

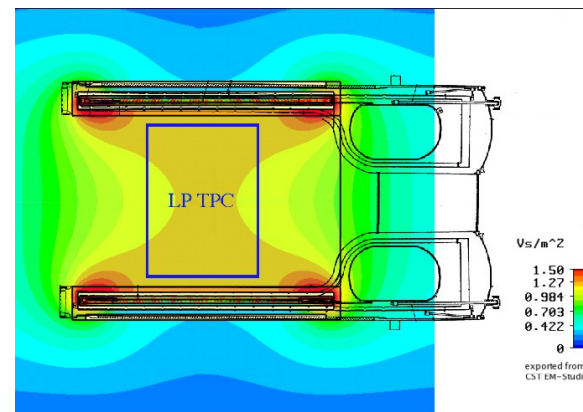
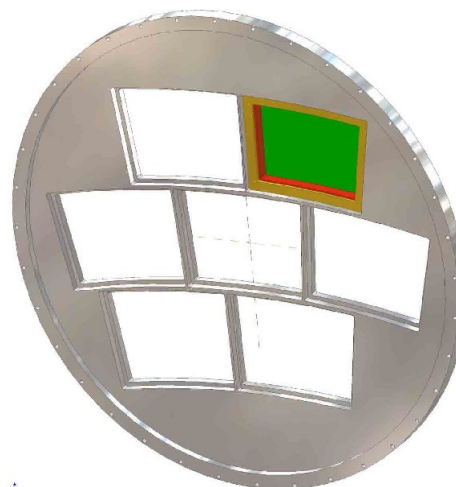
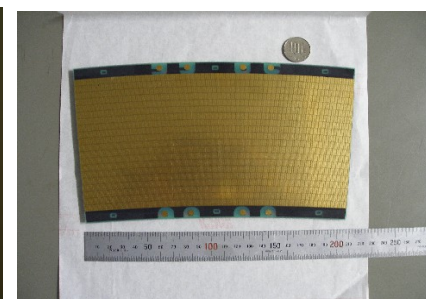
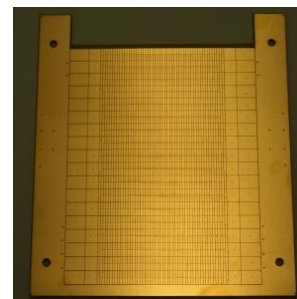
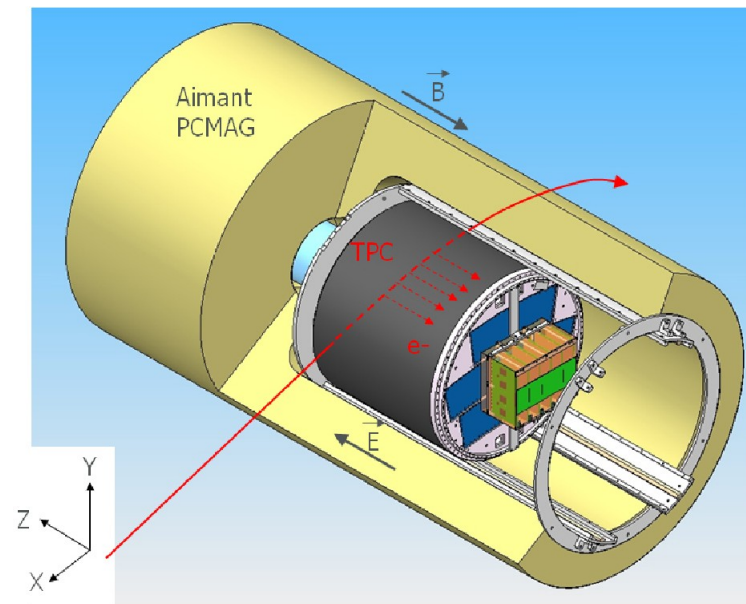
Recent Developments and Status of MarlinTPC and Related Software

R. Diener, DESY

EUDET Annual Meeting 2010



- Simulation and Reconstruction of TPC Prototype data (also used for ILD TPC studies)
- Especially of the Large Prototype:
 - Installed at DESY in test beam T24/1
 - In large parts funded by EUDET
 - Comprises: 1T magnet (PCMAG), movable stage, gas, slow control and HV systems, beam and cosmic trigger, large prototype field cage, modular read-out end plate
 - Planned: external reference via silicon detector
- Software challenges:
 - Geometry: pad/module layouts, coordinate systems
 - Tracking over several read-out modules
 - Inhomogeneity corrections



