

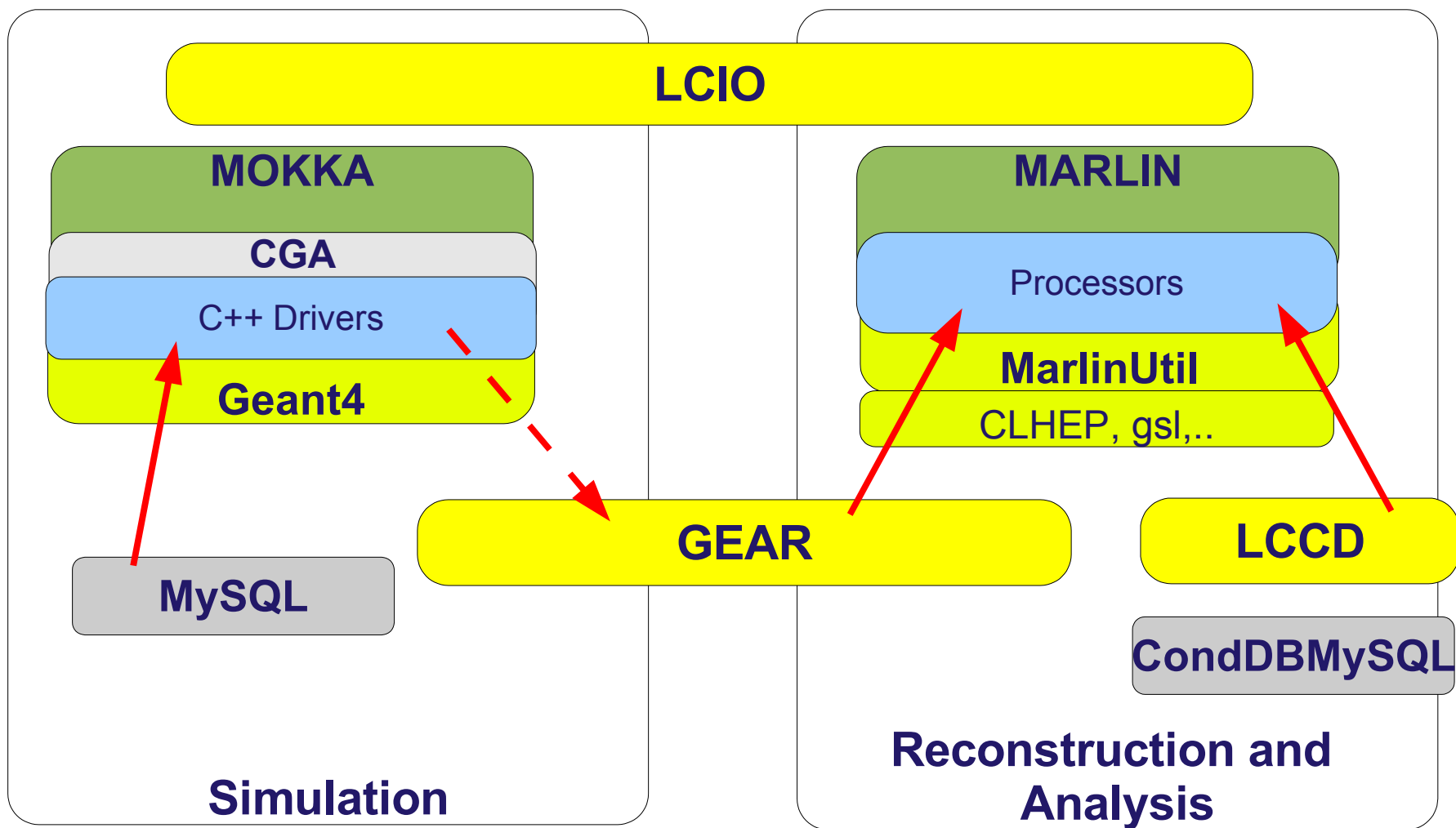
Analysing events for the ILC, using Marlin and MarlinReco



