Track Residuals wrt Vertex

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Ideas

- Effects of misalignment are "averaged" over many tracks in a primary vertex and, therefore could be smaller than for a single primary track
- We repeat with CMS data/MC some of tests which were used at ZEUS
- How CMS misalignment becomes visible in the distance of a track wrt vertex was discussed by M.Musich at Tracker Alignment Meeting (19/01/10)

Data samples

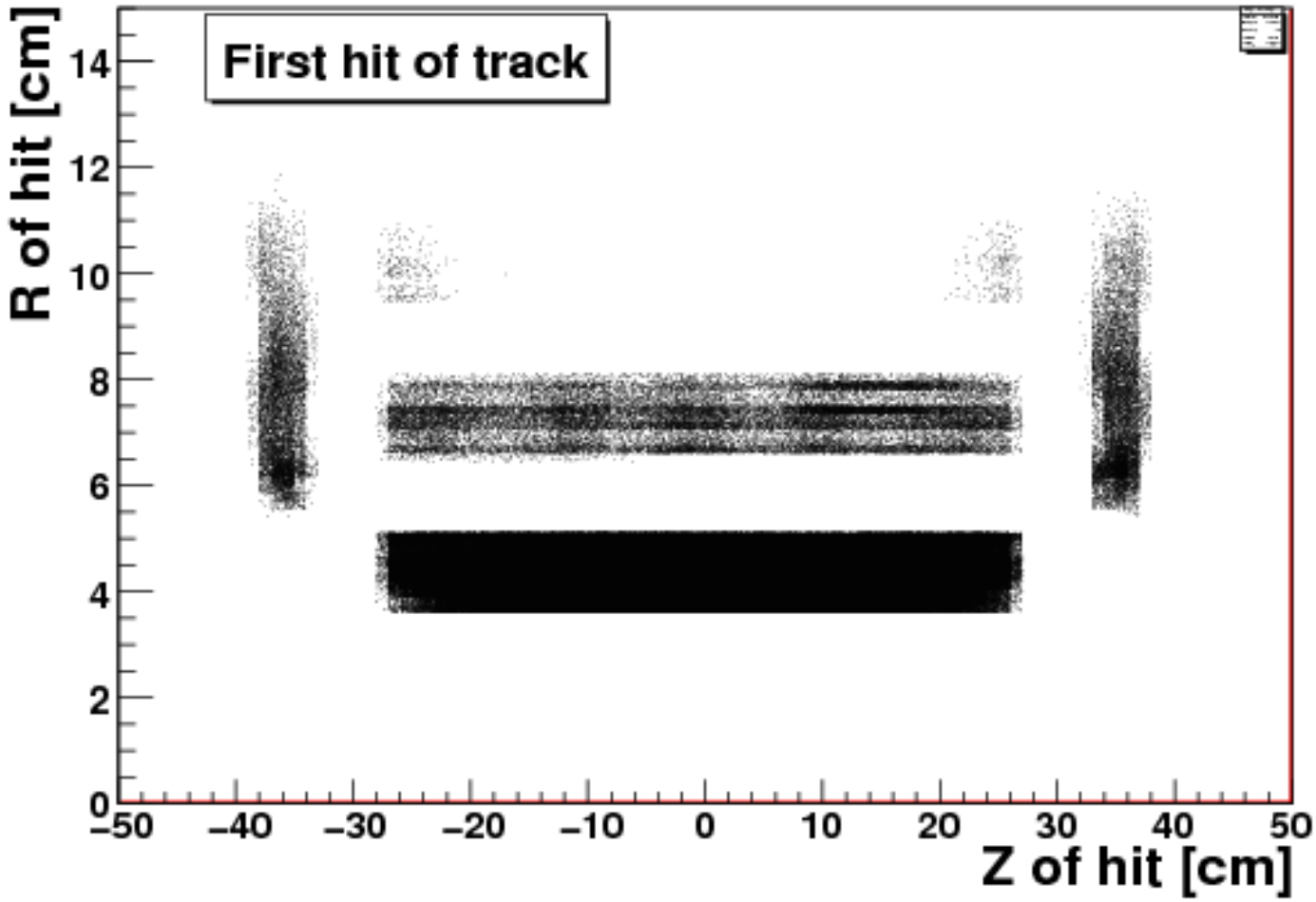
- We made a study for data: /Run2010A/Mu/RECO/Jun14thReReco_v1/, runs 136088, 136100
- And MC: /CMSSW_3_8_0_pre8/RelVal…./GEN-SIM-RECO/MC_38Y_V6-v1/ for the mixture with MinBias, DIS, TTbar
- We used collections: offlinePrimaryVertices and generalTracks

Selection criteria

- We select a primary vertex, loop over primary tracks and evaluate track's parameters wrt the vertex
- Select vertex if number of tracks > 10
- For reference track: p > 1GeV, NDOF > 4
- Results are obtained without vertex refit

