plane, and two planes skewed at 60 degrees form a station. The tracker consists of 18 stations.



A schematic of the calorimeter. You can see the two separate disks and the readout locations. The bottom half of the shows the test module assembly schematic and the final assembled module.

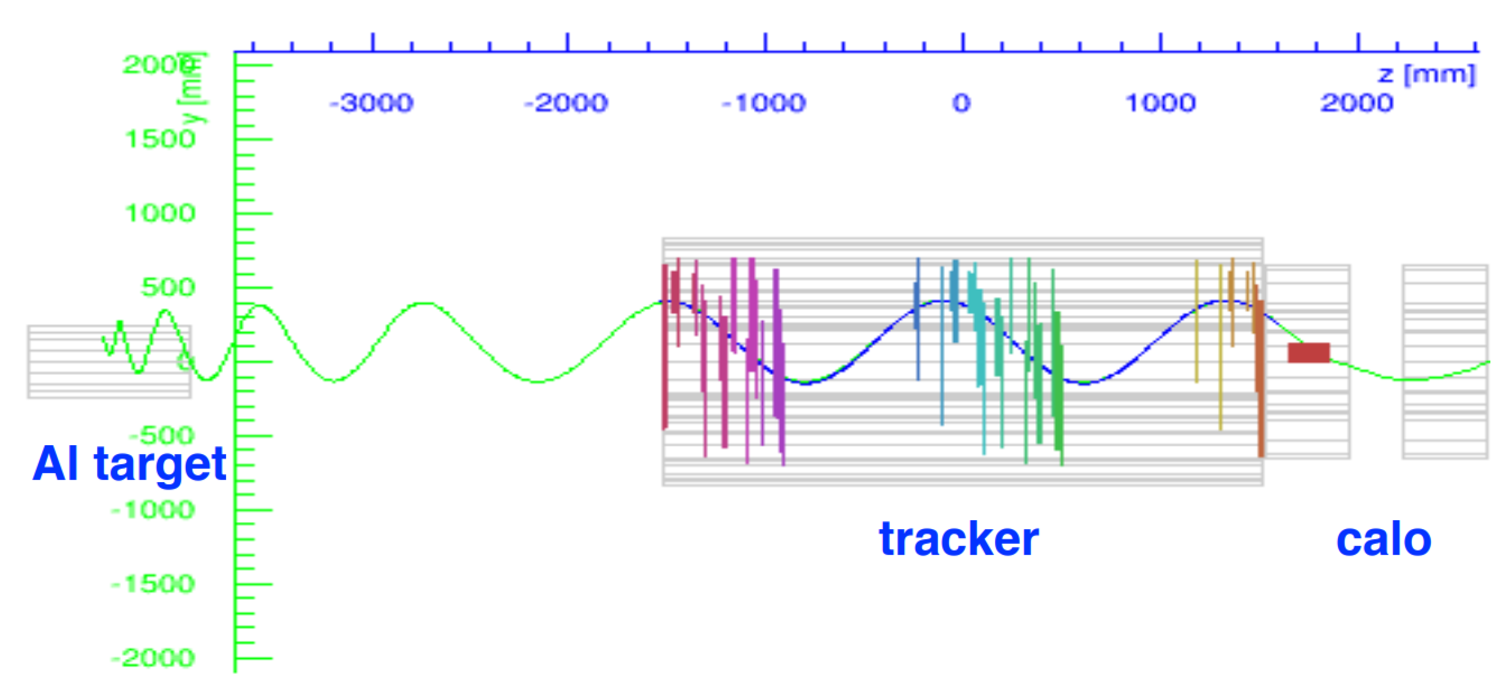
Tracker Based Veto

- Cosmic rays colliding with the calorimeter produce electrons that can travel upstream in the detector before being turned by the magnetic field, returning downstream and mimicking a muon conversion electron.
- These upstream tracks may be usable to create an additional veto.
- The tracker does not consistently recognize these upstream tracks, so work can be done to improve the upstream track recognition.



On the left is the collects of all hits in the tracker during one event. The blue circle is a reconstructed helix.

