MarlinTPC

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Overview

MarlinTPC: Marlin package for TPC studies

More than 50 processors in different sections:

- Simulation
- Digitisation
- Reconstruction
- Calibration
- Analysis

- Validation
- Tools
- Examples

- LCIO data classes for conditions data

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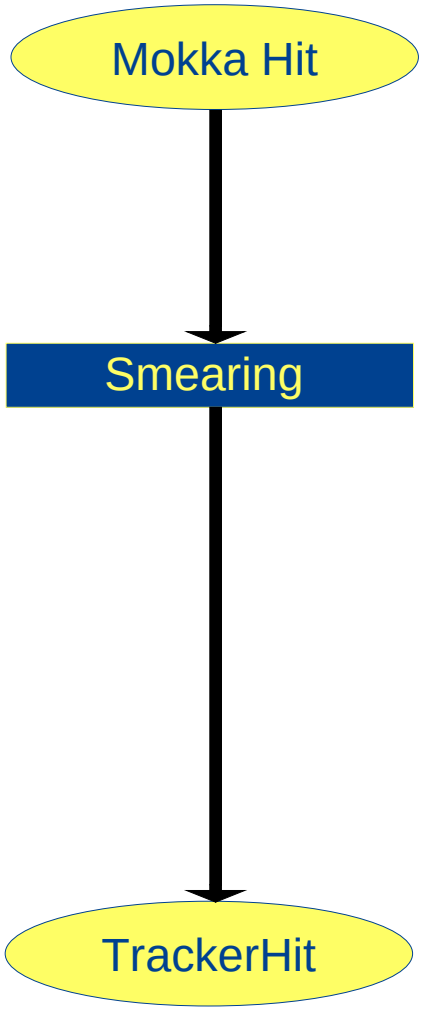
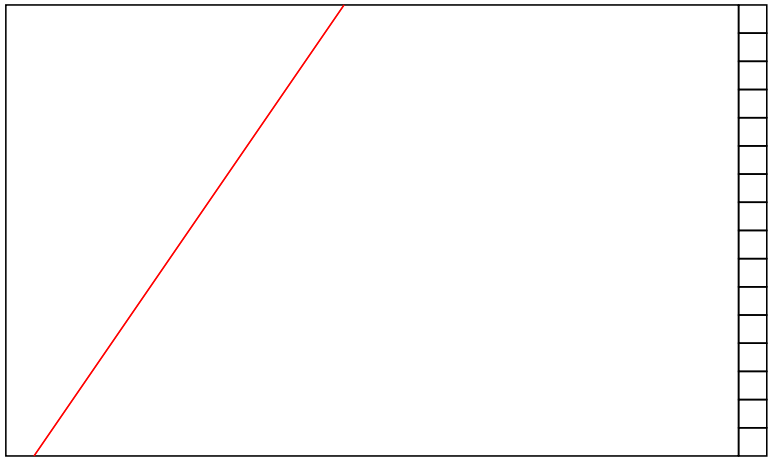
Simple "Digitisation"



Why is this not always sufficient?

- Does not provide raw data
  (ADC counts on electronics channels)
- Completely skips pad geometry
- Skips major parts of the reconstruction
- No event pile-up
- Dead or noisy channels not included

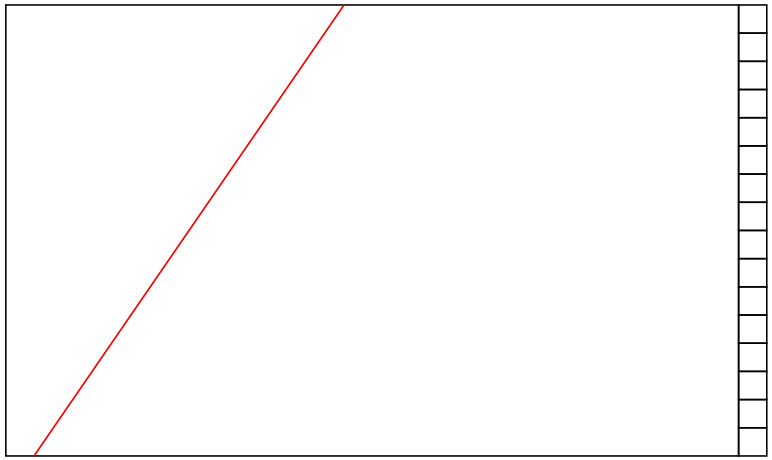
DAQ in a TPC



- TPC takes a long time to read out ($\mathcal{O}$ 150 BX)
- Electronics records many 2D pictures with readout frequency

$\Rightarrow$ 3D picture with *voxels*

DAQ in a TPC



- TPC takes a long time to read out ($\mathcal{O}$ 150 BX)
- Electronics records many 2D pictures with readout frequency

$\Rightarrow$ 3D picture with *voxels*

- Tracks from multiple events simultaneously in the TPC
- TPC makes one large 3D picture per bunch train
- Matching with silicon tracker and calorimeter to determine BX

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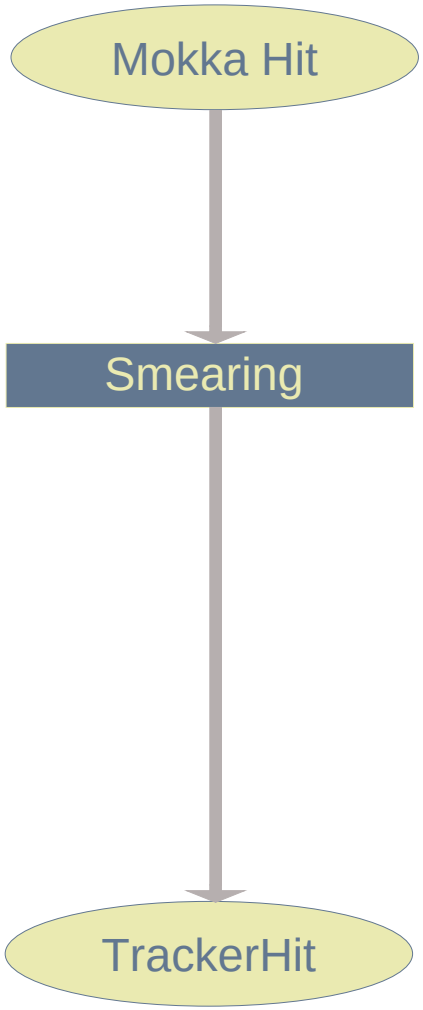
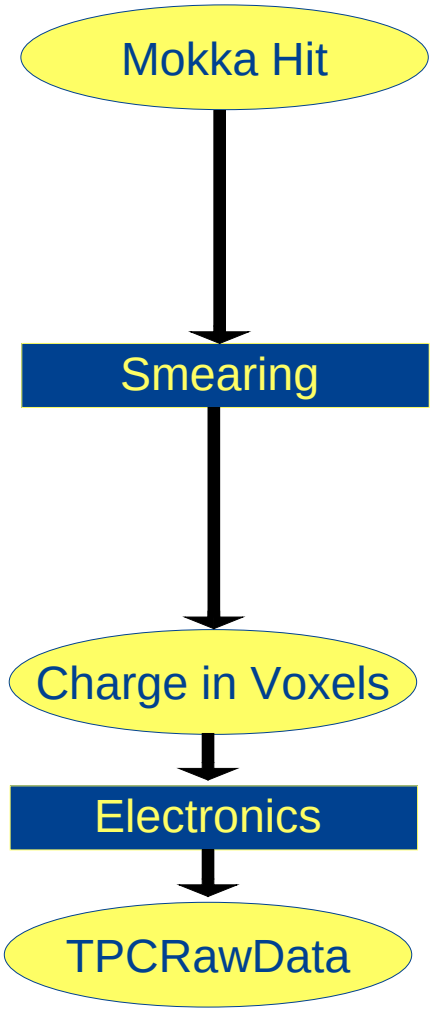
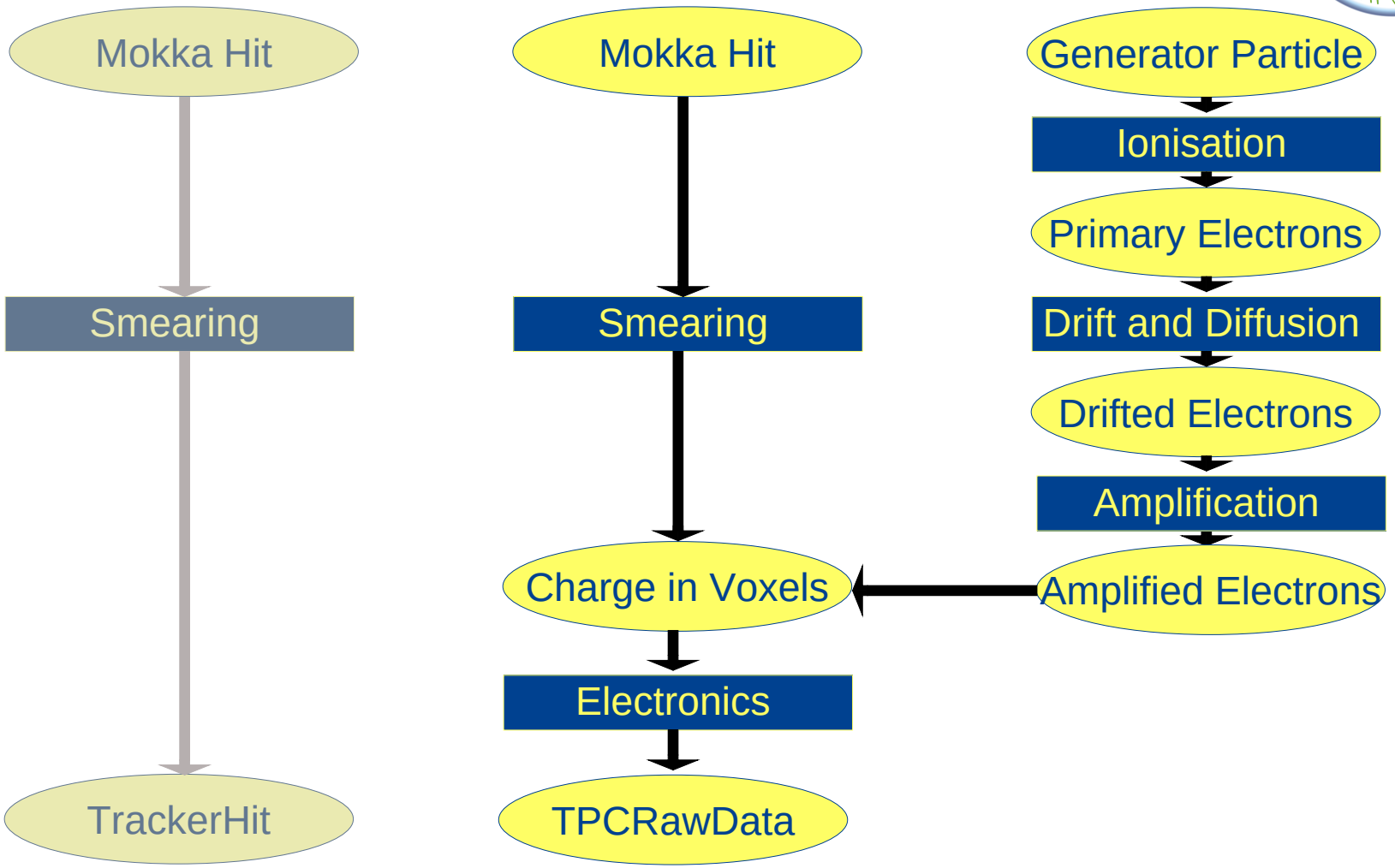
Digitisation in MarlinTPC