Innermost hit of reference track

- 2-D histogram of R vs Z for first hit of selected tracks



Parameters of vertex and track

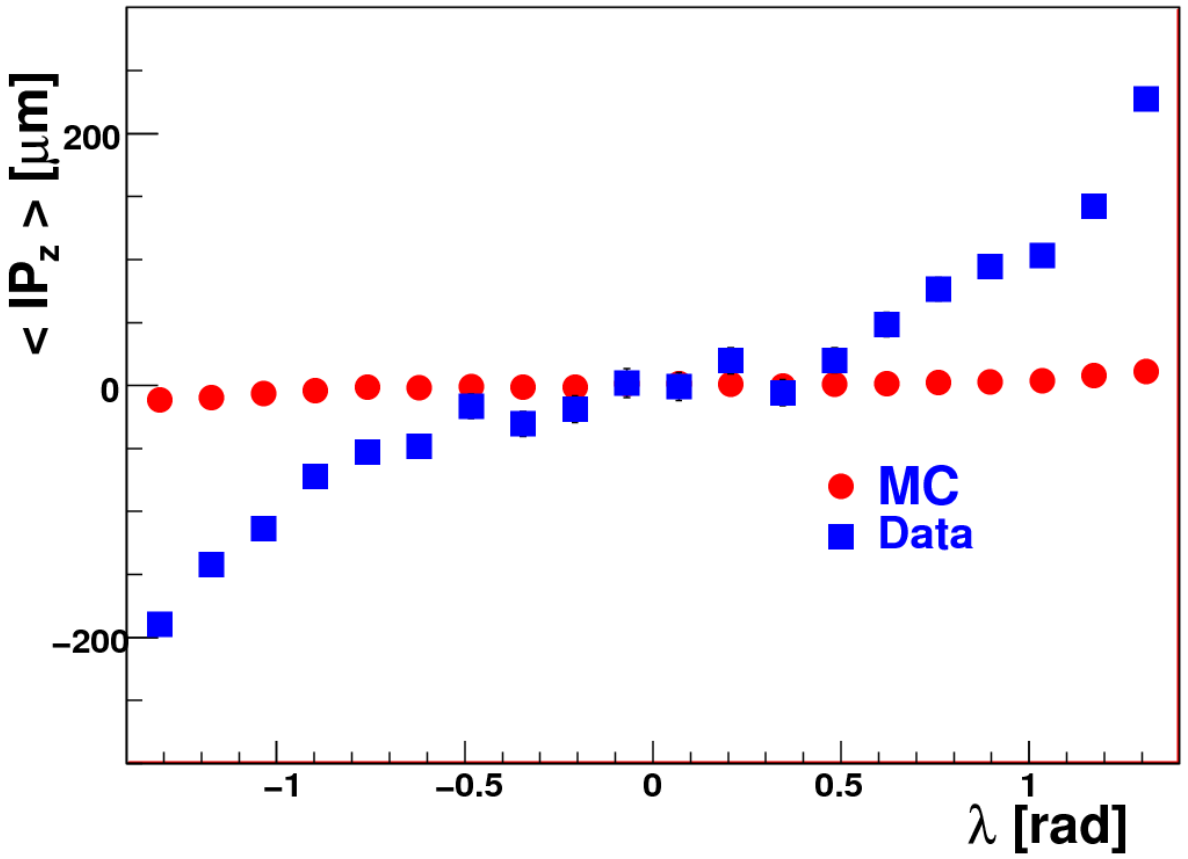
- Coordinate of the vertex V=(Xv, Yy, Zv)
- For the reference track we calculate trajectoryStateClosestToPoint(V)
- Longitudinal Impact Parameter of the latter state we call IPz
- Innermost Measurement State of the reference track we propagate to the surface which is perpendicular to Z-axis and includes the point V
- Propagated track coordinates are (Xtr, Ytr, Zv)

What we study

- We study average values of track residuals wrt vertex: <IPz>, <Xtr-Xv>, <Ytr-Yv>
- We use TProfile to show how the latter values depends on track angles λ $(\pi/2-\theta)$ and ϕ
- I.e. no additional selections or fittings of distributions

