Global Track Reconstruction

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Rutherford Appleton Laboratory
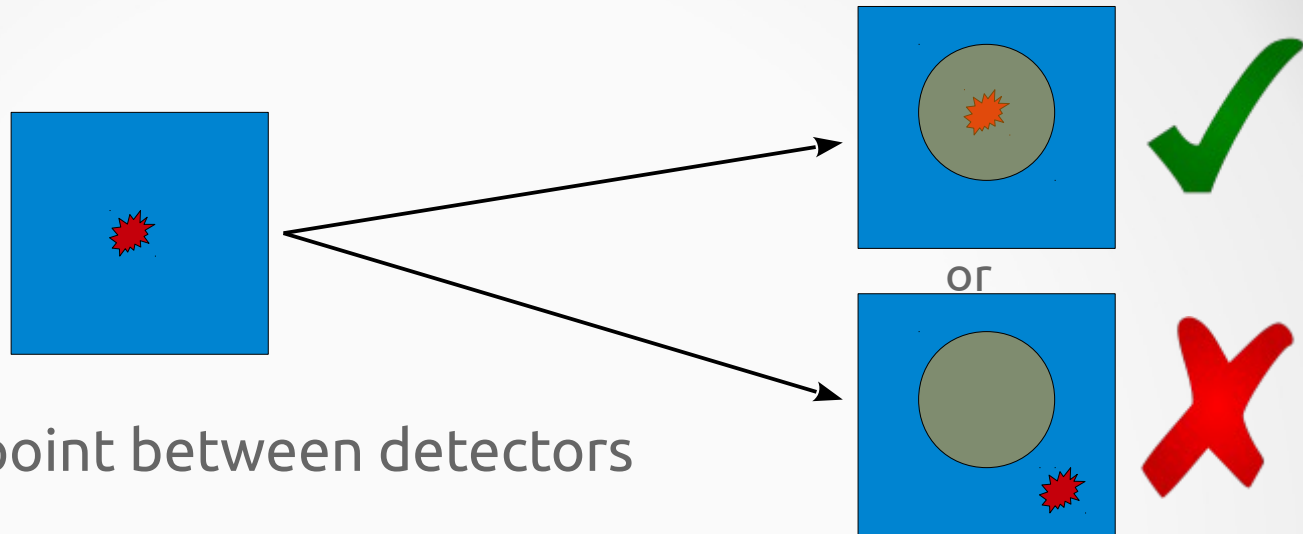
Global Track Reconstruction

- Track Matching – Determine which detector hits belong to the same track and combine them so that PID (and later analysis) can be run on them

- Track Fitting – Improve the matched trackpoints using information from all detectors as well as provide the possibility of inter- and extrapolation to uninstrumented sections of the beamline

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Track Matching

- Propagate track point between detectors

- Compare agreement between propagated and measured track point

- ⟶ Accept / Reject

Track Matching

- Includes all detectors (excl. Chkov)

- Propagate outwards from trackers, separate for US and DS

- Propagation to TOF0 problematic at present as energy loss not incorporated into MAUS RK4 implementation – to be remedied shortly

- Propagation requires mass and charge to be known, so track matching creates 3 or 6 tracks for each particle tagged with a PID hypothesis. Celeste's PID code then picks out the correct one

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Track Matching Efficiency

- Currently working with mean energy loss only, some fine-tuning remains before switching to full physics processes to ensure numbers are due to physics rather than code

- To calculate efficiency, match tracker track to MC event based on agreement, then compare matched hits in other detectors to hits in MC event

