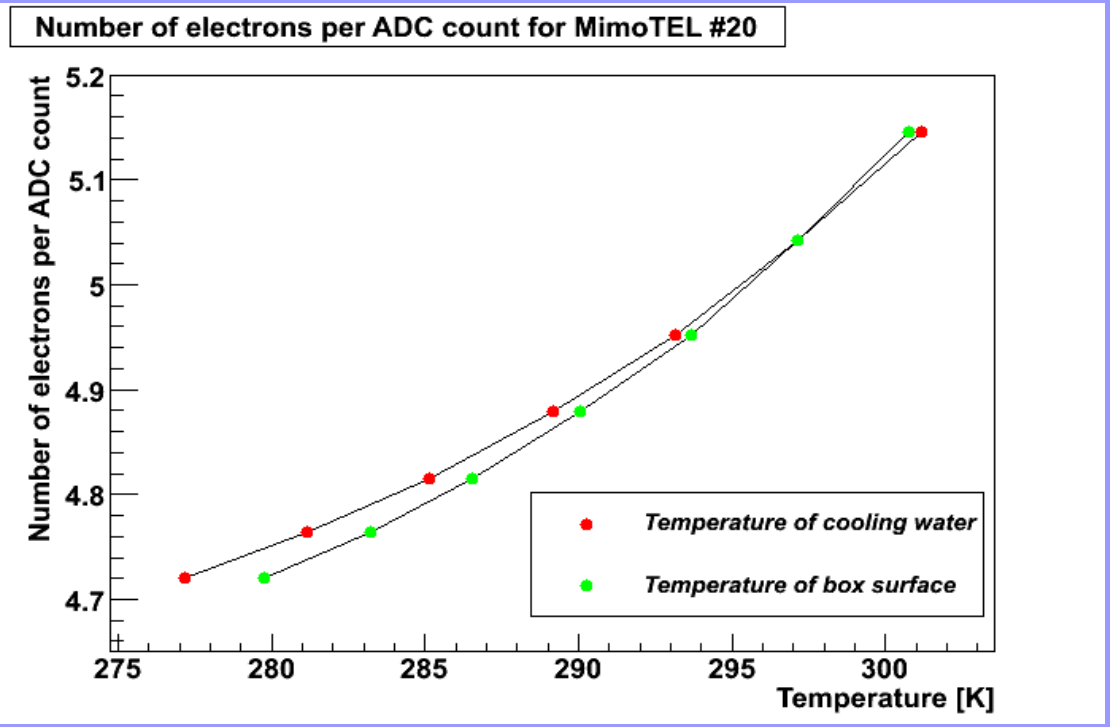
Alignment and analysis news

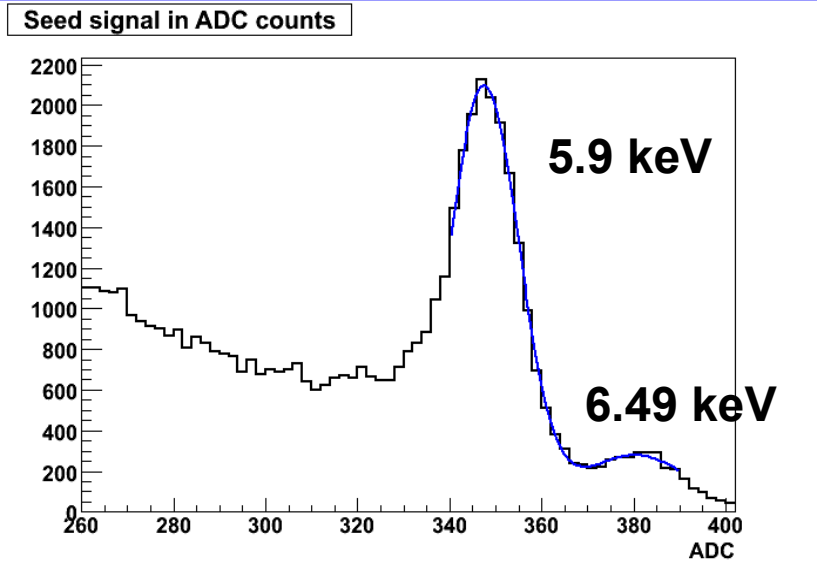
Philipp Roloff (DESY)

- Noise measurements
- Alignment:
  - time dependence
  - CERN data
- Sensor resolution

Conversion: ADC counts to electons

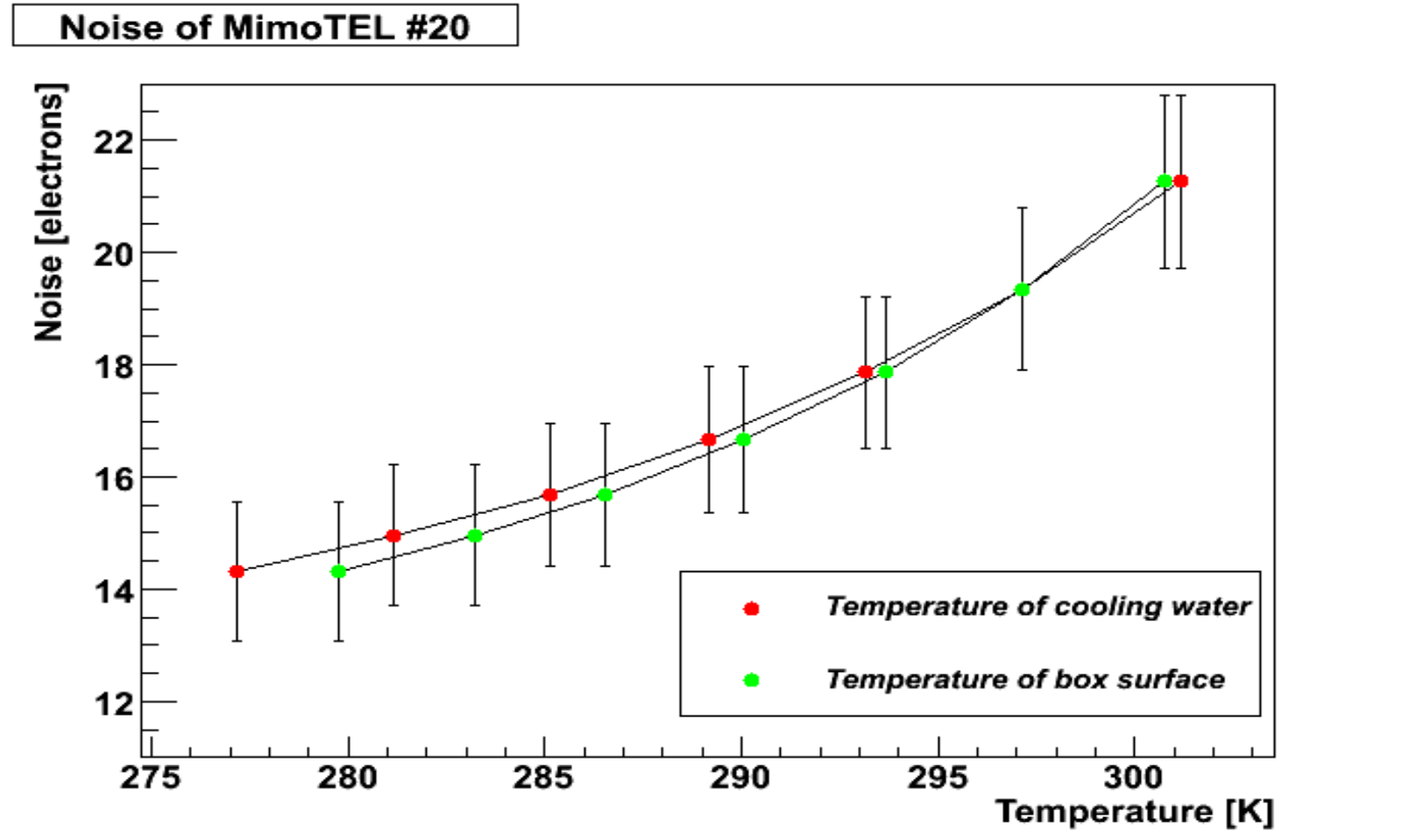
- Side product of tests for new mechanics
- Dependent on temperature





