SIMULATIONS WITH GEMS IN HYBRID TRACKER

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ATHENA Tracking Working Group Meeting

Overview

- Modified the hybrid detector shown last week to reduce material
  - *Resolutions compared for a few configurations*
- Added Material for more realistic studies going forward
- Investigation of low-momentum resolution

Detector Configurations

- Nominal Detector
  - *Shown in detail last week*
  - *This is a starting point to serve as a basis of comparison. All others will be modifications to this*

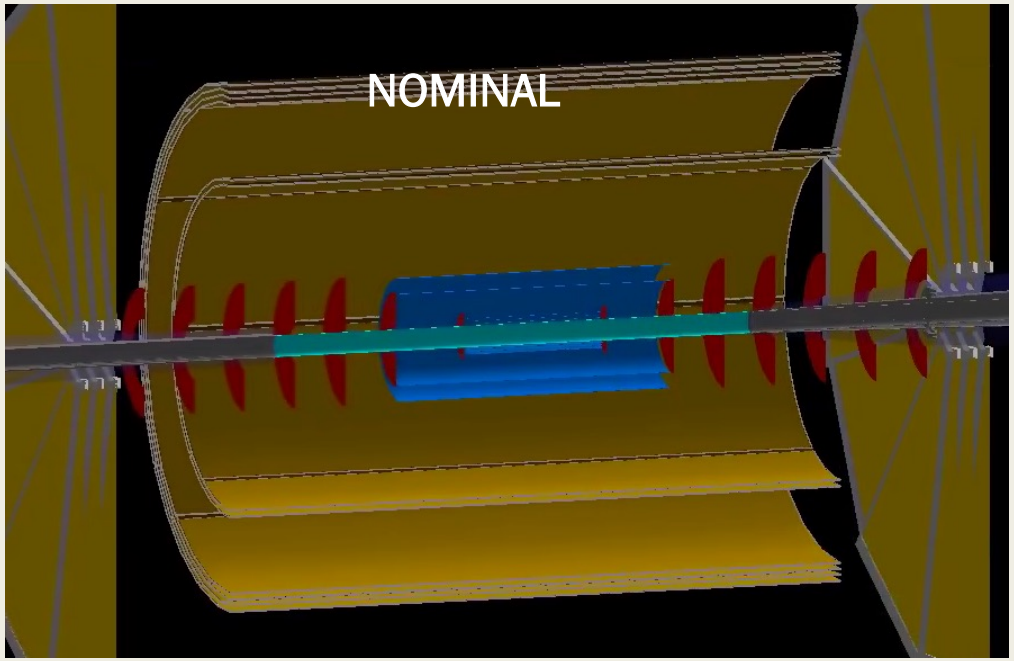
- 5 Silicon Disk
  - *Reduced the number of Si disks from 7 to 5 per side*

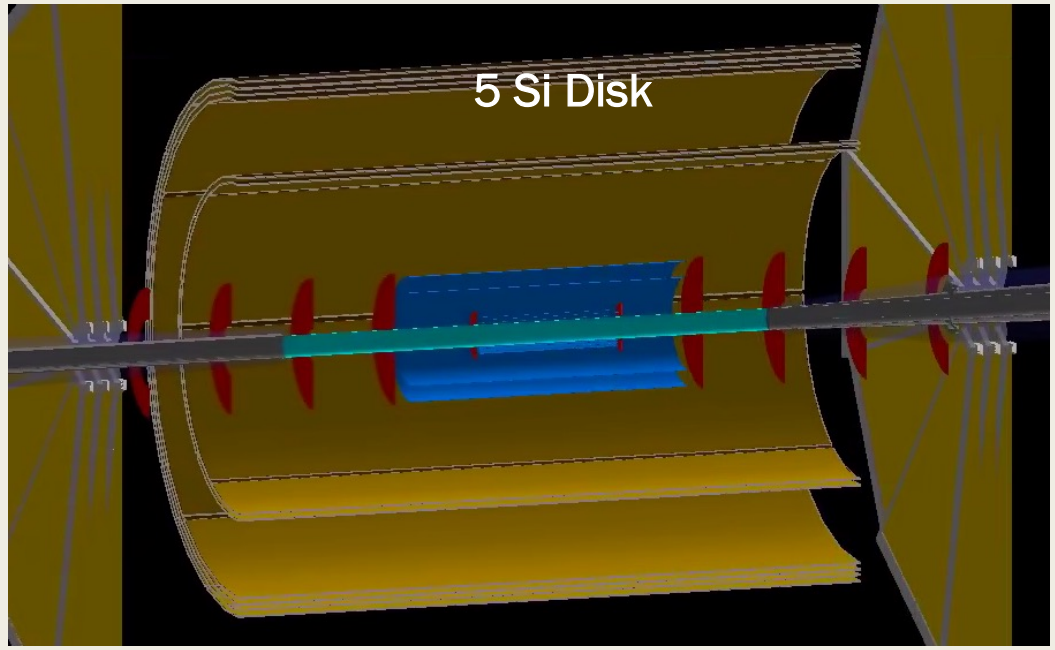
- Wide Bore GEM Disks
  - *Increased the inner radius of the GEM disks*
  - *Re-positioned between the last two Si disks on each side*

