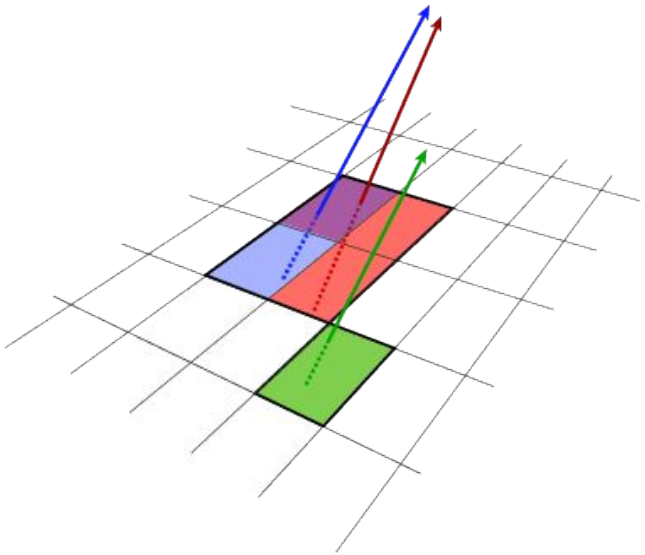
# Tracking In Dense Environments for the ATLAS ITk Strip Detector

for the HL-LHC Upgrade



**Akhilesh Tayade**

DPG Spring Meeting 2022, Heidelberg/Virtual

HELMHOLTZ

DESY.

# ITk Strip Detector

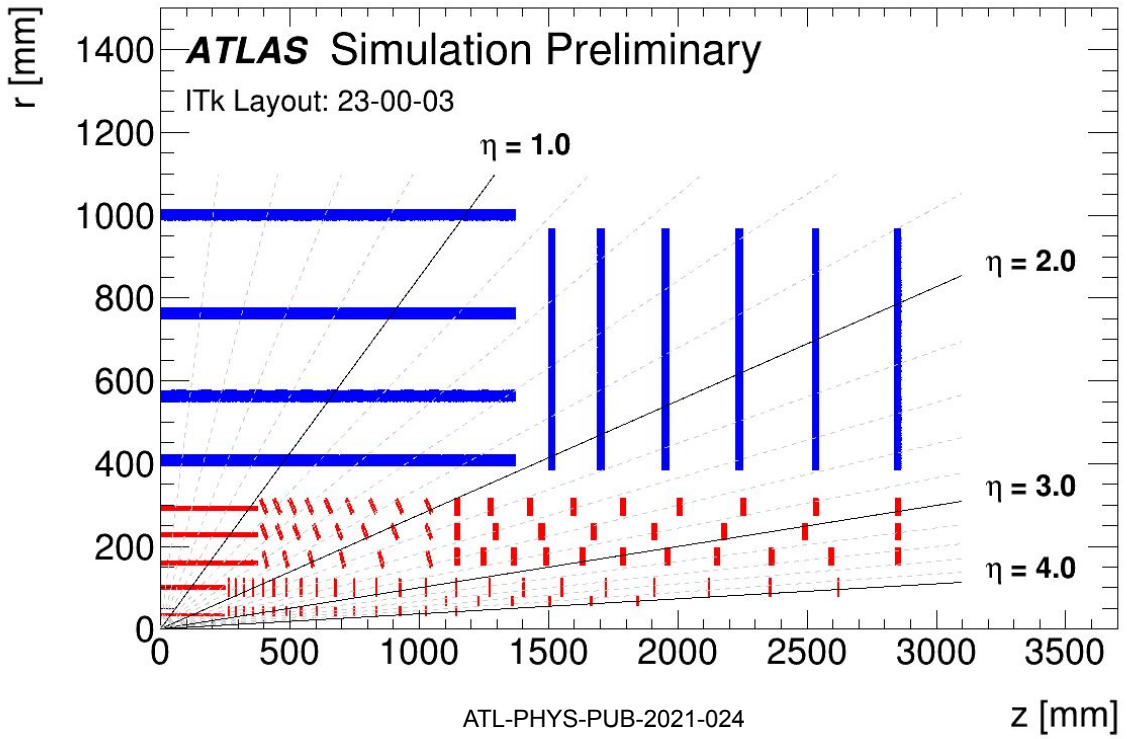
- **ITk Pixel**:

  **Smaller Sensors**
  **Closer to the IP**

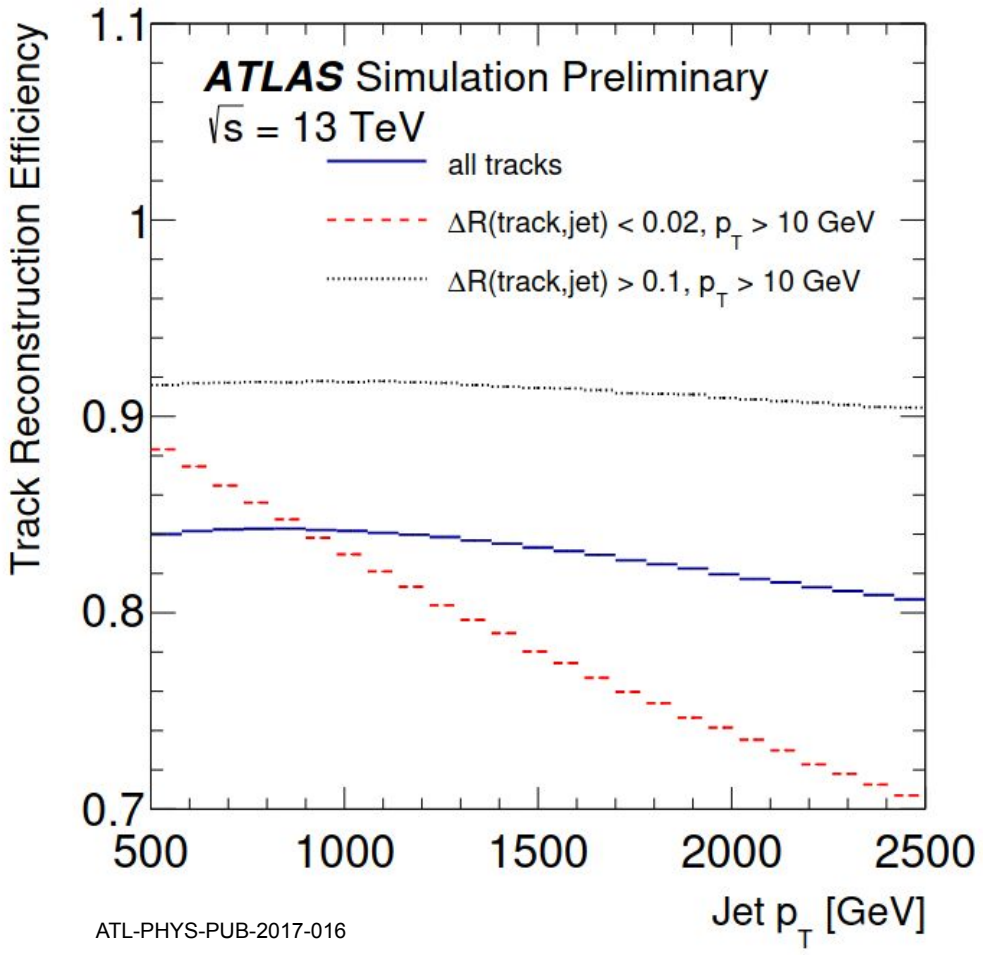
- **ITk Strip**:

