Latest Results on EUDET Testbeams

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on behalf of the JRA1 software/analysis group

JRA1 Meeting
30/01/2008

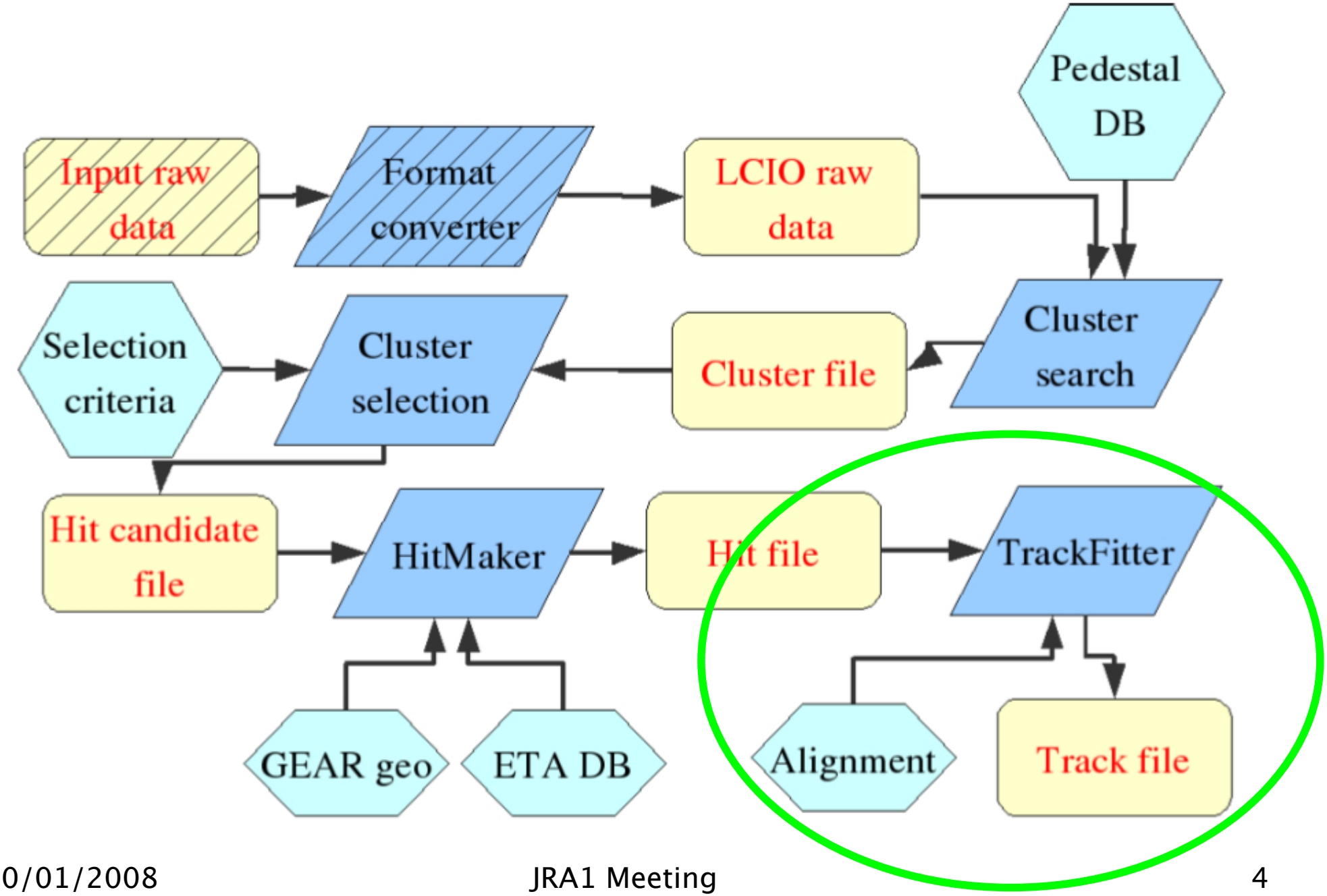
This talk

- Status of the offline analysis package **EUTelescope**.
- Latest results from the analysis of testbeam data.
- Will focus on news since the Paris meeting and plans for the future.
- **New documents**:
  First Test Beam Results from the EUDET Pixel Telescope, EUDET-Report-2007-06
  EUTelescope: tracking software, EUDET-Memo-2007-20

Reminder: EUTelescope

- Set of Marlin processors.
- Very flexible, user integration can be done at different levels.
- Based on the existing ILC software framework (Marlin, LCIO, GEAR, (R)AIDA, CED).
- Prepared to be executed on the GRID.
- CVS and documentation:
  http://ilcsoft.desy.de/portal/software_packages/eutelescope

