An approach to the global muon-tracker alignment

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Tracker Alignment Meeting
DESY
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A model

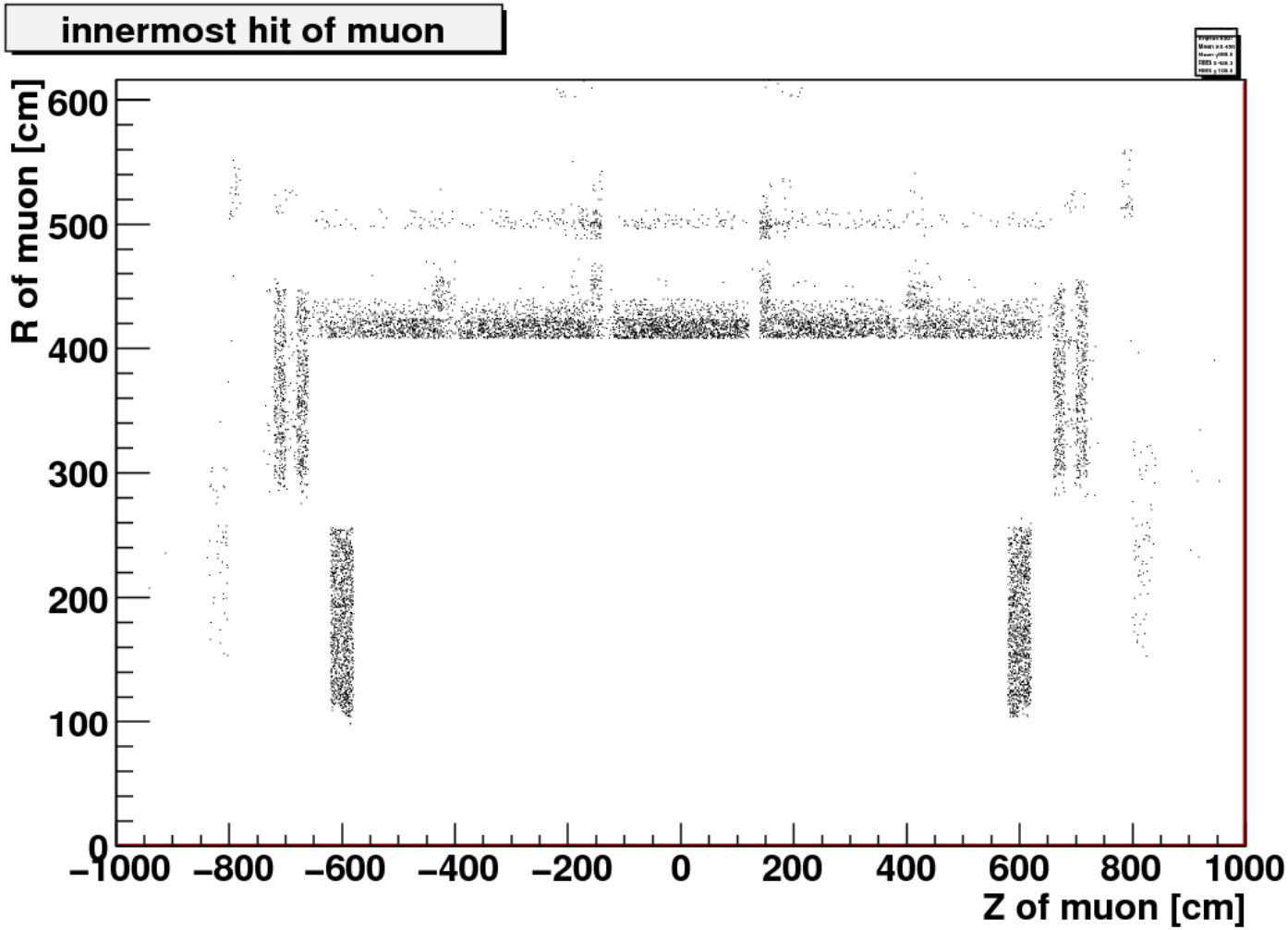
- Inner tracker and muon detector are aligned in two independent Cartesian coordinate systems
- Standalone muon and tracker segments of global muons give as a possibility to validate relative alignment of the systems
- Minimal residuals for muon-tracker we can obtain by a propagation of the tracker segment to innermost hit of the muon segment.

