

MarlinTPC

Martin Killenberg



ILC Software and Tools Workshop

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Status up to now

- Many different TPC simulation and reconstruction packages
- Most packages are monolithic programs
- Many different data formats, coordinate systems etc.

Goal of MarlinTPC

- Collect the available algorithms in a common framework
- Avoid work being done twice: Modularity allows high reusability
- Provide a complete reconstruction and analysis framework for simulation and real data using LCIO and Marlin
- Provide detailed TPC simulation which produces TPC raw data

Proposal for an ILC TPC data stream

TIES BEHNKE^a, MAXIMILIEN CHEFDEVILLE^b,
FRANK GAEDE^a, CHRISTIAN HANSEN^c, MATTHIAS ENNO JANSSEN^a,
ALEXANDER KAOUKHER^d, MARTIN KILLENBERG^e,
JASON MCGEACHIE^c, ASTRID MÜNNICH^e, ADRIAN VOGEL^a,
MICHAEL WEBER^e, PETER WIENEMANN^f

^a*DESY*

^b*NIKHEF*

^c*University of Victoria*

^d*University of Rostock*

^e*RWTH Aachen*

^f*University of Freiburg*

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Abstract

This document proposes a TPC data flow model for use during ILC detector R&D studies. It is based on LCIO data structures and Marlin as analysis and reconstruction framework.

- Simulation
- Reconstruction
- Analysis
- Examples for getting started
- Library for TPC conditions data based on LCCD

Simulation package for detailed studies of a GEM based TPC

- Parameterized deposition of primary electrons
- Drift of electrons incl. diffusion
- Detailed simulation of amplification and charge transfer in a GEM stack
- Digitization incl. pulse shaping of the electronics

→ Provides `lcio::TrackerRawData`

- Additional processor calculates ion backdrift

Established and well debugged and documented.

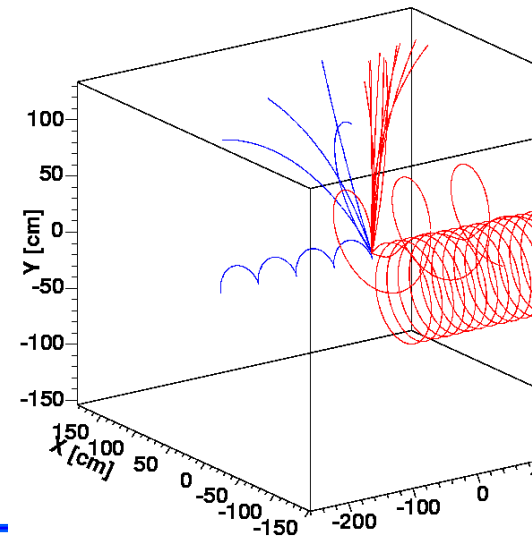
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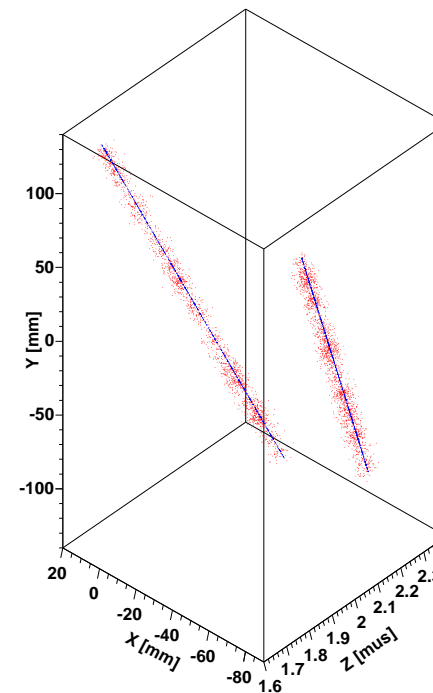
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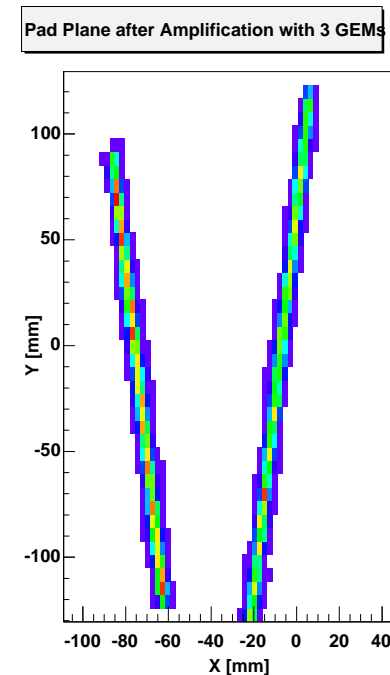
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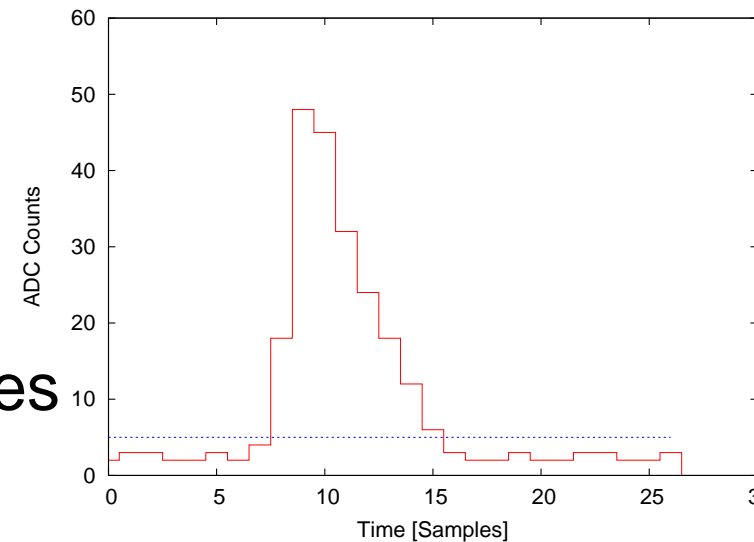