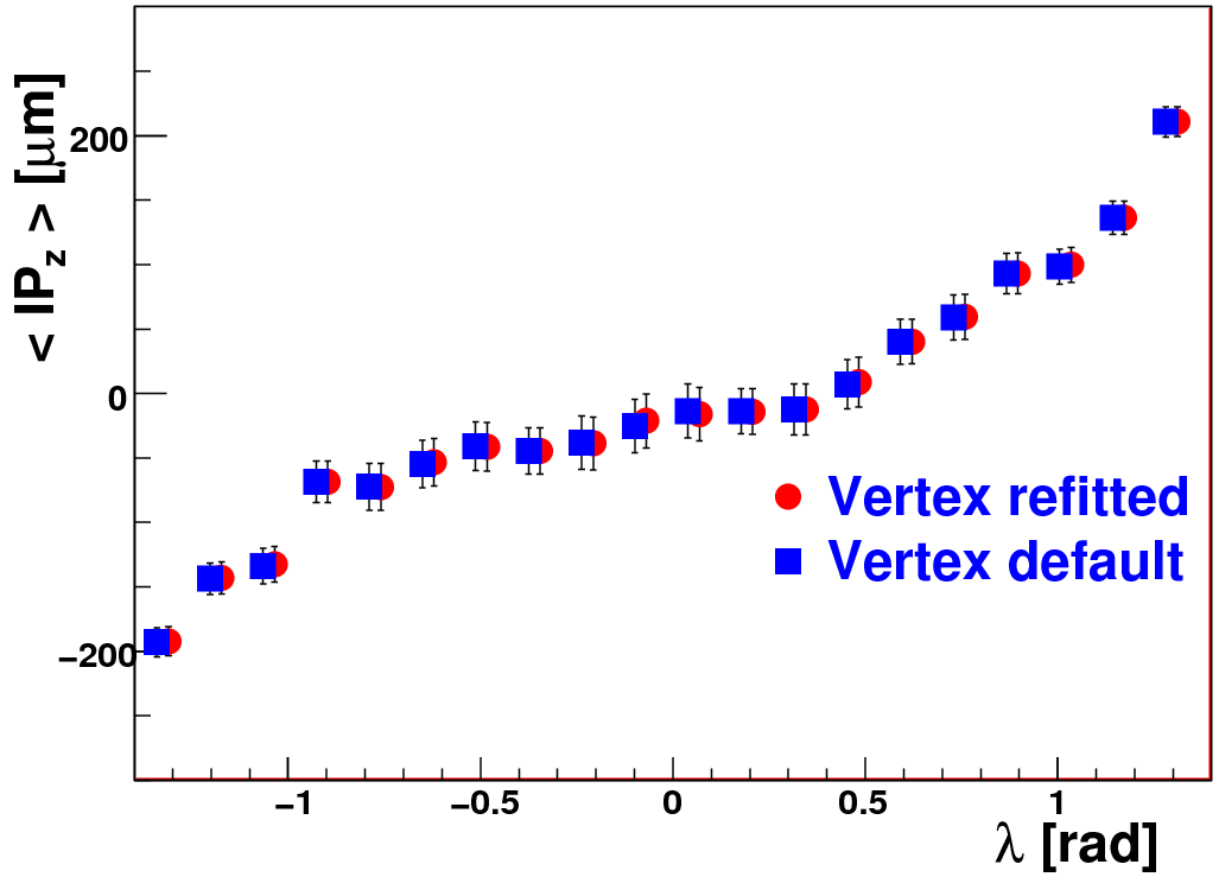
<IPz> vs λ for data and MC

- Longitudinal impact parameter is biased for forward/backward tracks for data



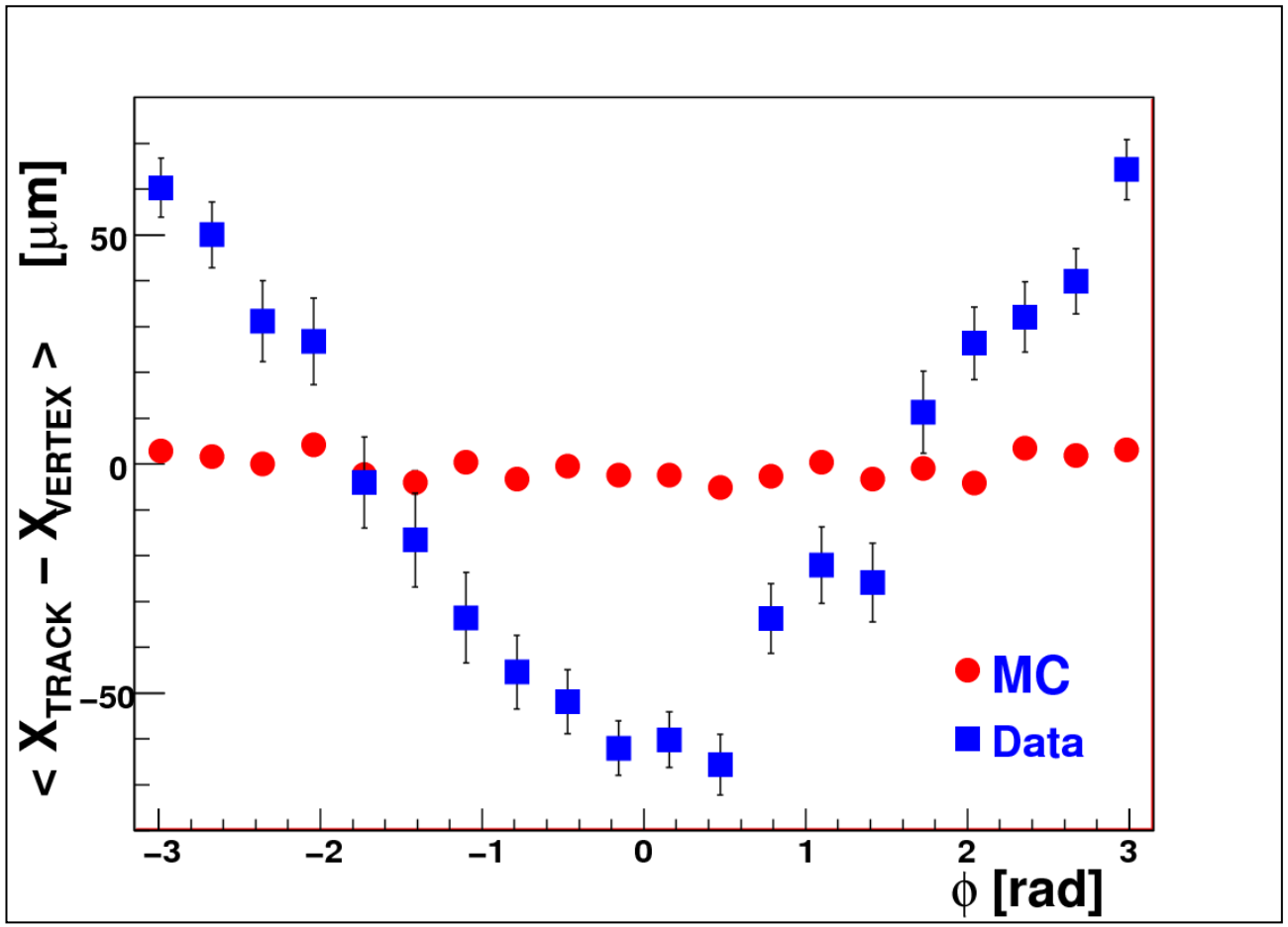
<IPz> vs λ with vertex refit

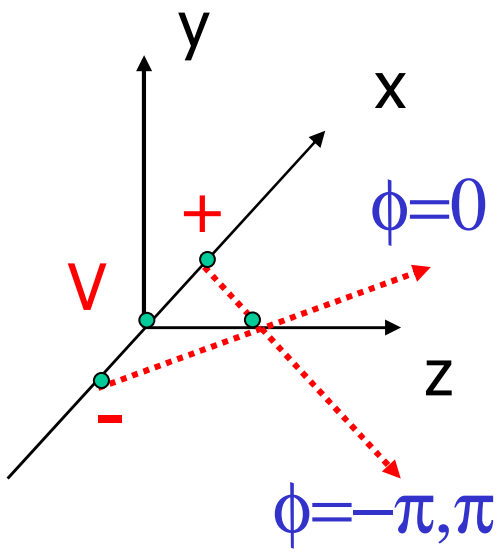
- Unbiased refit of vertex (without reference track) shows almost no difference



