

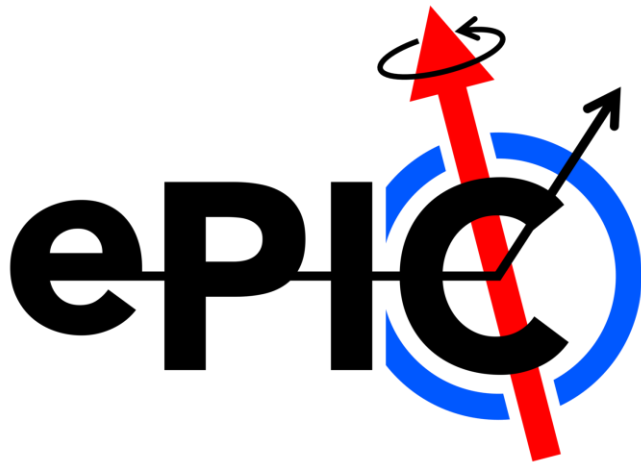
A Realistic B0 Tracker Implementation

Joint track and vertex reconstruction and tracking wg meeting

Tom Bleher, Igor Korover

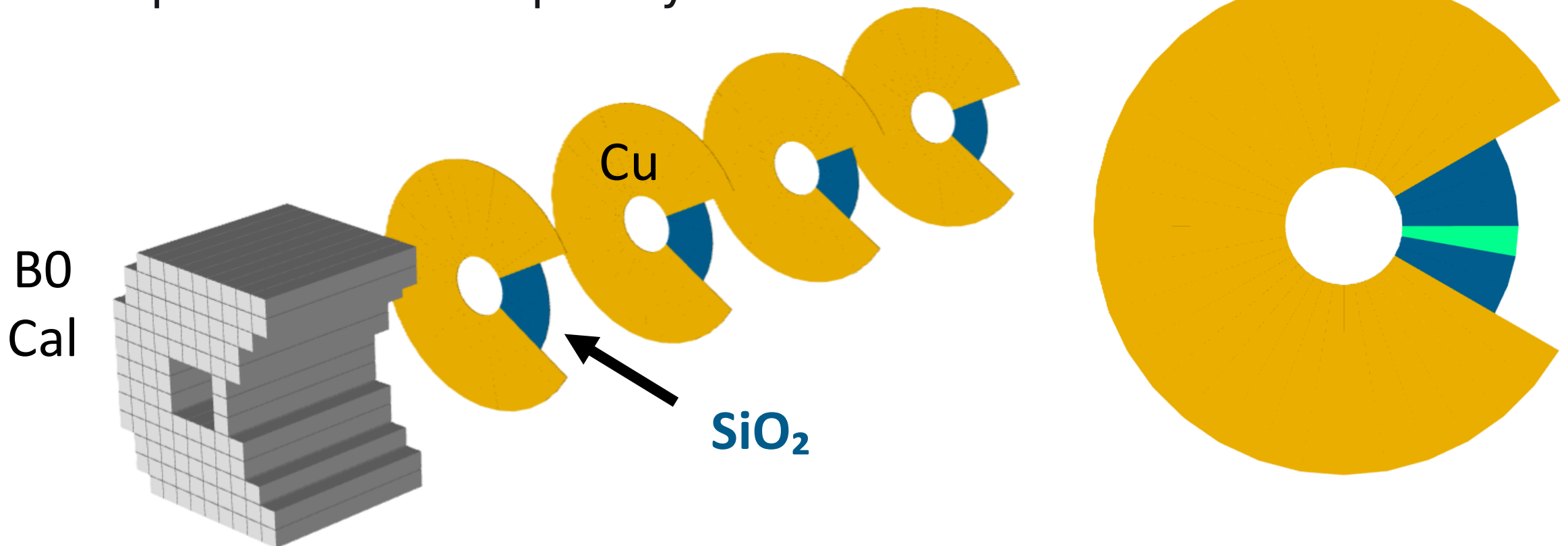
Tel Aviv University

23.07.2026

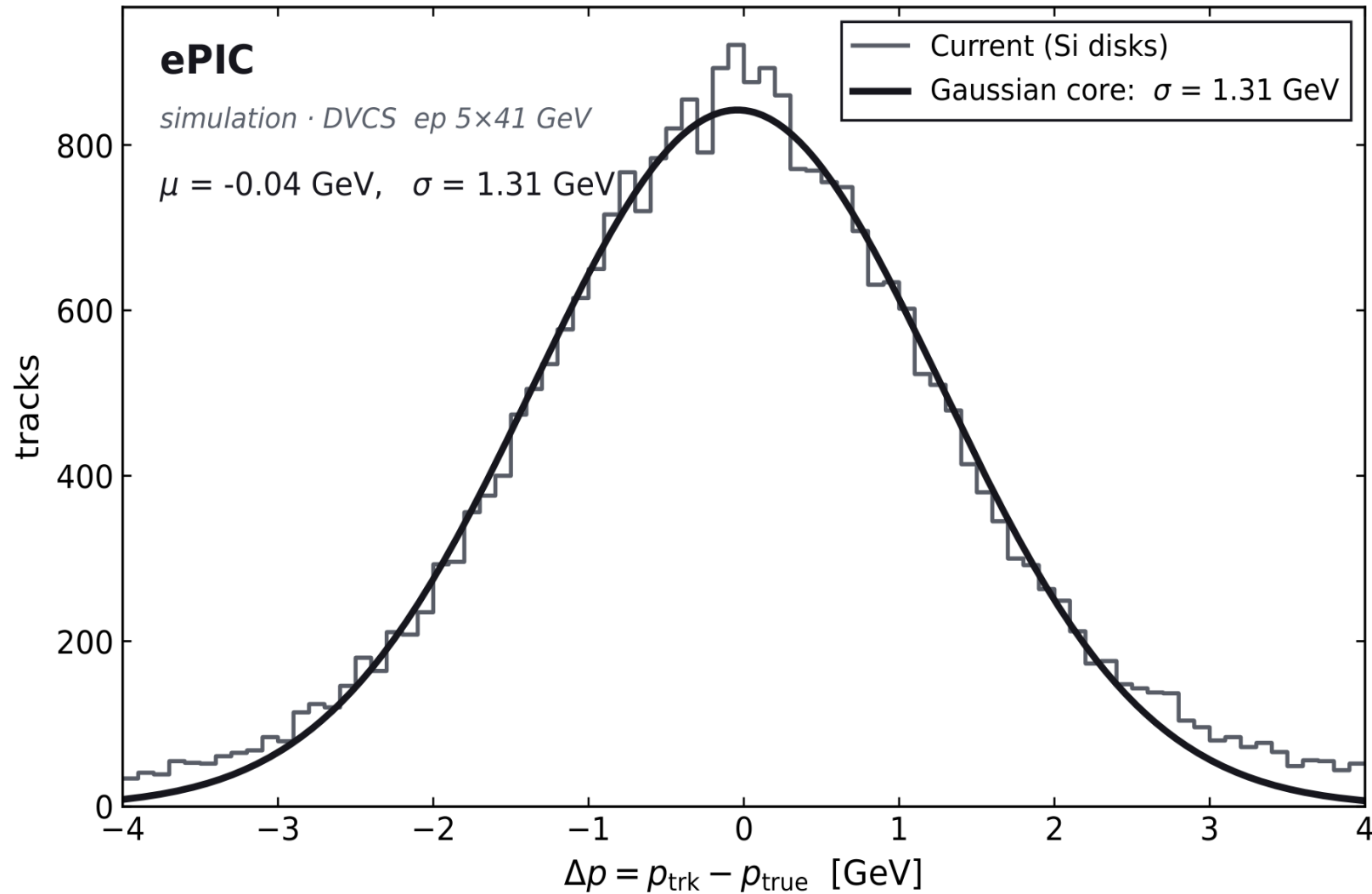


Current B0 Tracker: a simplistic model

