A preliminary analysis of data from ALICE's new ITS and MFT detectors

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Honour's Research Project
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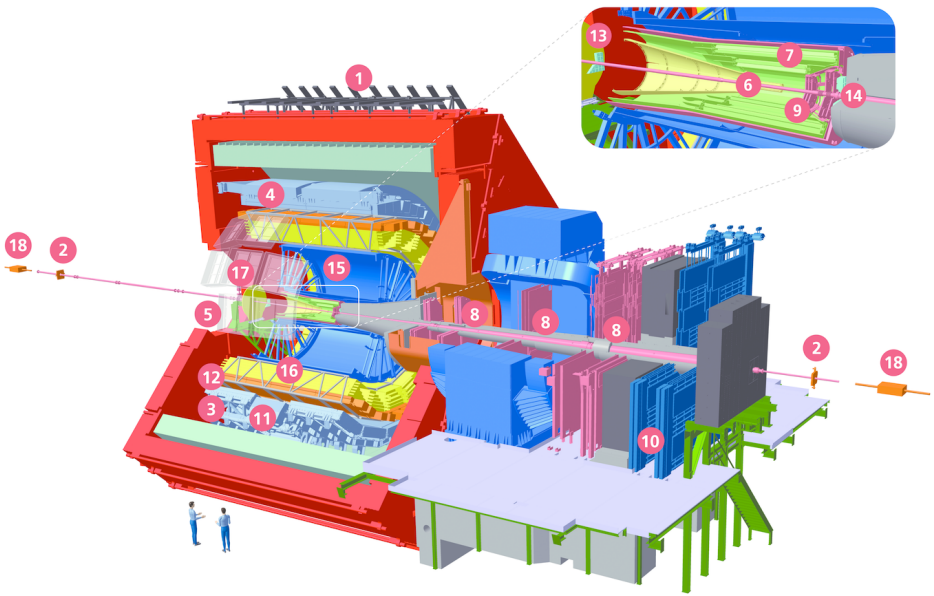
ALICE Run 3

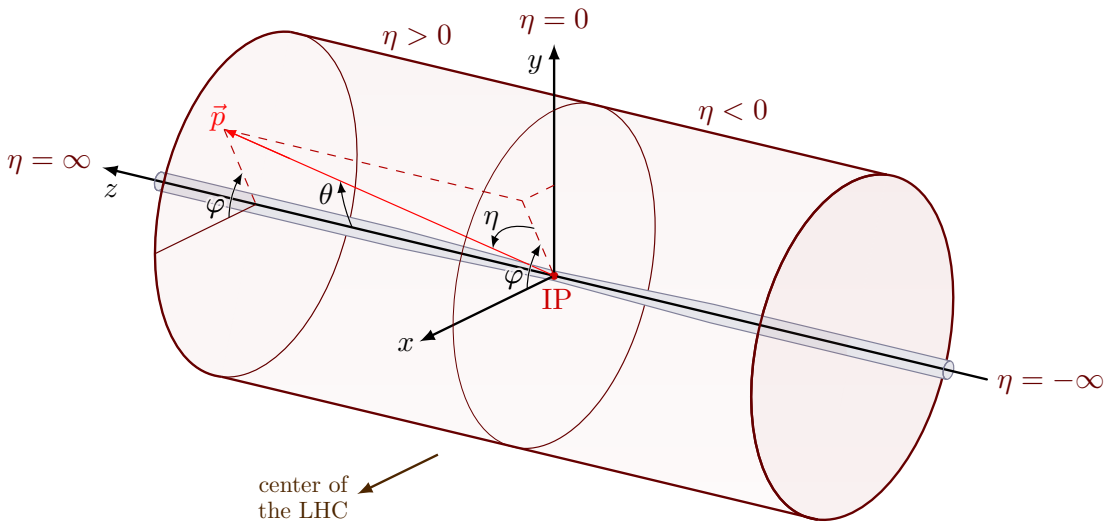


ALICE Run 3 Detector Array

- LHC Run 3 comes with increased $\sqrt{s}$ and luminosity of collisions
- This requires a new untriggered data capture scheme, so detector readout electronics were upgraded at ALICE
- The MFT (9) was added, the ITS (6, 7) was upgraded, and the analysis framework was overhauled entirely
- Learning this framework, and how the MFT and ITS interact with it, was the main goal of this project

Coordinate System

- Z: Distance along Z-axis (cm)
- φ: Azimuthal angle around beam axis
- θ: Polar angle



- p_{T}: Transverse momentum (GeV/c)

$$p_{\mathrm{T}} = \sqrt{p_x^2 + p_y^2}$$

- y: Rapidity

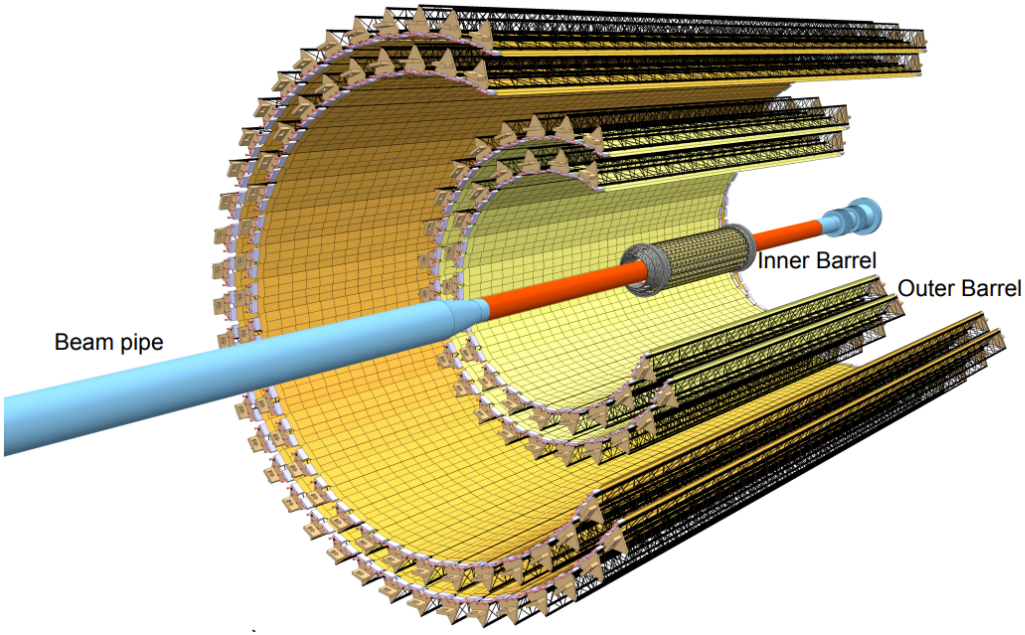
$$y = \frac{1}{2} \ln \frac{E + p_z}{E - p_z}$$