<Xtr - Xv> vs ϕ for forward tracks

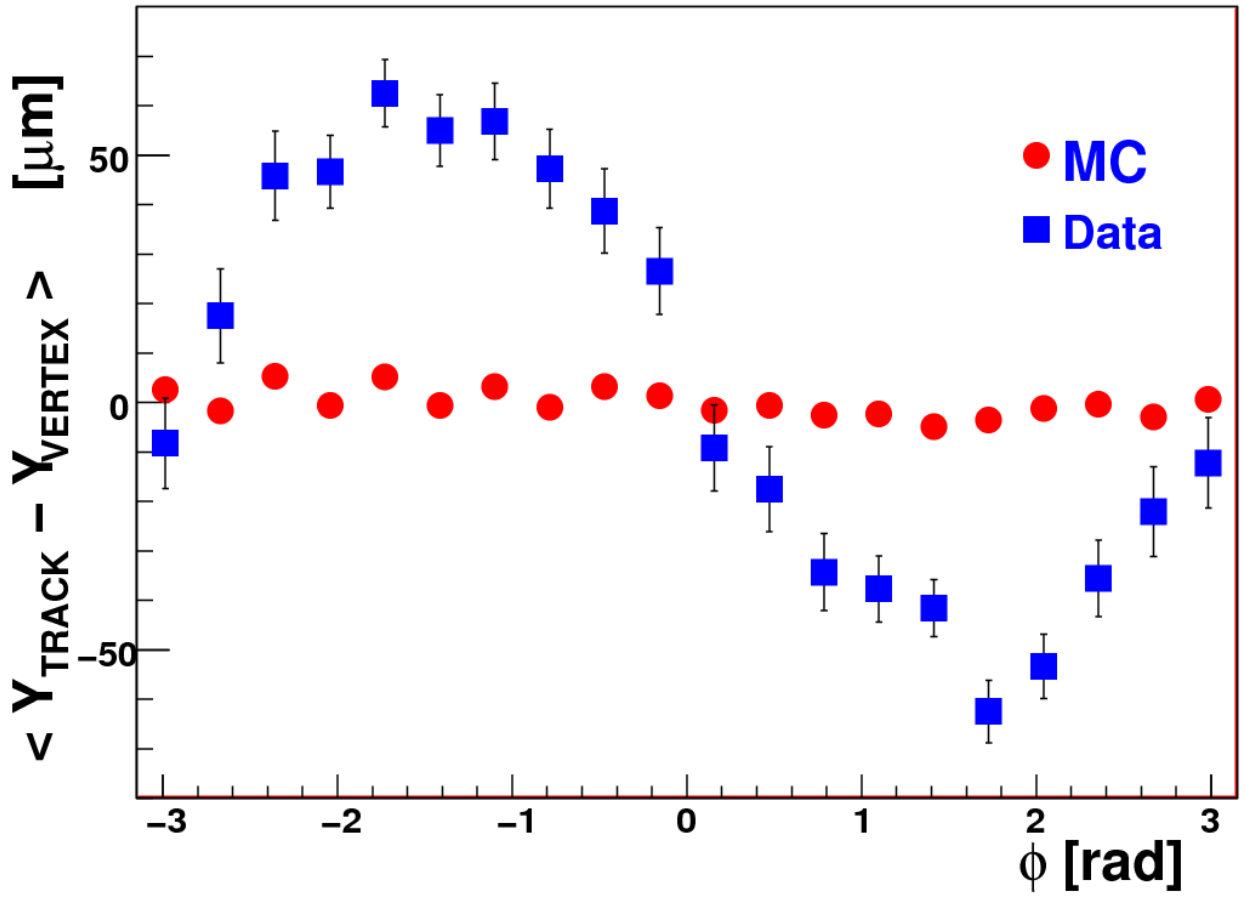
- Xtr-Xv are biased for forward tracks (λ>0.8) for data





