Inner tracker studies

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Thanks to: A. Dainese, C. Gargiulo, M. Concas, A. Di Mauro, F. Reidt, C. van Veen, I. Altsybeev

5th ALICE Upgrade week ∗ Krakow, Poland ∗ 10.10.2024

Outline

- Updates of the tracker geometry description in O^2
- Updated reconstruction results using ACTS

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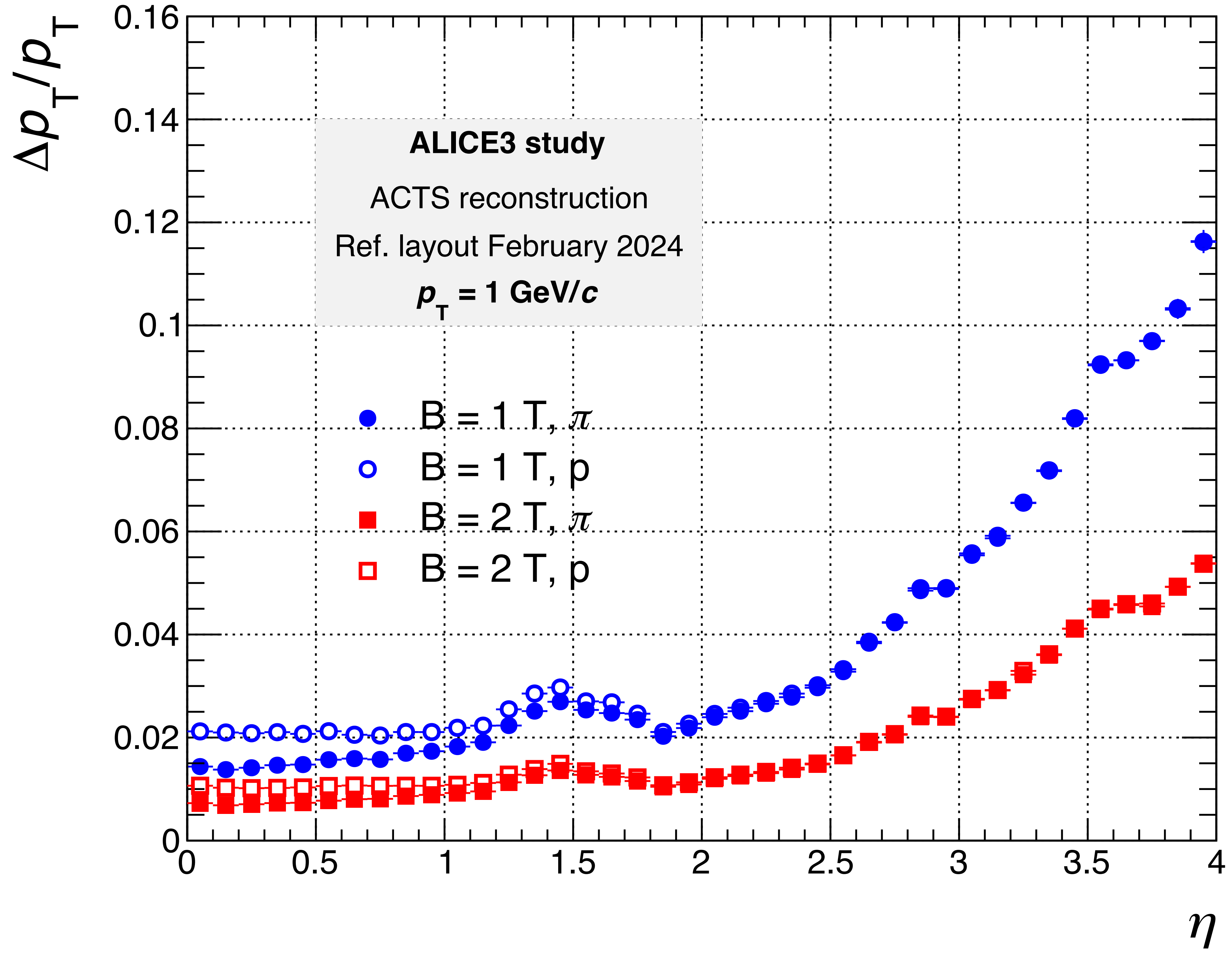
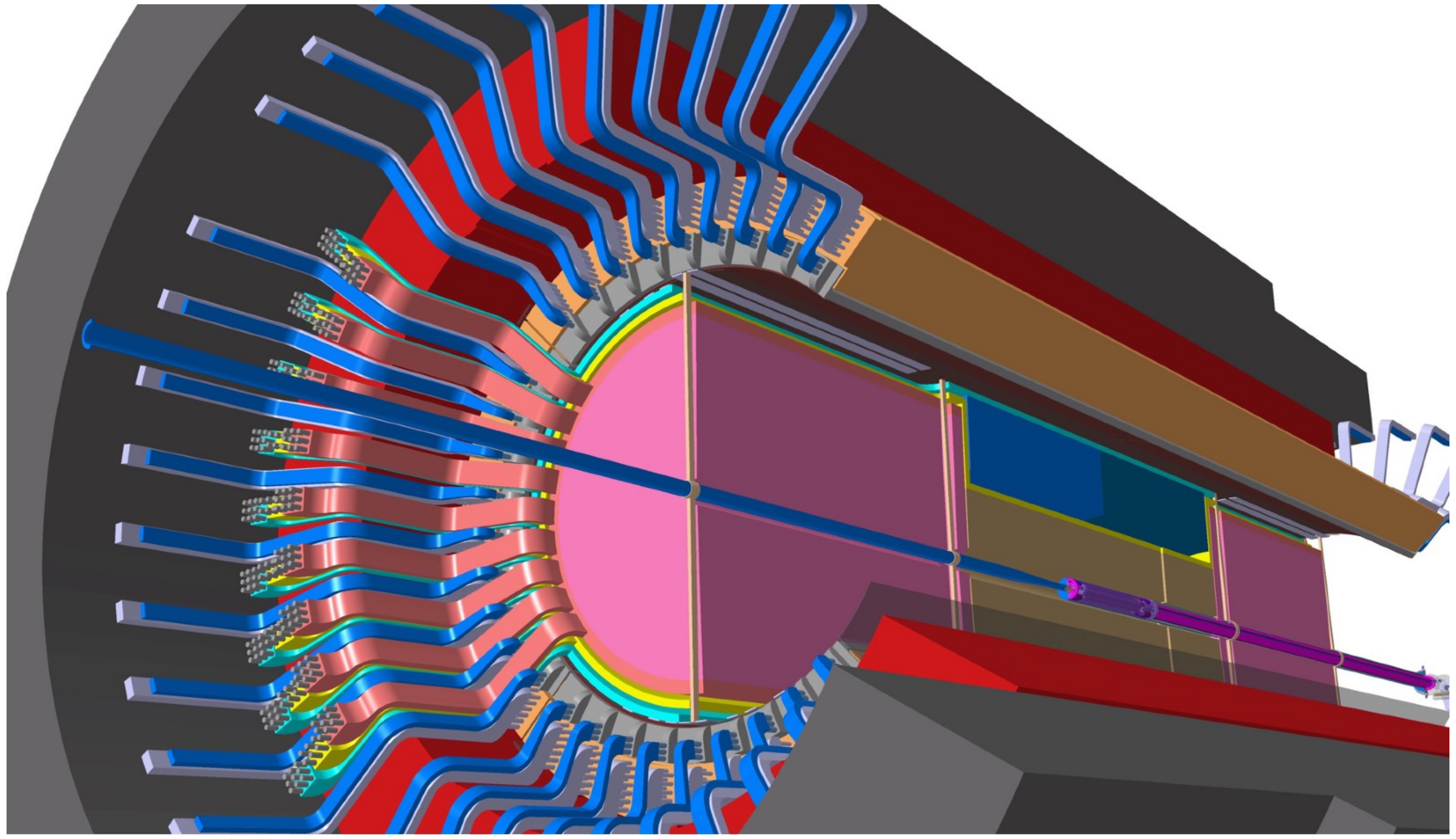


Services not included



Engineering team: ALICE 3 tracker services

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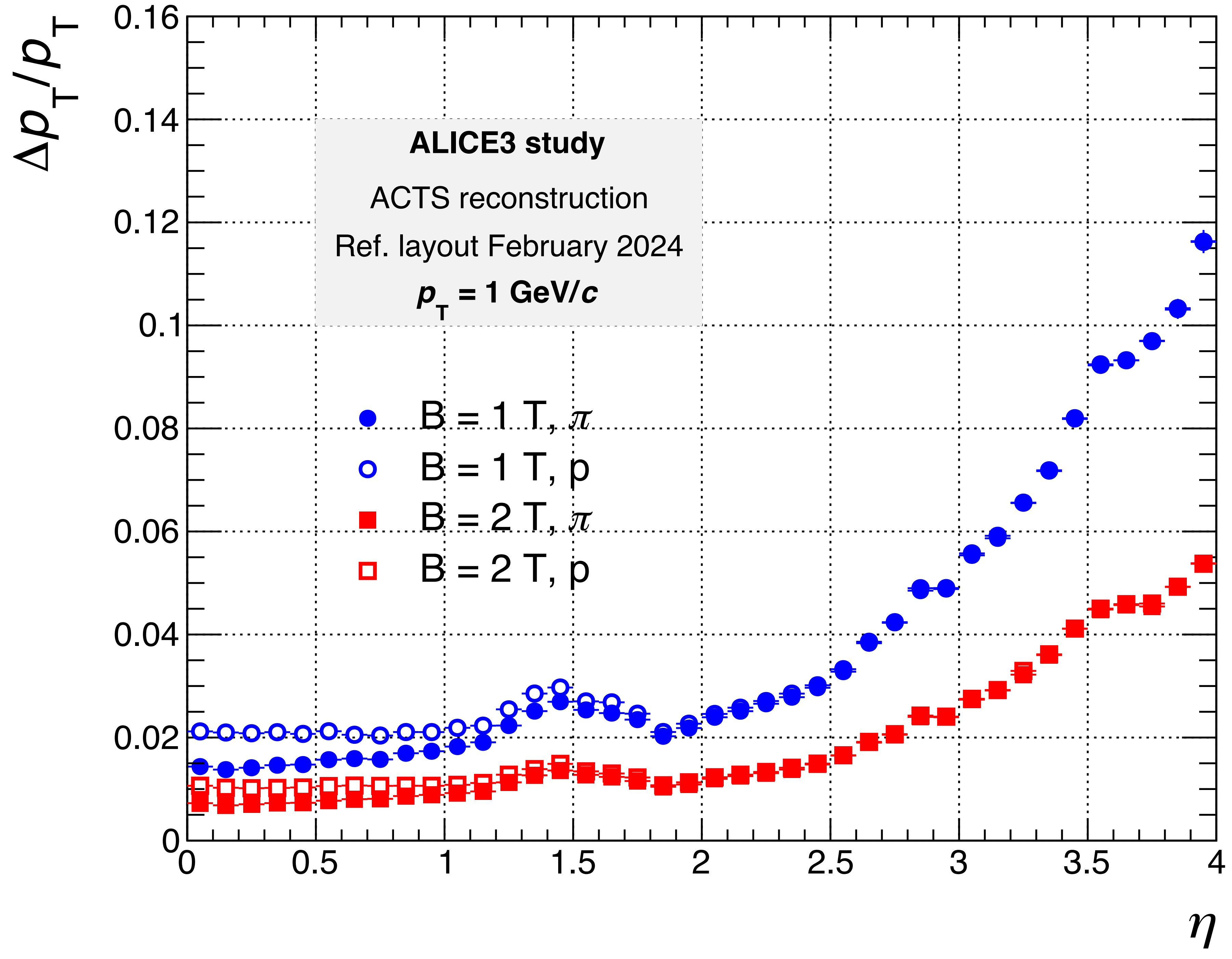

