Track Selection for the Alignment of the ATLAS Inner Detector

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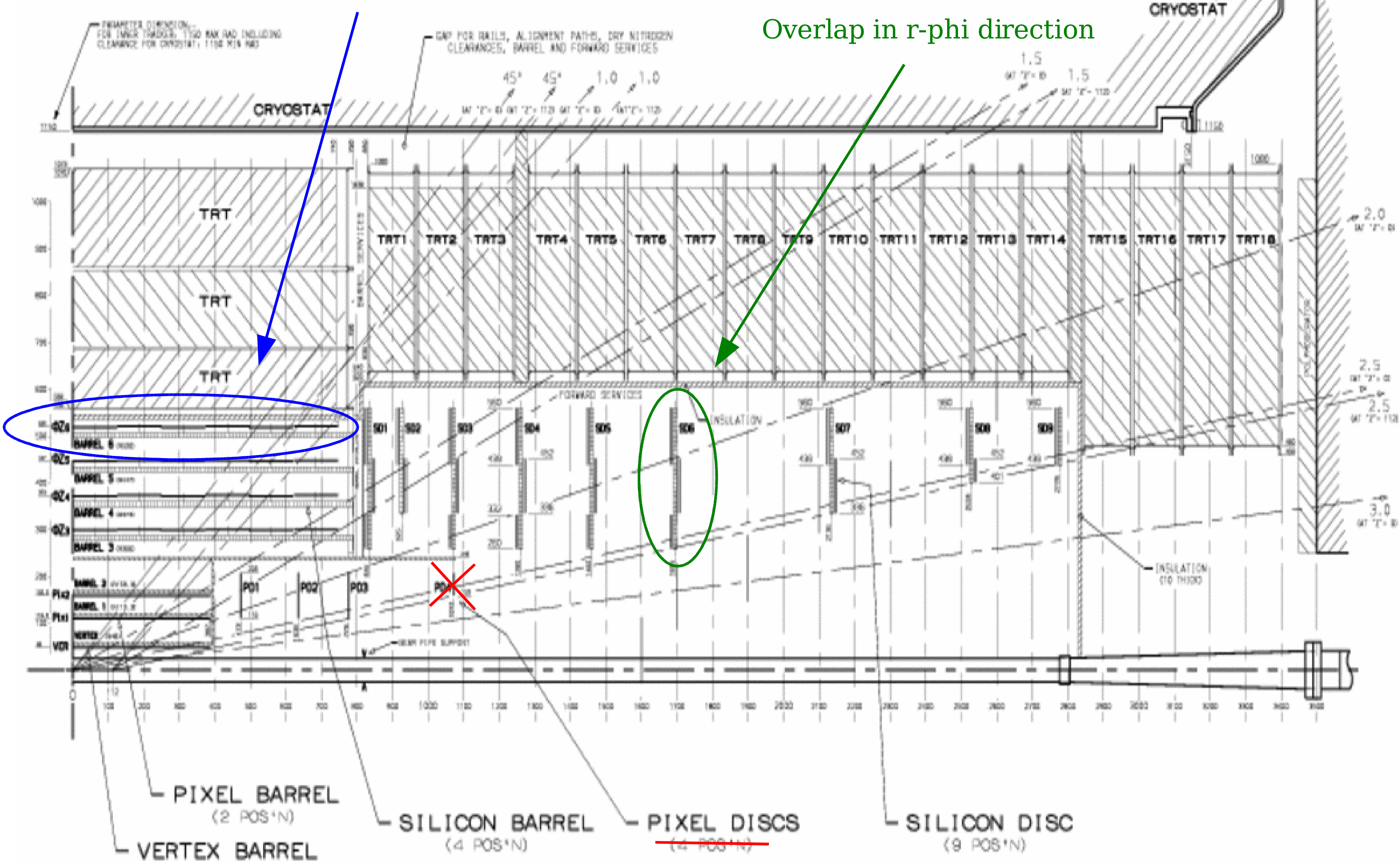
Why track selection for the alignment of the ATLAS ID ?

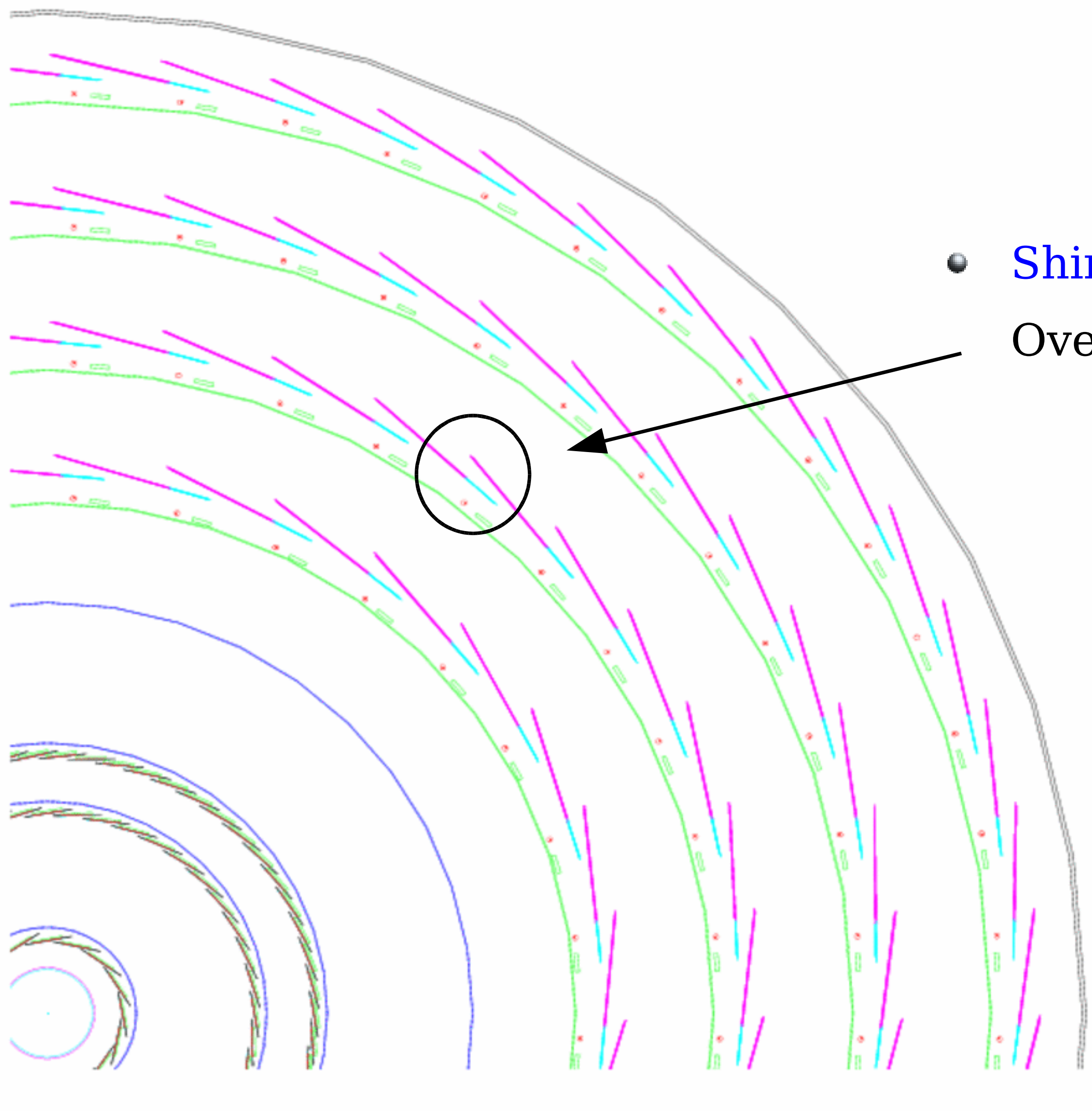
- ATLAS is one of the 5 experiments at the LHC at CERN
- Within ATLAS particle trajectories will be reconstructed using Inner & Muon detectors
- Alignment of ID is crucial for:
  - Secondary vertex reconstruction
  - Momentum resolution
- Large rates of high pT muons enable the use of track-based alignment procedures to:
  - Provide the ultimate precision alignment constants
- Quality studies of reconstructed tracks and their impact on track-based alignment procedures are needed