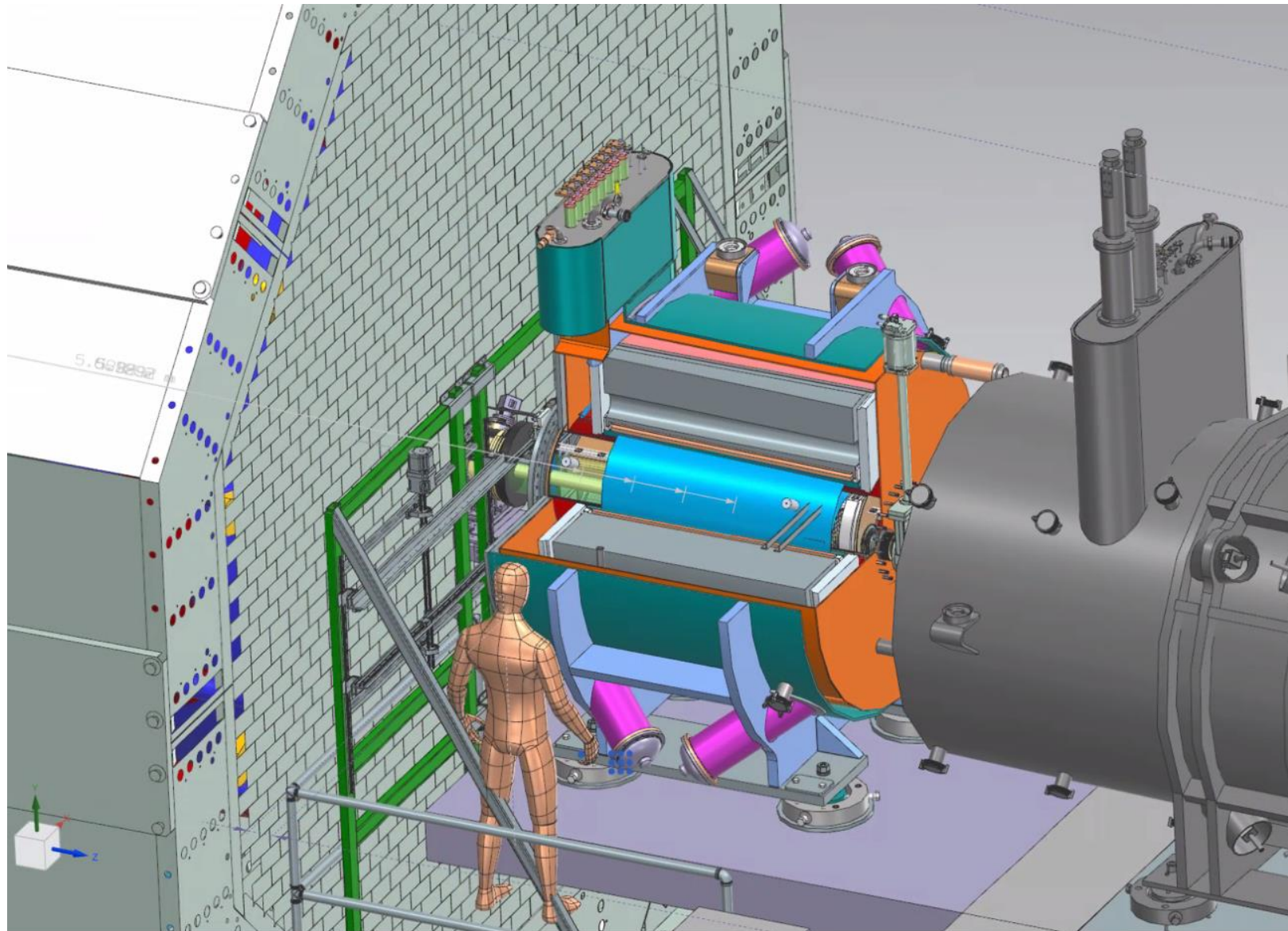
- 4 sensitive silicon disks, one ACTS plane per station
- 0.715 mm Cu + 0.3 mm SiO₂ (sensitive)
- 36 trapezoid modules per layer



Current B0 Tracker momentum resolution

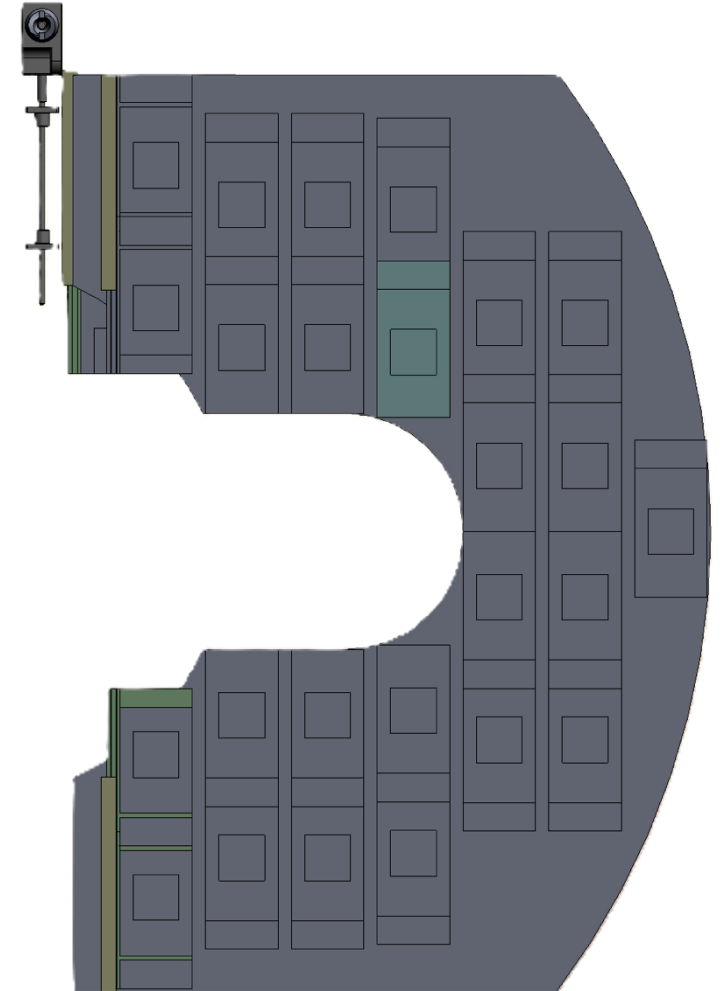
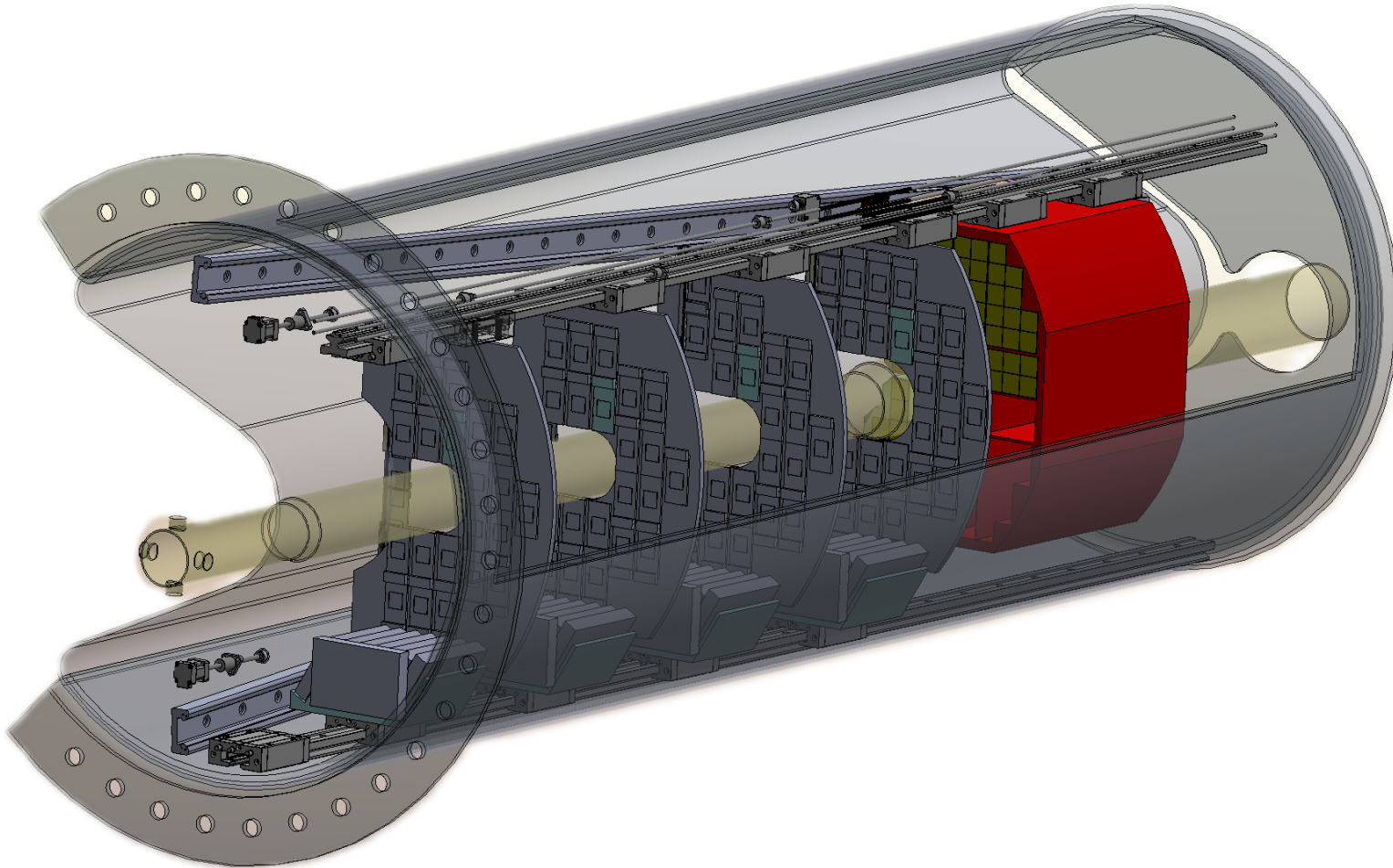