Analysis scheme



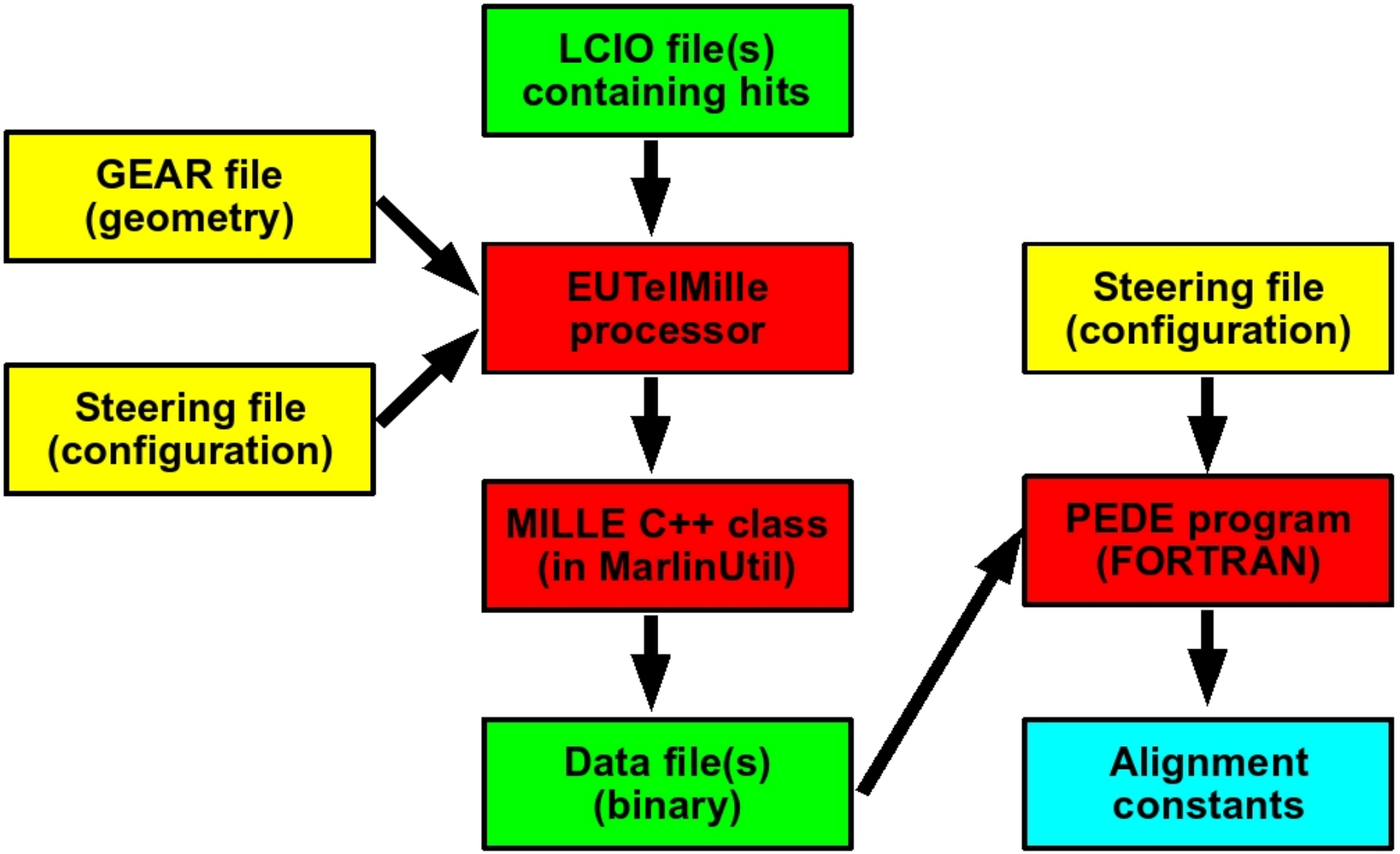
New alignment using MILLEPEDE II

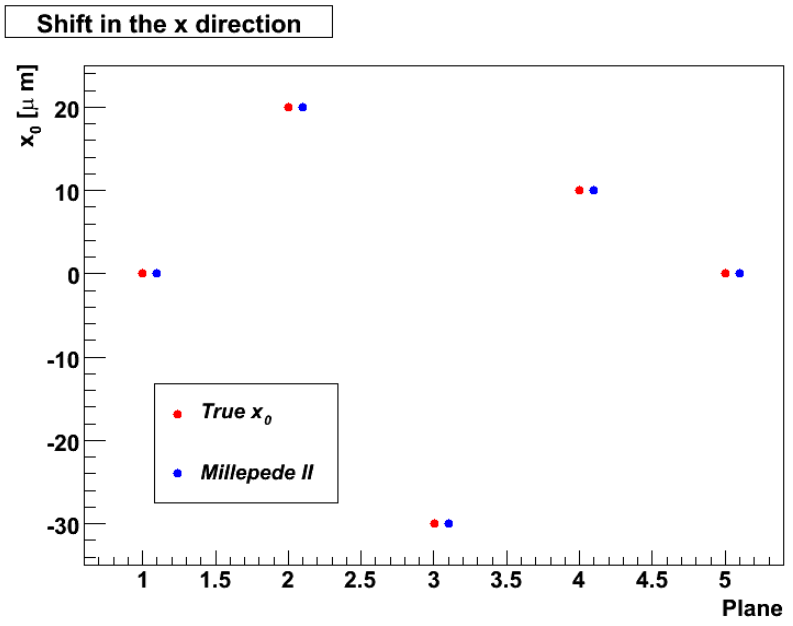
- **EUTelAlign:** Only two planes are compared at a time.
- Better solution: Use full tracks → try **MILLEPEDE II** (as announced in Paris).
- **local parameters:** only present in a subset of the data
  N = 4 • number of tracks
  (linear track model)

  global parameters: shifts and rotations of sensors
  N = 3 • number of sensors
  (two shifts and a rotation, other choices possible)

- MILLEPEDE II solves the **linear least sqares problem** with a simultanious fit of all global and local parameters, irrespectively of the number of local parameters.