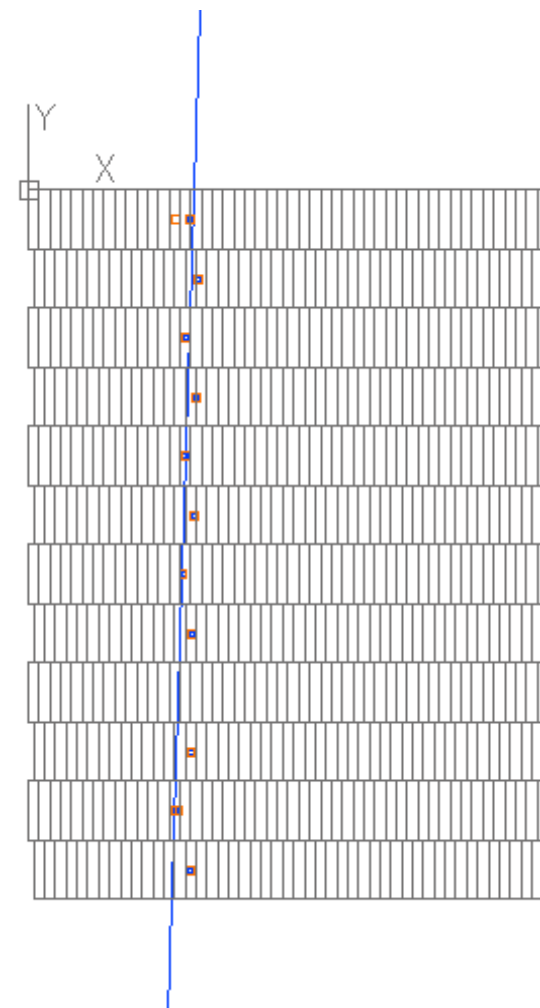
- International effort with participation from all regions (Americas, Asia, Europe)
- Software uses the ILC software framework (MARLIN, GEAR, LCCD)
- Modular software design allows to compare algorithms and reuse existing solutions
- Repository:
 - Recently moved from Bonn university to the central DESY IT server in Zeuthen:
<https://svnsrv.desy.de/websvn/wsvn/General.marlintpc>
 - So far 30 contributors, recently active 12
 - Nearly 600 commits in the last 12 months
- New Wiki page with documentation:
<https://znwiki3.ifh.de/MarlinTPC/MarlinTPC>
- Monthly EVO/Phone meetings

- **Basic Level reconstruction** means here: up to *Hit* level
(Hit = information per pad row)
 - Combine time-binned ADC counts on a pad to *Pulses* and these row wise to *Hits*. Result:
3D position and charge information including errors

OR
 - Combine pixel data to clusters
- Apply basic corrections
- Only some changes in PulseFinder and RowBasedHitFinder processors necessary to complete the basics; Correction algorithms need work
- **Higher Level reconstruction**: track finding and fitting
 - Up to now basic functionality in processors, recently move to external libraries
 - Current developments: see next slides