B0 Tracker Mechanical Constraints



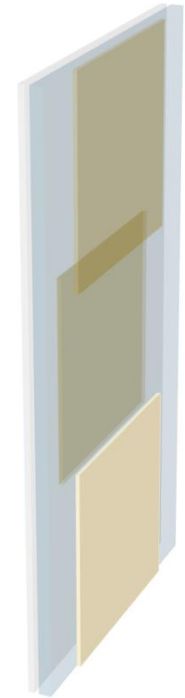
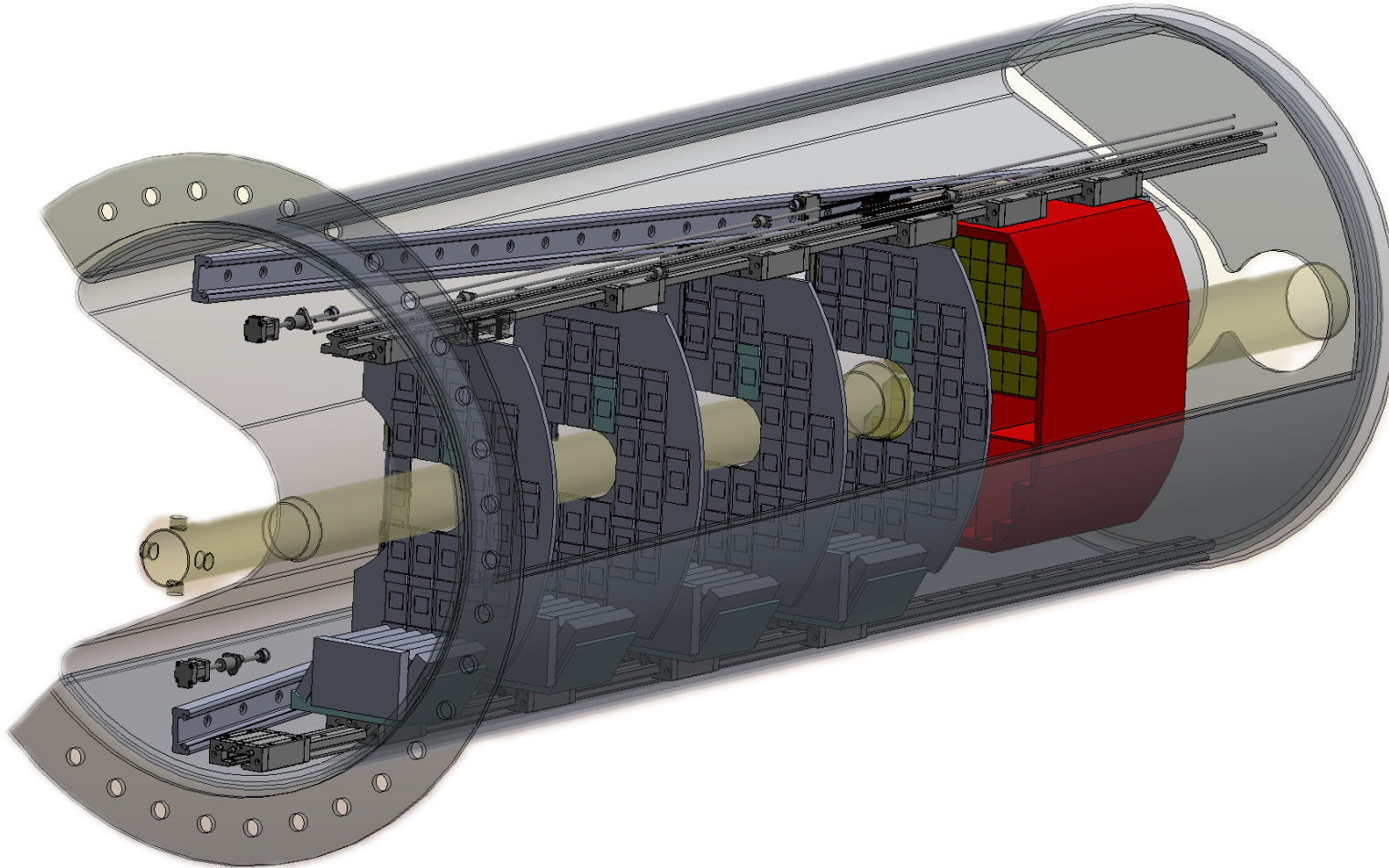
B0 Tracker Mechanical Constraints

- CAD model guides simulation design



B0 Tracker Mechanical Constraints

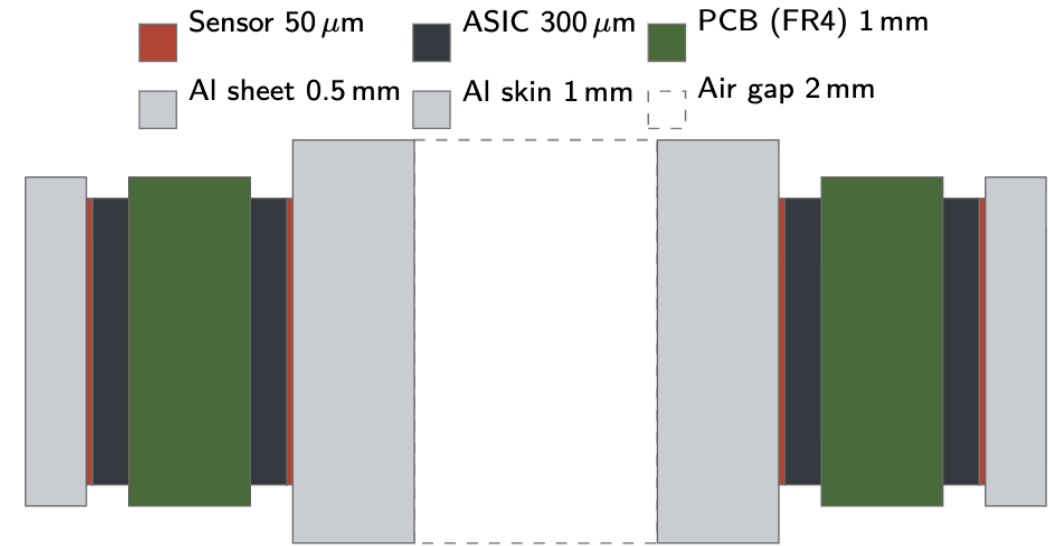
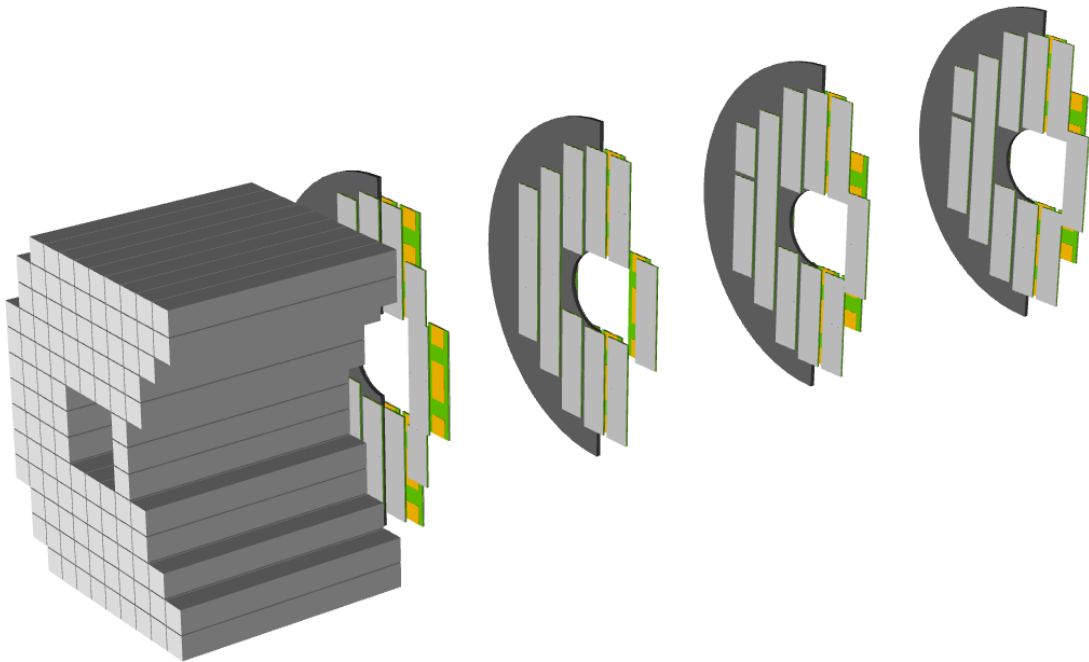
- CAD model guides simulation design



Tracking unit

Realistic B0 tracker (new)

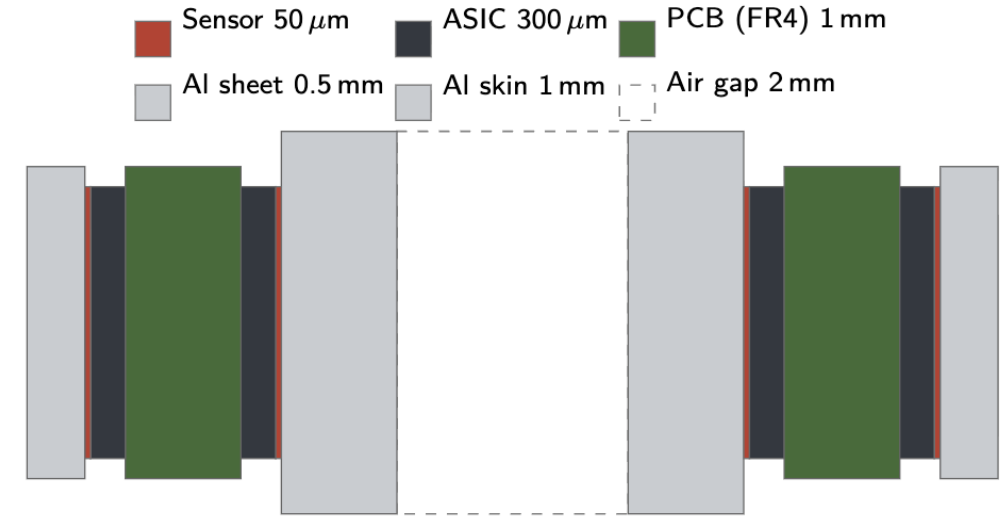
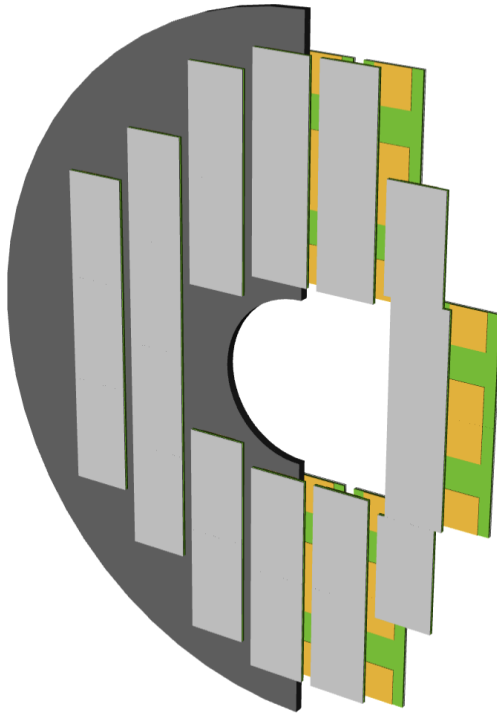
- Four stations, each represented by a front and back sensor layer: 8 ACTS layers
- Hollow support: 1 mm Al skin + 2 mm air core + 1 mm Al skin



- Each module: 1 mm FR4 PCB; 50 μm Si sensors; 300 μm Si ASICs; 0.5 mm outer Al sheet
- Front/back module grids are offset to improve tiling around the beampipe aperture.