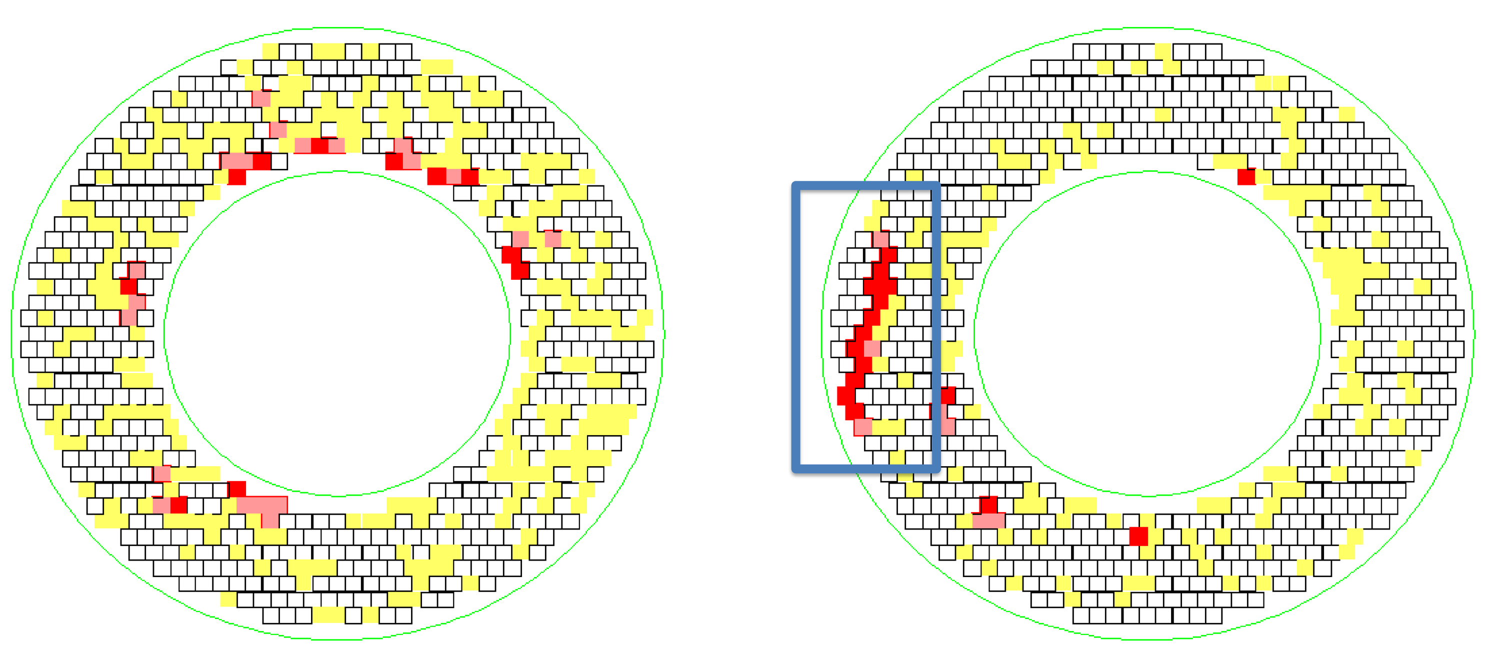
On the right are all the hits during the timecluster of the reconstructed helix.



The reconstructed path of an electron produced from a cosmic ray interaction in the stopping target, passing through the tracker and calorimeter and mimicking the muon conversion signal.

Calorimeter Based Veto

- The calorimeters large size and density mean it the part of the detector most likely to interact with cosmic rays.
- Cosmic rays passing through the calorimeter create a distinctive line of ~20 MeV signals, a "cosmic sword."
- The cosmic sword provides another means to identify and cosmic rays that the CRV missed, and may thus provide an additional veto or independent efficiency measurement.



A diagram showing the energy deposited in calorimeter crystals over the course of a simulated event. The long red line in the right diagram is characteristic of a cosmic ray muon passing through the calorimeter.

Future Work

- Examine the efficiency of the CRV to see how much improvement these additional vetoes could provide.
- Examine tracks and calorimeter data from events where the CRV did not recognize an incoming cosmic ray, I can see if these additional vetoes could reliably pick up on cosmic rays that the CRV missed.
- Investigate methods to improve the efficiency of the existing CRV coincidence finder by corelating different signals coming from the same cosmic ray within the same scintillator strip.

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