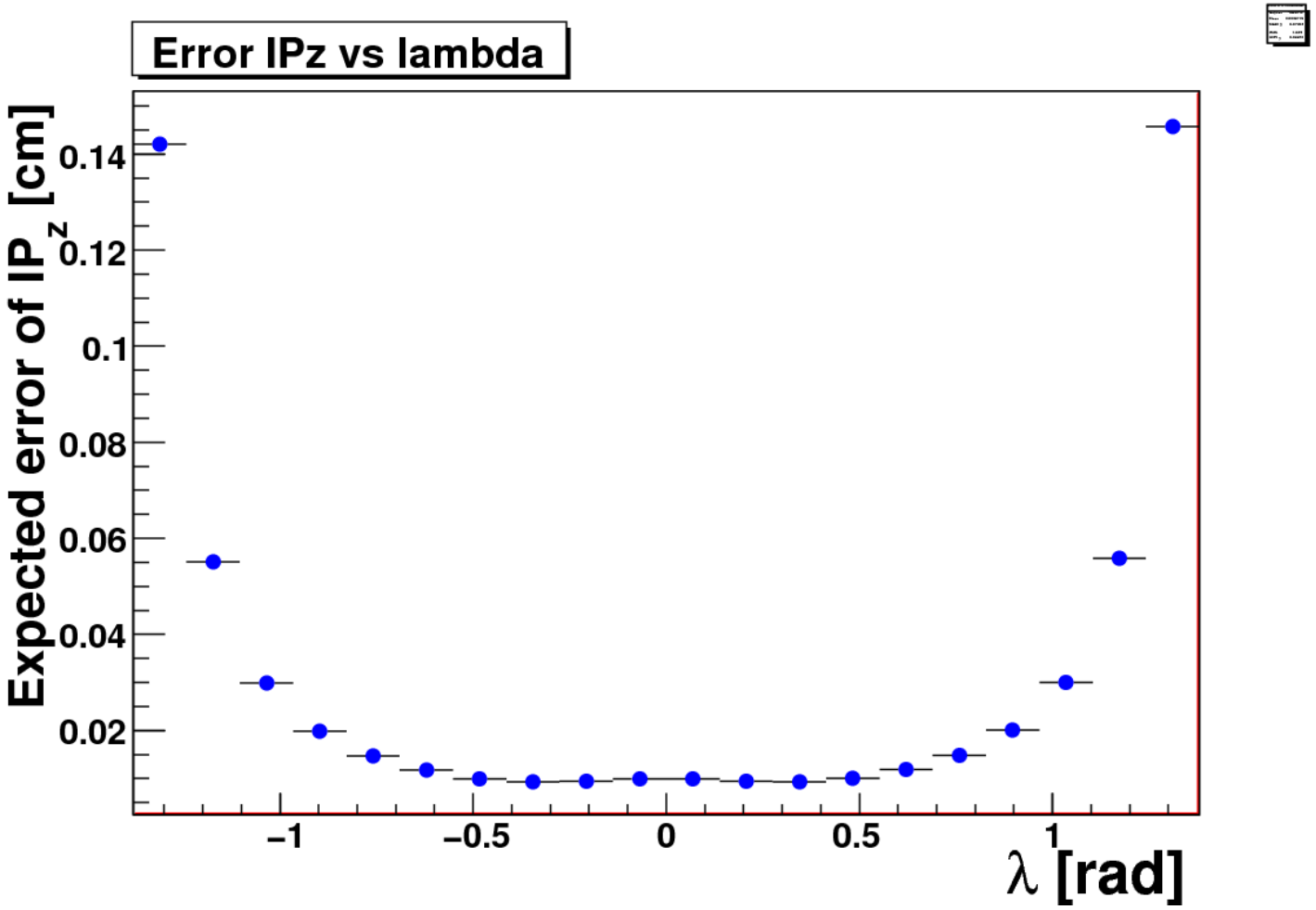
<Ytr - Yv> vs ϕ for forward tracks

- Ytr-Yv are biased also for forward tracks (λ>0.8) for data



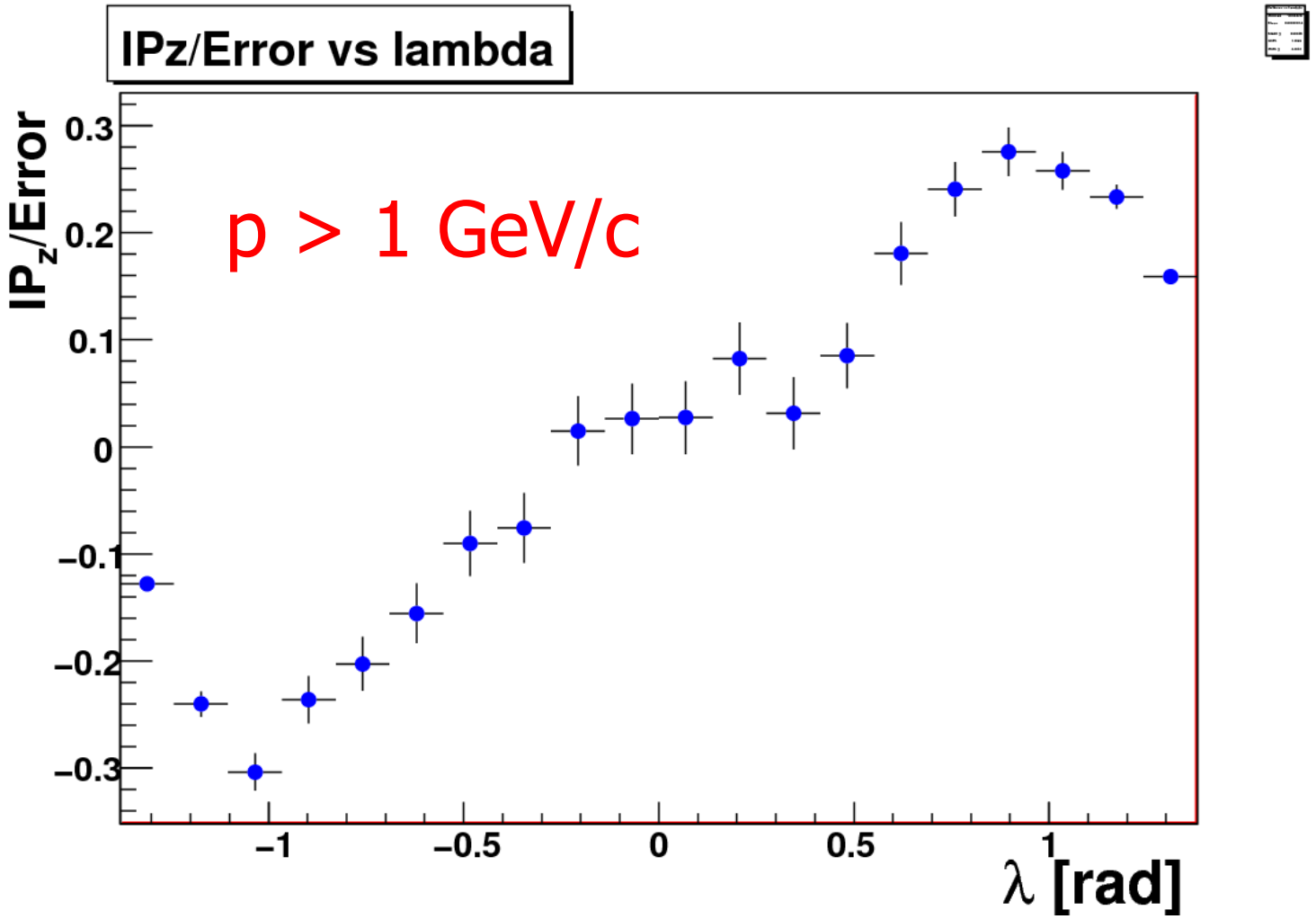
Expected error of IPz vs λ for data

- Expected error of the longitudinal impact parameter increases for forward/backward tracks