- For the moment only studies of:
  - Coverage of inner detector: Pixel & SCT
  - Single track performance, that is, perigee parameters of single tracks
- No track selection yet
- Single-particle sample used:
  - Muons with pT = 50 GeV
  - Generated with Athena framework software
  - No pile up

COVERAGE OF THE INNER DETECTOR

- Geometry: Pixel = 3 barrel layers & 3 end-cap disks (on each side), SCT = 4 barrel layers & 9 end-cap discs (on each side)
- Stepped-Stave Layout: Overlap in z direction



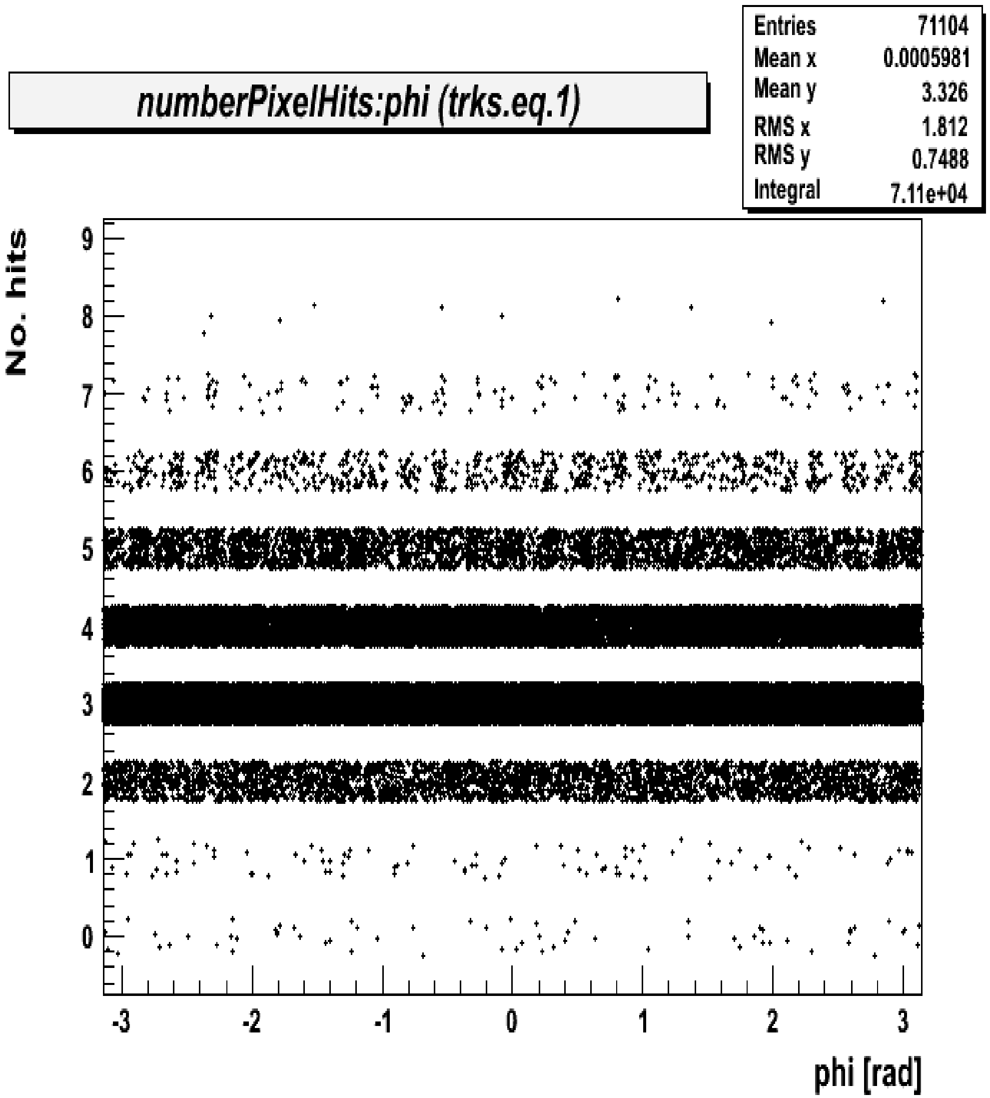


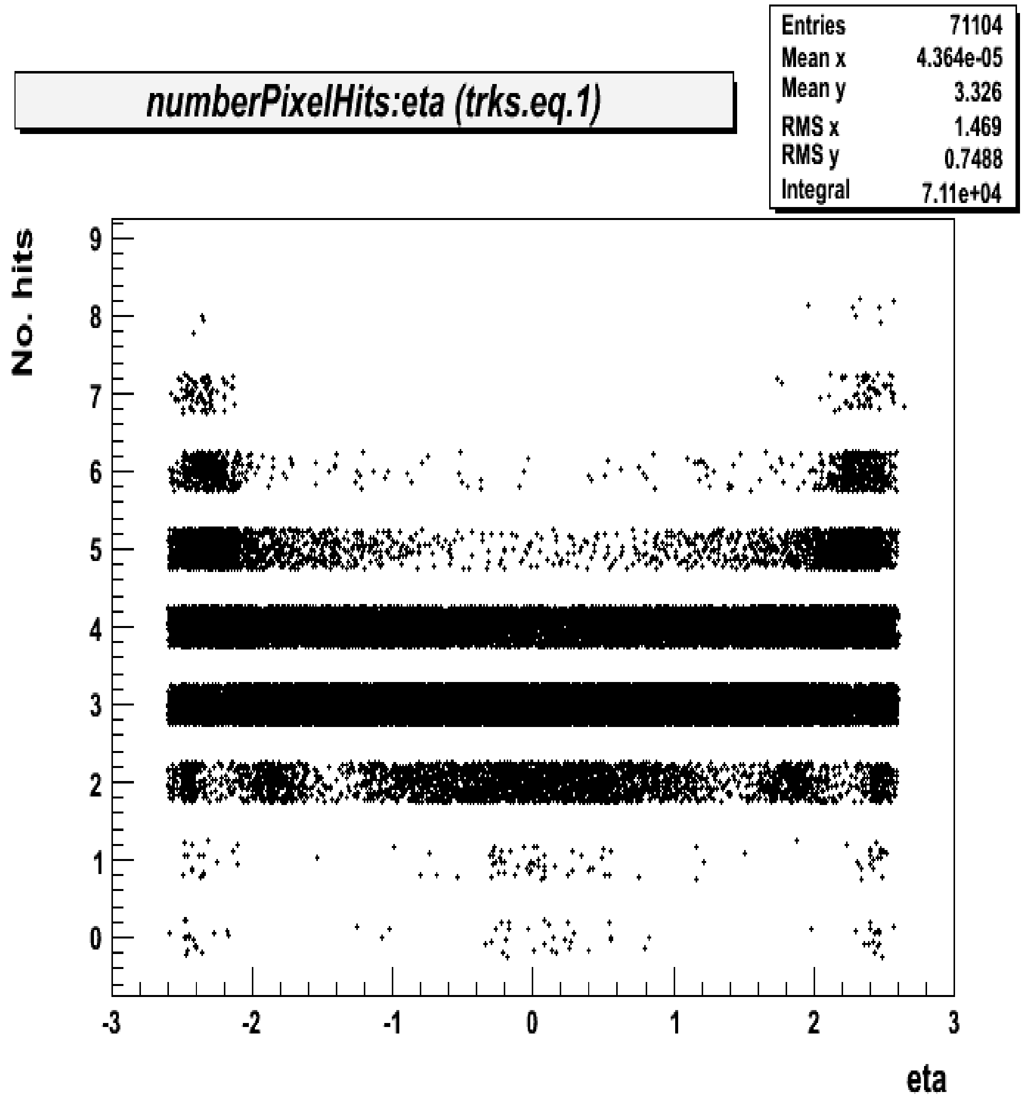
- Shingled-Stave layout :