Outline

- LDC Simulation and Reconstruction Framework
- Marlin
- Processors for Marlin
- Software Packages and MarlinReco
- Event Reconstruction with MarlinReco on the GRID
- Summary

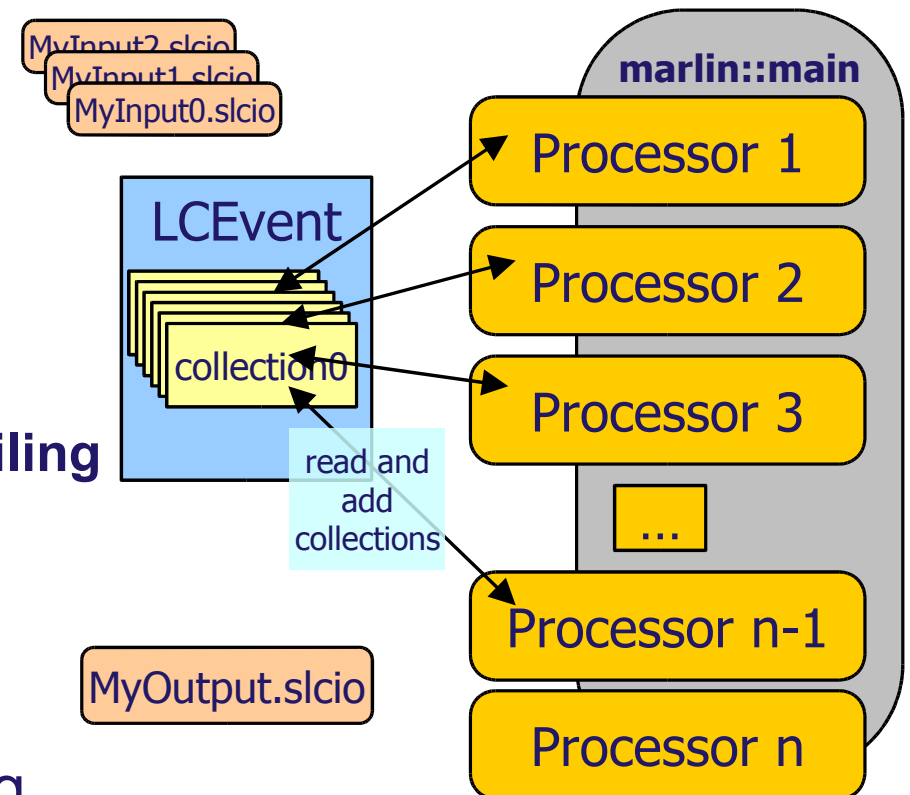
LDC Simulation and Reconstruction Framework



