B0 Tracking Study: part 1 (update)

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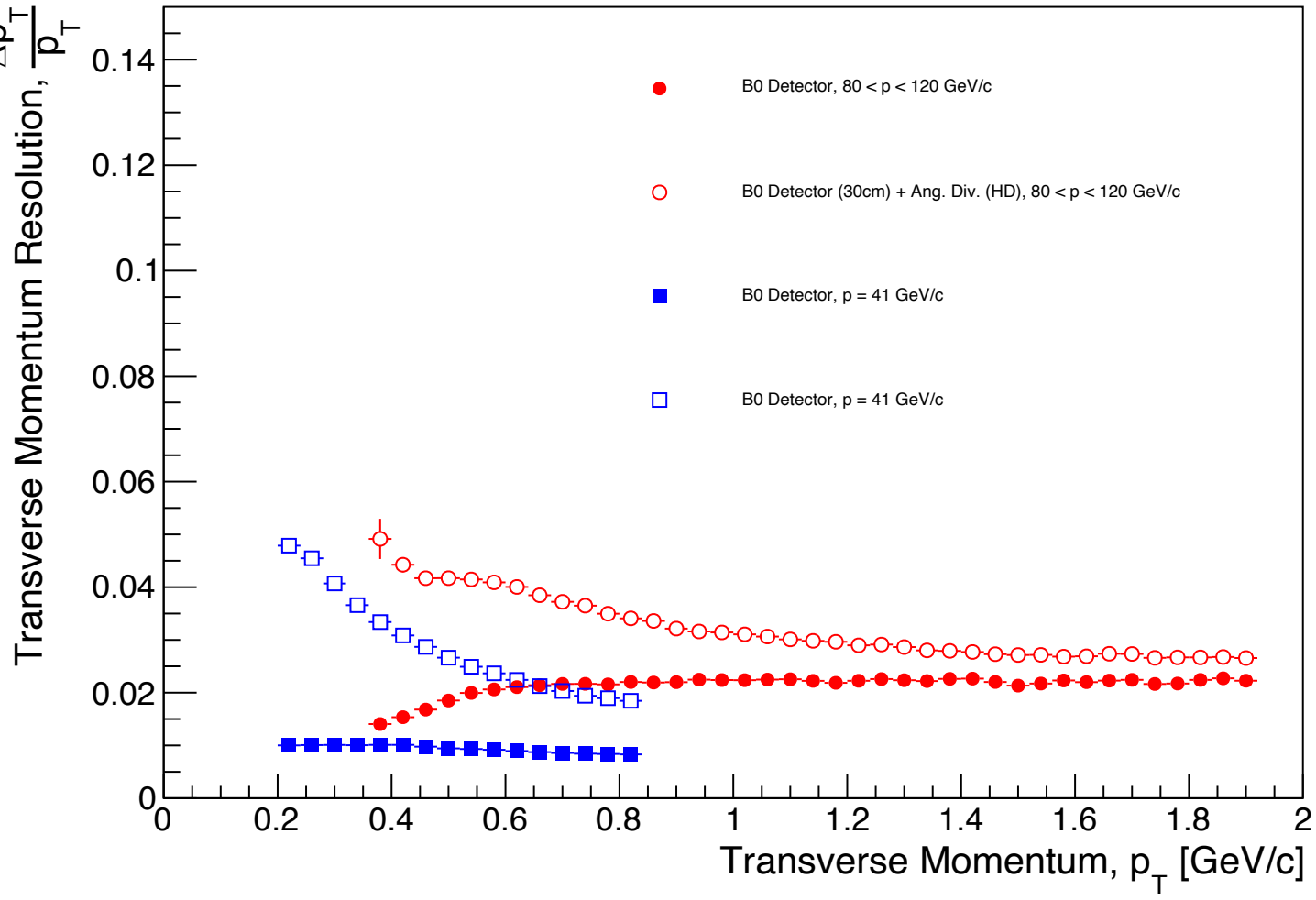
Preliminary