Realistic B0 tracker (new)

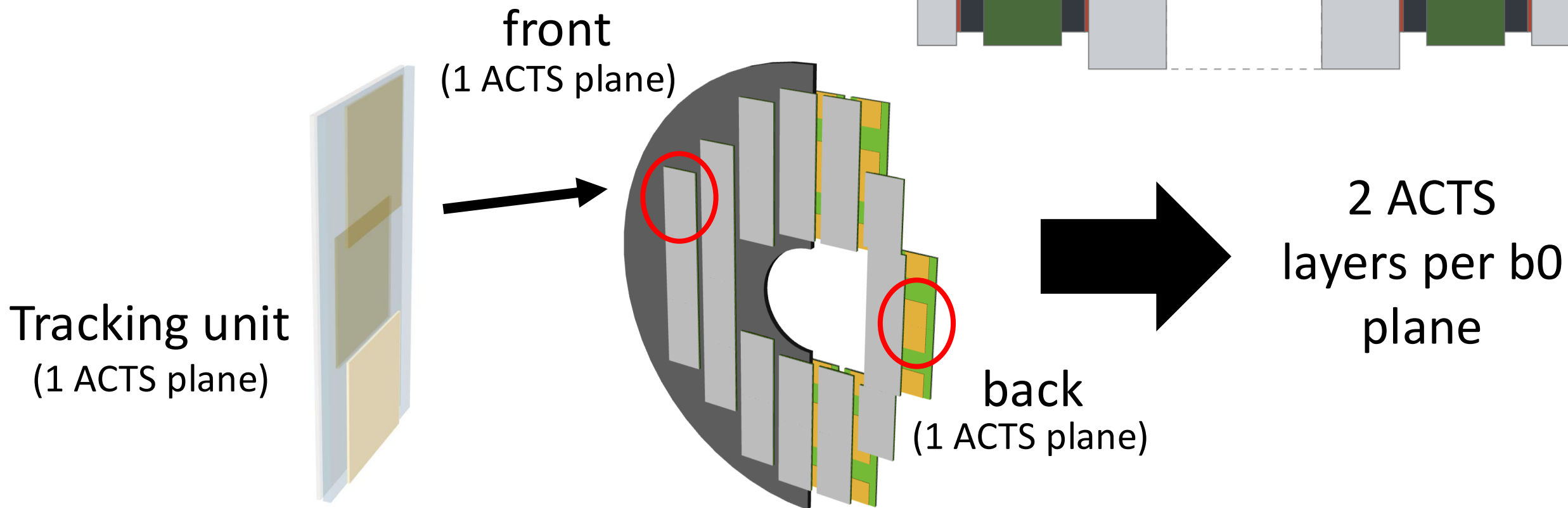
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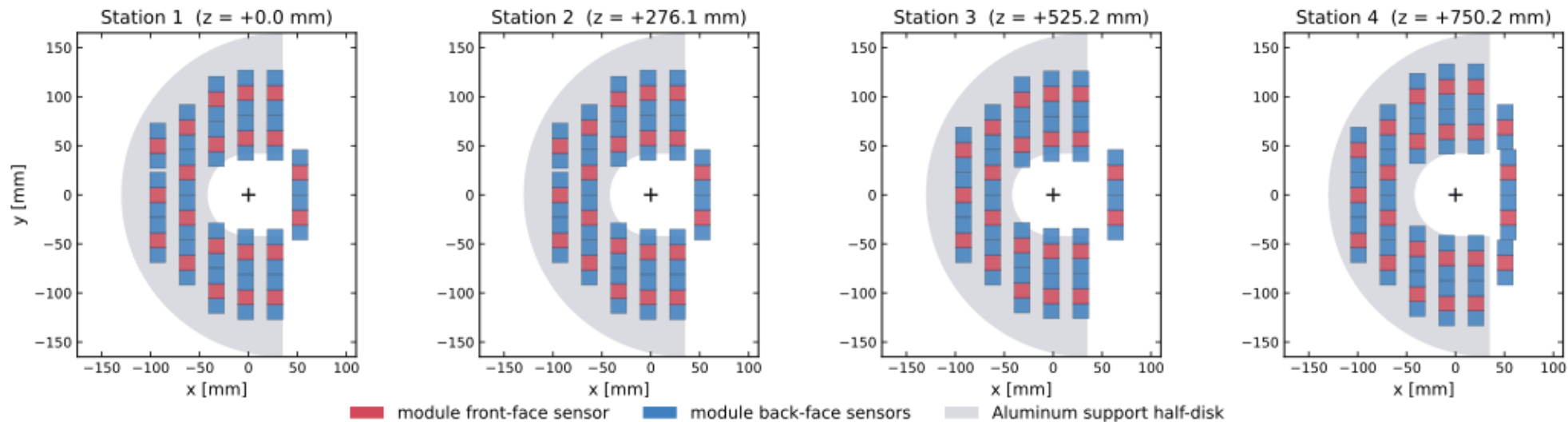
New B0 tracking scheme

- 4 b0 planes $\times$ front/back = 8 ACTS planes
- 166 PCB modules; each carries 3 sensors

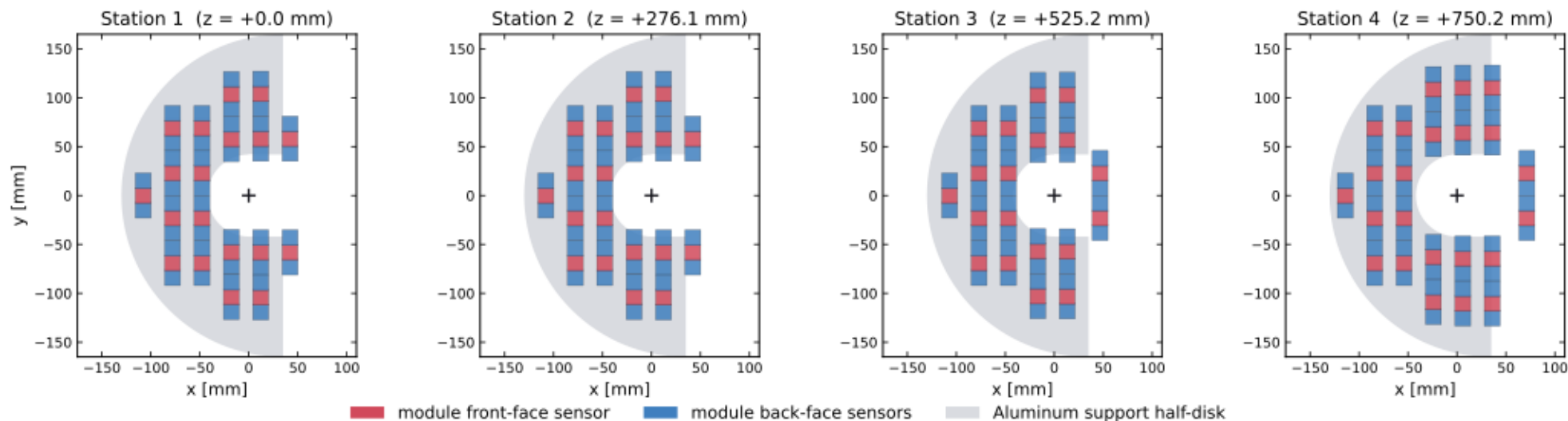


Front/Back Sensitive Coverage (One ACTS plane)

B0 tracker — station Front plane: silicon sensors by module face (dev/epic, as built)



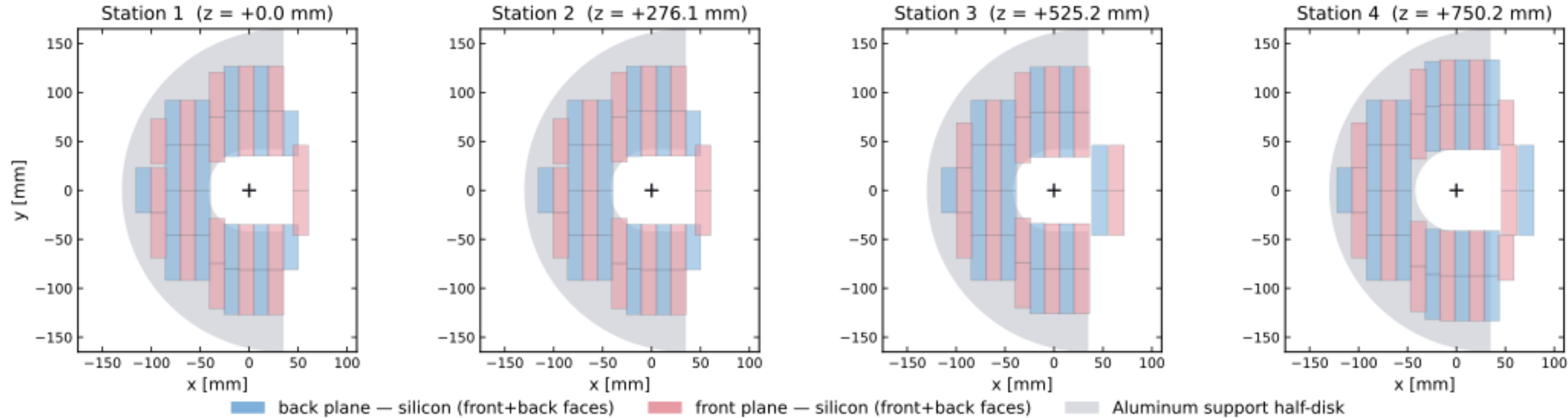
B0 tracker — station Back plane: silicon sensors by module face (dev/epic, as built)