Marlin

Modular Analysis & Reconstruction for the L I N Near Collider

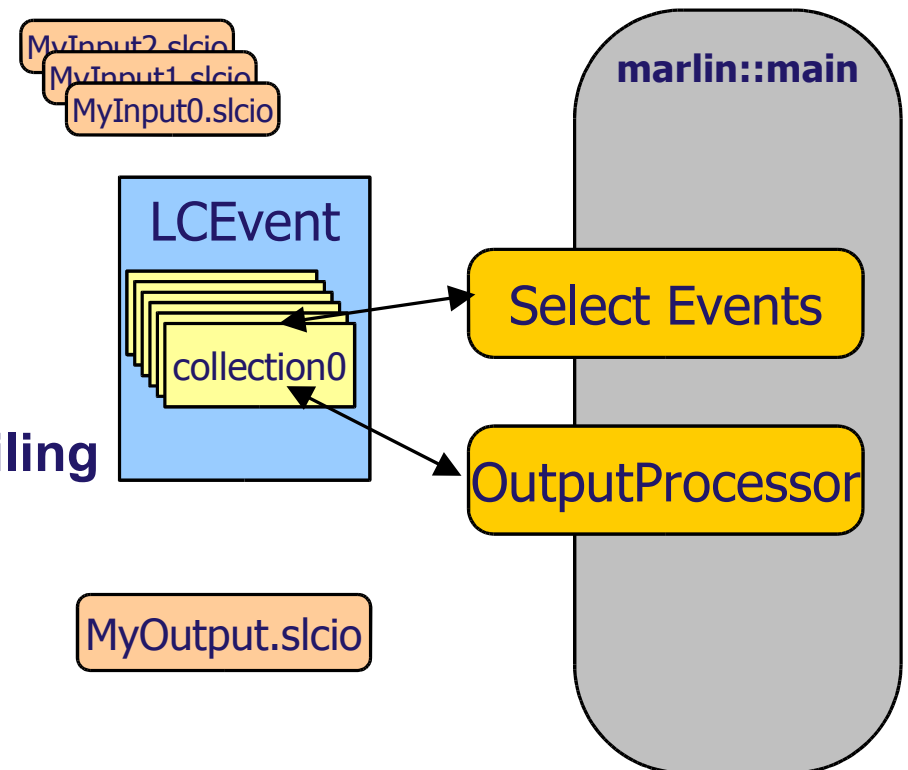
- modular C++ **application framework** for the analysis and reconstruction of LCIO data
 - modules called Processors
 - provides **main program**
- user steering via steering file
 - exchange Processors **w/o recompiling**
 - **same Processor with different parameters in one job**
 - conditional jump (if)
- task can be as simple as selecting events or as complex as a full event reconstruction