- η: Pseudorapidity

$$\eta = -\ln \tan \frac{\theta}{2}$$

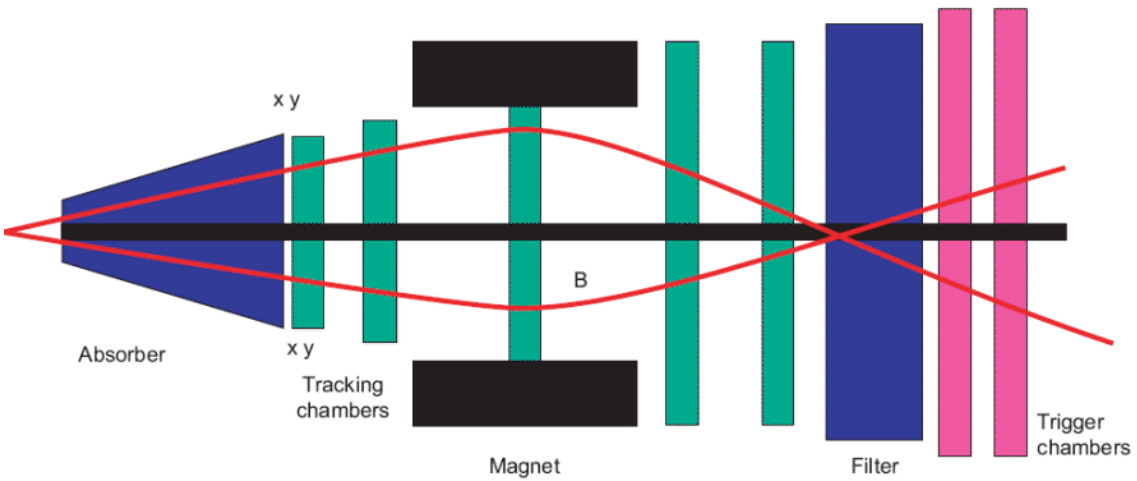
Inner Tracking System (ITS)

- Fully revamped for Run 3 with 7 layers of brand new pixel detectors
- Used to determine position of the primary vertex and help with particle tracking
- 22.4 mm to 391.8 mm radial extension from IP
- Covers $|\eta| < 1.22$
- Stand-alone tracking has no minimum required number of layers with hits



Muon Spectrometer (MCH)

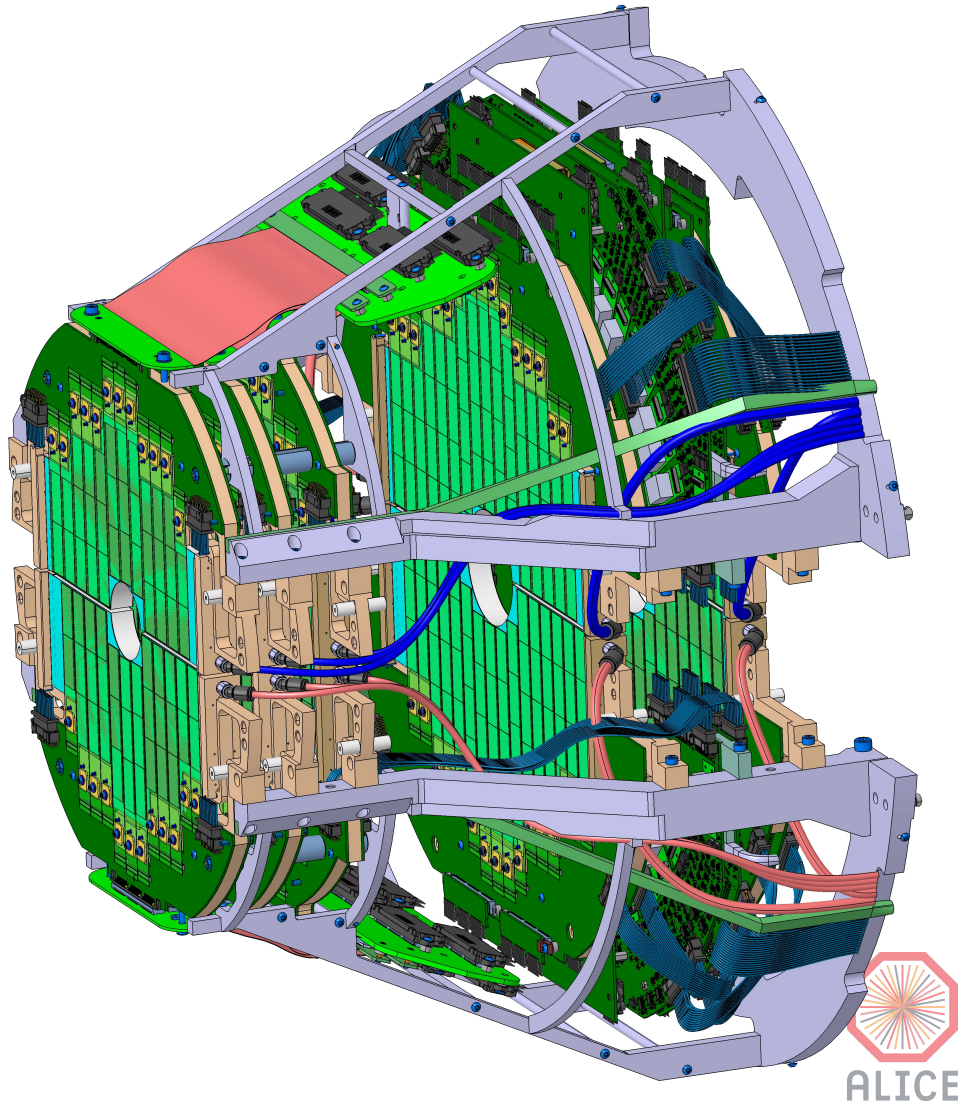
- Used to study various heavy particle decays via their single- and di-muon decay channels
- All detector material sits behind $\sim$4 m of hadronic absorber



