A summary of the ECFA ILC Simulations Workshop at DESY

Guilherme Lima

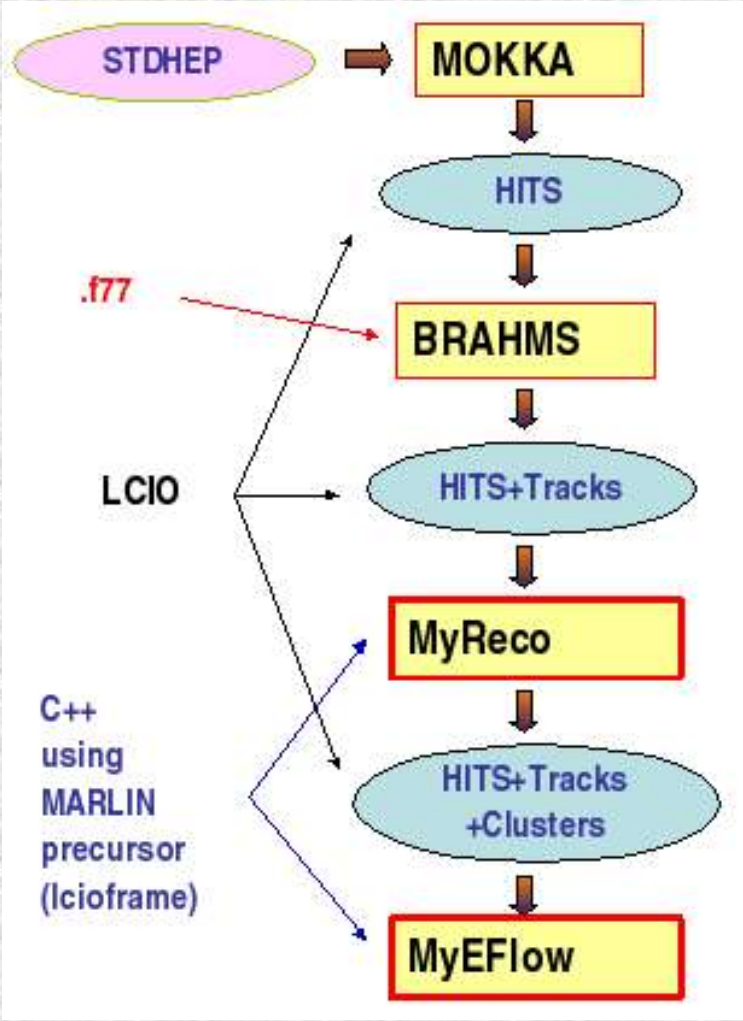
NORTHERN ILLINOIS UNIVERSITY

LC-Cal Meeting
December 20, 2004

Simulations Mini-Workshop at DESY

- DESY, December 09-10, 2004
  - Day 1: Established tools and tutorials
  - Day 2: Tools under development
  - About 20-30 participants
  - Live DVD for tutorials (RAM-only SUSE linux)
  - Web page: http://www-flc.desy.de/simulation/ (includes video streams of talks!)
  - Will show selected topics (my choice!)

Software needs for ILC detector optimization



Mark Thomson (Cambridge)

- Most software needed is available, use was easier than expected
- Changing detector geometry is too difficult for non-experts
- Common framework and geometry independence are critical for collaborative development

Mokka: Status and perspectives

Paulo Mora (LLR, France)

- support for binary StdHep files
- improved hit-to-particle association
- test beam description is complete
- under development: a new database architecture to describe the many detector options for study
- (available from the live DVD)

Mokka: Recent developments

Gabriel Musat (LLR, France)

- Materials database
- A common CGA API for Fortran, C++, C, Java to be used by reconstruction, event displays, etc. (CGA is tightly coupled with the Mokka DB)

Jupiter and friends

Akiya Myamoto (Japan, video)

- Modular architecture
- No LCIO support yet

Brahms + CVS

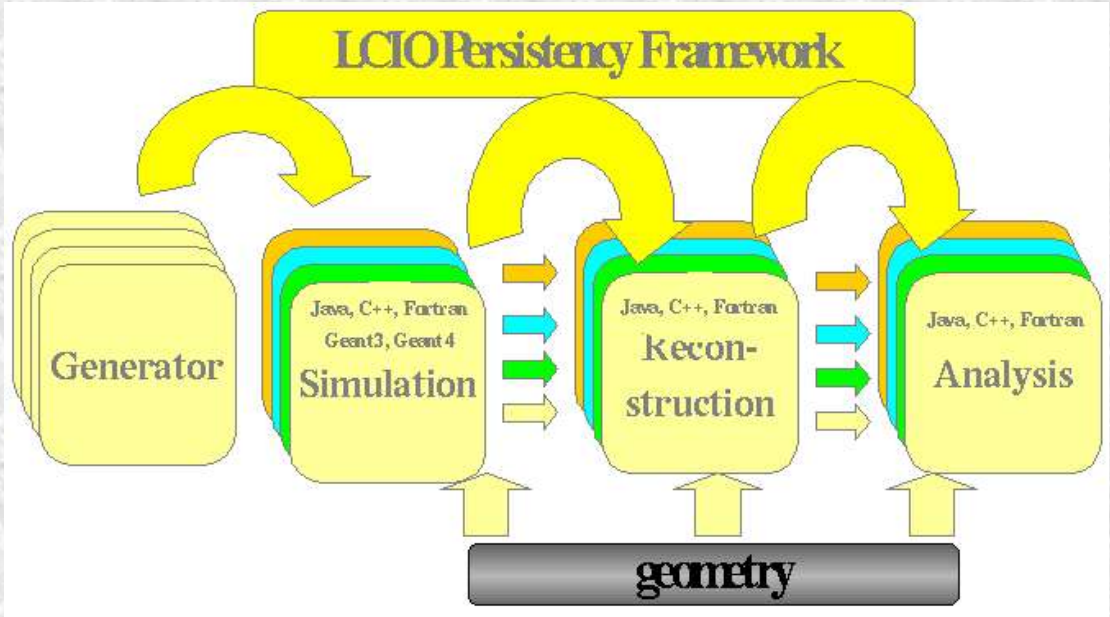
Harald Vogt (DESY)

- Fortran-based framework for detector simulation (Geant3), reconstruction and analysis
- LCIO support recently added for reco objects
- A lot of algorithm development is still being done within Brahms
- (Available from the Live DVD)
- CVS for ECFA ILC software: no local account needed Brahms, SIMDET and Marlin already available

LCIO and Marlin

Frank Gaede (DESY)