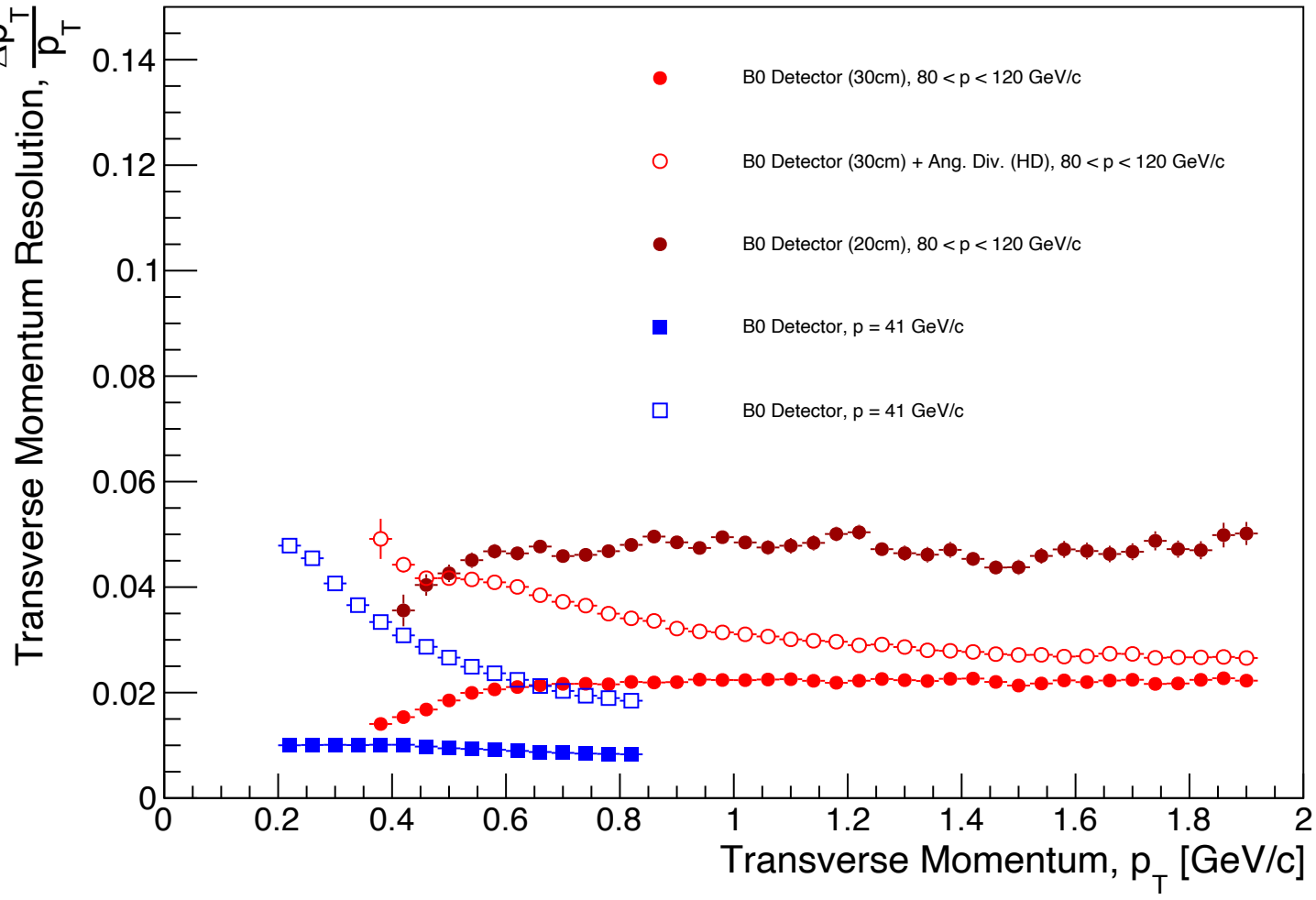
- Need to make final decisions about technology and arrangement for B0 detector system.
  - Technology for tracking well-established: MAPS for the 1st, 2nd, and 4th layers, and AC-LGADs for the 3rd layer.
  - Technology + arrangement for EMCAL still being looked at.
- Goal of the present study is finalize the layout of the tracking system and choice of layout/design of EMCAL components.
- All simulations done in EICROOT (using GenFit).
- **Part 1:** summarize resolutions and effects on distributions.
- **Part 2:** study intermediate plane separation, beam pipe, and EMCAL material.