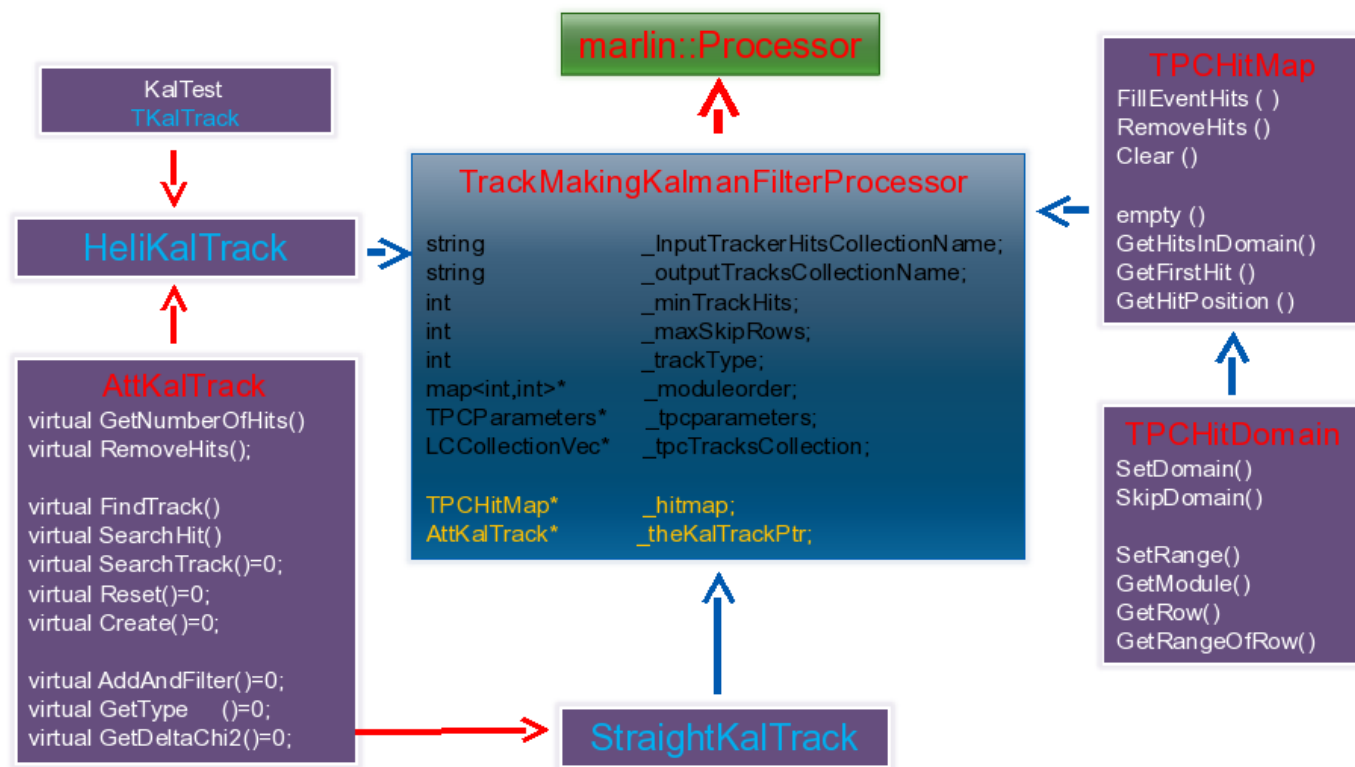
LCIO Type	Default Collection Name
TrackerRawData	TPCRawData
TrackerData	TPCConvertedRawData
TrackerPulse	TPCPulses
TrackerHit	TPCHits
Track	TPCTracks

- Hough Trafo Track Finding and Fitting library are being developed for straight line and helix track models
- First approach was to implement a Marlin processor which does track finding using a Hough transformation
- Now the Hough transformation track finding and a X^2 fitter go into a separate library that will be called from a processor: iterative processing and use in other software possible