Study with MC

- We made a study for mc/Summer09/InclusiveMu15/ALCARECO/MC_31X_V3_StreamMuAlCalIsolatedMu-v2/0005
- Events with one global muon were selected
- Stepping Helix Propagator was used to propagate TSOS of outermost tracker hit to innermost muon hit
- TSOS's of standalone muon and propagated track include vectors of Cartesian coordainates, momentum Rm, Pm and Rt, Pt, respectively
- Covariance matrices are available also

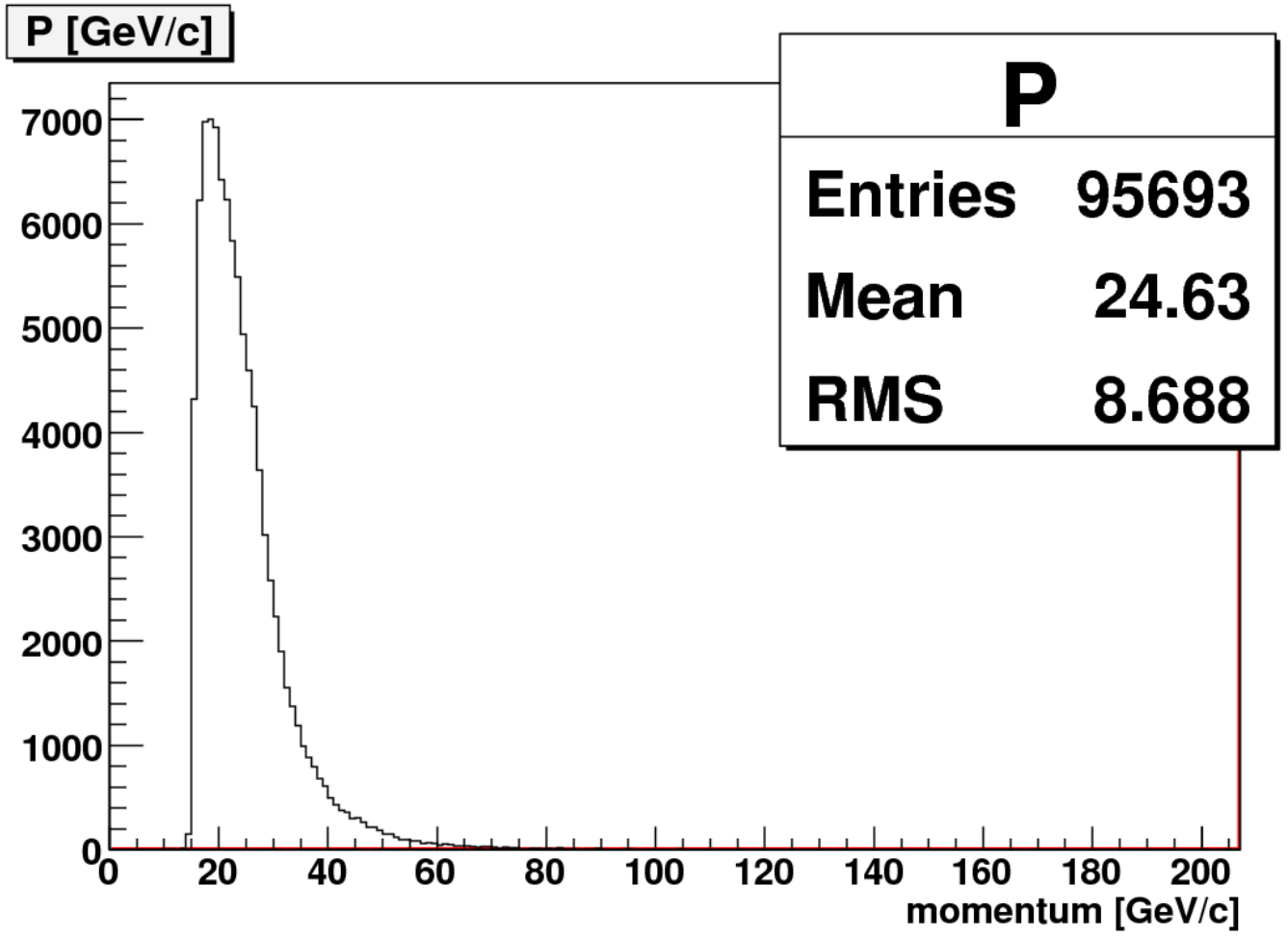
Innermost hit of muon segment

- We select 1st cylinder/plane , i.e. MB1/ME1



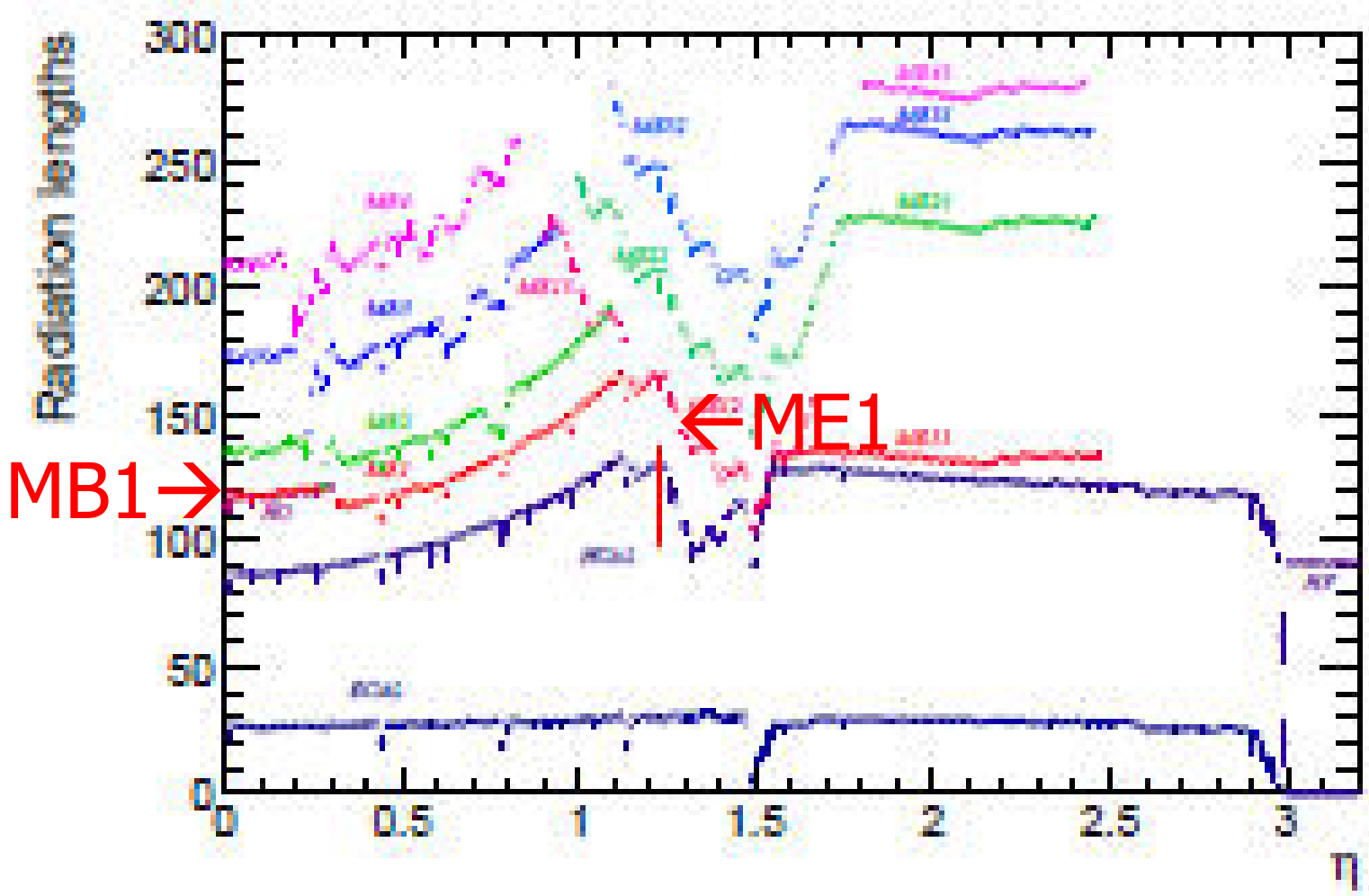