Total Sensitive Coverage (Two ACTS plane)

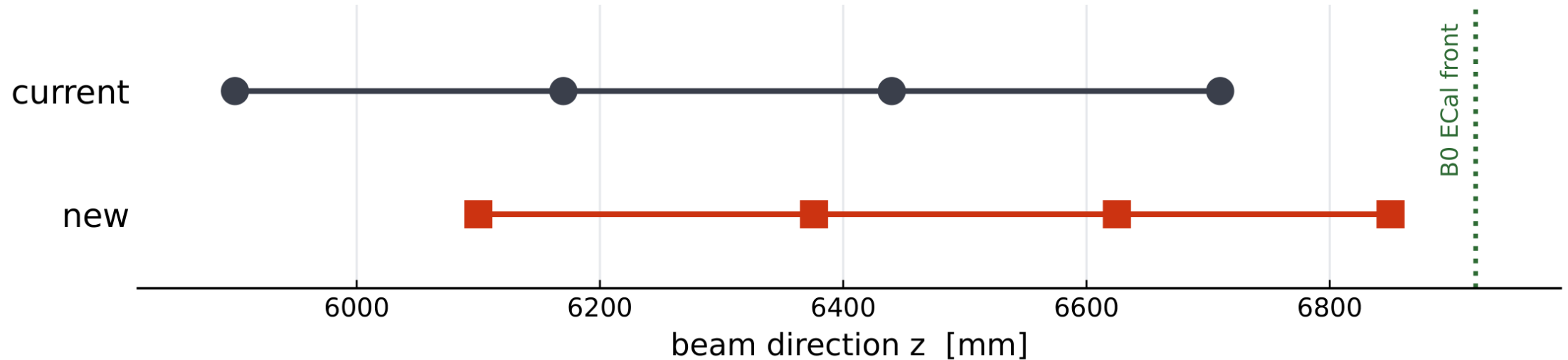
- Modules were placed shifted front/back for better coverage

B0 tracker — front + back plane silicon sensitive coverage per station (dev/epic, as built)



Plane z Positioning

Layout	P1	P2	P3	P4	gaps [mm]	P4→ECal [mm]
current	5899.9	6169.9	6439.9	6709.9	270/270/270	210
realistic (new)	6100.0	6376.0	6625.0	6850.0	276/249/225	70



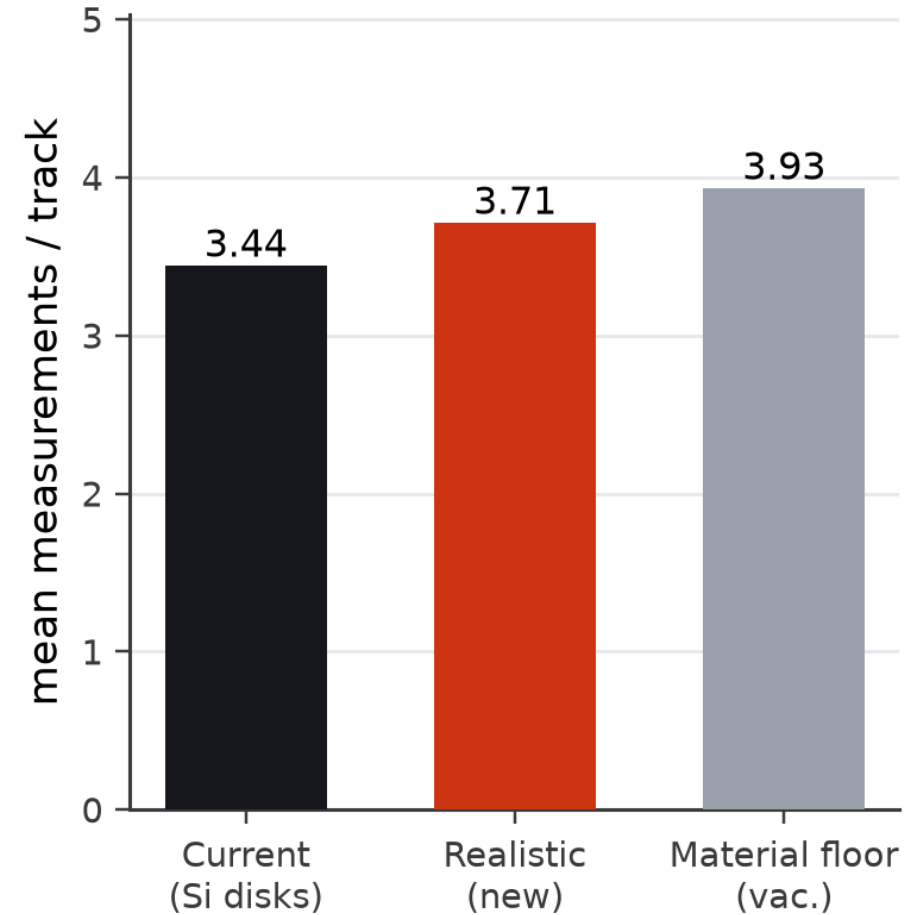
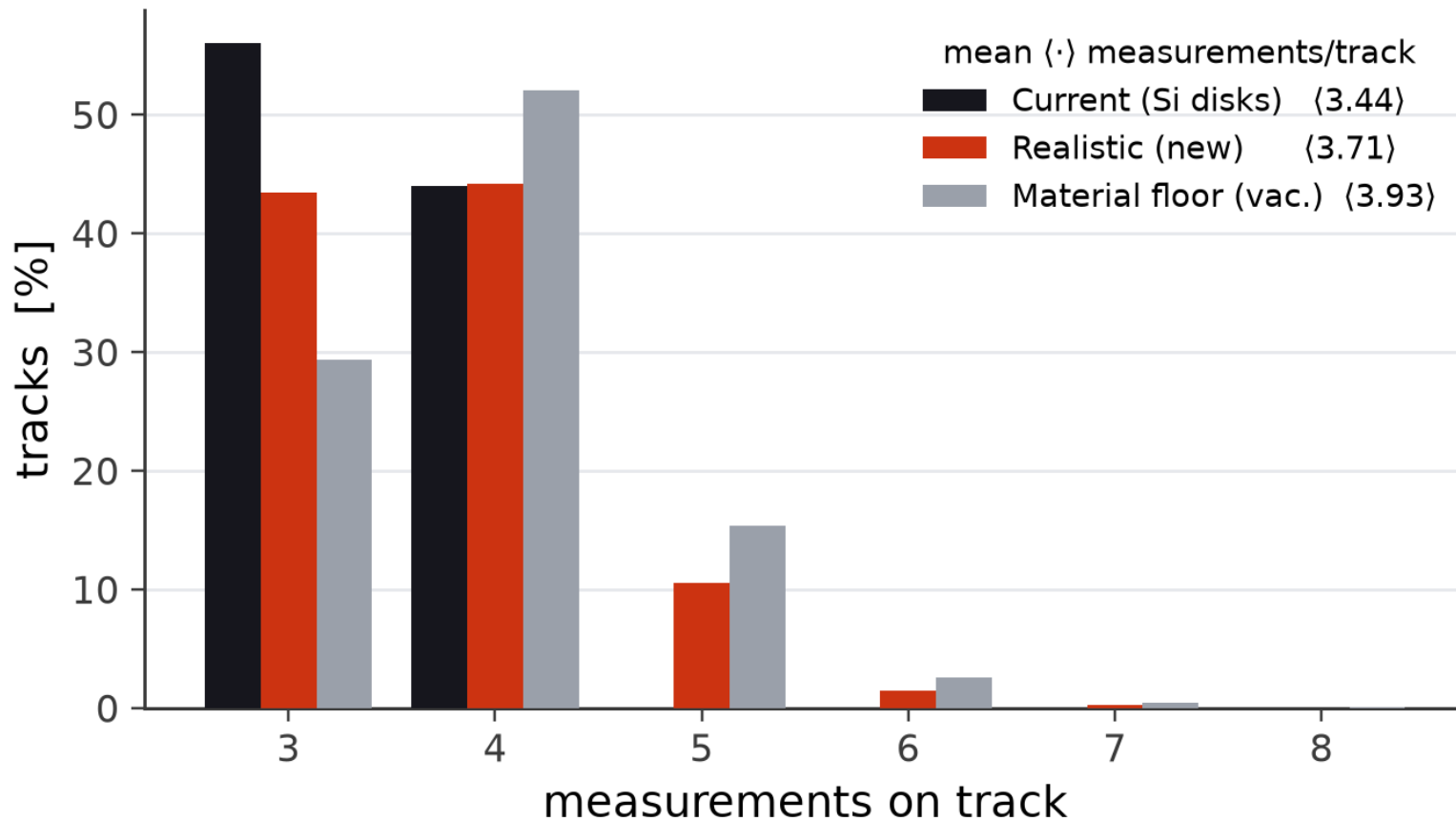
Truth-seeded vs. real-seeded CKF

- **B0TrackerCKFTruthSeeded:** seeds from the MC-truth proton is populated.
- **B0TrackerCKFTrajectories:** seeds from the hits is **not** populated.

This is currently being investigated..