  Overlap in phi direction

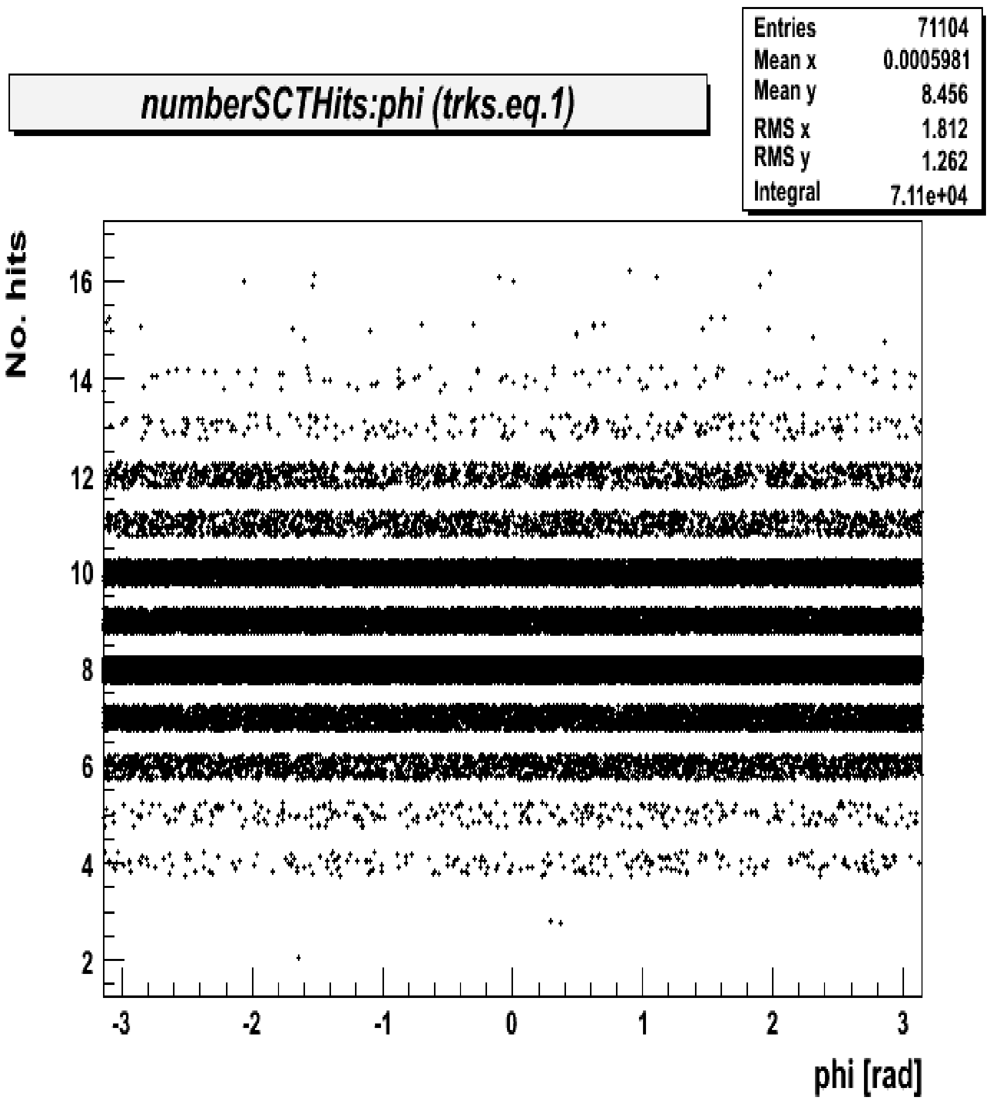
Pixel Hits

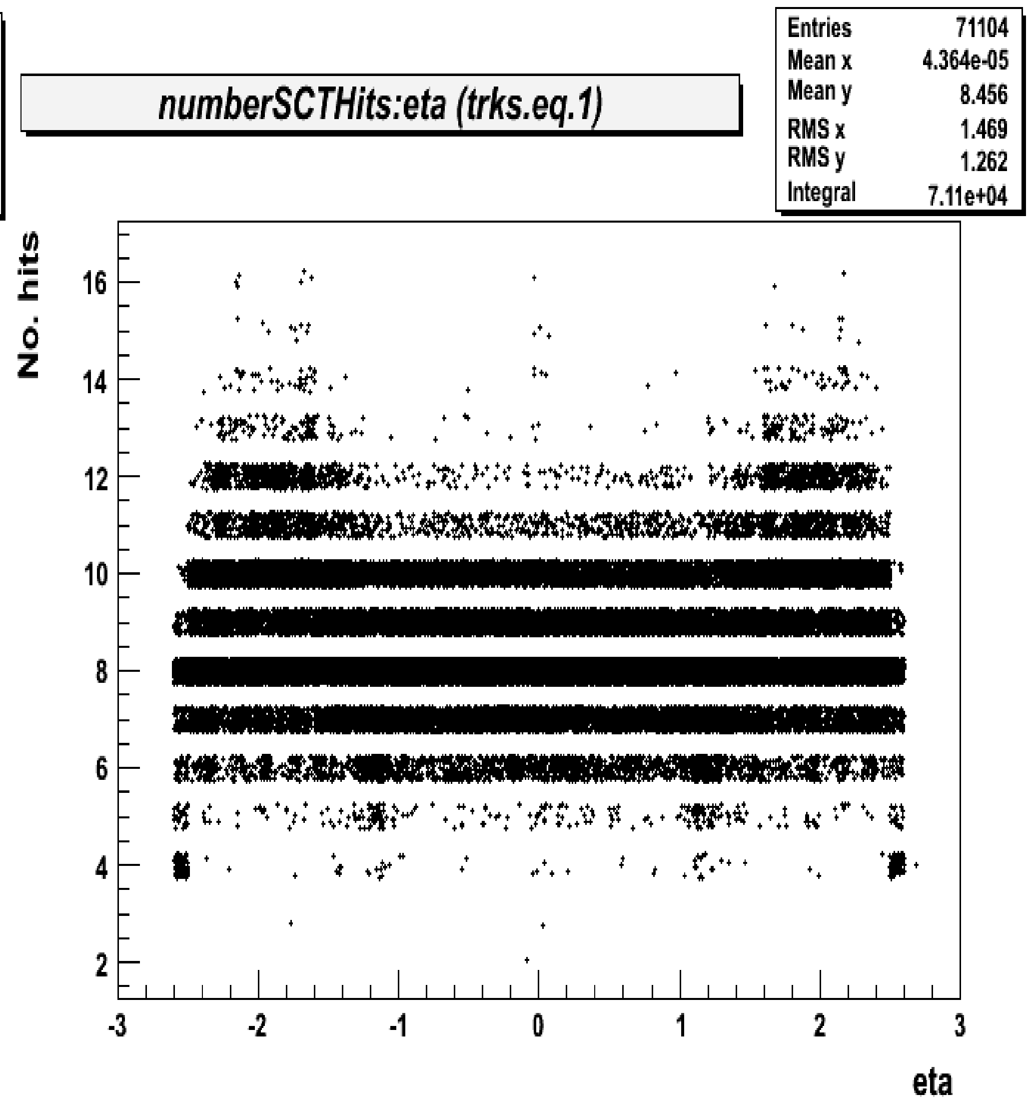
- Coverage of the 3 barrel layers together: |eta| < 1.9 and of the innermost layer: |eta| < 2.6
- Coverage of the 3 end-cap discs together: 2.2 < |eta| < 2.4 and of the outermost disc: 2 < |eta| < 2.6