Current Baseline



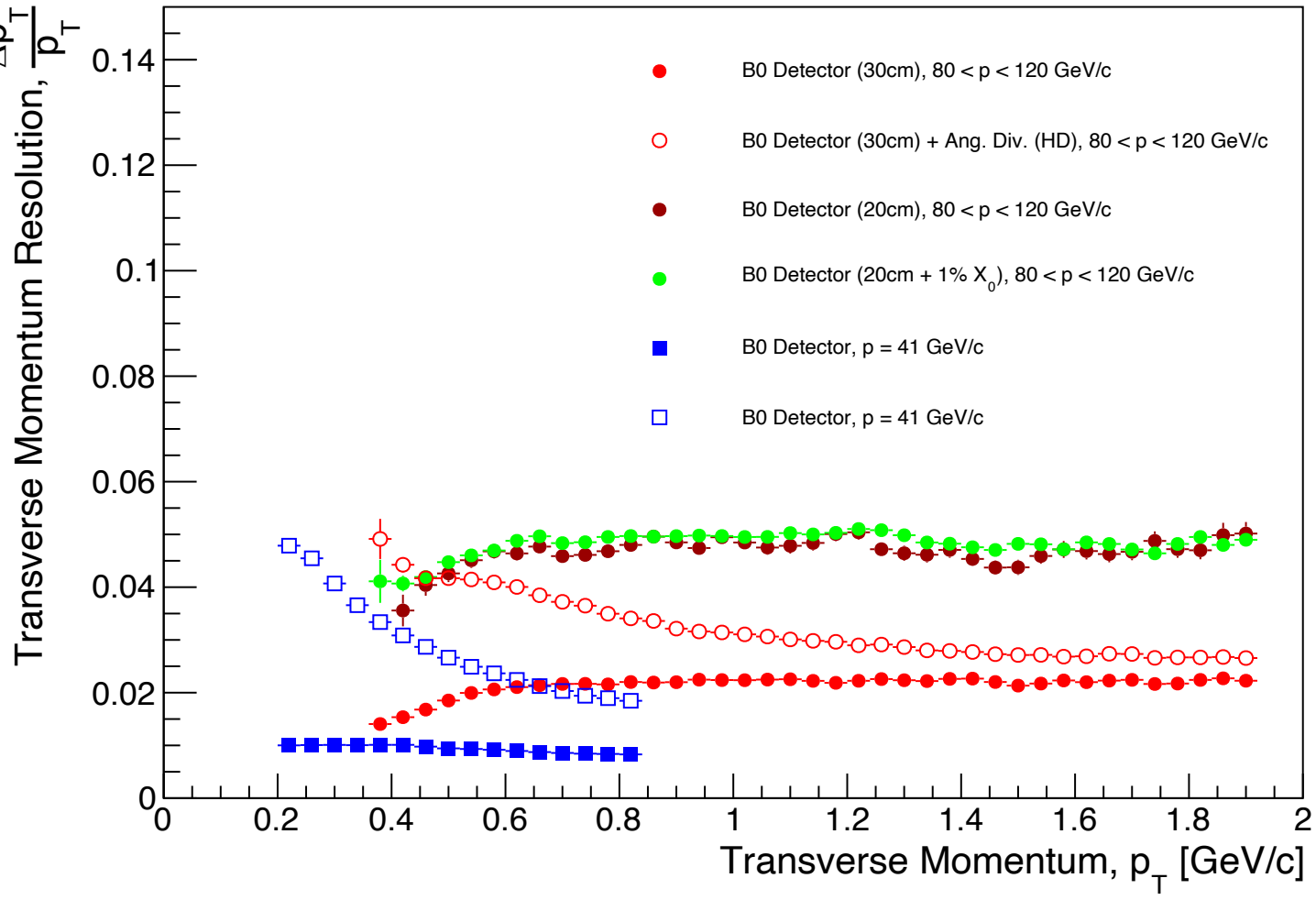
- Tracking layers separated by 30cm.
- No material consideration here.
- High Divergence angular divergence setting (worst-case).