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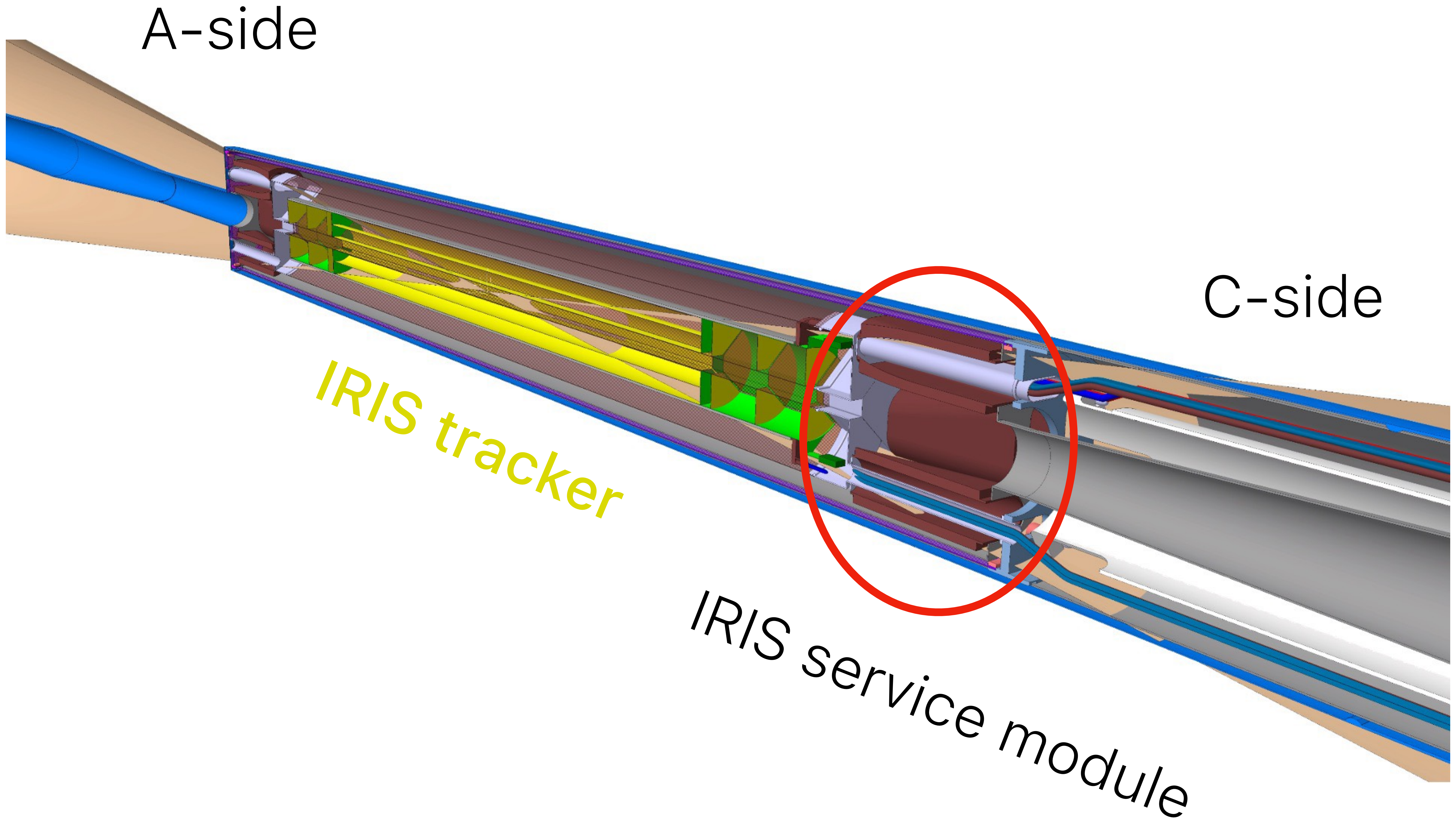

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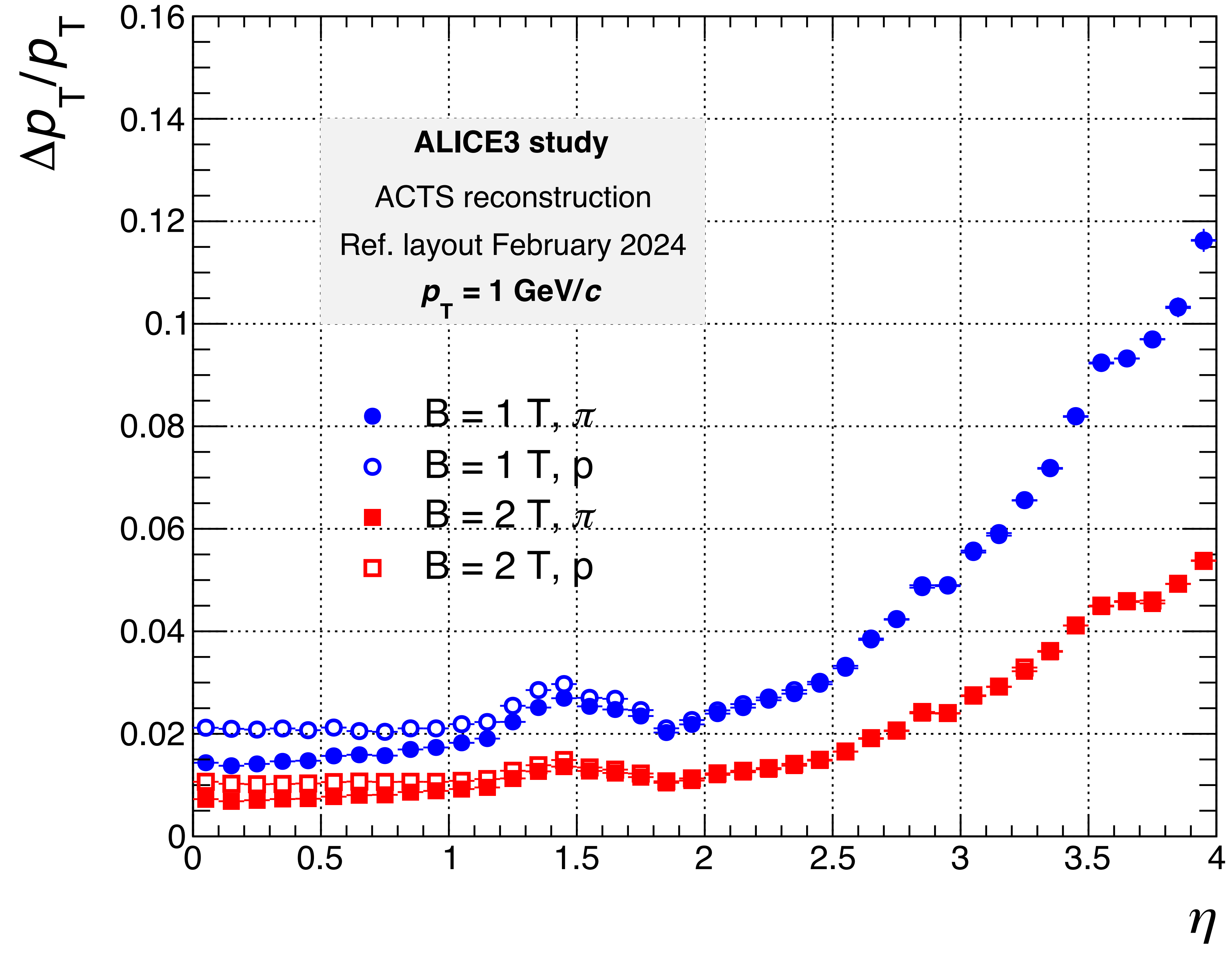
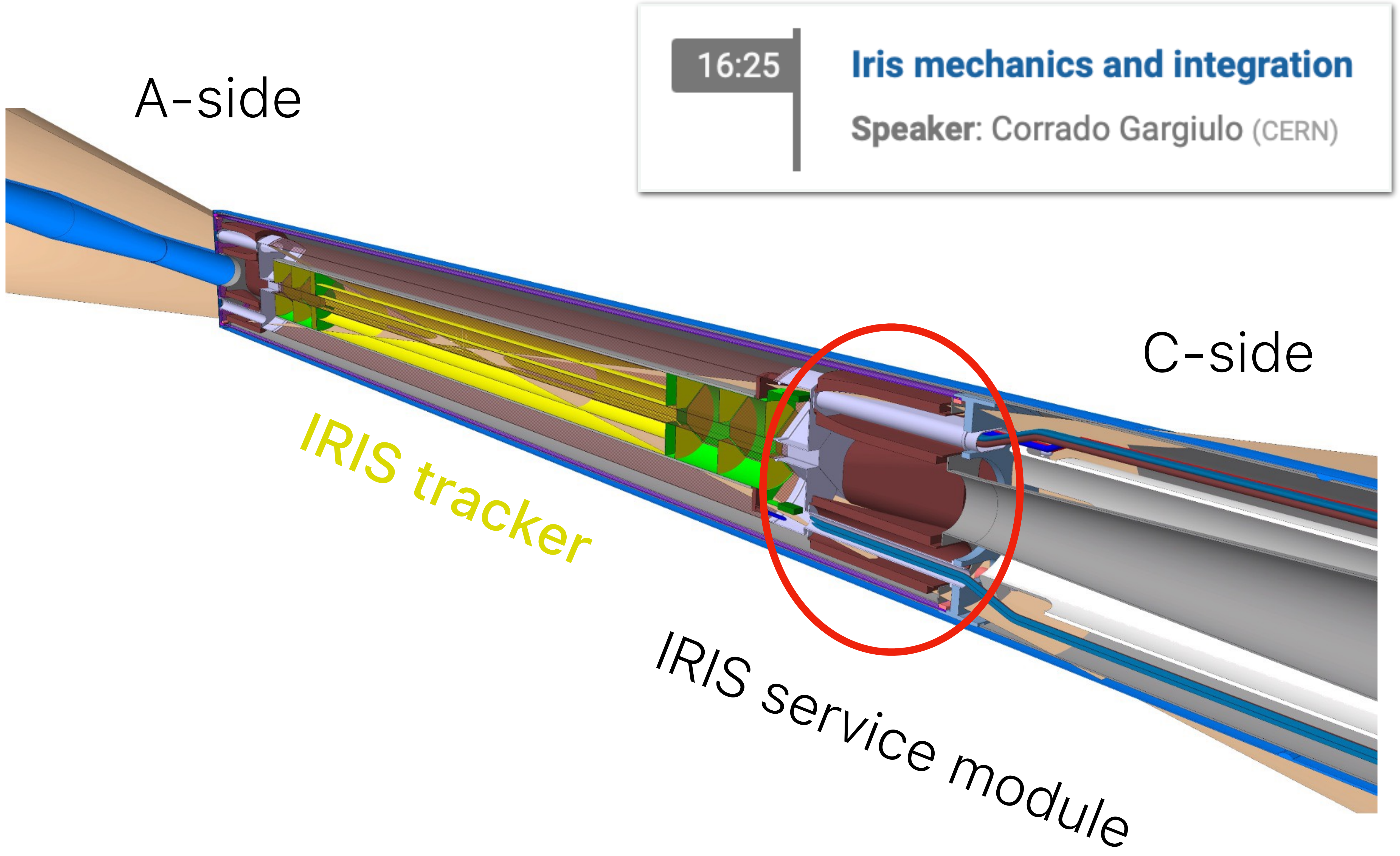
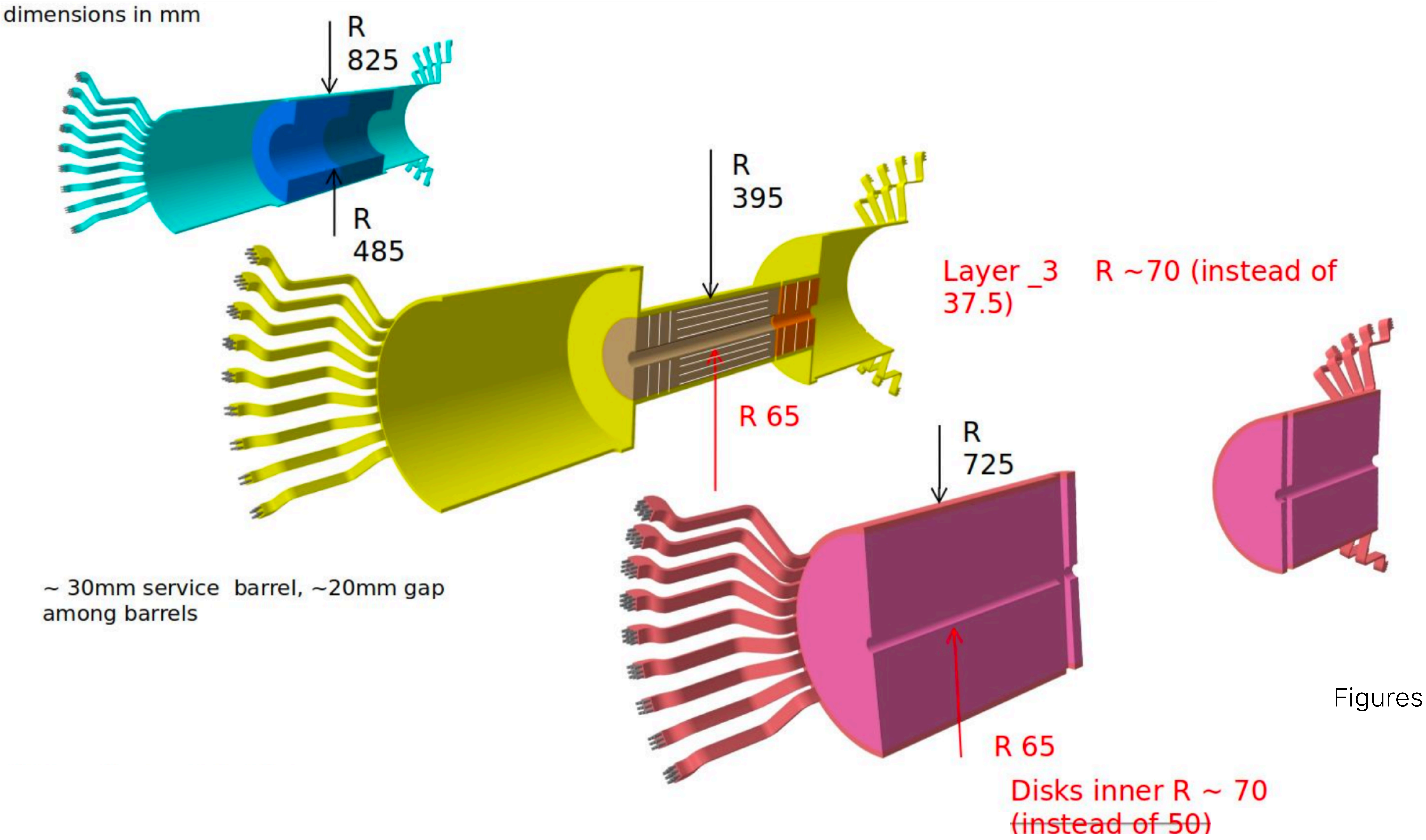