- 5 Si + Wide Bore GEM
  - *Combination of the previous two configurations*

5 Silicon Disk

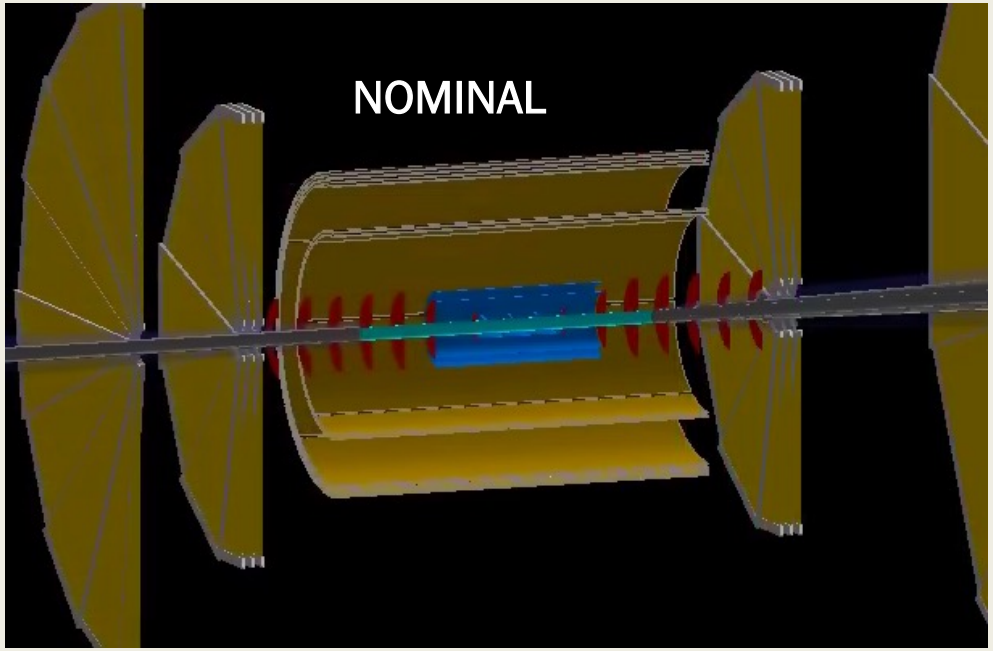
- The first and last Si disk remain with their current position and size
- The middle 5 are replaced by 3 equidistant disks
  - *Each has same outer radius as last disk*
  - *Inner radius increases with z to accommodate beam pipe*

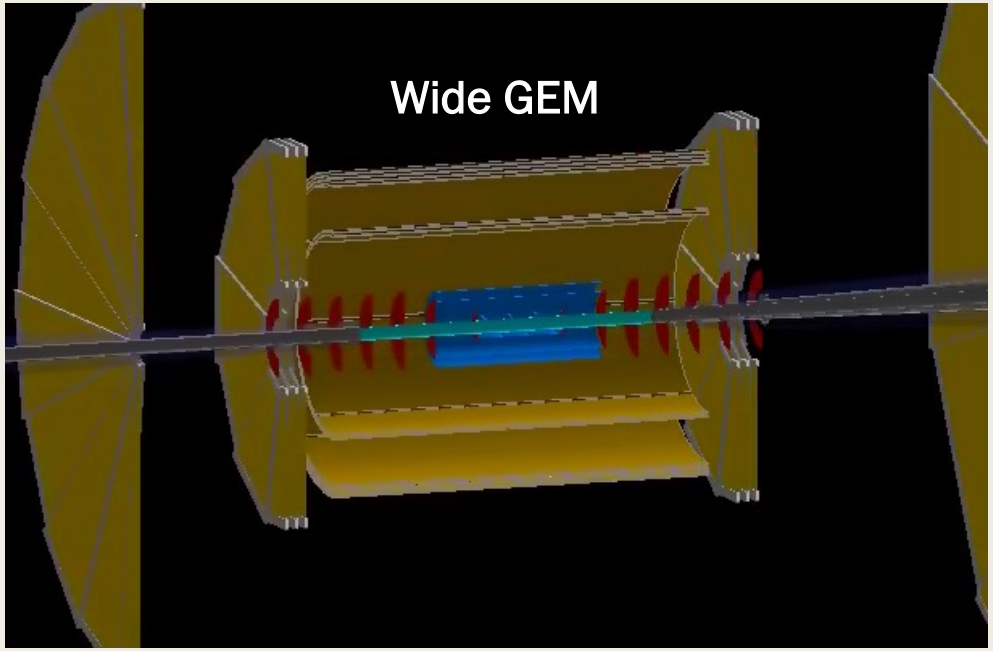




Wide Bore GEM Disks

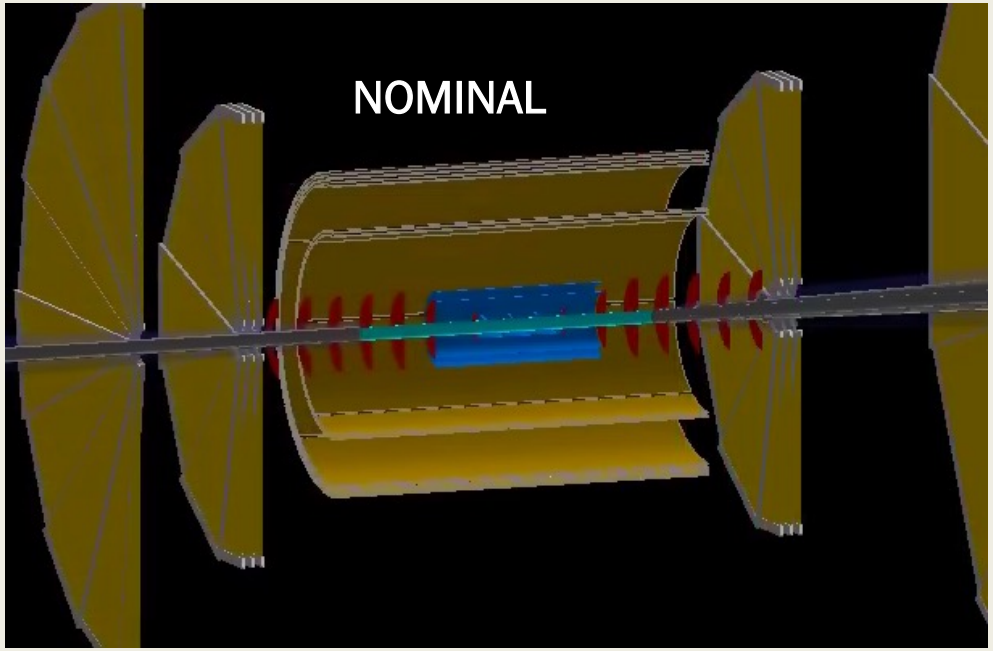
- Inner radius of GEM disks increased to have 5 cm clearance between Si disk and GEM disk frame.
- Re-positioned in z from 130 cm to 108.25 cm (disks still spaced 5 cm apart)
- Same minimum eta coverage (1.05) but smaller z, so reduced overall size