Setting #1: 20 cm spacing between layers



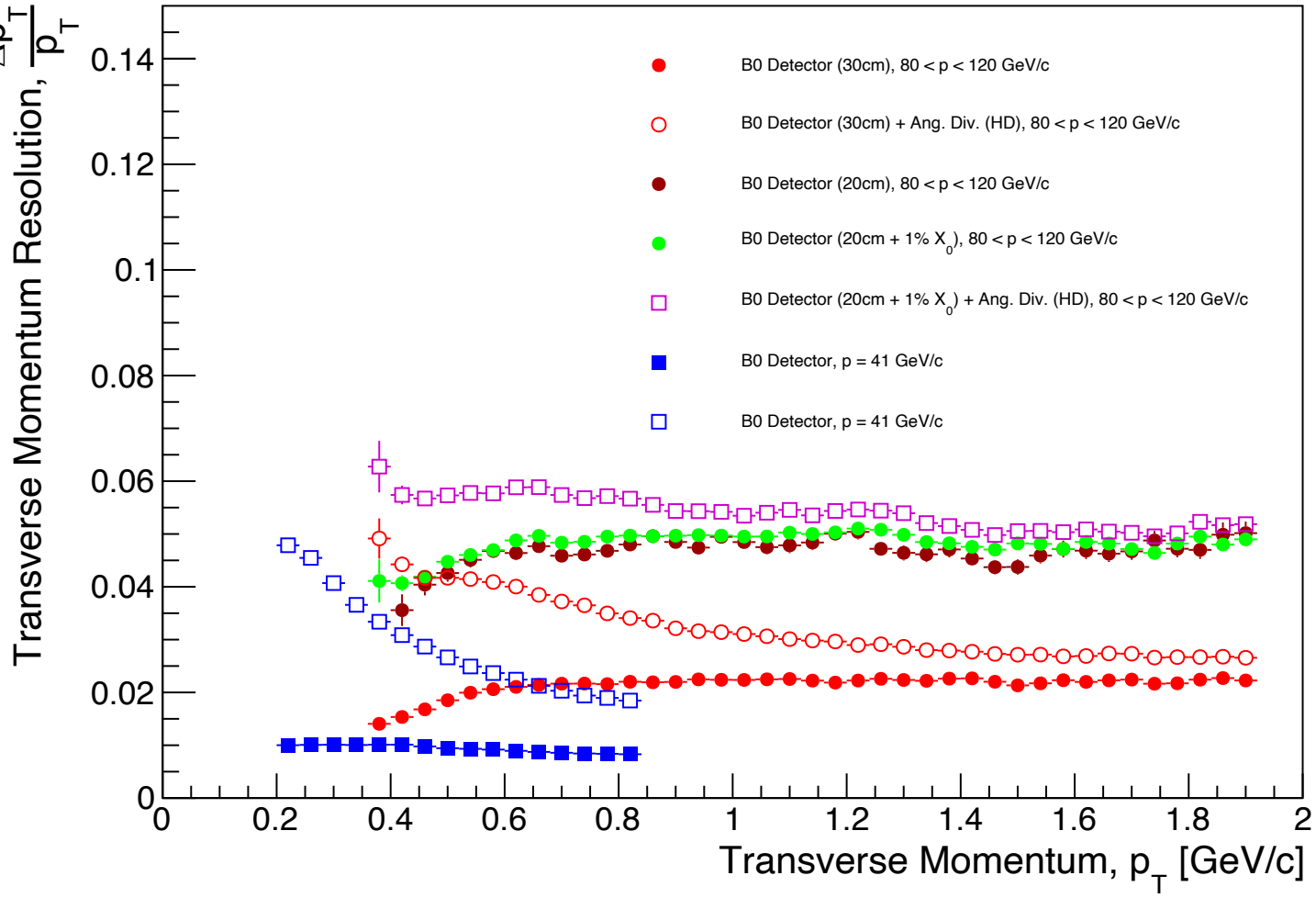
- Tracking layers separated by 20cm.
- No material consideration here.
- No beam effects.