Services not included



Outer and middle barrel layer services in O^2

M. Concas

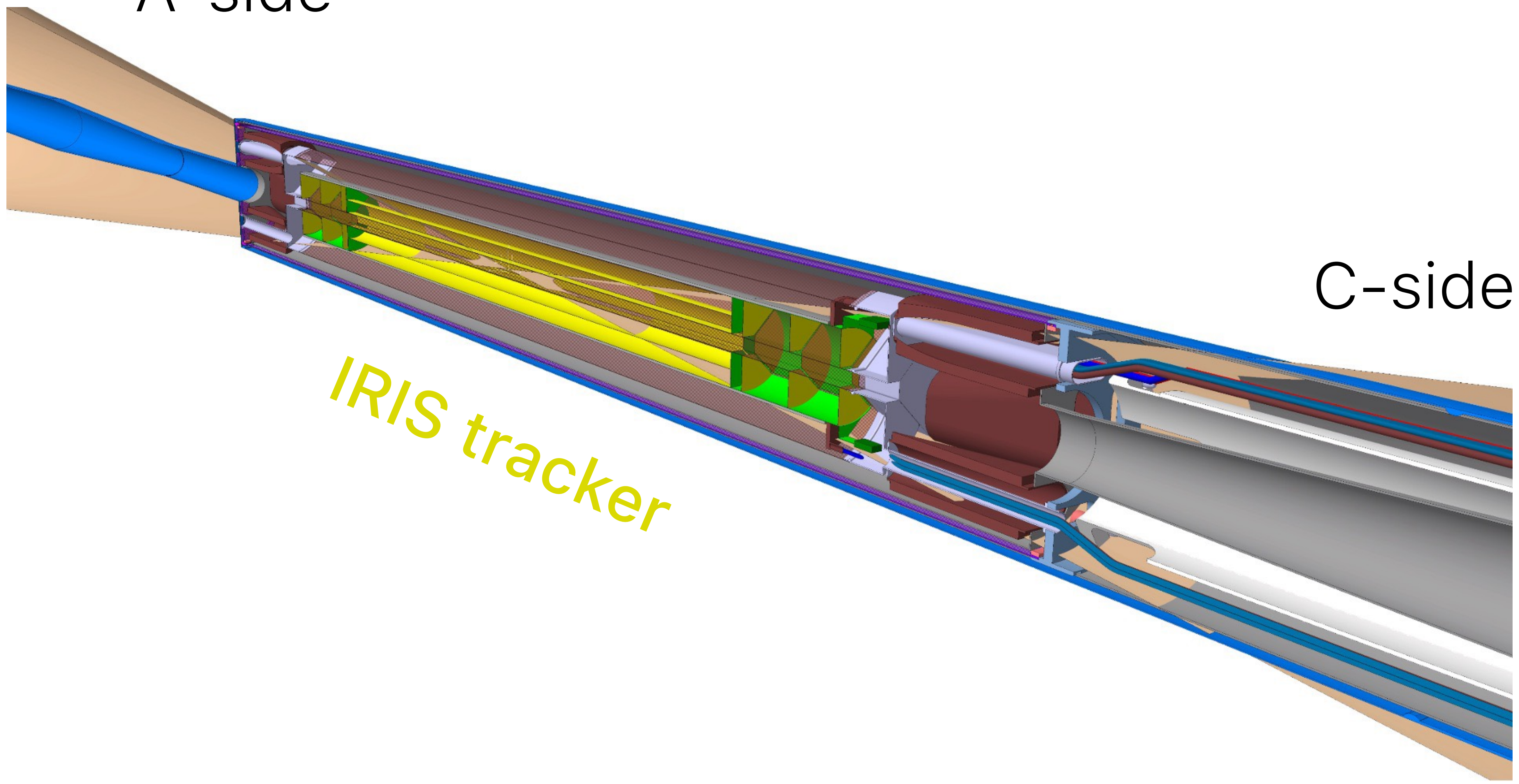


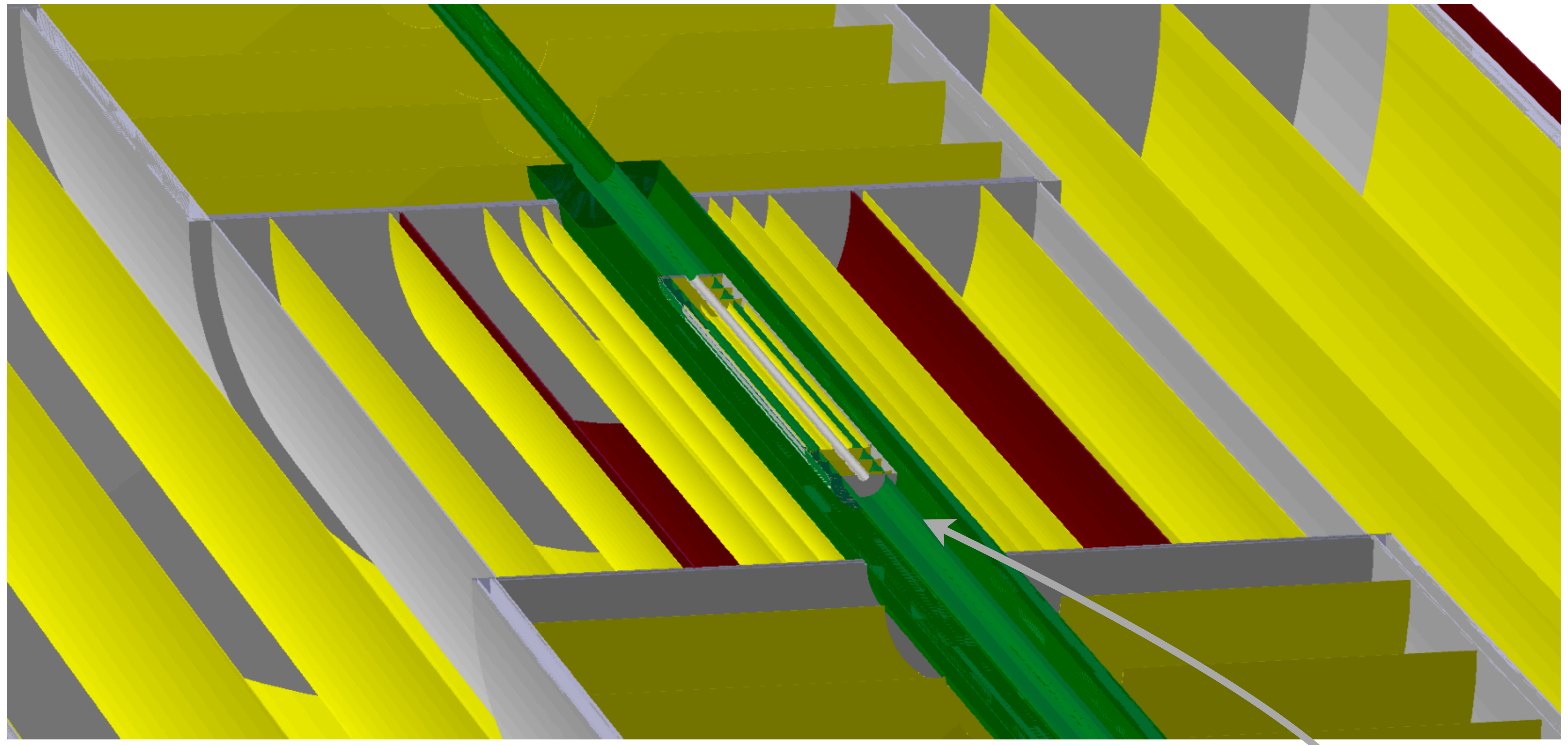
Figures: C. Gargiulo

Detectors/Upgrades/ALICE3/TRK/simulation/src/TRKServices.cxx

Vacuum vessel & beampipe description in O^2

C. van Veen



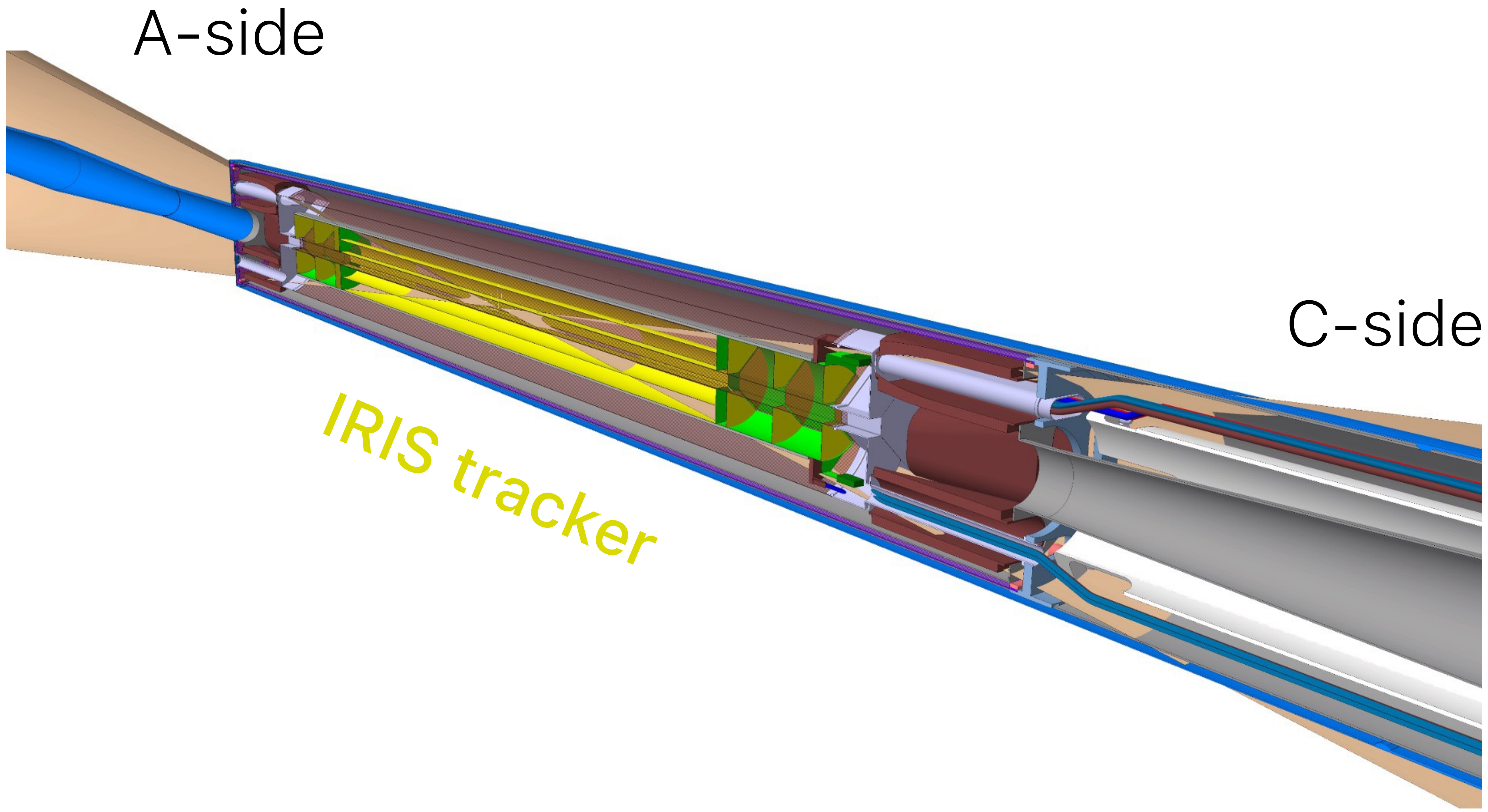


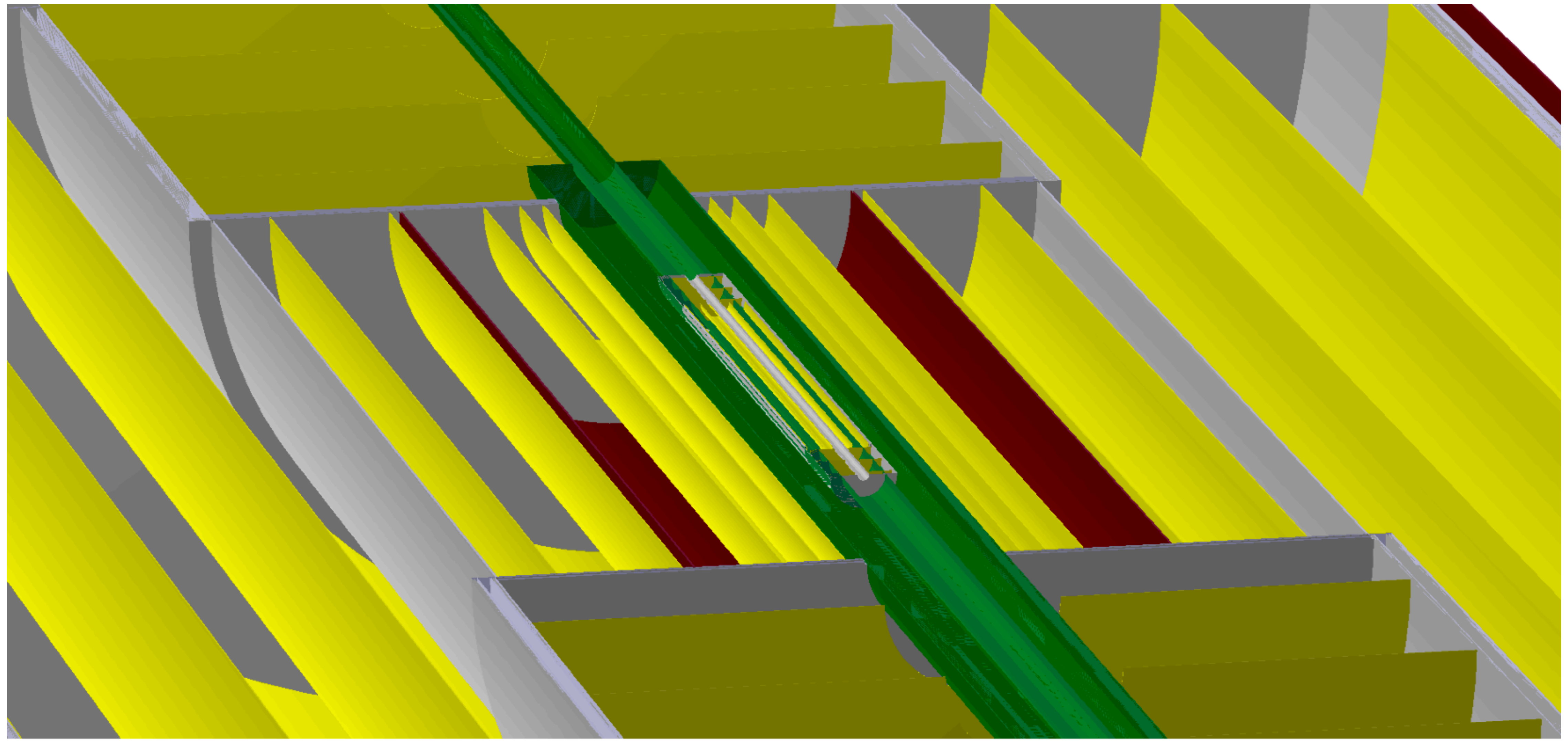
O^2 updated beam pipe (green), vacuum vessel (grey)