Seed pixel spectrum of Fe55 source at 4˚C

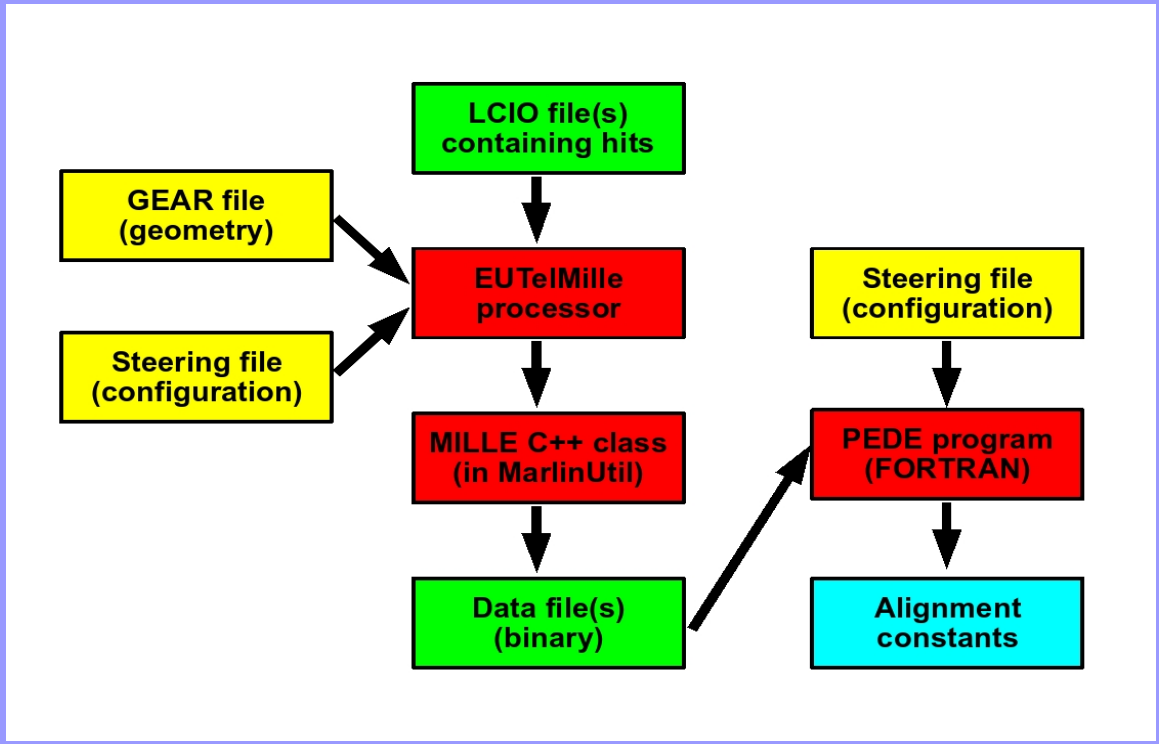
Noise of MimoTEL



Errors given by widths of noise distributions.

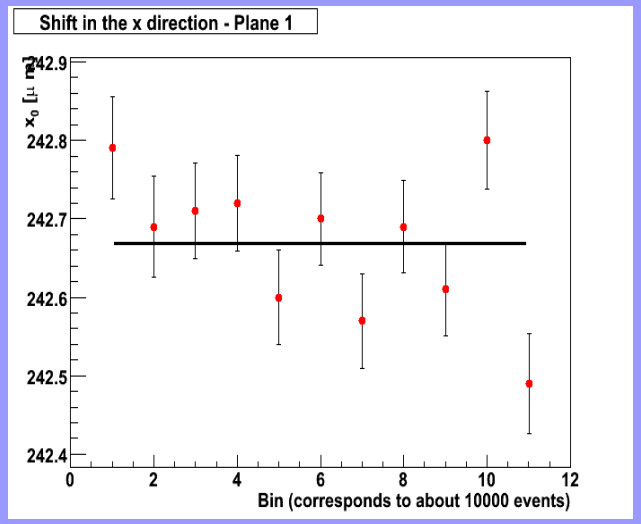
Alignment: time dependence

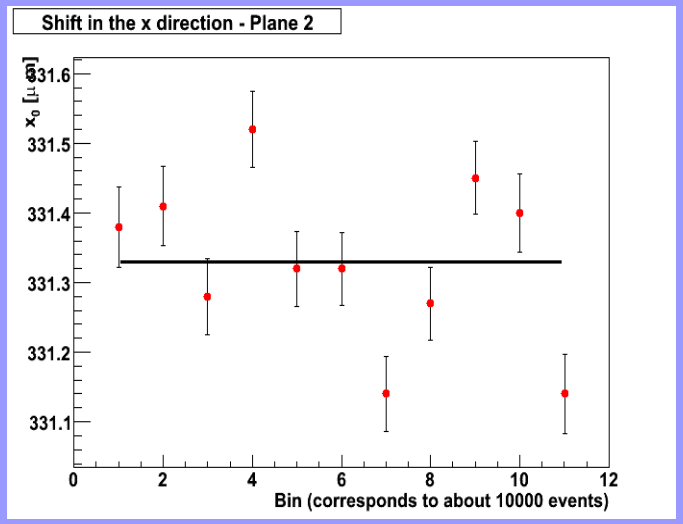
- New processor EUTelMille allows to use full tracks for the alignment.
- For technical details see my presentation during the software meeting on 31/01/2008.
- Now in CVS.

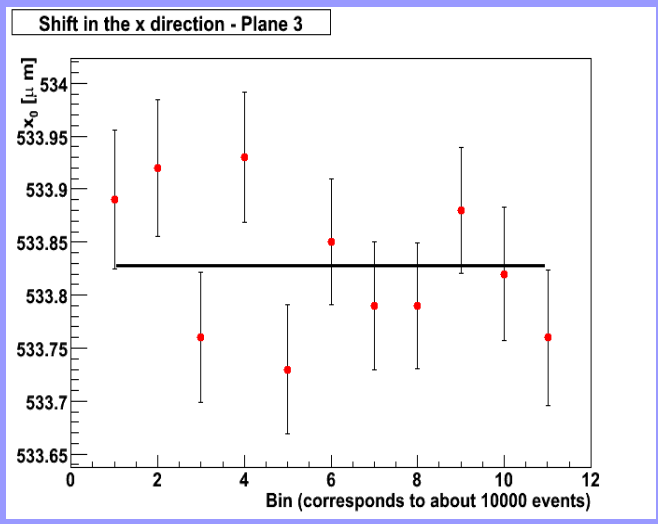


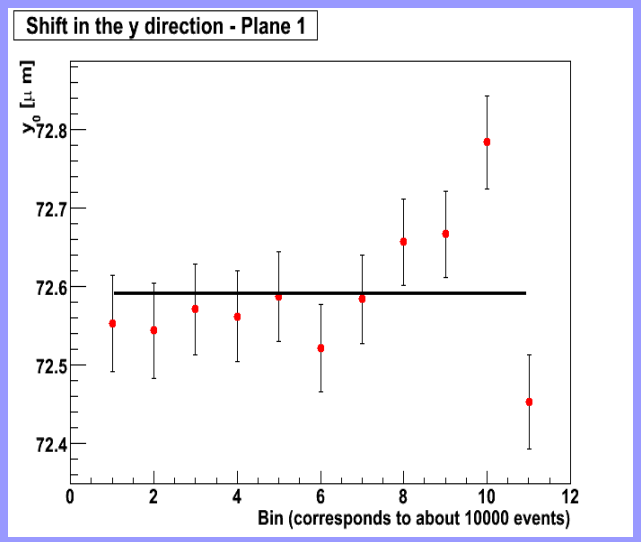
- Now spilt the datasets in smaller parts and look at the time dependence of the constants.

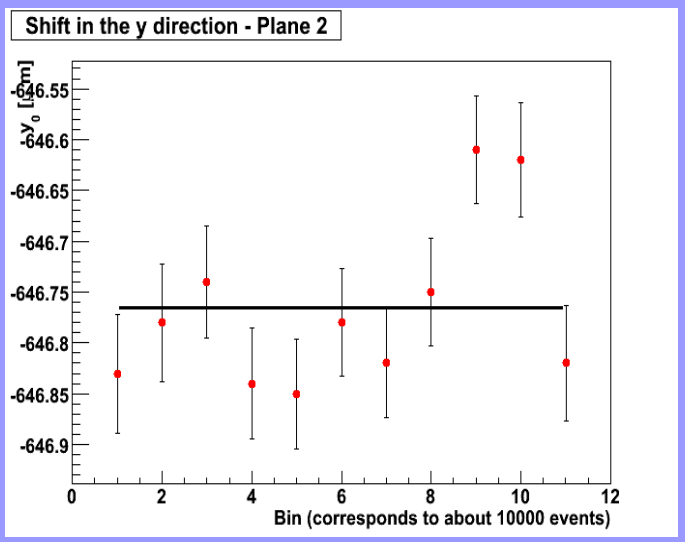
Shifts in X and Y (6 GeV)