Momentum in barrel

- Average momentum is about 24.6 GeV/c



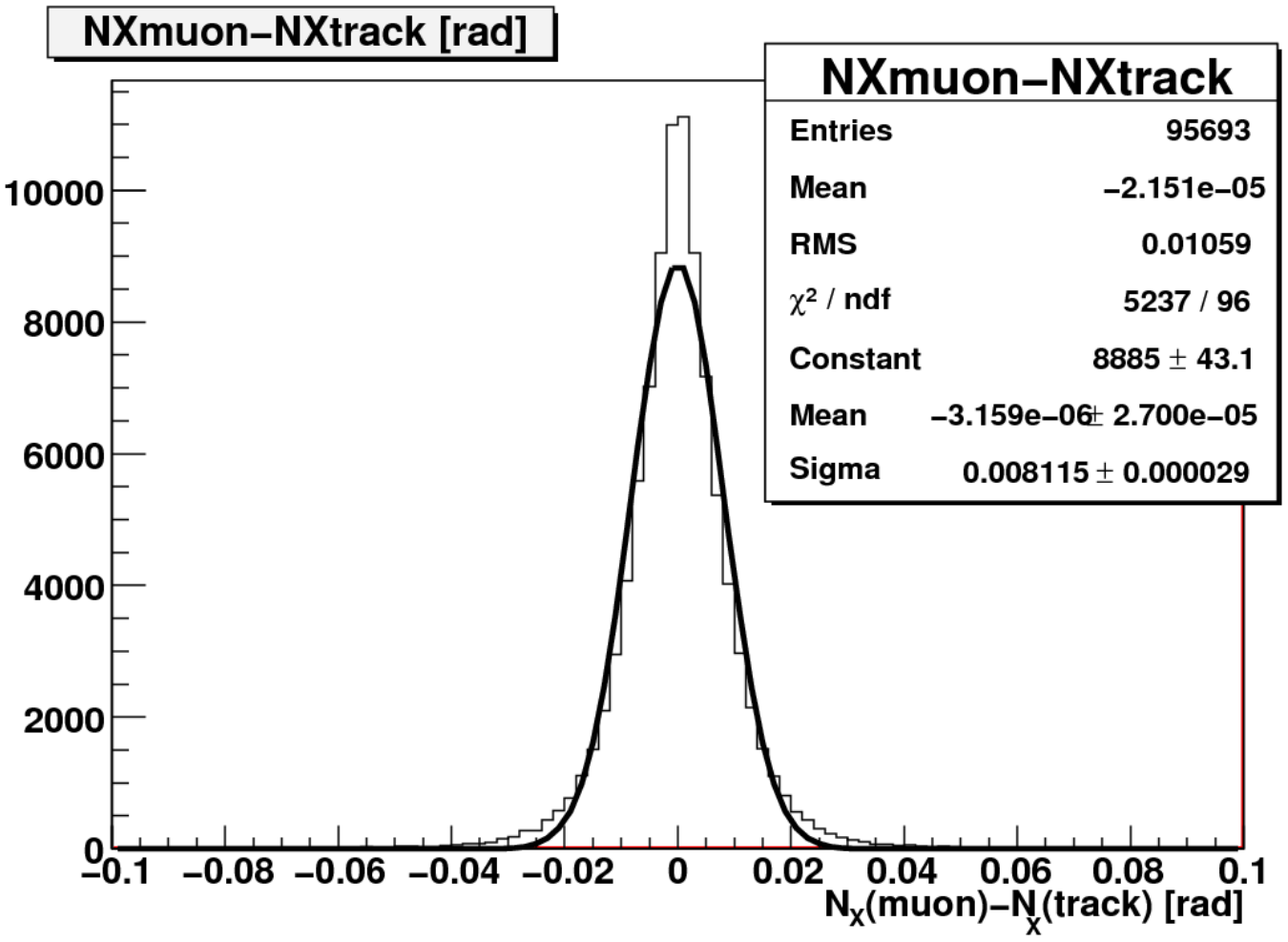
Material thickness in radiation lengths

- Multiple scattering contributes a lot in error



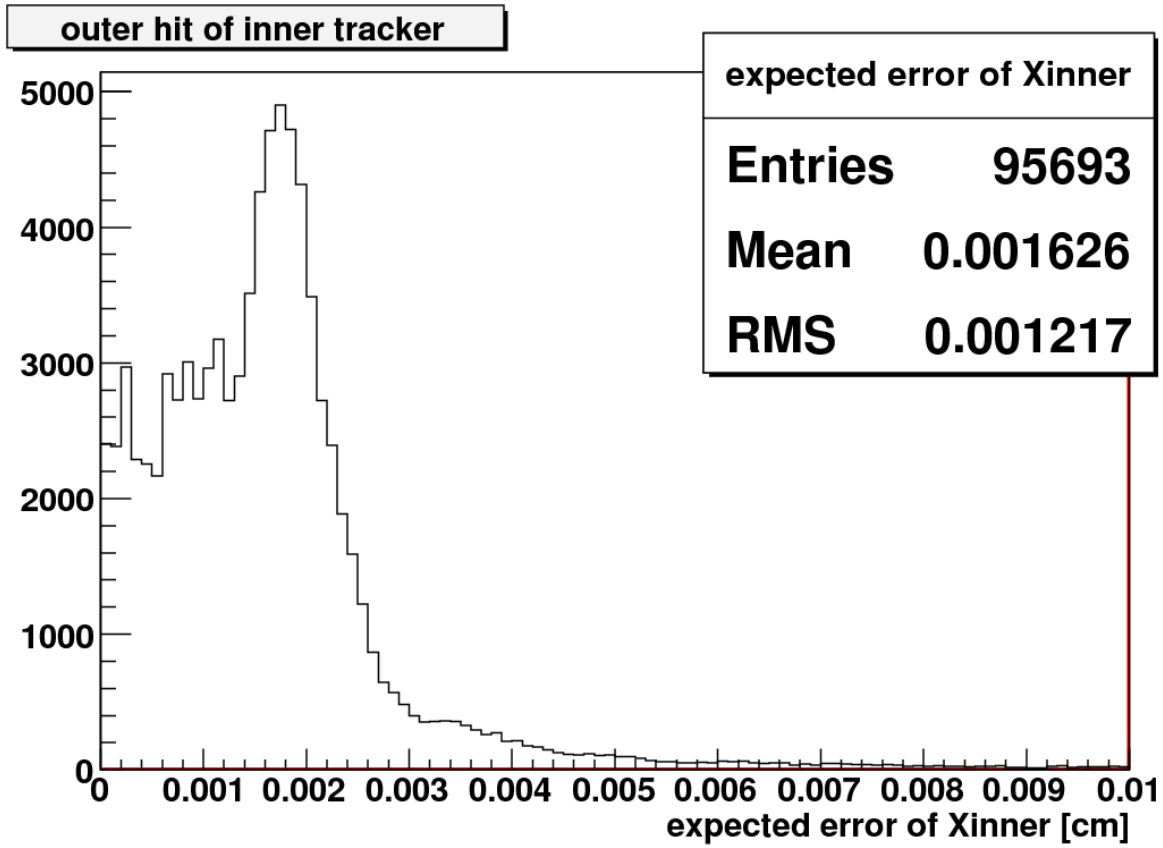
Angular residuals for muon-tracker in barrel