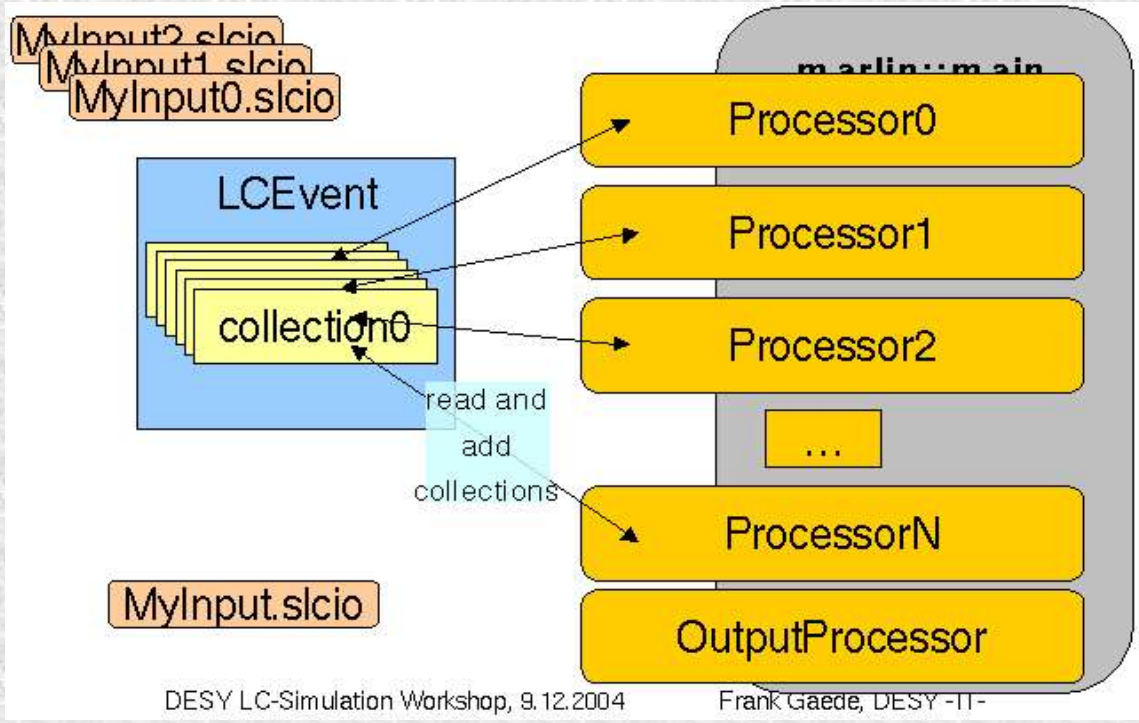
- **LCIO**: Linear Collider Input/Output format
  - provides a common basis for ILC software worldwide (I/O and transient data)
  - API support for C++, Java and Fortran
  - LCIO is well consolidated for ILC studies
  - (available from the Live DVD)



LCIO and Marlin

Frank Gaede (DESY)

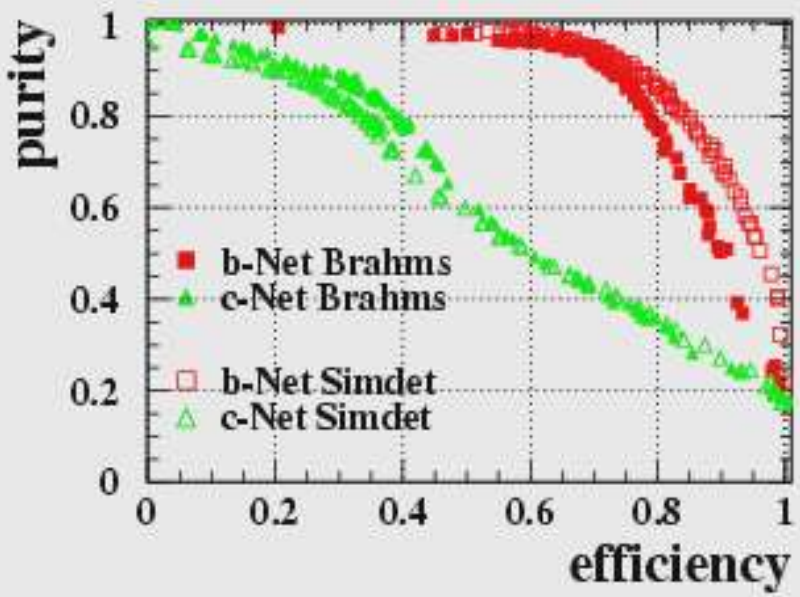
- **Marlin**: a C++ framework for reconstruction and analysis
  - Very simple, based on LCIO event model
  - Some Marlin processors already available (including DigiSim)
  - Things to improve:
    error handling, flow control, documentation
  - large interest in porting existing tools to Marlin
  - (Available from the Live DVD)



SIMDET – detector parametrizations

Hans Jürgen Schreiber (DESY)

- Optimal (detailed parametrization) for trackers, ok for calorimeters, problems for forward detectors
- No LCIO support yet
- Tesla only for now, plans for SiD, LD and Huge detectors
- (Available from the Live DVD)



Comparing c- and b-tagging results using Simdet and Brahms

ILC Detector Simulations

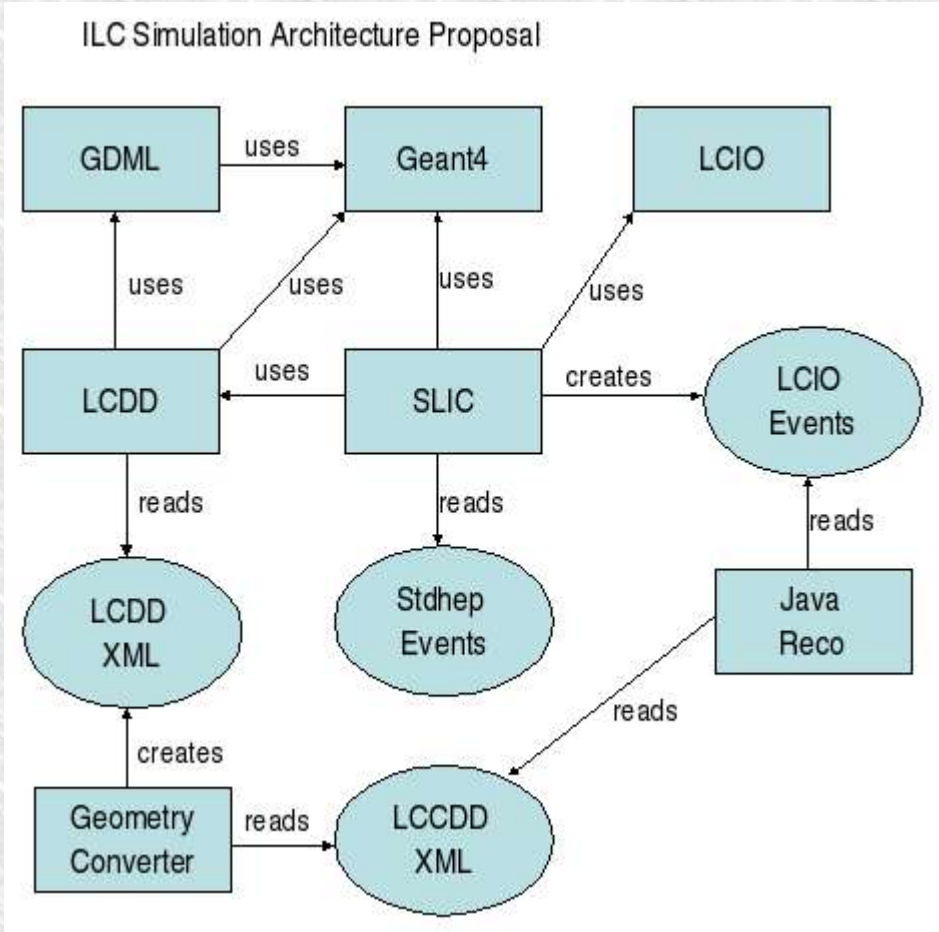
Norman Graf (SLAC, by video)