- Coverage of the 4 barrel layers together: |eta| < 1.1 and of the innermost one: |eta| < 1.6
- Coverage of at least one of the 9 end-cap discs: 1.1 < |eta| < 2.6
    - A track crosses 8 rings at most

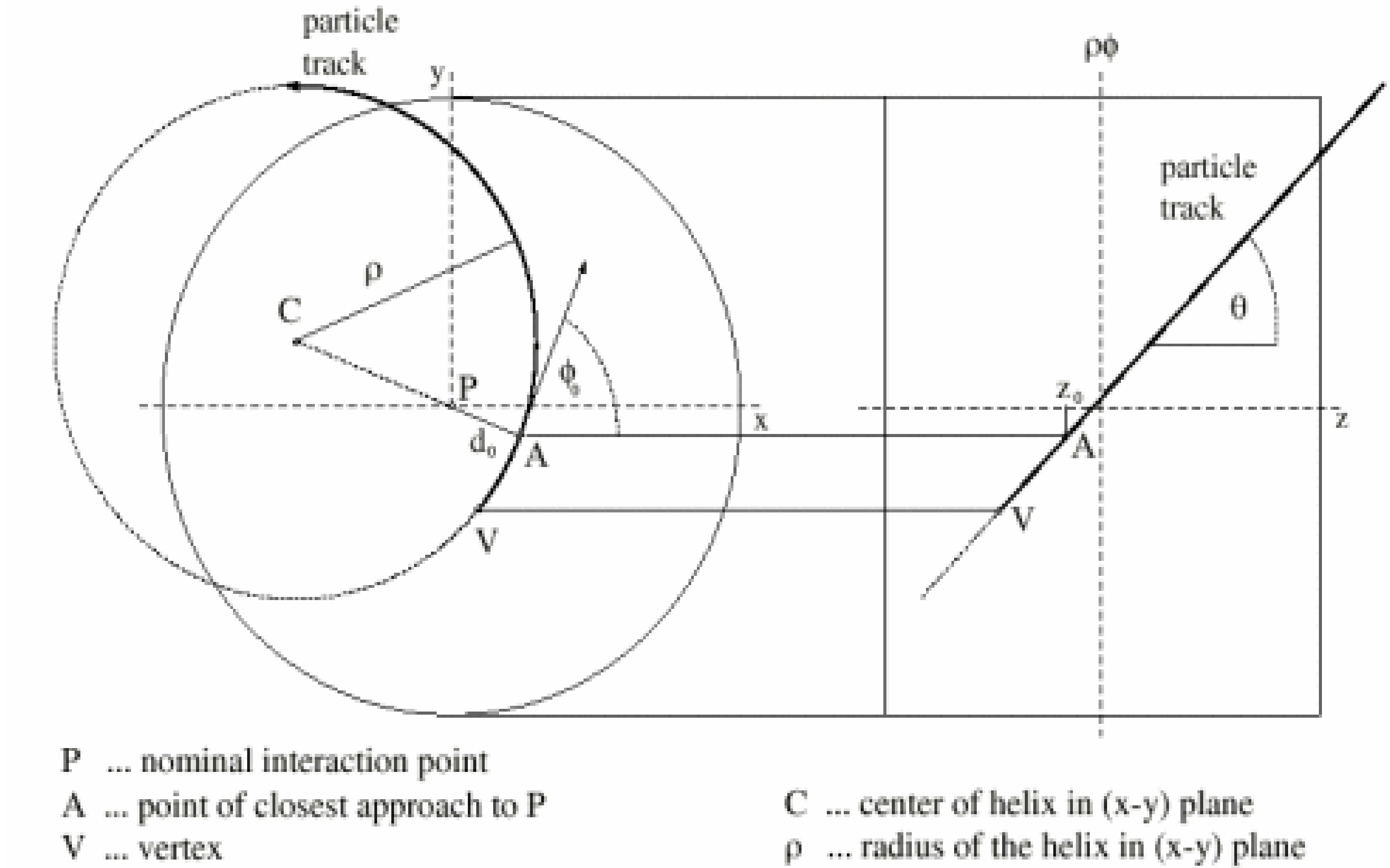




SINGLE TRACK PERFORMANCE

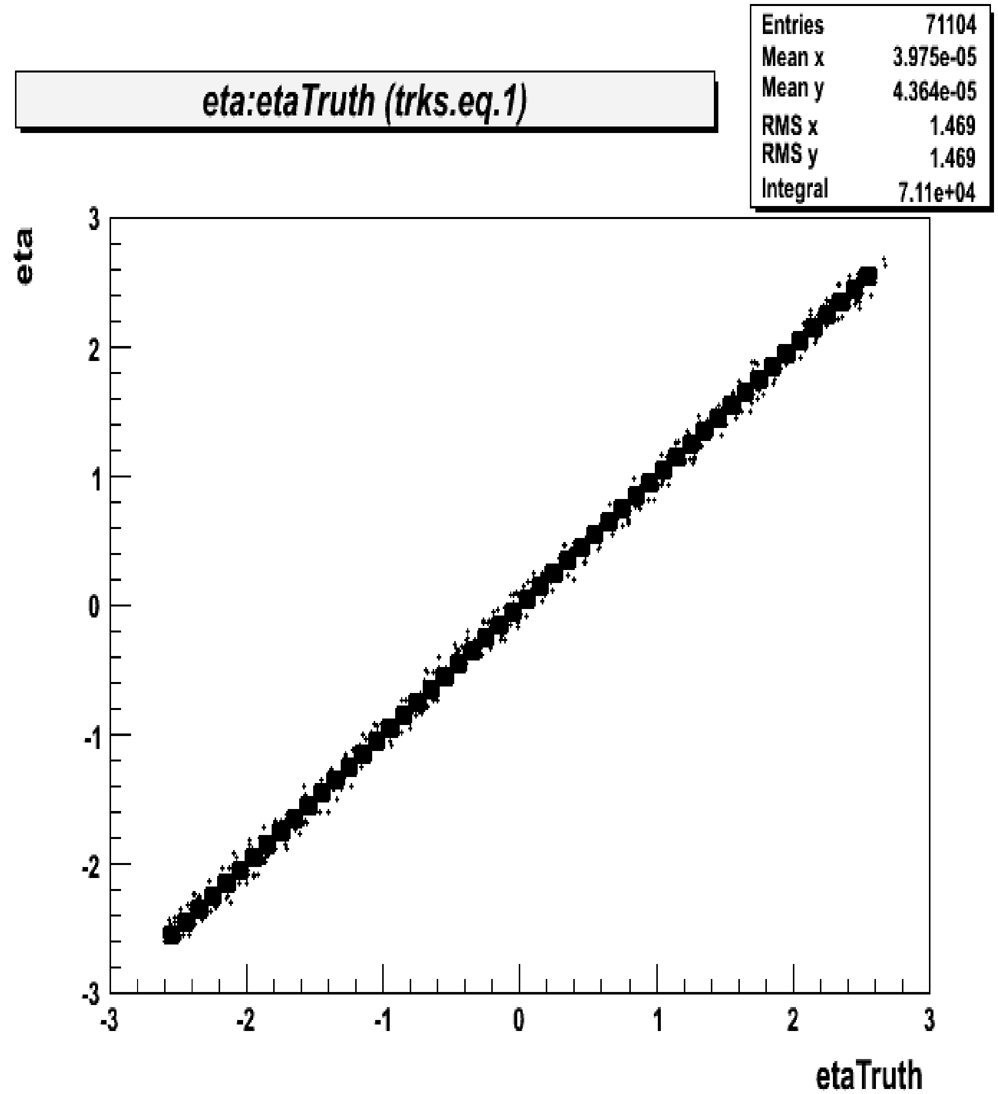