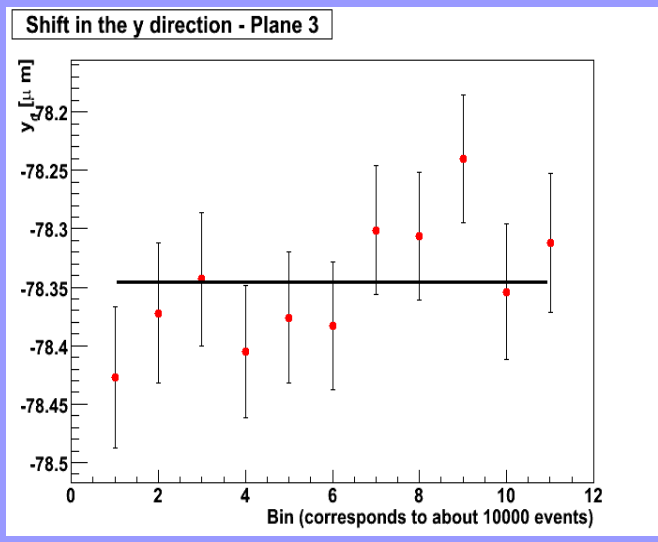




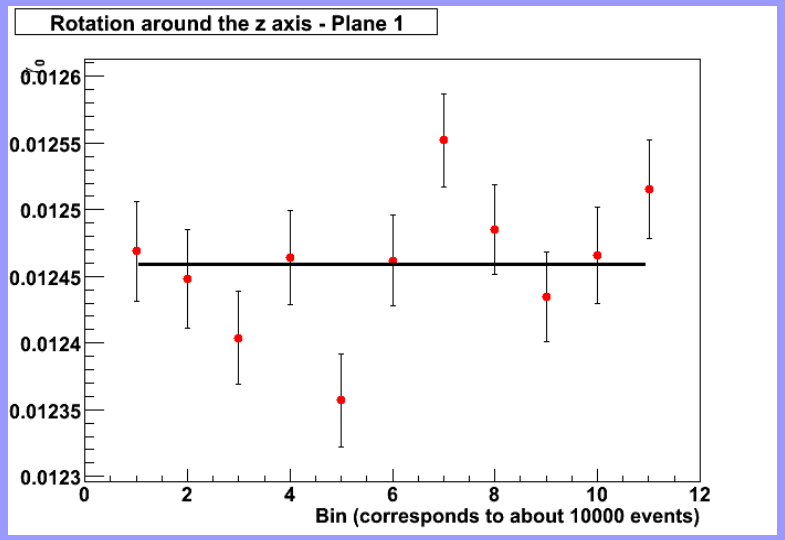


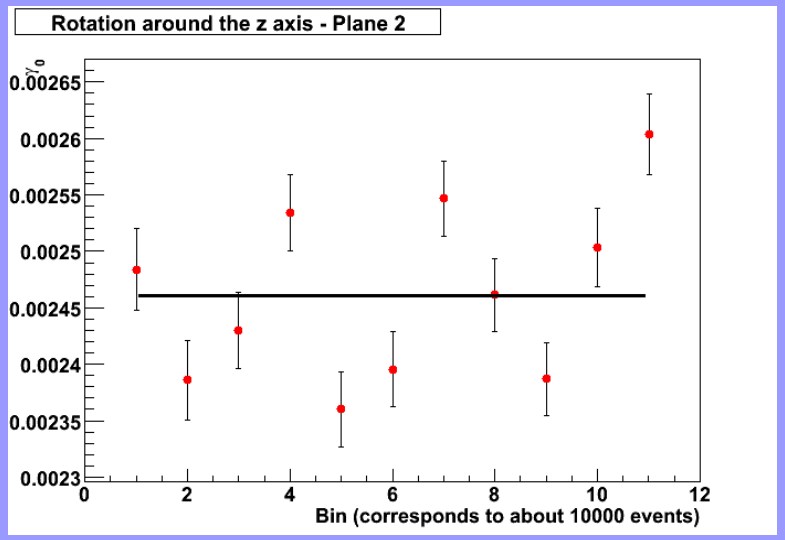


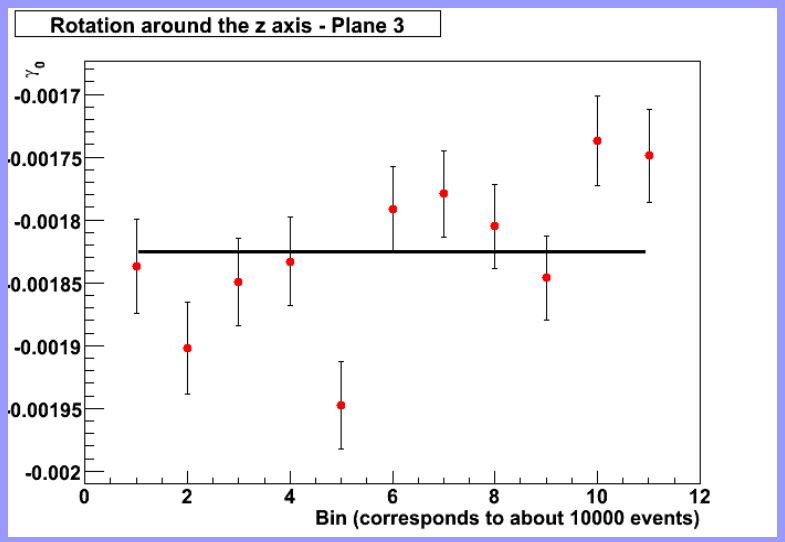




Rotations (6 GeV)





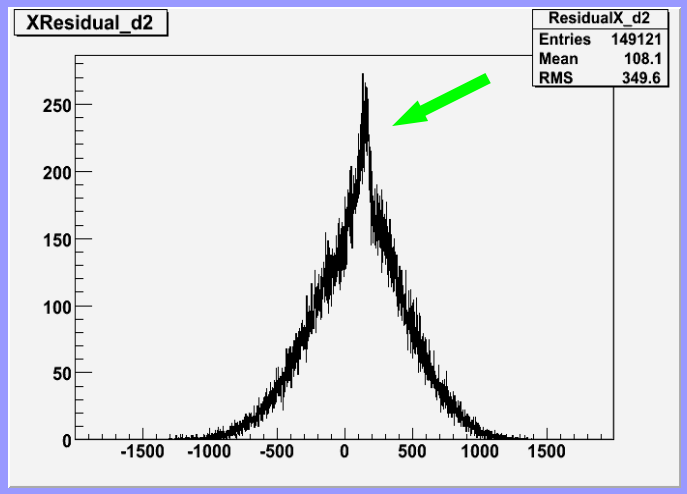


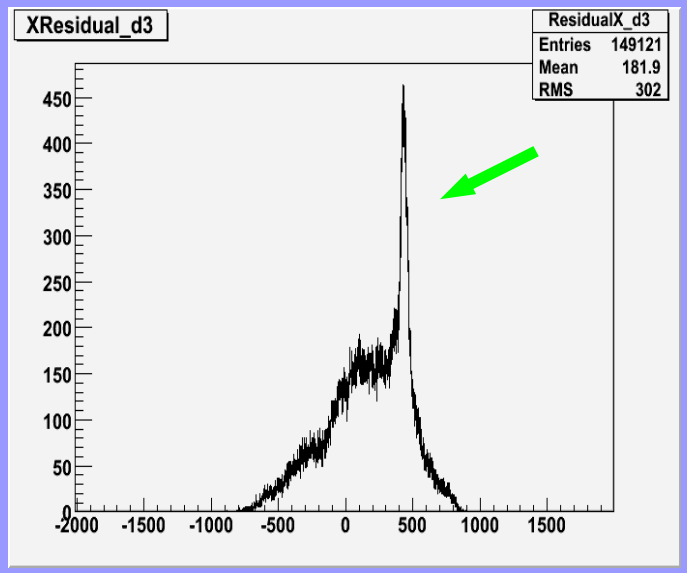
- No problems visible.
- Telescope stable for about 28 hours.
- Similar for 3 GeV data (→ backup)

Alignment of CERN data

- For the DESY samples only events with one track per event were used.
- This is not possible for CERN data any more!
- **Procedure:** Repeat fit 10 times and:
  - Decrease cut on χ^2 for later iterations
  - Downweighting of outliers

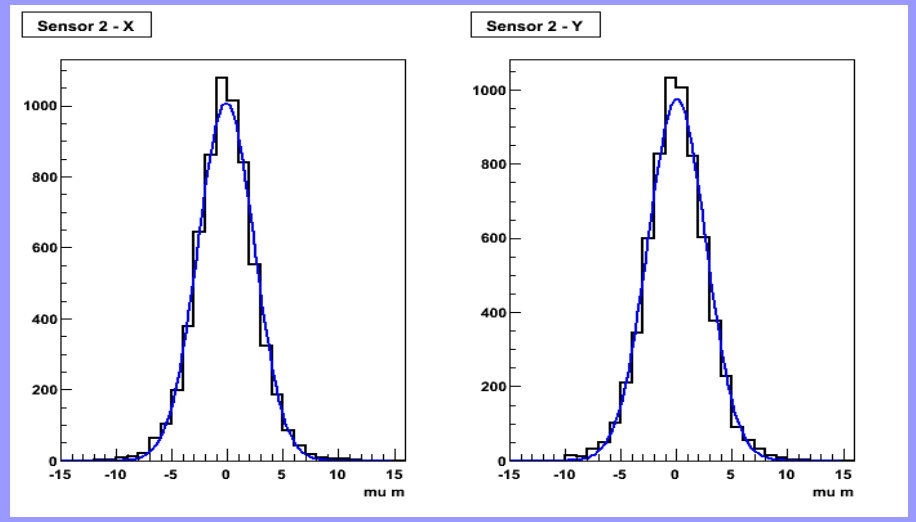
It works!

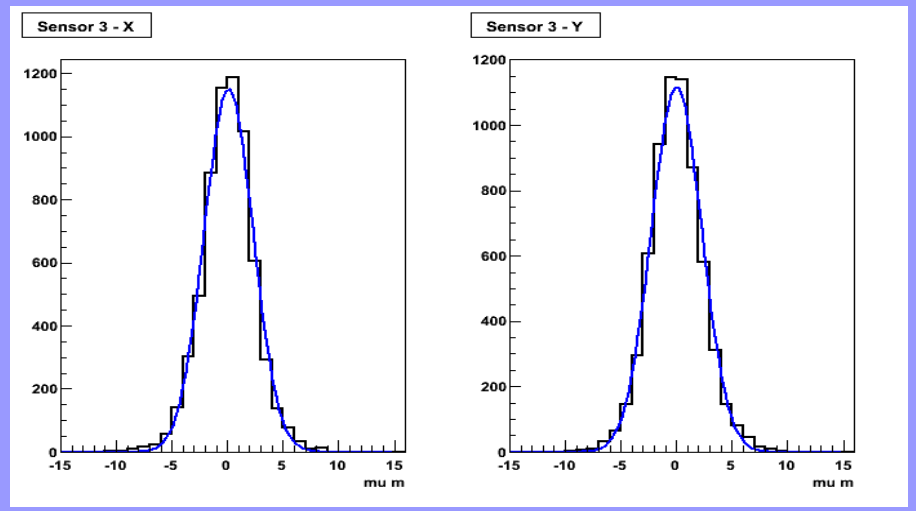




Input track candidates.