[Detectors/Upgrades/ALICE3/Passive/src/Pipe.cxx]

Vacuum vessel & beampipe description in O^2

C. van Veen



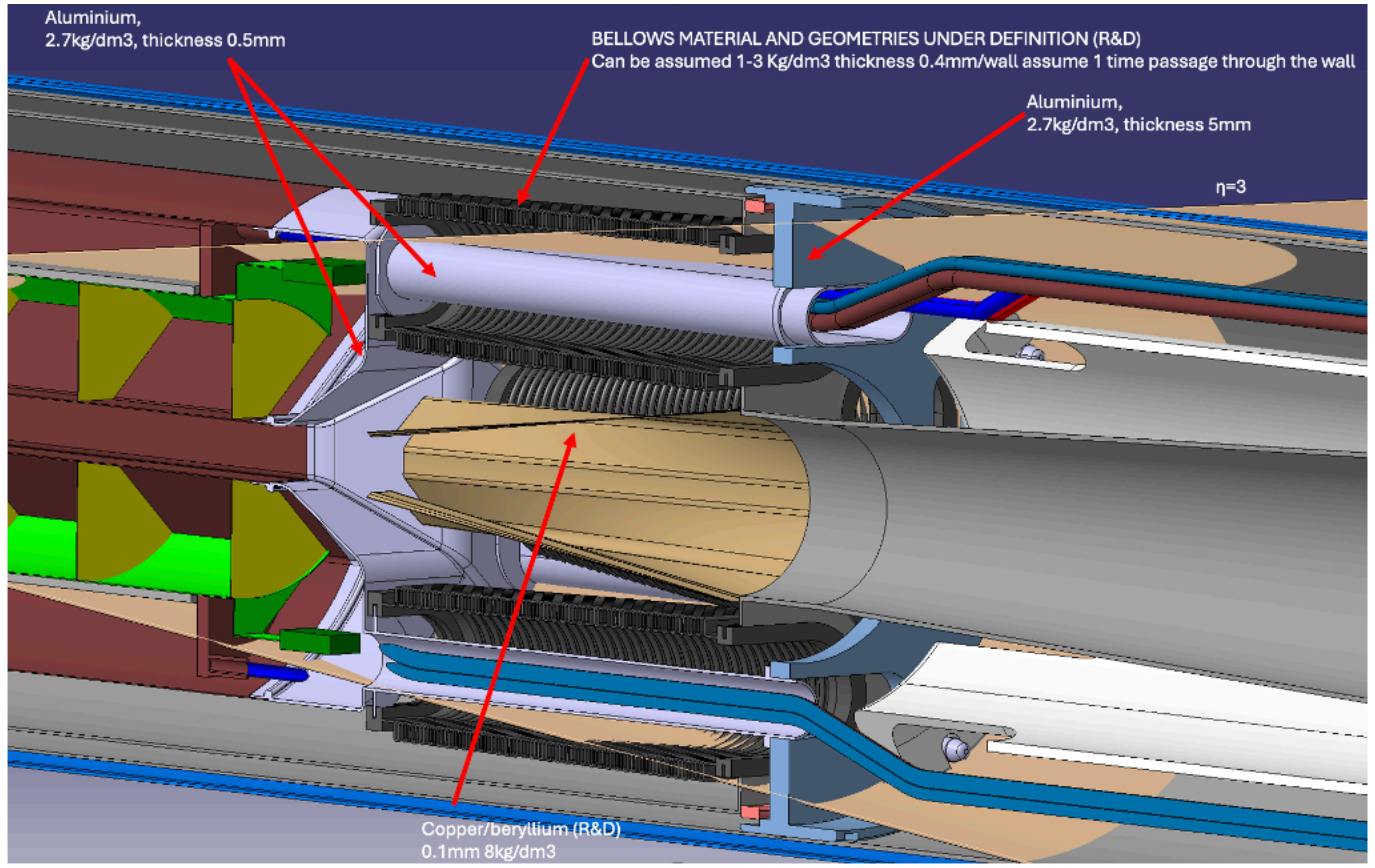


- Beam pipe radius from 37 mm to 56 mm
- Beam pipe on C-Side will be longer to be able to access iris tracker
- Disk inner radius of ML and OT (FT3 in O2) from 50 mm to 70 mm
- L3 of barrel layers (TRK in O2) from 50 mm to 70 mm

[Detectors/Upgrades/ALICE3/Passive/src/Pipe.cxx]()

IRIS service module estimated material

A. Dainese
C. Gargiulo
F. Reidt



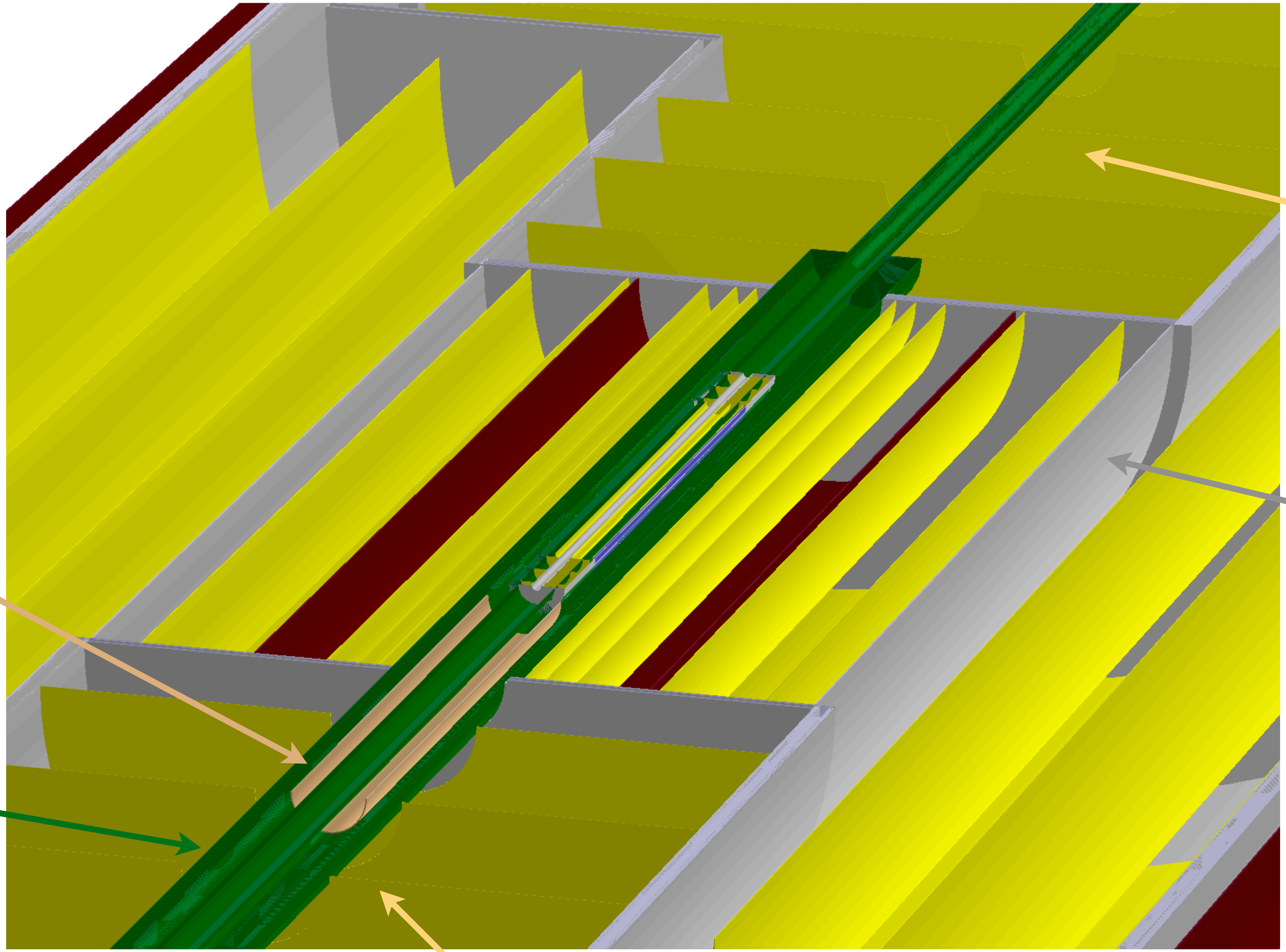
New!

All materials ”mapped” to a tube, to be added to the beam pipe thickness
Disk thickensses have to be decreased by factor sin(3.5deg) = 0.06, where 3.5deg is the polar angle for eta=3.5

1) First Aluminium “disk”: 0.5mm*sin(3.5deg)= 0.03mm, X0=89mm → x/X0=0.0003 (0.03%)
2) Aluminium flat tubes: 2crossings*0.5mm = 1mm, X0=89mm → x/X0=0.011 (1.1%)
3) Bellows: Ncrossings*0.4mm*sin(3.5deg), X0? Same as Al? → x/X0 = Ncrossings*0.00024 → neglect?
4) Second Aluminium “disk”: 5mm*sing(3.5deg)=0.3mm, X0=89mm → x/X0=0.003 (0.3%)

Total to be added to beam pipe: 1.33mm of Al, x/X0 = 1.43%
OR Total to be added as disk adjacent to last VD disk: 1.33mm/sin(3.5deg) = 21.8mm of Al, x/X0 = 0.24 (24%)