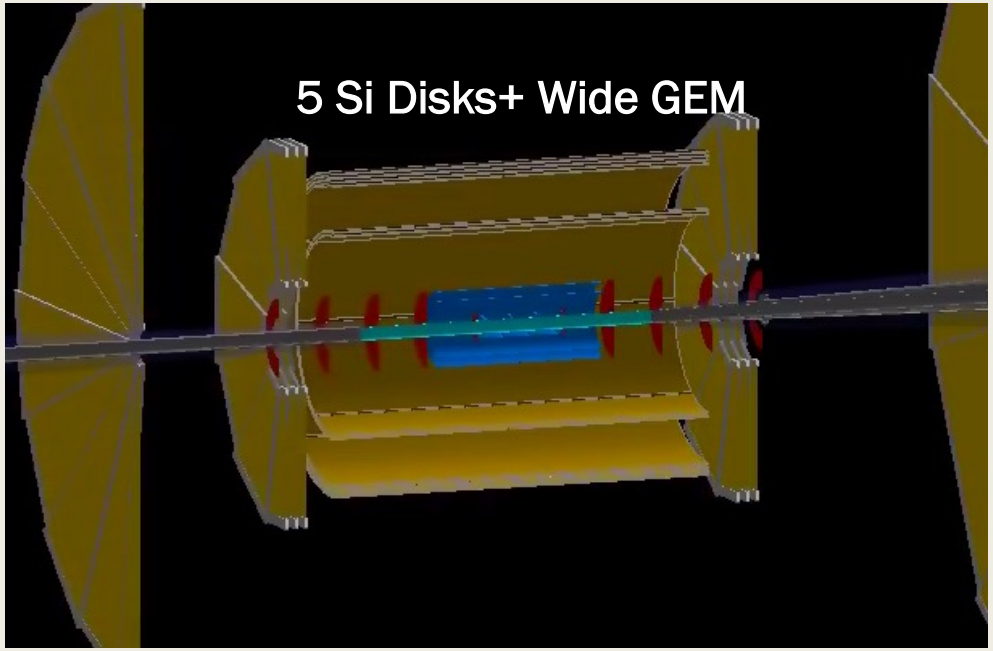




5 Si Disks + Wide GEM

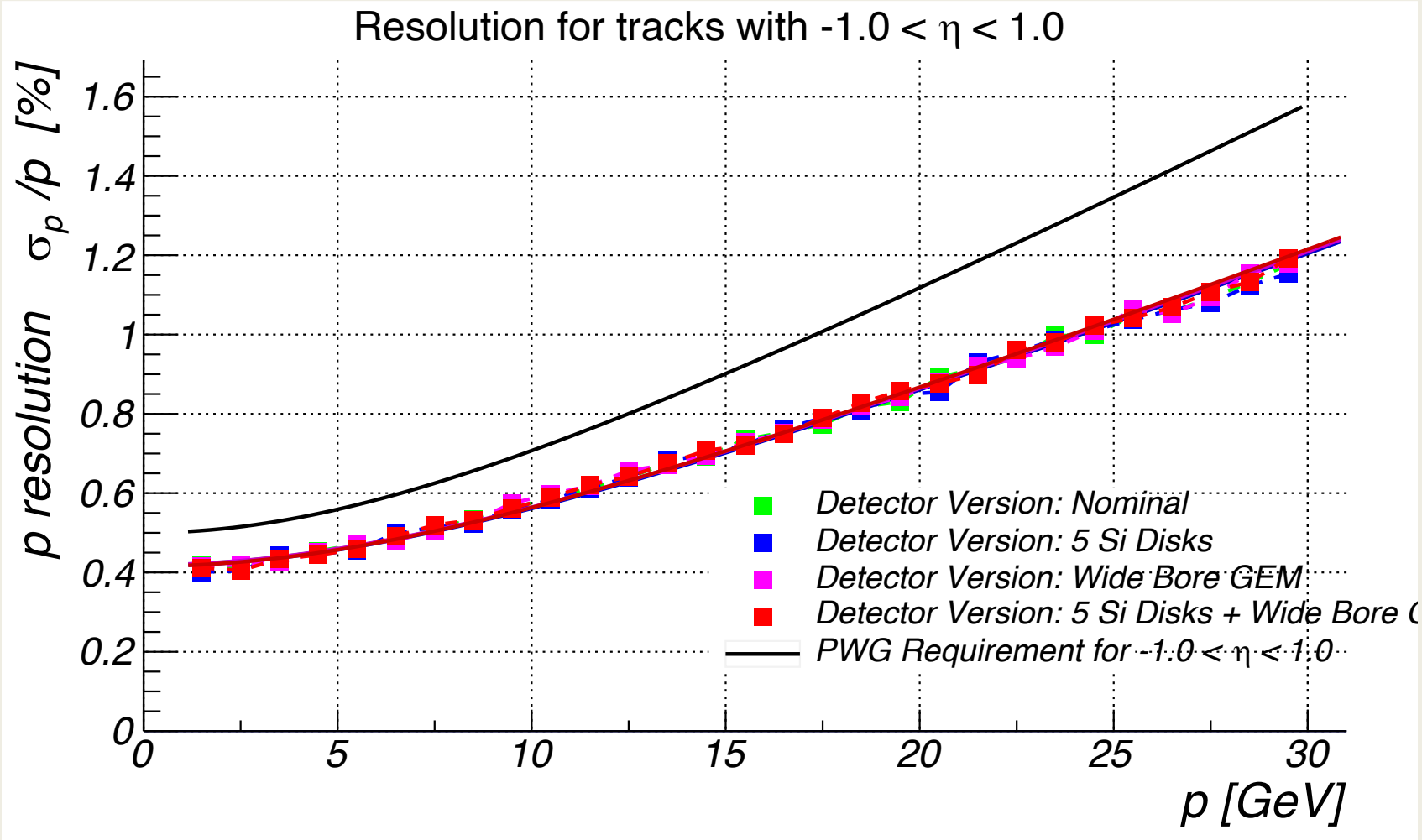
- Combination of the last two modifications