Marlin

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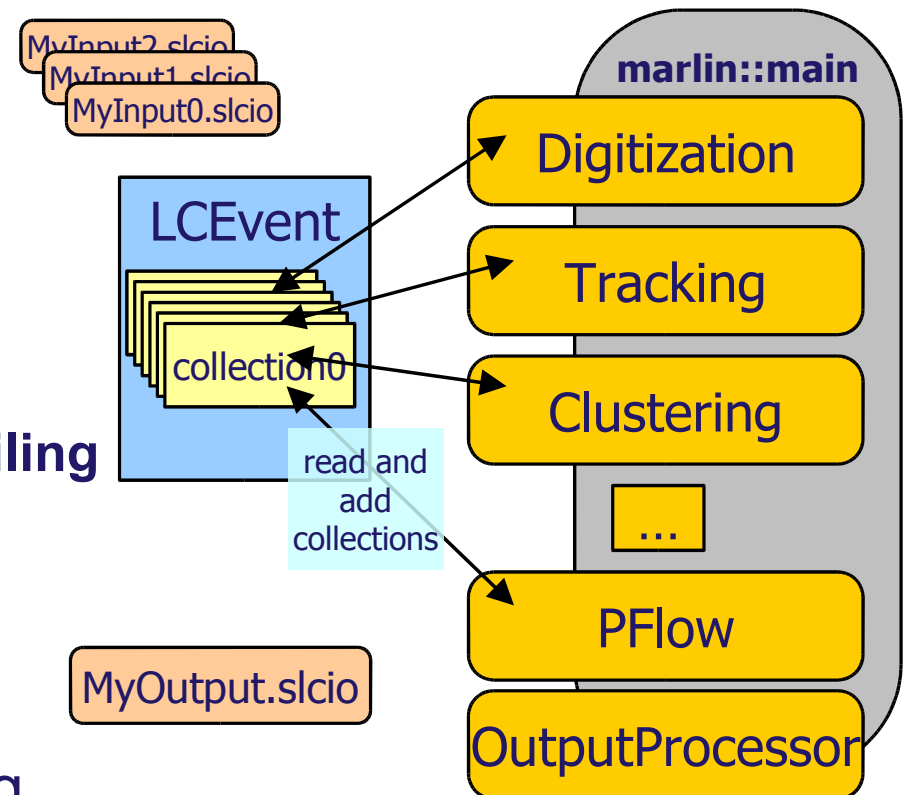
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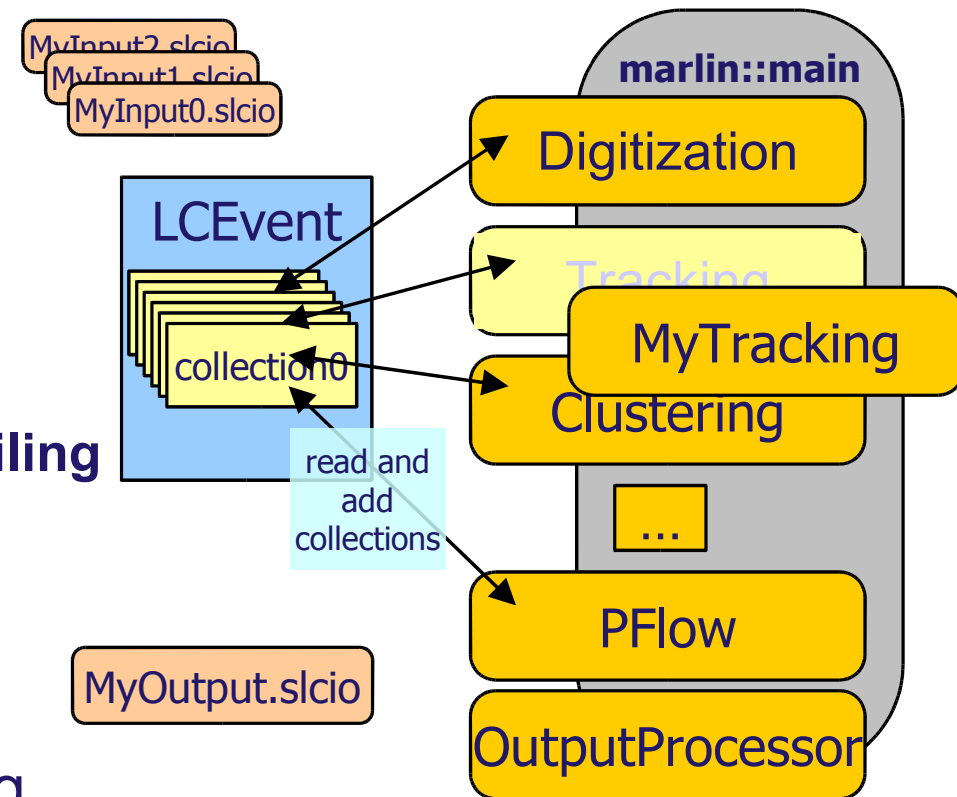
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Status of Marlin

- Marlin v00-09-02 available on the web
 - it allows to use GEAR and has updated documentation
- visit our **software portal**:

The image displays two screenshots of the ILC Software Portal website. The left screenshot shows the 'Marlin v00-09-02' release page, which includes a navigation menu, a search bar, and a list of available downloads. The right screenshot shows the 'Software packages' overview page, which lists various software packages and provides a login form.

Marlin v00-09-02

Navigation: Home, Software packages, Brahms, CEDViewer, Gear, LCIO, Marlin, Releases, Marlin 00-09, Marlin 00-09-01, Marlin v00-09-02, MarlinReco

Mainly updated documentation

Available downloads

- Download Marlin v00-09-02 for all platforms

Release Notes

Software packages

This portal contains information for software for ILC detector development.