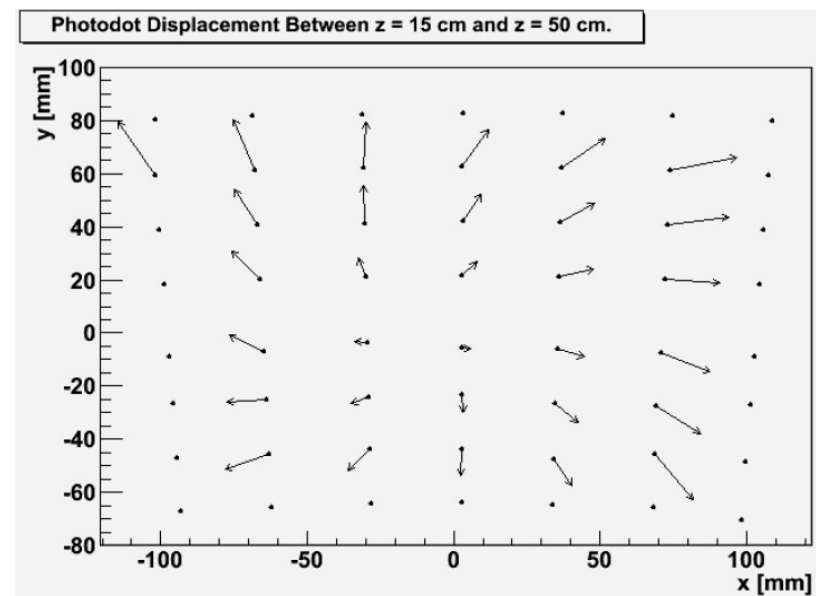
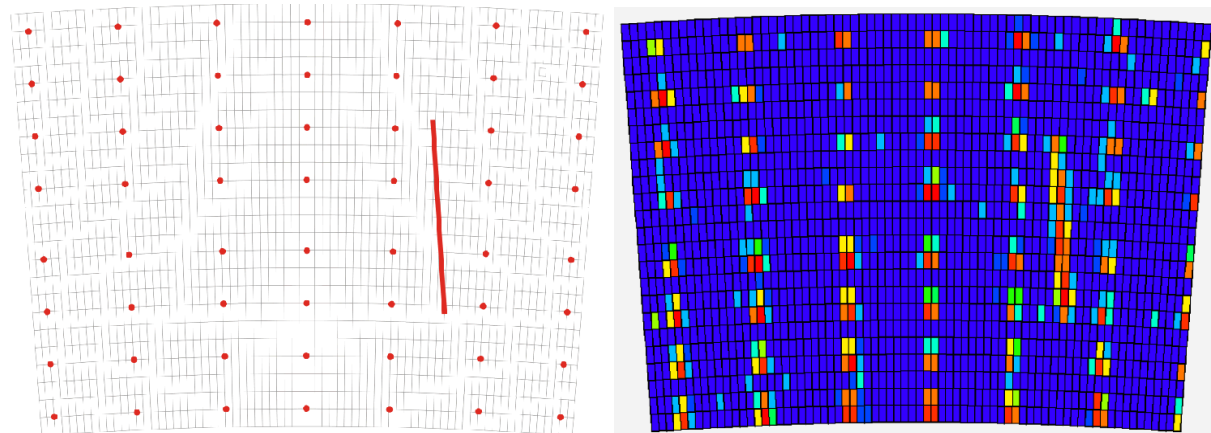
- Kalman Filter Track Fitting (and Finding) library
- Kalman Fitter library ready
- Source committed to MarlinTPC repository

- Can fit tracks over several modules
- Track finding possible but currently still limited
- Planned: implement solution to fit tracks in non-uniform magnetic fields



- Presentation on ILC Agenda

- Photodot reconstruction:
 - Pattern on cathode liberates electrons when illuminated by UV light
 - Pattern measured on read-out plane
- Simulation and reconstruction are implemented in MarlinTPC
- Preliminary results show that the system works in principle
- Simulation and measurement do not match yet:
source of differences could be implementation of B-field map or electron drift
- Studies ongoing



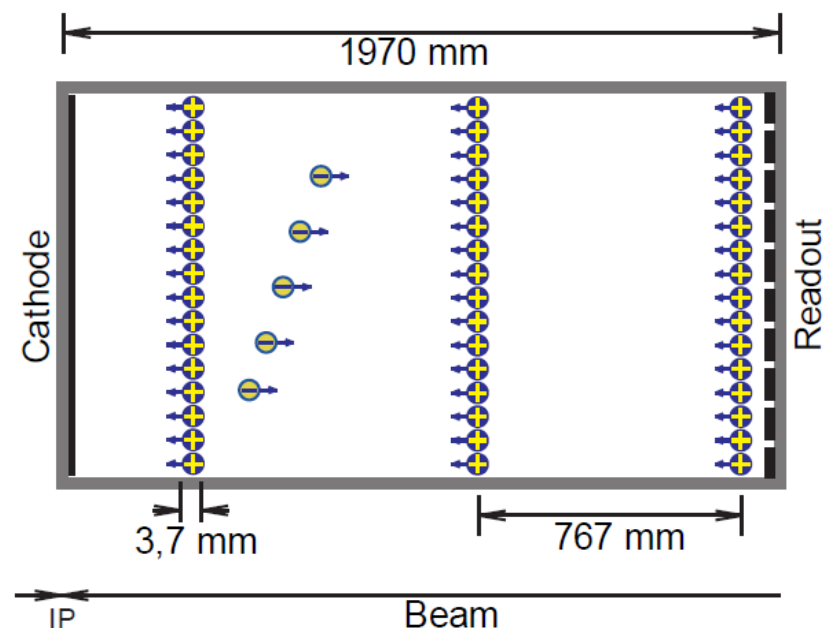
- Due to bunch train structure at ILC ion disks will form at the amplification area
- They drift through the sensitive volume towards the cathode
→ field distortions
- Is this a problem?