Data Structure	Processor Name	Collection Name
TrackerRawData		TPCRawData
	TrackerRawDataToDataConverter	
TrackerData		TPCConvertedRawData
	PedestalSubtractor	
TrackerData		TPCData
	PulseFinder	
	ChannelMapper	
TrackerPulse		TPCPulses
	HitFinder	
TrackerHit		TPCHits
	TrackFinder[Method]	
Track		TPCSeedTracks
	TrackFitter[Method]	
Track		TPCTracks

Correction processors (gain, pad response, linearity, time shift) still missing

● PulseFinder:

- Can handle positive and negative polarity
- Pre and post samples in pulses
- Threshold from pedestal
- Zero-suppressed and non zero-suppressed data
- No correct handling of double pulses

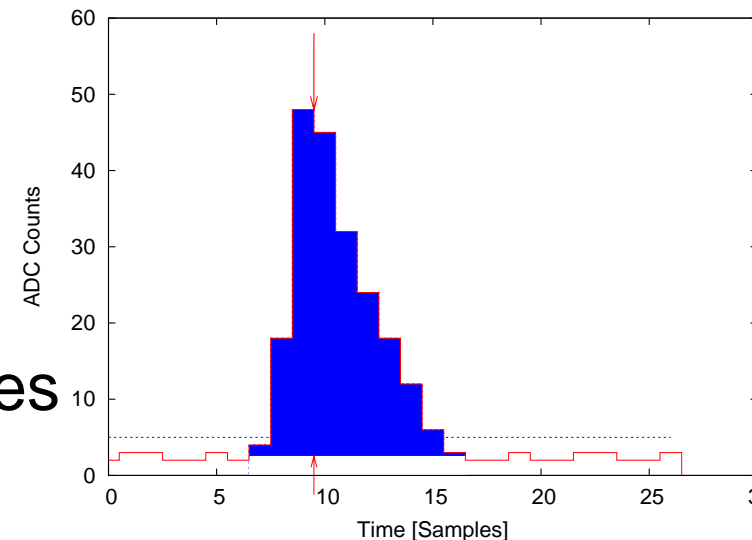


● HitFinder:

- Simple clustering algorithm without handling of double pulses (two track separation)
- Only RectangularPadRowLayout (from GEAR)