- Covers $-4 \leq \eta \leq -2.5$
- Outside the range of the ITS so previously had to perform its own tracking and vertexing
- Run 3 added the Muon Forward Tracker in front of the absorber to fill this role

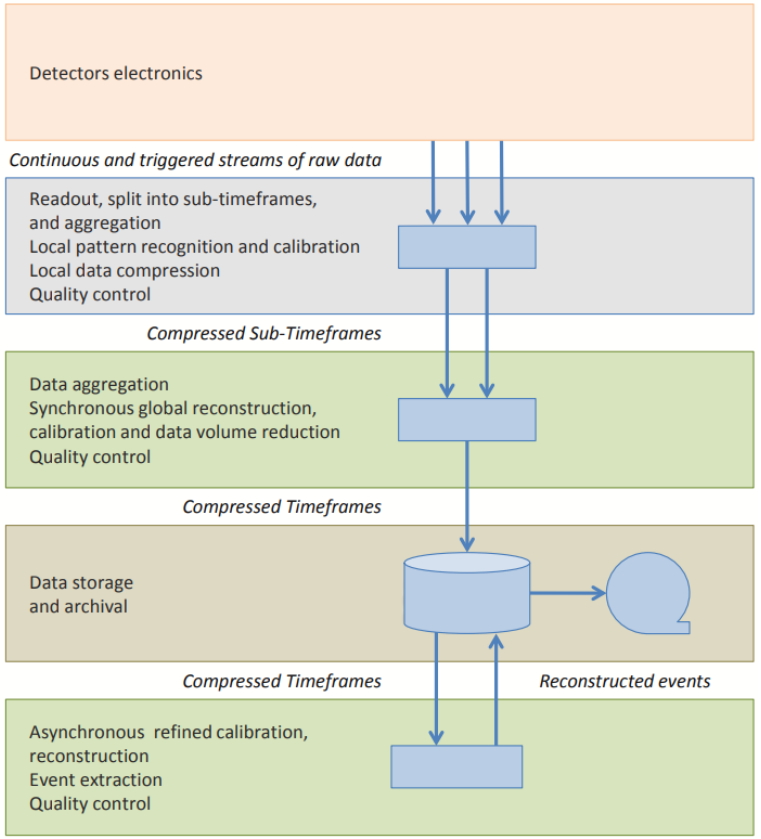
Muon Forward Tracker (MFT)

- Uses the same pixel detector technology as the ITS in a better-suited geometry
- Sits in front of the hadronic absorber, with 5 double-sided disks between −46 cm and −76.8 cm
- Each disk is 1.4 cm thick
- Covers $-3.6 \leq \eta \leq -2.45$
- Reconstructing a track requires hits in 4 of the 5 disks



Online-Offline Analysis Framework (O2)

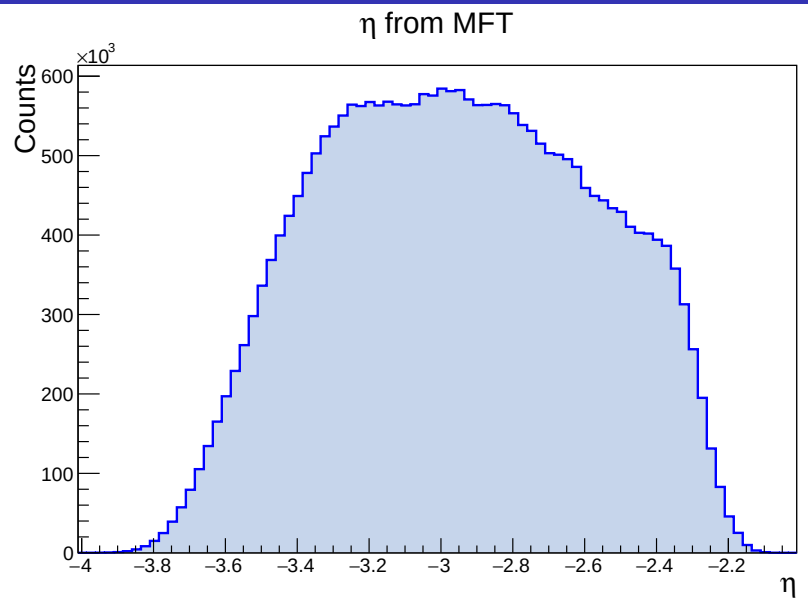
- Created for Run 3 to deal with untriggered data capture, splitting it into 10 ms “timeframes” in online processing
- Raw data converted to usable data with “reconstruction passes” in the offline stage
- Then analysed with C++ and ROOT to make the most of computational resources and to minimise disk space usage
- Don’t breathe near O2, or it might break