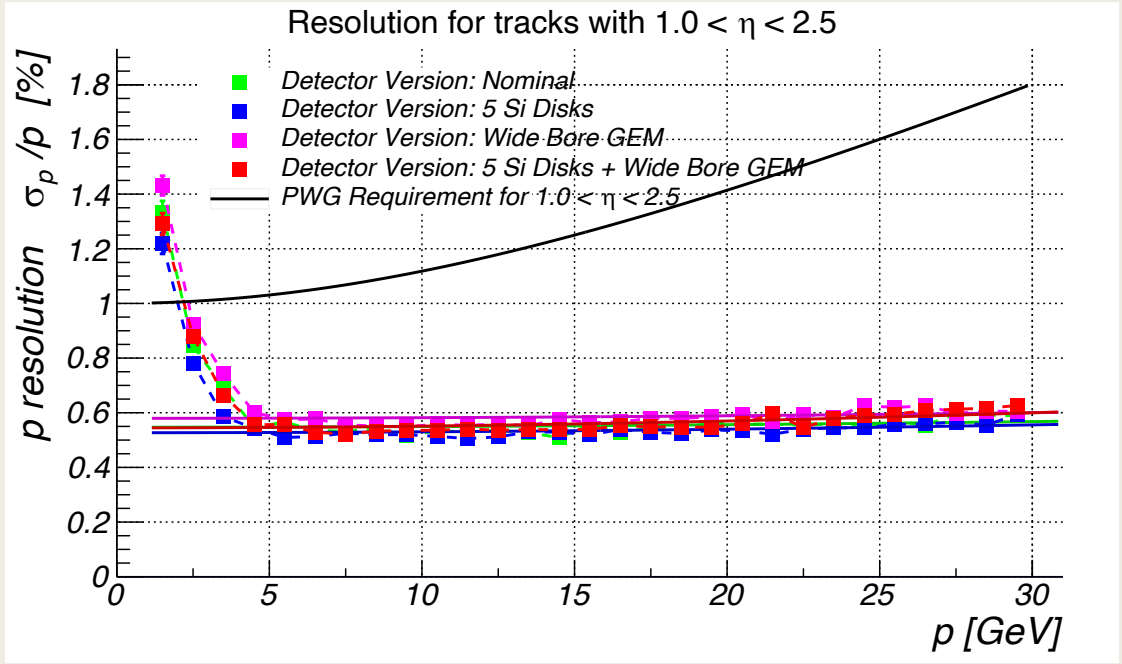
Resolution Comparison - Central

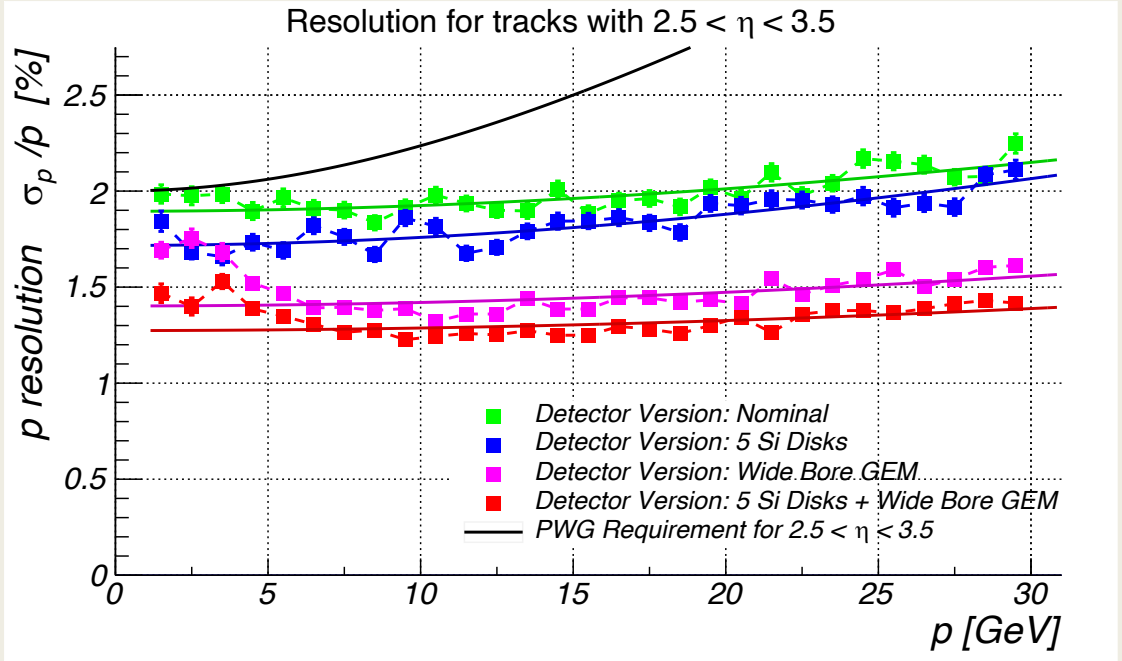
- Obviously no difference, still meets requirements