- Standard deviation for angle is about 8mrad



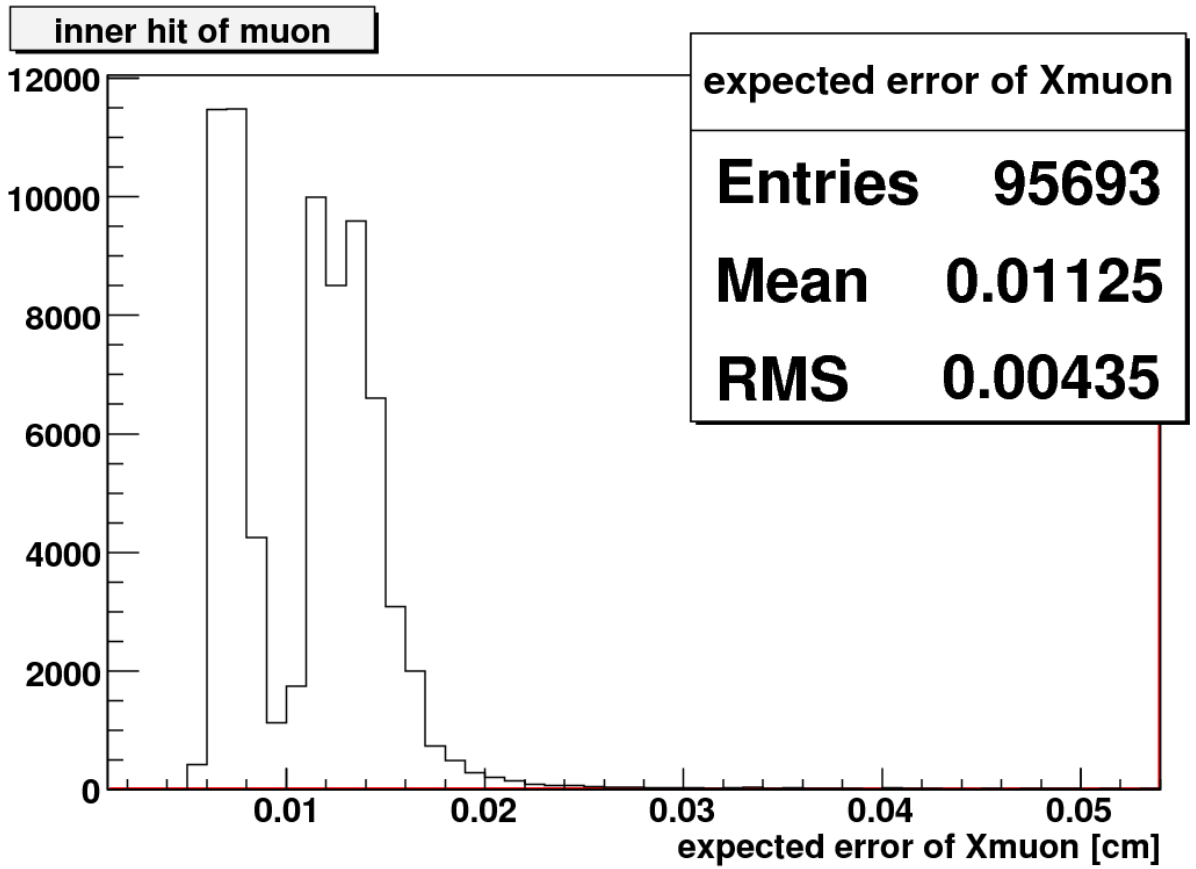
Expected error of X in inner tracker in barrel

