Introduction to EUTelescope and its Analysis Workflow

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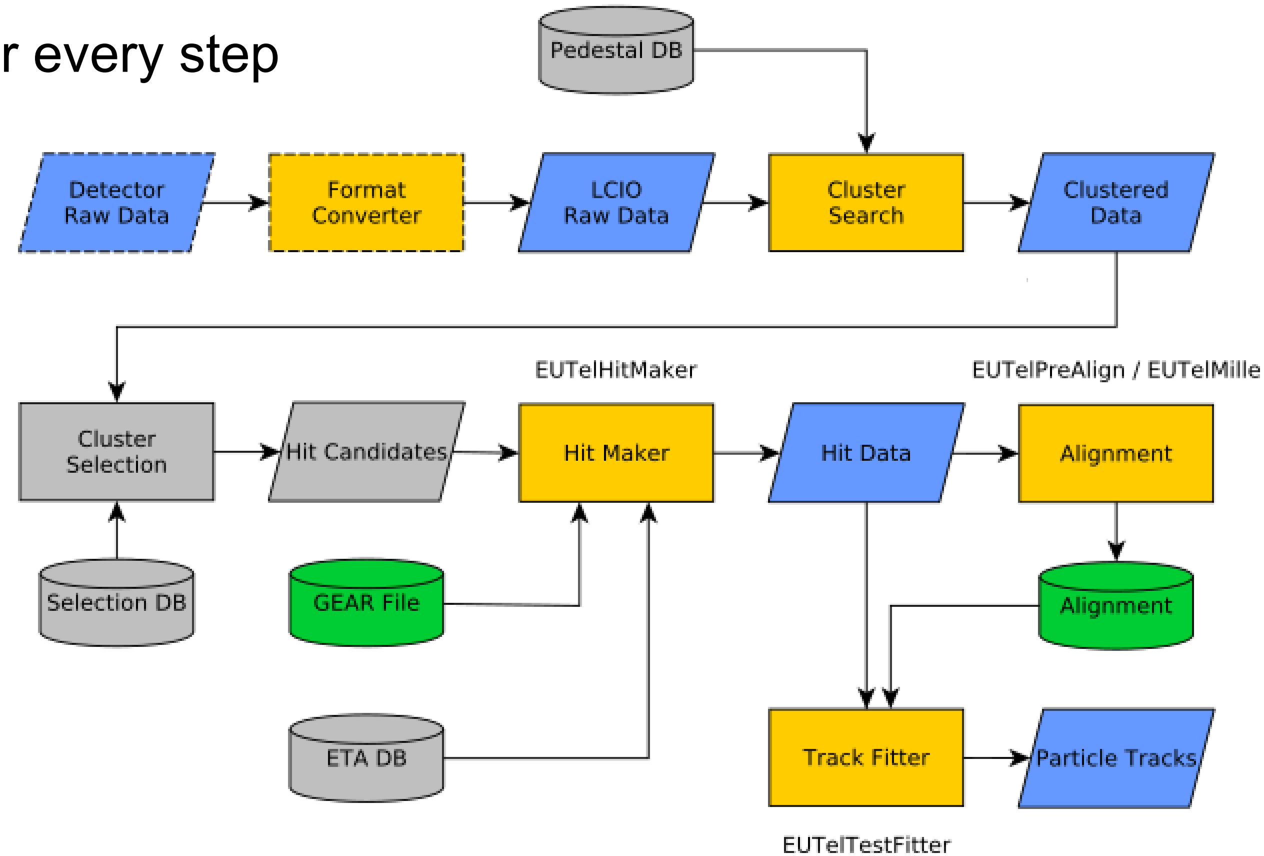
Overview

- Overview of EUTelescope
- Typical Step-By-Step Data Analysis Workflow
- Example Analysis: Telescope Planes as DUT

The EUTelescope Data Analysis Software

- Group of Marlin processors for offline data analysis and reconstruction
- Step-by-step transition from single pixel array (raw data) to 3D coordinates of fitted tracks in a global frame
- XML steering file for every step

Data state
Analysis step
External file
Unused



S. Spannagel

Step 1: Data Conversion

- Goal: Transfer the data from raw into LCIO (=Linear Collider I/O) format

- Close the gap between detector simulation and reconstruction by unique data format for both sides.

- LCIO is an event-based data format.
  - All data belonging to one trigger decision and detector readout is stored together
  - Event consists of the event header and the actual data. Header contains information on detector, timestamp, and run number.
  - The event data is stored in collections of different types. Each collection contains specific data entities with a unique ID.

- Used Marlin processors:
  - Native Reader – performs the conversion
  - Hot Pixel DB – identifies and removes noisy pixels

Step 2: Clustering

- Find clusters in the (LCIO-format) data

- Typically used Marlin processors:
  - AIDA – creates and fills histograms and tuples
  - Pedestal Noise Processor – provides noise status of the sensor planes
  - Load Hot Pixel DB – inputs hot pixels from file or from a database
  - Correlator – fills histograms with correlation plots
  - Clustering Processor – detector specific algorithms, find CoG

- Various implementations, two main approaches:
  - fixed frame – specify cluster size and signal
  - sparse cluster – seed pixel and a max. cluster 'length'

Step 3: Hitmaker

- Transform coordinate system:
  - From local clusters (col | row) on a sensor plane → global frame (x, y, z)

- Typically used Marlin processors:
  - AIDA, Load Hot Pixel DB, Correlator – as is previous steps
  - Hitmaker – relates the center of gravity of a cluster on a sensor plane to the global frame with the GEAR XML file
  - PreAligner – calculates rough alignment

Step 4: Sensor Alignment

- Calculate alignment constants for telescope sensor planes and the DUT

- Typically used Marlin processors:
  - AIDA, Load Hot Pixel DB, Correlator – as is previous steps
  - Load PreAlignment, apply PreAlignment – get a rough idea where the sensor planes are
  - Apply Alignment – generate a steering file and run MillePede, apply residual cuts

- Further information in later talks!