Resolution Comparison - Forward

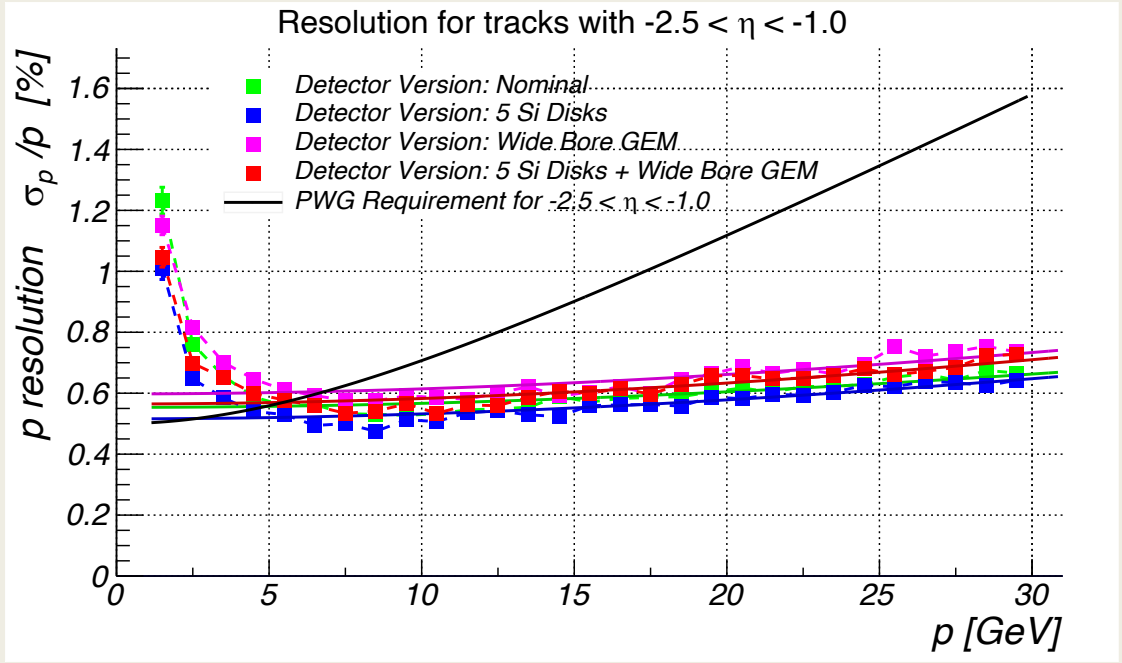
- For the region 1 < eta < 2.5 there is very little difference
- For the region 2.5 < eta < 3.5 there is significant improvement by increasing the inner radius of the GEM disks, which is further improved by removing 2 Si disks

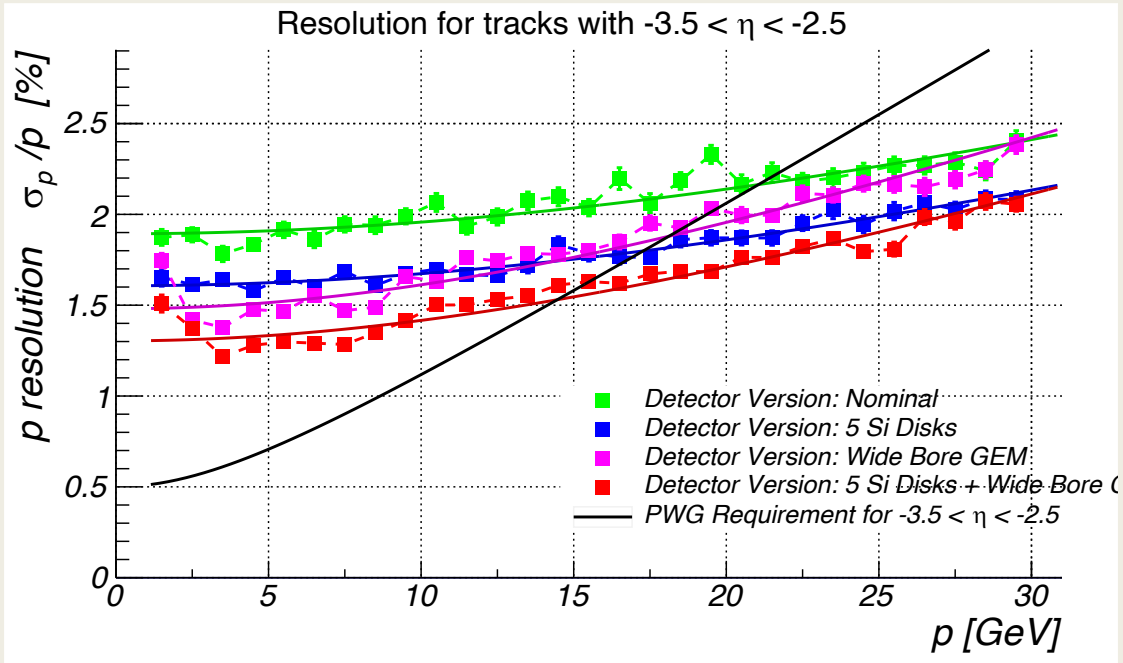




Resolution Comparison - Backward

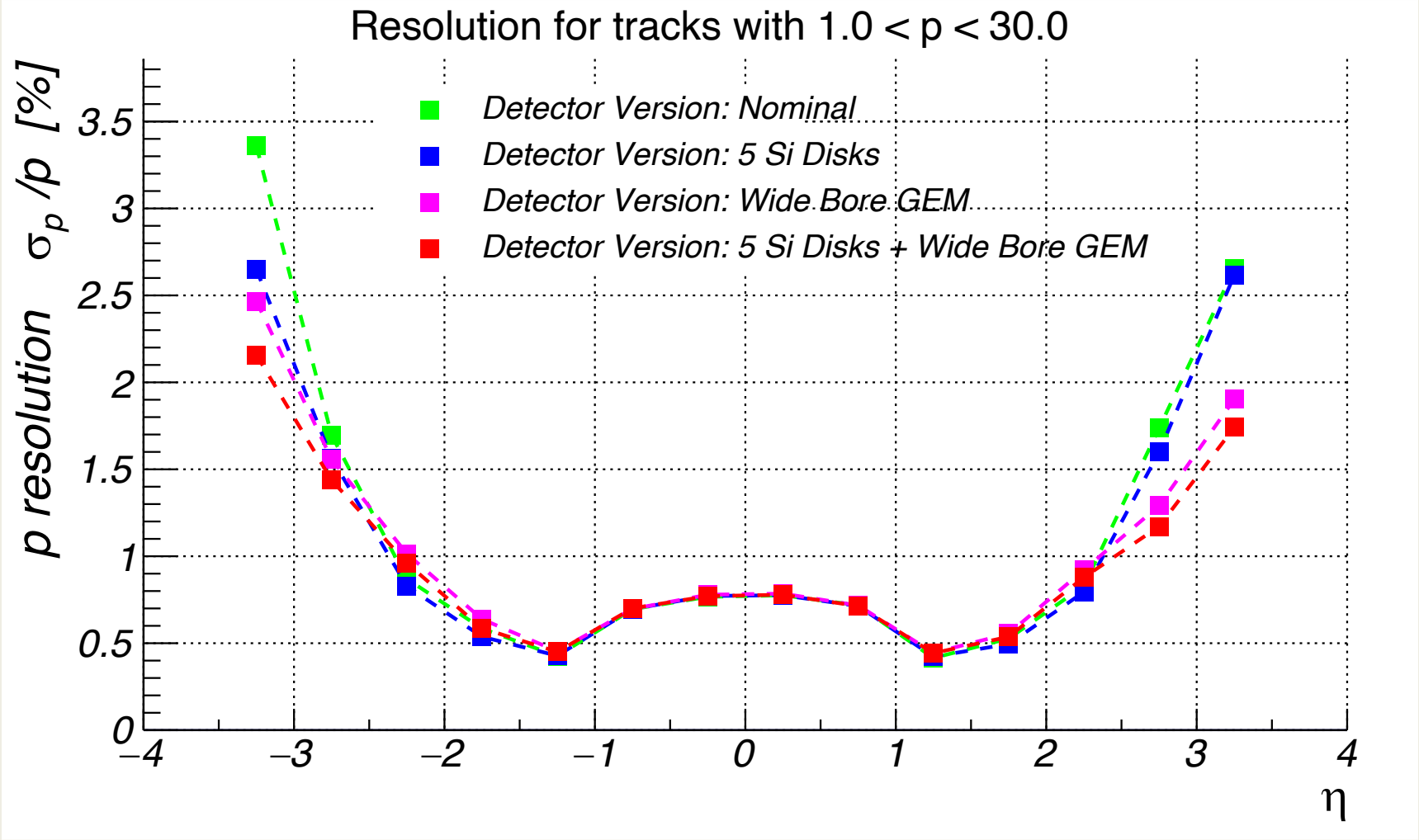
- As with the forward region, the combination of removing 2 Si disks and increasing the inner radius of the GEM disks improves resolution, which is more apparent at the high rapidities





