Far-Forward Updates

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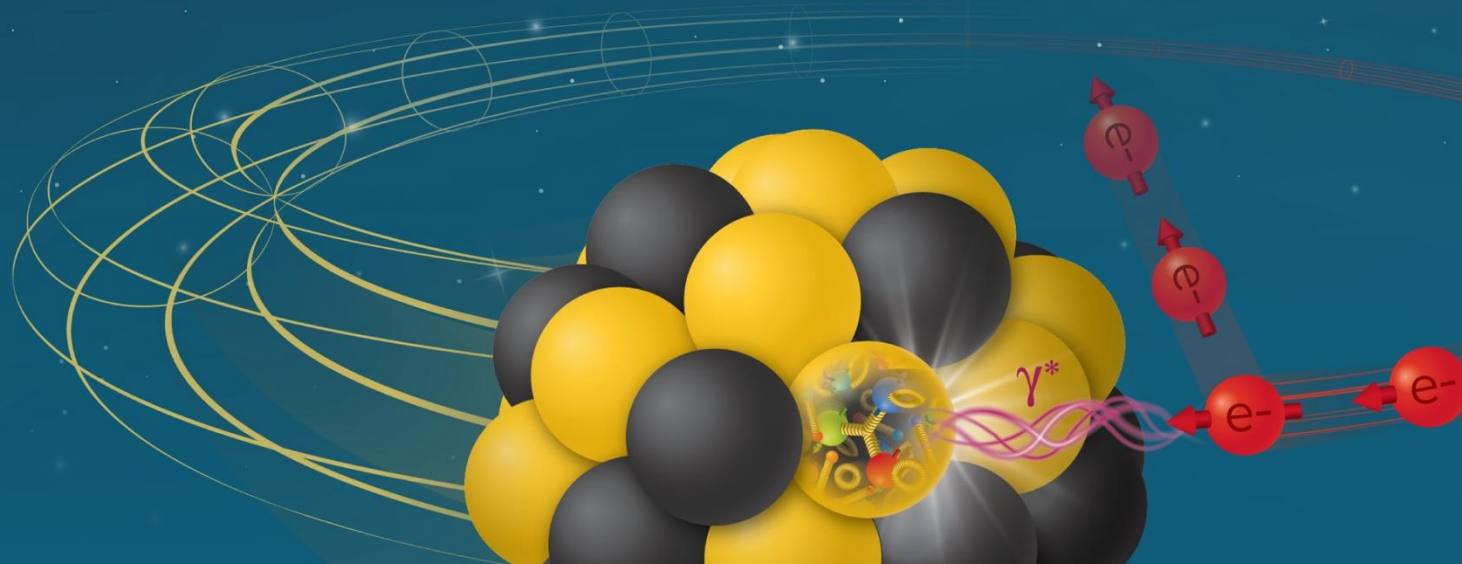
ePIC TIC Meeting
Monday, Oct. 14th, 2024