- Calculate matches (correctly matched hits), expected matches (a reconstructed hits agreeing with MC exists in recon event), false matches (matched hit doesn't agree with MC), and events where local recon failed (no corresponding hit exists in recon event)
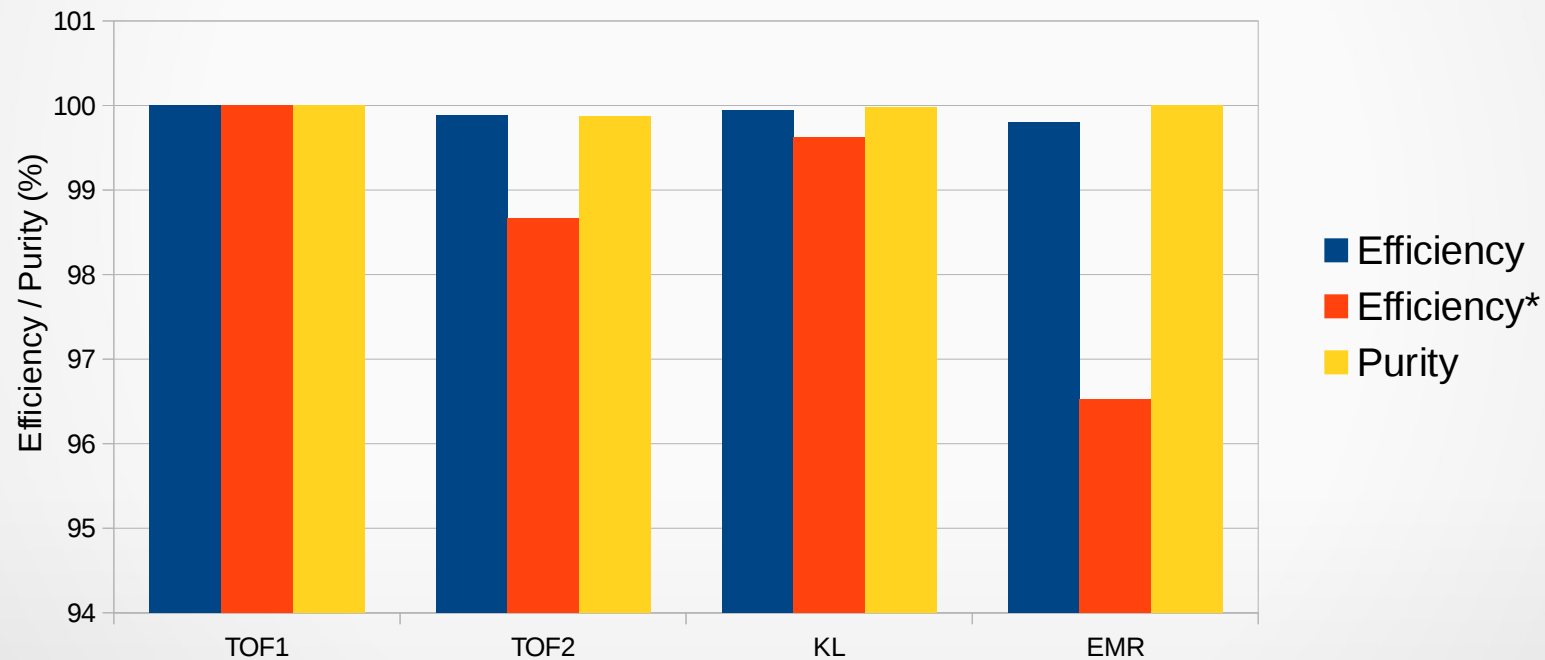
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Track Matching Efficiency