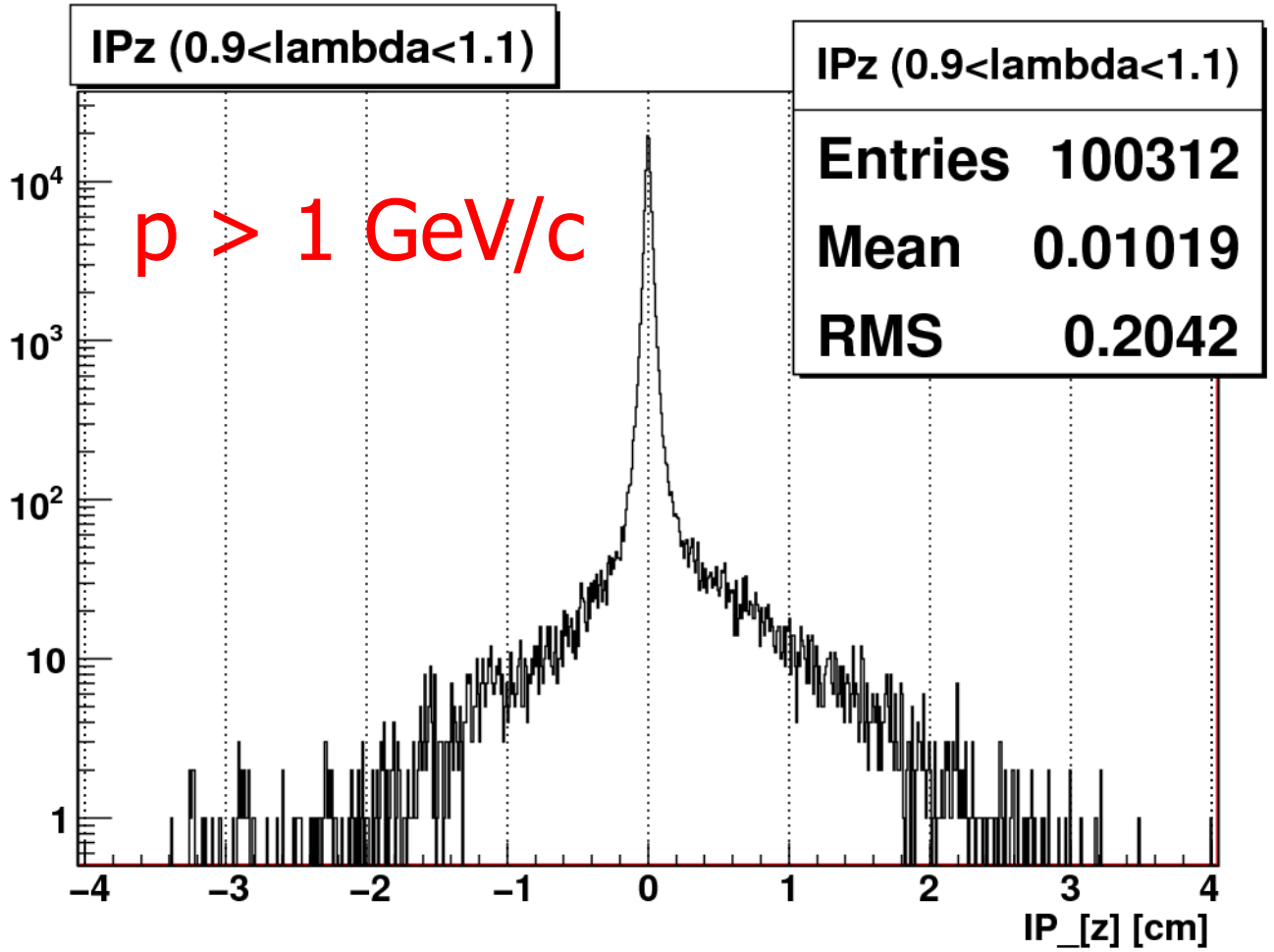
<IPz/error> vs λ for data

- Maximal bias of <IPz> is about 0.3 of expected error



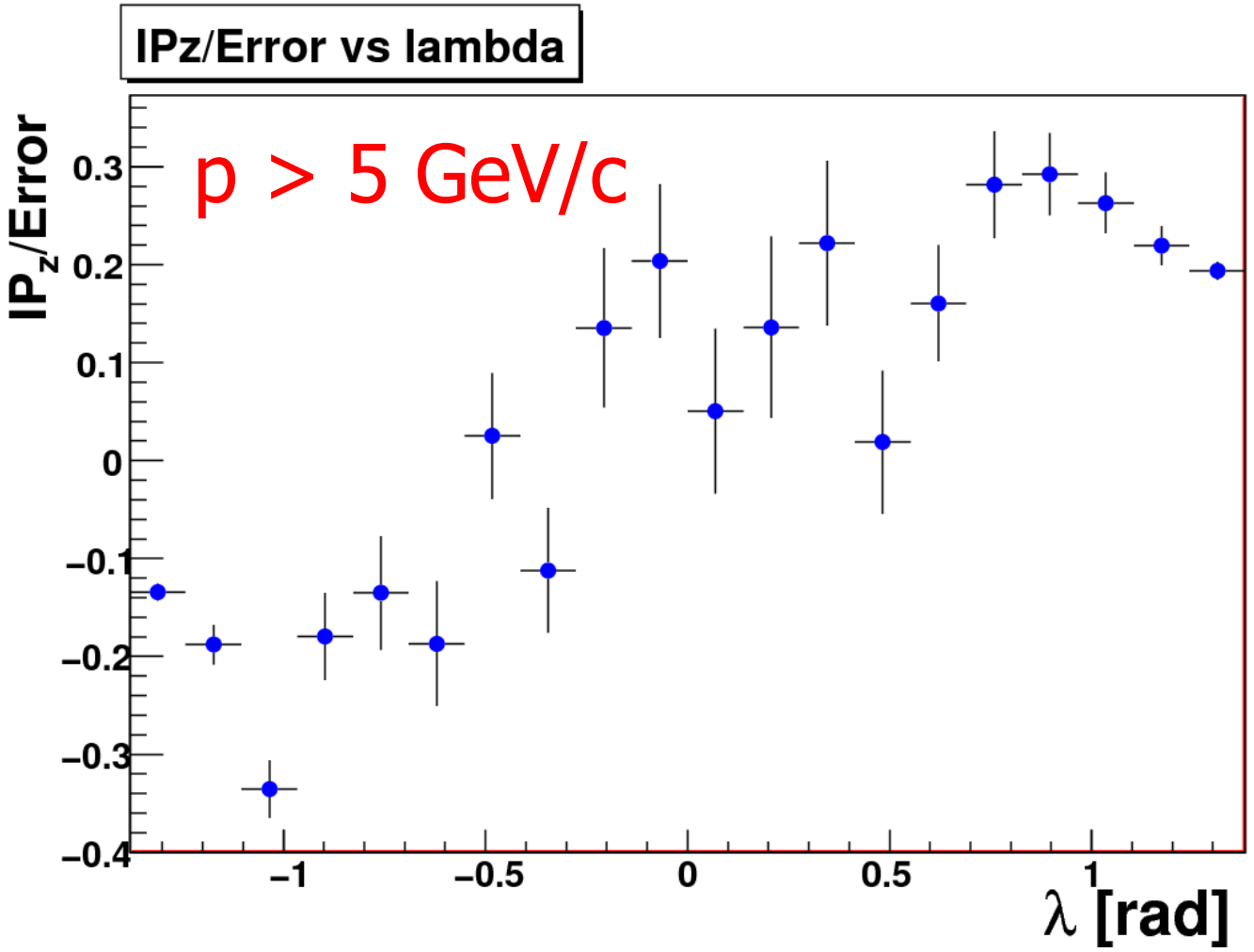
IPz for forward tracks $(0.9<\lambda<1.1)$ for data