MILLEPEDE II in EUTelescope

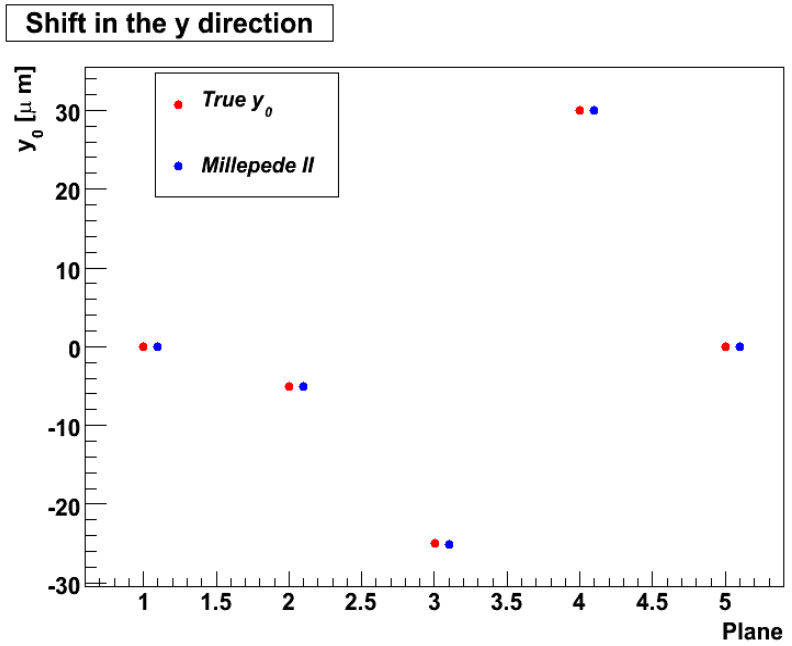


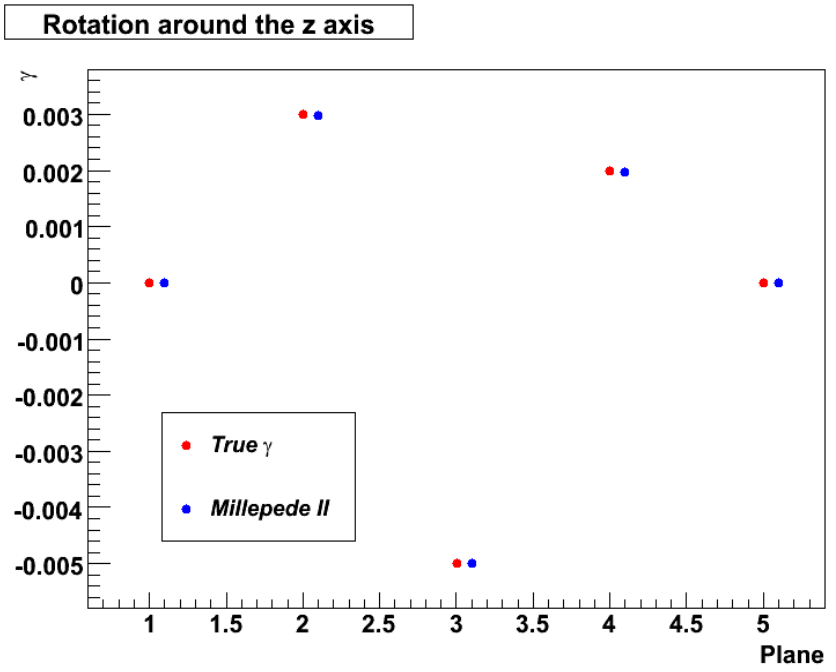


First test: "Simulate" telescope using a simple smearing approach.

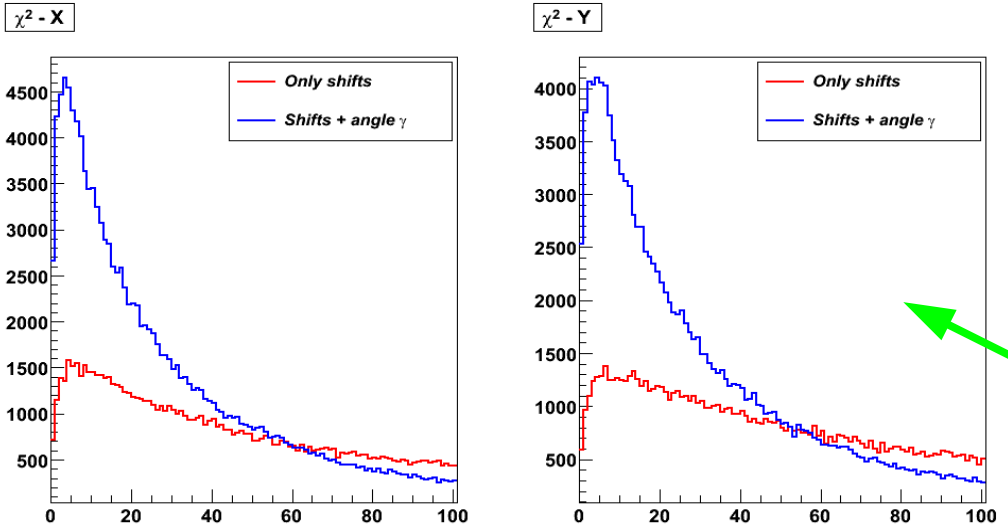
About 80.000 tracks, geometry of the August testbeam at DESY.

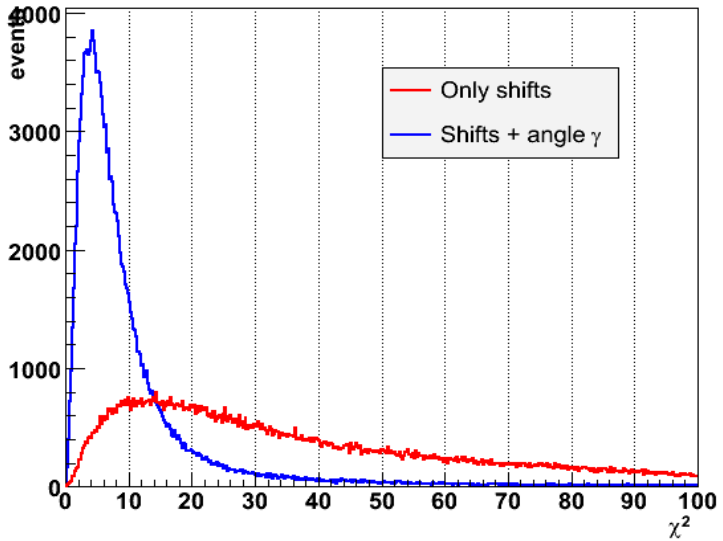
Introduce misalignment: shifts x_0, y_0 and rotation around the z axis γ.





Look at 3 GeV electron data from DESY...





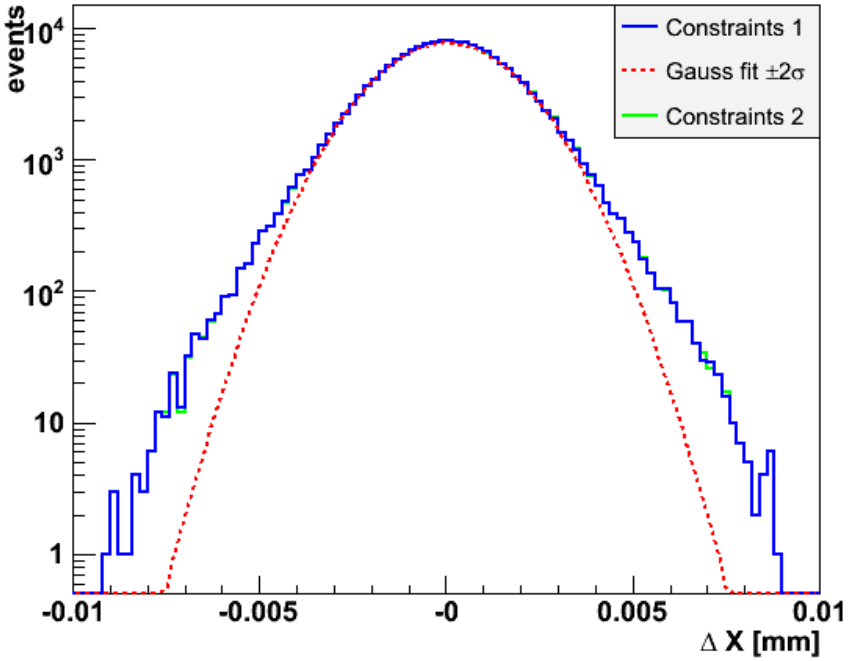
Use events with a single track for the alignment.

Tests:

- Simple straight line fitting
- Analytical fit considering MS

→ Alignment considering two shifts and a rotation gives good results.

Alignment precision below 0.1 μm.



- Constraints and starting values (of the global parameters) can be adjusted without rerunning the EUTelMille processor.
- Time to align the telescope on a 3 Ghz Pentium 4: **≈ 10 s**. (Useful for online DQM?)
- More technical details will be given in my talk tomorrow.