- Efficiency = Matches / Expected Matches

- Efficiency* = Matches / (Expected Matches + LR failed)
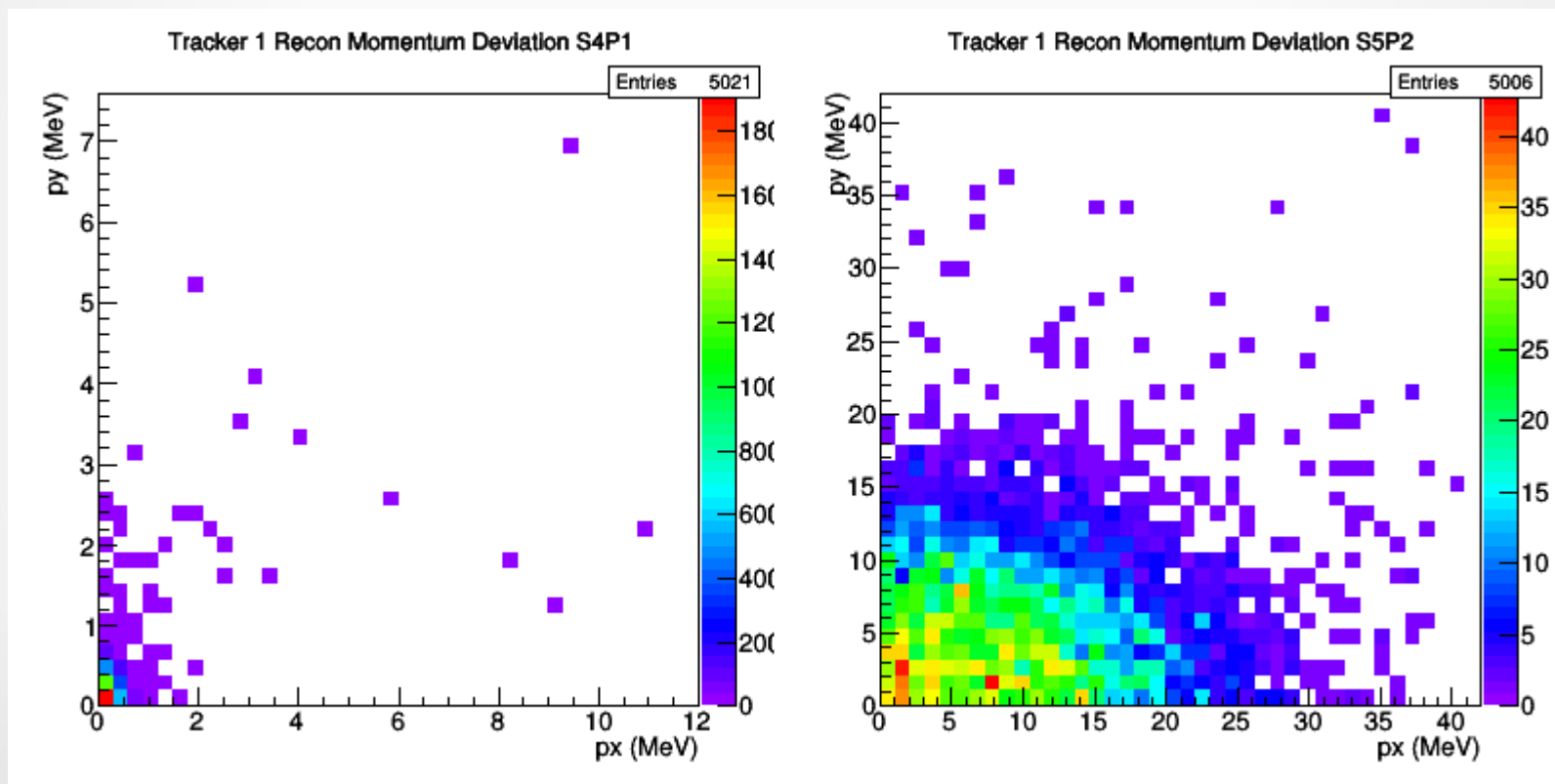
- Purity = 1 – (False Matches / Matches)