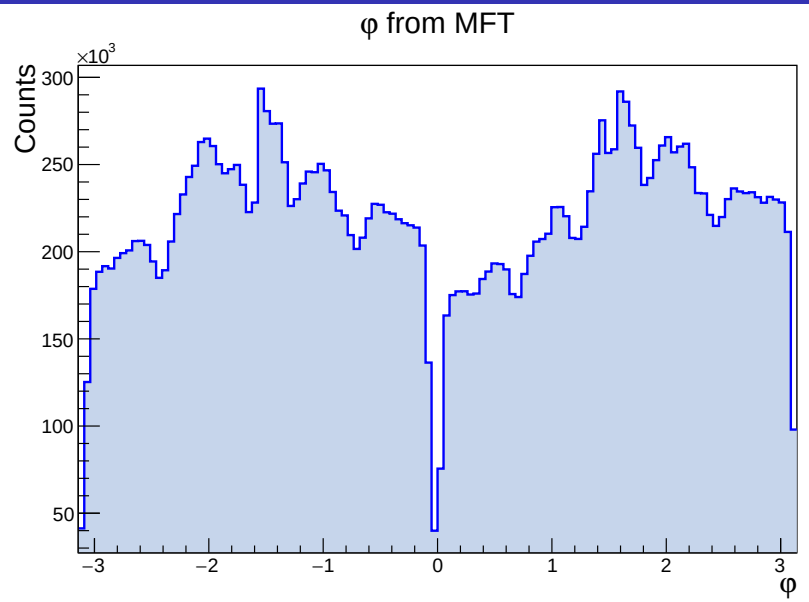


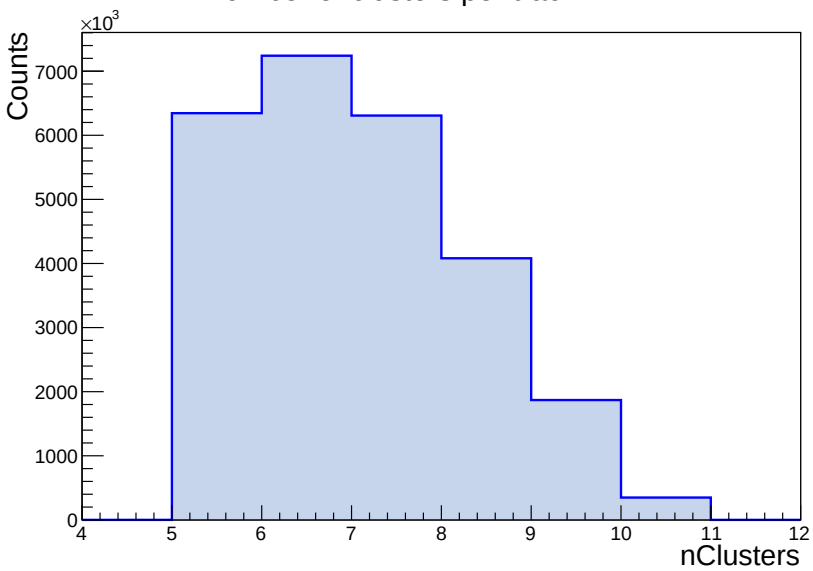
What data are we using?

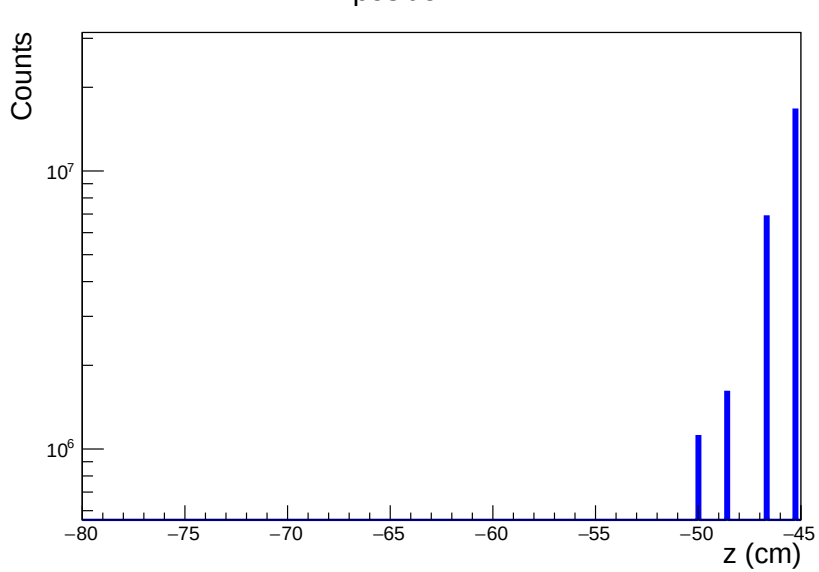
- Pilot beam runs 505548 and 505645 from October 2021
- Non-nominal centre of mass energy $\sqrt{s} = 900\,\mathrm{GeV}$
- Detectors running: ITS, MCH, MFT, MID, TOF, TPC, TRD
- All plots include data from both runs
- We used data from two different reconstruction passes

MFT Kinematics (pass 3)



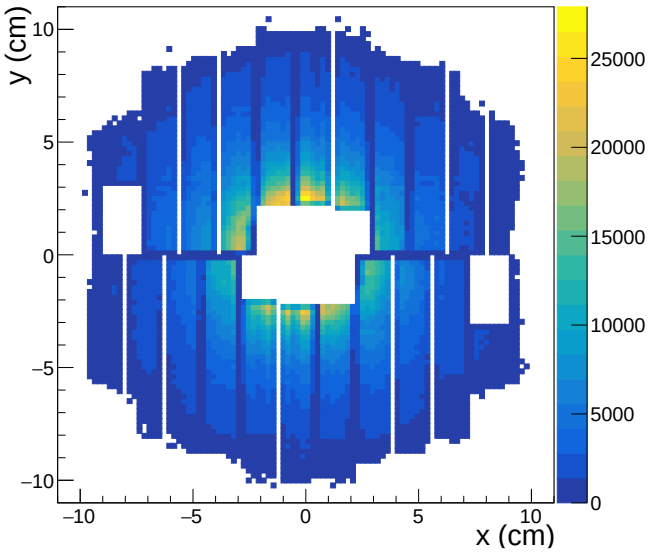




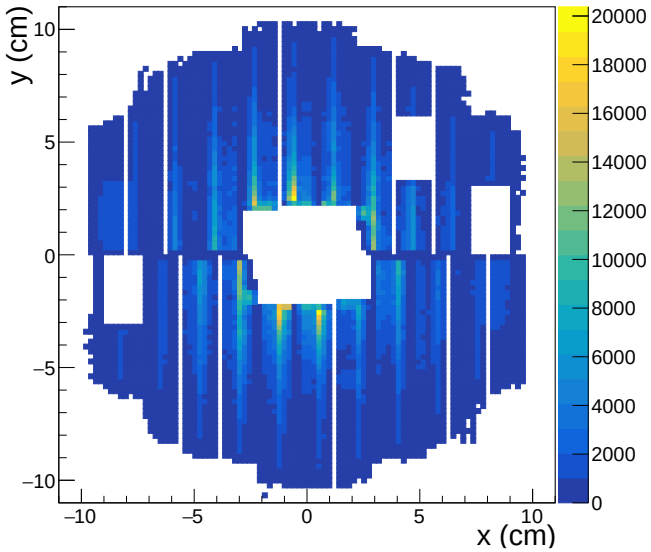


MFT x-y Plots (pass 3)