- Map of voxels resembles readout electronics
- Automatically implements event pile-up
- Background can be added
- Electronics specific converter provides realistic raw data

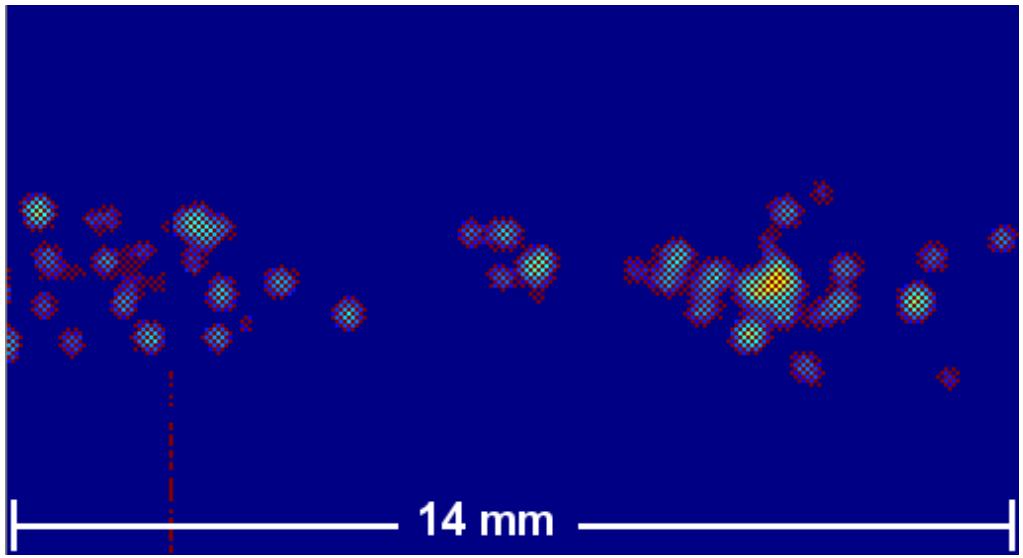
Digitisation in MarlinTPC



Detailed Digitisation

Why do we want to track every primary electron?

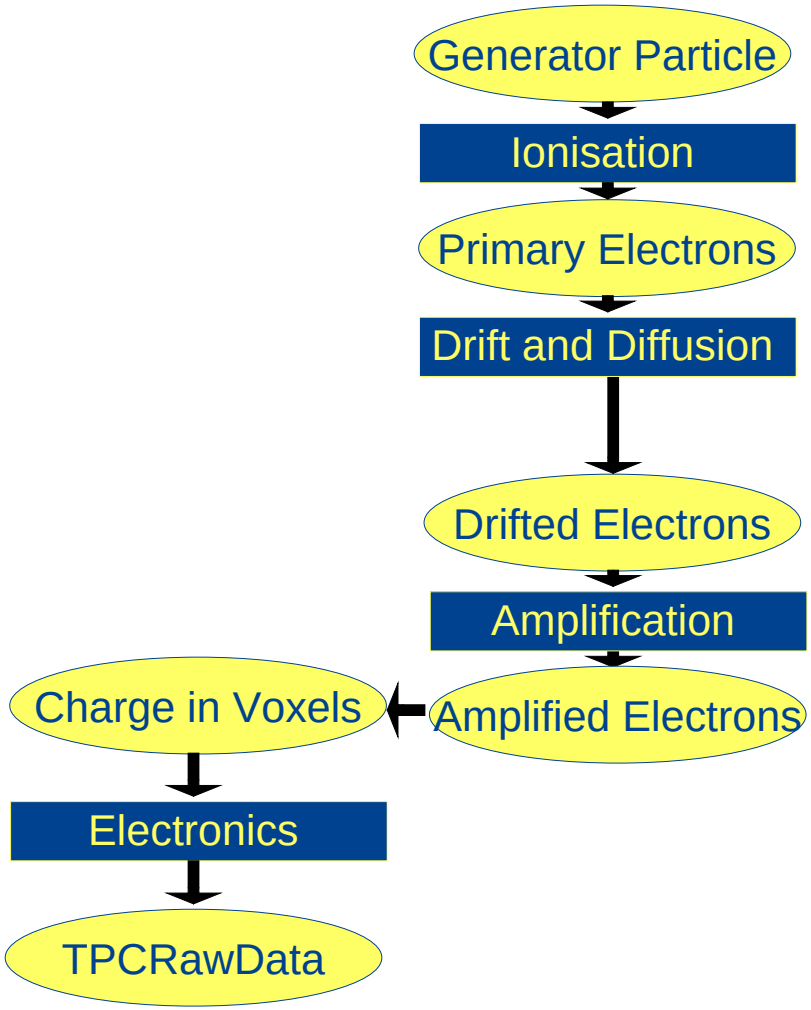
- TimePix Chip with $55 \times 55\ \mu m^2$ pixels
  is able do resolve individual ionisation clusters and single electrons