Setting #2: 20 cm spacing between layers + 1% X0



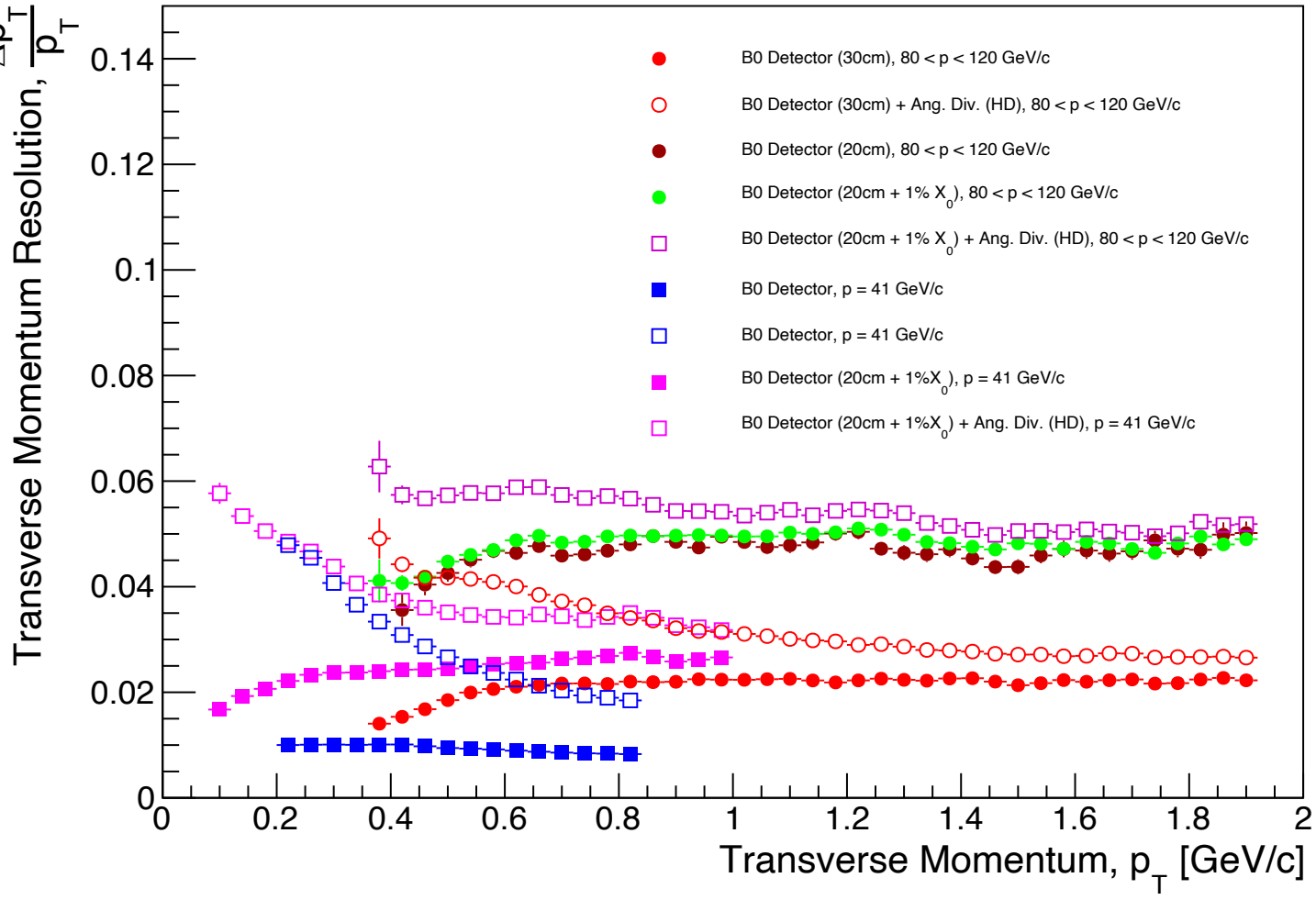
- Tracking layers separated by 20cm.
- 1% X0 material per layer.
- No beam effects.

Setting #3: 20 cm spacing between layers + 1% X0 + High Divergence Angular Divergence



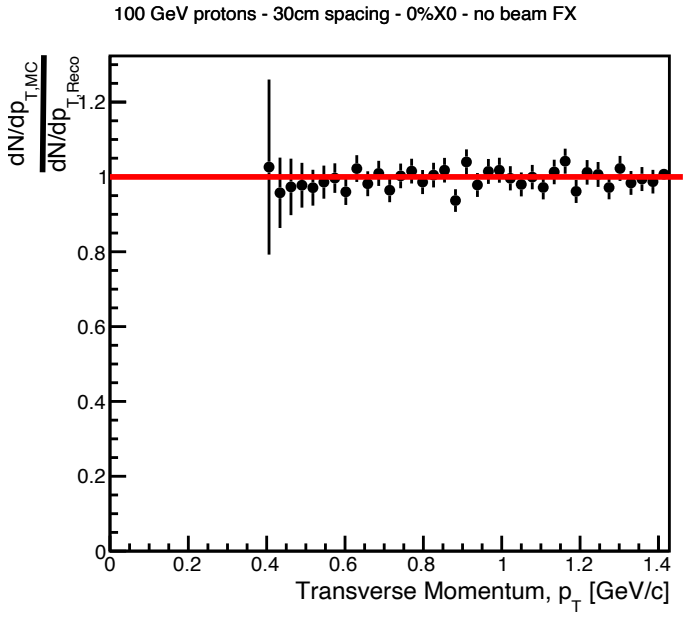
- Tracking layers separated by 20cm.
- 1% X0 material per layer.
- Angular divergence: high divergence.