Definition of Perigee Parameters

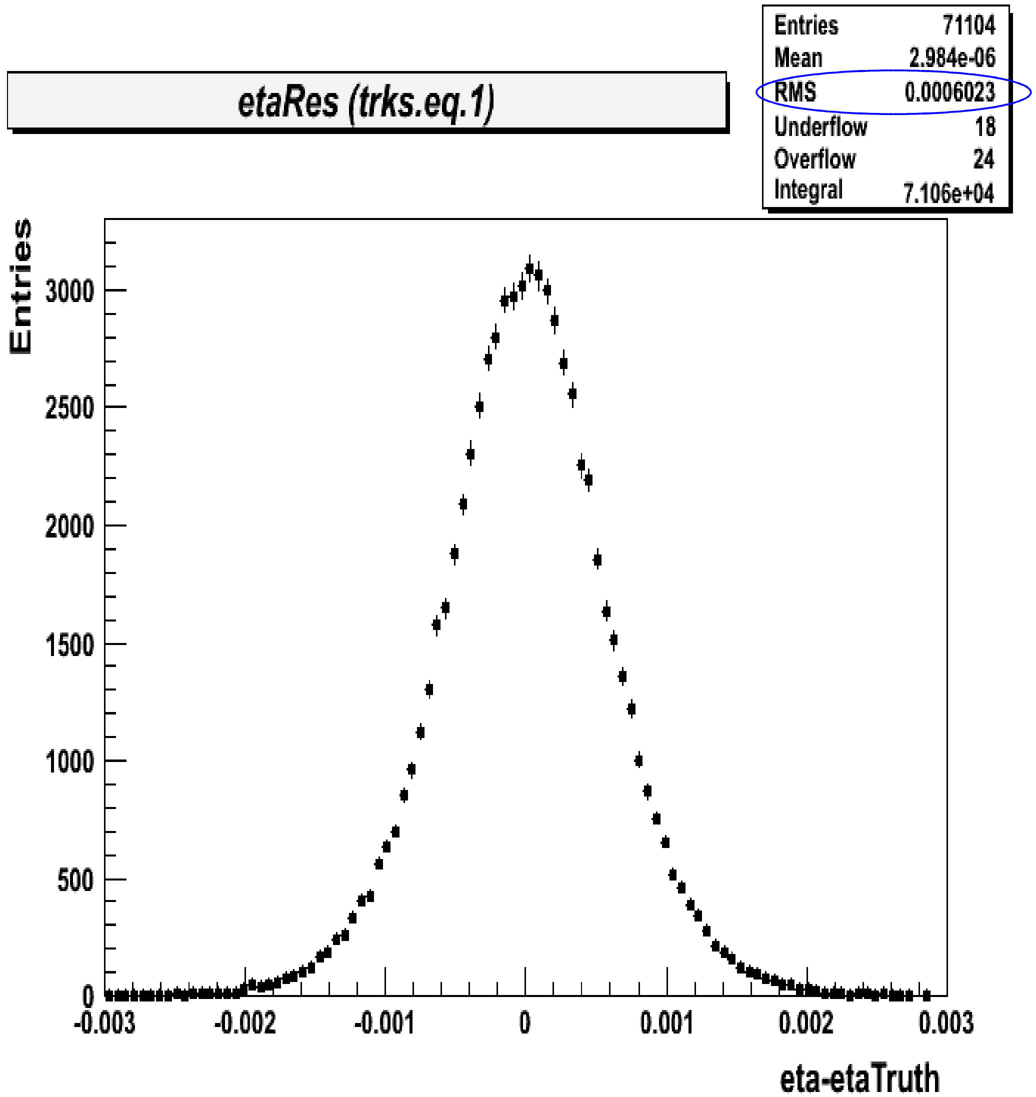
- d0 = distance from the point of closest aproach A to the nominal interaction point P (x=0, y=0)
- z0 = the z value at the point A
- $-\pi < phi < \pi$, $0 < theta < \pi$, $eta = -\ln(\tan(theta/2))$



