MarlinTPC: Towards a common TPC software framework

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Status quo

- Many different TPC simulation, reconstruction and analysis packages have been developed
- Varying motivations for writing them
- Often similar codes, but they use different data formats, coordinate systems, units, etc.
- Most are monolithic programmes
- Exchanging code or data for cross-checks can be time consuming and error-prone

Agreement

Held a TPC software workshop at DESY in June 2006, trying to improve on the situation

Outcome of long discussions:

Proposal for an ILC TPC data stream

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Abstract

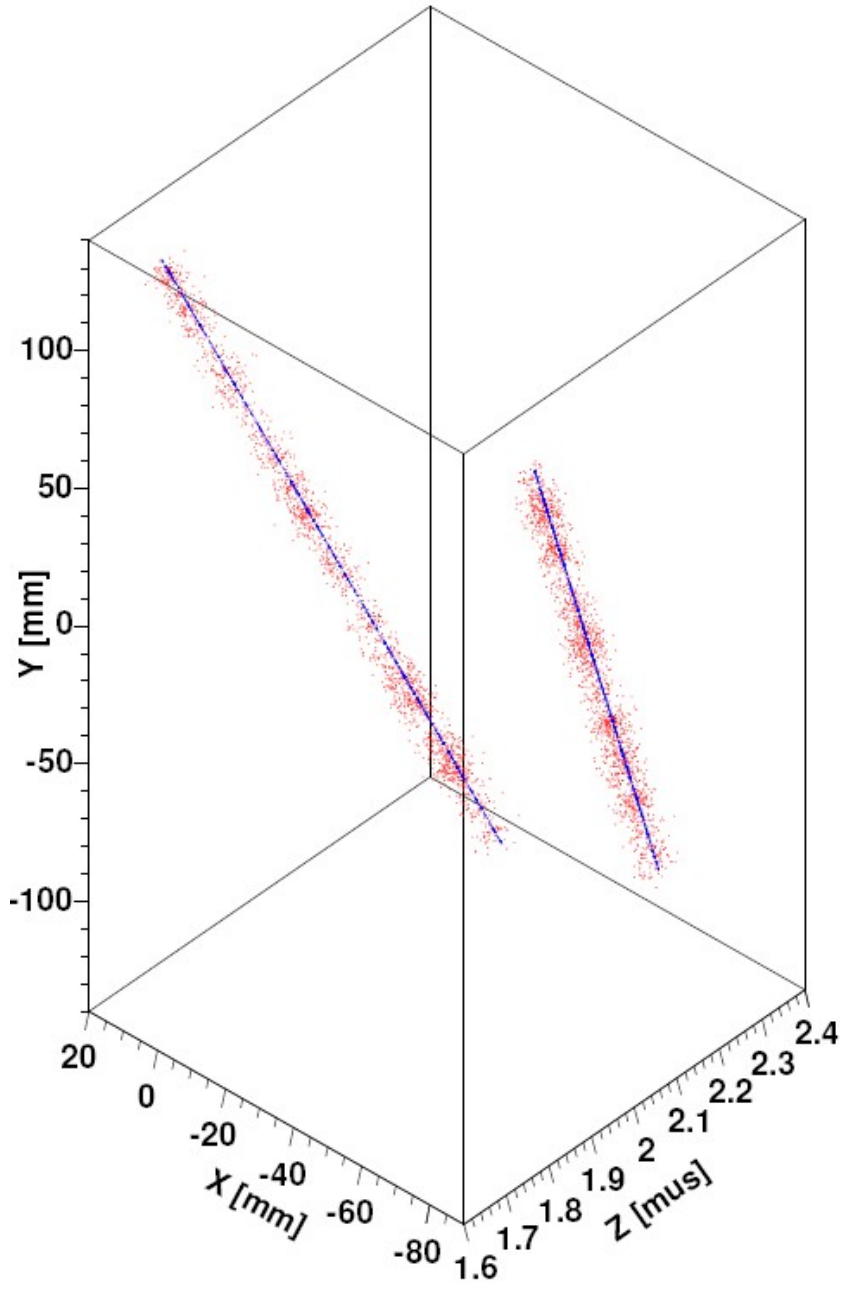
This document proposes a TPC data flow model for use during ILC detector R&D studies. It is based on LCIO data structures and Marlin as analysis and reconstruction framework.