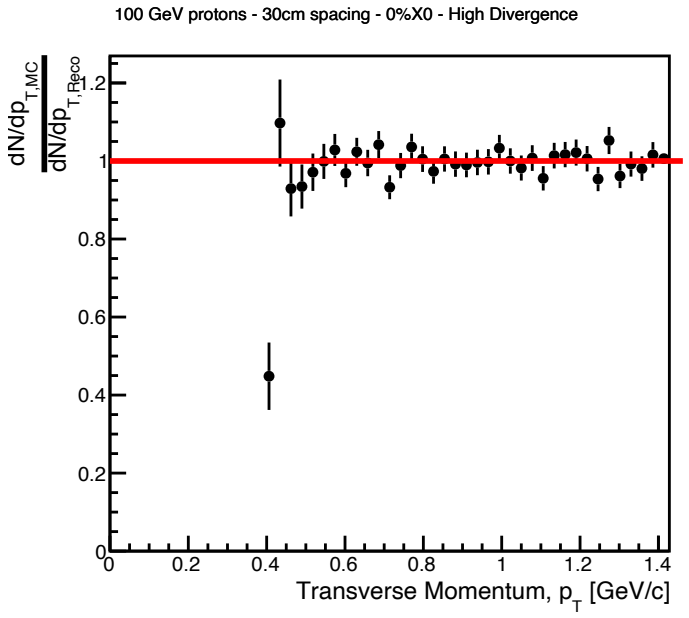
Setting #4: 20 cm spacing between layers + 1% X0 + High Divergence Angular Divergence – 41 GeV (low energy)