Updates in the O² geometry



A-side:
Disks R_{in} = 50 mm

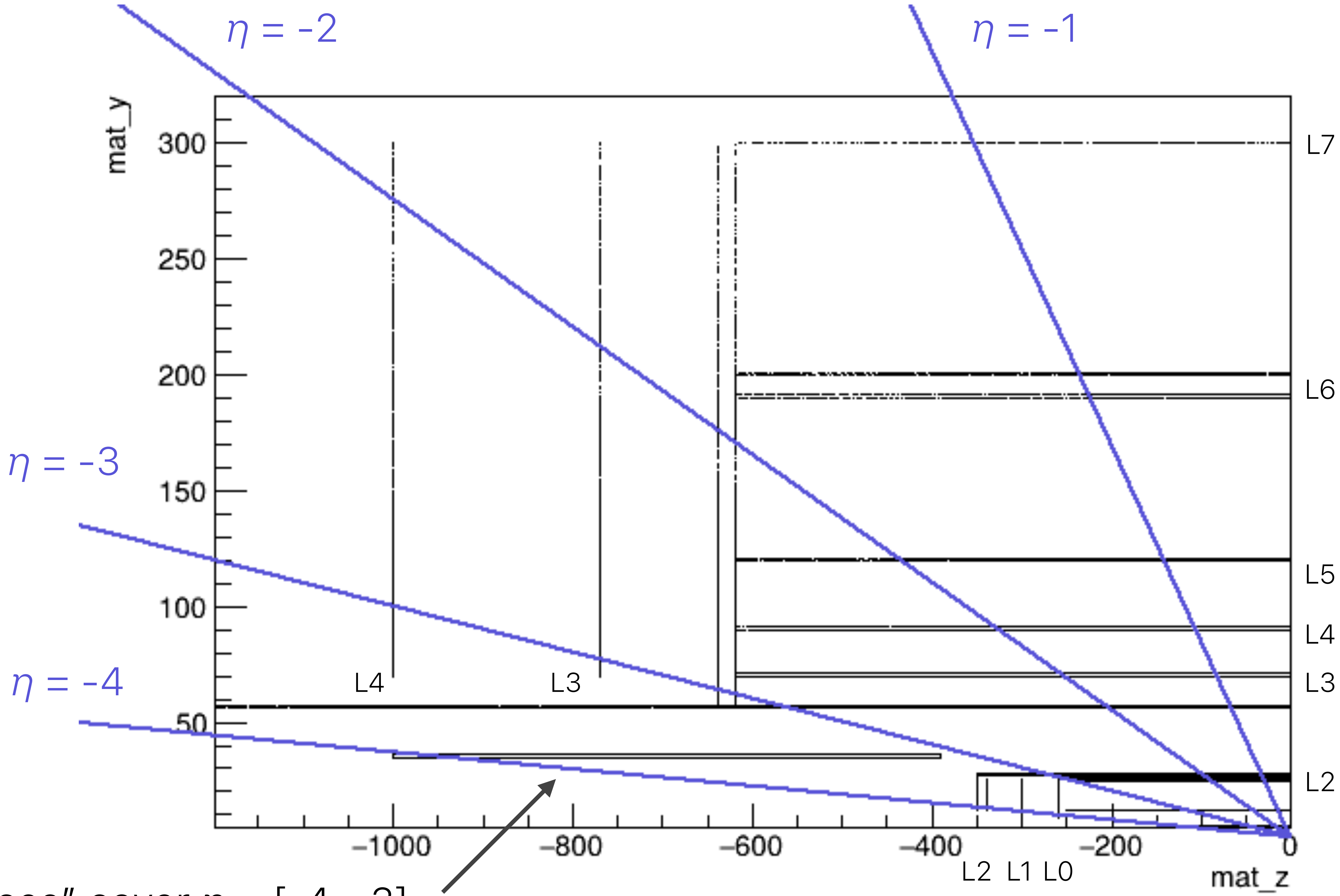
Middle & outer layer services

1.33 mm Al added

Beampipe C-side
R = 56 mm

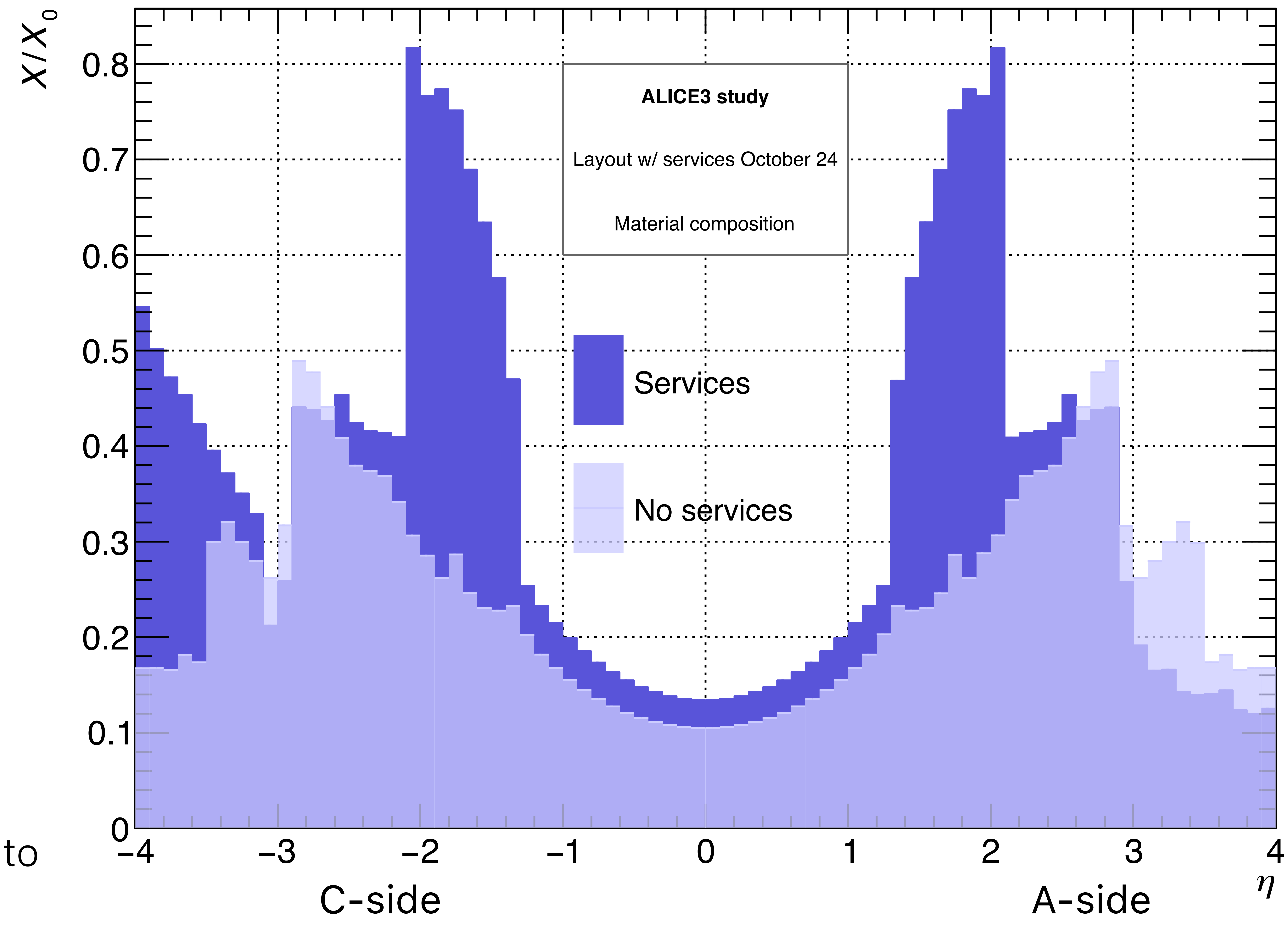
C-side: Disks R_{in} = 70 mm

Geantino scan



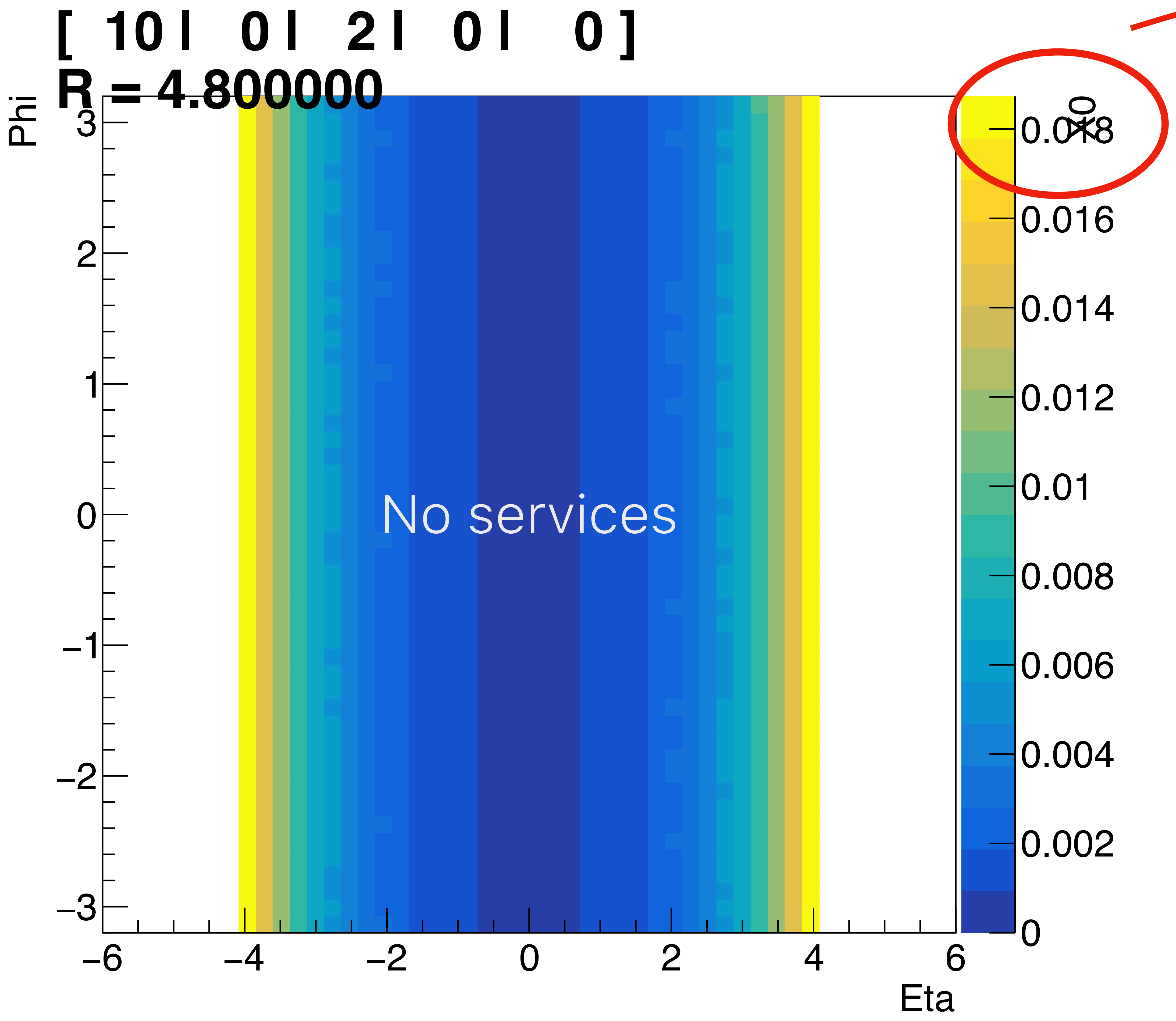
"Services" cover η = [-4, -3]