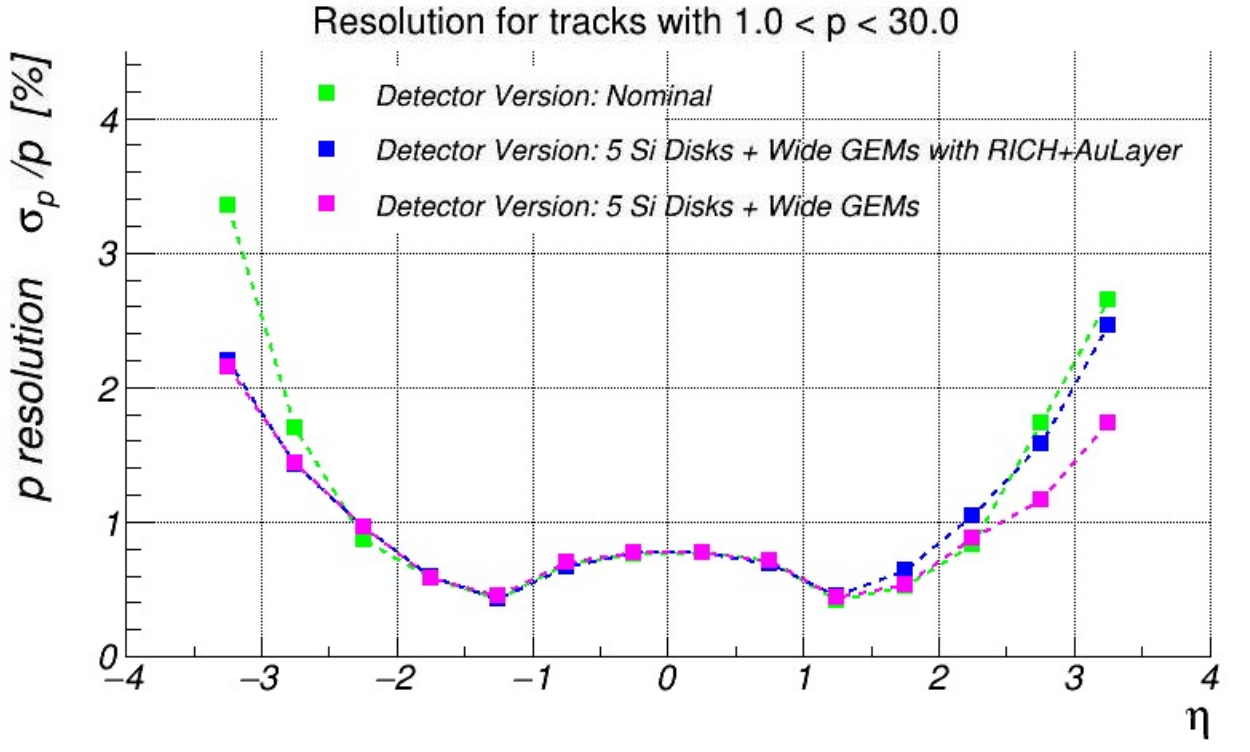
Resolution Comparison

- As before, the combination of the increased inner radius GEM disks and reduced number of Si disks has the best overall results