Improvements – new Tracker Kalman

- Current tracker Kalman falls over for the last few tracker stations

- New Kalman about to be released

Improvements – TOF Errors

- Vast majority of TOF recon points within half slab width of the MC hit

- A few around the edges, presumably from particles hitting two adjacent slabs

- Apparently, TOF local recon produces errors now, need to be put into the global import, should catch the cases where recon error is larger
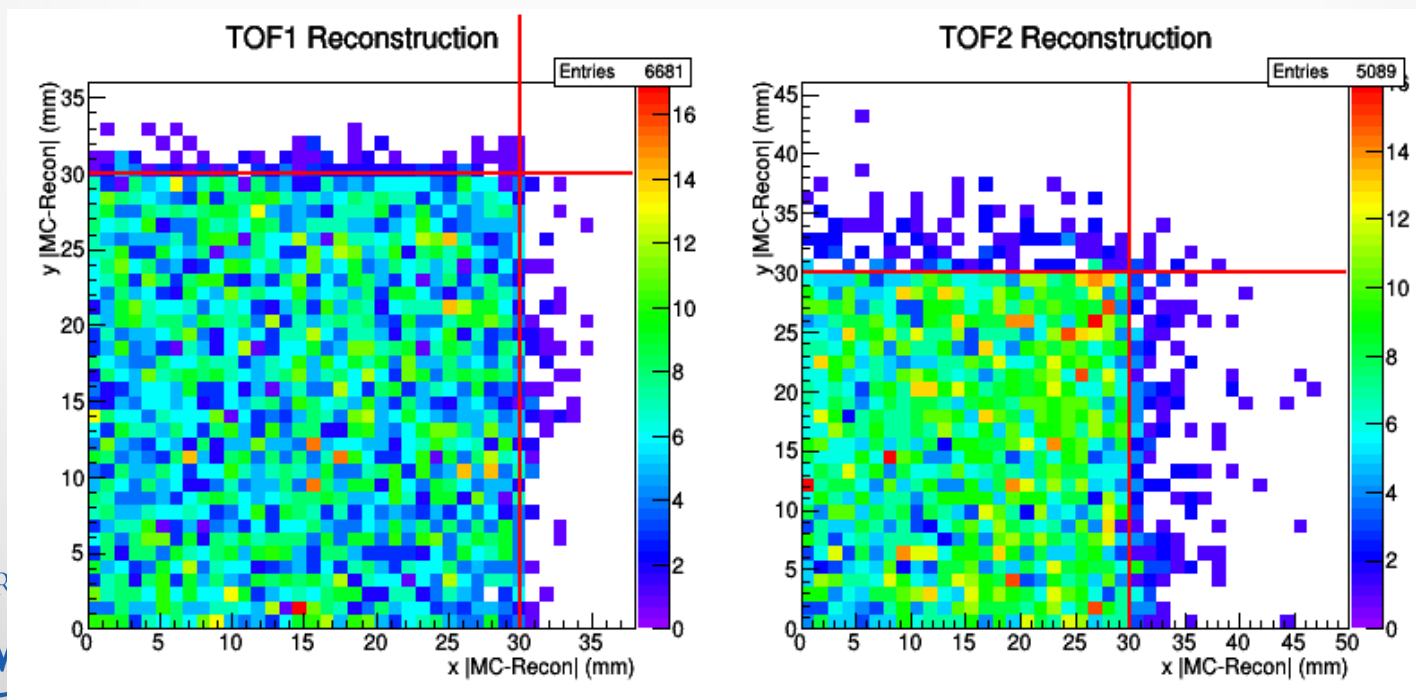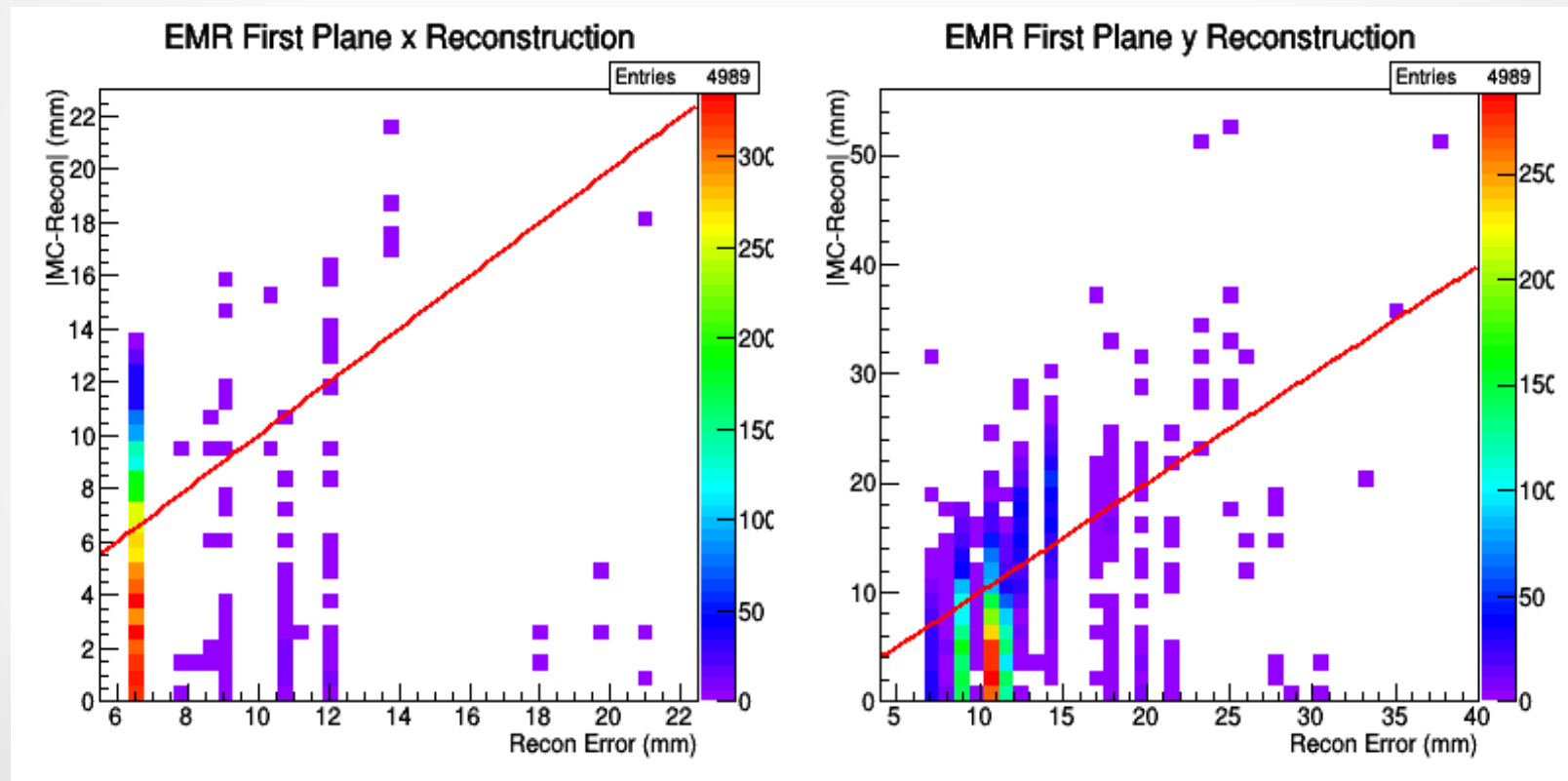
Improvements – EMR Errors