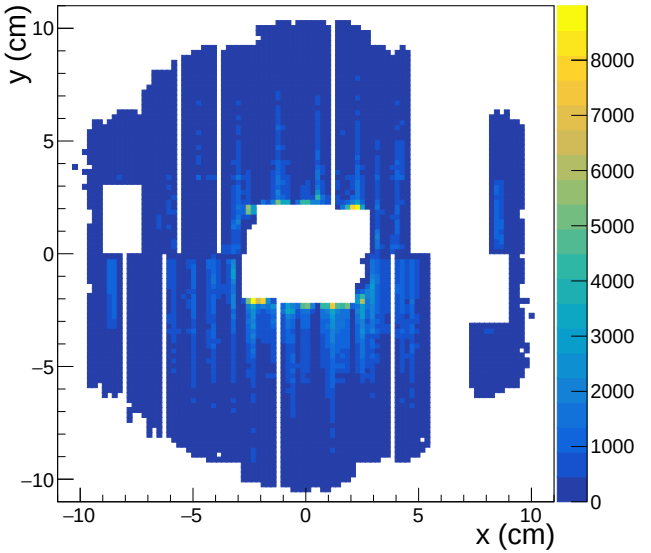
x-y at first MFT plane



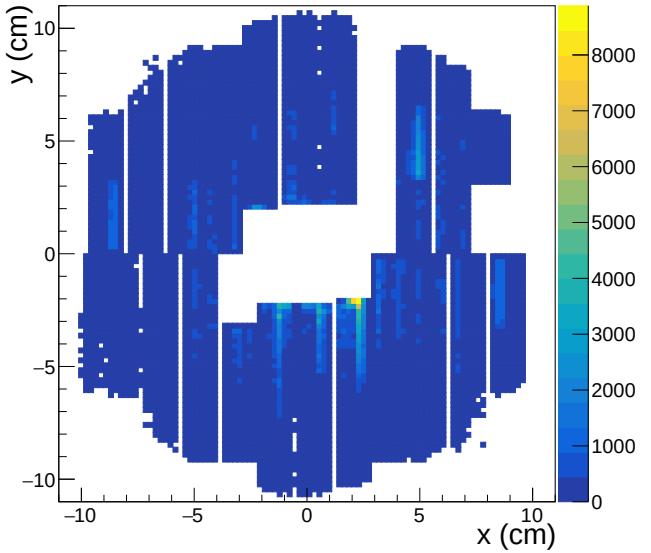
x-y at second MFT plane



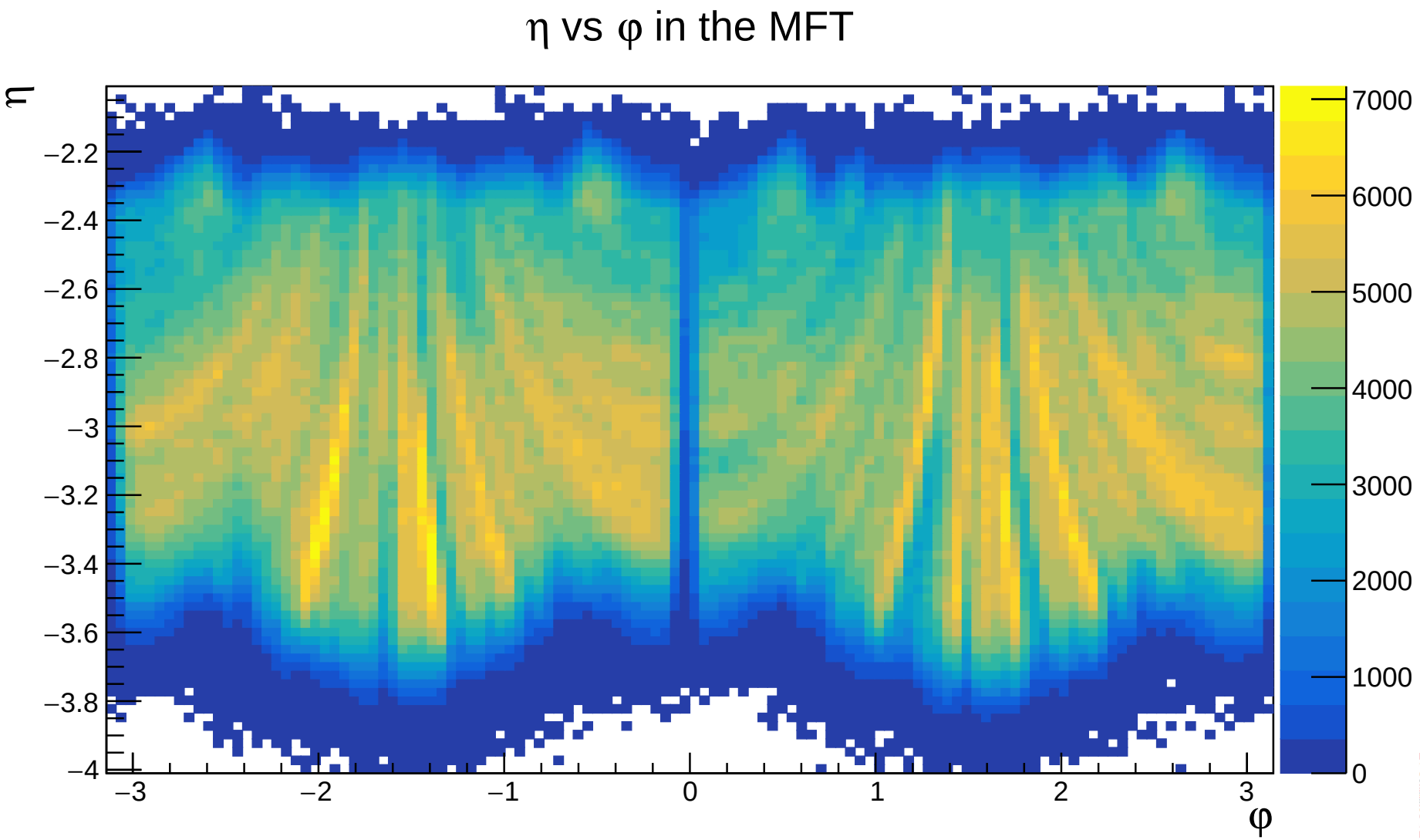