- Expected error is about 16μm



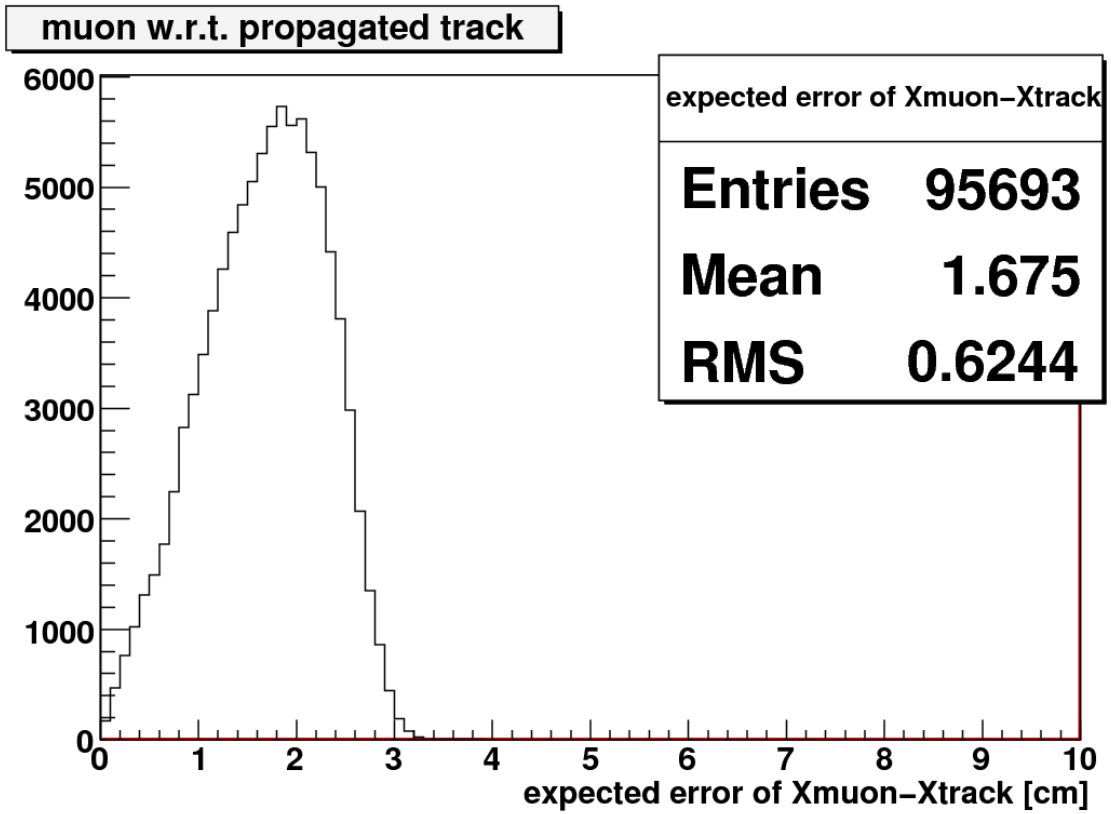
Expected error of X in muon detector in barrel