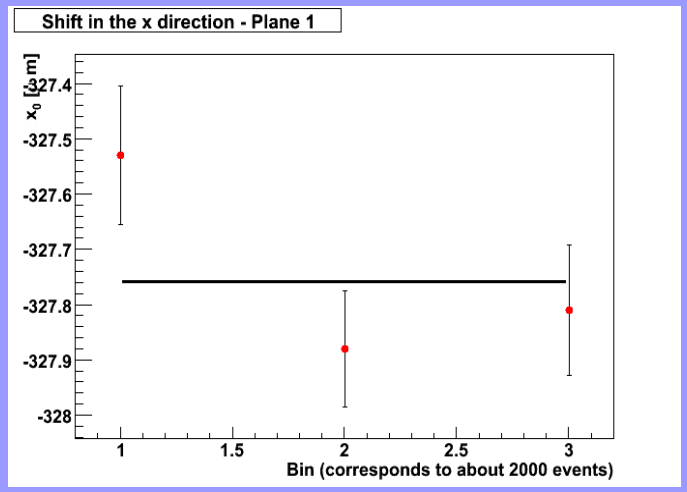
MILLEPEDE II

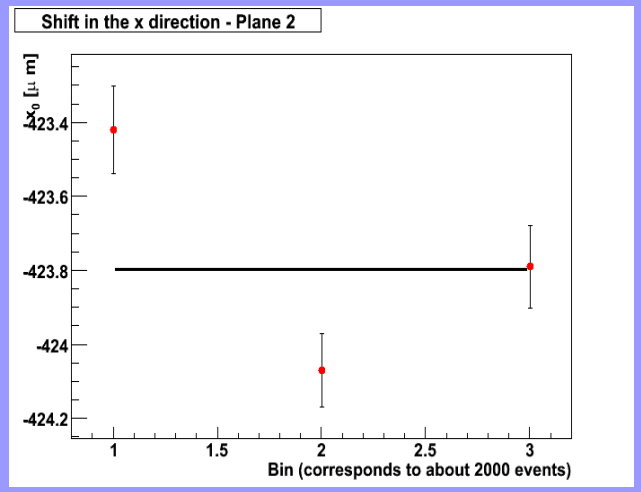


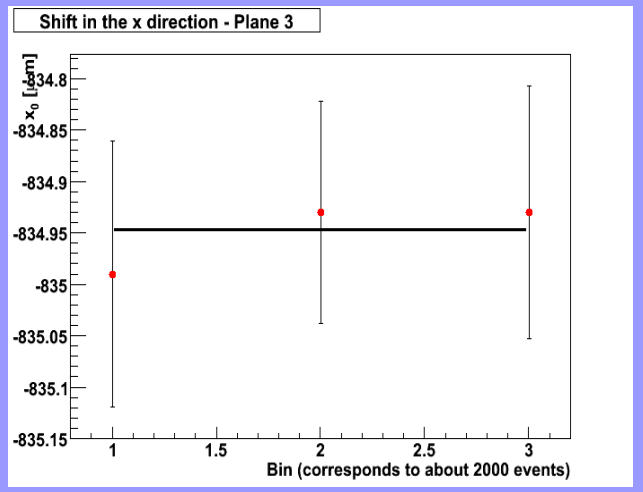


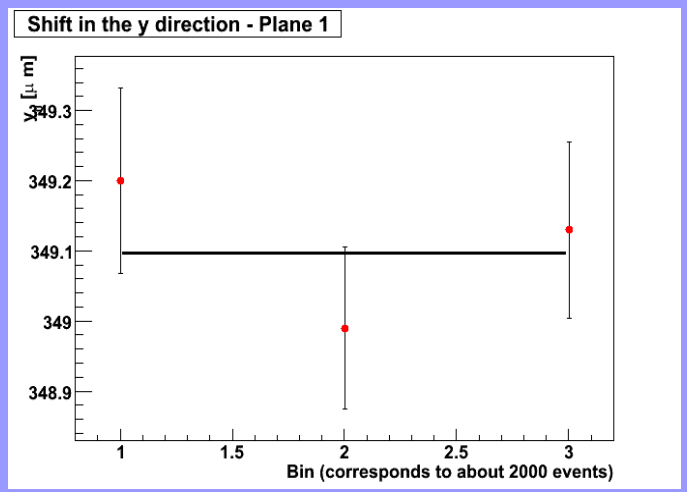
Aligned telescope.

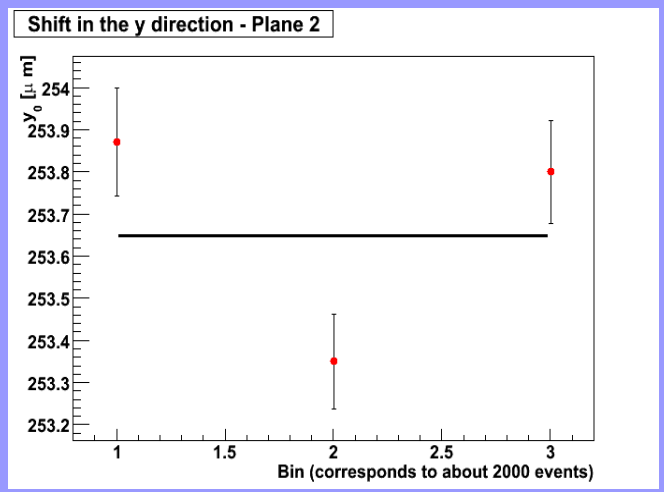
Time dependence (CERN)