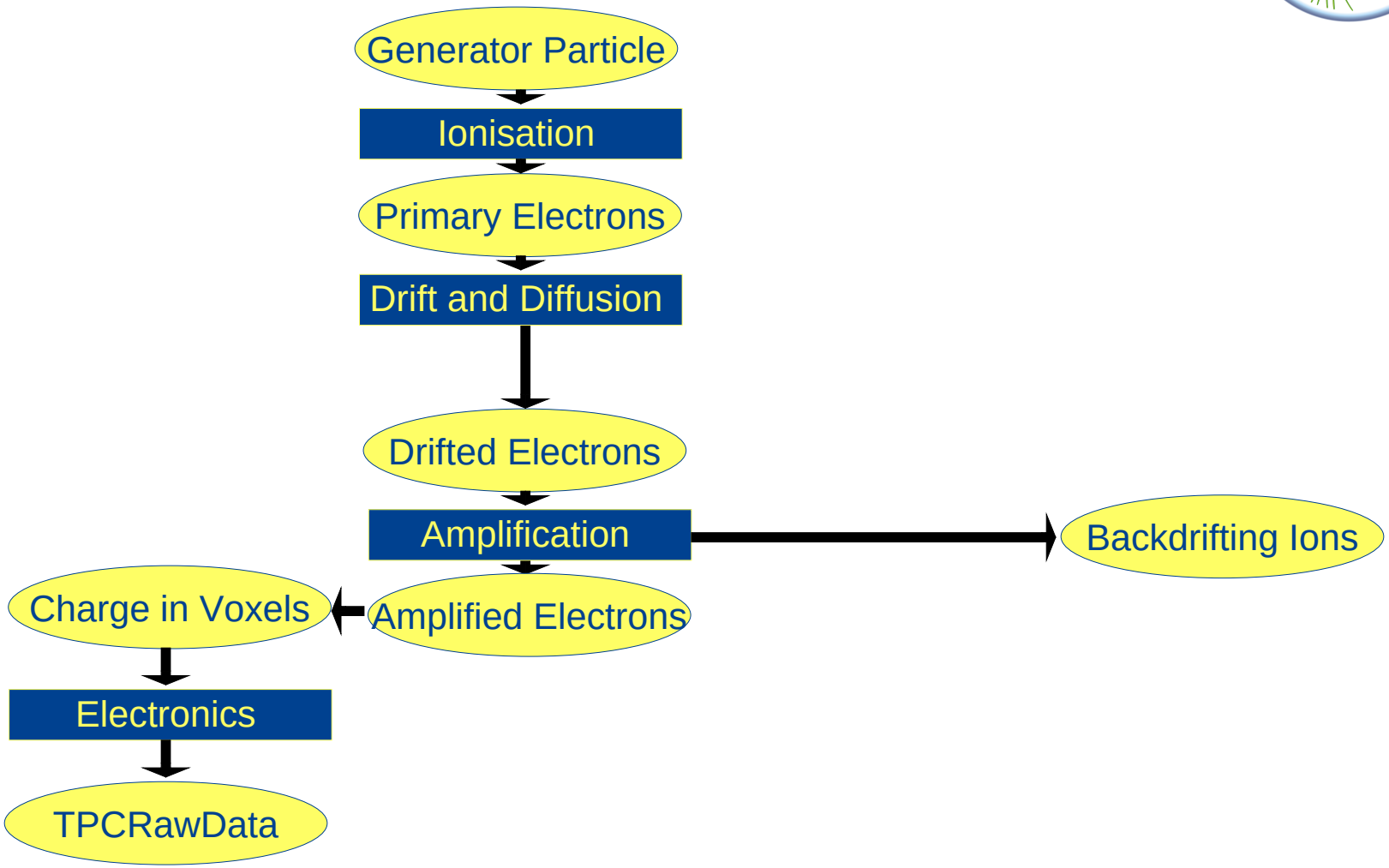
PixelMan Event Display

- Transfer coefficients in GEM readout are taken into account using binomial statistics
- Ion backdrift can be calculated