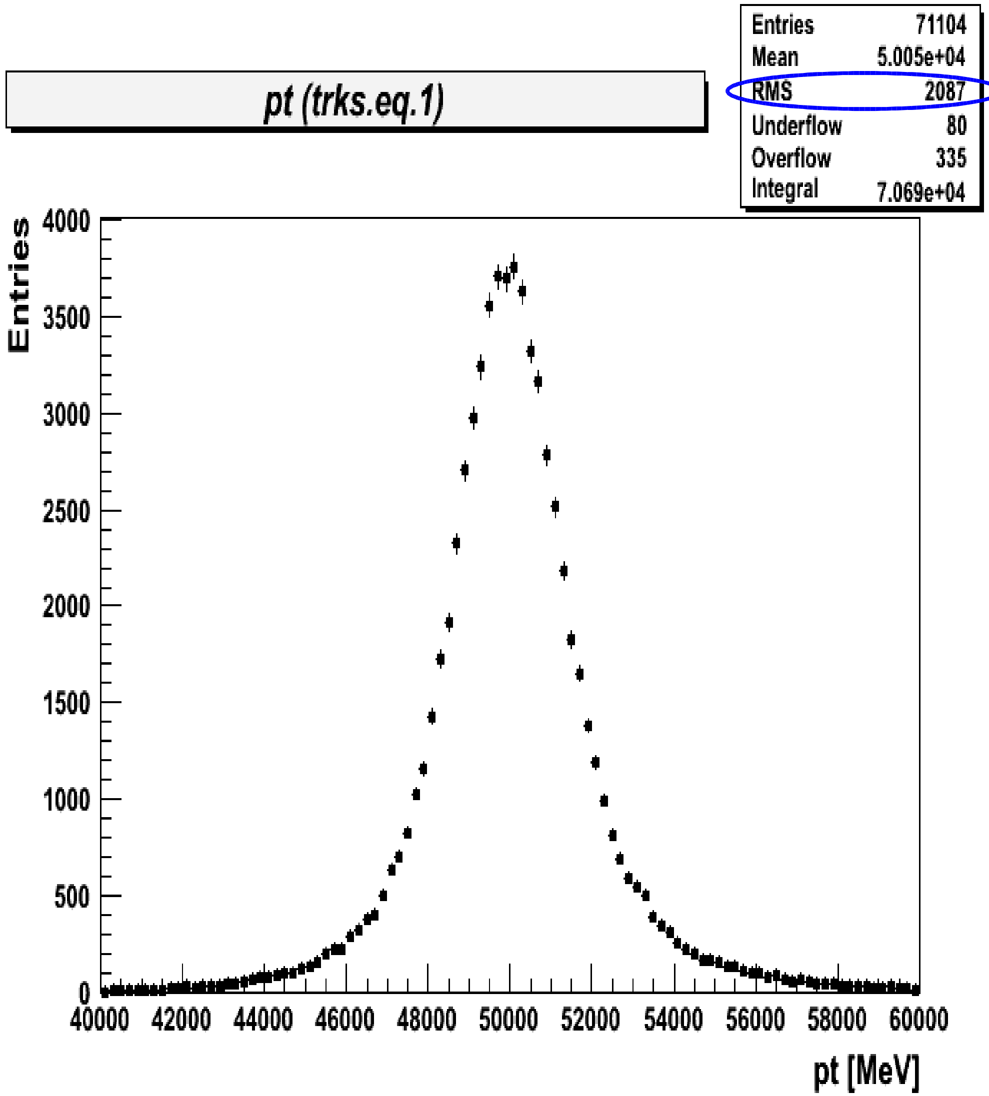
Pseudorapidity

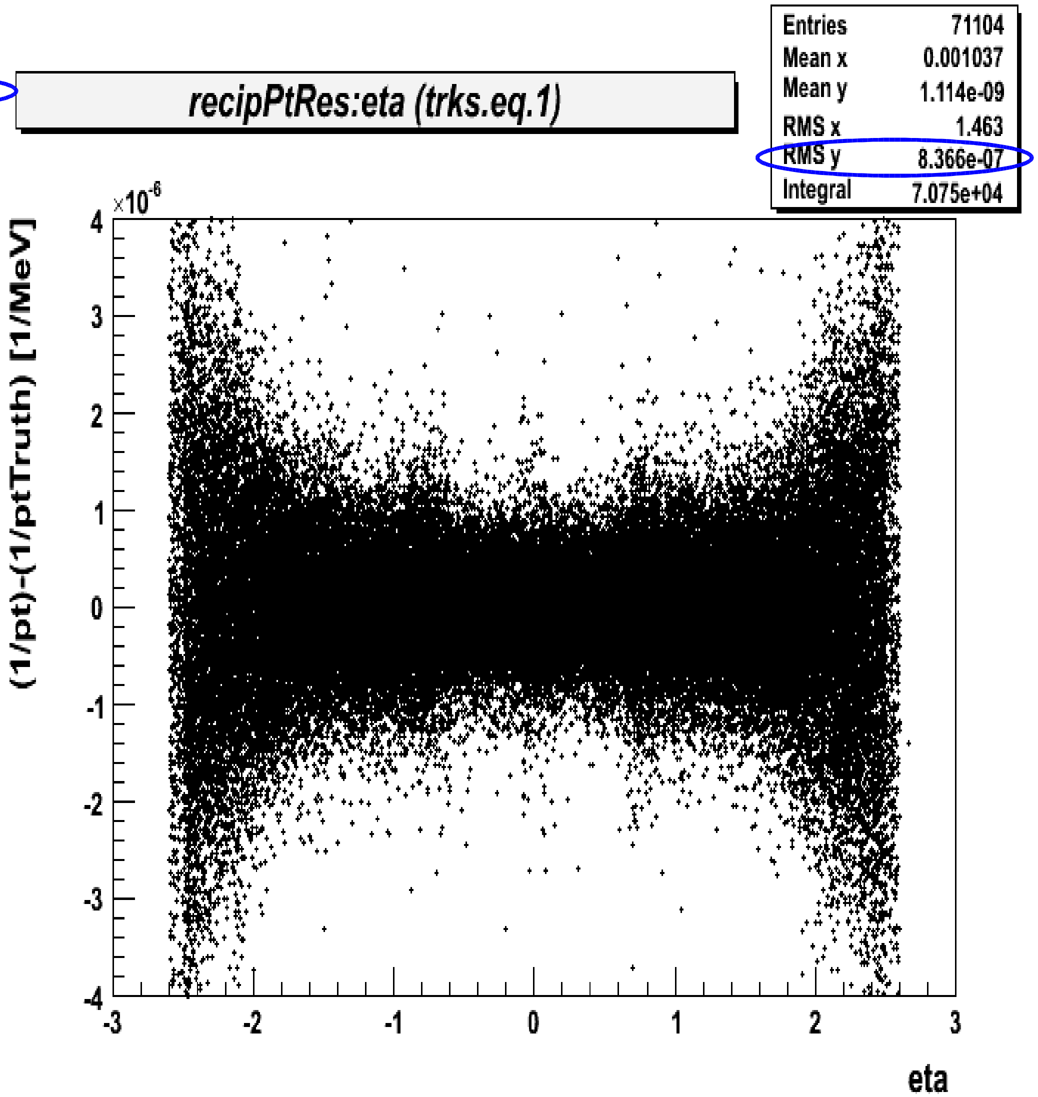
- eta of tracks is well measured
- Residual = reconstructed - truth
- eta resolution = 0.0006