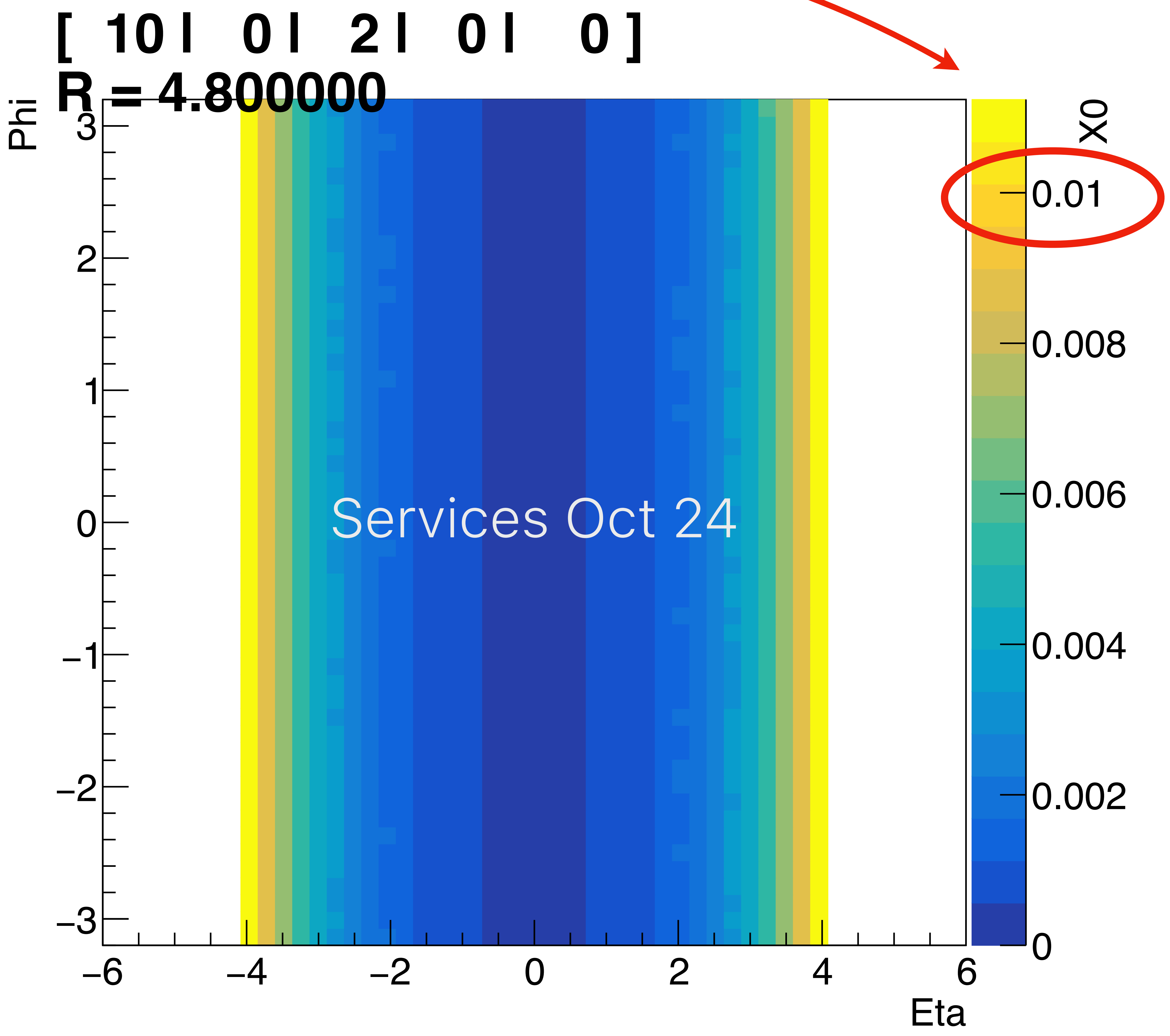
Material composition*



*recorded up to
R = 68 cm

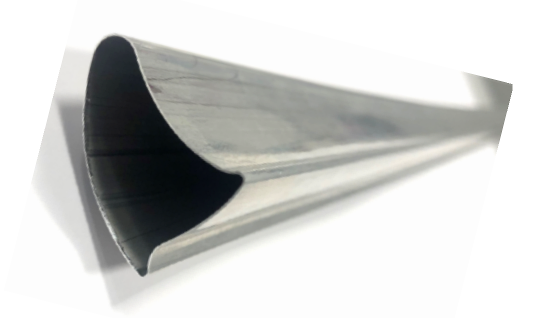
Material composition



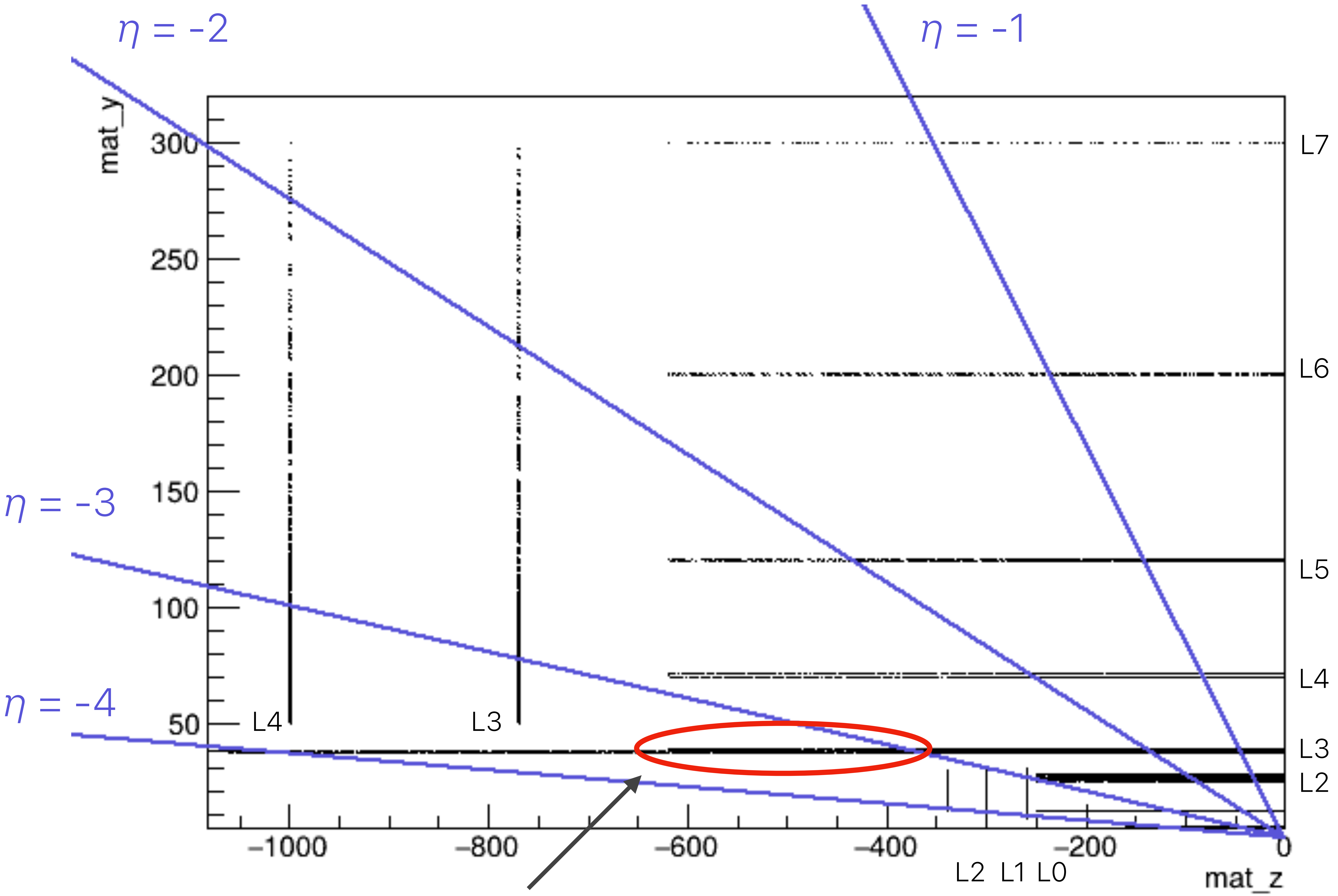


Thickness of the IRIS petal was updated

PETAL CASE
Target 0.15mm wall Beryllium,
Alternative Albemet (60% beryllium)

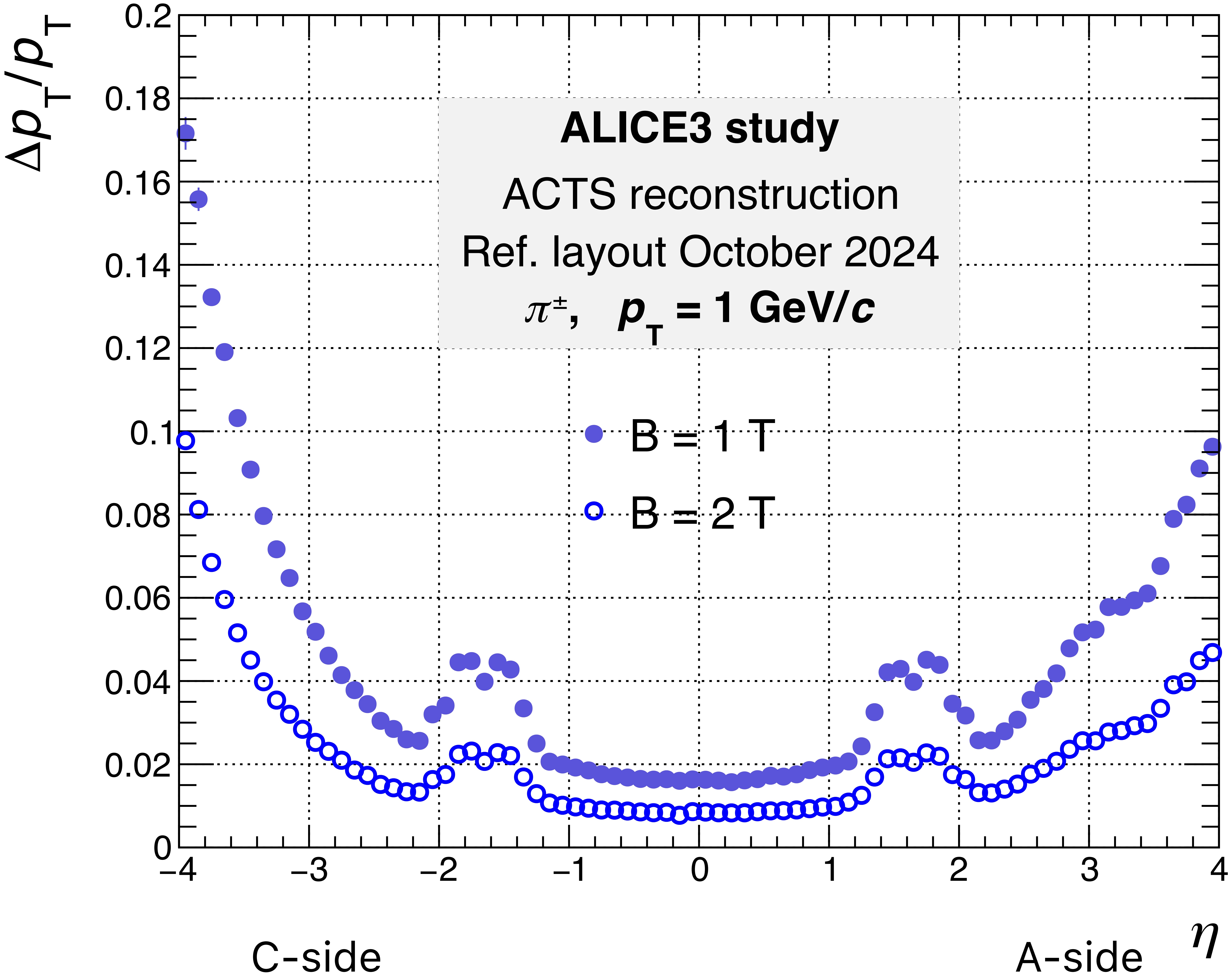


Geantino scan "No services"

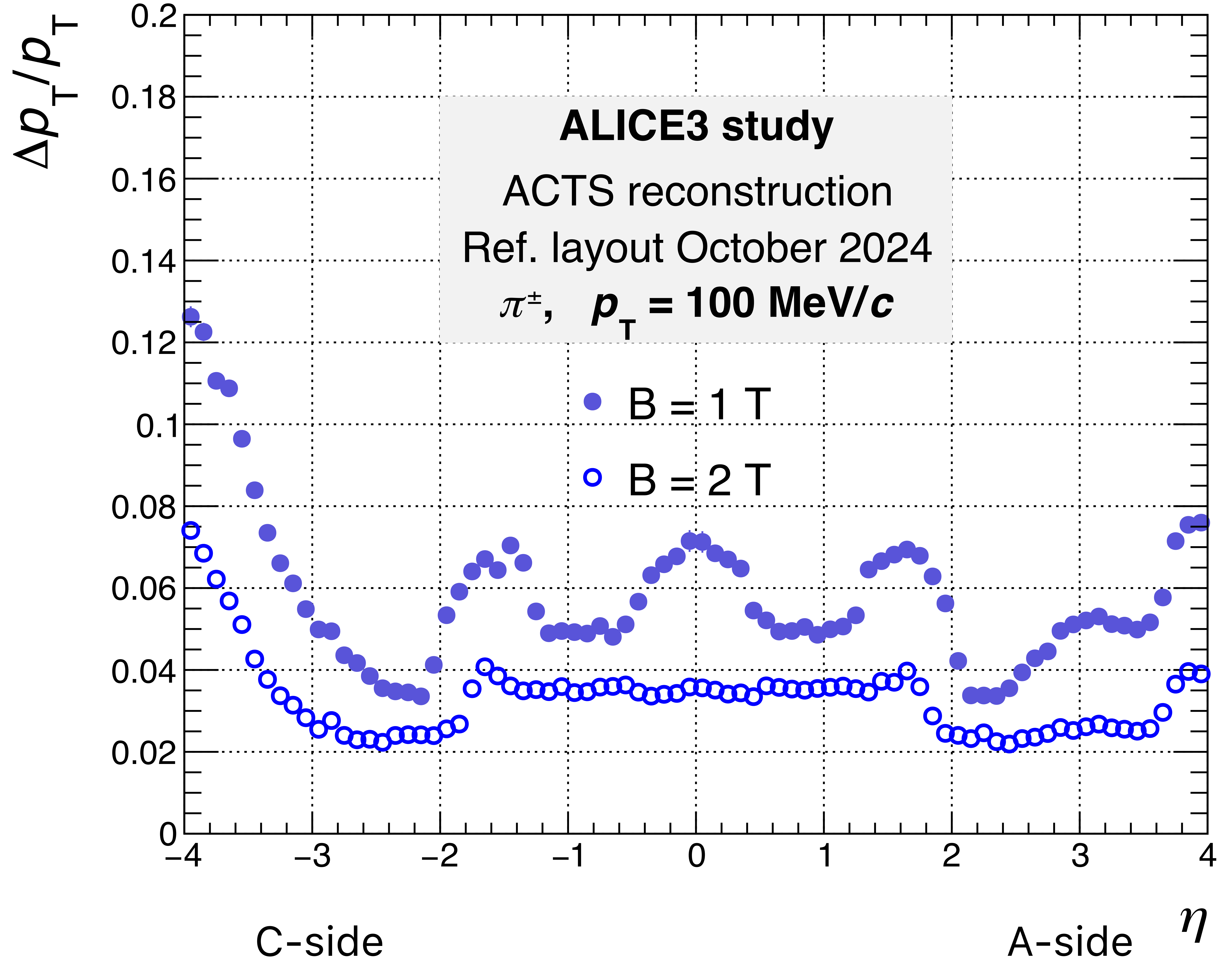


L3 at 37.5 mm (will be moved to 70 mm)