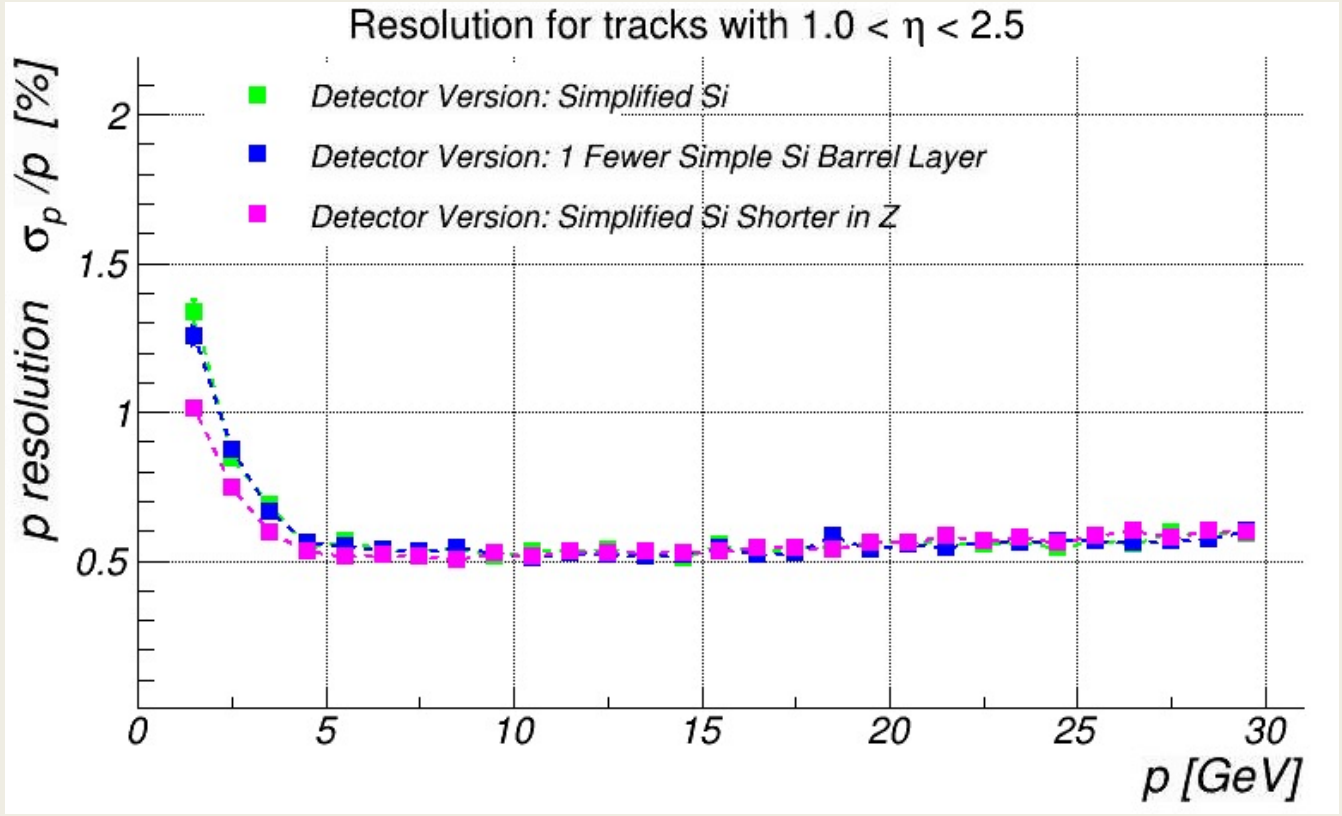
Additional Material

- Added material
  - *RICH*
  - *10 micron Au layer on beam pipe*
- These will be used in studies going forward (NOT included in previously shown results)



Low Momentum Behavior

- Reducing the length of the Si vertex/barrel layers improve low momentum resolution
- More studies needed



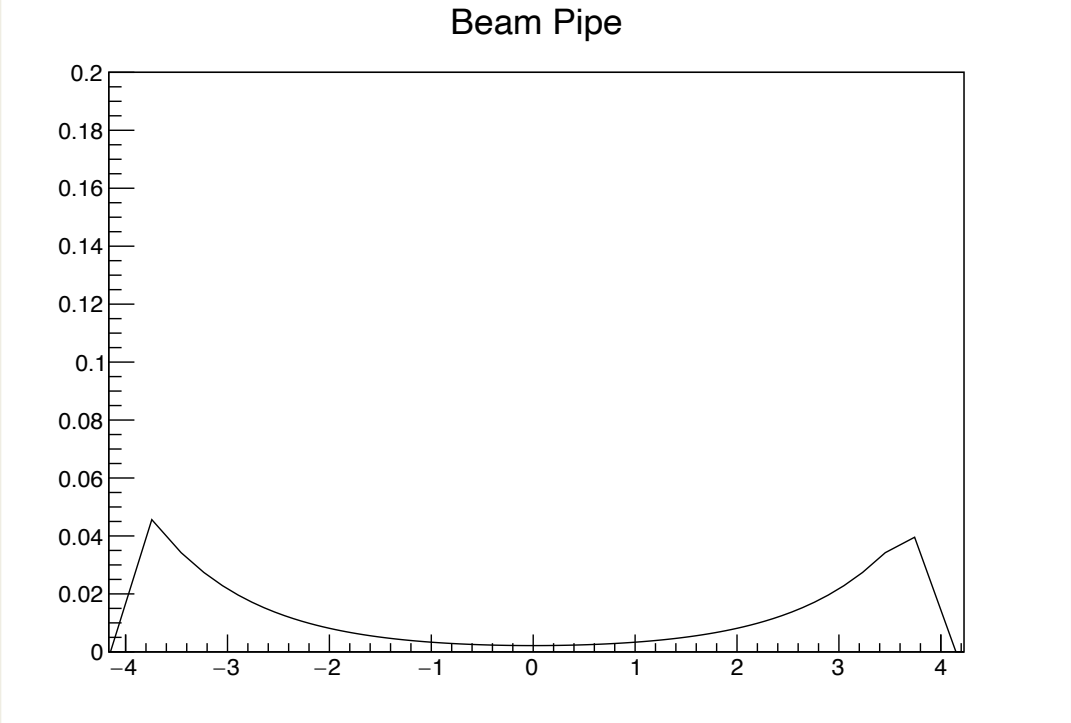
Summary

- Reducing the amount of material by removing 2 Si Disks, and increasing the GEM disk inner radius results in better resolutions at higher rapidities
- Material from the Si barrel layers negatively impacts resolution of low momentum intermediate rapidity tracks
- As expected, the addition of RICH material significantly impacts forward resolutions
- To Do:
  - *Study the low momentum region in more detail*
  - *Material Updates:*
    - GEM Material Updates:
      - *Support structure*
    - Si Disk Material Updates:
      - *Add Aluminum support*
  - *Optimize Si Layers*
  - *Optimize number and position of GEM disks*