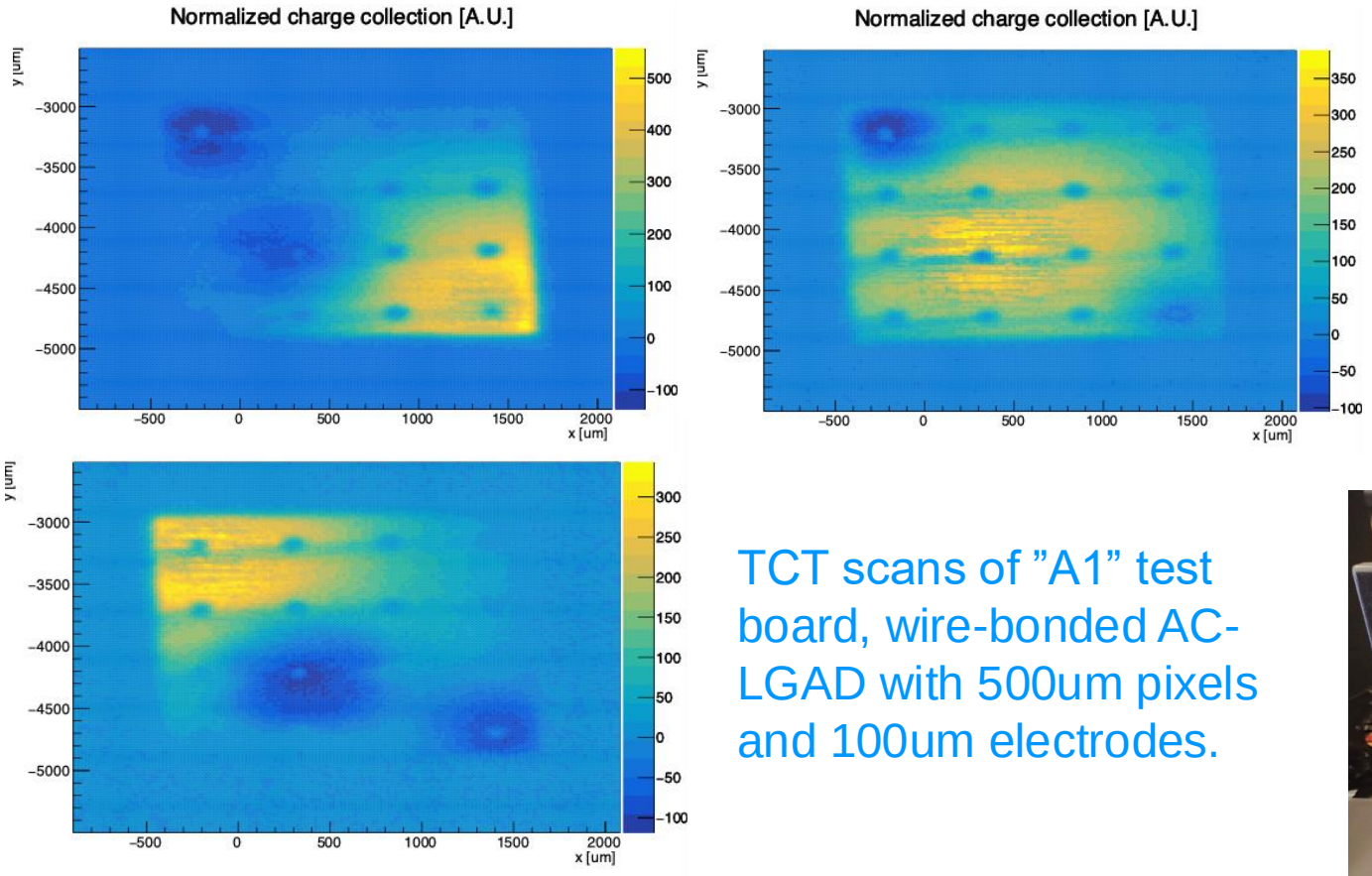
Electron-Ion Collider

Overview of things going on…

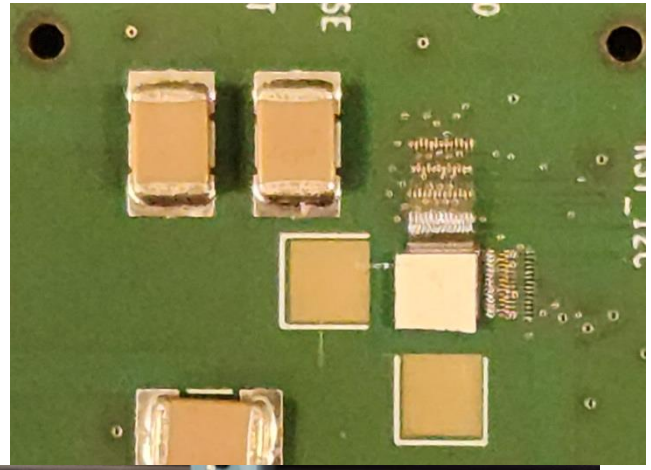
- Major work being done on AC-LGAD and EICROC testing.
  - Progress on ASIC testing with new firmware → still having some problems with the digital readout, should be solved (or ready to ask questions to ASIC experts) this week.
  - First “quality” TCT scans of pixilated AC-LGADs taken at BNL → work to be done this week on jitter measurements.
- Progress on FF beam pipe design and iterations with vacuum group.
- Much work to be done on B0 magnet and beam pipes.
  - We have made progress on the detector aspect of things, but we have dangling issues which need input from the machine → in-progress.
- ZDC was discussed a couple of weeks ago → nothing brand new since that discussion.
- Roman pots geometry has been updated (see the PR here) to properly account for various beam settings for protons.
- Bug identified in the RP matrix reconstruction.