- Overview of requirements for detector optimization
- emphasis on a generic geometry representation, easy to change and capable of describing realistic detectors
- different requirements for full and fast sim, reconstruction and event display
- geometry API for reco and others not to be based on Geant4 library
- Brief overview of existing tools in current use in USA: lcdtrk, FastMC, lelaps, lcdg4, lcs, org.lcsim, Wired

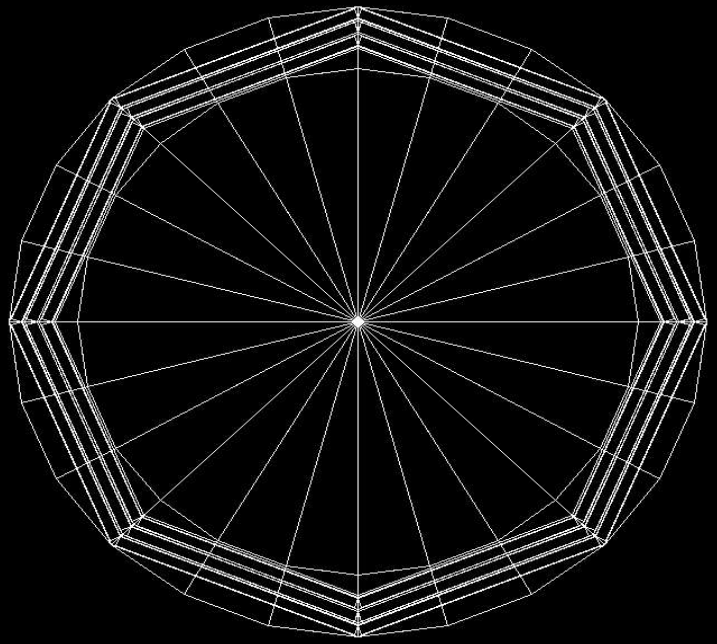
ILC Simulations Update

Jeremy McCormick (SLAC, by video)

- SLIC - Simulator for the LInear Collider
- Goal is to combine the strengths of LCDG4, LCS and Mokka into a new detector simulation package
- Proposes a new simulation architecture representation for run-time definition of detector geometry:
  - LCDD - A detailed description for full detSim (based on GDML)
  - LCCDD - A more compact description, for reco, ev.display, etc.
  - LCDD should be created from LCCDD by a geometry converter