Step 5: Track Finding and Fitting

- Fit tracks from the hits through the aligned sensor and DUT planes
- Typically used Marlin processors:
  - AIDA, Load Hot Pixel DB, Correlator – as is previous steps
  - Load and apply alignment
  - Track fitter – various fitters available, e.g.:
    - EUTelTestFitter
    - EUTelDafFitter

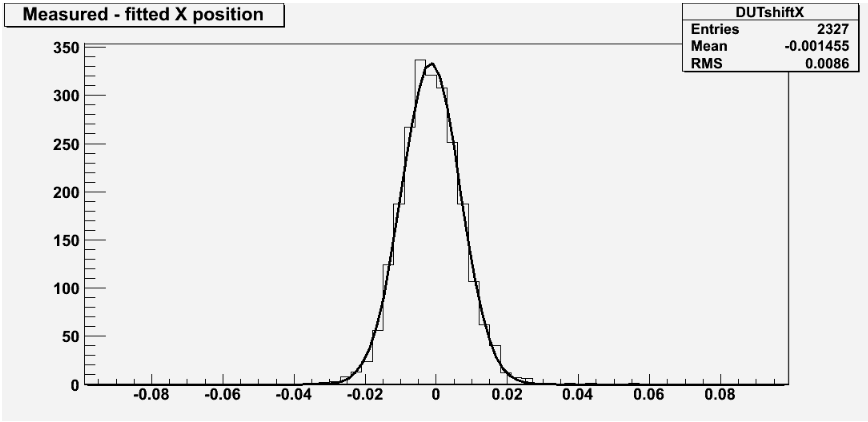
- Run your own analysis:
  - SLCIO files
  - ROOT output
  - Your own processor

    → Example: TelDUTHisto – one telescope plane as DUT, others for residuals

Example Resolution Analysis with TelDUTHisto

- Telescope figure of merit: intrinsic tracking resolution
- Use one telescope plane as DUT, take residuals from others
- Resolution dependent on beam energy, threshold and sensor distance (multiple scattering)

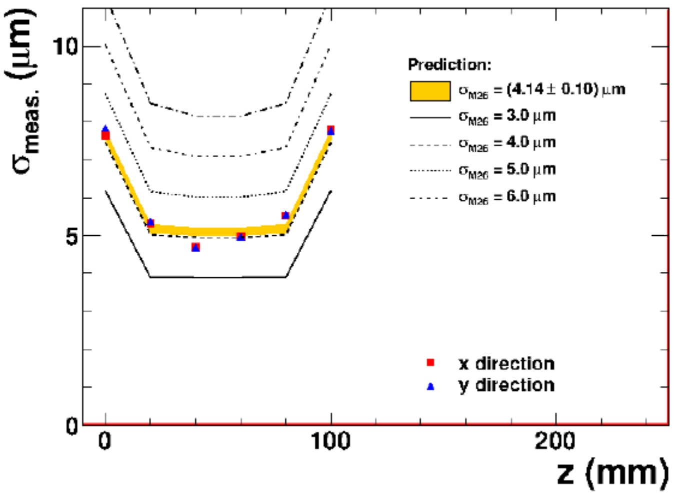
- Unbiased residuals:



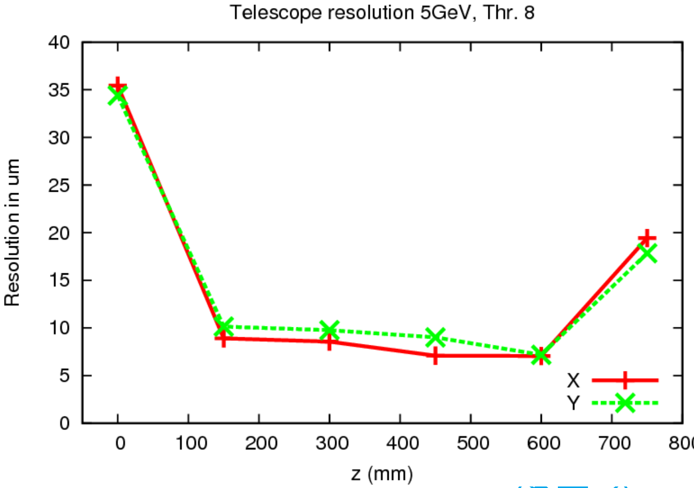
- Work in progress

- Studies will be made available as a test case

- d = 20mm, σ ~ 4µm



- d = 150mm, σ ~ 8µm



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EUTelescope Remarks

- EUTelescope website:

  eutelescope.web.cern.ch

  → bug tracker & forum

- Join the mailing lists (CERN e-group):

  users: eutelescope-users@cern.ch

  developers: eutelescope-developers@cern.ch

  - If you don't have a CERN account, external e-mail addresses can be added – contact me

Backup