AC-LGADs

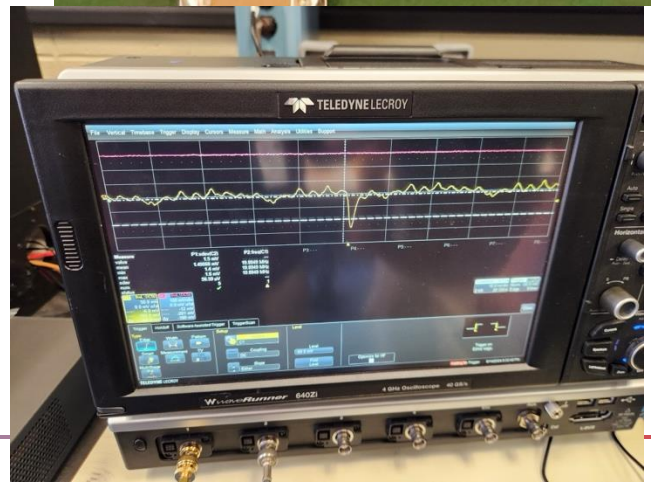
- TCT scanning and ASIC testing has been ongoing.
  - Work has been slow due to only a single (very obsolete) Xilinx board – cannot do separate tests in parallel.
- Several bump-bonded assemblies have been produced now at BNL.
  - One has already been tested with the full test setup, through the EICROC, using a Sr-90 source and a scope.



TCT scans of ”A1” test board, wire-bonded AC-LGAD with 500um pixels and 100um electrodes.



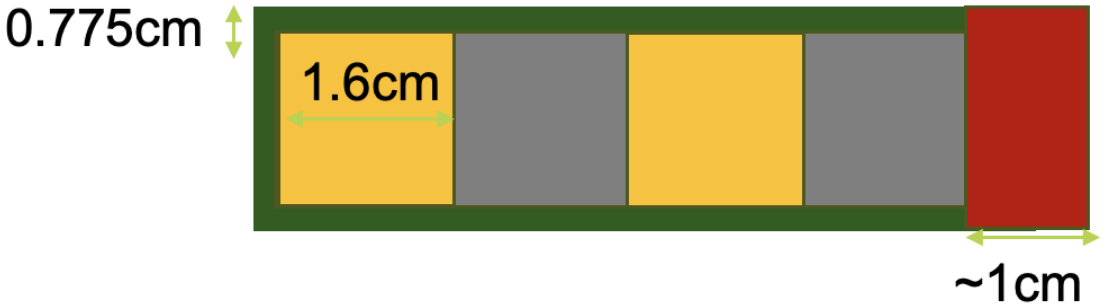
“B1” board with bump-bonded AC-LGAD + EICROC (bump-bonding done in BNL instrumentation).

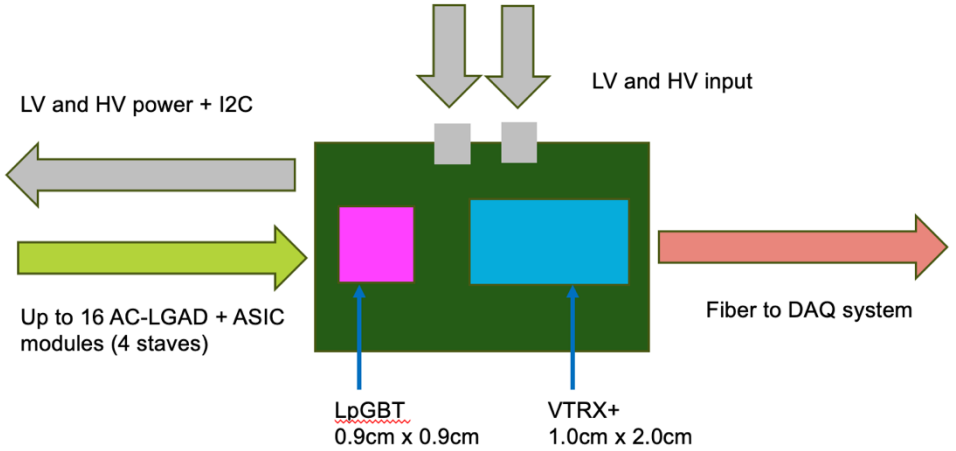


All 16 channels tested and showed clean analog signals with the Sr-90 source.