- Distribution includes tails



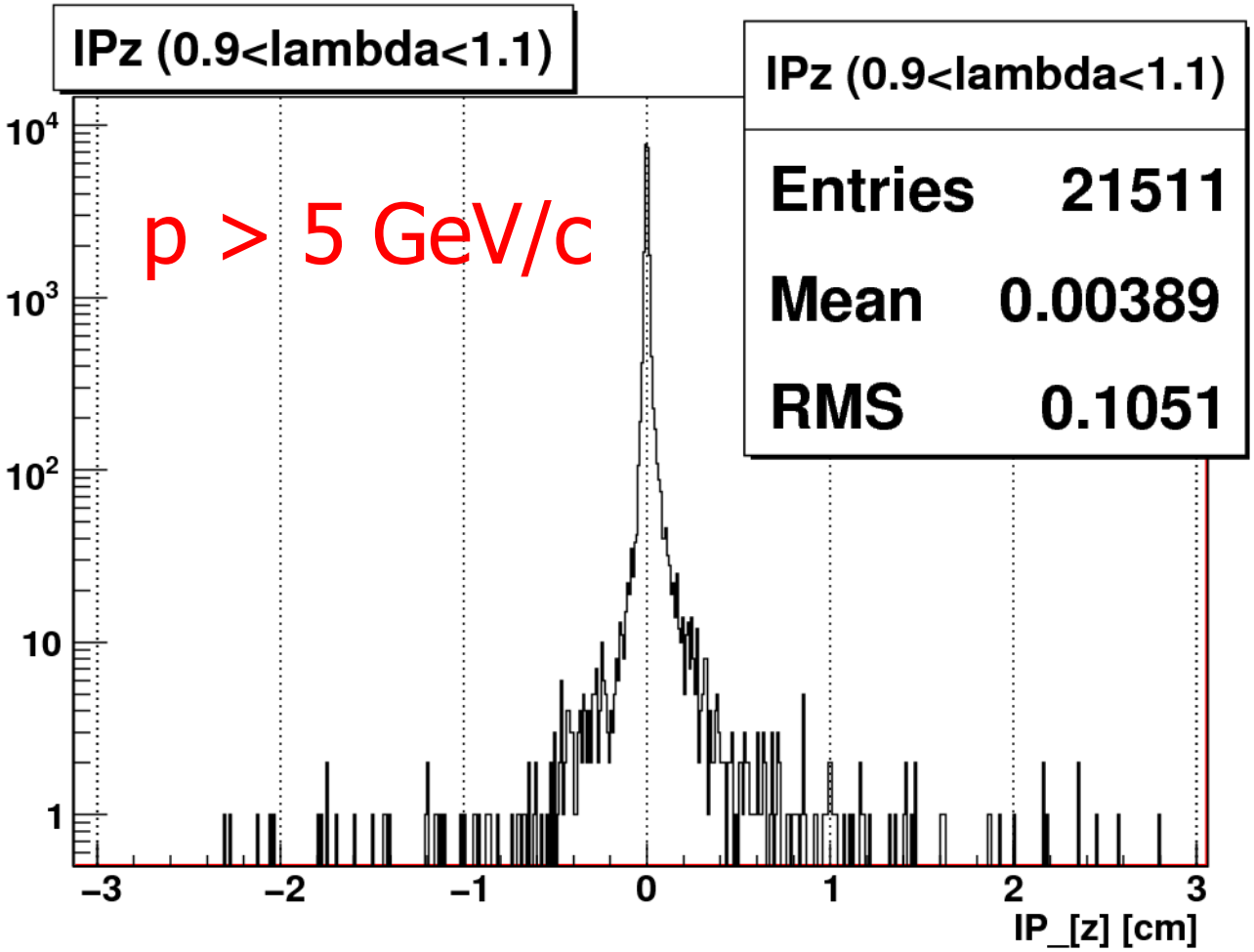
<IPz/error> vs λ for data (p > 5GeV/c)

- Maximal bias of <IPz> is also about 0.3 of expected error



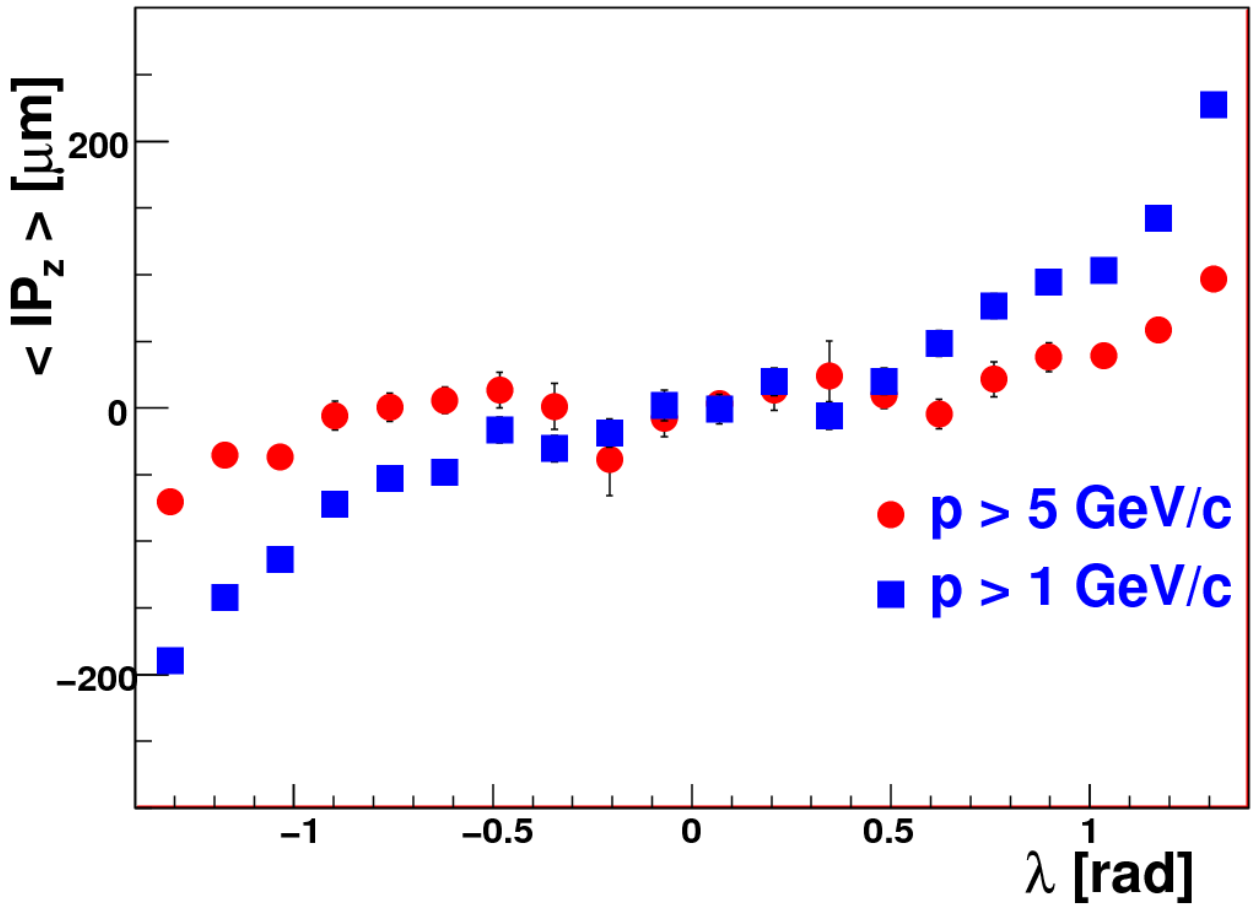
IPz for forward tracks $(0.9<\lambda<1.1)$ p > 5GeV/c