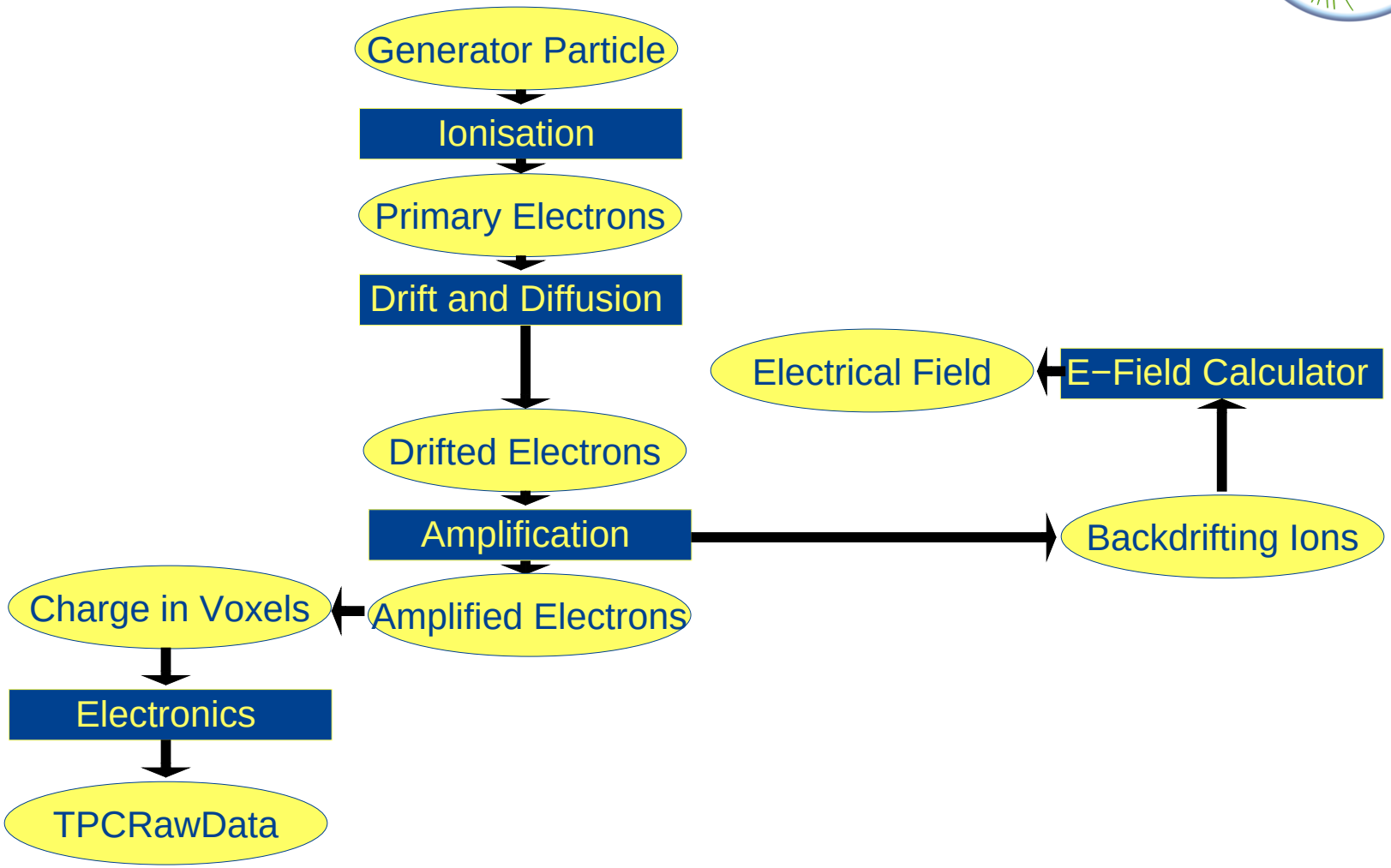
Ion Backdrift



Ion Backdrift



Ion Backdrift



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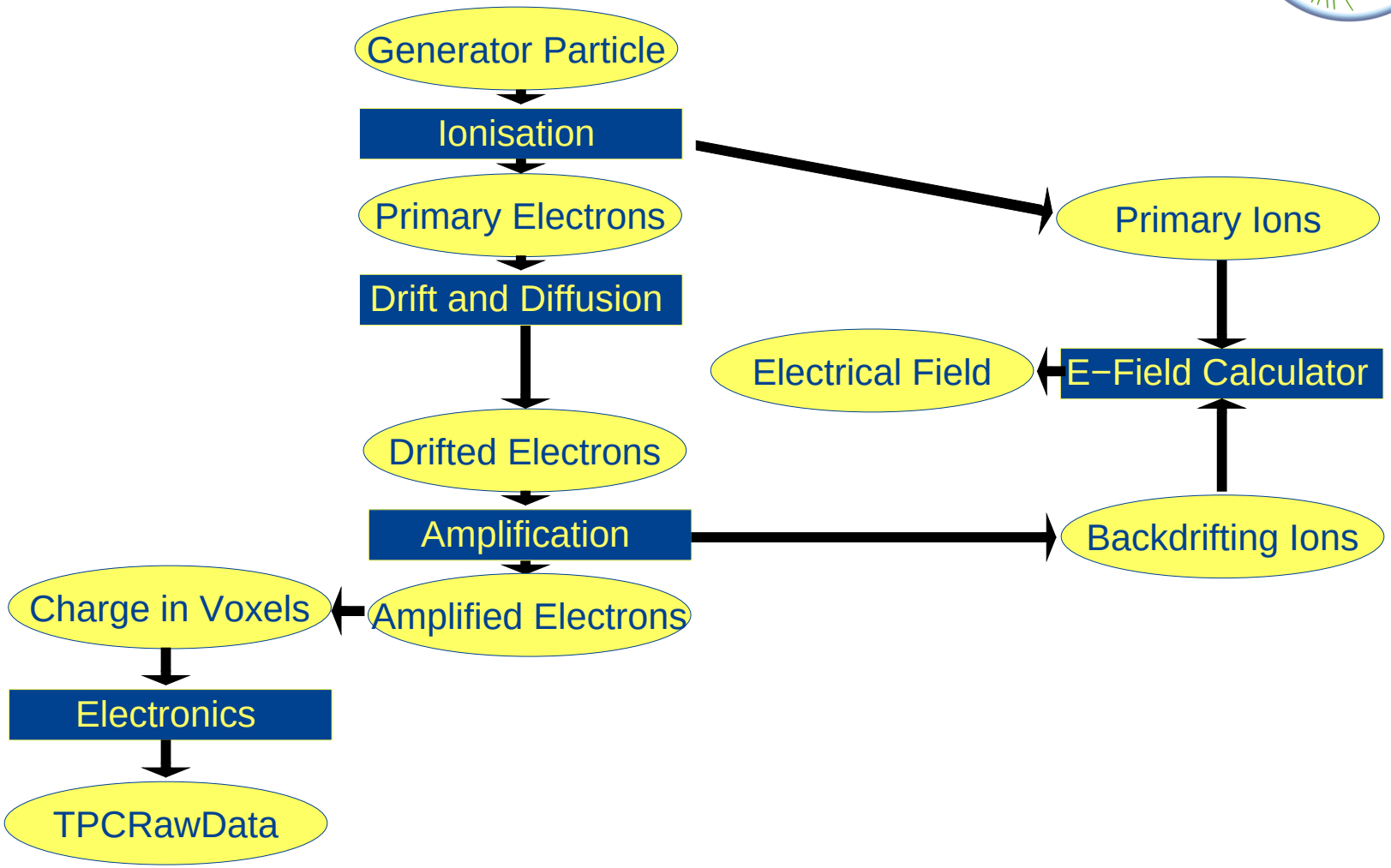

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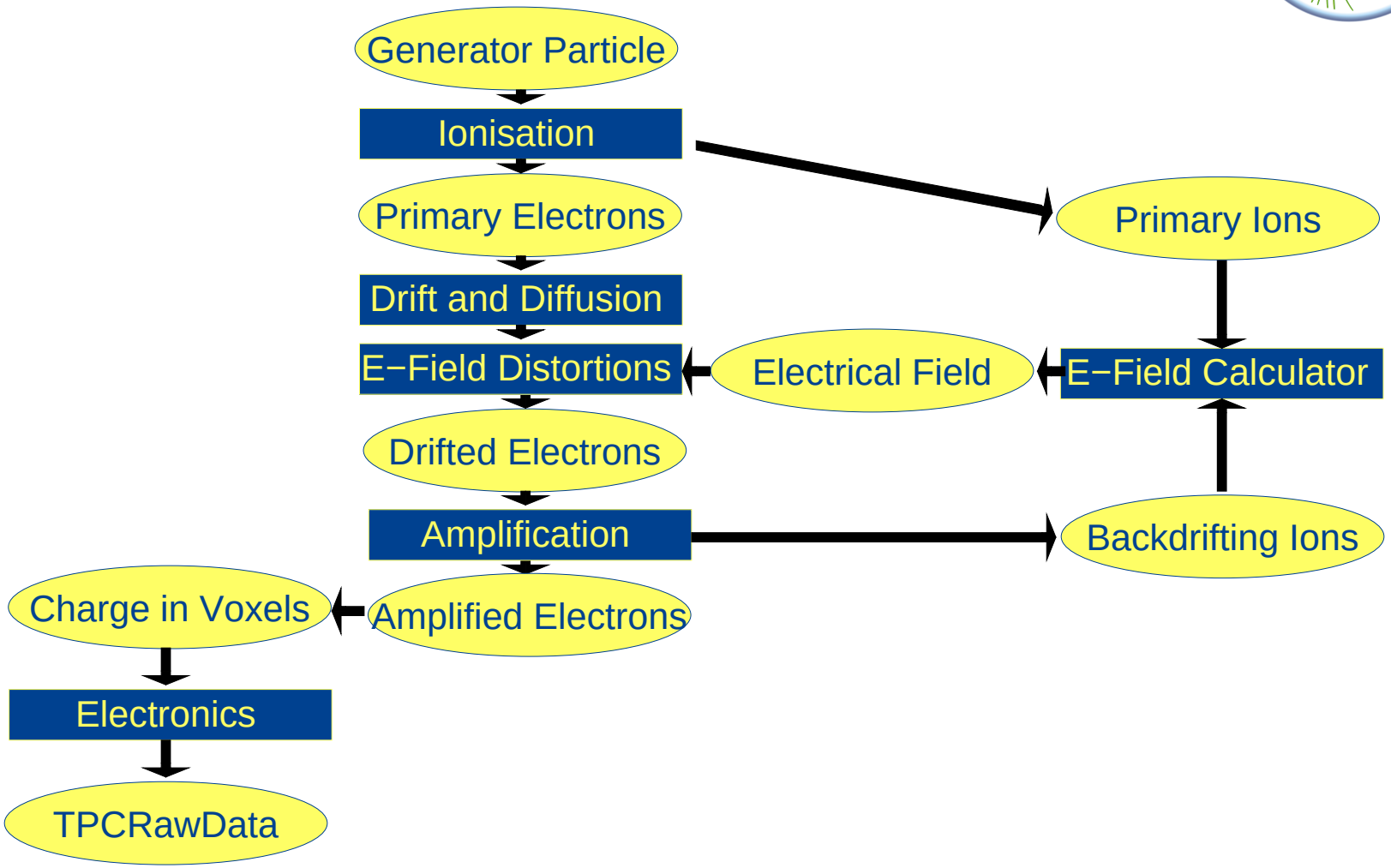
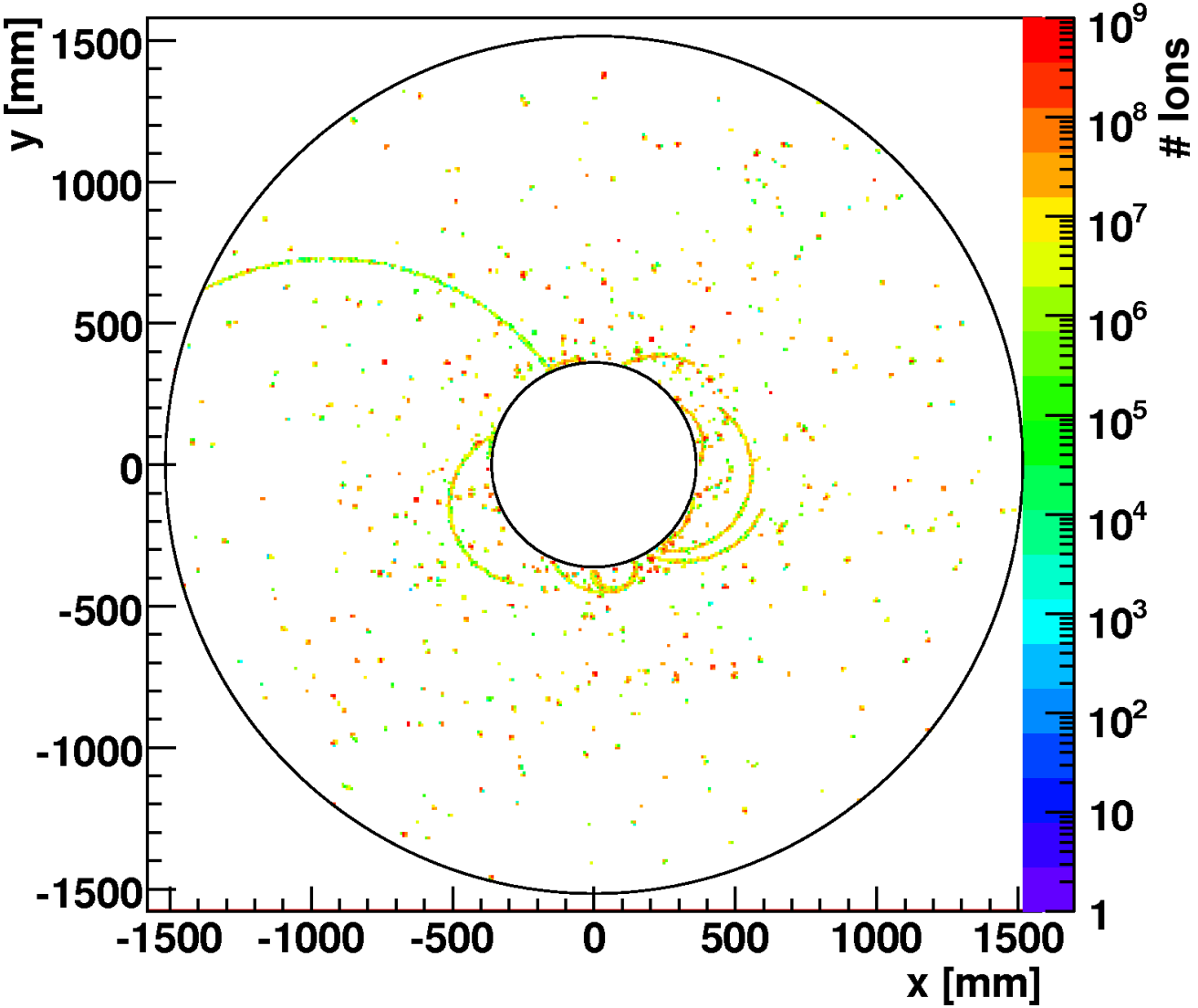