  **Pair of 1D Sensors**
  **Farther away from IP**

**Is ITk Strip relevant?**



# ITk Strip Detector

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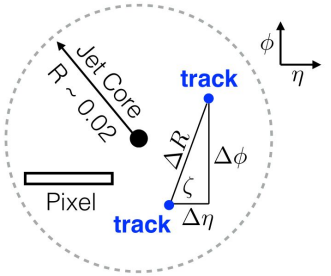
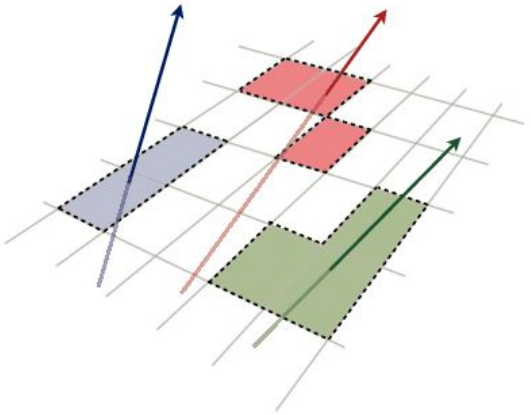
## Why bother?

- Boosted Objects -> High pT -> Collimated Tracks -> Jet Core
- Boosted Objects -> BSM Physics (eg. Di-Higgs)

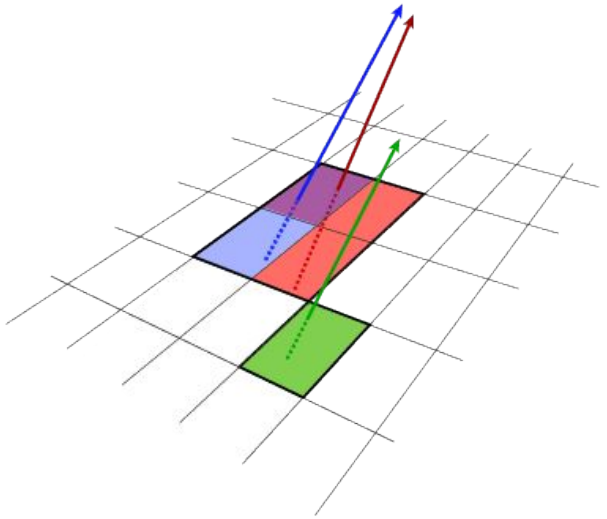


# CTIDE

## Clustering and Tracking in Dense Environments



Non - Merged Clusters



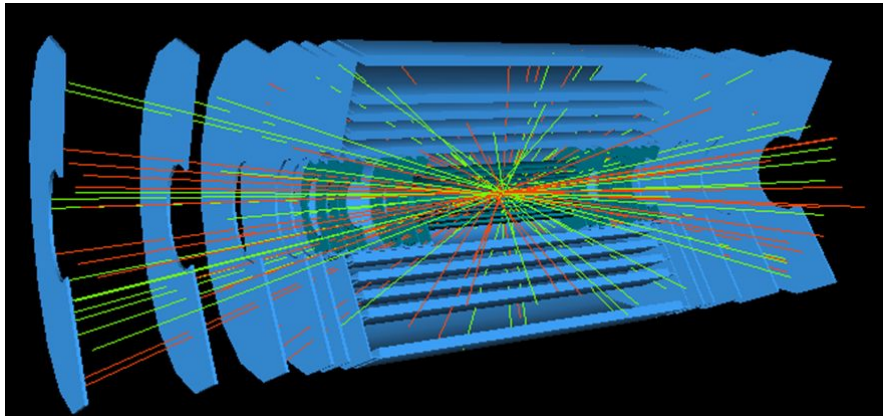
Merged Clusters

**Dense Environment = Jet Core + High Pt + Merging**

**Ambiguity Solver Punishes Shared Strip Cluster in Reconstruction**

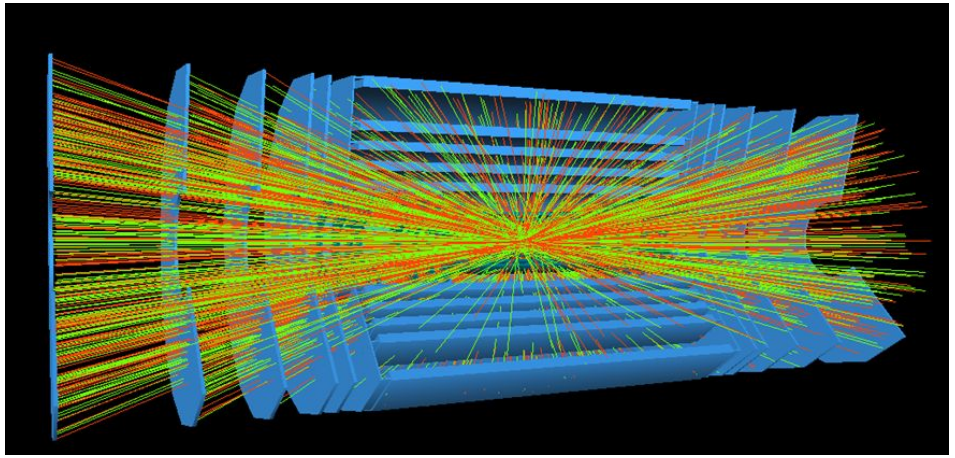
# The Future is Luminous (HL-LHC)