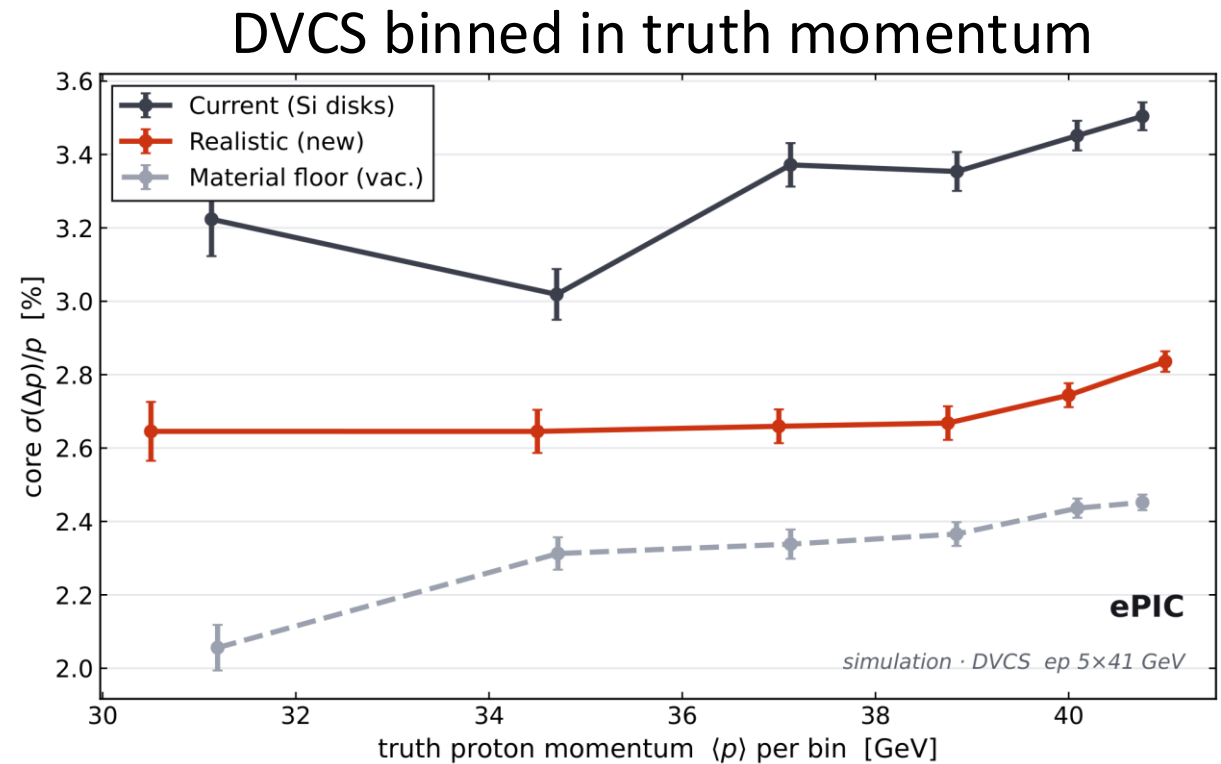
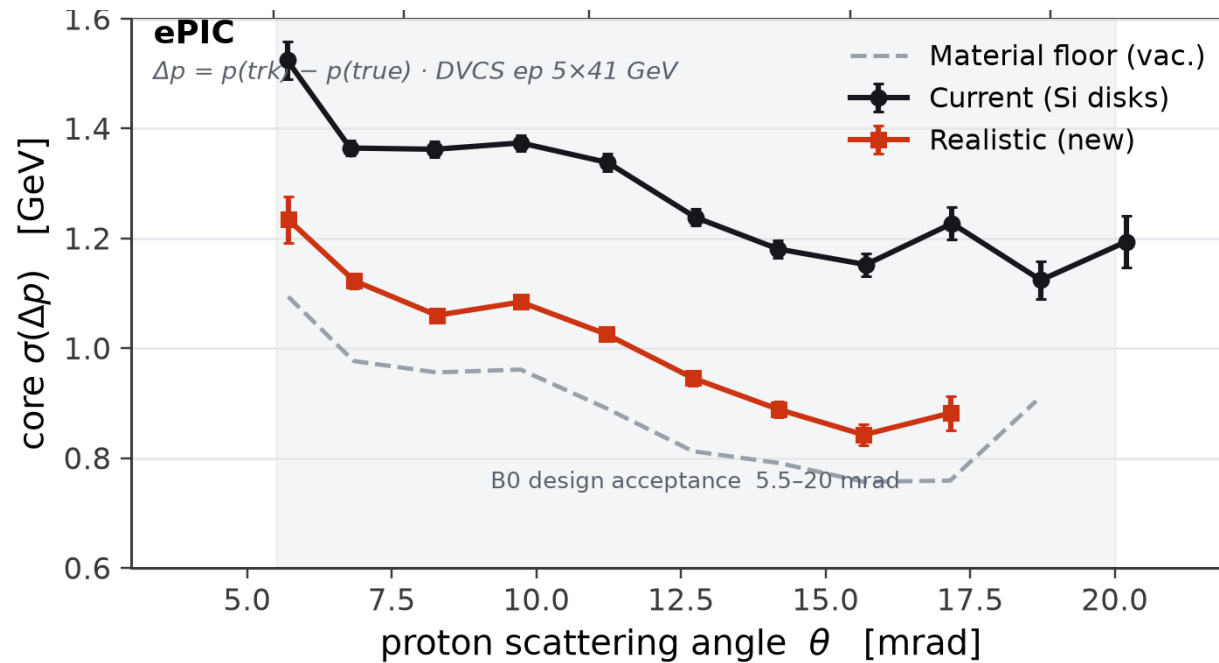
Per-track tracking diagnostics

- 8 sensor layers (was 4) $\rightarrow$ the CKF collects > 4 hits on $\approx 12\%$ of tracks
- Mean hits / track: $3.44 \rightarrow 3.71$



Momentum Resolution vs. Proton Angle

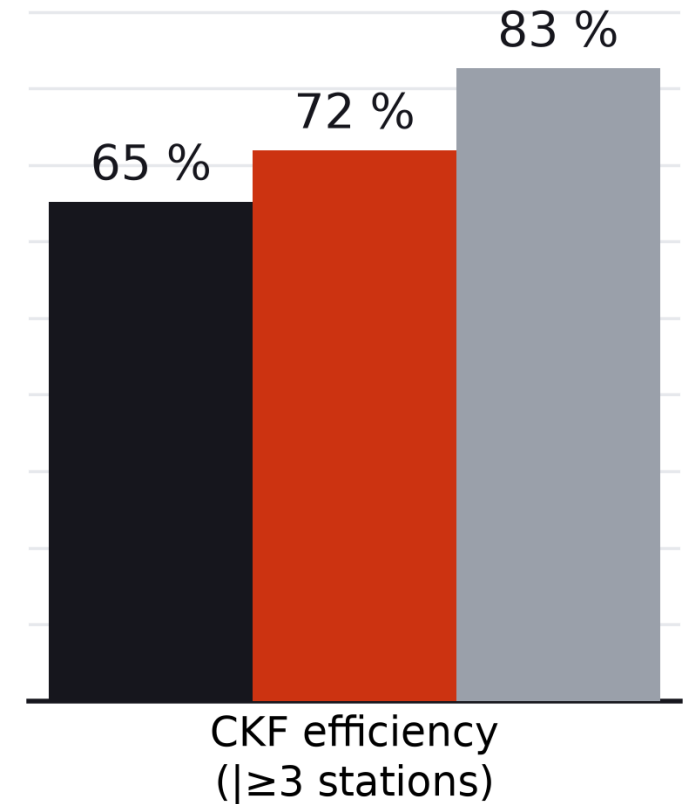
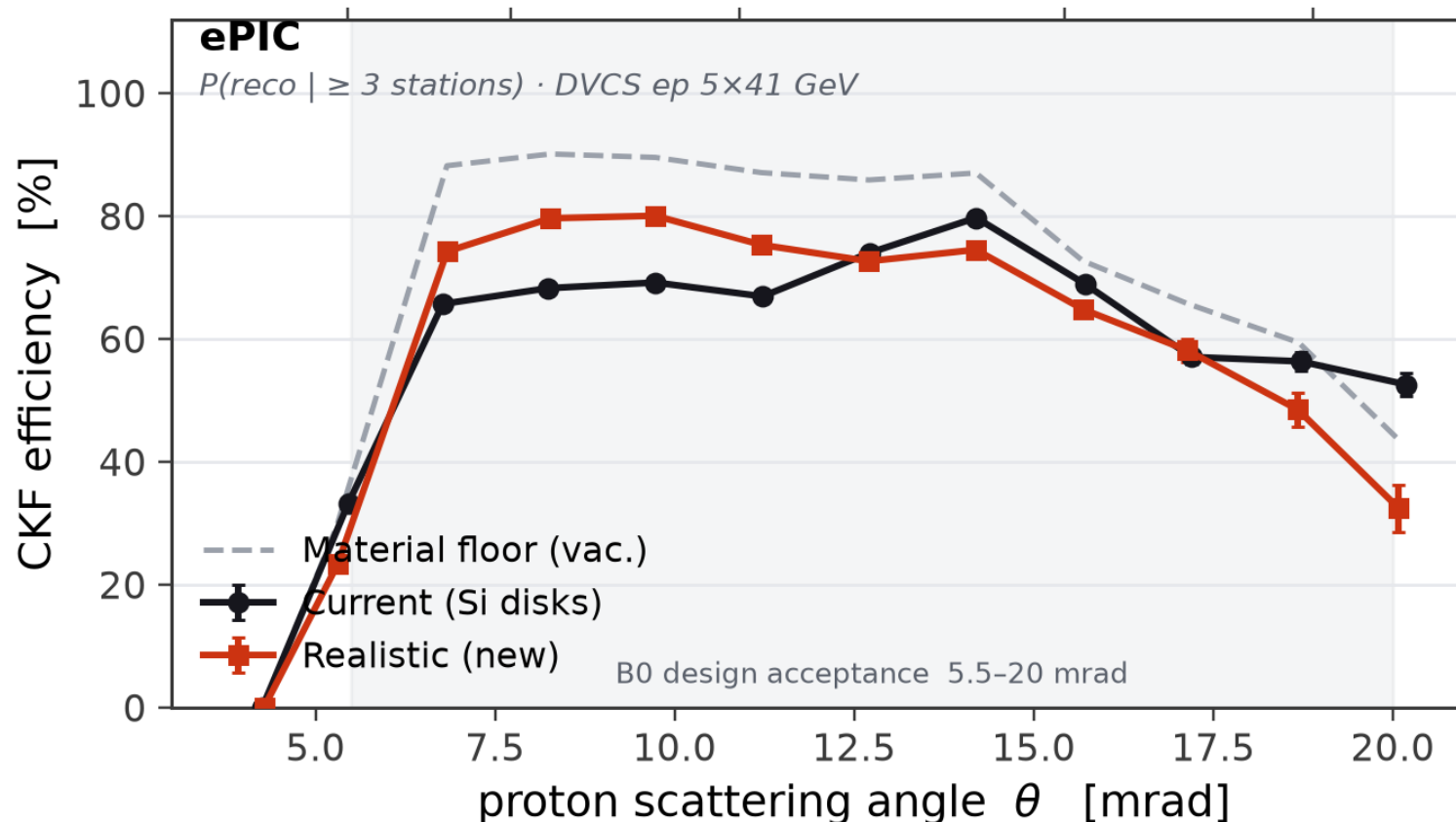
- $\sigma(\Delta p)$ is the momentum track resolution