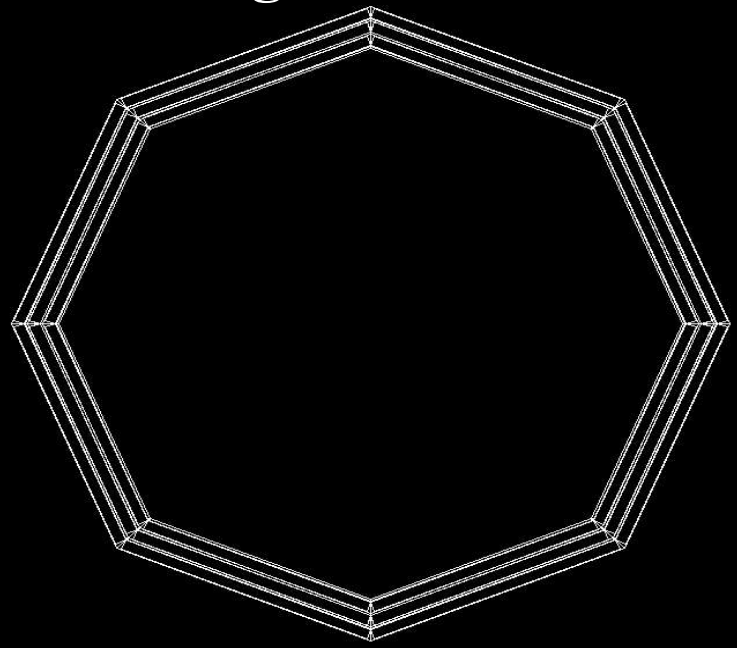


Calorimeter Barrel and Tracking Region

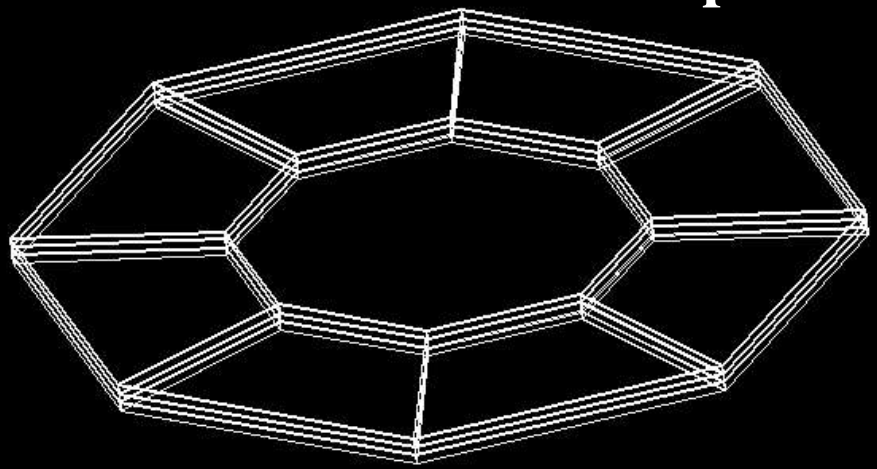


EXAMPLES

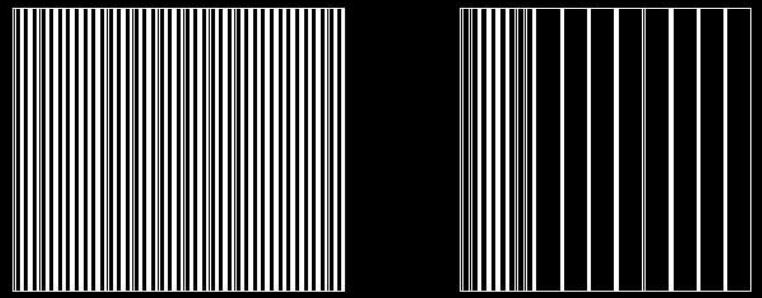
Octagonal Barrel



Calorimeter Endcap



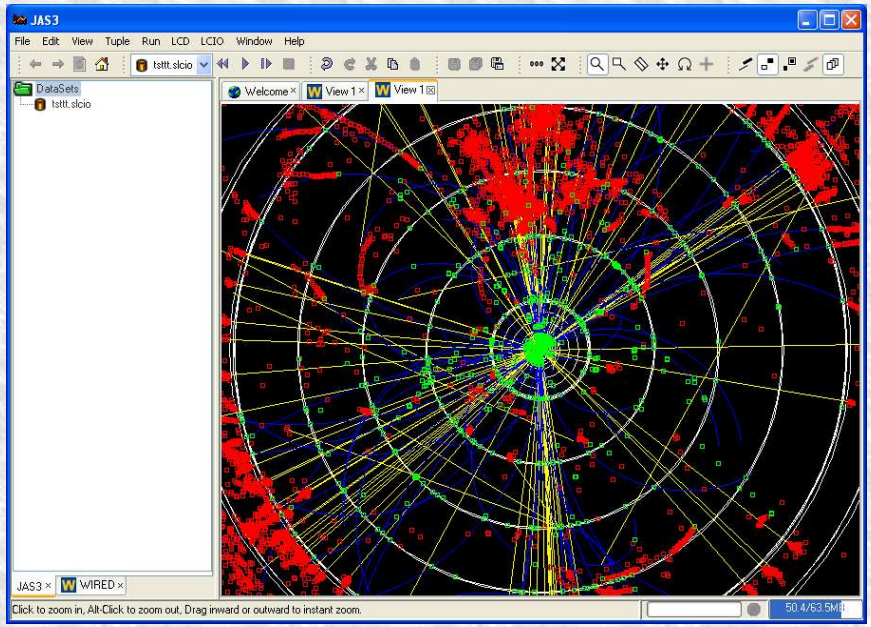
Test Beam



Java-based tools for Reco and analysis

Tony Johnson (SLAC, by video)

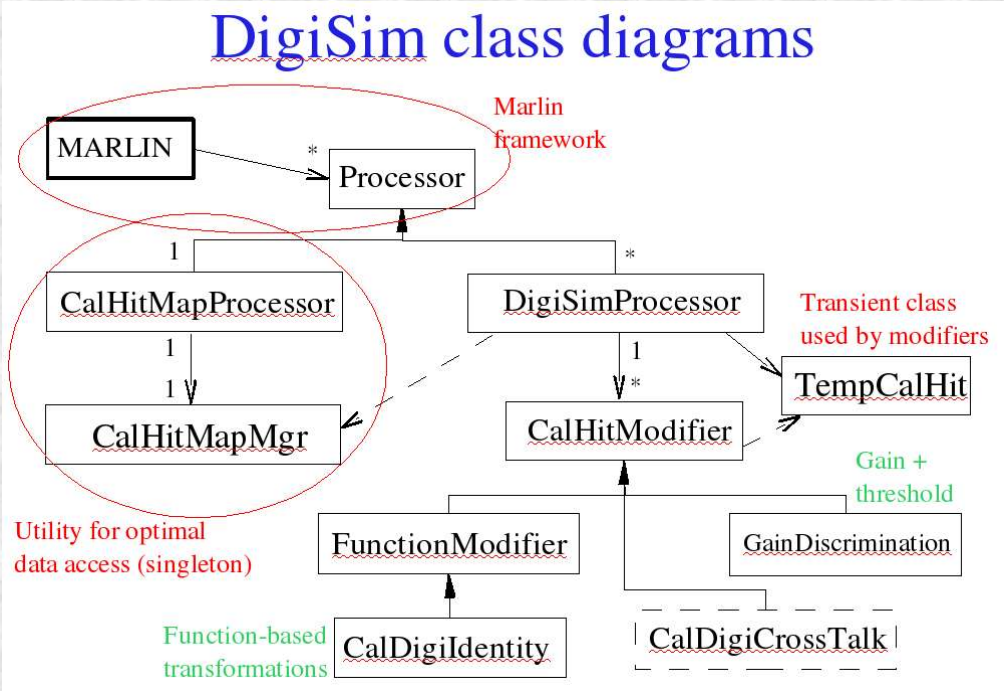
- JAS3: LCIOPlugin + Wired = event display
- org.lcsim: a new framework for Java-based reconstruction and analysis (expected by next LCWS in March '05)
- (JAS3 and Wired available from Live DVD)



Digitization simulation for the ILC

Guilherme Lima (NIU)

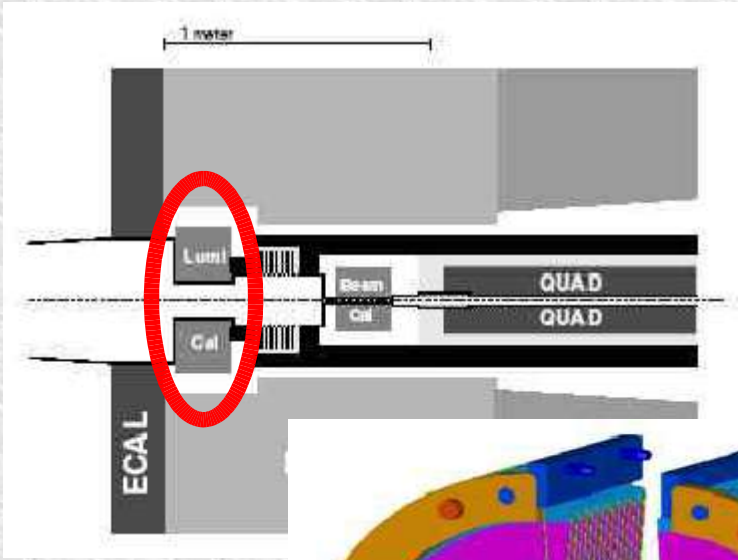
- A package to simplify development of digitization simulation
- To be used in Calice test beam as a test bed for the full ILC
- LCIO-based and implemented as a Marlin processor
- simple modifiers implemented: gain, threshold, function-based
- Easy to extend it to implement new functionality

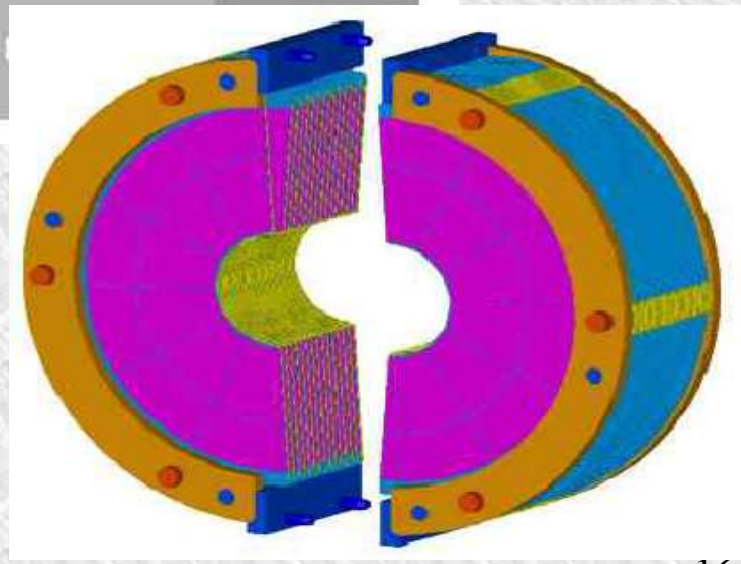


Simulation of LumiCal for Tesla

Bogdan Pawlik (INP PAS, Krakow)