- Studies done using detailed MarlinTPC simulation

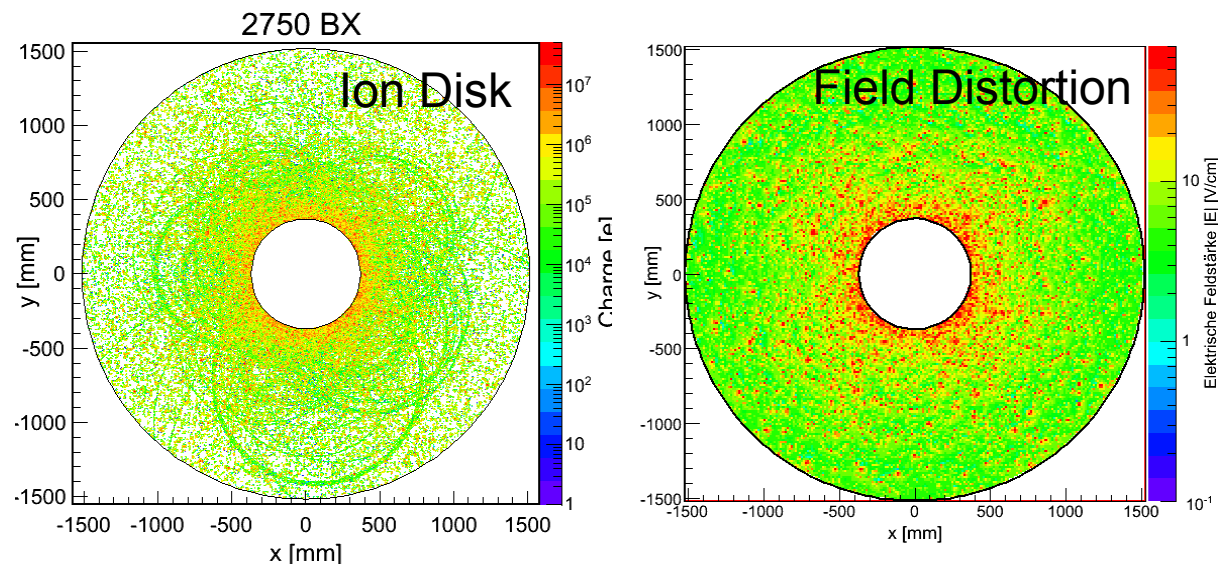
- Todo:

- $1/r$ potential used for field calculation; redo studies using Green's functions (standalone program)

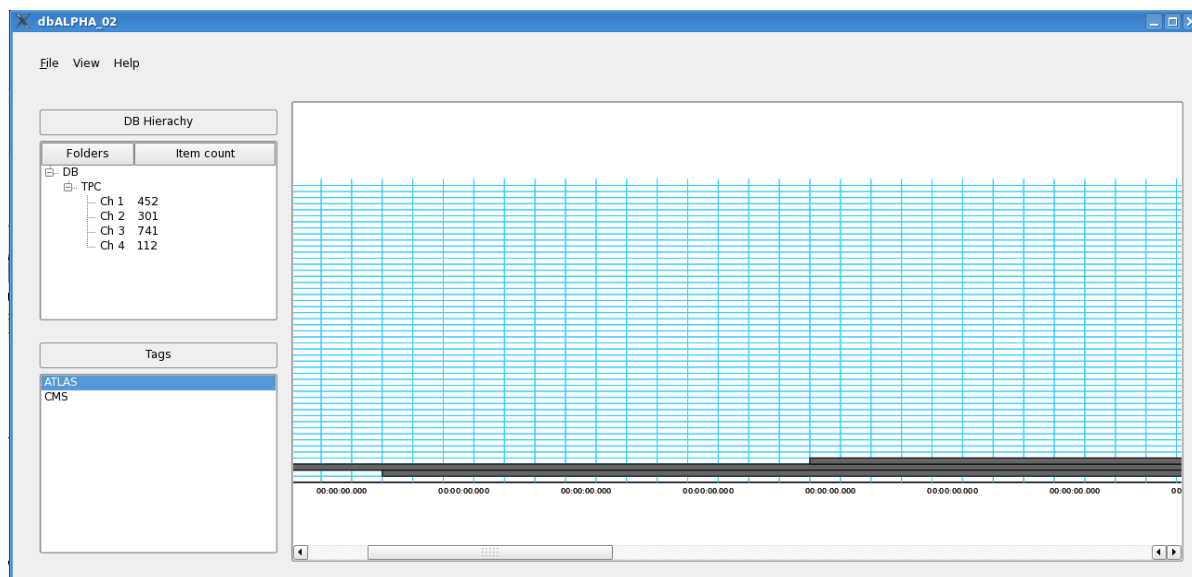
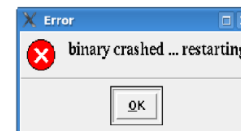
- Presentation on ILC Agenda



