Roman pots reco bug fix

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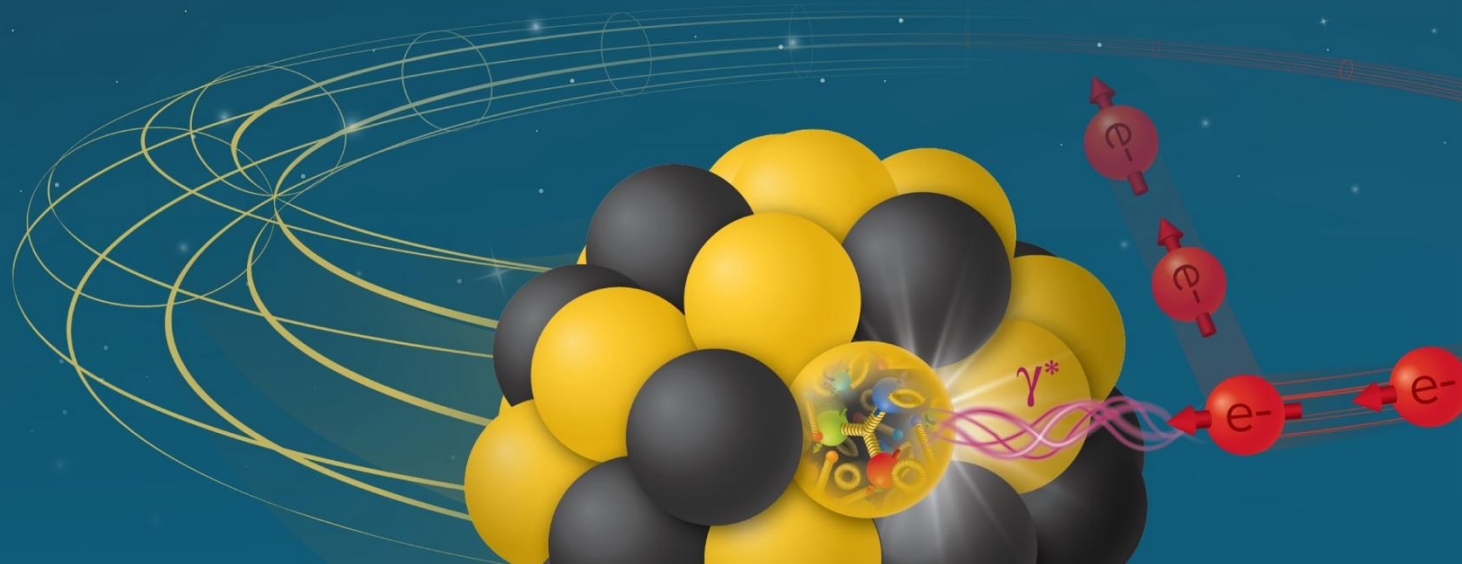
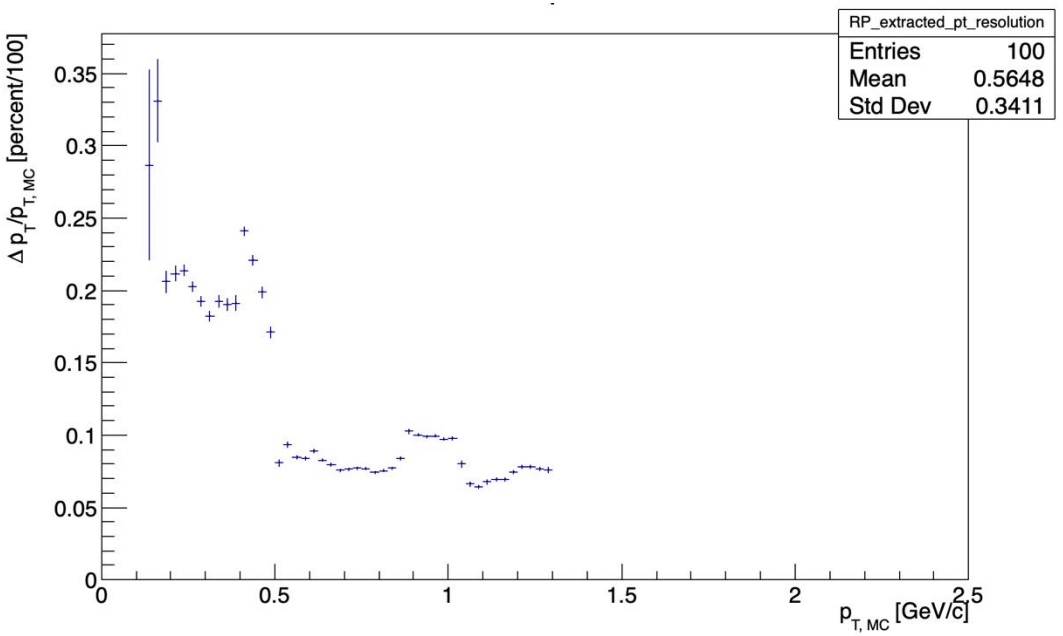