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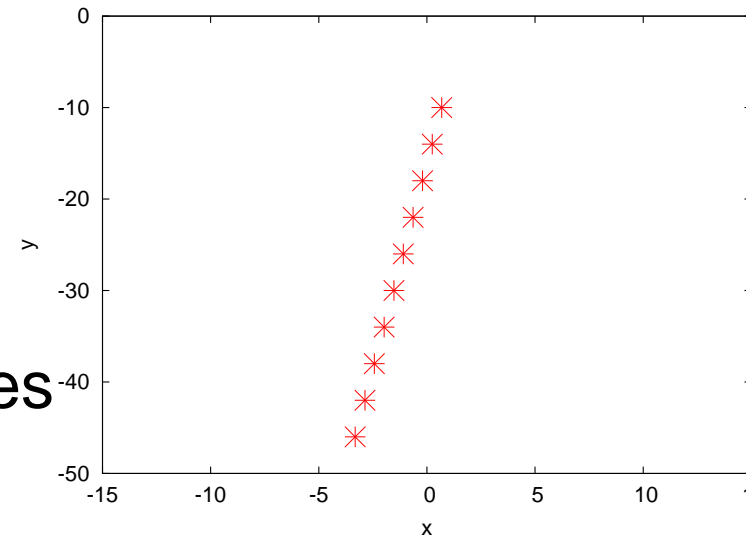


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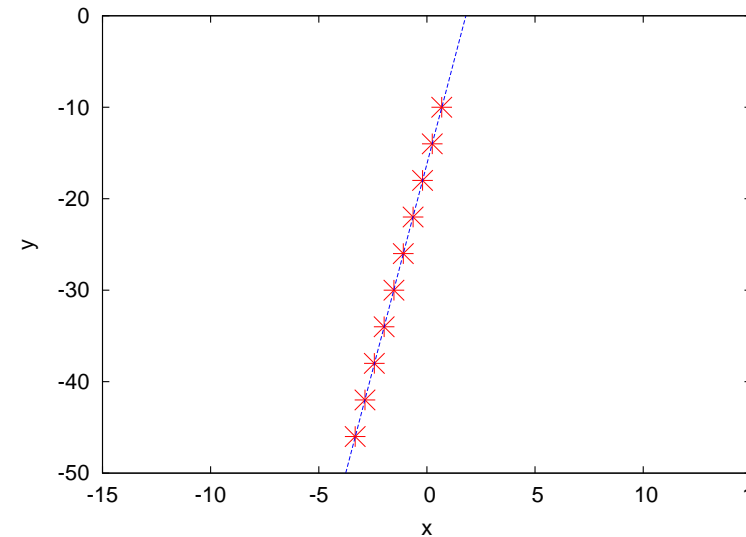
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- TrackFinderLinearRowBased:
 - Simple finder which assumes RectangularPadRowLayout
 - Only works for straight tracks (or small curvature using wide search window)
 - Performs linear regression
 - Identical to χ^2 minimization for straight line, provides all track parameters
 - Values can be used as seed for TrackFitter



- **TrackFinderHelix**

- Find curved tracks and curlers
- Work independently of pad layout
- Handle kinks / particle decay / delta electrons

- **TrackFitterGlobalLikelihood**

- Maximize Likelihood for given charge deposition on all pads
- Currently being implemented

Planned:

Provide a set of processors implementing the default analyses agreed on at first TPC Analysis Jamboree 2006 in Hamburg.

- Resolution using geometric mean of fits with and without the test row
- Resolution using external reference track (hodoscope or MC truth)
- Resolution in dependence on the drift distance
- Distribution showing number of 1-pad, 2-pad, 3-pad hits
- Bias plots (residuals vs. position on the pad)
- ...

Collection of LCGenericObjects/LCFixedObjects to use with LCCD

Class	Contents
ADCChannelMapping	Correlation between hardware channel and padID (GEAR)
ChannelCorrection	Calibration factors, dead and noisy flags
FieldSetting	GEM voltages, electric and magnetic fields
GasConditions	Gas mixture, pressure, temperature
Pedestal	Pedestal and it's width on each channel
TPCConditions	Drift velocity, amplification, diffusion coefficients
WeatherConditions	Temperature, pressure, humidity

- Define interface of other readout techniques: TDCs, TimePix
 - How to store data in LCIO?
 - Where to join the common reconstruction chain?
 - Implement the required Marlin processors, incl. digitization for the simulation.
- Test the reconstruction with real data

What Else Is Missing?



- **Event Display** showing charge distribution on pads and/or in voxels
- **Data Browser** for LCIO data classes
- **GEAR Extension** to simultaneously handle multiple layouts for different modules

- Detailed simulation provides very realistic data, ready for further studies
- Reconstruction chain is now complete, provides basic functionality
- No analysis yet, hope to have first processors for LCWS

Subversion repository: <svn://pi.physik.uni-bonn.de/MarlinTPC>

Mailing list: <https://lists.desy.de/sympa/info/ilcsoft-marlintpc>

Wiki page provides user and developer workbook:

<https://twiki.cern.ch/twiki/bin/view/ILCTPC/MarlinTPC>