- pT resolution = 2.1 GeV
- 1/pT resolution = 0.84 1/TeV





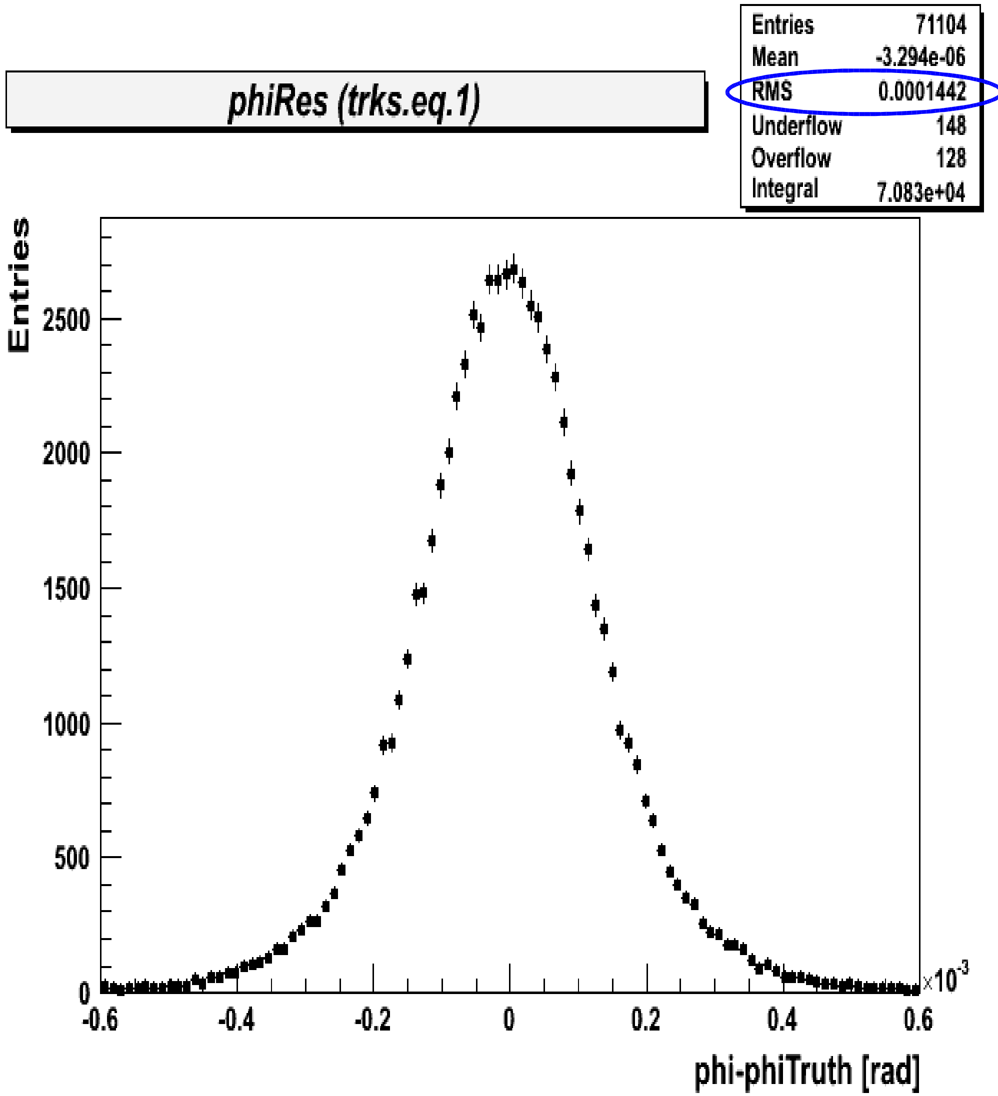
We lose pT resolution at high eta

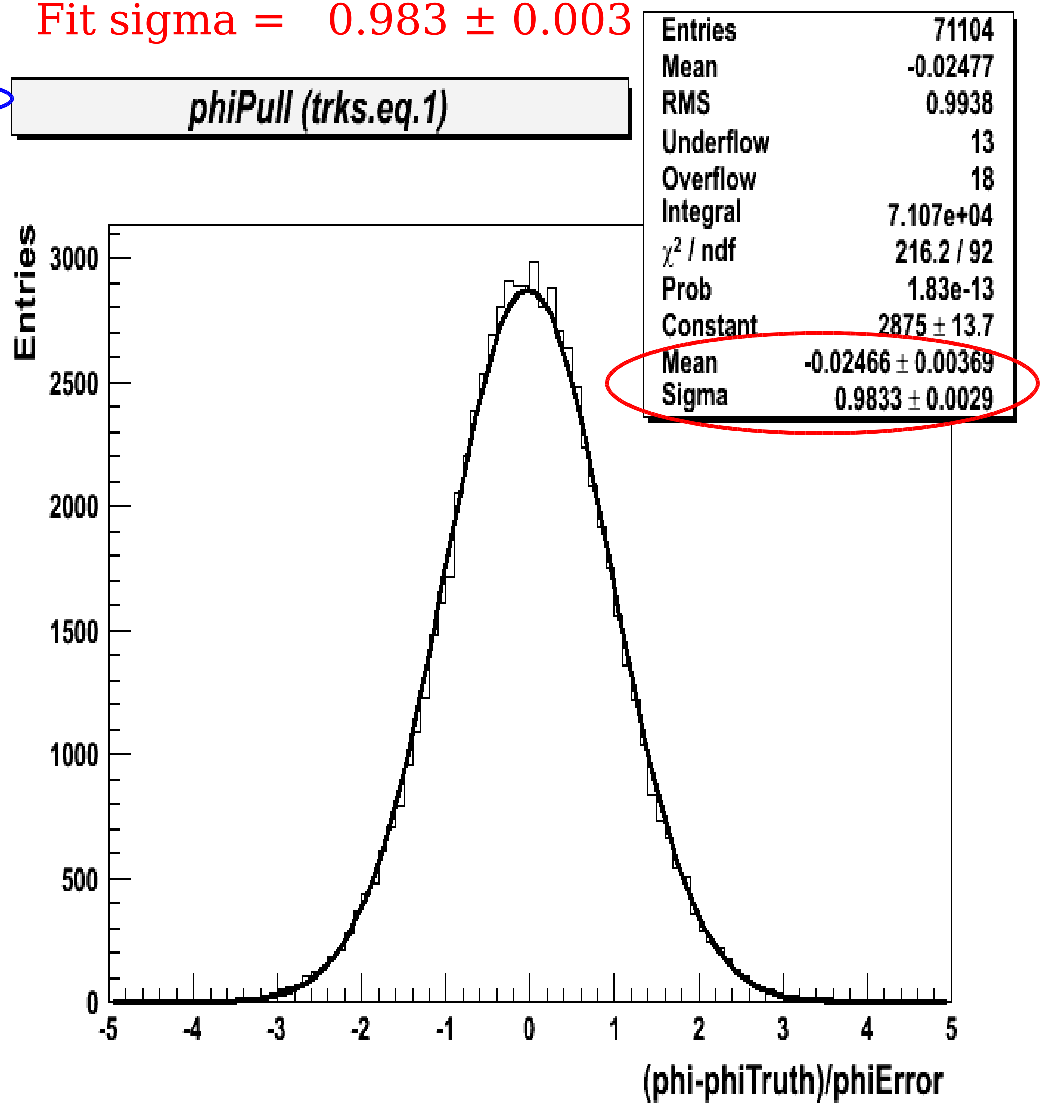
- phi resolution = 0.14 mrad

- Pull = (reconstructed – truth) / error

  Fit mean = - 0.025 ± 0.004

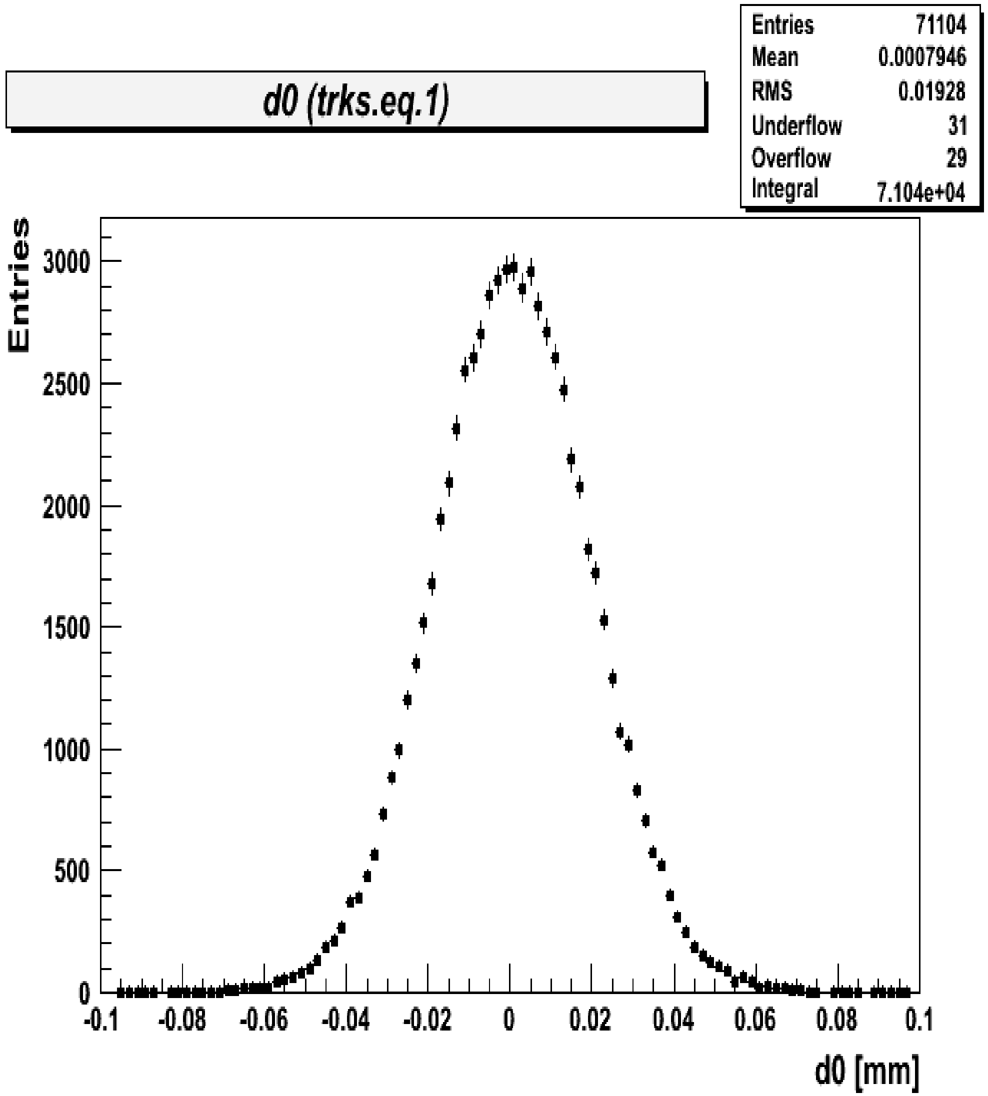
  Fit sigma = 0.983 ± 0.003

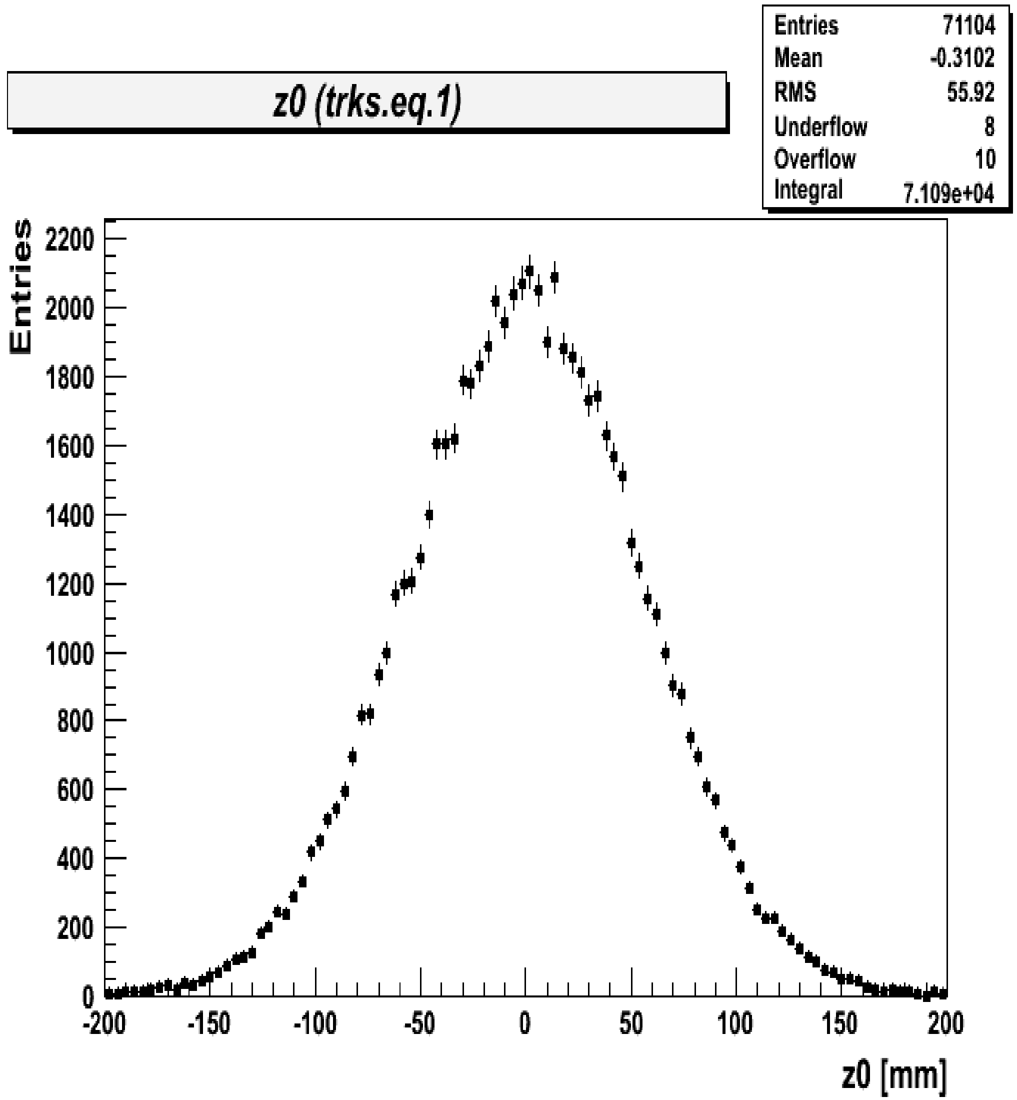




error of phi is correct !

Impact parameters





CONCLUSION & OUTLOOK

Conclusion & Outlook

- No conclusion on track selection so far
- More quality studies of reconstructed tracks and their impact on track-based alignment procedures are needed
  - Impact parameter resolutions, track chi square, etc
- Use of other samples, e.g. pions
- Studies about efficiencies for track finding
- Studies about primary vertex reconstruction
- Finally provide a robust track selection TOOL for alignment algorithms

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- Diploma students: T. Goettfert, M. Kayl