Software plans: LCCD

- We need to **store conditions data** from testbeams like alignment constants, details on the setup etc.
- Usual solution by big experiments: **database**. But large effort to setup and maintain!
- Simpler approach: store conditions data in the **LCIO files** (needed anyway). But no tags, versioning and history.
- **LCCD**: Combination of both options by using the conditions database interface **ConditionsDBMySQL** (from Atlas).

Further software plans

- **Event display:** CED is still not able to display tracks. Switch to another tool?
- **MonteCarlo:** We consider to interface Geant 4 and some digitisation simulation to EUTelescope to use our analysis chain also with simulated data.
- **Getting closer to the DAQ:**
  - Write LCIO files directly from the DAQ SW.
  - Immediately process pedestal runs and use new thresholds for datataking when running in ZS mode.
  - Submit analysis jobs to the GRID directly from the DAQ SW?
- Documentation!
- What else do we need?

Testbeam results

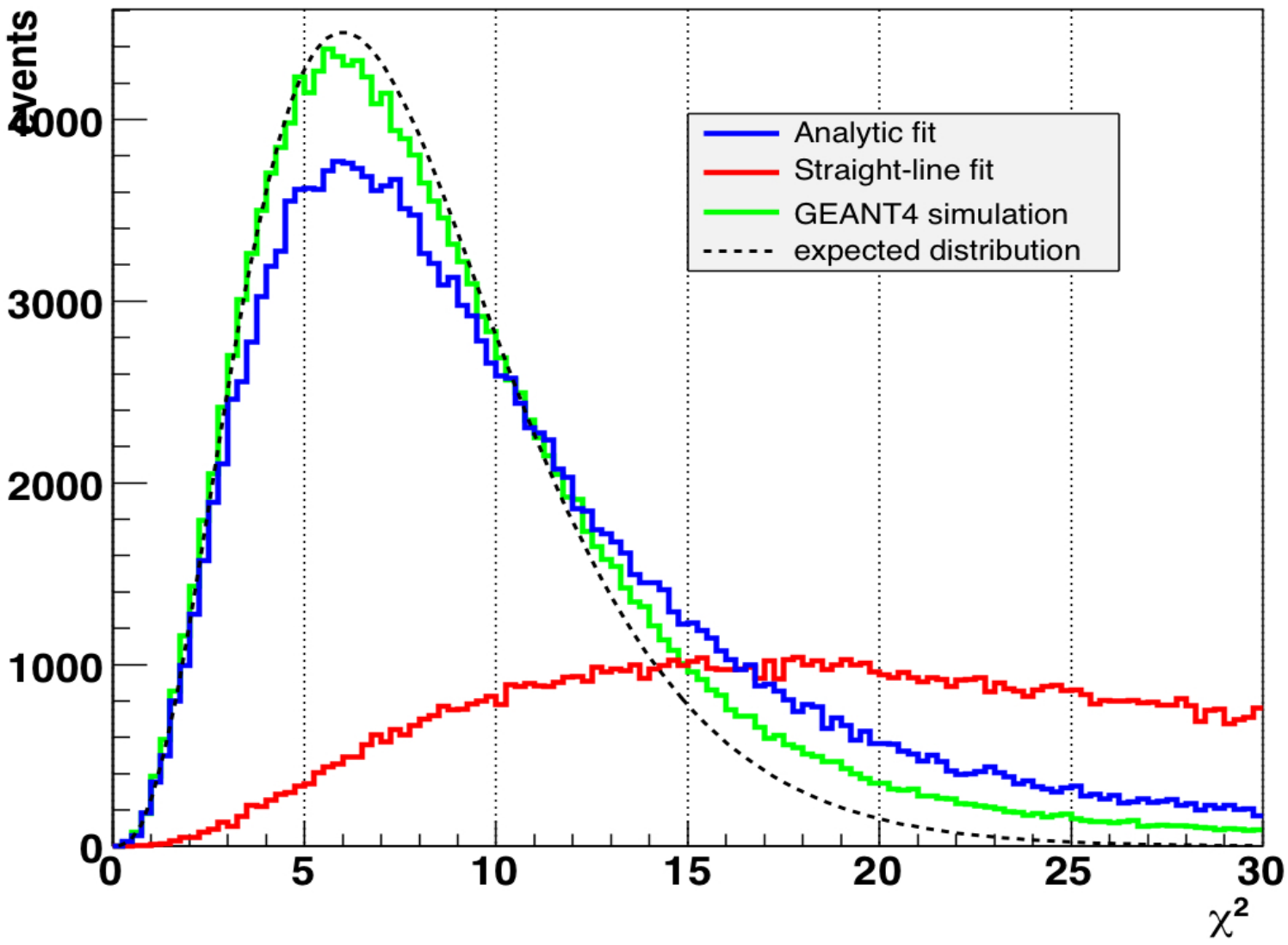
- The data of the testbeams at DESY in August 2007 (3 and 6 GeV electrons) and CERN in September 2007 (180 GeV pions) were reanalysed by Filip.

- Details on the **analytical track fitting** considering MS please: EUDET-Report-2007-01.

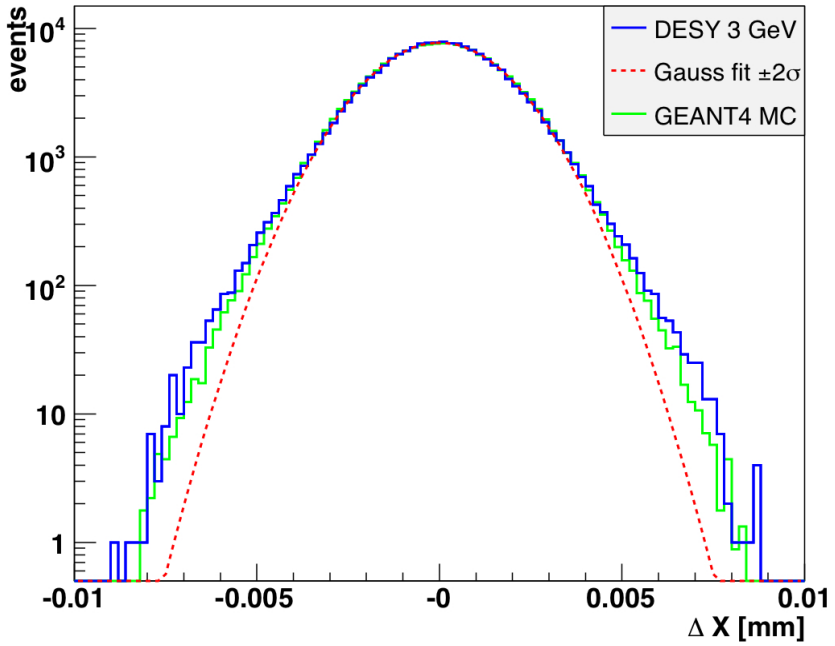
- **Geant 4 simulation:** particle positions in each layer (stand alone).