- LumiCal is a detector to measure luminosity and monitor beam parameters
- based on Geant3 and other beamstrahlung and Bhabha simulators
- To do: move into Geant4/Mokka/Brahms

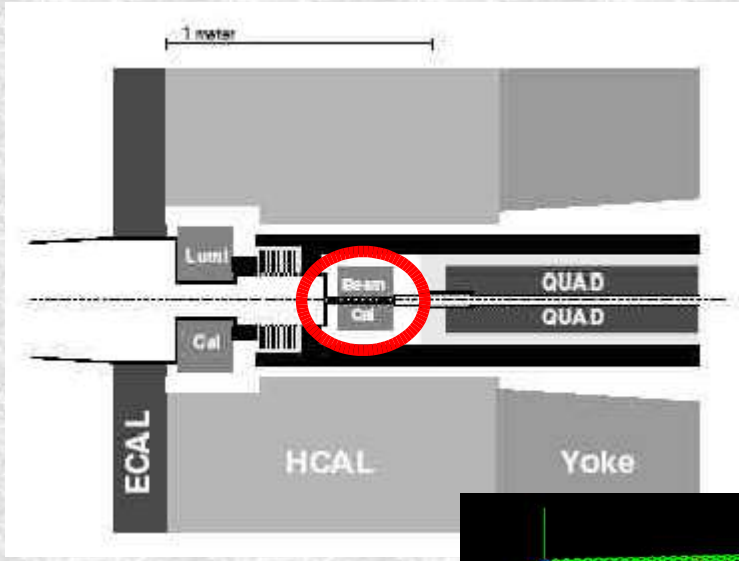


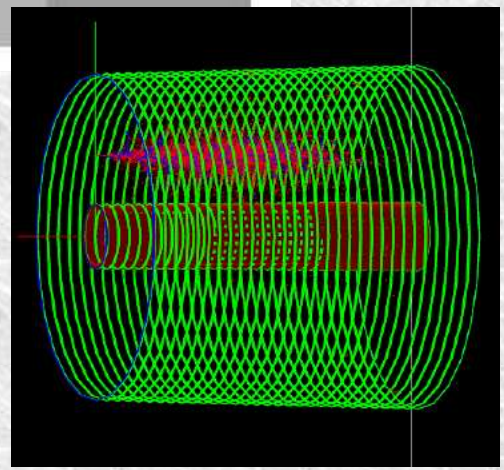


BeamCal Simulation for Tesla

Andrey Elagin (Dubna)

- exists in Brahms, should move to Geant4
- preliminary Geant4 version exists
- input is ASCII, output is Root
- optimal segmentation under study

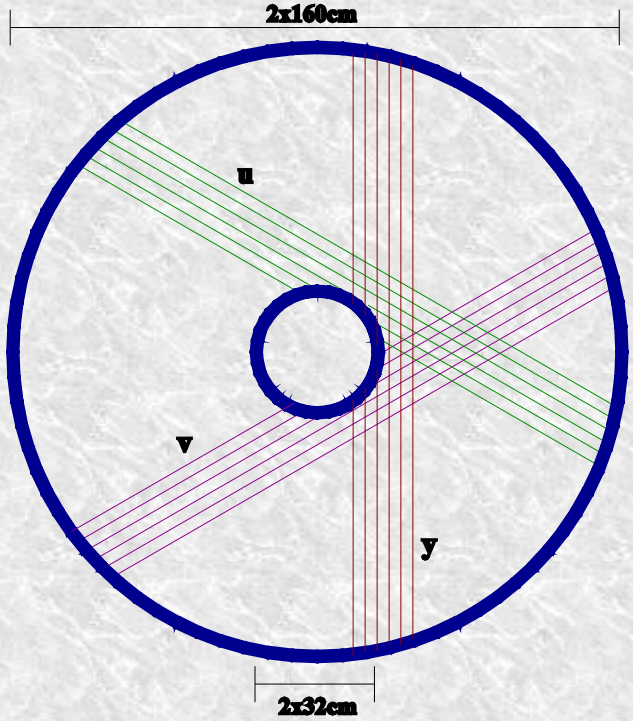




FCH Pattern Recognition

Irina Polenkevich (JINR, Dubna)

- PatReco studies based on straw option for the forward chambers
- Tracking efficiency:
  - 87% for tracks originating from e+e- IP
  - 82% for all tracks, based on ideal case (no dead zones, noise or wire inefficiency)
- Dependence on drift-tube spatial resolution, track multiplicity, kinematics and detector radius, wire noise and inefficiency
- Plan to study also the silicon-based FCH option



PFlow reconstruction

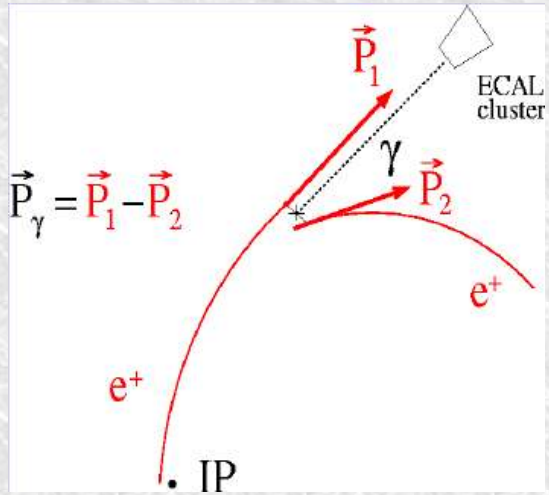
Vasiliy Morgunov (ITEP, Moscow)

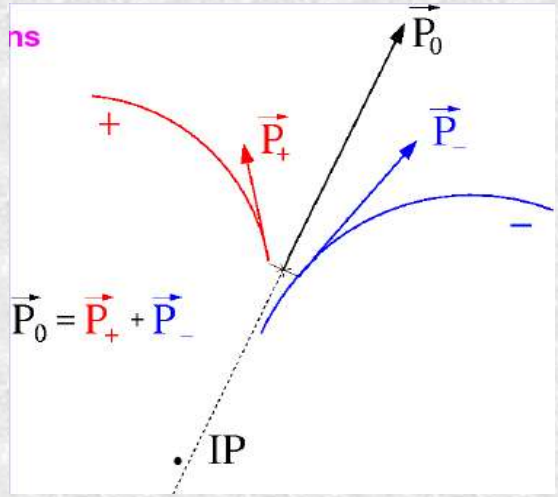
- Some thoughts on the structure of a particle flow reconstruction program
  - Minimize dependence on specific detector geometries, by isolating the geometry dependent modules
  - Considerations of energy cut-offs, hit density and digital or semi-digital
  - Use of clusters to reduce processing time: a cone or histogramming algorithm
  - cluster finding should consider a track-based prediction for showering
  - Some prescriptions on photon finding, pi0 finding, neutral clusters, shower analysis (overlaps), splitting, classification (hadron types) and special cases
  - Special cases: muons, low-energy hadrons (dE/dx and MS), neutrons and tracks close to beam pipe
- Estimated resource needs: 3.5 men*years