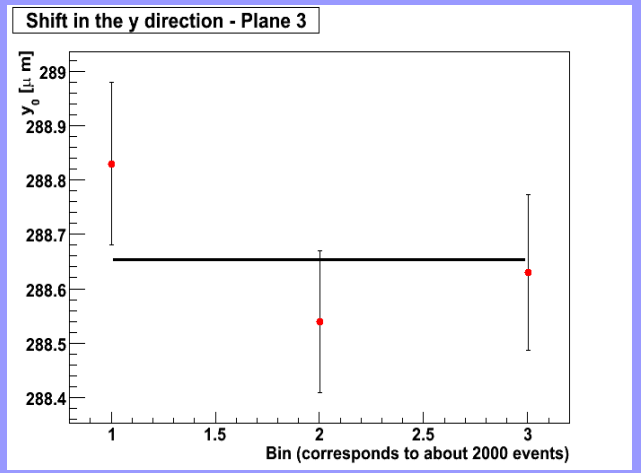




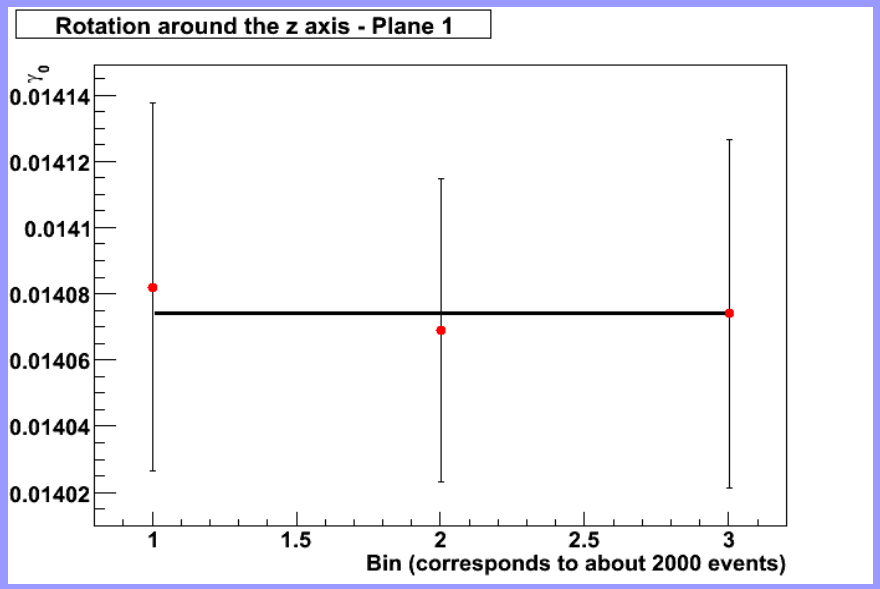


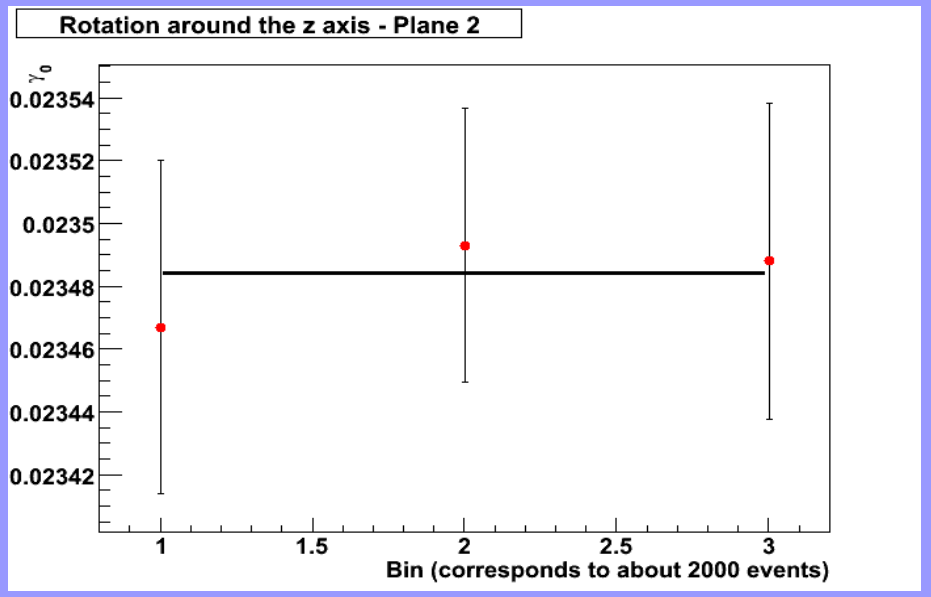


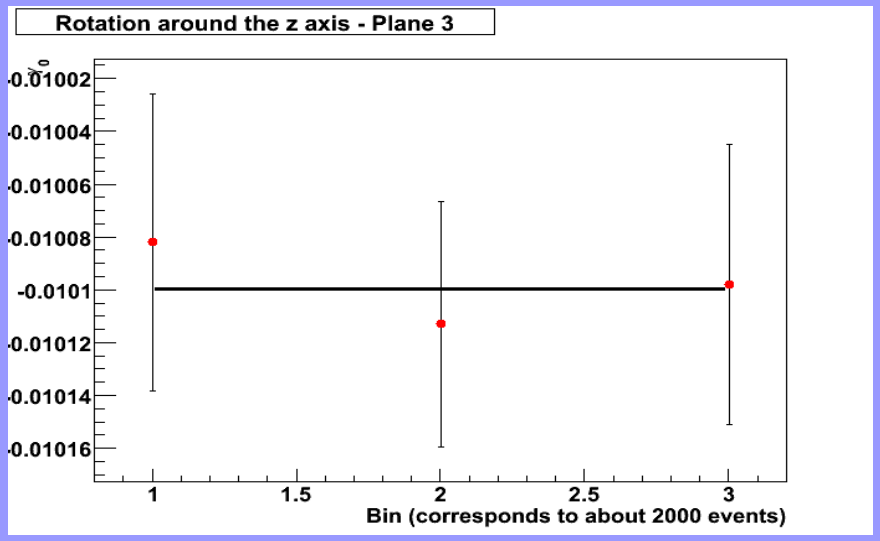




Rotations (CERN)



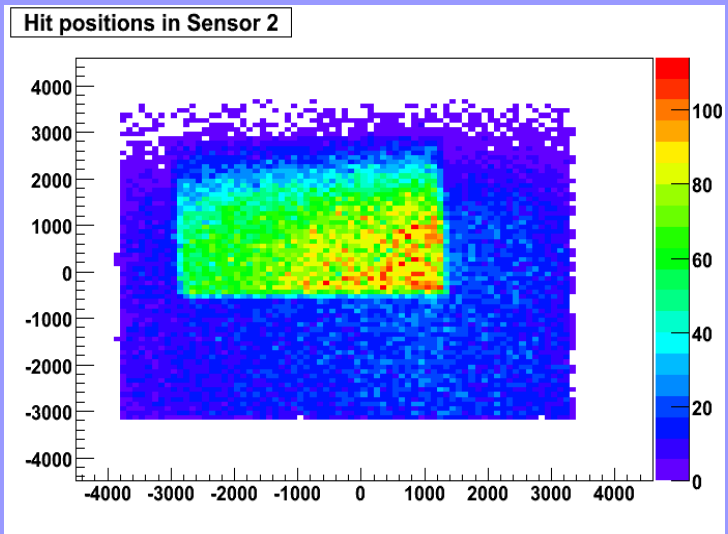




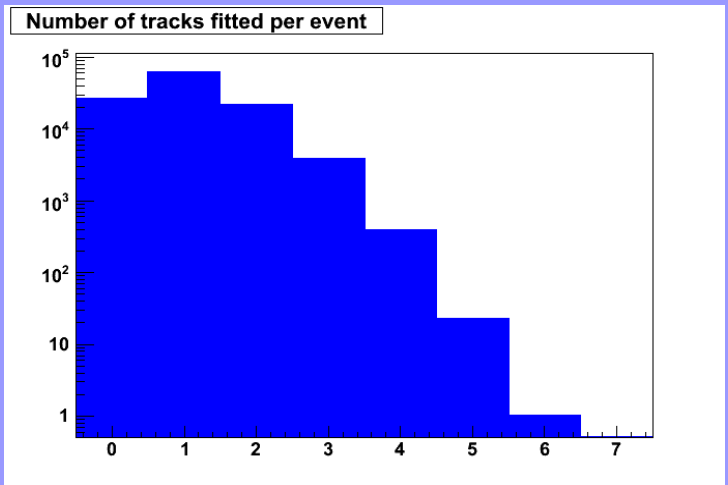
Sensor resolution studies

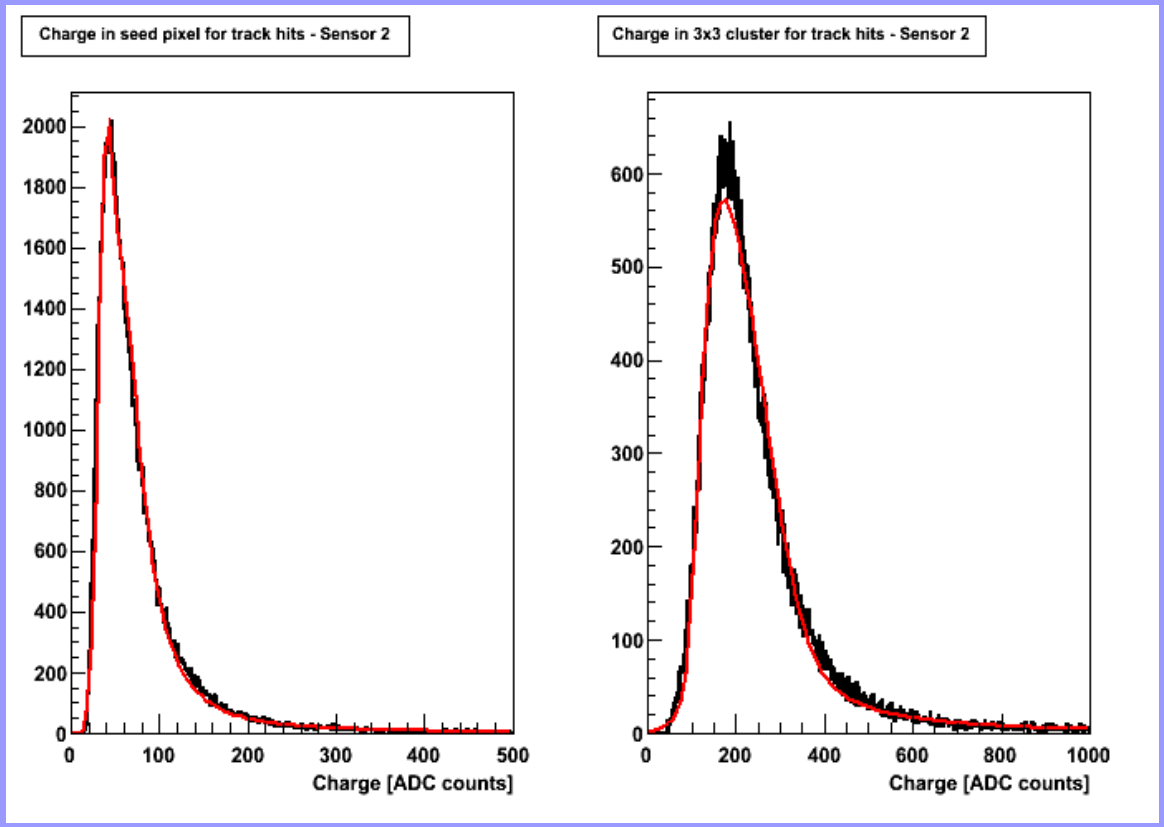
- Use hits from existing files:
  - Seed SNR > 5 (> 6 for first plane)
  - 3x3 cluster SNR > 4
  - maximal 100 seeds
  - η−correction
- Alignment from MILLEPEDE II
- Linear tracks (EUTelMultiLineFit) fitted:
  - $\chi^2(x) < 20$, $\chi^2(y) < 20$
  - distance < 250 μm
  (< 850 between sensor 2 and 3 in CERN setup)