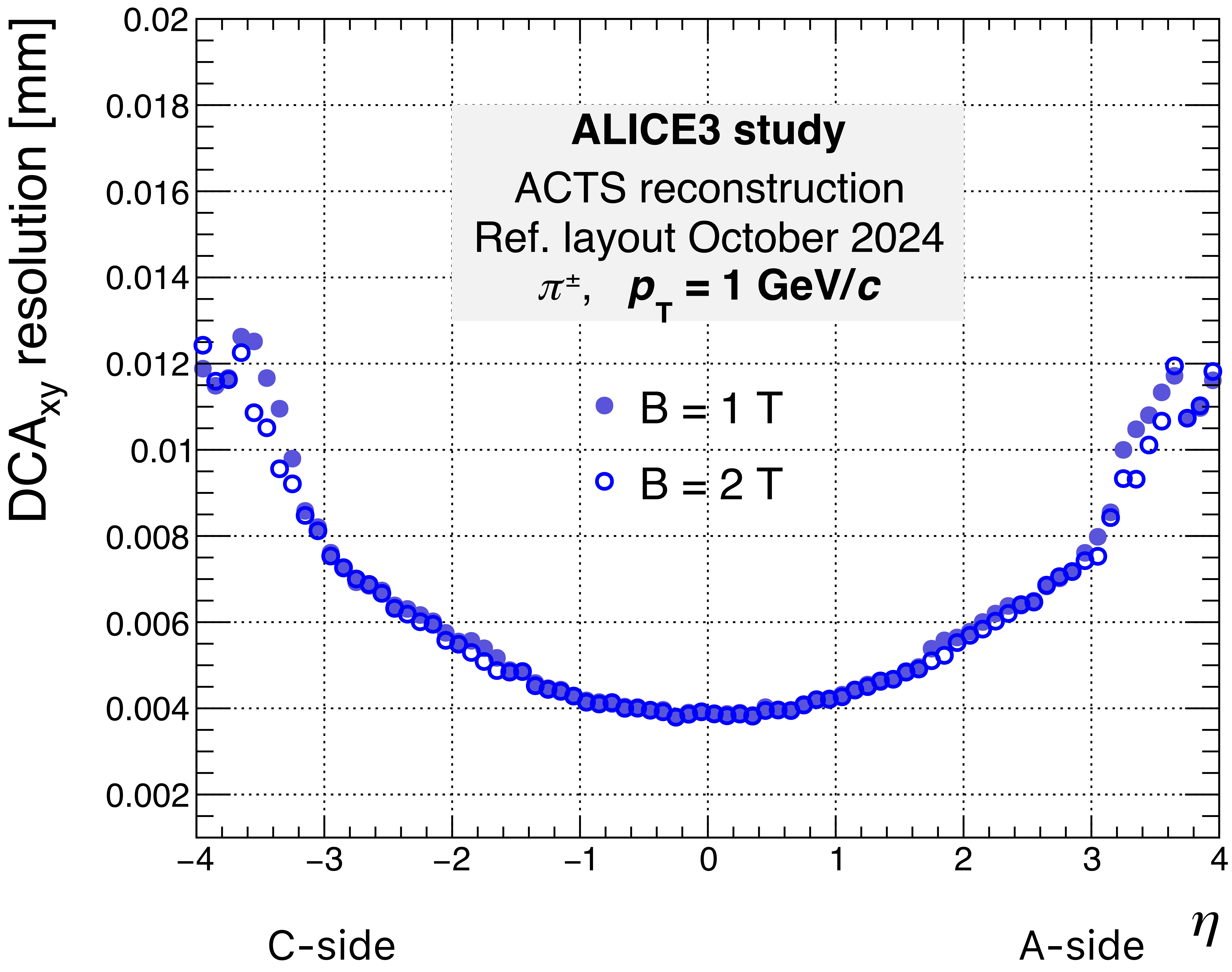
p_T resolution



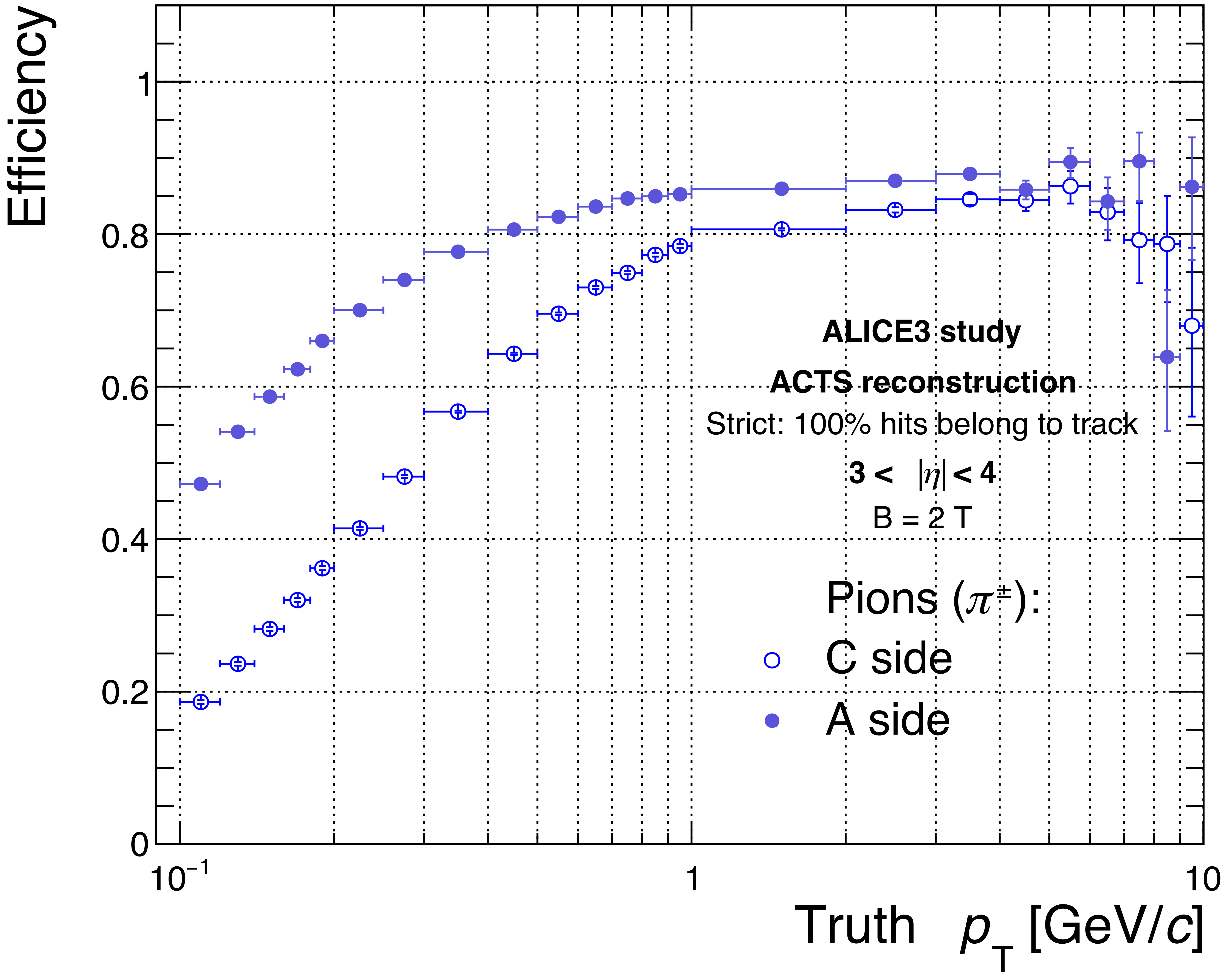
p_T resolution



DCA_{xy} resolution



Reconstruction efficiency



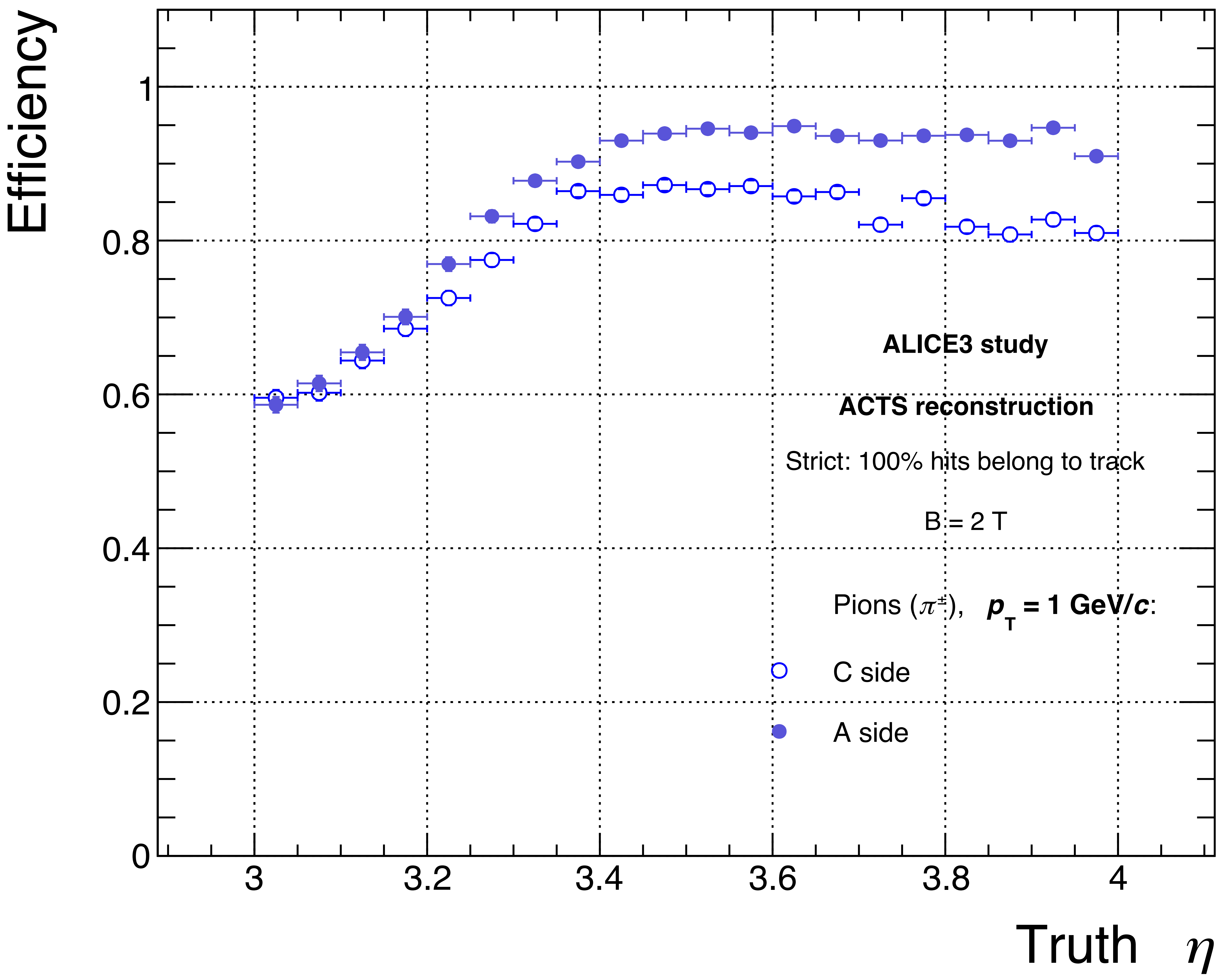
Pions, $3 < \eta < 4$

Simulation:

Pythia pp 14 TeV pile-up 500

$dN/d\eta \approx 2300$

Reconstruction efficiency



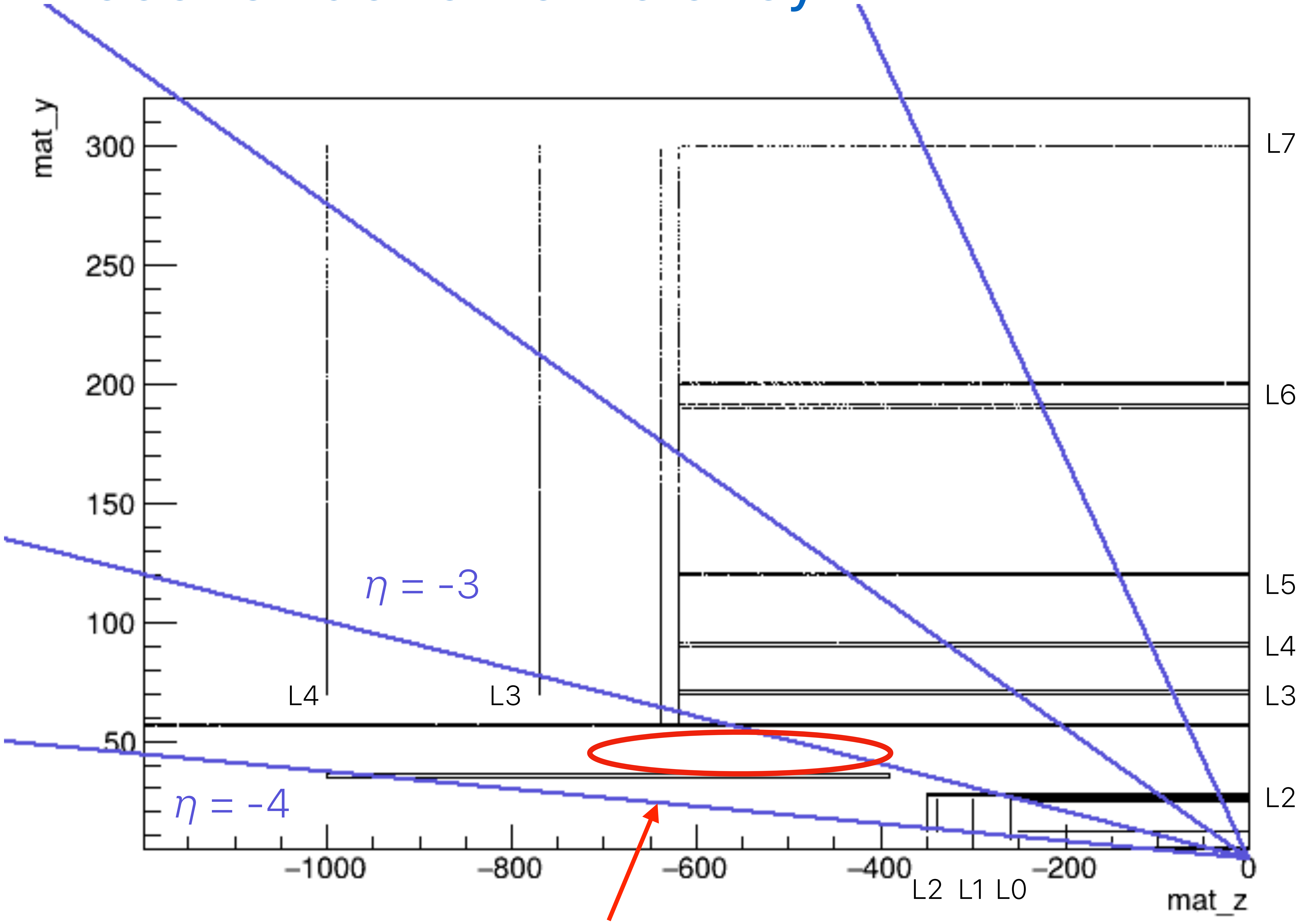
Pions, p_T = 1 GeV/c

Simulation:

Pythia pp 14 TeV pile-up 500

$dN/d\eta \approx 2300$

Reconstruction efficiency



Pions, p_T = 1 GeV/c

Simulation:

Pythia pp 14 TeV pile-up 500

dN/dη ≈ 2300

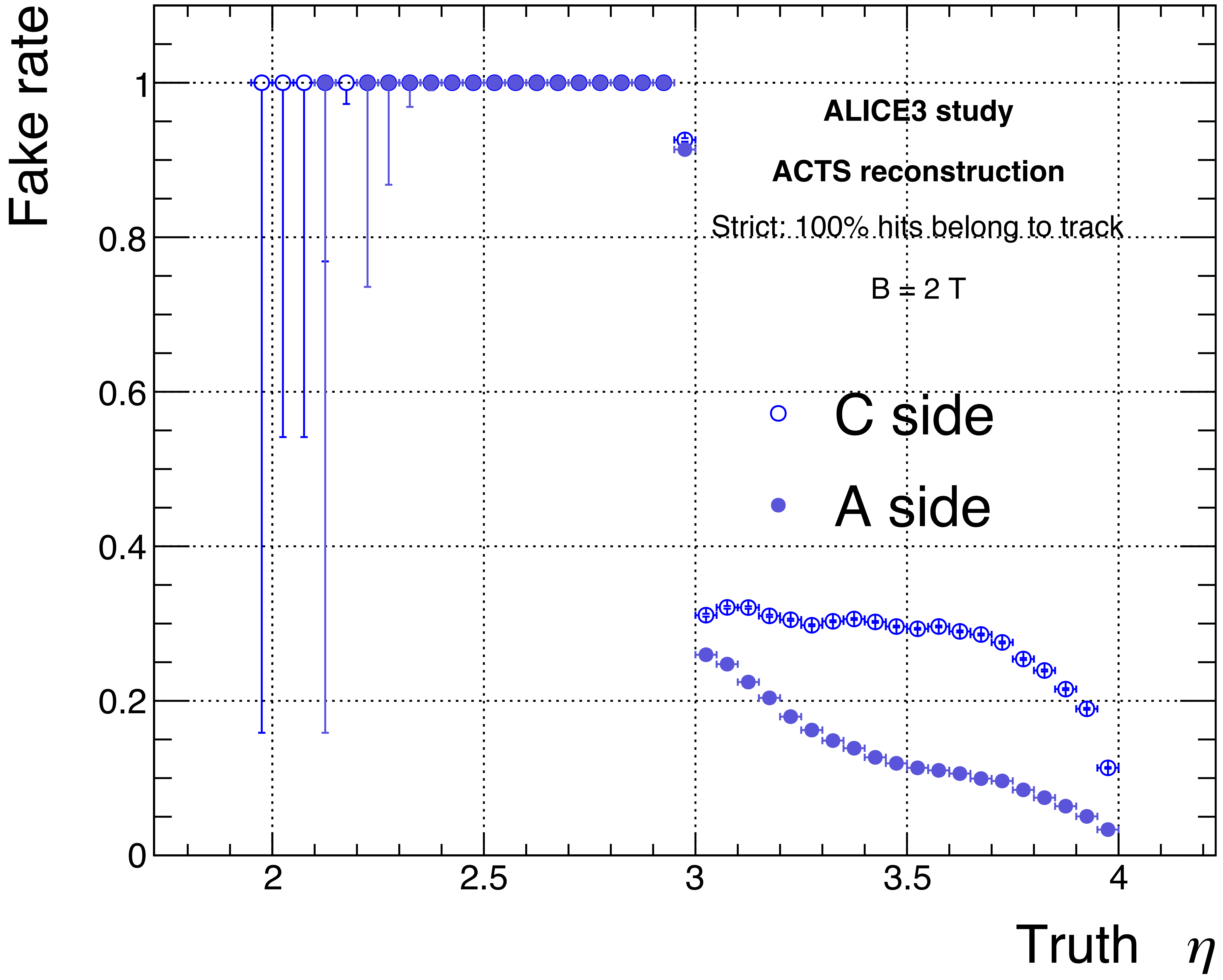
No hits here anymore. L3 moved from 37.5 mm to 70 mm (both A and C sides)

Summary and next steps

- ALICE 3 O^2 geometry is evolving
- IRIS service module: first estimate of the material
  - p_T resolution: approx. **×2 at η = 4 on C-side** due to the service module
- Reconstruction efficiency: **both A and C sides affected at $3 < \eta < 3.4$**
  - TRK L3 moved: 37.5 mm → 70 mm
  - Address the gap between the L2 and L3 disks (seeding strategy?)
- Update the efficiencies including the CKF inward search
- Include the services for the outer disks (see talk by R. Sadek)

Backup

Fake rate



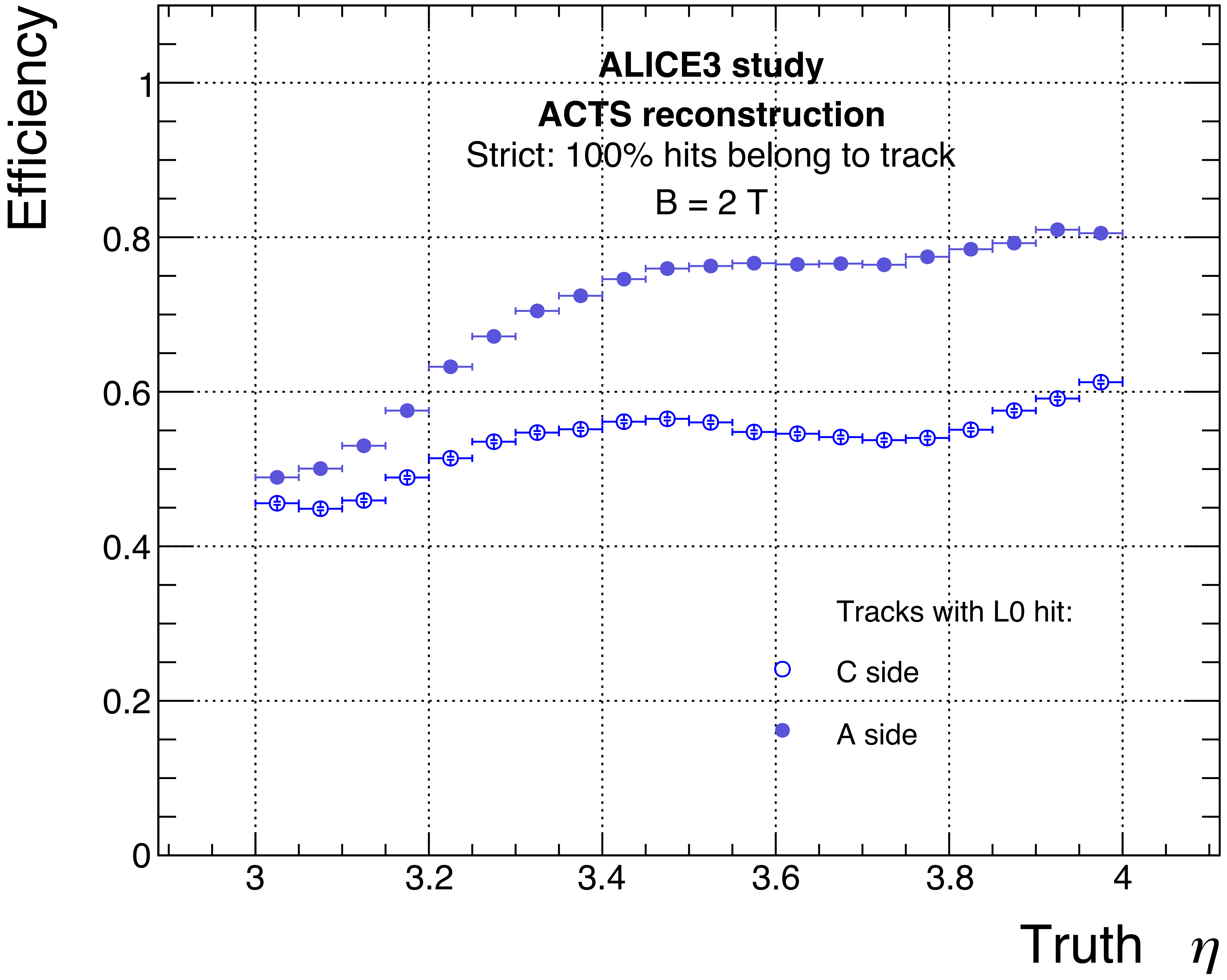
All, $3 < \eta < 4$

Simulation:

Pythia pp 14 TeV pile-up 500

$dN/d\eta \approx 2300$

Reconstruction efficiency, tracks with L0 hit



All, p_T = 1 GeV/c

Simulation:

Pythia pp 14 TeV pile-up 500

$dN/d\eta \approx 2300$

Reconstruction efficiency

Reconstructable particles are defined as:

Those which produced at least 7 hits in the detector layers and

having $p_T >= 100$ MeV/c

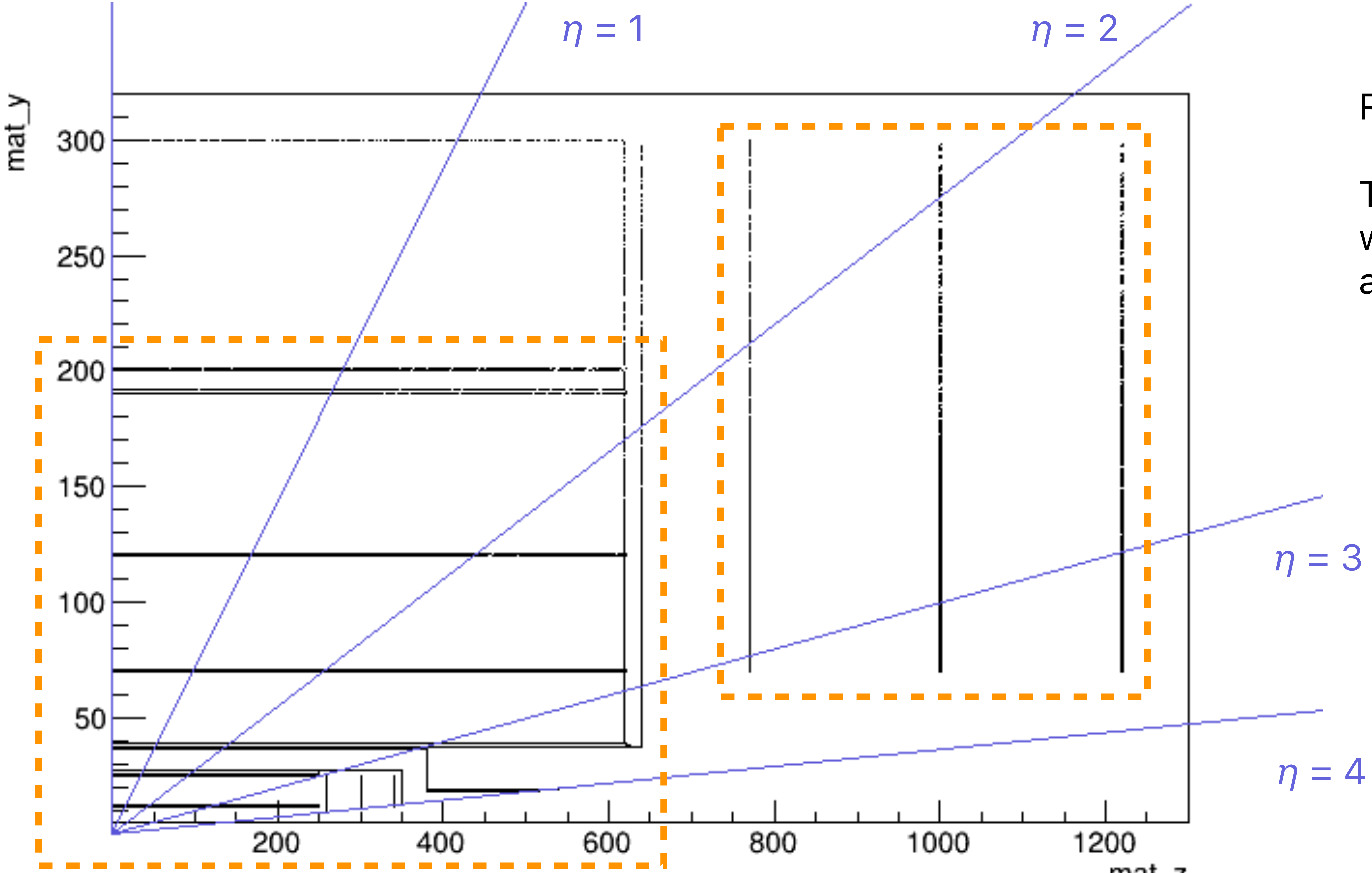
Efficiency defined as:

Fraction of particles from the selection above which have 100% association with tracks

Fake rate:

Fraction of reco tracks which aren't 100% associated with particles

Geometry



R = 7 cm

The selection shows in which layers the seeds are created