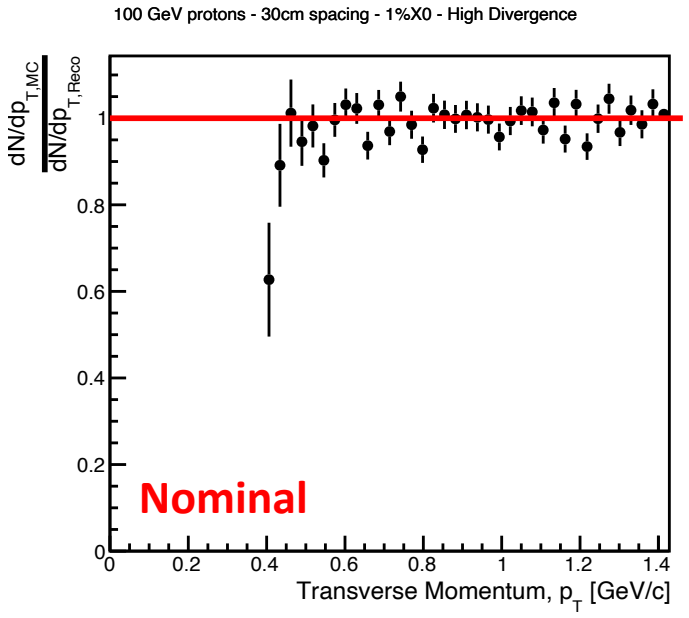


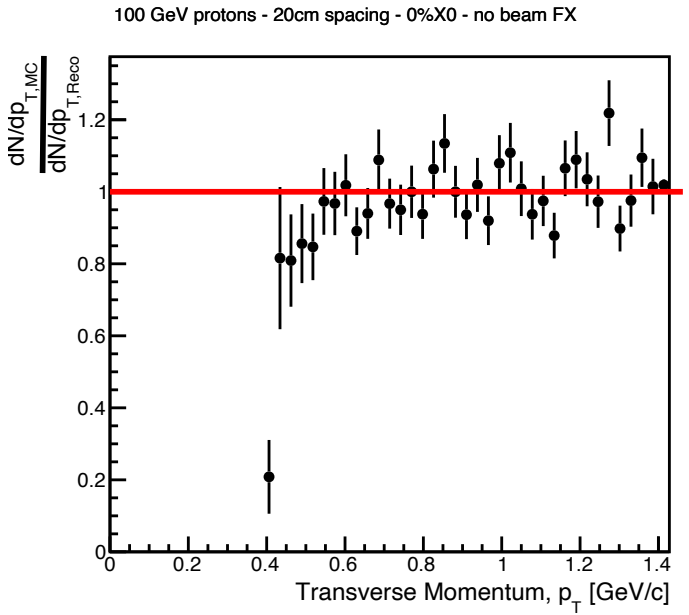
- Tracking layers separated by 20cm.
- 1% X0 material per layer.
- Angular divergence: high divergence.