Dedicated C++ program: Gaussian measurement errors, efficiencies, noise and event pileup.

3 GeV DESY data: χ^2 from analytical fit

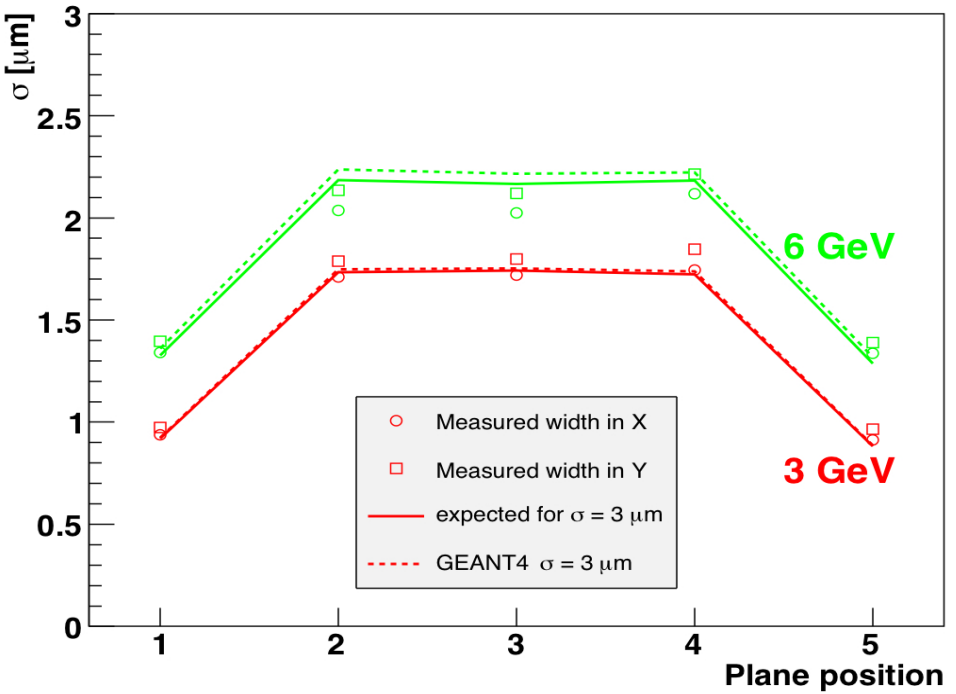


Residuals



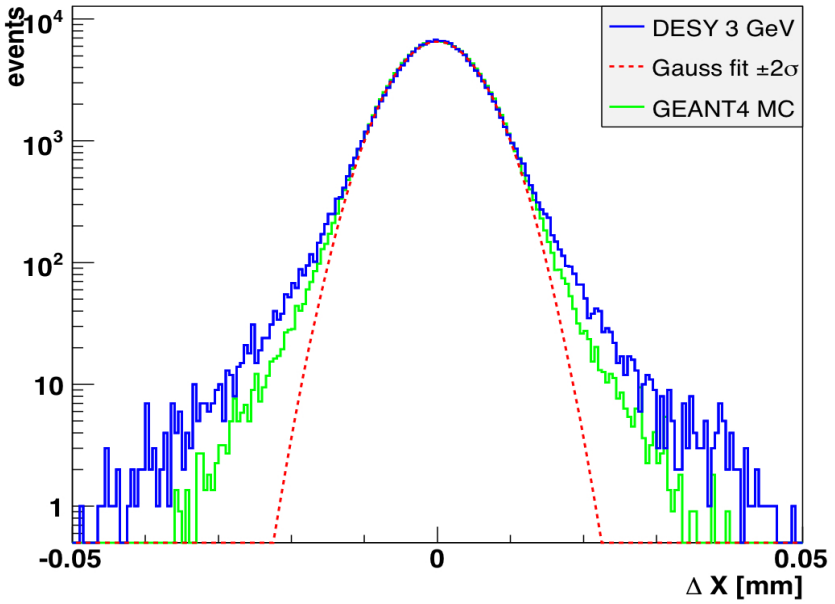
Residuals in the middle plane.

Geant 4 describes nongaussian tails.



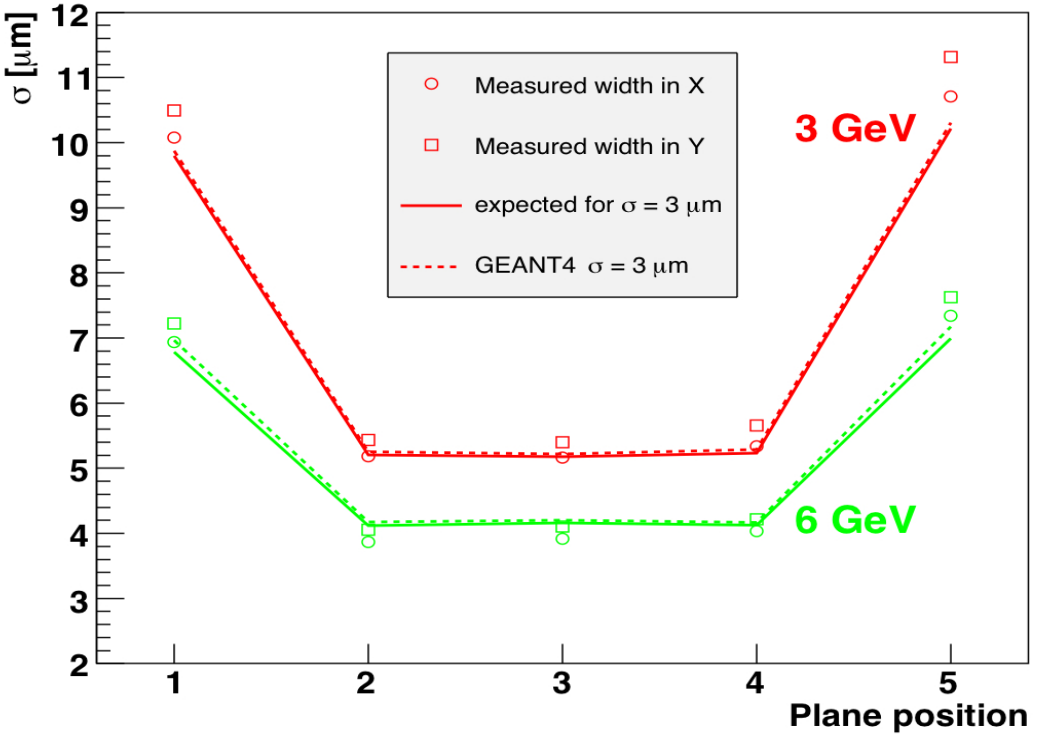
Very good agreement between predictions and measurement.