## Run I/II



## Run IV

- **2.5 x instantaneous luminosity**
- **Beam Axis IP useful to mitigate the Pile Up effect.**



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# Analysis

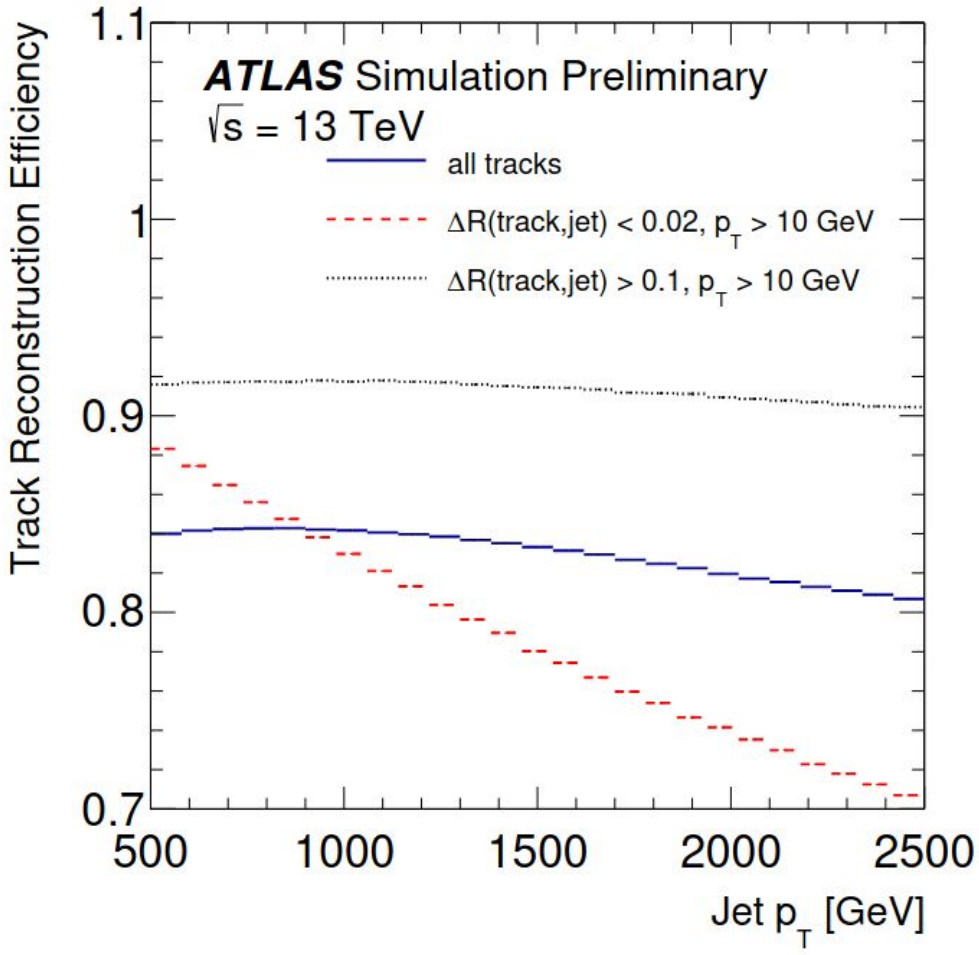
## Sample

**qq -> Z’ -> Hadrons (PU0)**

- **High Pt Tracks**

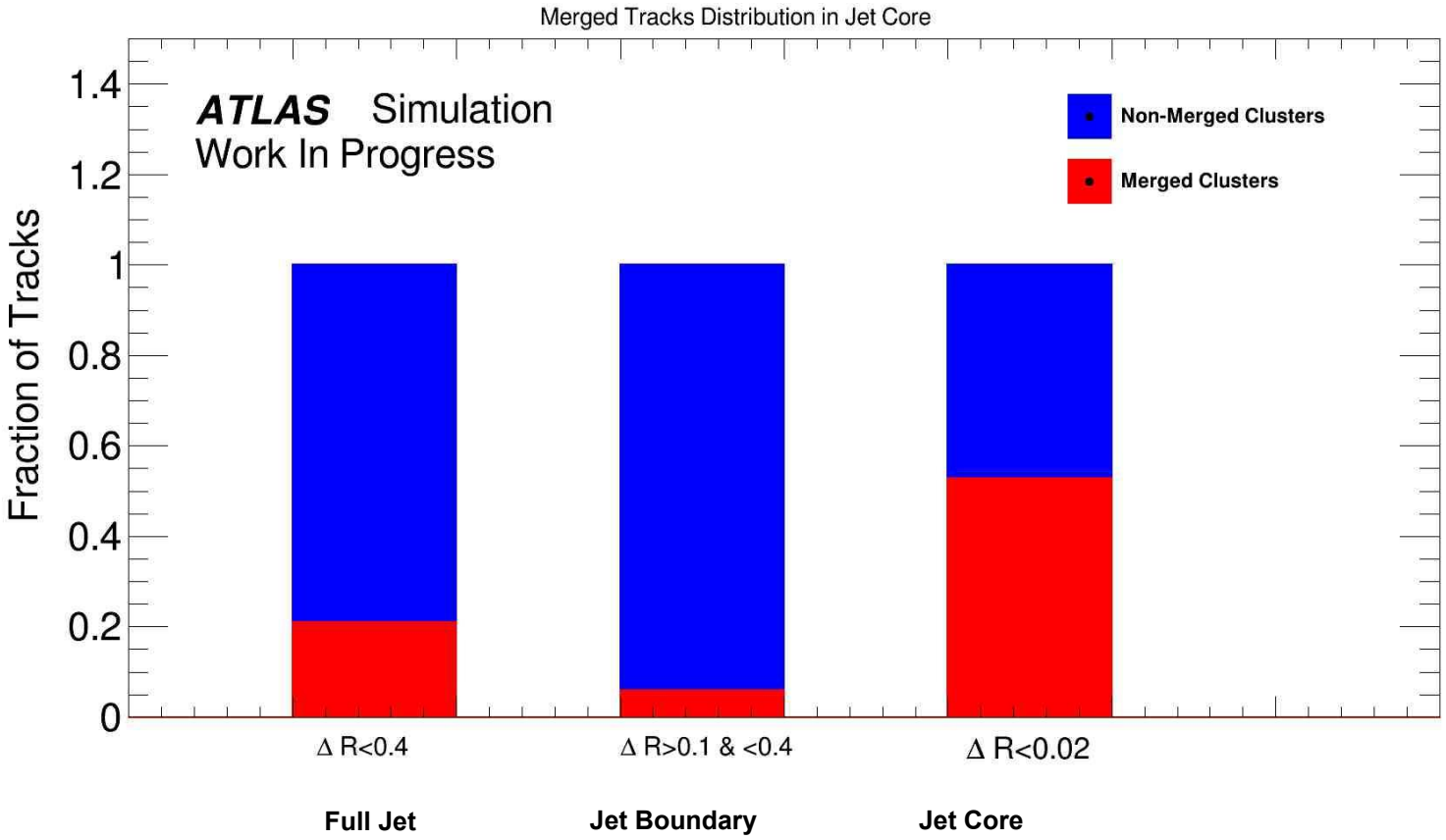
**Anti-Kt 4 for Jets**

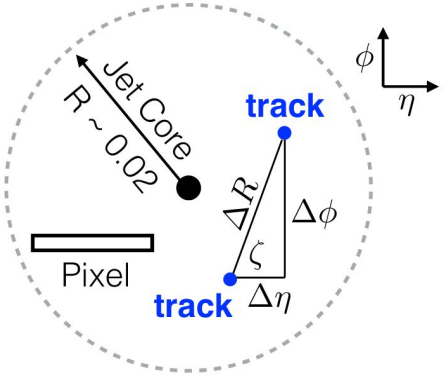