x-y at third MFT plane



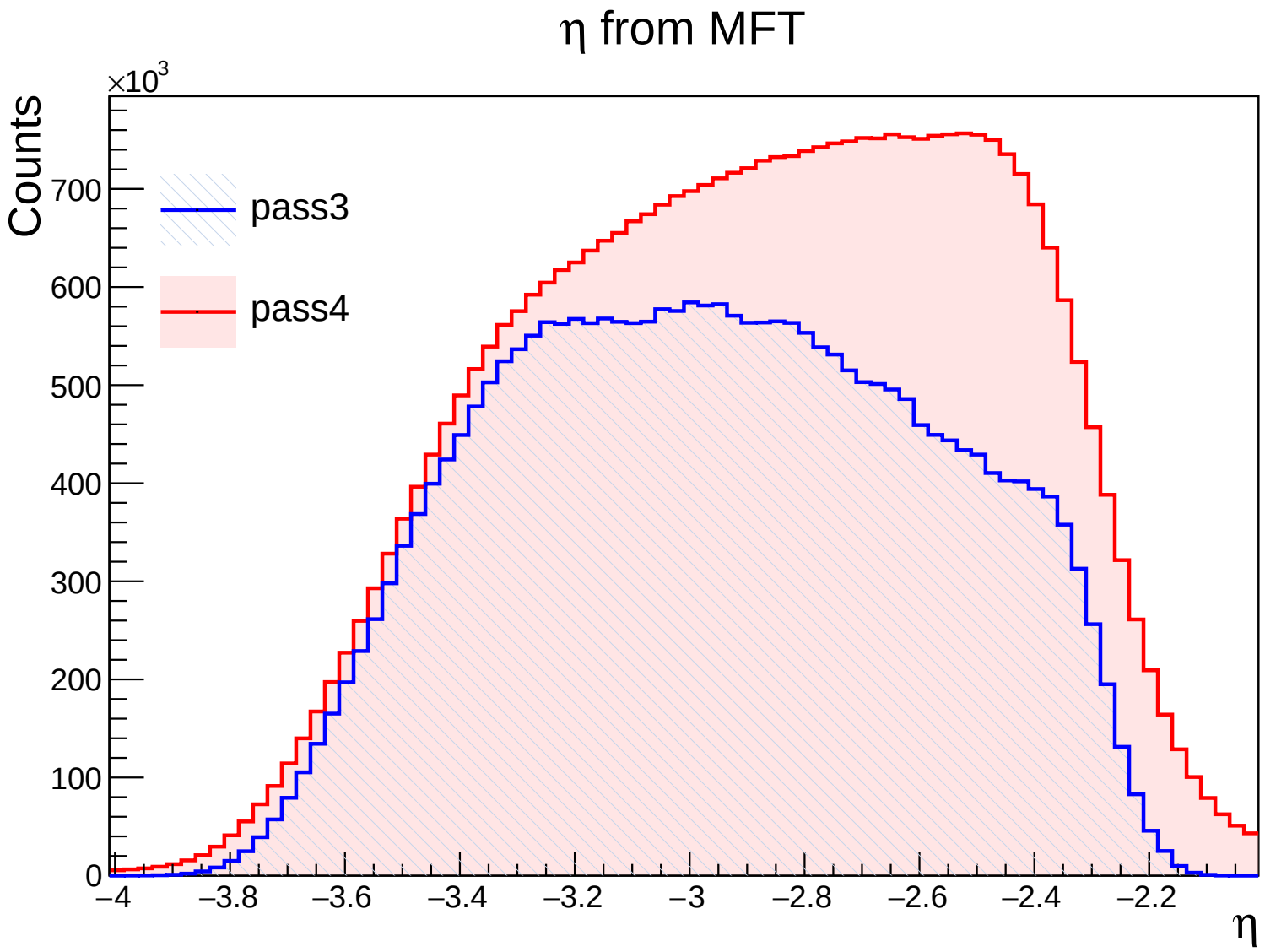
x-y at fourth MFT plane



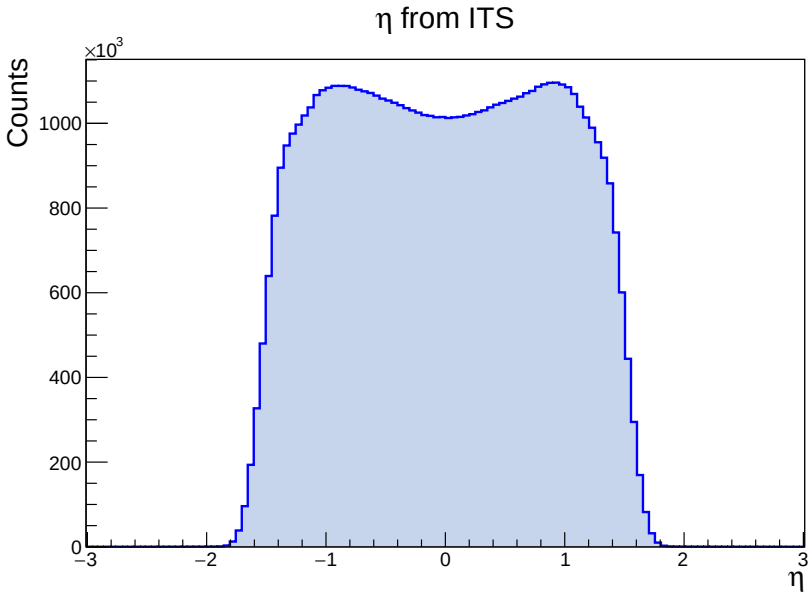
η-φ in the MFT (pass 3)