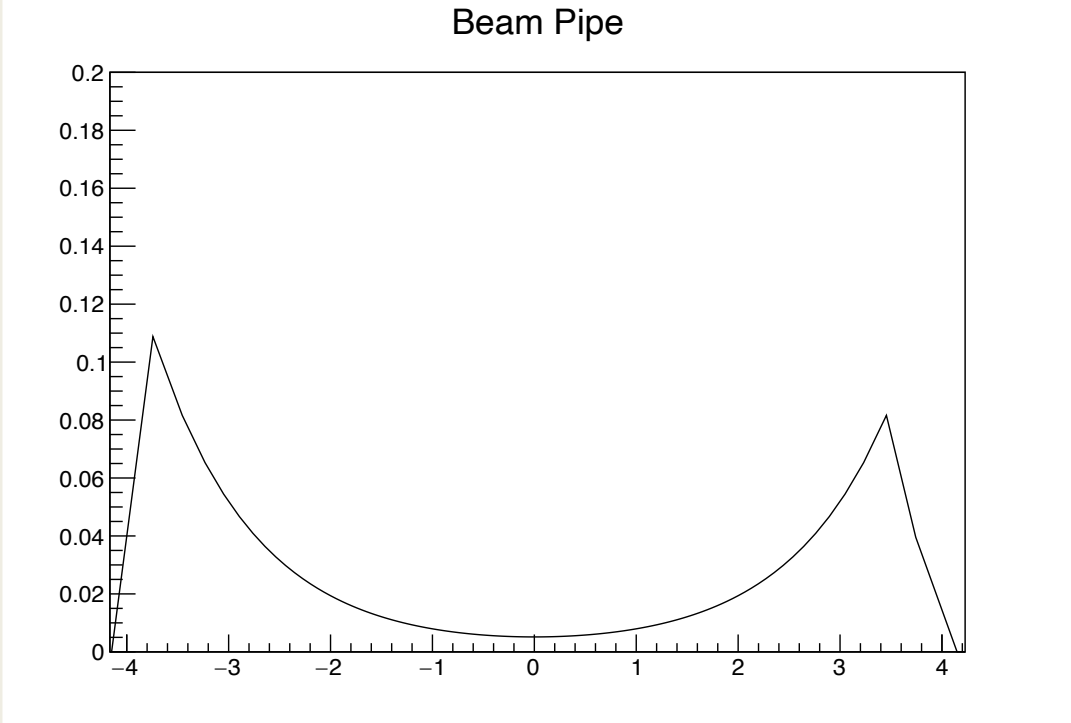
BACKUP SLIDES

Gold Coating On Beam Pipe

Original Beryllium Beampipe

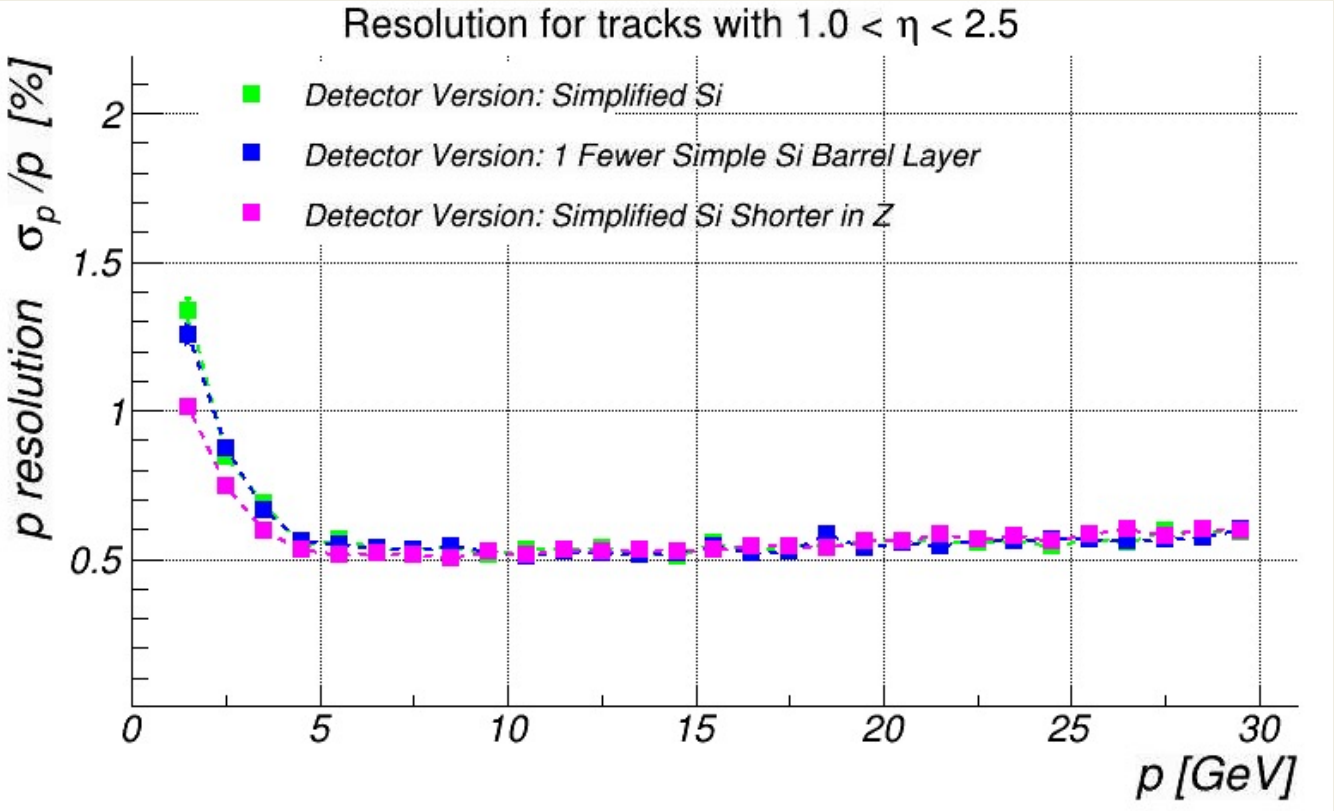


Beryllium with 10 micron Gold Coating



Si Barrel Layers

- 2 Barrel layers shortened from 84 cm to 54 cm
- 3 vertexing layers shortened from 42 cm to 27 cm



Maximum eta coverage of each layer (starting from outermost to innermost layer)
Original: {1.6, 1.9, 2.1, 2.3, 2.5}
Shortened: {1.2, 1.5, 1.7, 1.8, 2.0}