**Efficiency(in a jet) = Truth Matched Track/ No. of Tracks**



# Analysis

## Jet-level




**More Merging in Jet Core**

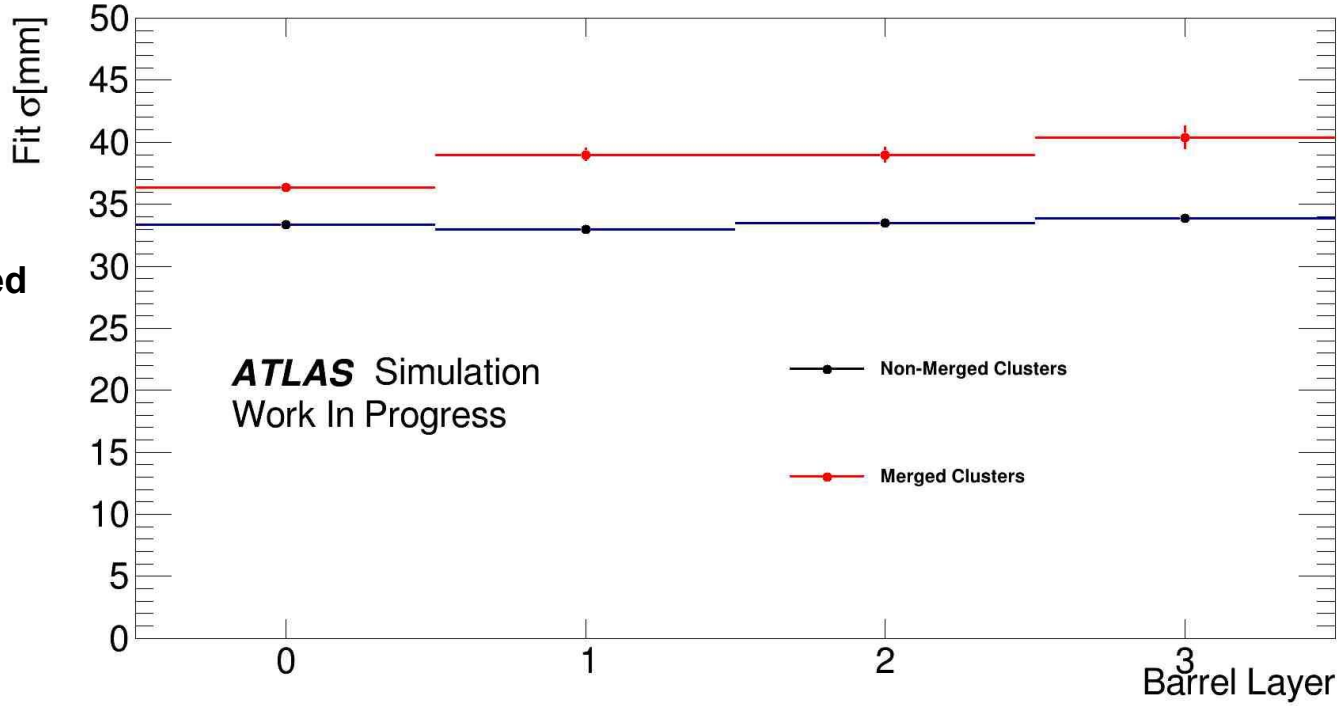
# Analysis

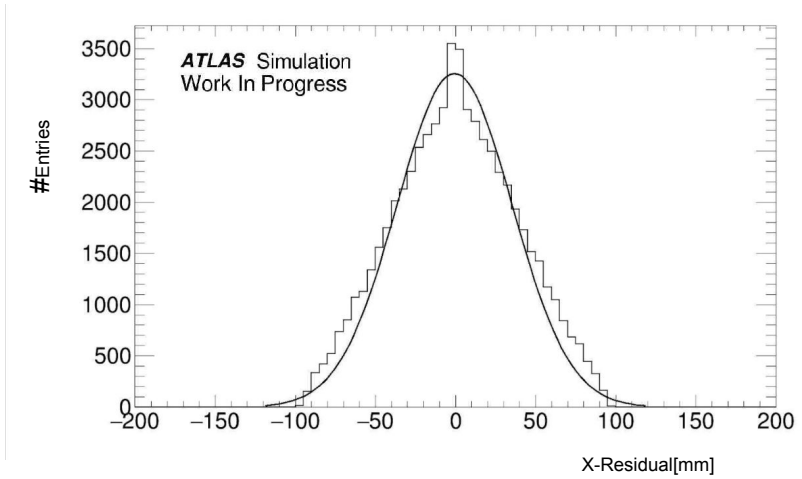
## Residuals

- **Residual (on a surface) = Truth position - Reconstructed Position**
- **Fit Gaussian and Obtain $\sigma$**