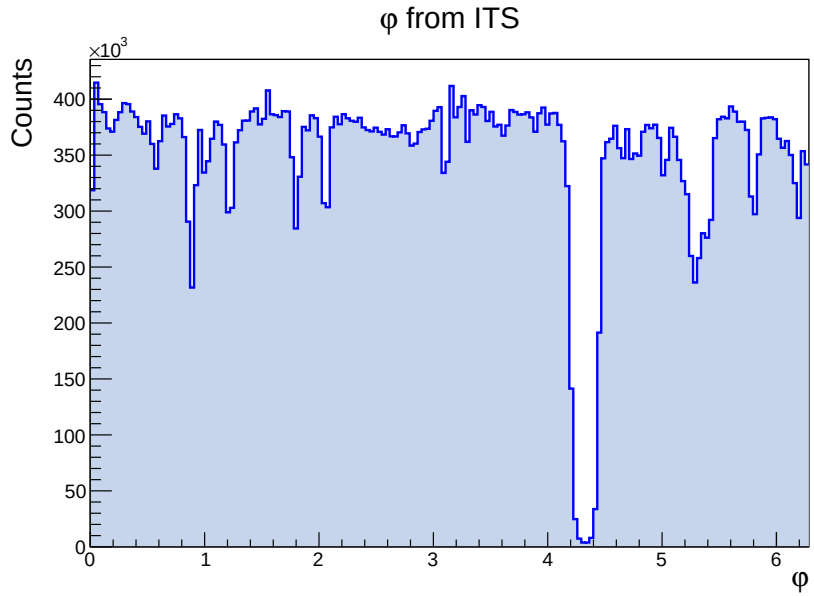


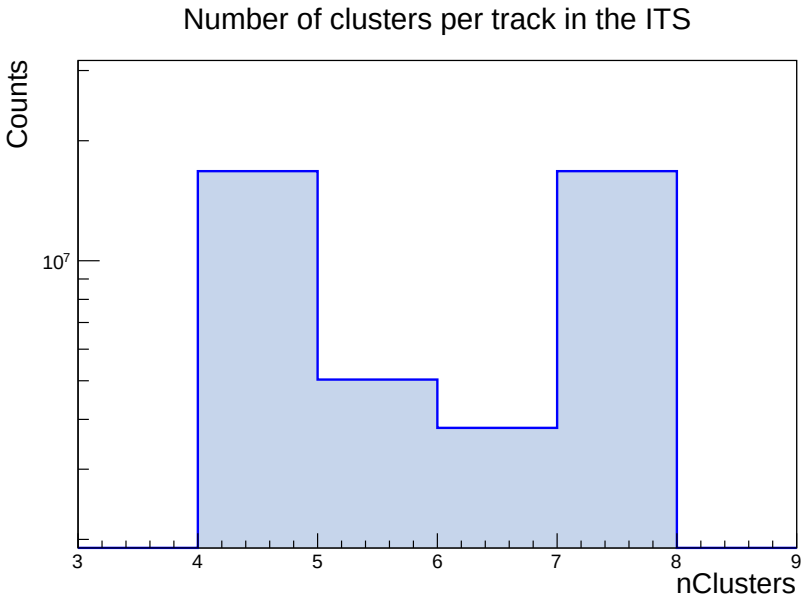
Comparison of η for pass 3 and pass 4 in the MFT

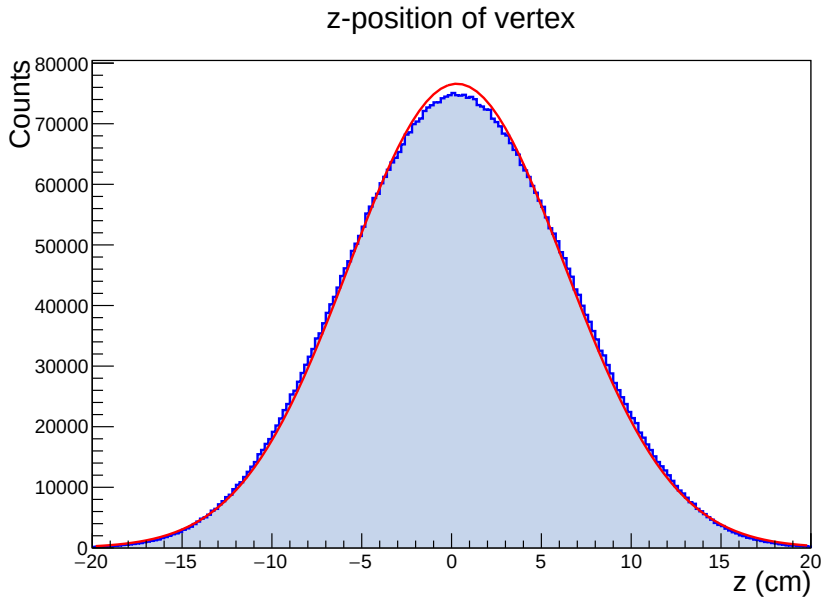


ITS Kinematics (pass 4, hasITS)