- EMR error calculation seems too optimistic at times

- Fix should allow tightening of very generous acceptance criteria

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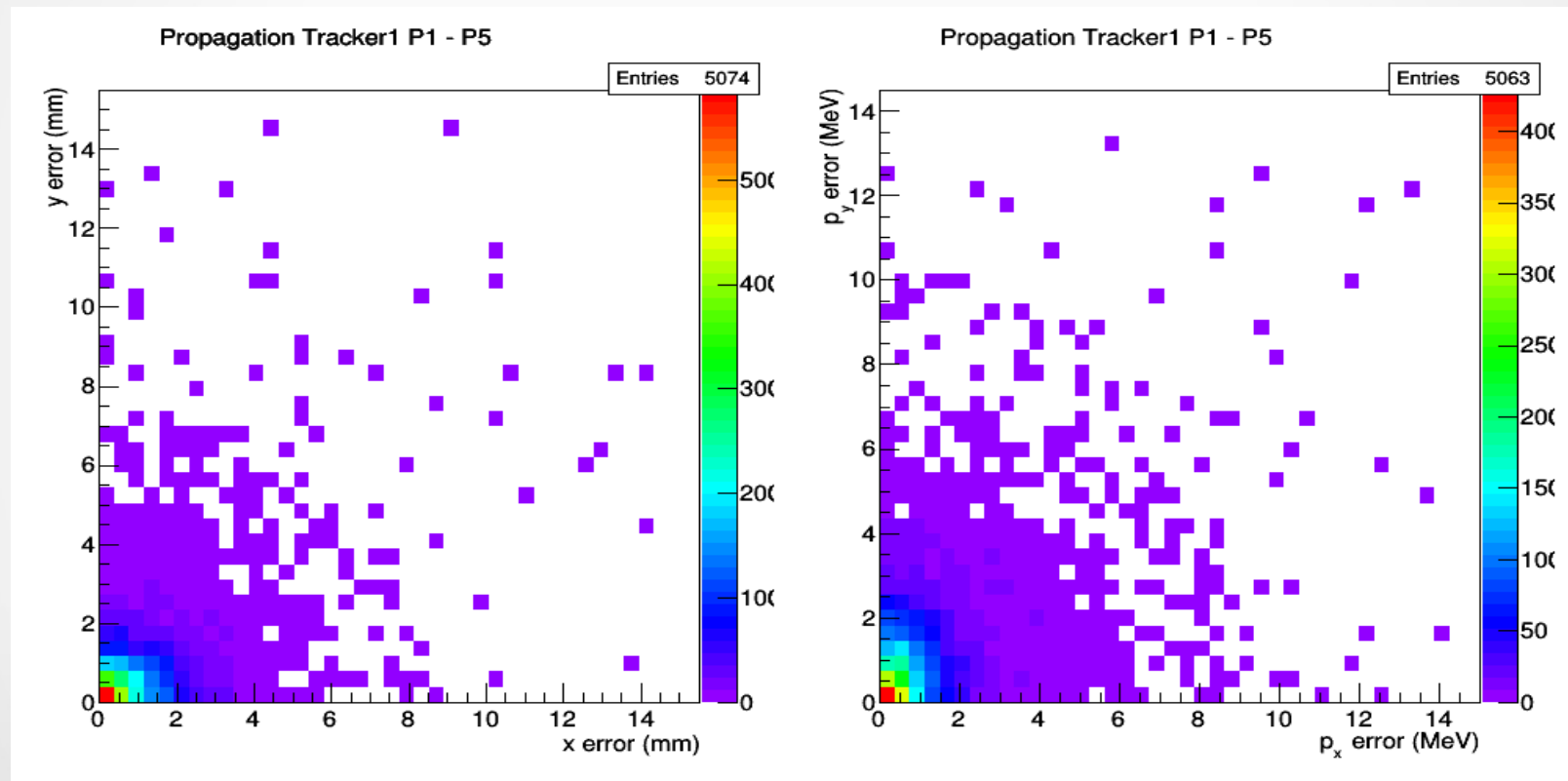WARWICK