**Low Residual ⟶ High Reconstruction Accuracy**

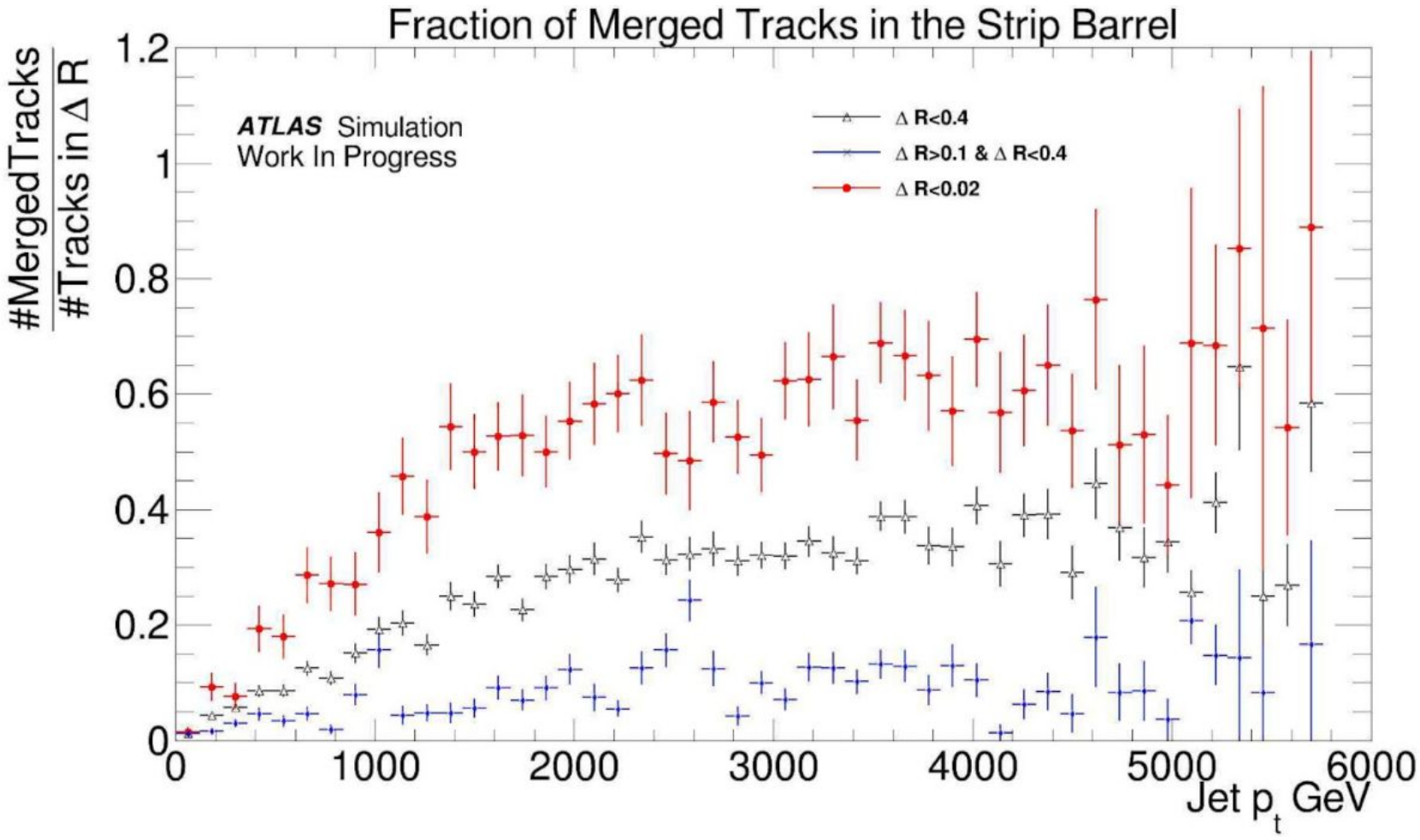
**More Merging ⟶ Lower Reconstruction Accuracy**