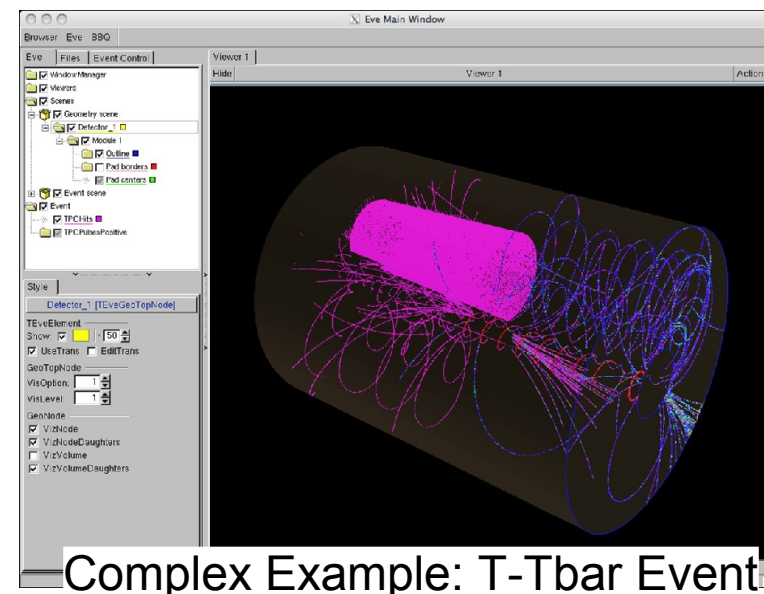
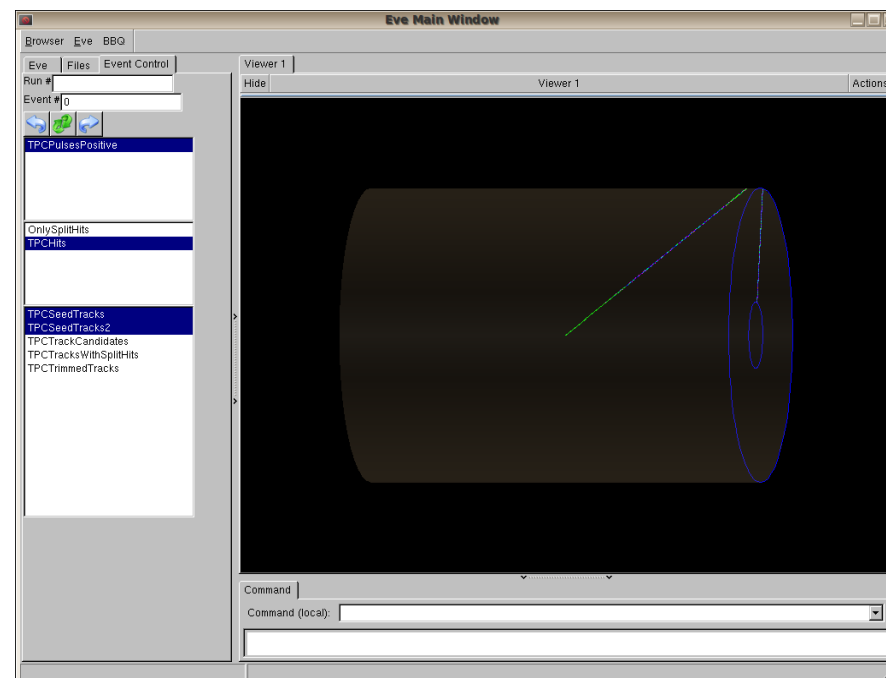
Simulation with older LDC model, TDR gas, $E_{\text{drift}} = 240 \text{ V/cm}$