Neutral vertex and kink reconstruction

Alexei Raspereza (DESY)

- Goal: improved PFA performance by identifying V^0s and kinks for more appropriate treatment (remove secondaries, correct primaries)
- kinks: charged decays, bremstrahlung, MultScatt at large angles and artificial kinks due to tracking procedure. Search using pairs of tracks with same charge
- V^0s: neutral decays or gamma conversion. Search using pairs of tracks with opposite charge
- detector simulation by Brahms, reconstruction by SNARK. Use of control distributions for identification



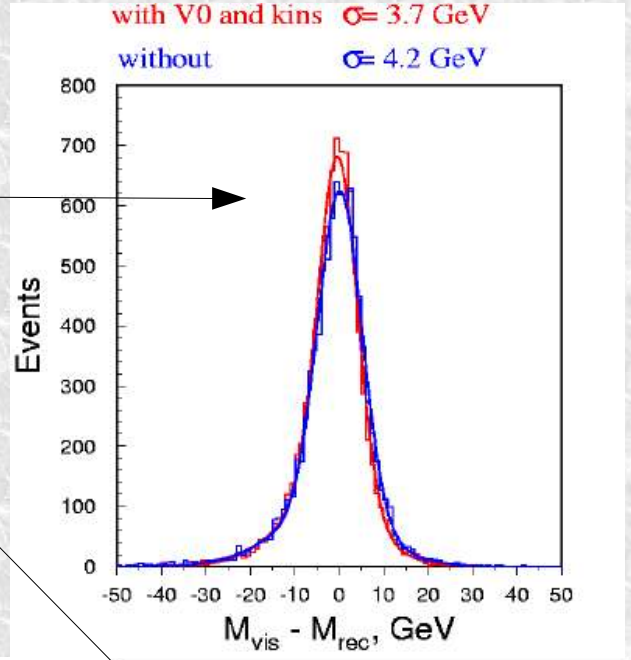


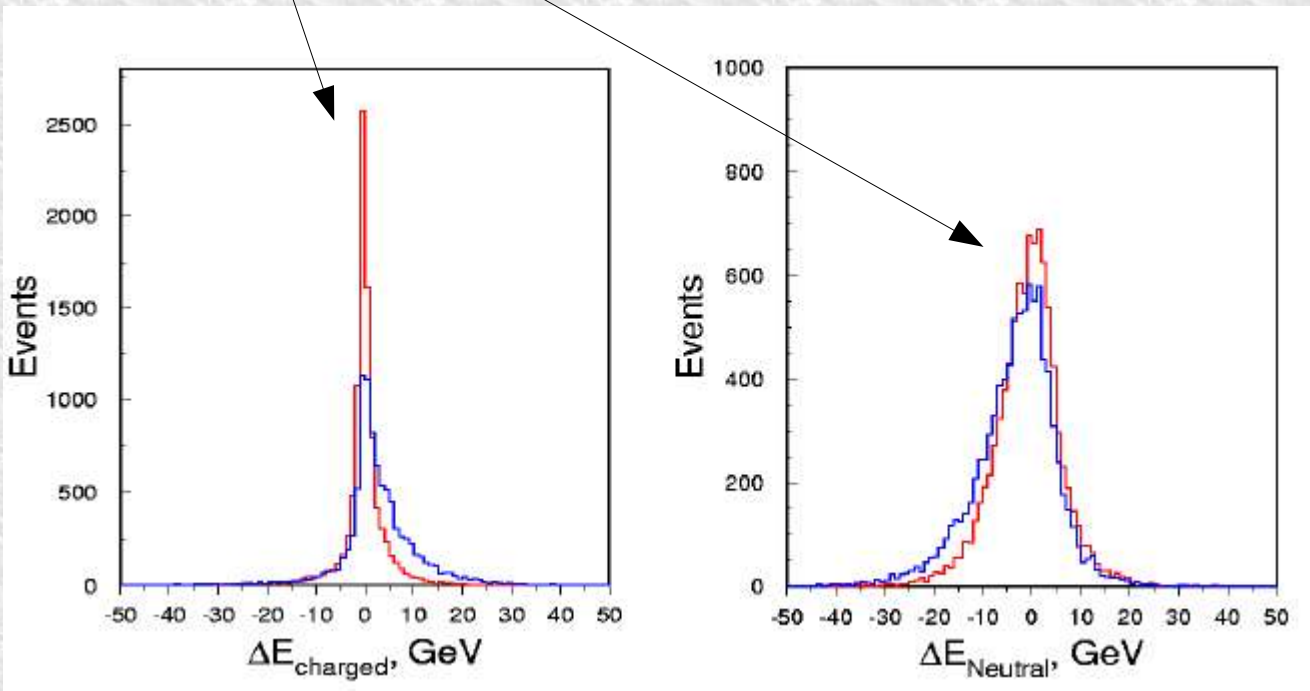
Preliminary results

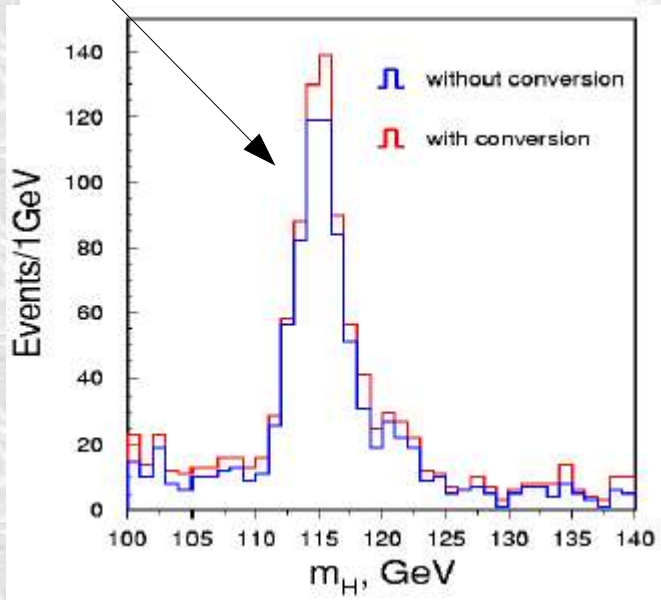
Z^0 mass resolution improves from 4.2GeV to 3.7GeV

for HZ -> gamma gamma qq, ~20% of events have at least one gamma conversion, and about 17% is recovered by the V^0

significant improvement on energy resolutions for total energies in charged or neutral componentsreconstruction procedure