Ion Backdrift

Ion disk from 100 background events



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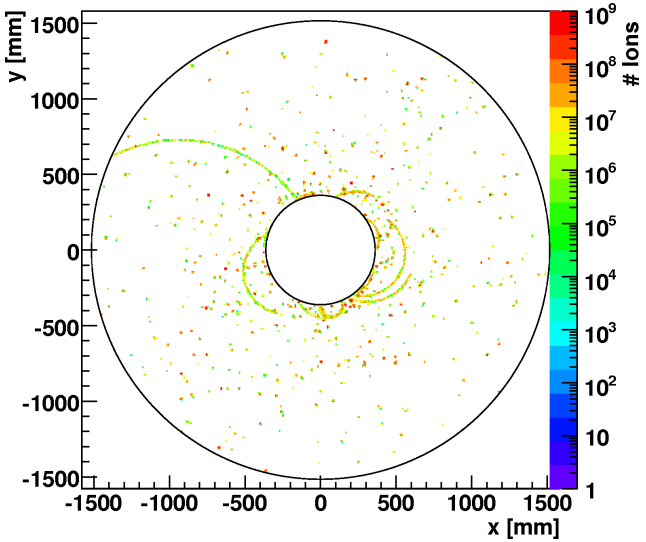
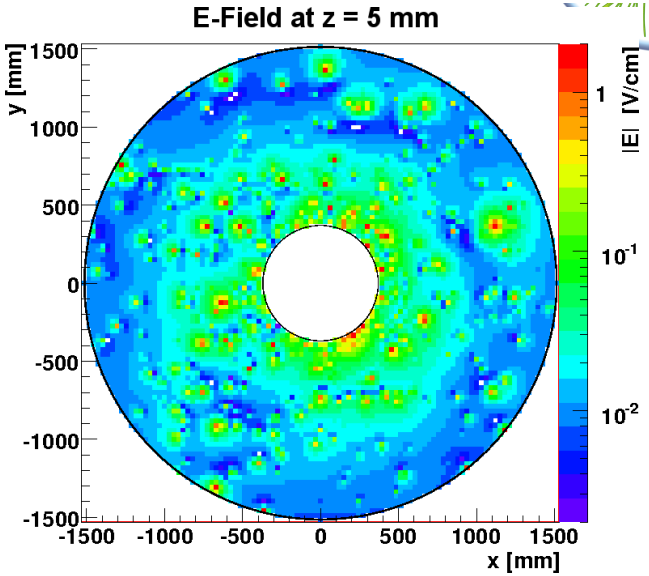


E-Field distortions after 100 events



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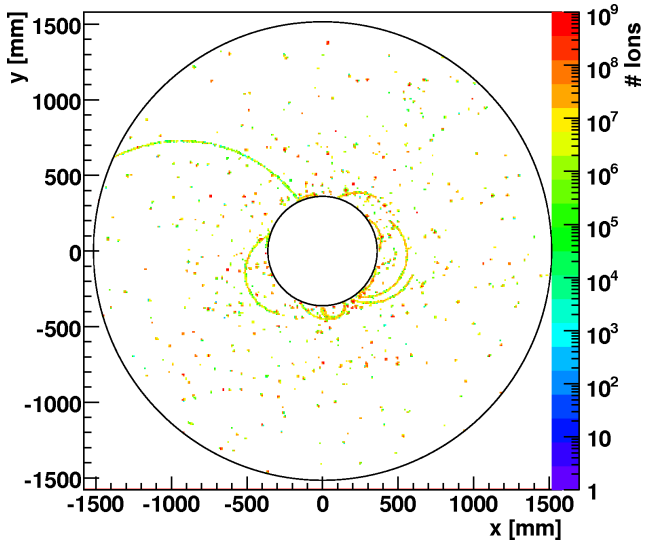

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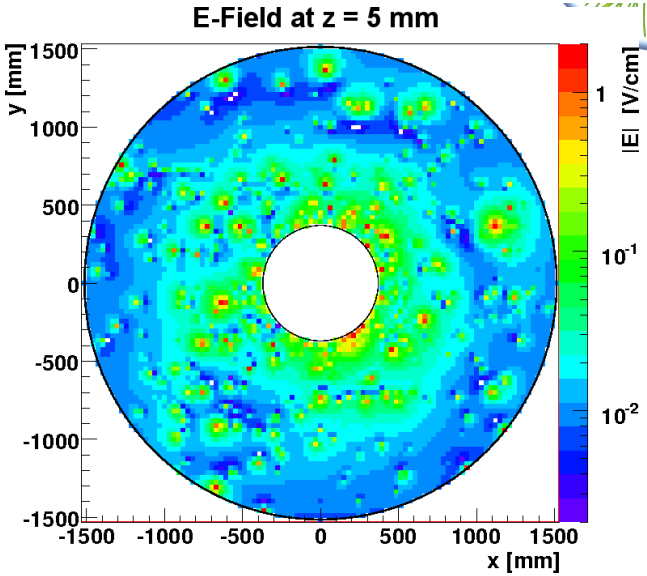
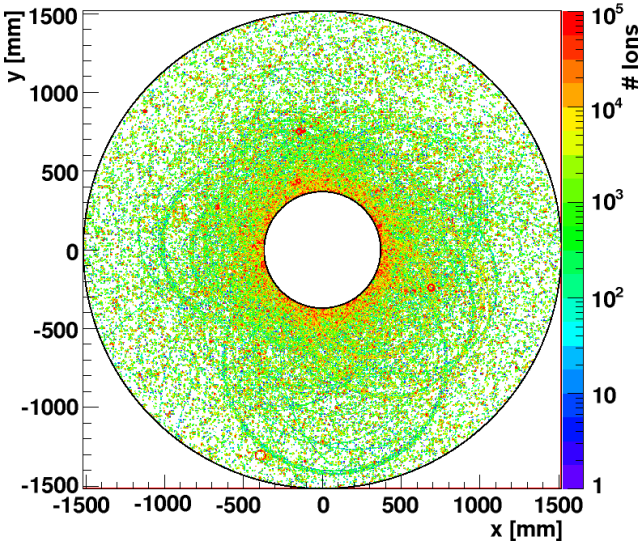
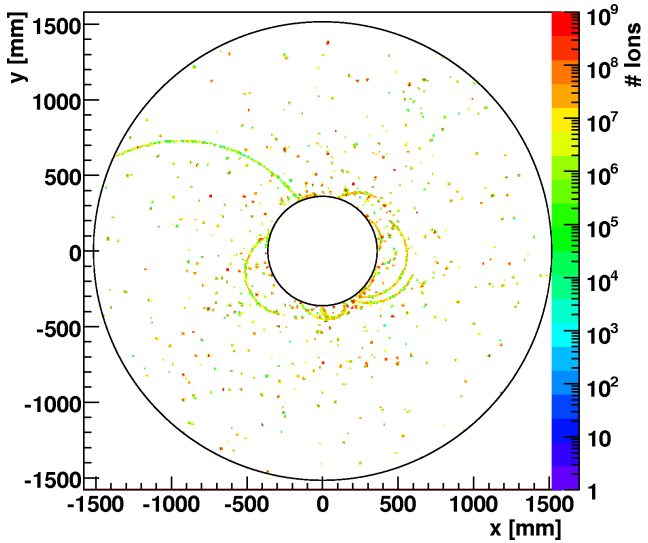