DUT mode

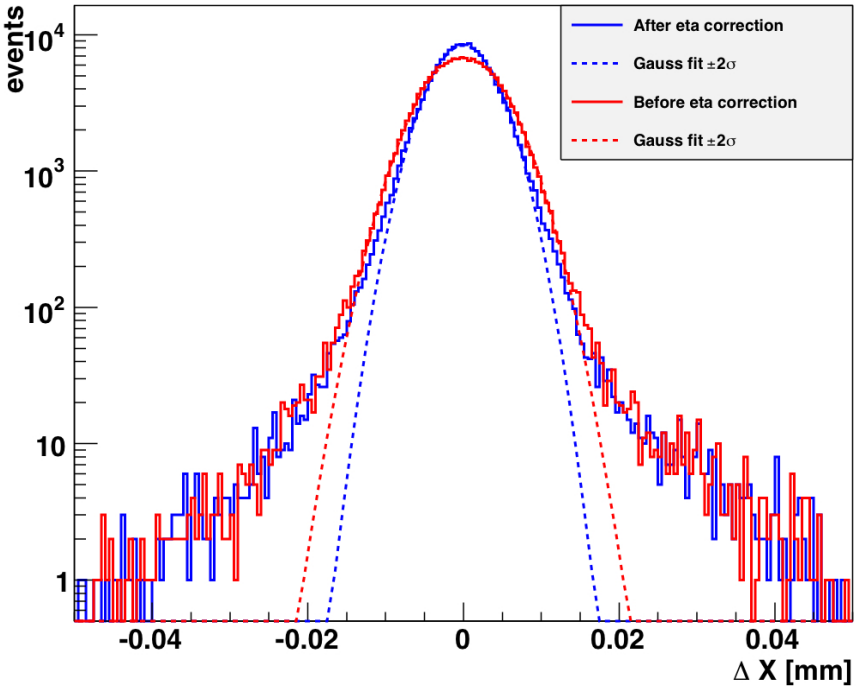


The middle sensor is treated as DUT and excluded from the track fit.

Again, the agreement is very good.



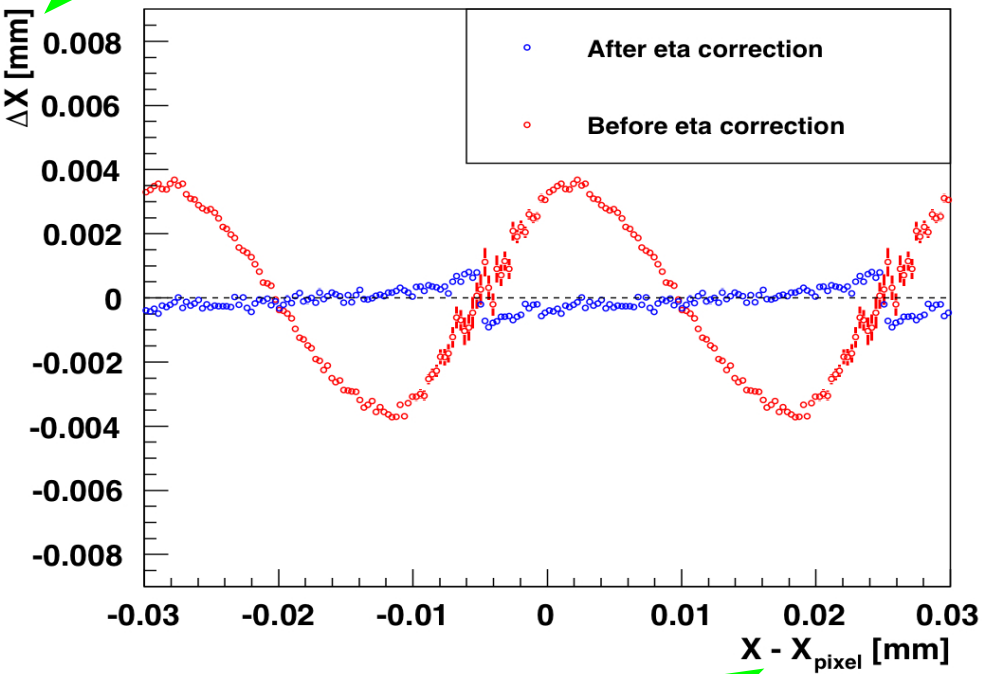
6 GeV DESY data: the η correction



It seems that we are slightly overcorrecting the data.

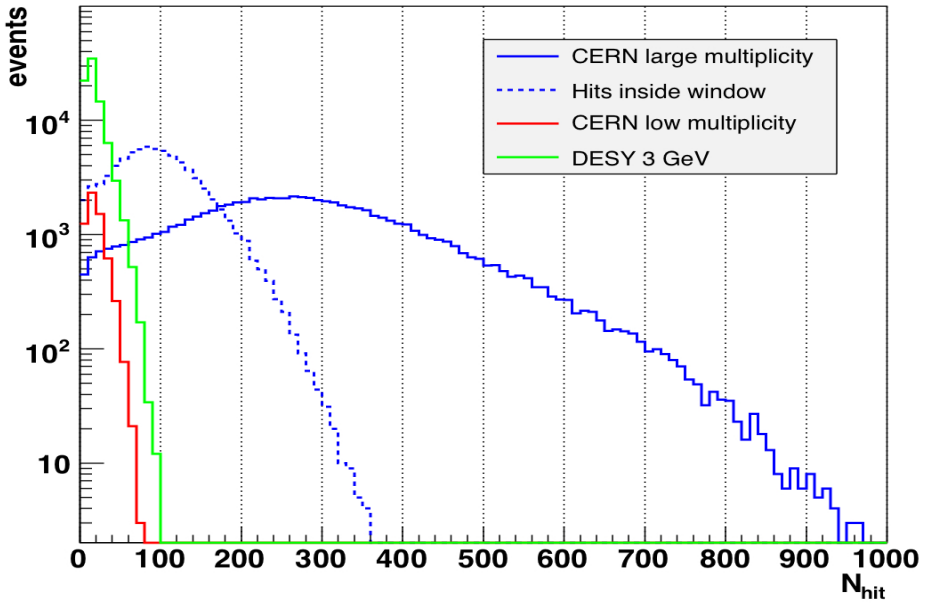
More results from will be shown by Filip tomorrow.

Average position shift.