Efficiency vs. Proton Angle (preliminary)

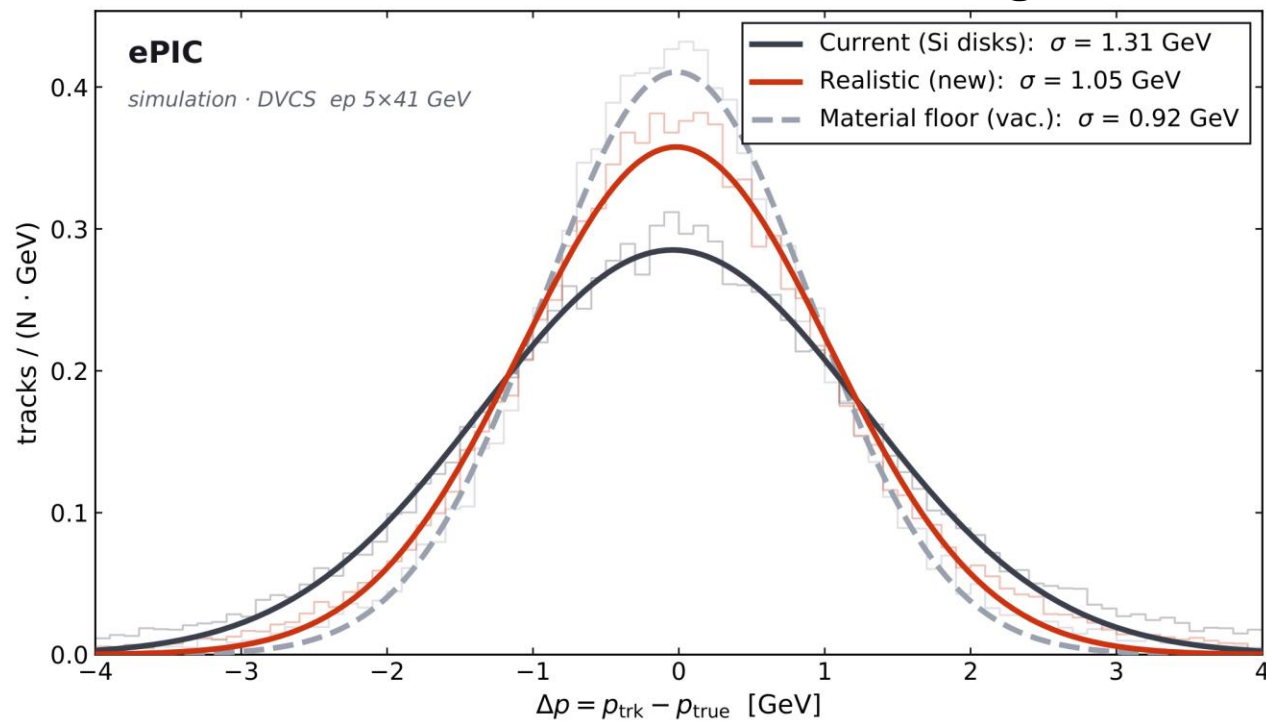
- **CKF track efficiency:** $N(\text{in acceptance and fitted track}) / N(\text{in acceptance})$, where in acceptance = truth proton crosses ≥ 3 b0 planes.

*Three crossings based on geant4 truth

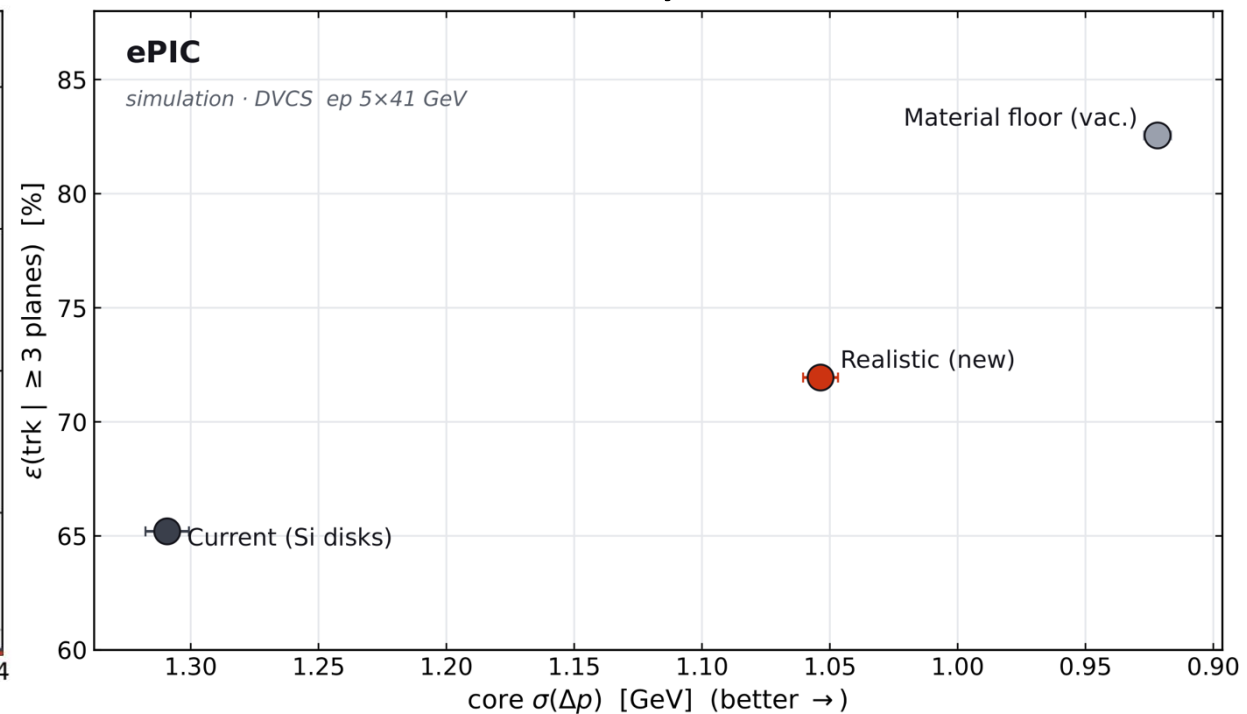


Comparison: current vs. realistic B0 tracker

Track momentum residual histograms



Track efficiency vs resolution



Summary & Outlook

Summary

- A new b0 tracker was implemented for the ePIC detector
- The new implementation is more realistic and true to mechanical constraints