- Both bias and RMS are smaller for higher momentum



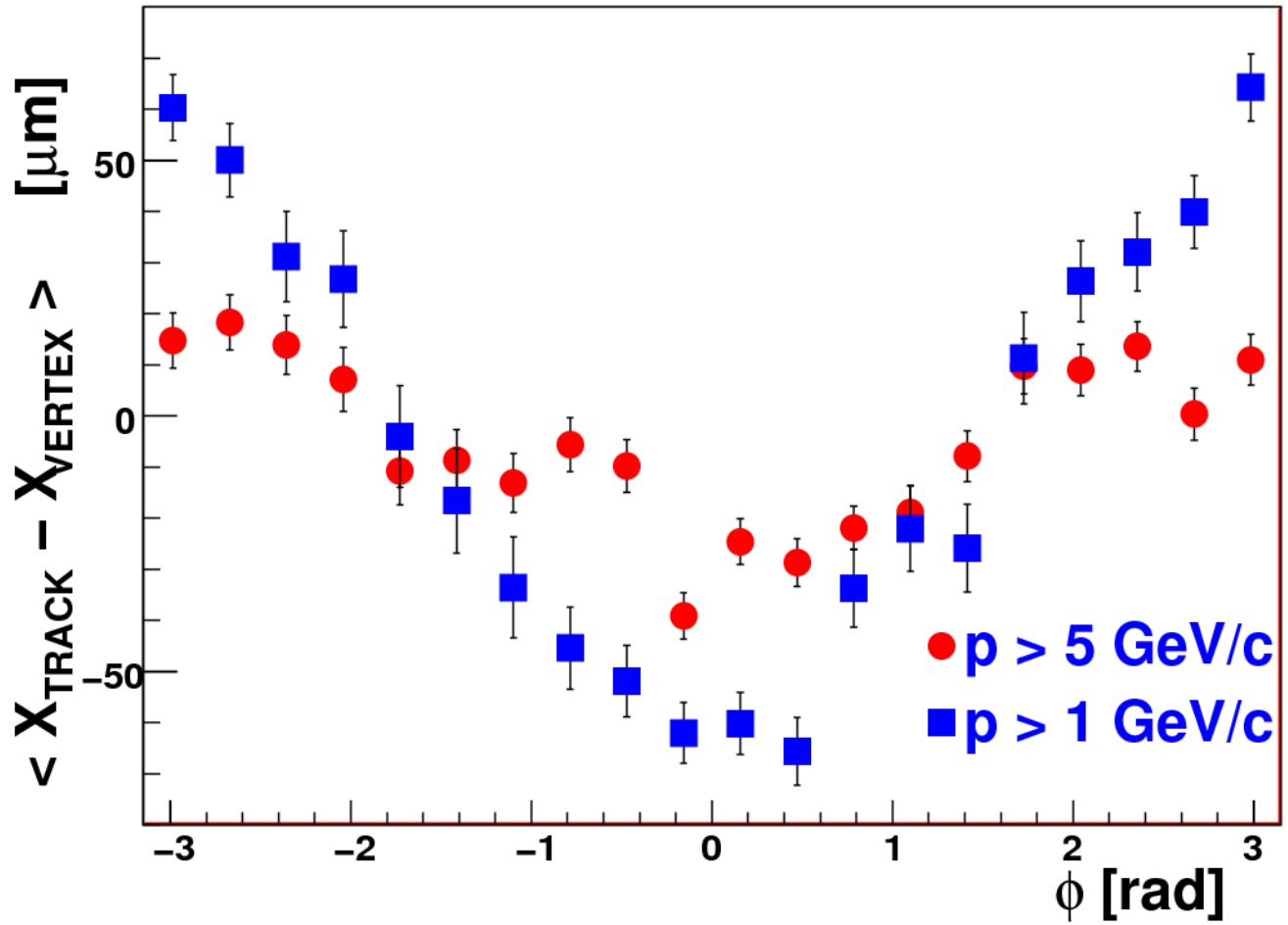
<IPz> vs λ for data for p > 1 or 5 GeV/c

- Bias is smaller for higher momentum cut



<Xtr - Xv> vs ϕ for forward (λ>0.8)

- Bias of Xtr-Xv is also smaller for higher momentum cut



S U M M A R Y

- Tracks residuals wrt vertices show bias
- The latter bias could be an indicator of misalignment
- Residuals of IPz can be included in the objective function for Millepede
- The implementation of residuals Xtr-Xv and Ytr-Xv is also possible for Millepede, but we have to compare it with the usage of track impact parameter wrt beam line (vertex errors and beam width)

Backup Slides

- no slides more