Ion disk from one bunch train



Ion Backdrift

Ion disk from 100 background events



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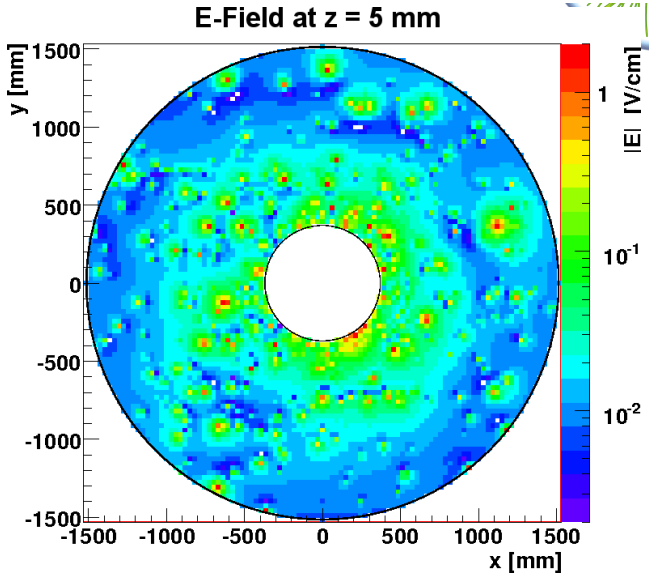
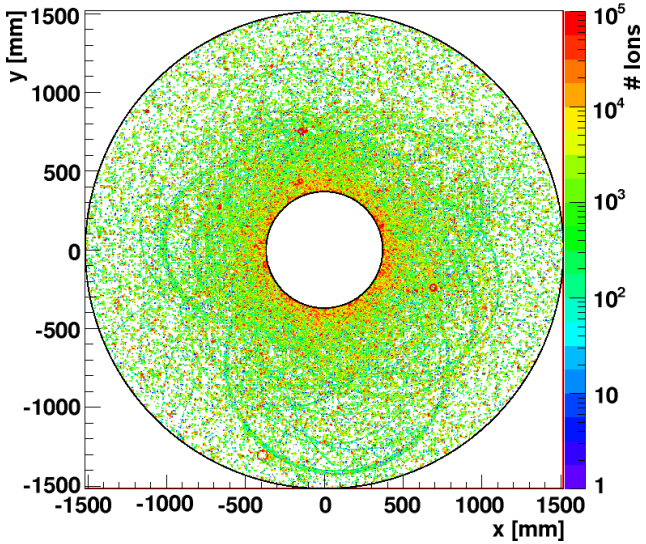


Ion disk from one bunch train



E-Field distortions after one bunch train

Still calculating. . .

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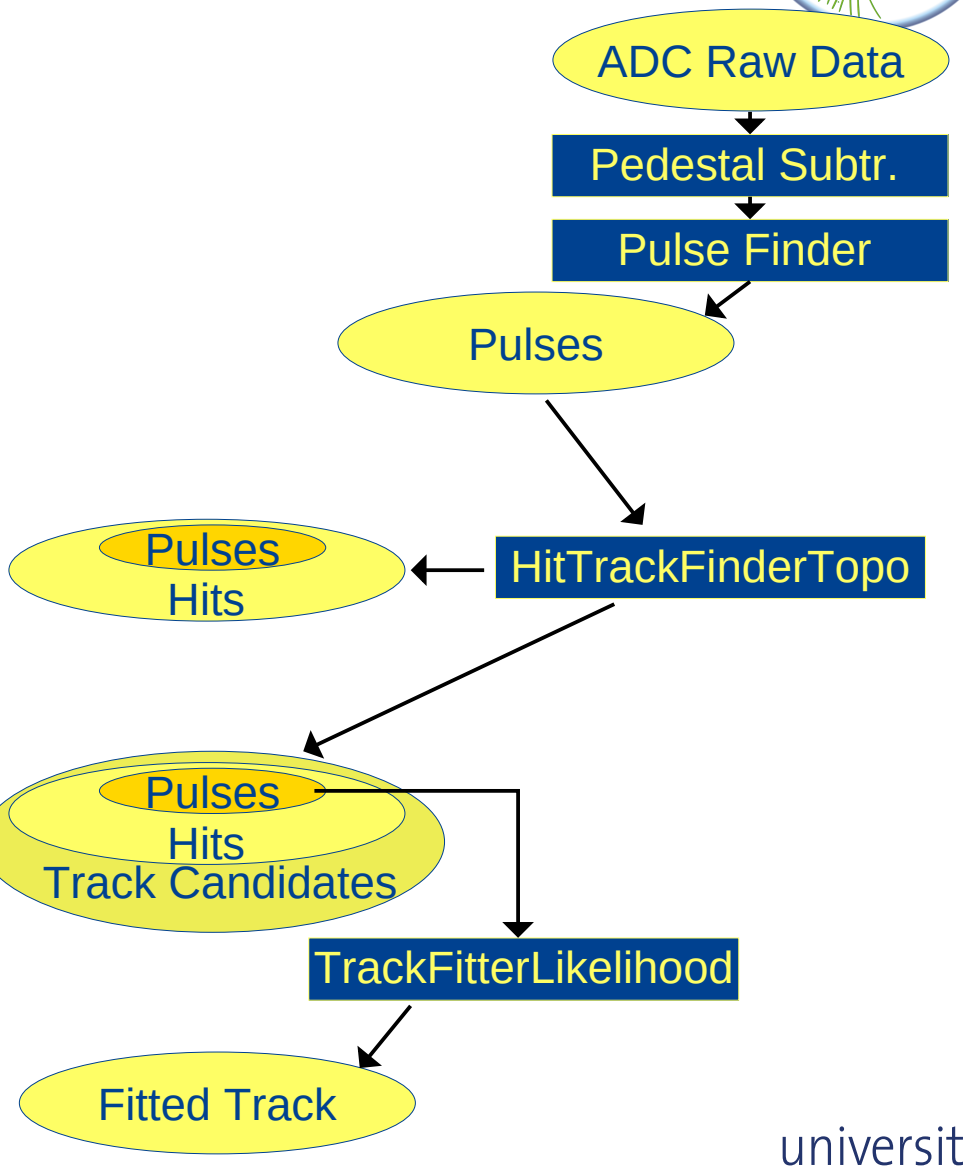
Reconstruction



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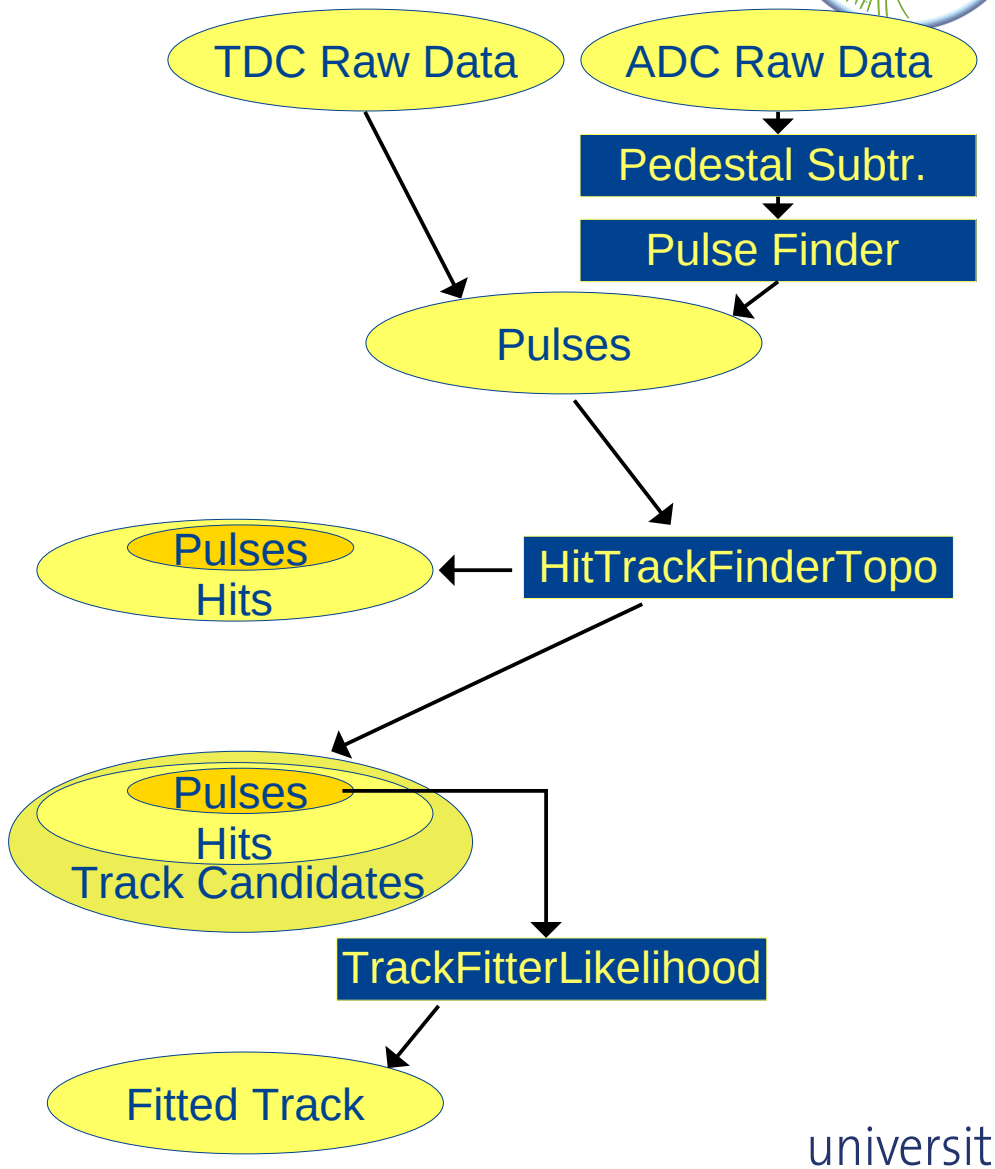