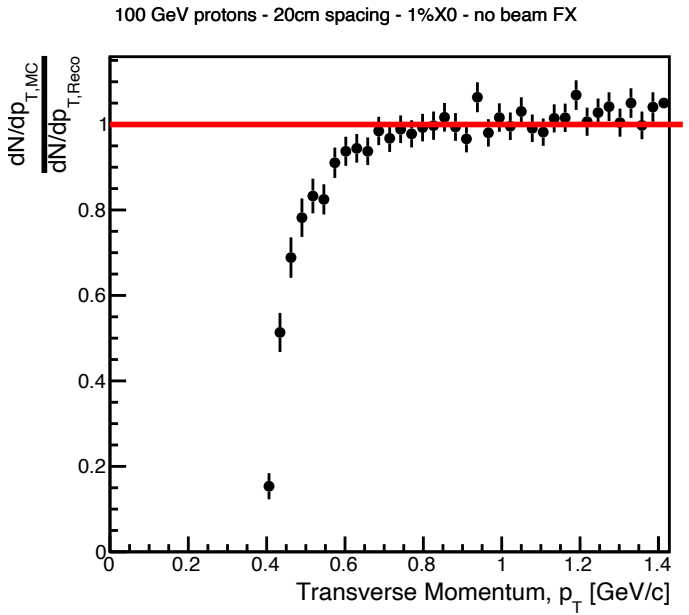
Effect on pT distribution

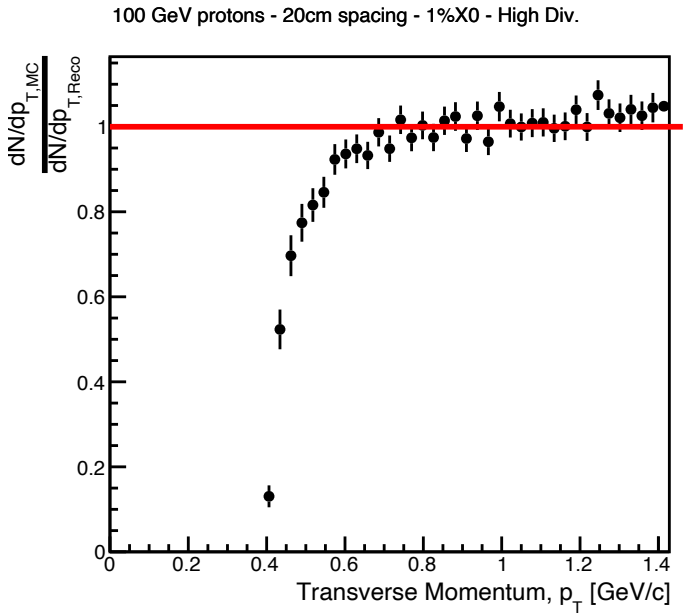




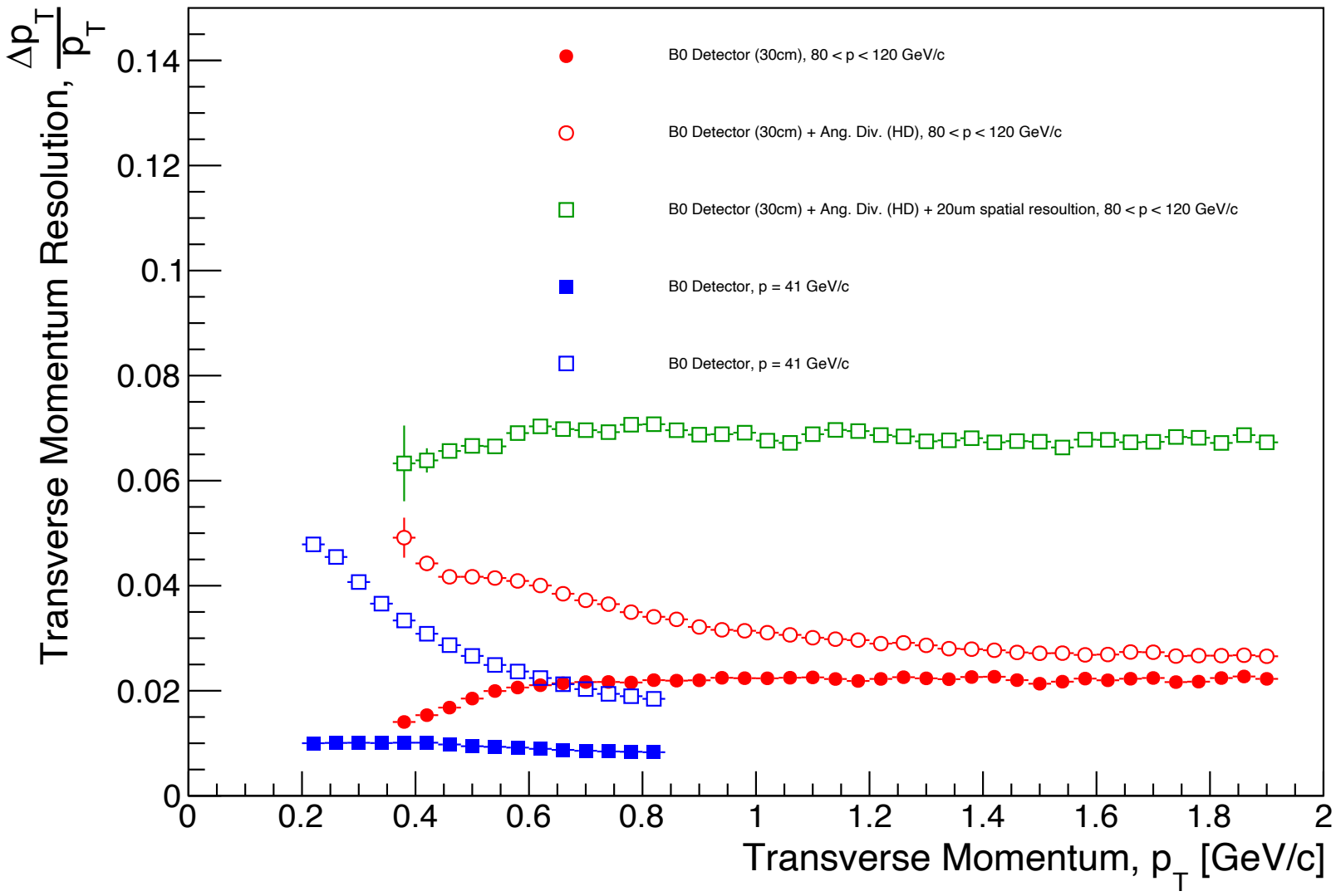








Final Comment on Technology (update)



- Best-case AC-LGAD can deliver 20um spatial resolution (green).
- 5-10um resolution needed to keep smearing contributions reasonable for physics.
- 20um resolution with AC-LGADs requires charge sharing, and could degrade with radiation damage.
- Our baseline is 3 layers of MAPS, with a single layer of AC-LGADs for timing in the middle (red and blue).

Summary and next steps

- Moving from 30cm to 20cm spacing worsens the resolution by a factor of 1.5-2 across the pT range.
  - It seems likely we can find a solution which saves a bit of space (e.g. lower the spacing by 2-5cm per layer).
- **Need to also add the B0 beampipe into the mix and see how that affects the resolutions.**
- Once we have established a comfortable landing spot for the tracking system, we will investigate the placement of the EMCAL, and start considering services.
  - N.B: we still do not have a final B0pf magnet design – it is going to get shorter overall.