MarlinTPC

- Goal: provide complete simulation, reconstruction and analysis framework using the data model described in the document
- Collection of existing and new algorithms in a single modular framework
- Modularity simplifies re-usability
- Based on ilcsoft tools widely used in ILC community:
  - LCIO: underlying model for transient and persistent data
  - MARLIN: modular analysis and reconstruction framework
  - GEAR: store and access geometry information
  - LCCD: conditions database package

Simulation

- Included Astrid Münnich's GEMTPCSimulation package in MarlinTPC
- Performs
  - parametrised primary charge deposition
  - drift with diffusion
  - detailed parametrised simulation of amplification and charge transfer in GEM stack
  - digitisation (providing `lcio::TrackerRawData`)



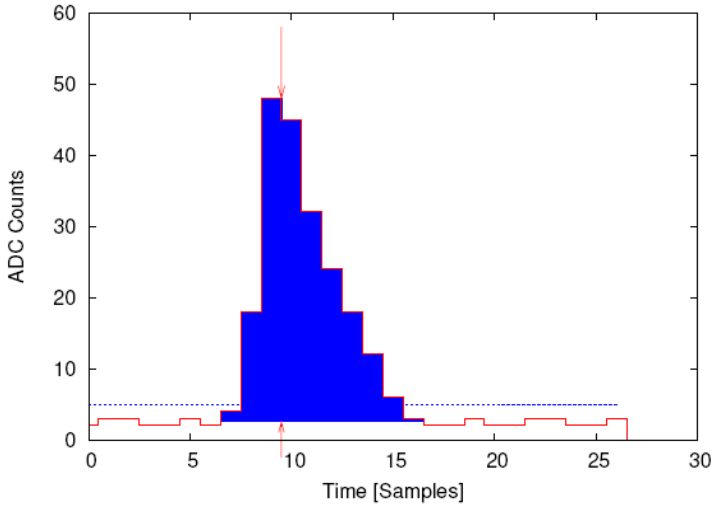
Reconstruction

Reconstruction chain (from document):

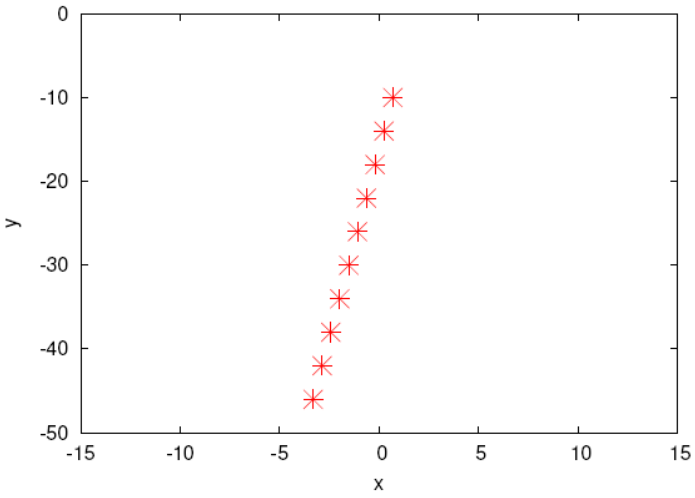
Data structure	Processor name	input/output collection name
`TrackerRawData`		TPCRawData
	TrackerRawData2DataConverter	done
`TrackerData`		TPCConvertedRawData
	PedestalSubtractor	done
	ChannelByChannelCorrector	missing
	LinearityCorrector	missing
	TimeShiftCorrector	missing
`TrackerData`		TPCData
	PulseFinder	done
	ChannelMapper	done
	GainCorrector	missing
`TrackerPulse`		TPCPulses
	HitFinder	done
	HitPRFCorrector	under development
`TrackerHit`		TPCHits
	TrackFinder[Method]	done
`Track`		TPCSeedTracks
	TrackFitter[Method]	under development
`Track`		TPCTracks

Reconstruction

- PulseFinder:
  - handles positive and negative signal polarity, both zero and non-zero suppressed data
  - pre and post samples included in pulses
  - threshold in terms of standard deviations from pedestal calculator
  - no correct handling of double pulses

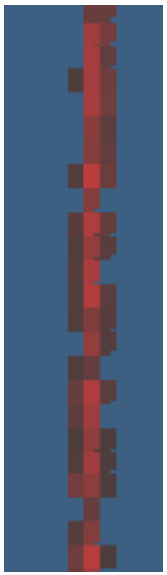


- HitFinder:
  - simple clustering algorithms without proper treatment of double tracks
  - only RectangularPadRowLayout



In the pipeline

- Global likelihood based track fit processor
  - algorithm as developed at University of Victoria
- Event display
  - extension of CED
- Analysis processor
  - providing all information as formulated in the conclusion of the first ILC TPC Analysis Jamboree in 2006
- Track finder for strongly curved tracks
- Pad response function corrector and hit based track fitter
  - algorithm as developed at DESY



Summary and outlook

- Test MarlinTPC with real prototype data (not simulation)
- Include other readout technologies (TDCs, Timepix) in the data model and subsequently in MarlinTPC code