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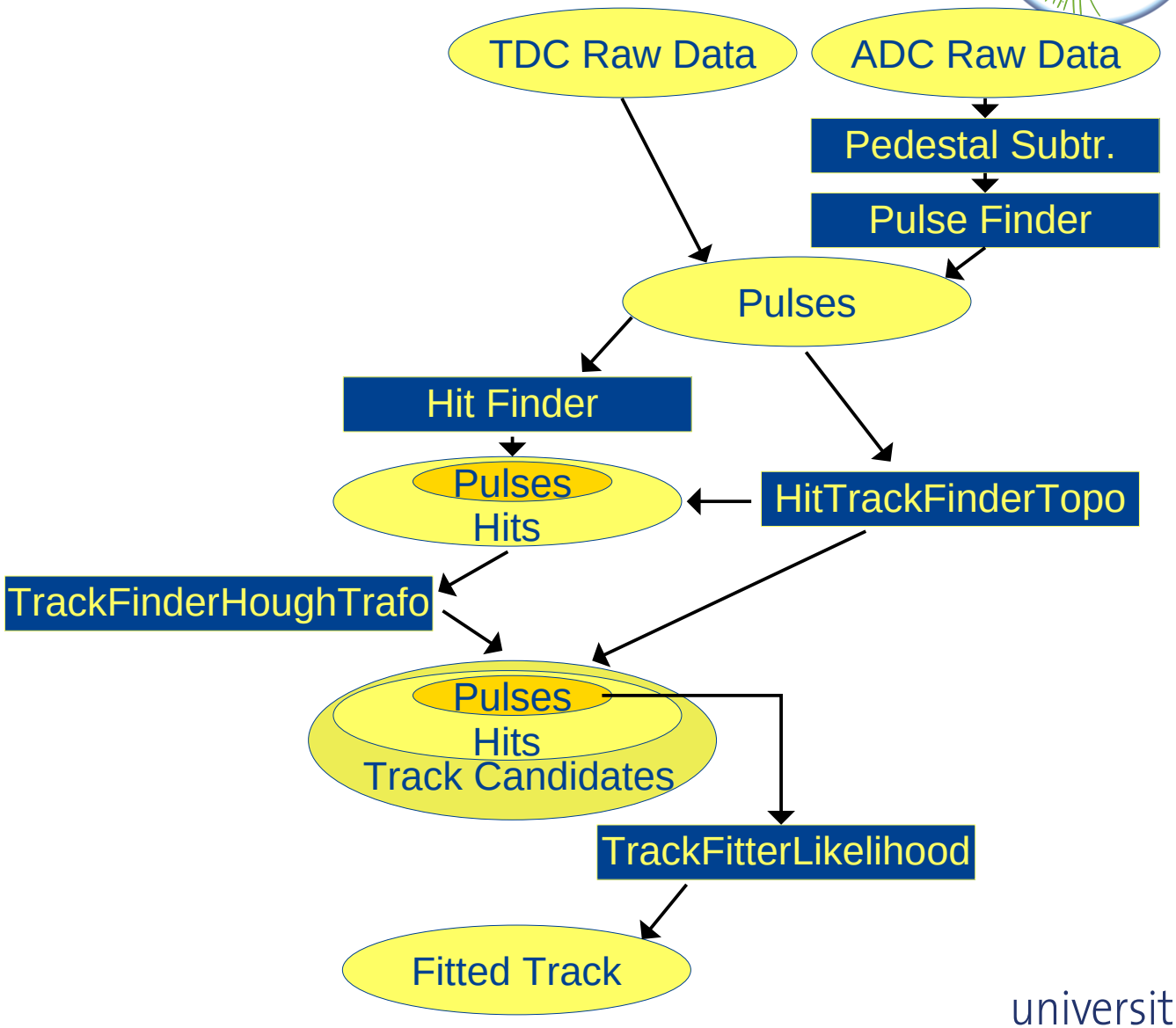
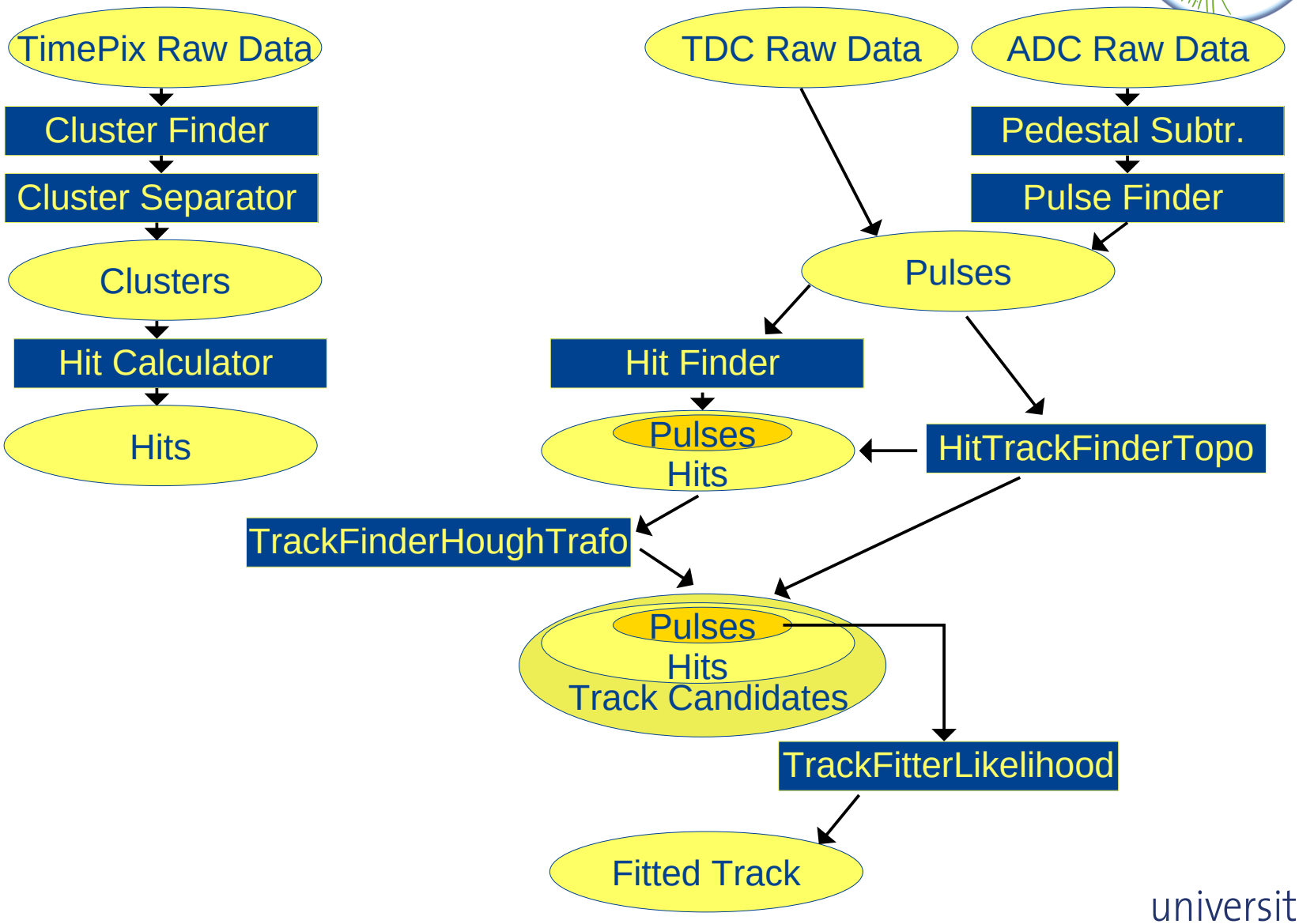
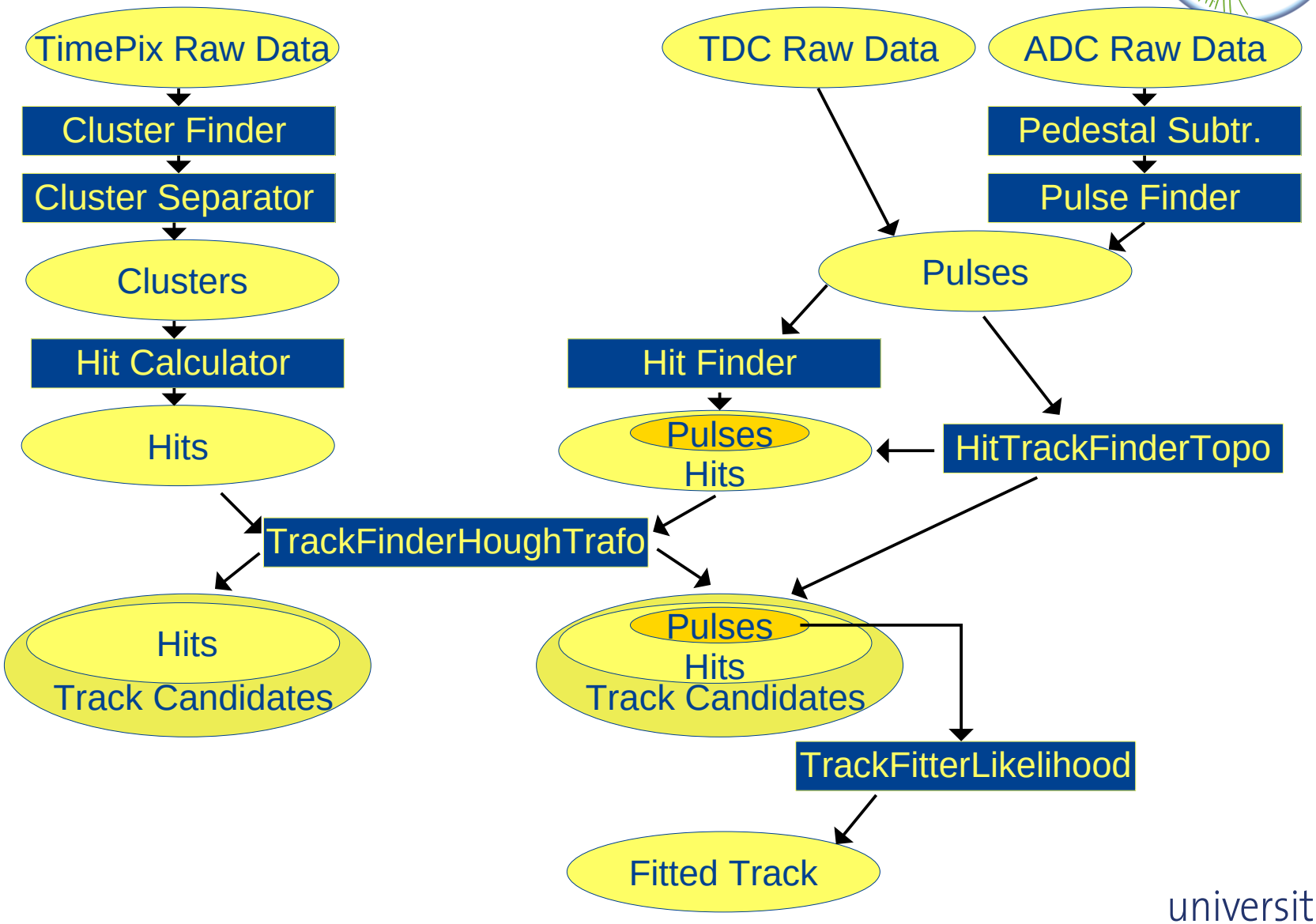