# Analysis

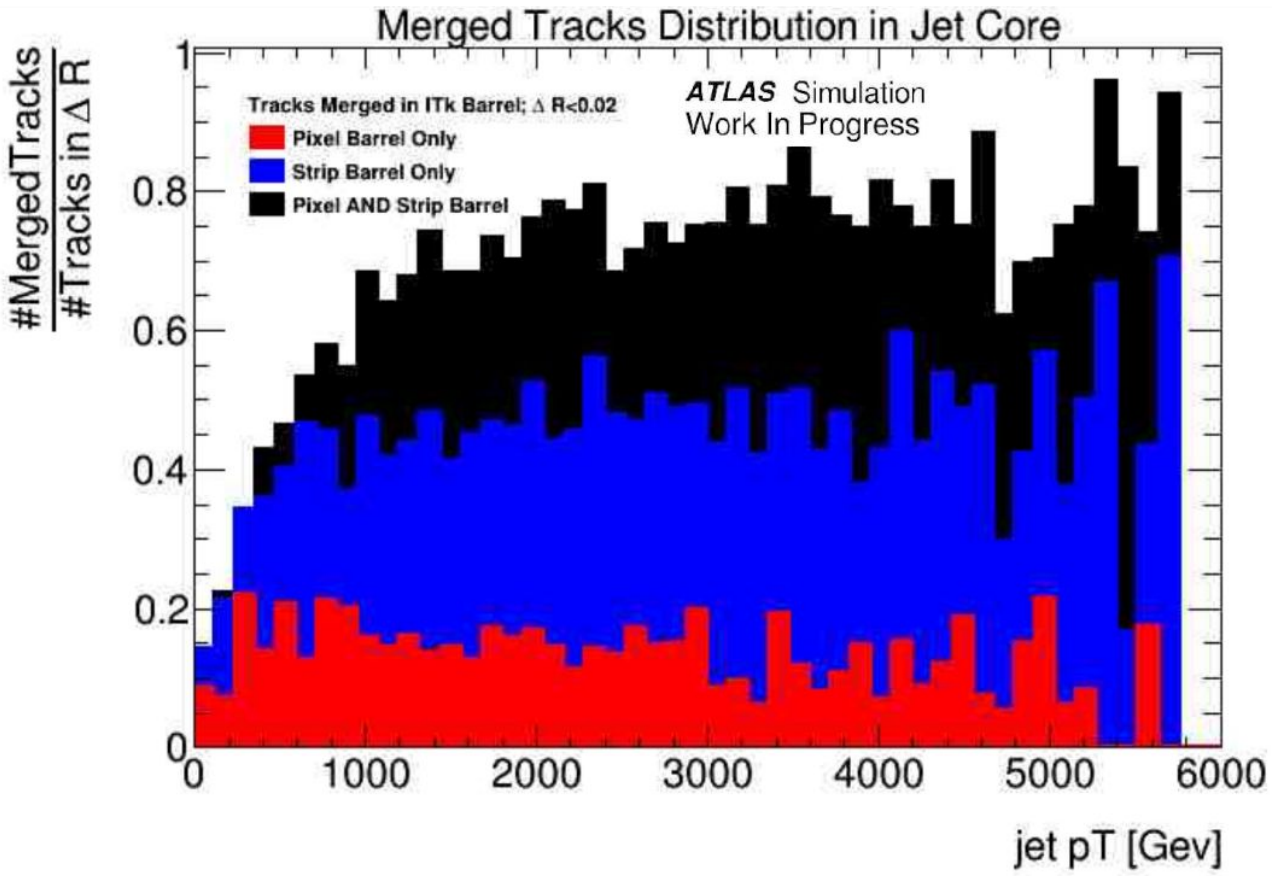
## Jet-level

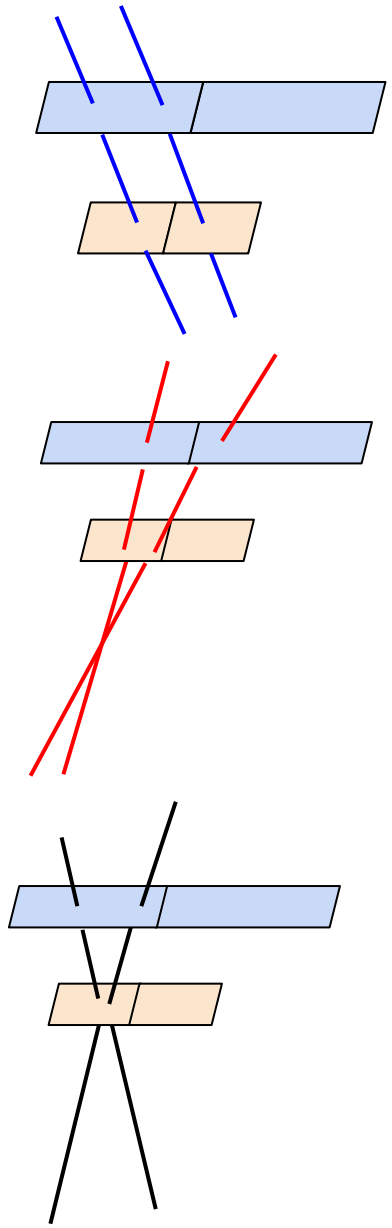



**Fraction of tracks increase with Jet pT and reach a plateau.**

# Analysis

## Jet-level



**Merging in Pixel and Strip is comparable.**

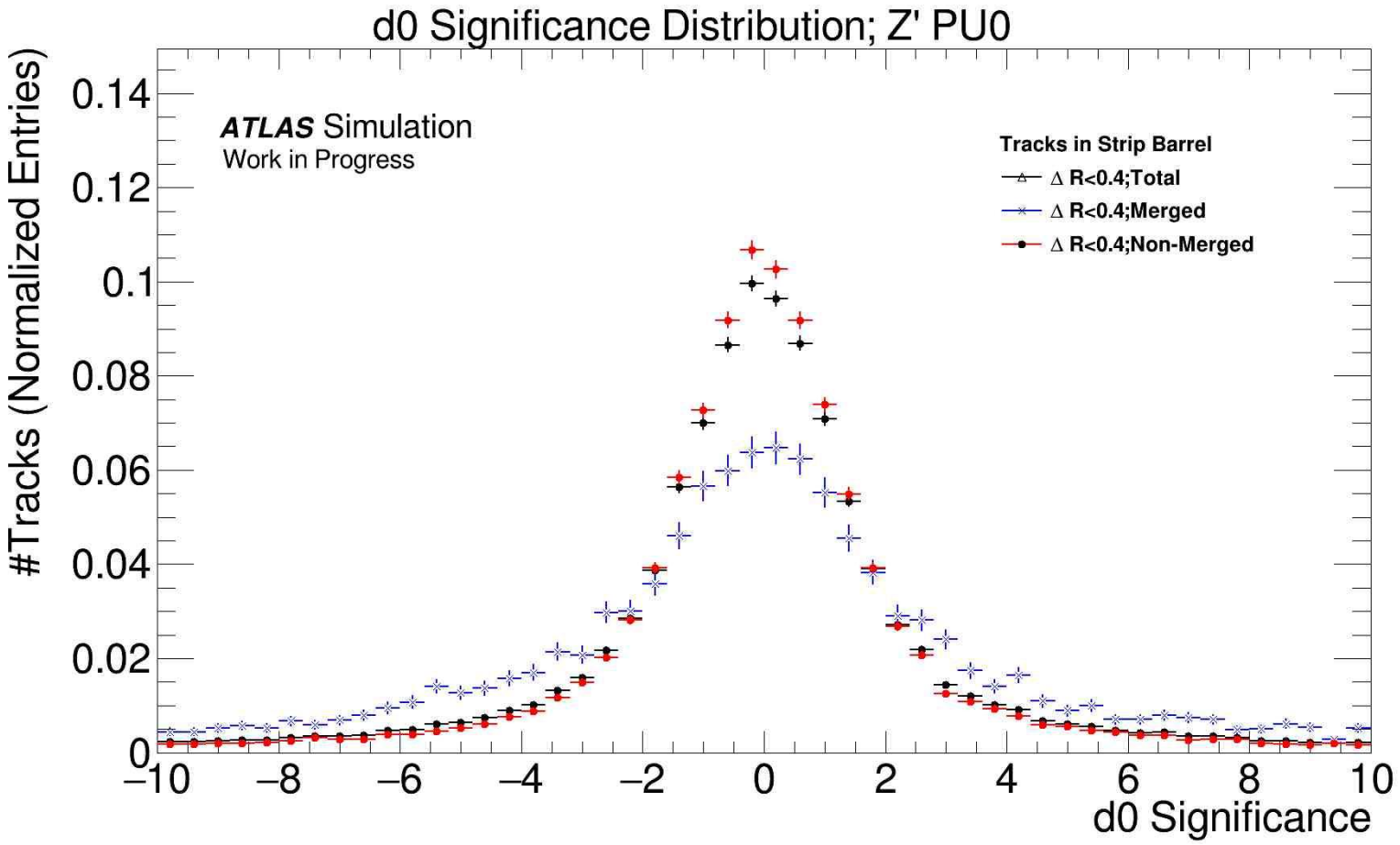
# Analysis

## Jet-level

**d0 = Transverse Distance of the track from the IP**

**Significance = Measurement/Error**

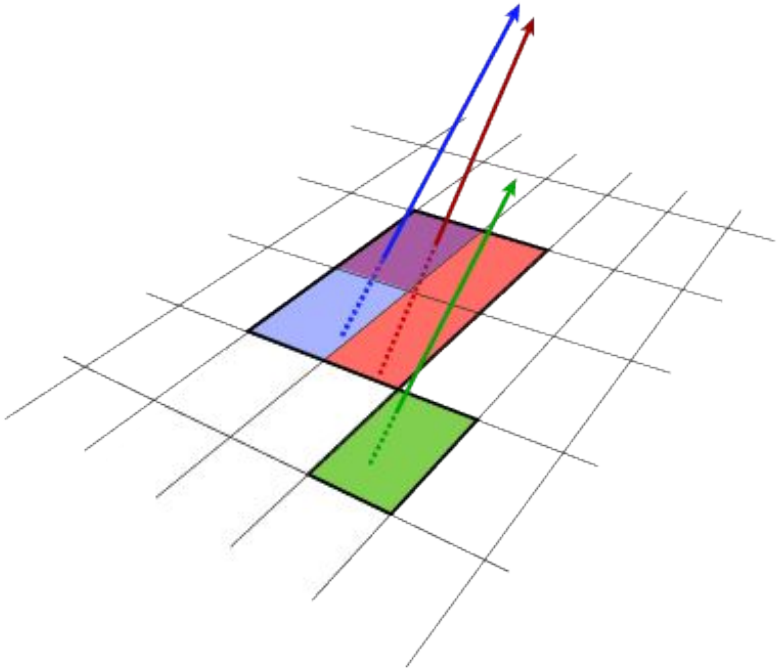
