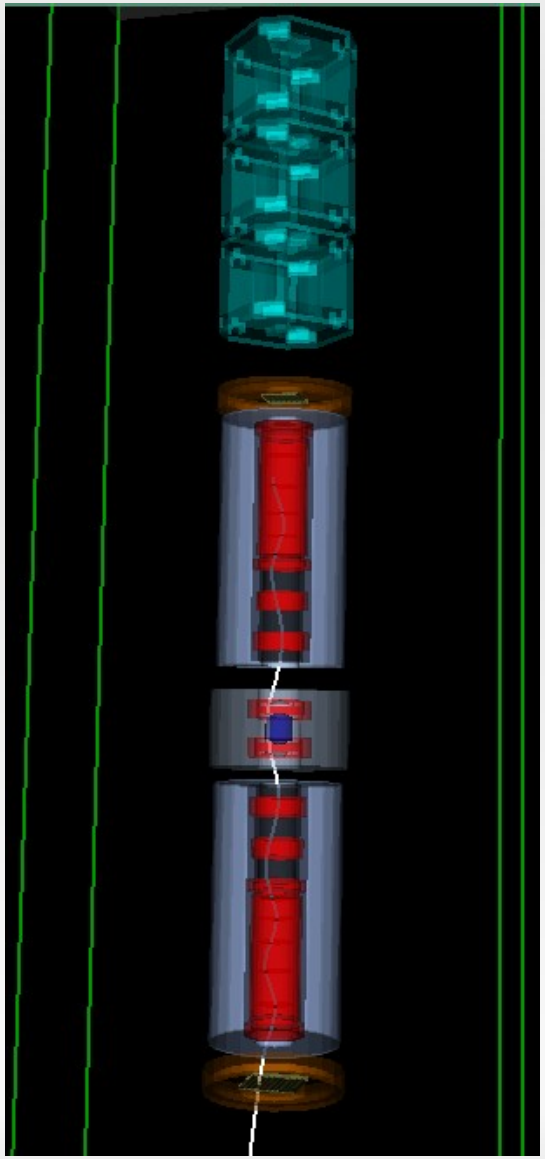
Status of the Tracker MC

Christopher Heidt
UC Riverside

For MICE CM 34

Outline

- Since Last CM
- Current Projects
  - Code Tests
    - PR Analysis
  - Physics
    - Tracker Geometry
    - Noise from Electronics
    - DAQ Timing
- Conclusion



Updates Since Last CM

Scintillating Fiber Definition

- At last CM and at the tracker workshop, fiber length determined by clipping off the side of mother geometry
  - Fiber length fixed, plane geometry created by running fibers beyond defined area
  - Poor implementation, it works, but may lead to trouble in the future
- Length should be handled by Geant Parametrization class
  - Change introduced in how parametrization function “ComputeDimensions” is called in a Geant updated
  - Incorrect function definition in MAUS meant function never found when Geant called parameterizations
- End result, passing the correct information to function, allows for parameterization and size of fibers now changed based upon position within the tracker plane

Tracker MC used as Test

- Passed the Digitization stage MC recon is identical to data recon
  - Provides a useful tool for troubleshooting code
  - In the process of building more tests
- Updated tracker data structure
  - Heavy lifting done by Adam Dobbs
  - MC used in bug testing the switch
- Test tracker pattern recognition code
  - Straight track and helical track recon code run against MC StepIV runs
  - Output shows good (“eyeballed”) track reconstruction

Other Smaller Issues

- Test written for MC code
  - Increase in line coverage from ~ 10% to ~85%
  - Allows changes in MC to be pushed to general MAUS trunk
- Issue of incorrect NPE being generated has been solved
  - Digits being collected to form clusters incorrectly
  - Digit cutoff too high, ignored lower energy events
- Attempts to model fibers off active plane made
  - Implemented incorrectly, needs more care.
- Origin of beam moved, now travels through all of the tracker

Projects

Pattern Recognition Analysis

- Being developed primarily by Savannah Thais and Natalie Harris at the University of Chicago
- Develop code to seed PR functions with MC truth results in tandem to using space point reconstruction from Geant energy deposition.
  - MC normal running
    - Hit Event(edep) → Digits(channels) → Clusters → Space Points → Pattern Recognition
  - PR Analysis
    - MC True → Pattern Recongnition

Pattern Recognition Analysis

- Requires two pieces of code:
  - The Map
    - Runs during simulation
    - Collects MC truth results
    - Transforms MC truth into a form that can be used by PR functions
    - Writes out results to separate file
  - Analysis Script
    - Reads in the Map's output
    - Runs analysis against MAUS output
- Oct 8th Map pushed to tracker development branch
  - Rumors abound about existence of the Script, however, it is yet to be seen.

Tracker Geometry

- Transfer current geometry information from .dat legacy format to GDML and upload to CDB
- Once the legacy information is uploaded some questions need to be answered:
  - Verify position of objects already in geometry
    - How were these numbers generated?
    - How much do we trust them?
  - Deformations in planes (Bowing)
    - Should be able to model bowing, but...
    - Should we worry about it?

Tracker Geometry

- More Questions:
  - Station position relative to each other
    - Can we get offset information from cosmic runs?
    - Has the been done?
  - Add objects not in legacy
    - Fibers outside active area
    - Carbon fiber tracker body and stations
    - Down to what level?
      - Light guide connectors?
      - Bolts?
      - Other?

Simulating Noise from Electronics

- Noise will be introduced via cross talk between channels and in thermal electrons in VLPC
  - Thermal electrons should result in 2% chance in extra PE per channel
  - Cross talk will produce jitter in NPE per plane
- Steps to be completed
  - Analysis of May single station run to determine extent of cross talk
  - Calibration currently implemented globally, needs to be on a per channel basis

Simulating DAQ Timing

- MC currently works on a particle by particle basis
  - No matter how close two particle events are in time they never overlap
  - Infinite resolution in time
- Propose change to how digitization works
  - Define trigger event to start data taking window
  - Use timing information to determine position of event in the window
  - Build digits from events that pass selection criteria
- Models MC results after MICE DAQ while preserving MAUS data structure.

Conclusion

- Tracker MC has provided a useful tool in preparing code for Step IV
- There is still a lot of:
  - Studies to be completed
  - Test to be written
  - Questions to be answered