AC-LGADs for FF detectors

- Presently trying to put together concept for a stave design → will need many iterations with engineer.
- We need staves which are small enough to fit between hadron and electron beam pipe + shielding in the B0 region, in particular (no more than one sensor wide!).
- Prefer to decouple ROB from front-end, especially for the RP and OMD where the active area is in-vacuum.
  - Right now, this is a *concept* until we have some input from an engineer.
- Need to leverage synergies with FTOF wherever possible, but the design needs are very different.



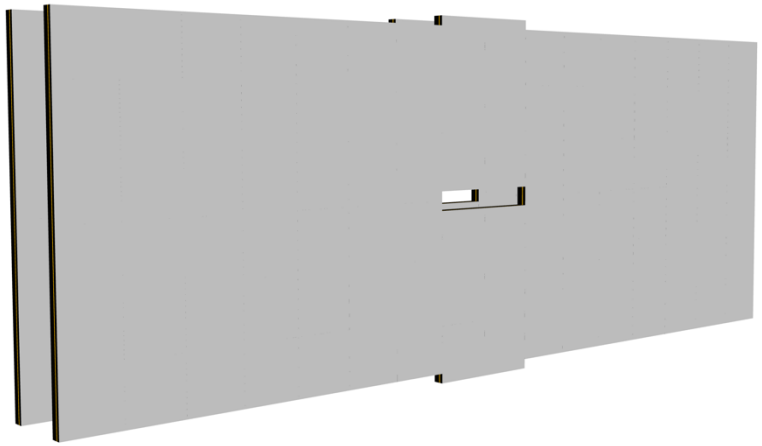


*drawings not to scale

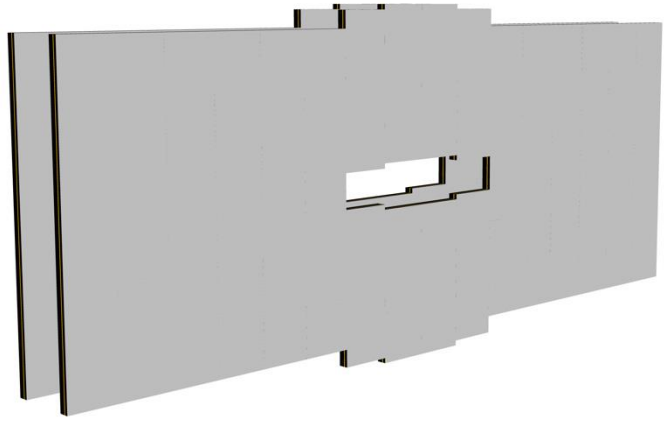
Roman pots geometry

- Roman pots geometry updated to enable changing geometry with magnet configuration choice.
- Sensor size updated to correct baseline assumption (3.2cm x 3.2cm → 1.6cm x 1.6cm).
- Acceptances compared for the various beam energies.
- Special thanks to Jihee Kim for helping me with some testing.