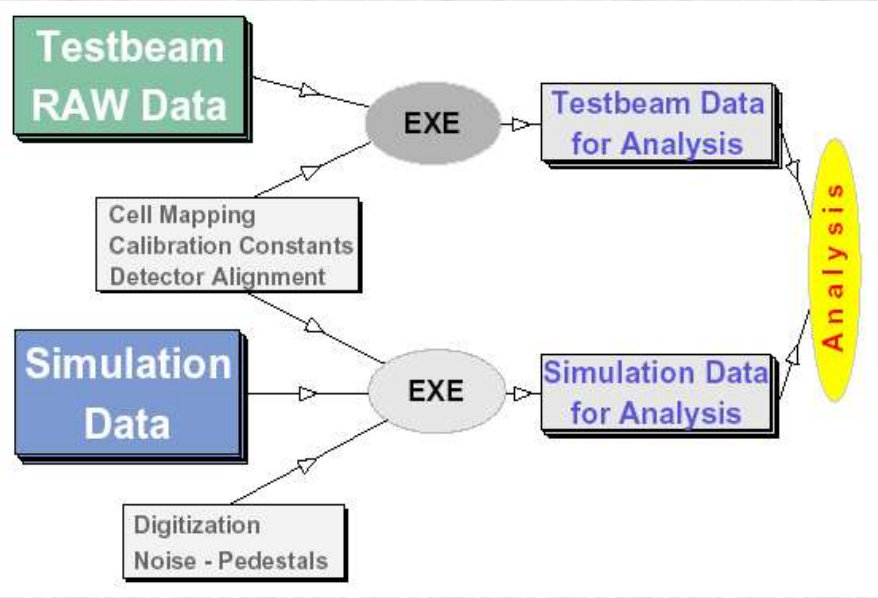




LCIO applications

Georgios Mavromanolakis (Cambridge)

- CALICE test beam software tools to be developed
  - use LCIO model as-is or extend it?
  - conversion schemes (from rawData or from SimData to a common format for reconstruction and analysis)
- Clustering: gNIKI (General Nodes Interlaced Klustering Implementation), based on MST (minimal spanning tree) theory
  - standalone C++, preliminary version exists
  - LCIO support and Marlin compliance planned
- Root vs. LCIO comparison: For similar user-defined constructs (see table)

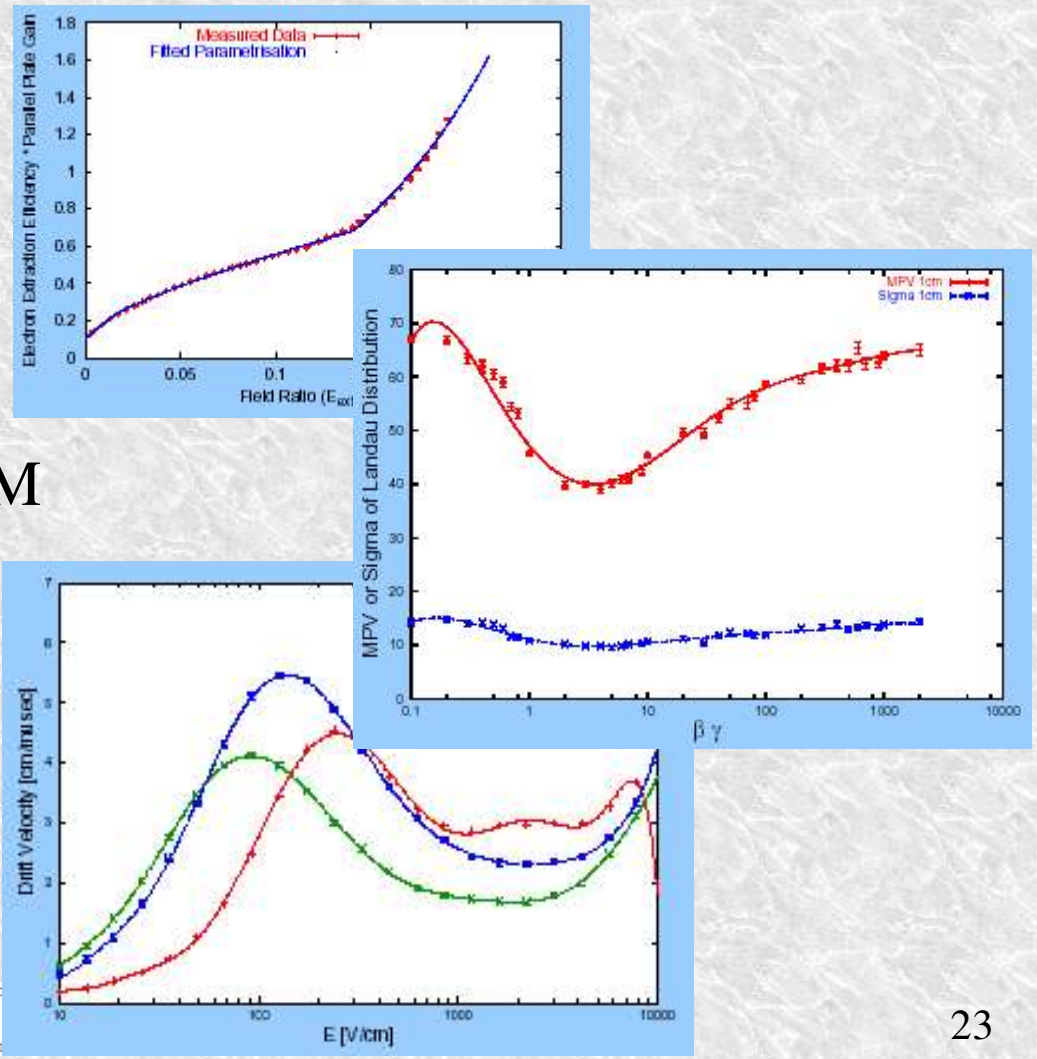


		LCIO	ROOT
100k events	size (MB)	28	4
	time write (sec)	64	9
	time read (sec)	71	19
500k events	size (MB)	139	19
	time write (sec)	365	48
	time read (sec)	328	95

TPC Simulation

Astrid Muennich (Aachen)