Reconstruction



Reconstruction



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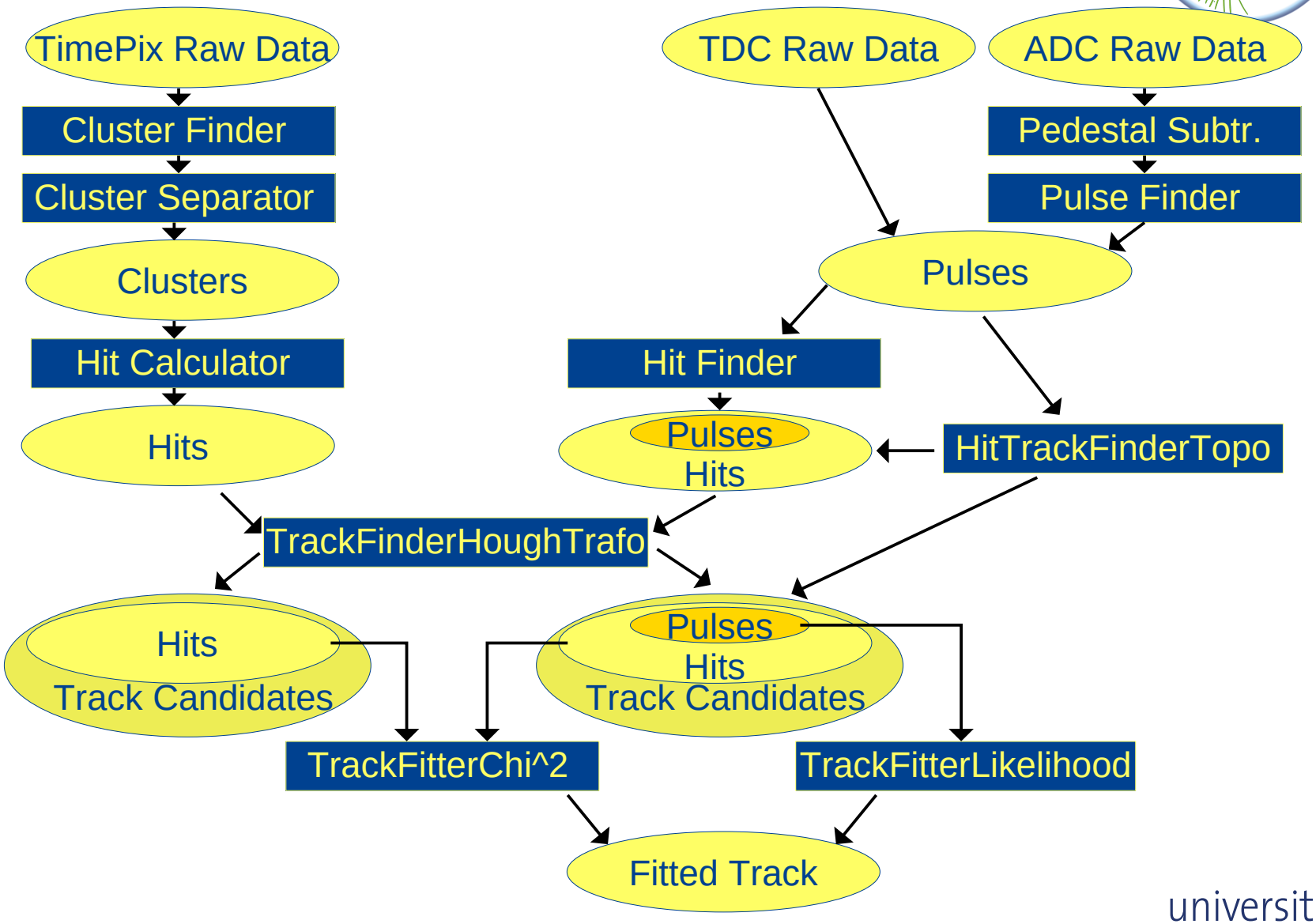
Reconstruction



Analysis

At the first TPC Analysis Jamboree 2006, the LC-TPC collaboration as agreed on default analyses, like

- Residual distributions
- Spatial resolution
- Track parameters
- Cluster sizes
- ...

Implementation of these processors has started, already 11 different processors available.

Planning to implement all analyses proposed at the Jamboree plus useful plots for commissioning a detector (e. g. occupancy plots).

Summary

MarlinTPC

- Highly modular
- Powerful digitisation
  - Realistic raw data
  - Realistic event pile-up
  - Fast branch and detailed branch
- Flexible reconstruction
  - Specialised and multi-purpose processors
  - Different kinds of readout

This month:

- Start data challenge
  - Test digitisation and reconstruction with muons
    Compare reconstructed momentum with MC truth
  - Test real data from DESY prototype

Goals:

- Be ready for the test beam in autumn
- Test performance in Particle Flow Algorithms
- Replace old LEP tracking code