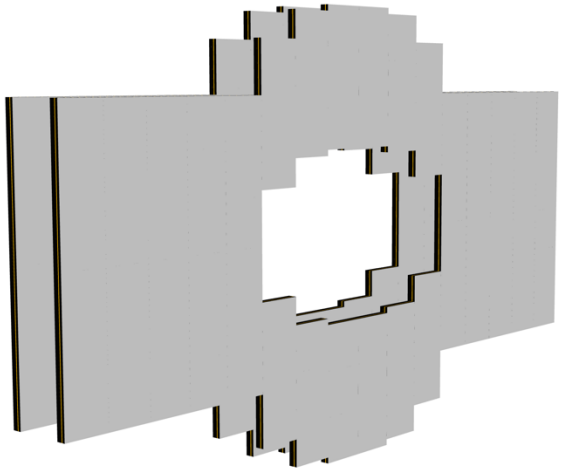
275 GeV



100 GeV



41 GeV



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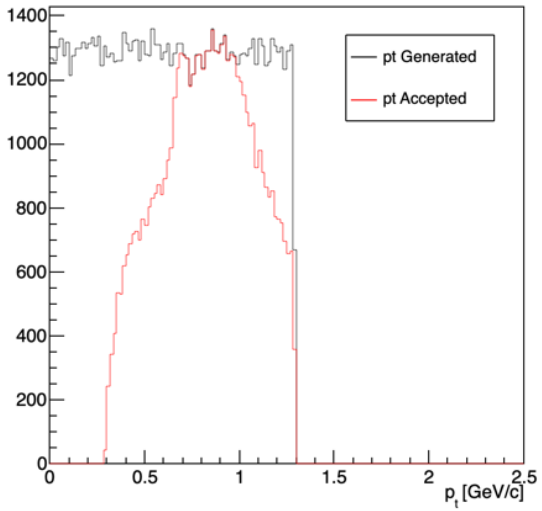
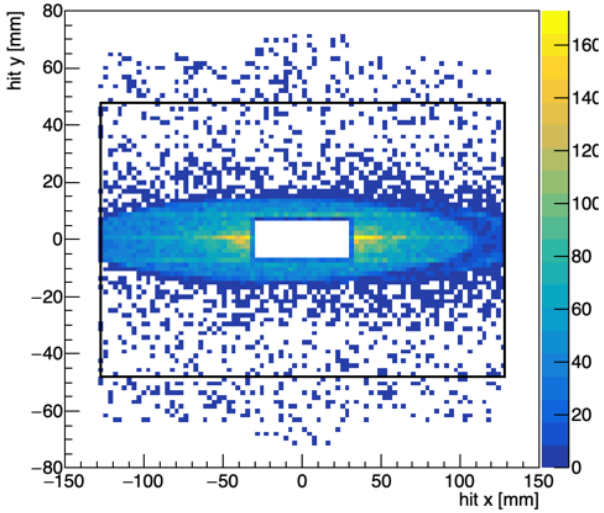
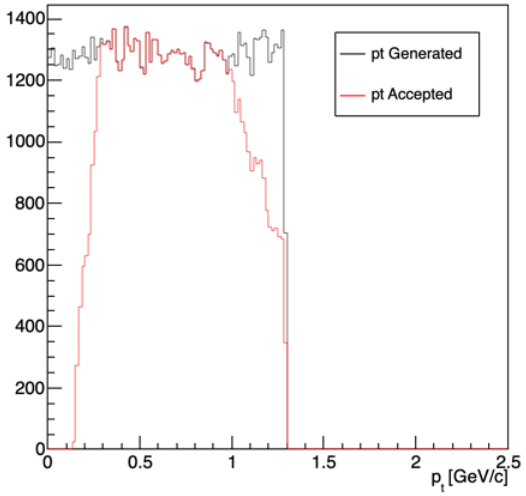
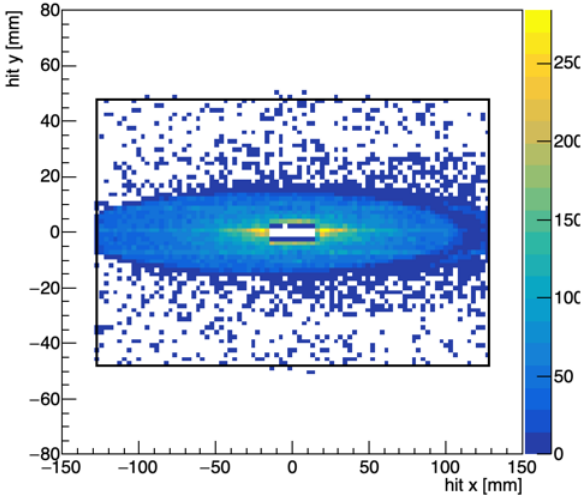
Old Geometry