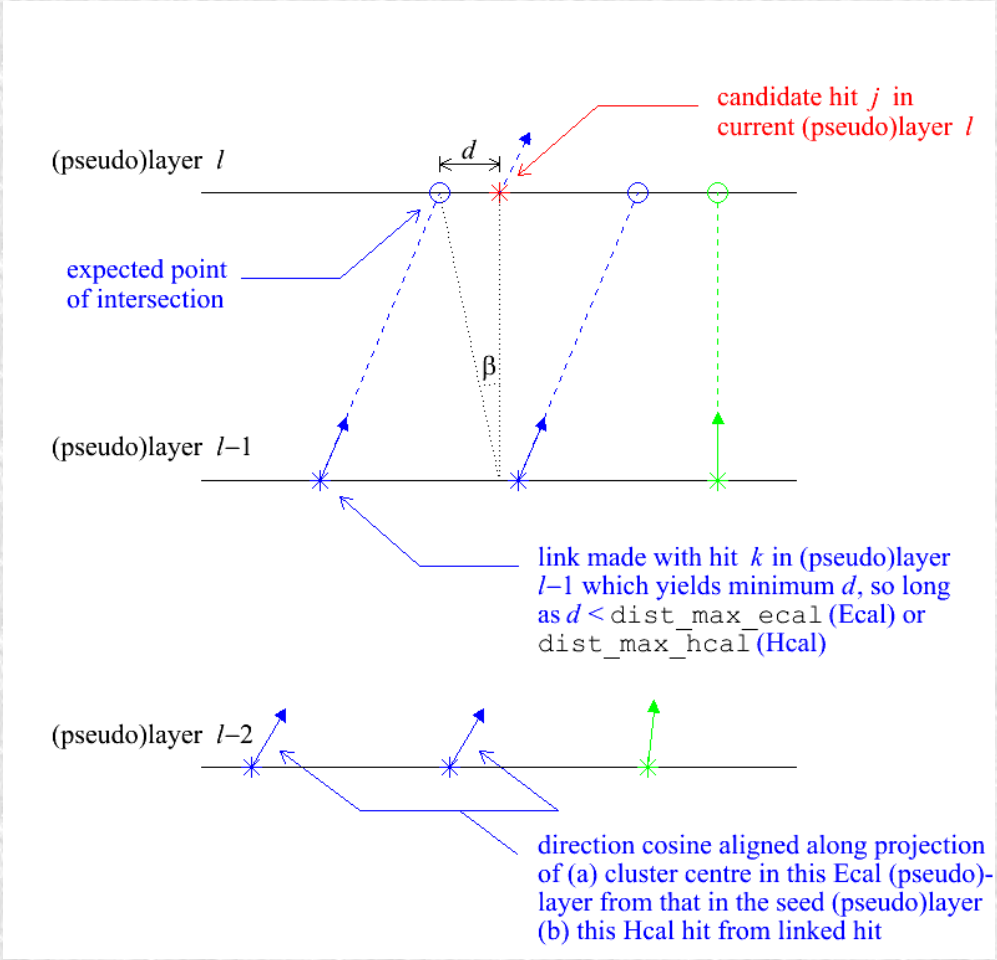
- Detailed TPC detection process difficult to simulate using Geant
- Effects simulated include: production and transport of primary electrons, influence of electric and magnetic fields, GEM amplification, ion backdrift and pad response
- Could be used to refine TPC simulation in the full detector simulators like Mokka



A clustering algorithm for a generalized calorimeter

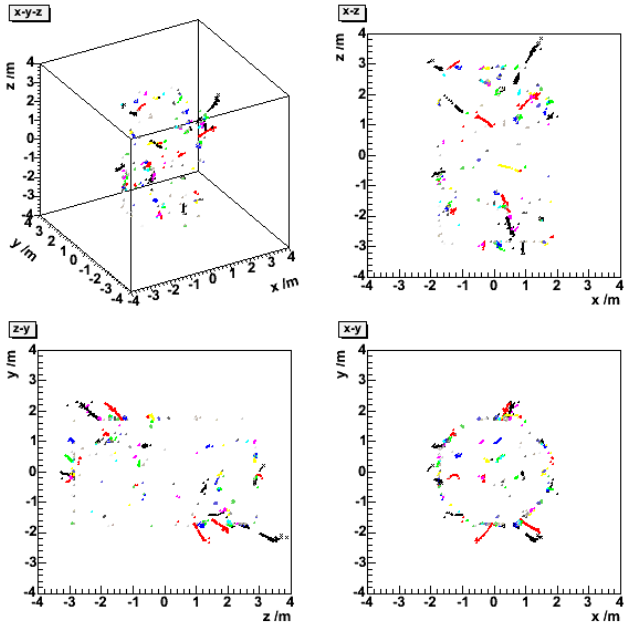
Chris Ainsley (Cambridge)

- tries to do particle tracking in calorimeter using a "layer-by-layer" approach
- uses modularized C++/LCIO (input separated from algorithm)
- geometry-independent (superlayers), can be used for different geometries (only Tesla has been tested so far)
- plans to be ported to Marlin in few months
- nice results, but the code is not publically available yet

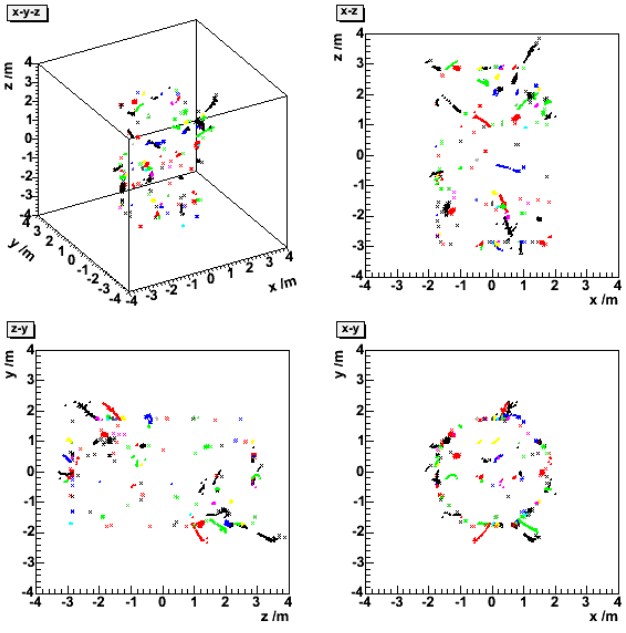


91 GeV Z u,d,s jets event

Reconstructed clusters



True particle clusters



Distribution of event energy (%)

Reconstructed cluster ID \ True cluster ID	1	2	3	4	5
5	0	0	0	4.05435	0
4	0	0	0	0	5.93354
3	0	6.49559	0	0	0
2	0	0	7.72404	0	0
1	8.53424	0	0	0	0

- Reconstruction in full detector (Si/W Ecal; RPC Hcal).
- `dist_max_ecal` = 2.0 cm; `dist_max_hcal` = 3.0 cm.
- Good 1:1 correspondence between reconstructed and true clusters (5 highest energy clusters shown).

Chris Ainsley
<ainsley@hep.phy.cam.ac.uk>

LC Simulation Workshop
9-10 December 2004, DESY, Germany

Summary

- DigiSim was quite well received, specially because it was already compliant to LCIO and Marlin
- Roman and Giorgios expressed interest in using DigiSim as part of their developments
- Interesting to meet some of our european ILC colleagues
- Surprised to see lots of developments under Brahms (Fortran)
- Morgunov (PFA), Ainsley (layer-by-layer clustering), Giorgios (MST-based clustering, ECal digitization) and Raspereza (V^0s and kinks) are obvious candidates for a possible collaboration in algorithms development