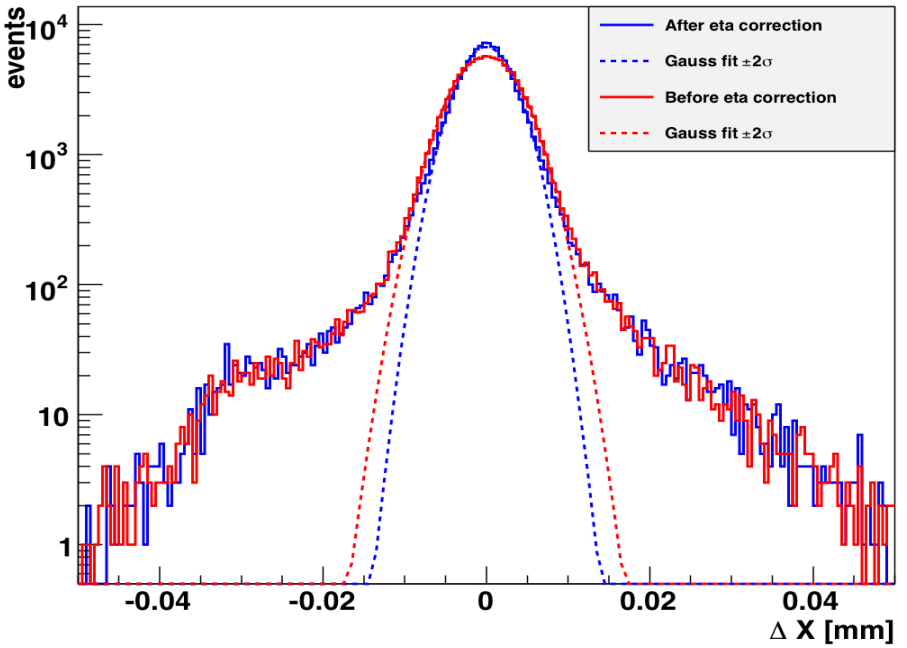
Position realive to pixel center

And there is also the CERN data...



Much higher multiplicities
→ more challenging to find tracks

DUT mode



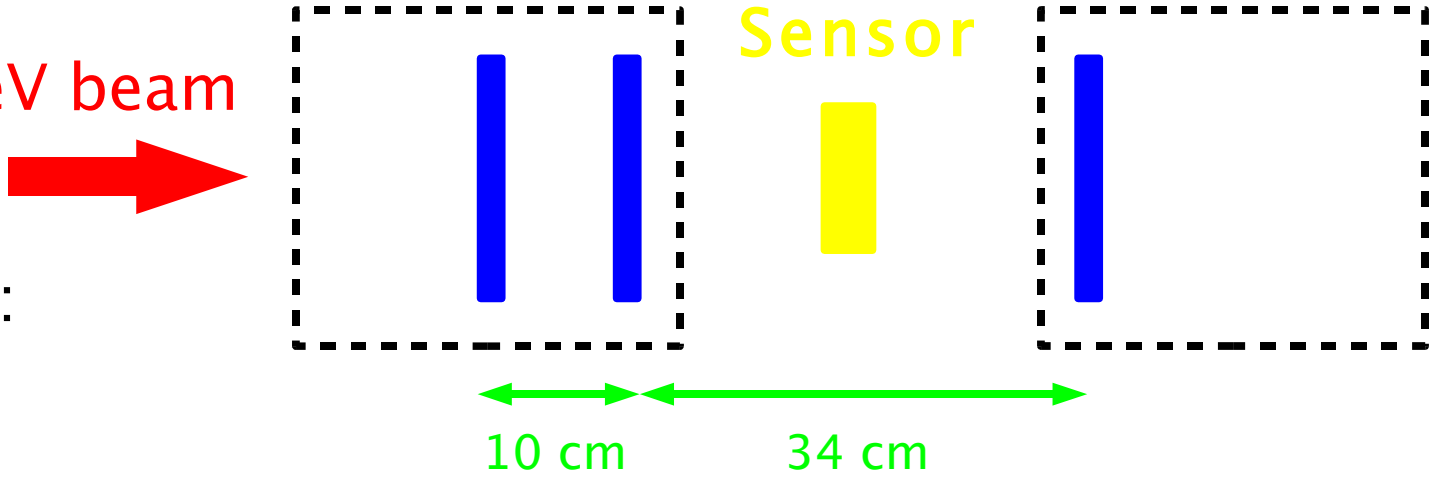
Plans for data analysis

- Finish the analysis as soon as possible.
- We have not looked at all available samples yet (e.g.: ZS data).
- Tomorrow we will review what has been done and discuss what is still missing.

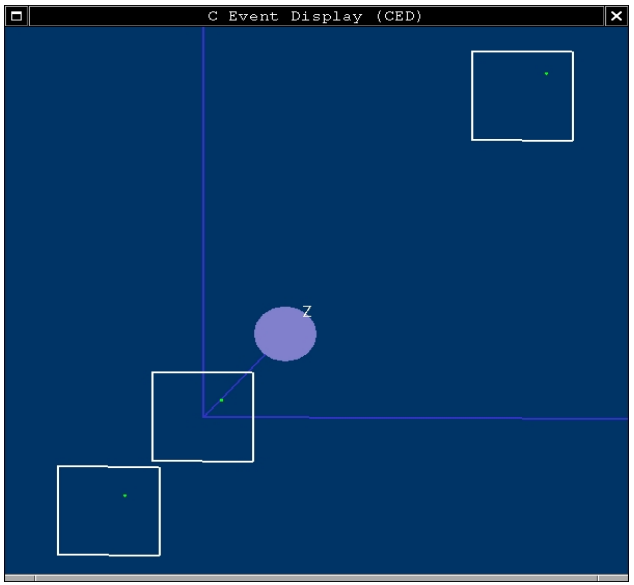
The BeamCal sensor in our telescope

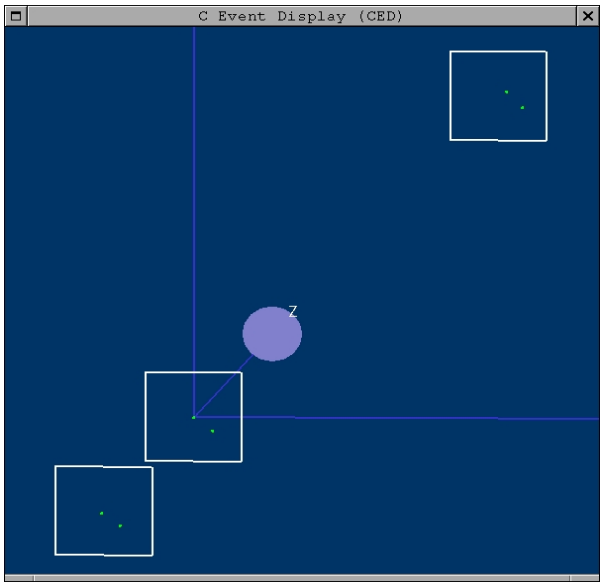
Goal: Measurement of the mean number of charge carriers created by a MIP in sCVD diamond.