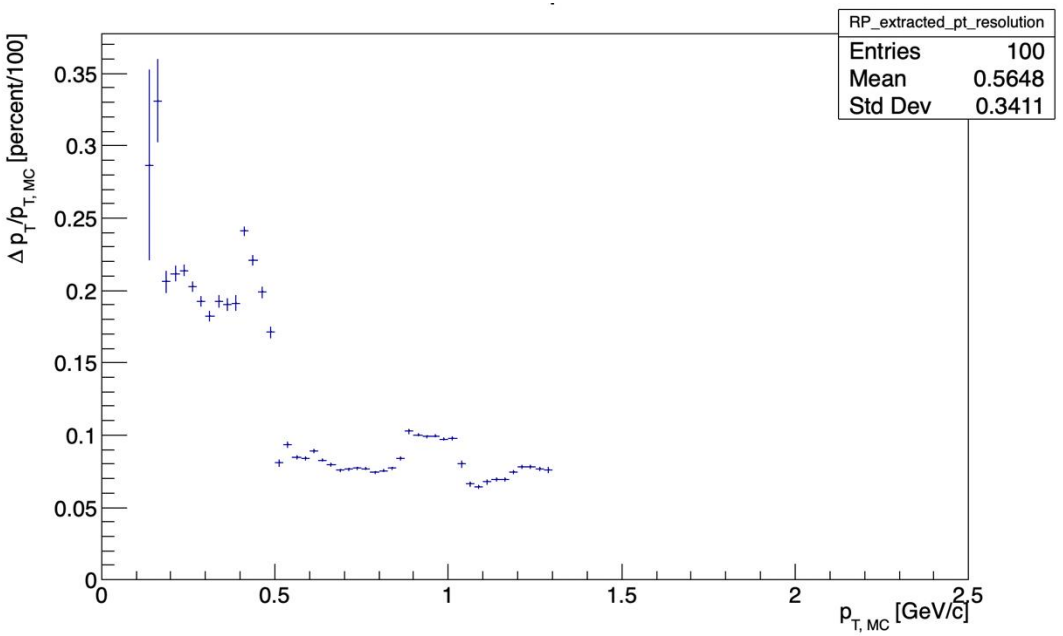
New Geometry



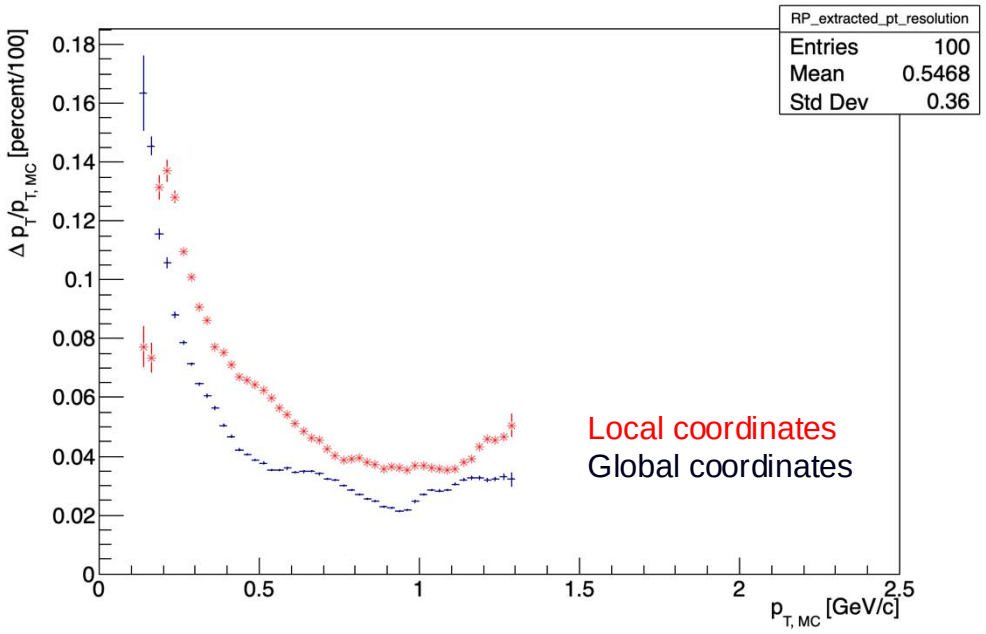


Roman pots reconstruction

- When seeing some results of study by Oliver Jevons, something was clearly wrong with the pT resolution.
  - While the ”static matrix method” isn’t amazing, it doesn’t perform *that* bad.
  - His results showed much worse than expected performance (see them here: https://indico.bnl.gov/event/24950/contributions/97146/attachments/57603/98917/PWGEDT_240930.pdf).
  - Looked into the issue, and it was stemming specifically from “py” portion of the momentum reconstruction.
  - This has been fixed as of Friday, but I need to test a few more things before I put in the PR (see example results below).
    - Testing done with 275 GeV protons and 0 < theta < 4.7mrad



Before bug fix.



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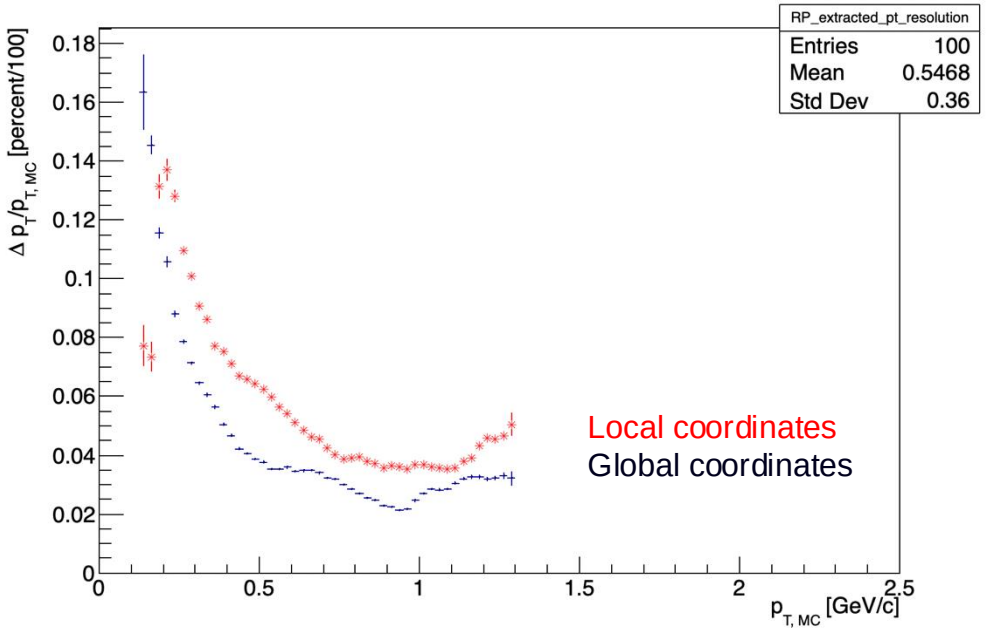
- **Open issues**
- There are a couple of things related to ”local” vs. “global” coordinates.
  - In principle the matrix reco should be done in local coordinates, where the detector alignment is based on the proton orbit.
- However, the problem is that what I thought was the local (0,0) point is actually not correct – it’s based on the edges of the detector sensitive area.
  - This means you have a beam-energy dependent reconstruction resolution, and the resolution is artificially worse than it should be in local coordinate system.
  - We can switch to global and use offsets to change the coordinate system.
  - Need to understand how the digitization affects the global coordinates (do we get the segmentation properly with the global coordinates?).
- In any case, there should be a live PR in the next 48 hours with the fix.



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Roman pots reconstruction

- **Some final things:**
  - For now, we must ensure that the SAME geometry XML compact file used in the DD4HEP simulation is ALSO used with EICrecon for the far-forward simulations.
    - It's probably good practice, period, not just for FF.
    - ANYTIME you use the GeoService to get local coordinates, it uses the XML compact file which is passed to EICrecon.
    - For the October simulation campaign, we should add the argument to the EICrecon portion of the simulations.
  - It would be a good idea to wait to run the October simulation campaign for Exclusive channels until I am done with these changes, otherwise we have to run them again.