**Merging worsens d0 performance.**



# Back to the Future

## Summary and Outlook

- **Merging worsens CTIDE performance.**
- **Use “Truth Based Ideal Splitting” to estimate room for improvement.**
- **Study Cluster Properties and make improvements.**



# Thank You!
# Questions?

# Backup Slides

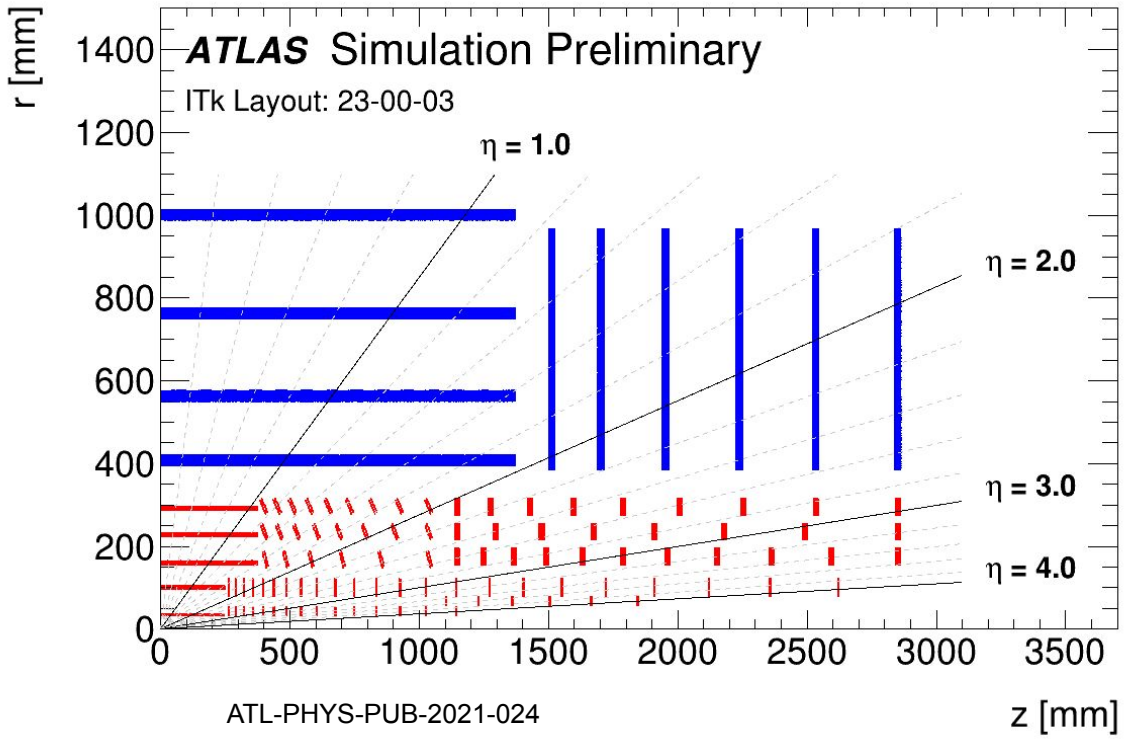
# ITk Strip Detector

- **ITk Pixel**:

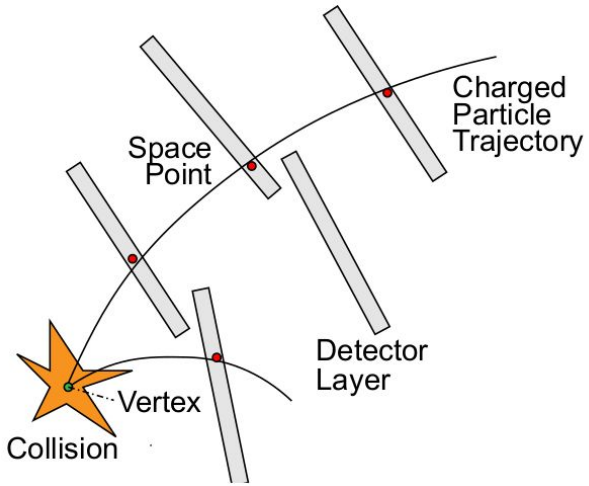
  25μm×100μm/50μm×50μm
  39mm - 271mm

- **ITk Strip**:

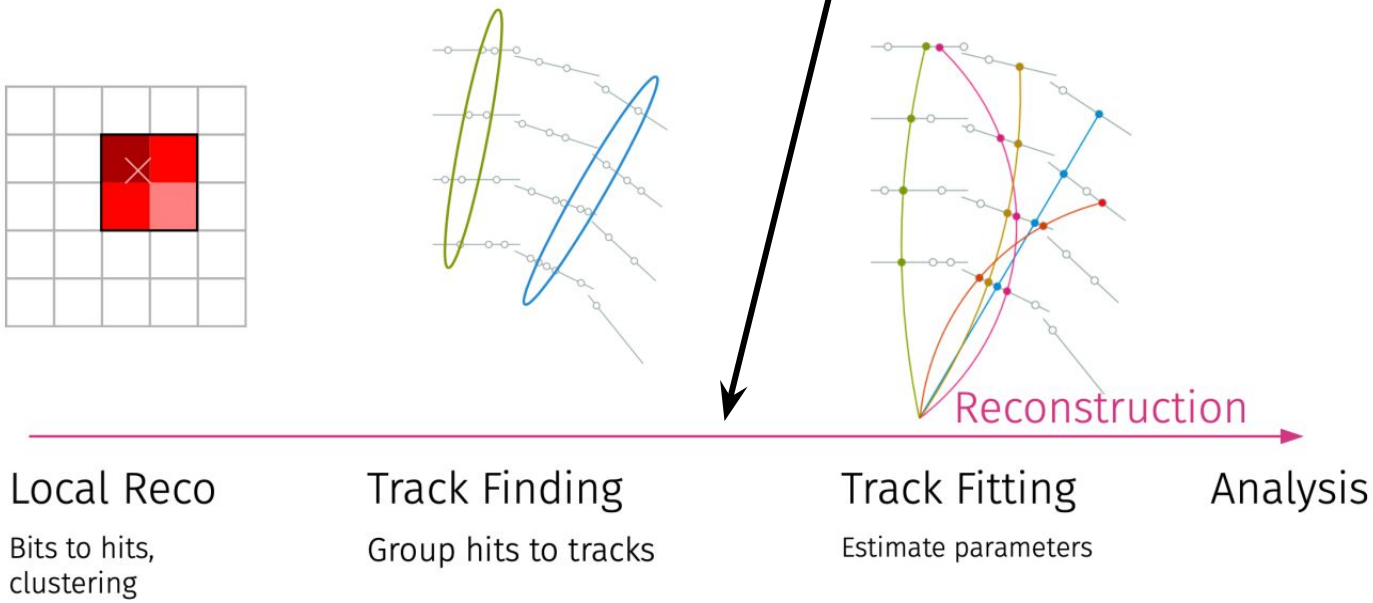
  69/85 μm
  Endcap Pitch Uniform in Phi
  405mm – 1000mm



# Tracking Overview

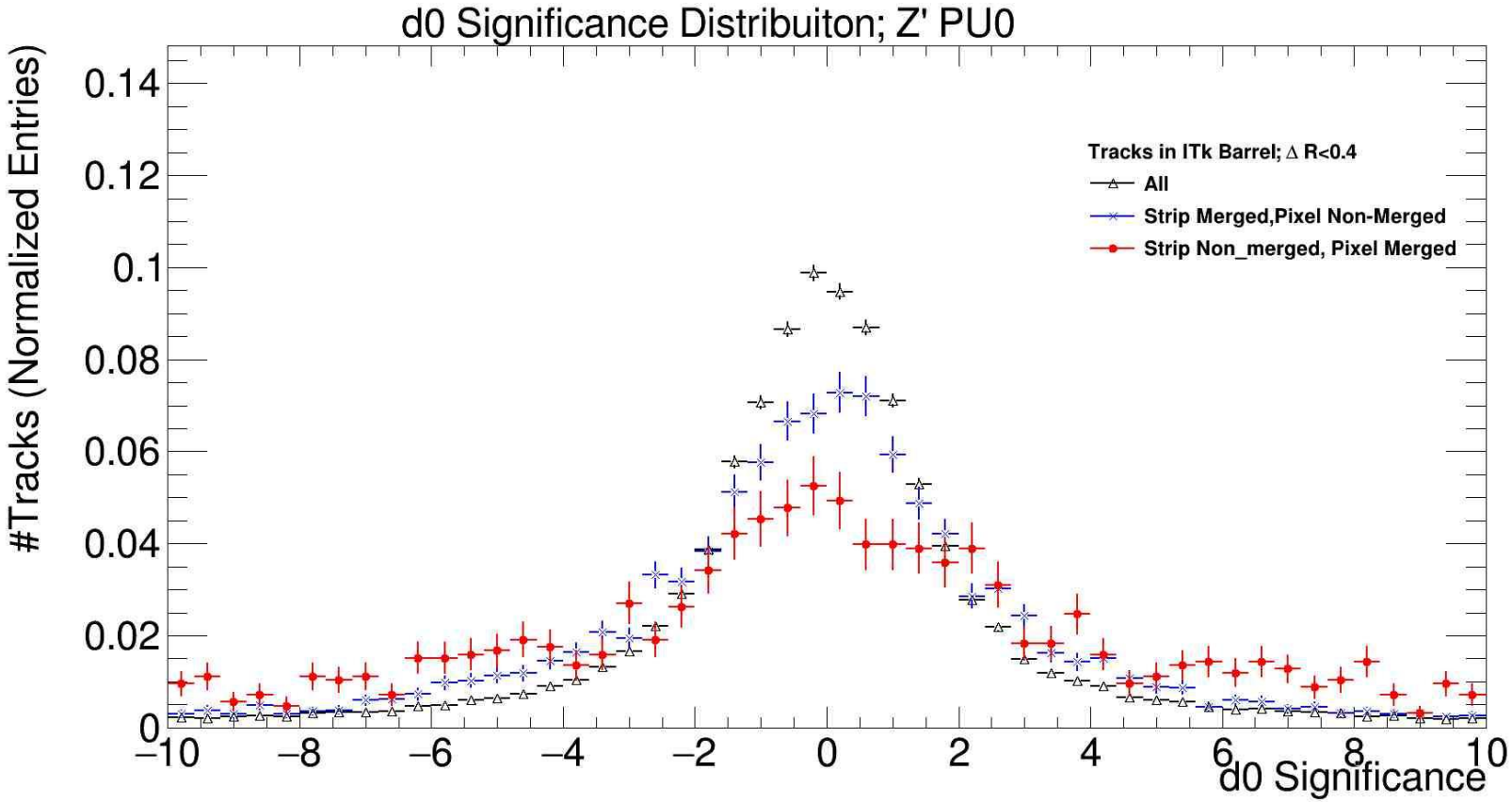



**Ambiguity Solver: Punish Shared Strip Cluster**



# Analysis

## Next Steps



# Analysis
## Next Steps