DESY 6 GeV: example plots



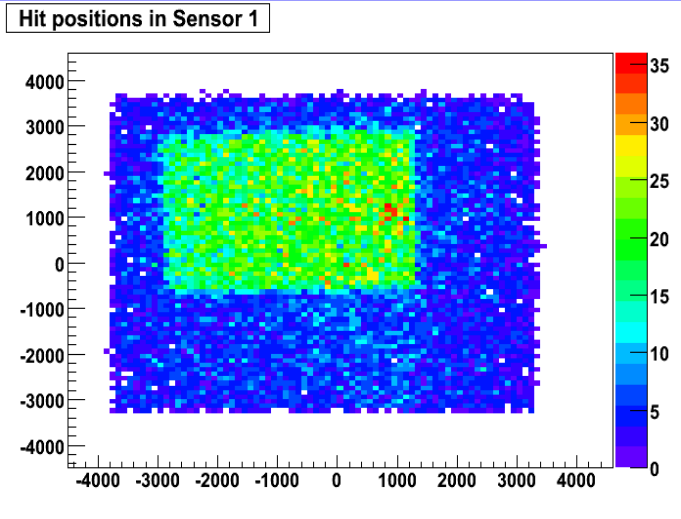
Track positions in sensor 2



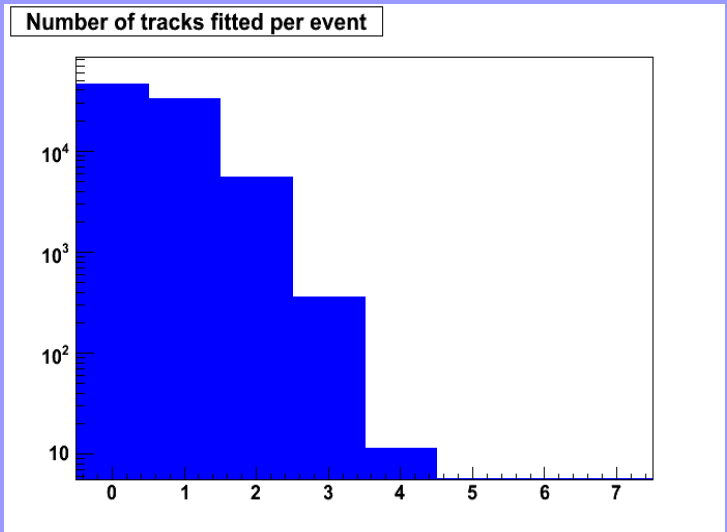


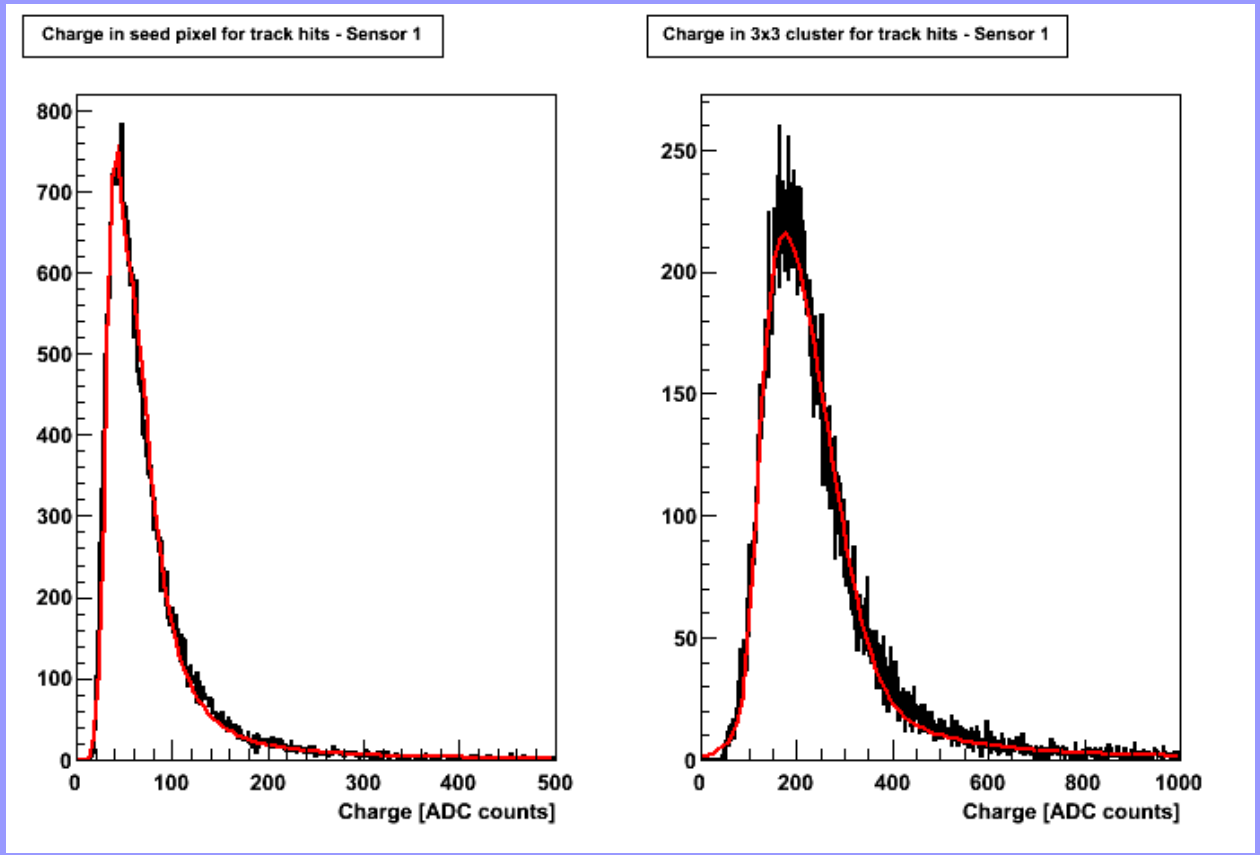
Charge in seed pixels and 3x3 clusters

DESY 3 GeV: example plots



Track positions in sensor 1





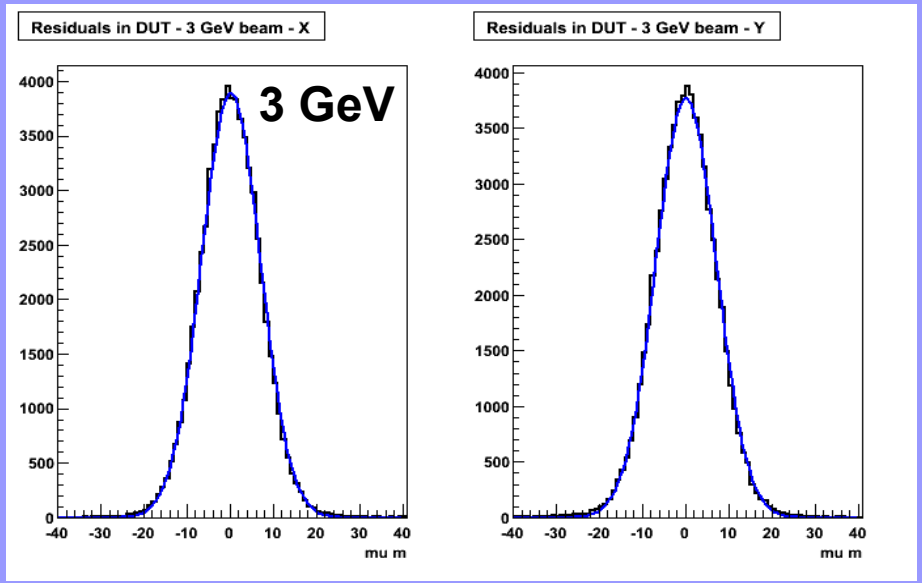
Charge in seed pixels and 3x3 clusters

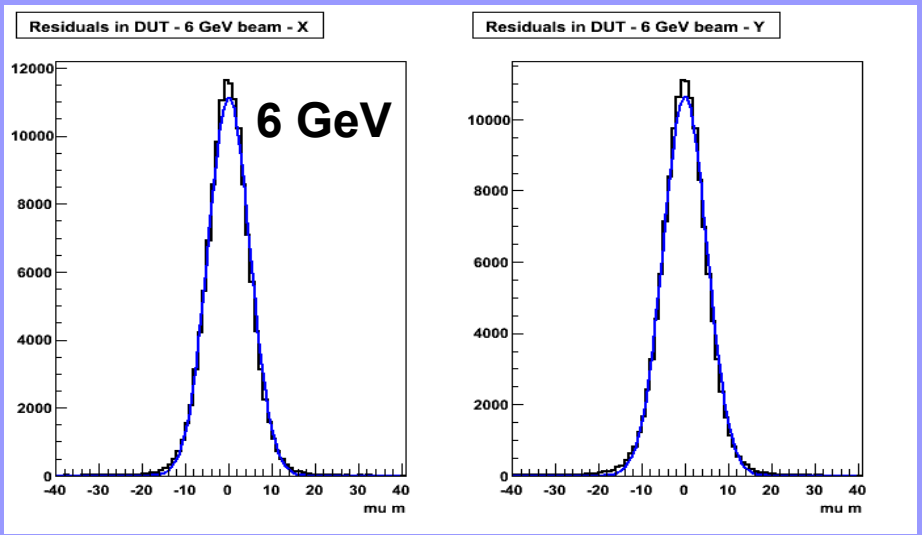
Sensor resolution

- In DUT mode:

$$\sigma^2 = \sigma^2_{DUT} + \sigma^2_{TEL} + \sigma^2_{MS}$$
$$= \sigma^2_{MimoTEL} + k \bullet \sigma^2_{MimoTEL} + \sigma^2_{MS}$$
$$= (1 + k)\, \sigma^2_{MimoTEL} + \sigma^2_{MS}$$