- Expected error is about 112μm



Expected error of X for propagated track

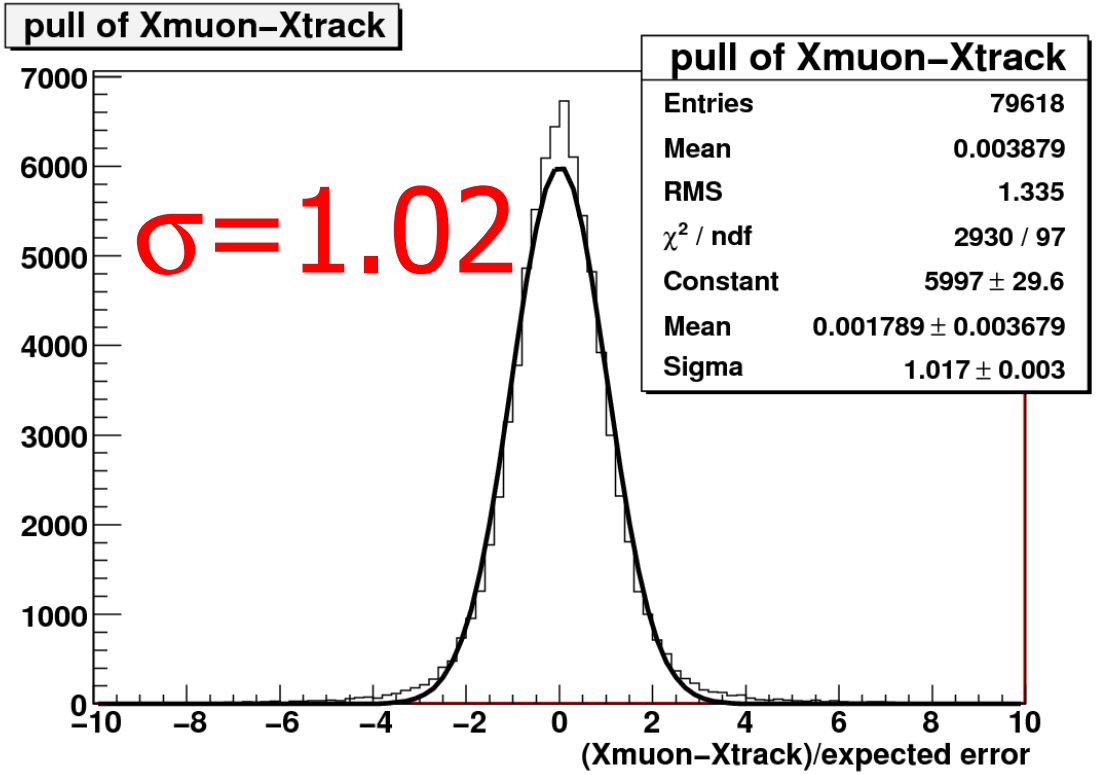
- Expected error is about 1.68cm



Parameter pulls for propagated track in barrel

- σ of pulls for parameters

X,	Y ,	Z,	Px,	Py,	Pz:
1.0	1.0	1.6	1.5	1.5	1.5



Search for the muon-tracker alignment

- Let's expect that muon cartesian system is shifted by a vector, $d = (d_x, d_y, d_z)$
- To obtain unbiased vector of track coordinates, Rt(d), we have to propagate track in addition to the shifted tangent plane of innermost muon hit
- An objective function for d is a sum over tracks:

  $1/2 \ \Sigma \ (Rm - Rt(d))\ W\ (Rm - Rt(d))^T \rightarrow \min$
- We use diagonal elements of the weight matrix, W
- For 200k of events in barrel we obtain for d=0: -105+/-55, -107+/-55, -60+/-51 μm , i,.e. unbiased

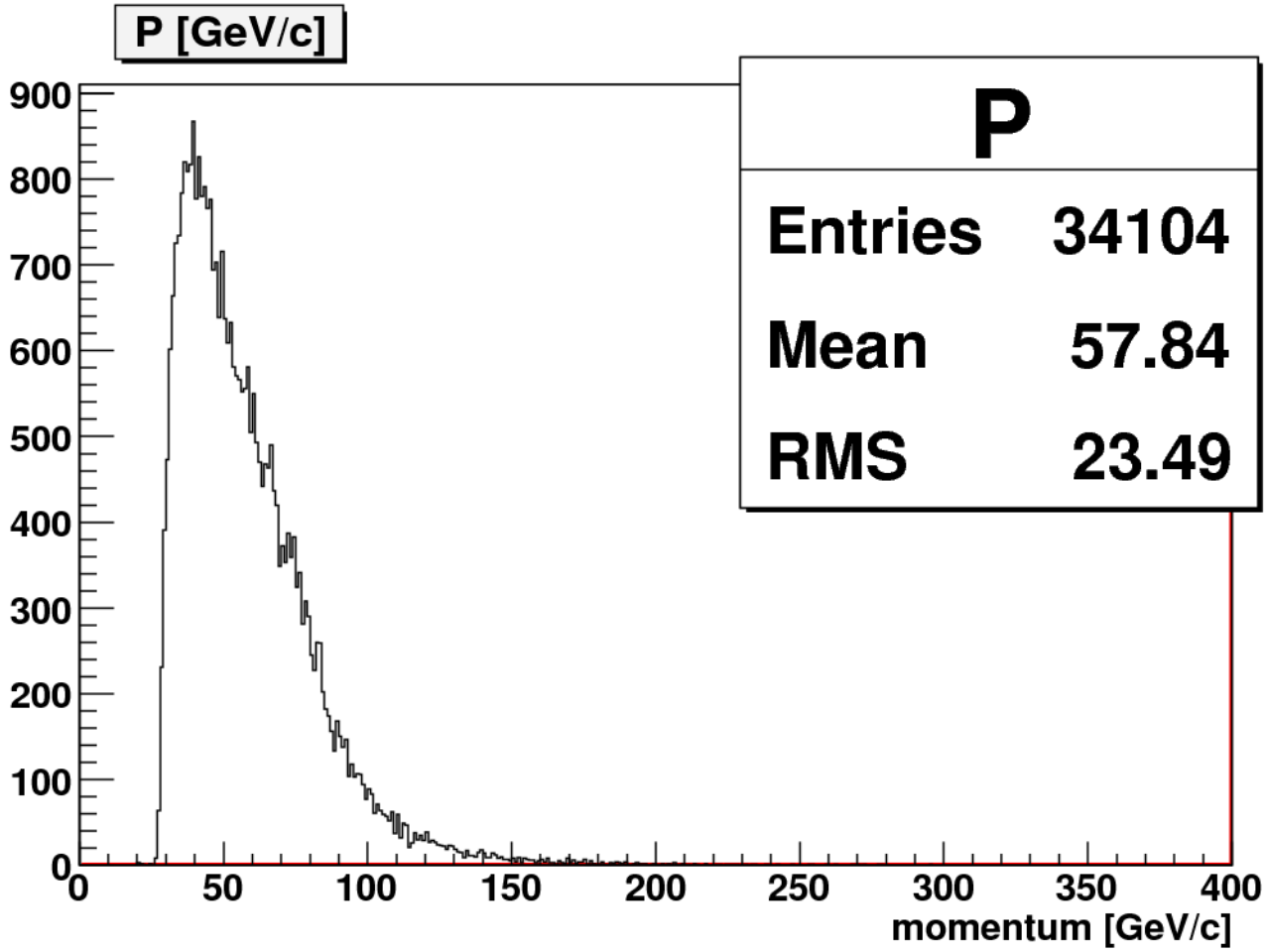
Results for muon-tracker in barrel

- We recalculate vectors of muon coordinates for the shift, d = (3000μm, 4000μm, 5000μm)
- Fitted, d, for global muons in the barrel:

Statistic	d_x	d_y	d_z
30K	2544+/-142μm	3568+/-142μm	5039+/-133μm
100K	3142+/-78μm	3849+/-78	5061+/-72μm
200K	2885+/-55μm	3887+/-55μm	4942+/-51μm

Momentum in endcap

- Average momentun is about 57.8 GeV/c

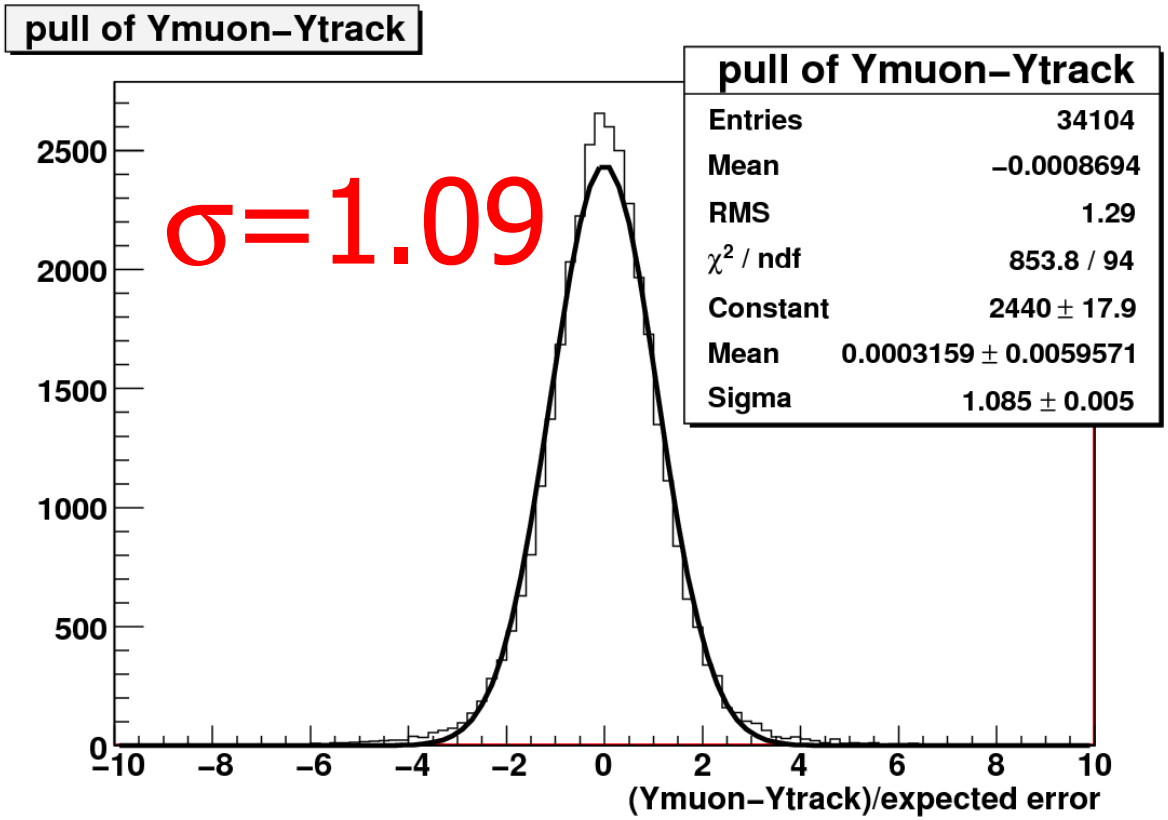


Parameter pulls for propagated track in endcap

- σ of pulls for parameters

  X, Y , Px, Py, Pz:

  1.1 1.1 1.8 1.7 1.7



Results for muon-tracker in barrel+endcaps

- We recalculate vectors of muon coordinates for the shift, d = (3000μm, 4000μm, 5000μm)
- Fitted, d, for global muons in all detector

Statistic	d_x	d_y	d_z
30K	2978+/-64μm	3827+/-64μm	5032+/-113μm
100K	3034+/-33μm	3936+/-33μm	5122+/-57μm
200K	2979+/-25μm	4034+/-25μm	5015+/-43μm

Next steps

- Introduce global rotations
- Usage of non-diagonal elements in covariance matrix (if they are appropriate)
- Test with another propagator (SmartPropagatorAnyRK ?)
- Test to introduce a (wrong) global corrections into the GlobalAlignmentRecord
- Storage of the fitted global corrections

Backup Slides

- No slides more