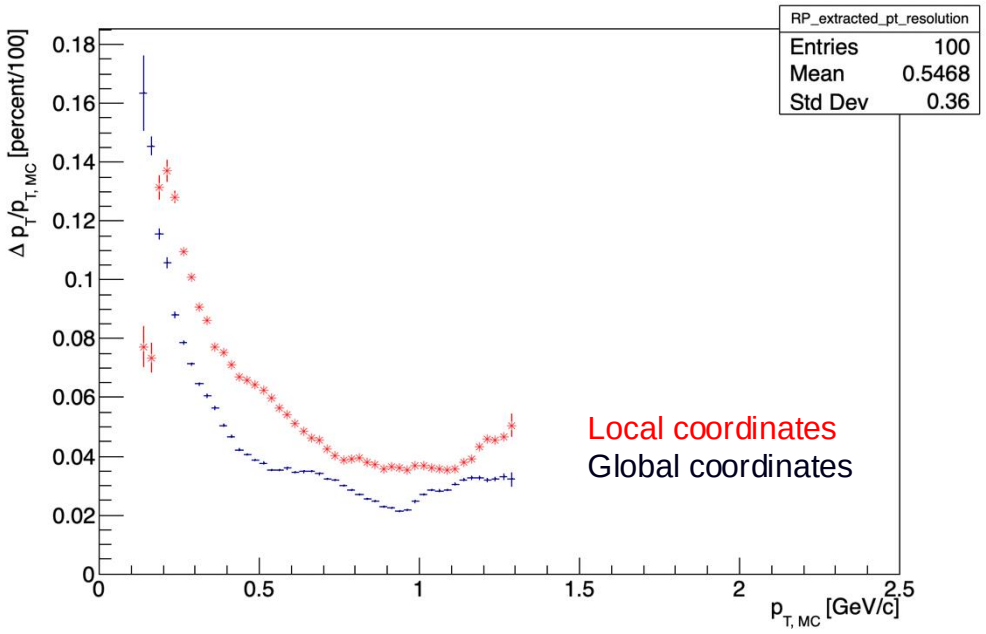
Electron-Ion Collider

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 (100 GeV and 41 GeV) protons and 0 < theta < 4.7mrad**



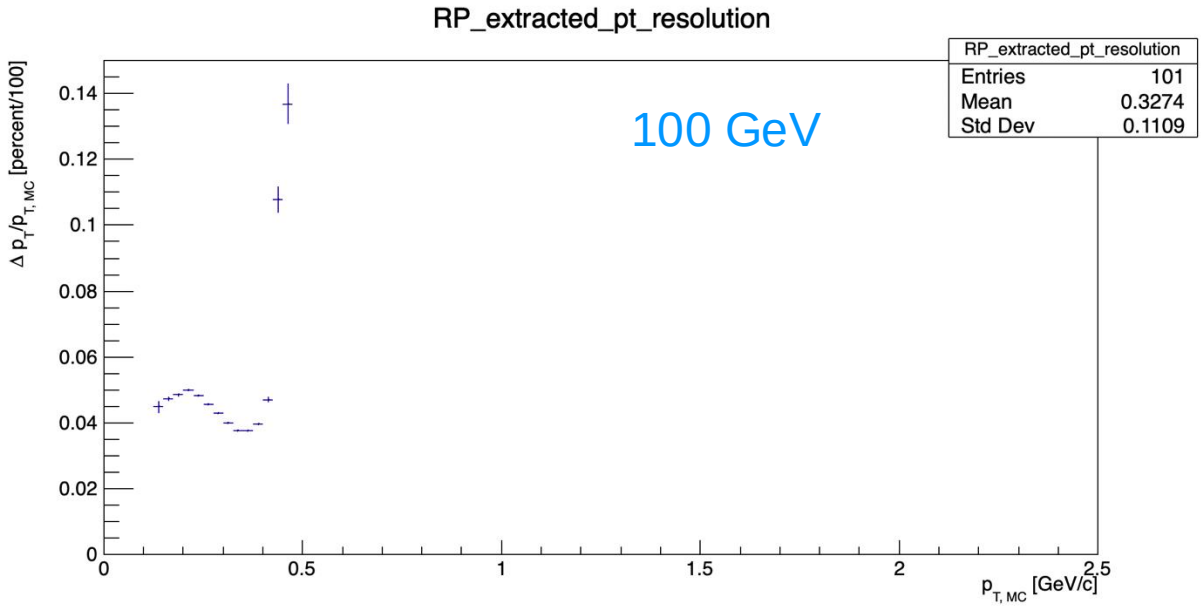
Before bug fix.