- Conditions Database: 2 virtual servers running to centrally provide conditions data
- Implementation of new LCCD functionality in MarlinTPC ongoing
- Revision of TPC condition objects necessary
- Documentation (tutorial) in progress
- Implement a clear way to access conditions data (not via GEAR, processor parameter ...)
- New Database Browser (summer student project):
 - Old Tcl script unstable and hard to maintain
 - New QT based implementation
- Status:
 - QT layout and class communication nearly ready
 - Database connection and condition object processing missing



- Summer student project
- TEve based:
 - C++, ROOT
 - OpenGL: 3D hardware acceleration
 - Object browser
 - Picking and highlighting
- Full GEAR support
 - All pad layouts
 - Multiple modules
- LCIO support
 - Read in files
 - Select collections
- Source:
<https://svnsrv.desy.de/public/bbq/trunk>
- Presentation on ILC Agenda



Complex Example: T-Tbar Event

- (Very) Preliminary test beam results from Asian colleagues:

- Use of a complete MarlinTPC chain in reconstruction

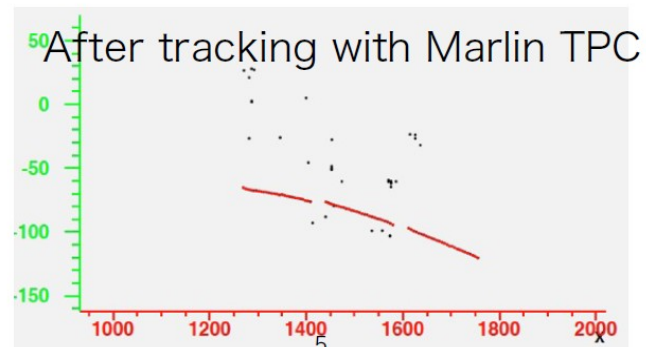
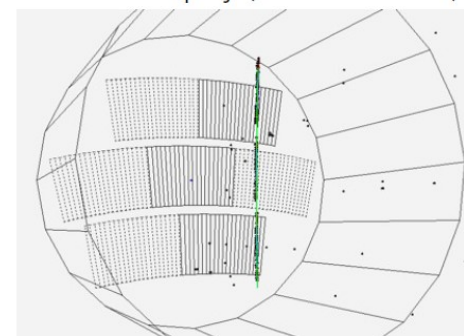
- Planned:

- Correction of module alignment
- Correction of field distortion (E-field near GEM)
- Tracking in non-uniform B-field
- Shift to MarlinTPC for analysis

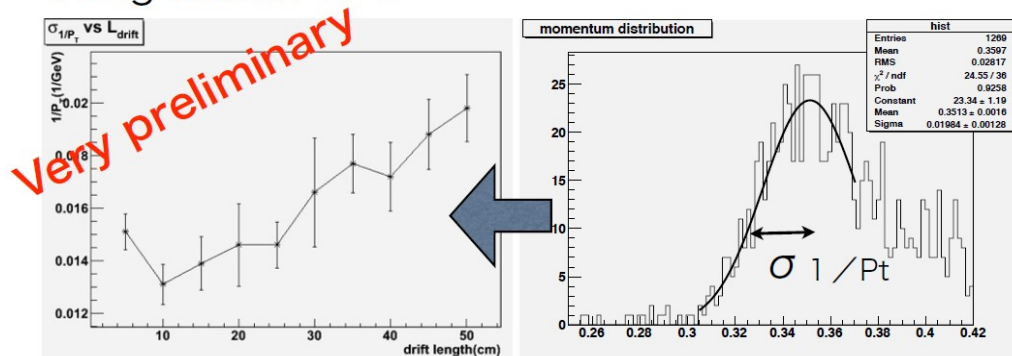
2D event display (not Marlin TPC)



3D event display (not Marlin TPC)



Momentum resolution ($1/Pt$) without any alignment correction
Using Marlin TPC



of events = 2000

- Many efforts for MarlinTPC ongoing in different areas
- Large Prototype data reconstructed using the full processor chain
- Chain for basic reconstruction converges to stable state: close to version 01-00-00
- Higher reconstruction on a good path:
Kalman Filter fitting ready, Hough transform and X^2 fitter nearing completion
- Useful tools available and/or under development
- No mentioned: different levels of simulation available, Likelihood fitter ...
- Active base of developers, but still manpower shortage
since most only work part-time on MarlinTPC development
- Much of the mentioned functionality became fully available during last year
- Plans:
 - Complete current projects
 - Calibration and correction methods (inhomogeneous fields, alignment)
 - Revise and extend included, detailed simulation for TPC prototypes