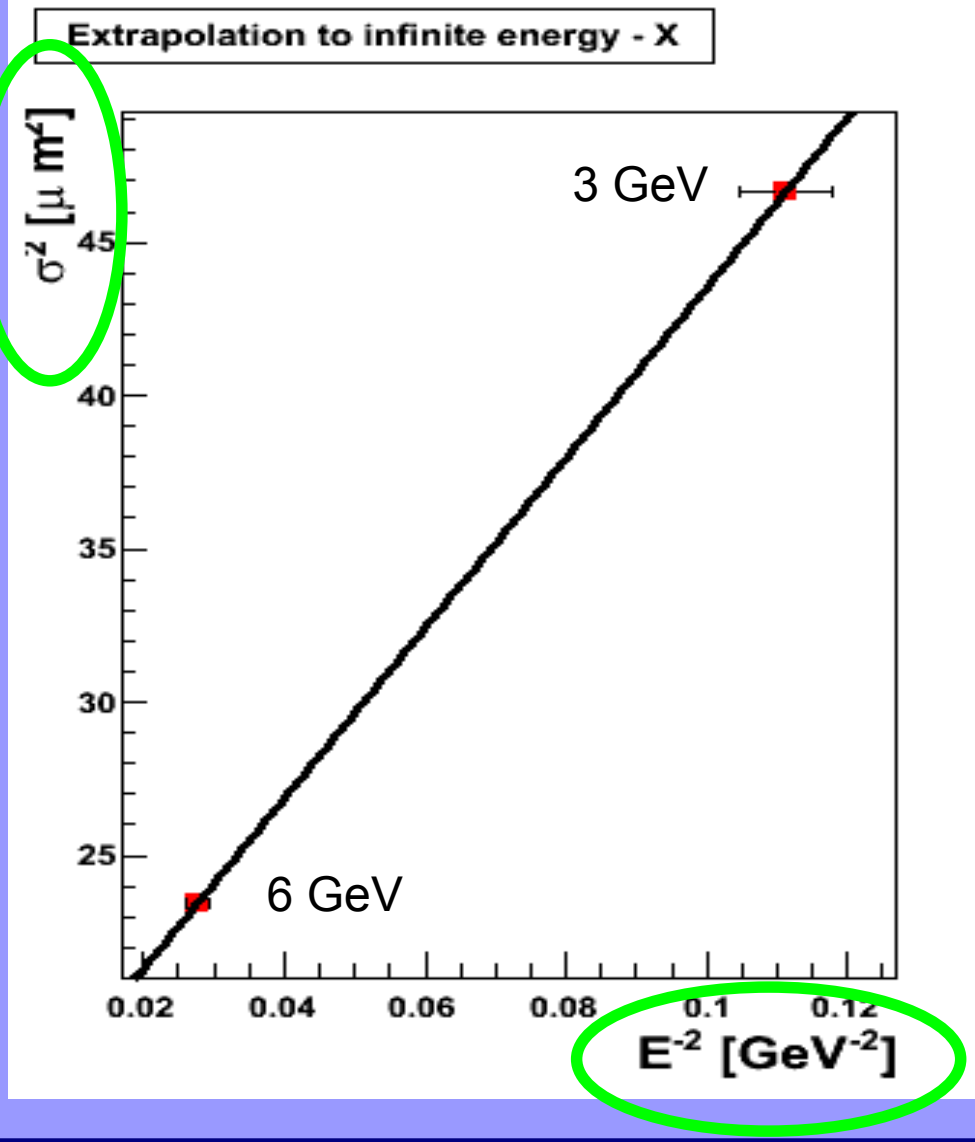
- Geometrical factor of telescope:
  $k = \sum z_i^2 / (n \bullet \sum z_i^2 - (\sum z_i)^2)$
  for DUT at z = 0
- Remove σ^2_{MS} by extrapolation to infinite energy: $1 / E^2 \rightarrow 0$

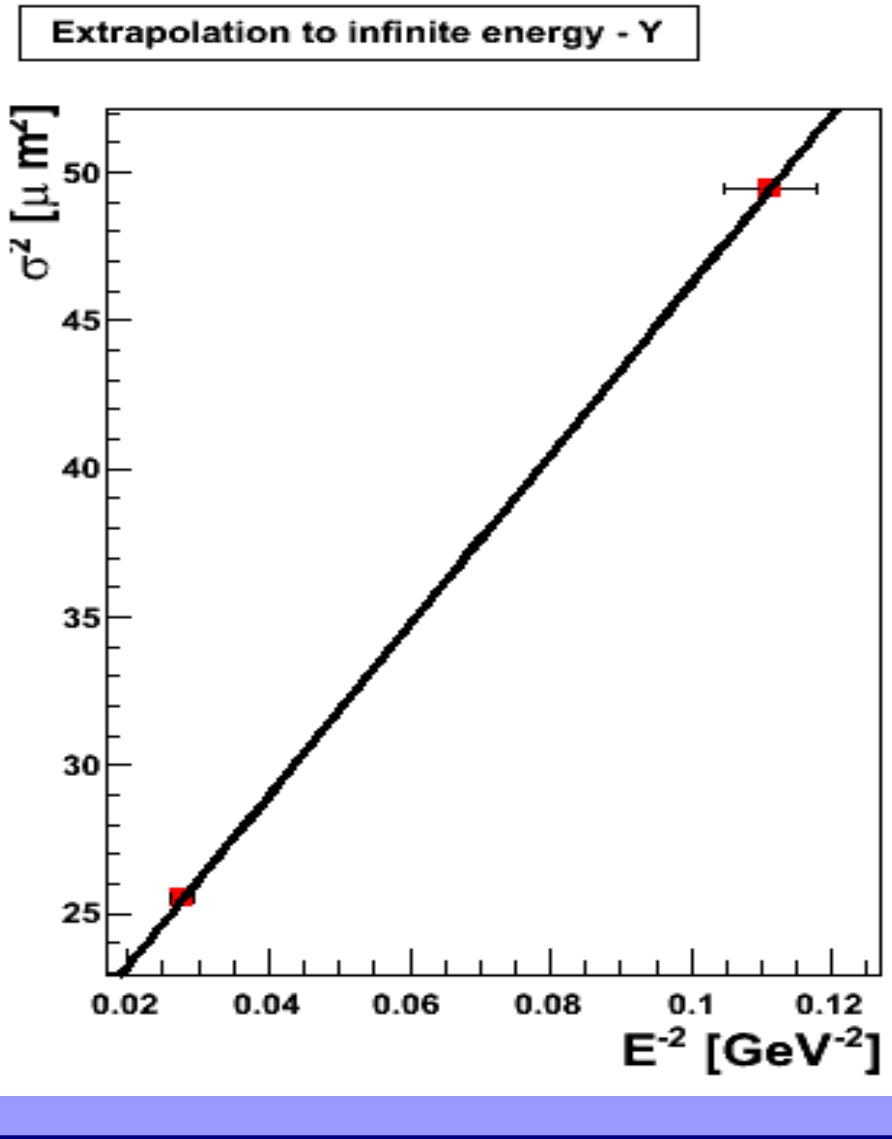




Example: Sensor 2 as DUT

Extrapolation: $E^{-2} \rightarrow 0$





Results

Sensor as DUT	σ(MimoTEL) – X	σ(MimoTEL) – Y
0	4.0 ± 1.2 μm	4.1 ± 1.3 μm
1	3.1 ± 0.6 μm	3.2 ± 0.6 μm
2	3.5 ± 0.8 μm	3.7 ± 0.9 μm
3	3.2 ± 0.6 μm	3.3 ± 0.7 μm
4	4.0 ± 1.3 μm	4.2 ± 1.3 μm

- All values consistent with 3.0 μm (within the large errors)
- Uncertainty of beam energy: 3%

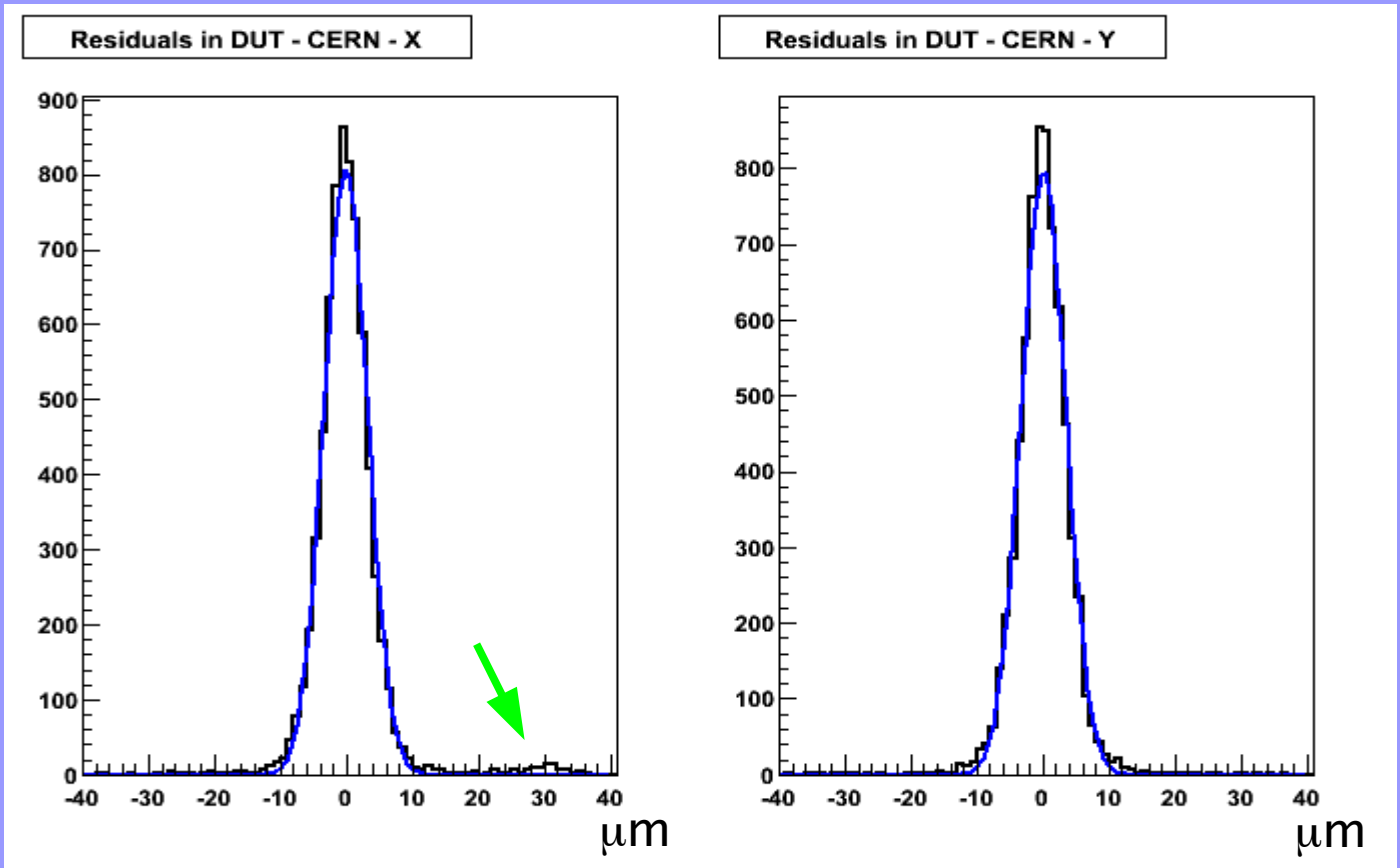
Sensor 2 as DUT:

3% → 5%: σ(MimoTEL,x) = 3.5 ± 1.1μm, σ(MimoTEL,y) = 3.7 ± 1.1μm

3% → 0%: σ(MimoTEL,x) = 3.5 ± 0.4μm, σ(MimoTEL,y) = 3.7 ± 0.4μm

Sensor resolution from CERN data

- 180 GeV pions: σ^2_{MS} was neglected



Sensor 2 used as DUT

„Little peak“ in X:

- One pitch away from „main peak“
- Only in DUT mode
- Also without η-correction
- Also in other planes

Results

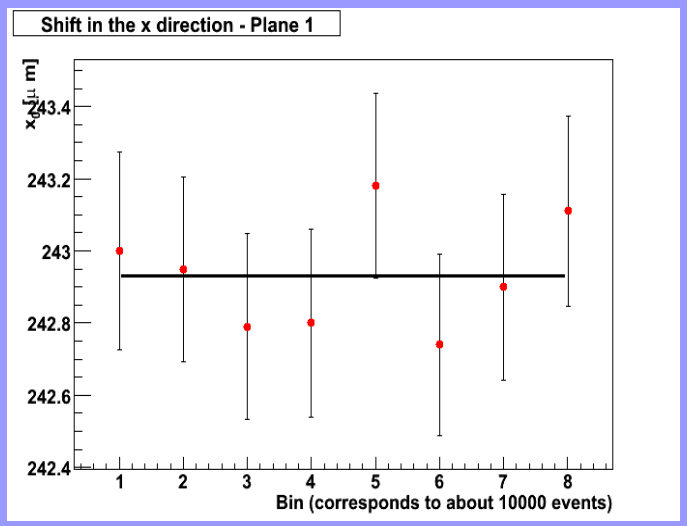
Sensor as DUT	σ(MimoTEL) – X	σ(MimoTEL) – Y
0	2.94 ± 0.03 μm	3.11 ± 0.03 μm
1	2.68 ± 0.03 μm	2.83 ± 0.03 μm
2	2.91 ± 0.03 μm	3.00 ± 0.03 μm
3	2.85 ± 0.03 μm	2.93 ± 0.03 μm
4	2.94 ± 0.03 μm	3.03 ± 0.03 μm

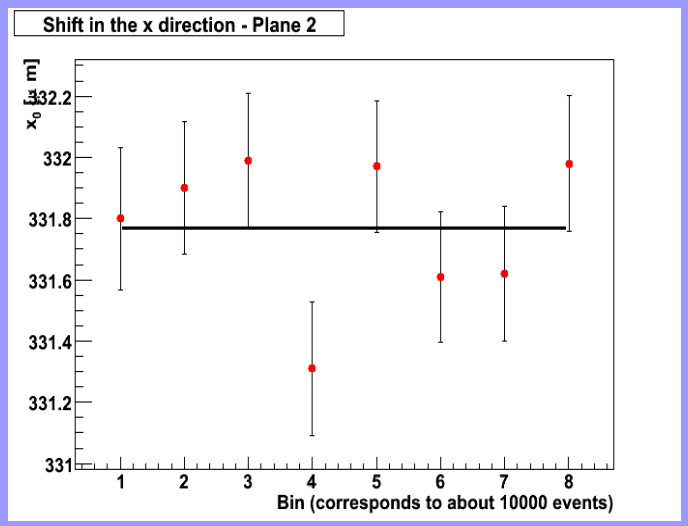
All values close to 3.0 μm

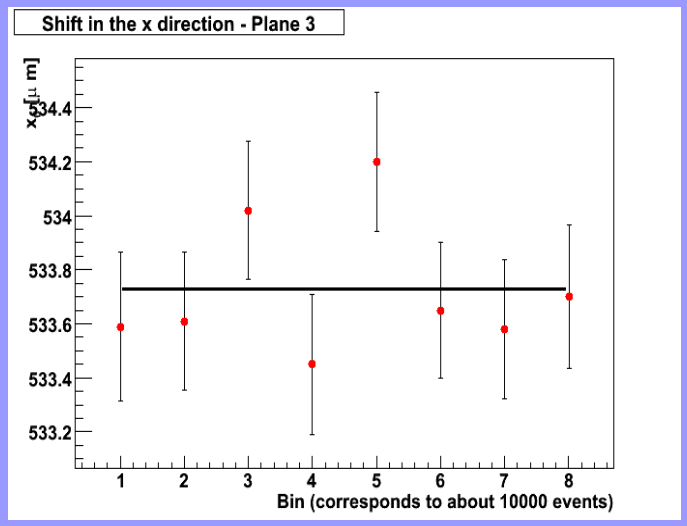
Summary

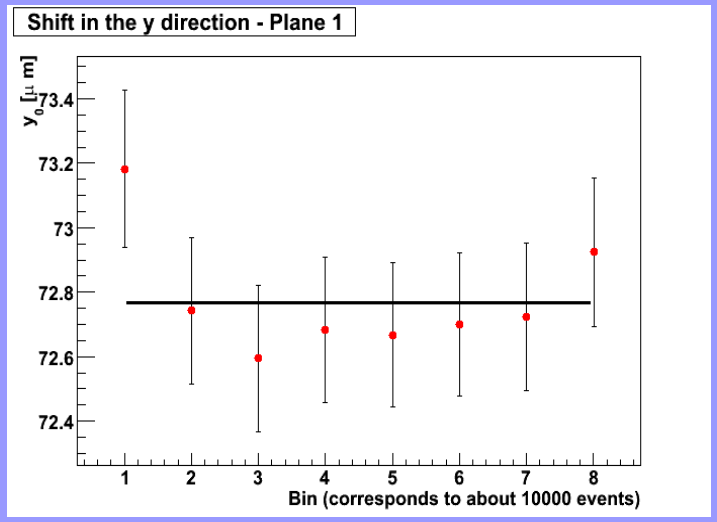
- Alignment constants are stable in time
- Millepede II works with CERN data
- Sensor resolution consistent with 3.0 μm

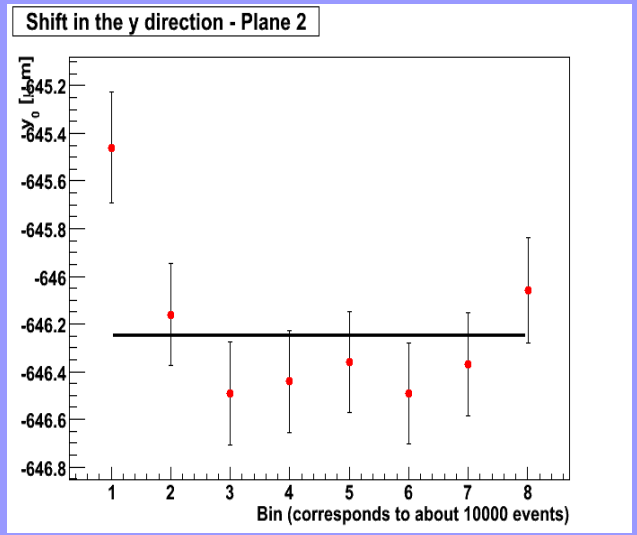
Shifts in X and Y (3 GeV)

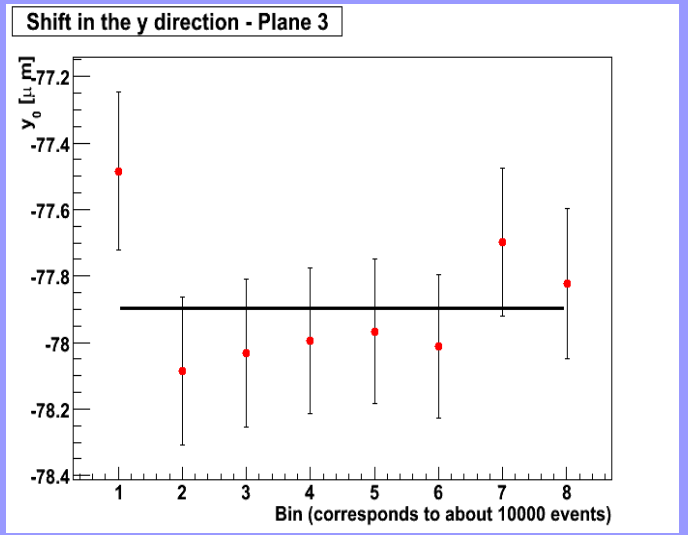












Rotations (3 GeV)