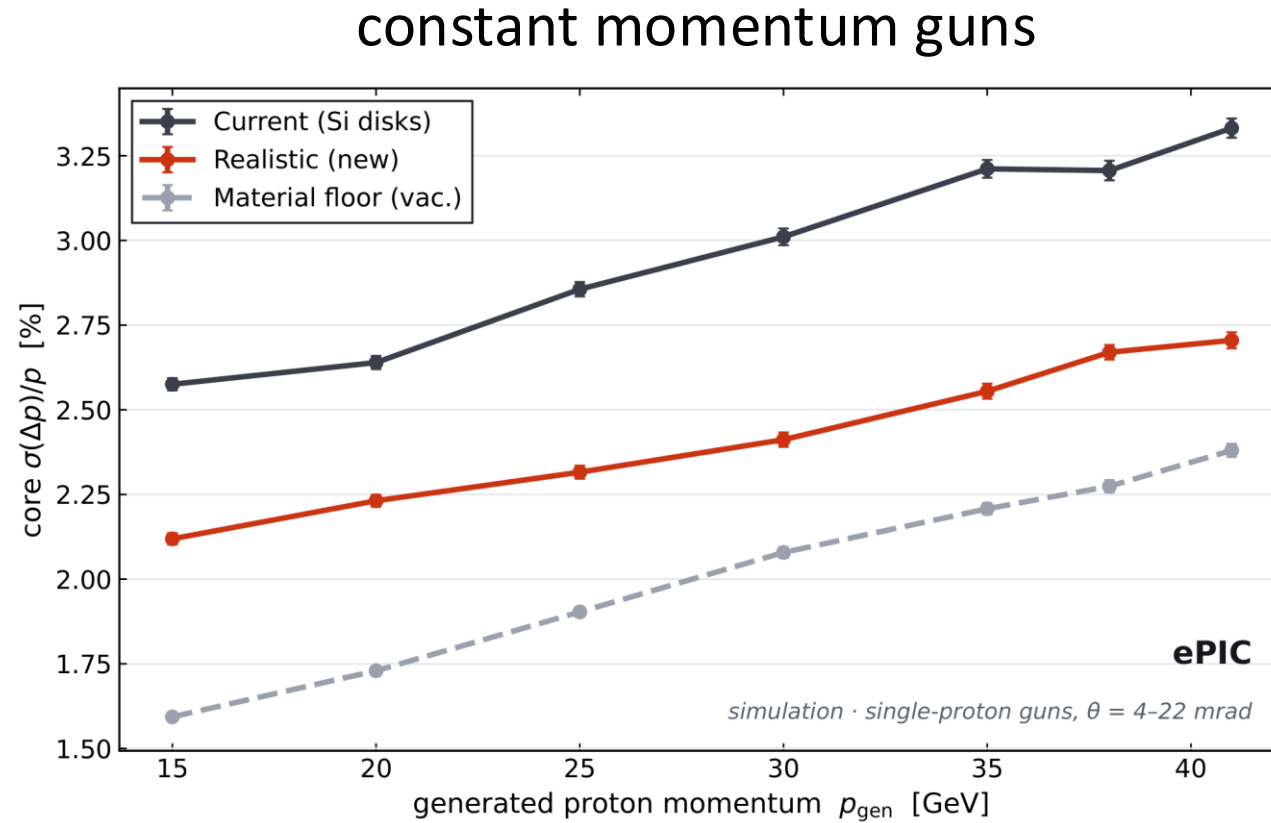
Outlook

- Finalize DD4HEP implementation of realistic b0 tracker driven by CAD design
- Finalize resolution and efficiency studies of the realistic implementation

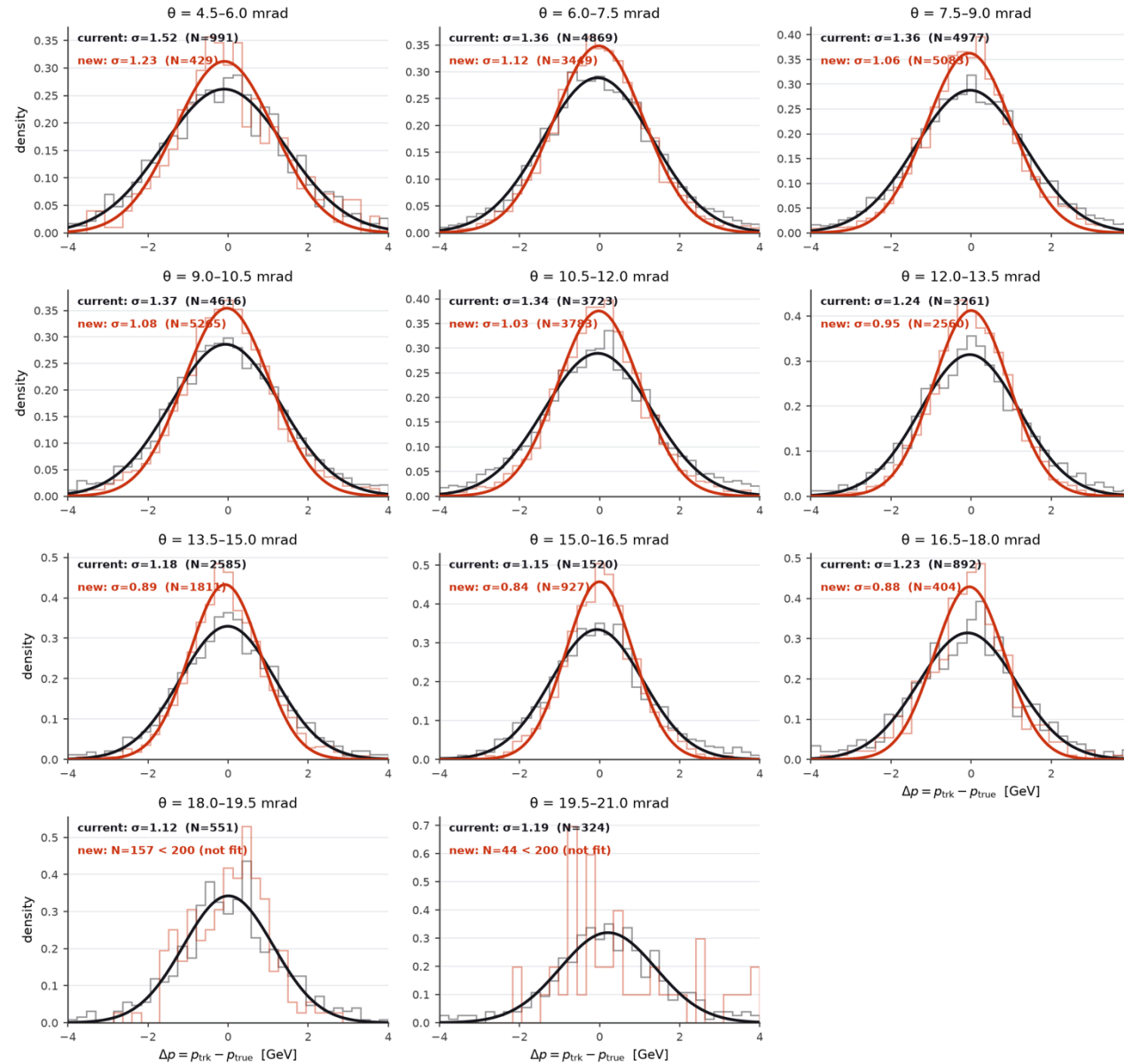
Thank you for listening

Appendix

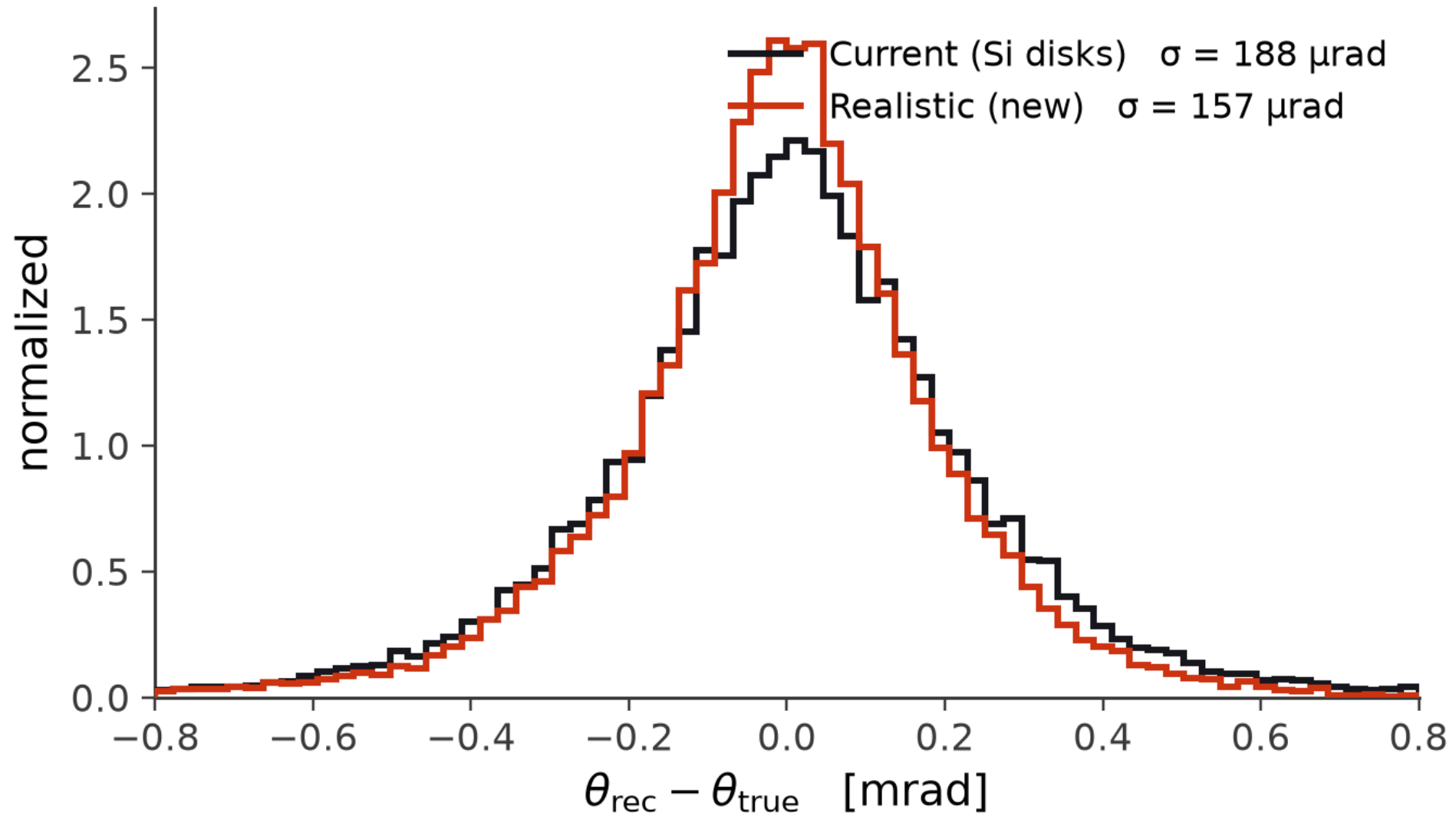
Comparison: current vs. realistic B0 tracker



Proton Angle Distribution



Proton scattering angle residual



Tracks per event