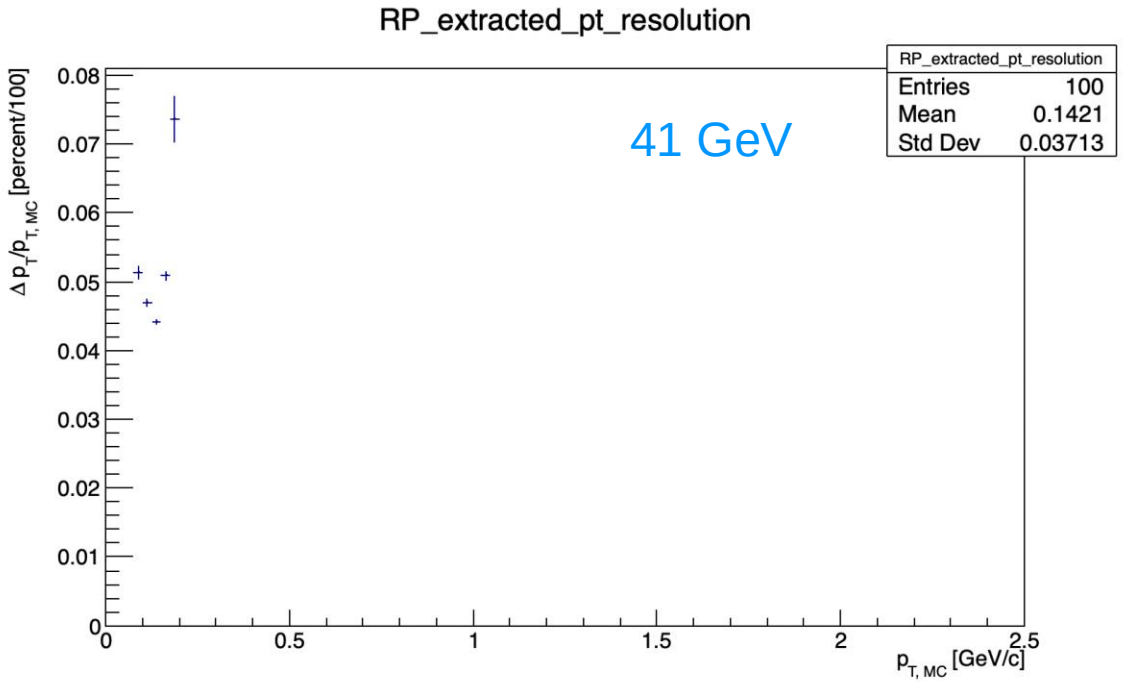


After bug fix.

100 GeV and 41 GeV particle gun

- Similar performance for the lower beam energies.





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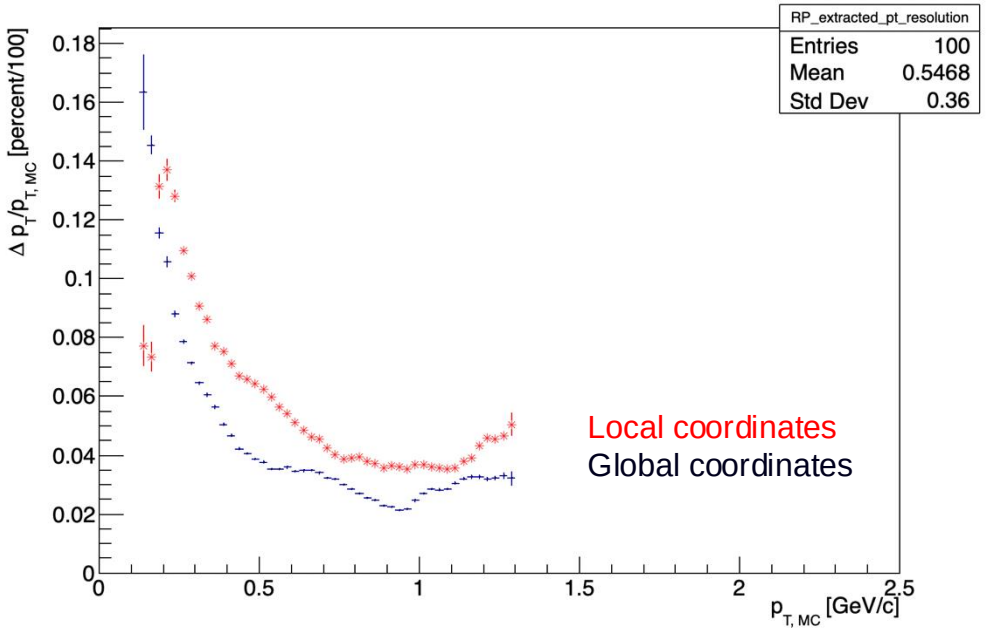
- **Open issues**
- There are a couple of things related to ”local” vs. “global” coordinates.
  - In principle the matrix reco should be done in local coordinates, where the detector alignment is based on the proton orbit.
- However, the problem is that what I thought was the local (0,0) point is actually 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?).



After bug fix.

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.