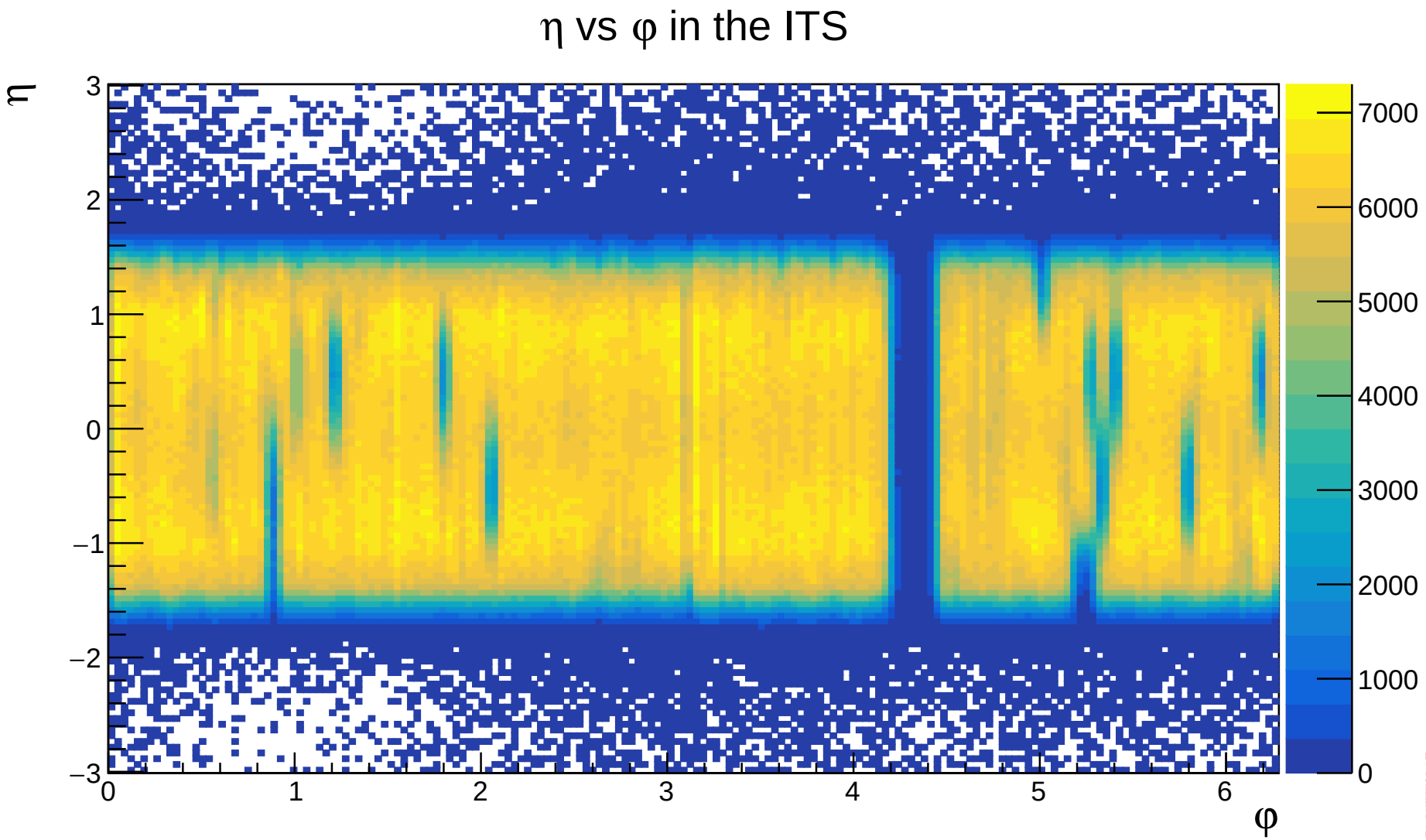








η-φ in the ITS (pass 4, hasITS)



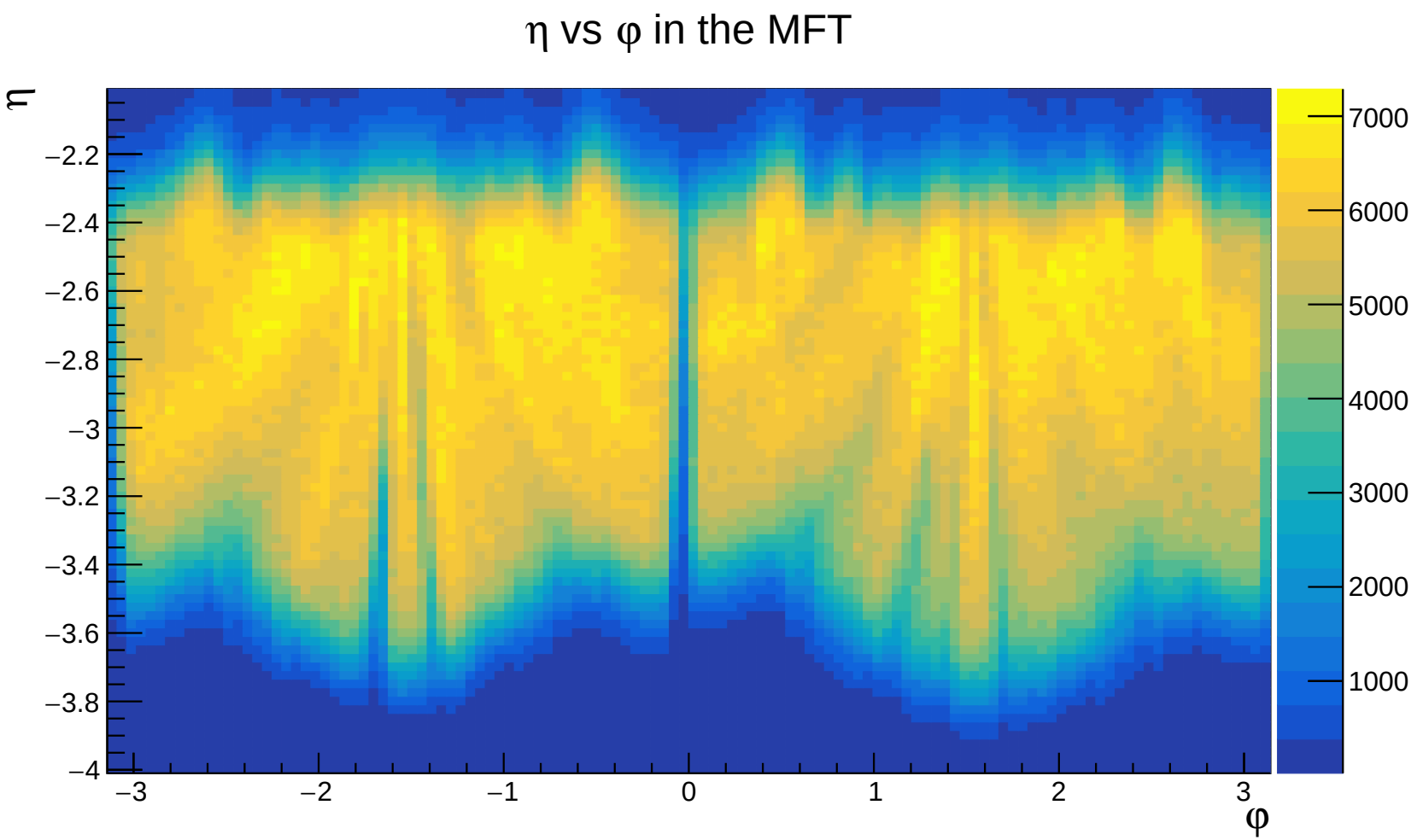
Next Steps

- Why does Z_{MFT} only show the first two disks?
- What is different about pass4?
- Was ITS working properly/what is that gap in the data?
- James mentioned a report but it's probably not that important

Thank you!

BACKUP

η-φ in the MFT (pass 4)



ITS Kinematics (pass 4)