3 GeV beam



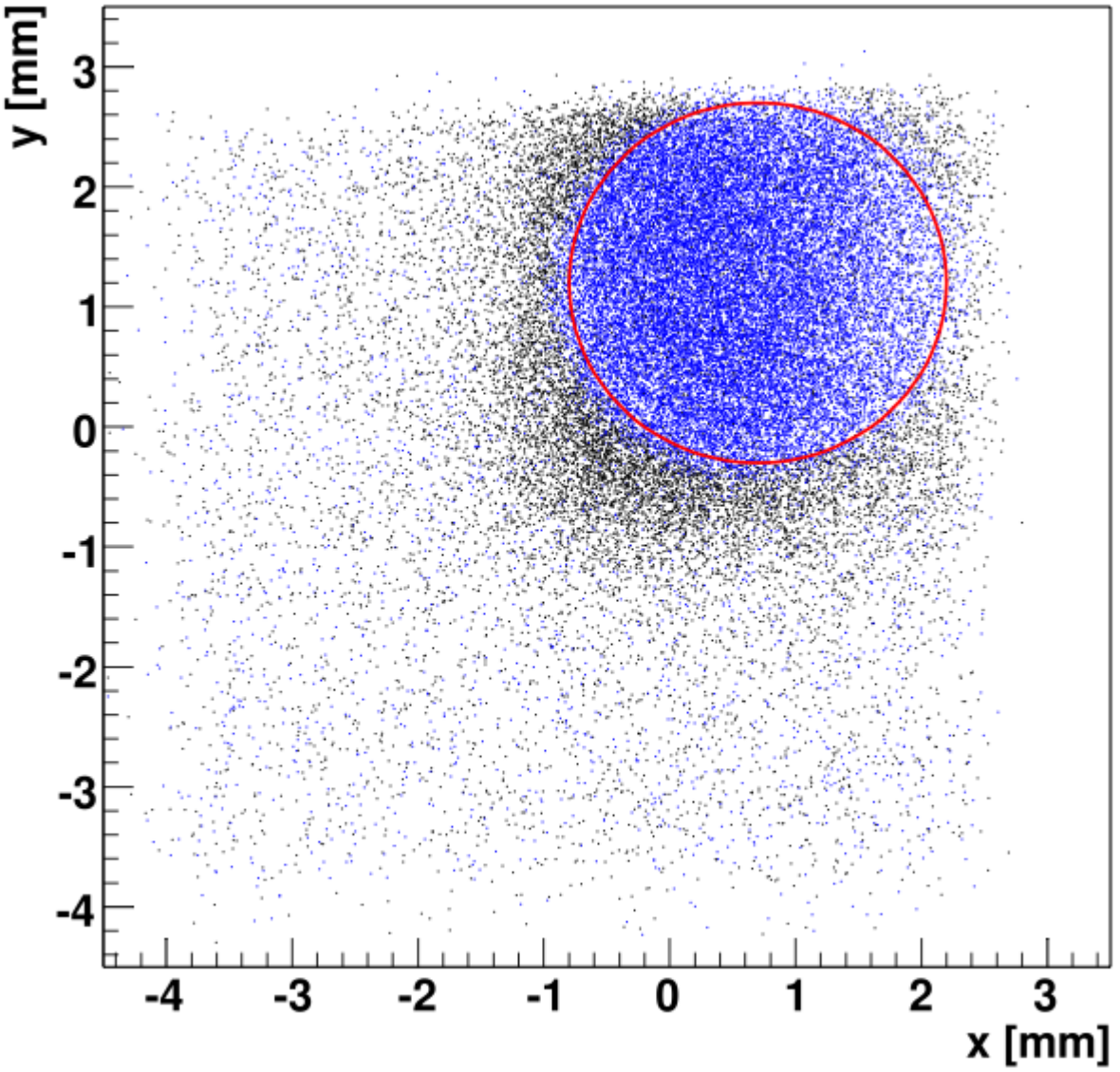
first two sensors:
14 µm epi layer





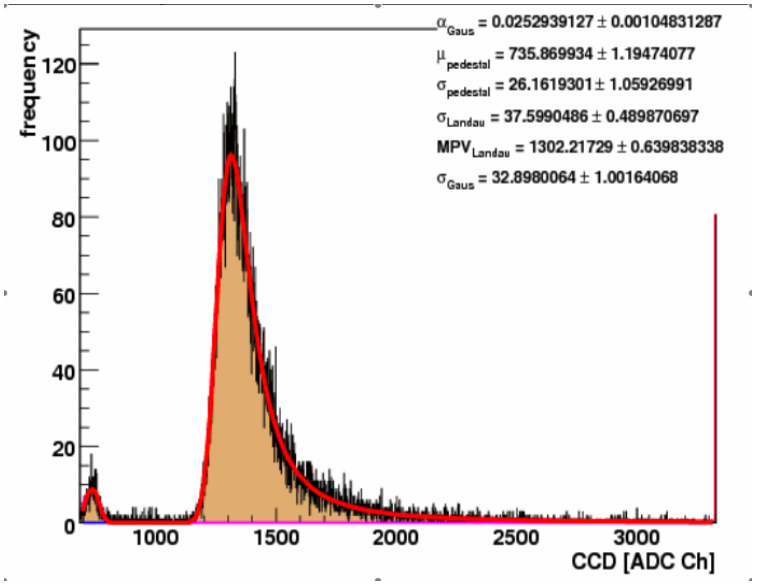
Despite a lot of problems
(see talk by Ingrid):
85.000 events in RAW mode taken in less than 24 hours.

Particle position in the DUT plane



Use the telescope to **avoid border effects.**

Black: sensor signal below cut.
Blue: sensor signal above CCD cut.



More details:
EUDET-Memo-2007-58

Tomorrow: Software Meeting

Thursday 31 January 2008 top

09:00->*15:00* **Software Meeting** (Location: building 1a/ sem.rm.1)

09:00	Latest development of the EUTelescope and experience with end user (30')	Philipp Roloff (*Deutsches Elektronen-Synchrotron (DESY)*)
09:30	RootMonitor (20')	Joerg Behr
09:50	Status of the analysis: what has been done (30') (Location: 1)	Aleksander Filip Zarnecki (*Warsaw University*)
10:20	Schedule and sharing what is missing (20') (Location: 1)	Antonio Bulgheroni (*INFN*)
10:40	Understanding of beam telescope resolution (30')	Auguste Besson
11:10	Open Discussion (20')	ALL

Everybody is welcome to participate!