Improvements – dE/dx in RK4

- dE/dx being implemented for RK4 – required for TOF0 matching

- Should also improve matching to other detectors

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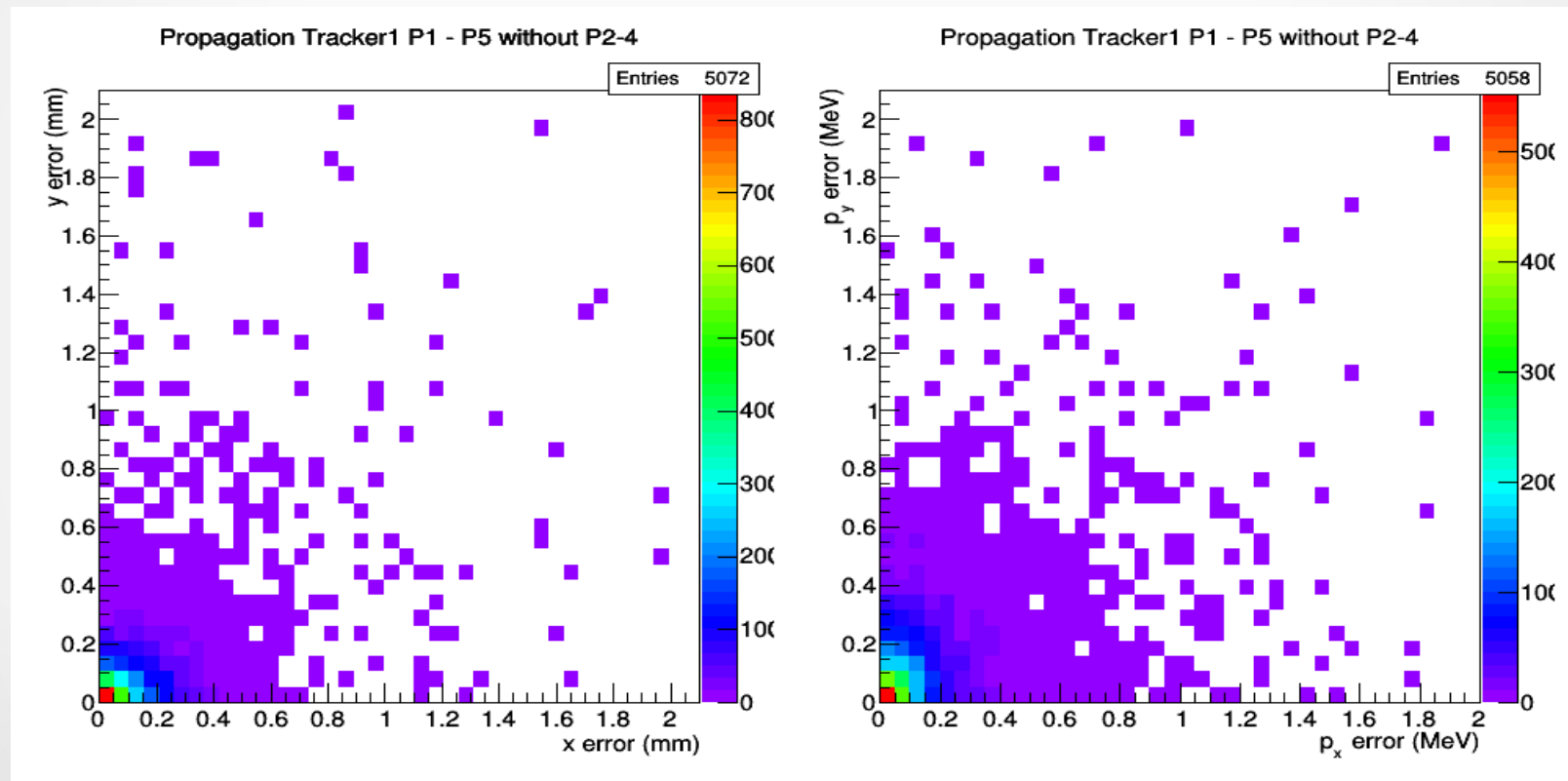WARWICK

Scattering

- Turning on scattering will reduce efficiencies

- As mentioned, first maximising efficiencies without scattering to make sure that values with scattering on are due to physics, not code

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Through Tracks

- Track matching code exists to match US and DS tracks using TOF1/2 time difference

- No-field through tracks to help with alignment

- No meaningful efficiencies yet as old Kalman worse for straight tracks

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Next Steps

- Mostly already mentioned:
  - Fine-tuning track matching using improvements to Tracker Kalman, EMR errors, dE/dx for RK4
  - Turning on scattering
  - No-field Through-track efficiencies

- Multiple tracks per trigger

- Track Fitting – method still under consideration

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