The latest releases in each category. To see all projects in a specific category, click "Show all".

detector simulation	reconstruction software	tools and utilities
Mokka 05.03	MarlinReco v00-01	LCIO v1.06
Mokka 05.02	Show all projects in this category...	Marlin v00-09-02
Mokka 05-01		CEDViewer v00-01
Brahms 3.1.3	Show all projects in this category...	MarlinUtil v00-01
		CED v00-01
		Show all projects in this category...

log in

Name: gaede

Password: [input field]

Powered by Plone Software Center

<http://ilcsoft.desy.de>
[former <http://www-flc.desy.de/ilcsoft>]

Processors for Marlin

- full set of Processors for **event reconstruction** available
- **Track Digitisation**
 - simple smearing
- **Calorimeter Digitisation**
 1. simple: calibration, ganging, threshold cut for energy
 2. advanced: based on detector geometry, calibration, ganging
- **Tracking**
 - algorithms taken from LEP (ALEPH and DELPHI)
 - full tracking in TPC
 - VTX, SIT hits included in the track fit
 - TPC tracks used as 'seeds'

Processors for Marlin

- **Clustering (Trackwise Clustering)**
 - spatial information needed only
 - applicable to digital and analogue calorimeters
 - minimal dependence on detector geometry
 - can be used for different detector designs
- **PFlow (Wolf)**
 - Track – Cluster matching
 - extrapolate tracks into the calorimeter
 - get (E,p) for charged particles from track parameters
 - get (E,p) for neutral particles from cluster
 - Particle ID assigned by fraction of energy in ECAL / HCAL

Processors for Marlin

- **Track and Cluster Cheater**

- use Monte Carlo information to combine hits to tracks and clusters
- tracker hits are fitted with simple helix hypothesis
- use instead of realistic tracks and clusters
- compare with them

- **Analysis**

- Event Shapes:
 - Thrust Reconstruction (Tasso & Jetnet algorithms)
 - Sphere (sphericity, aplanarity, ...)
- Satoru Jet Finder
 - originally developed by Satoru Yamashita for OPAL

Software Packages for Marlin

- **Package = set of Marlin Processors**, classes and functions
 - MarlinReco → full set of Processors for **event reconstruction**
 - Digitisation, Tracking, Clustering, PFlow and Analysis
 - MarlinUtil → **utility** and **helper** classes
 - CEDViewer → simple **event display** client processor
- stand-alone software modules:
 - CED → event display based on GLUT / OpenGL
 - RAIDA → **AIDA to ROOT** interface (coming up soon)
- Packages are **not** fixed
 - MAGIC → different Clustering, partly uses MarlinReco
 - PandoraPFA → Clustering, PhotonID, Cluster Association

Status of MarlinReco

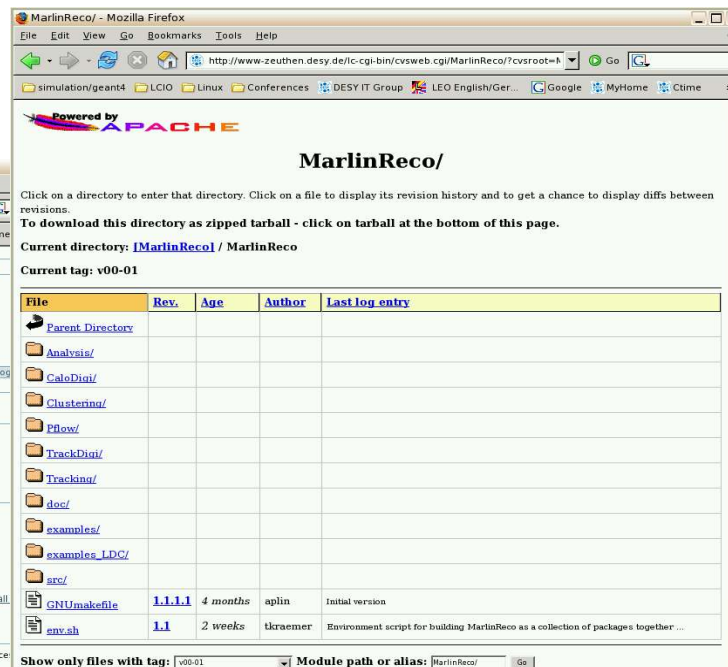
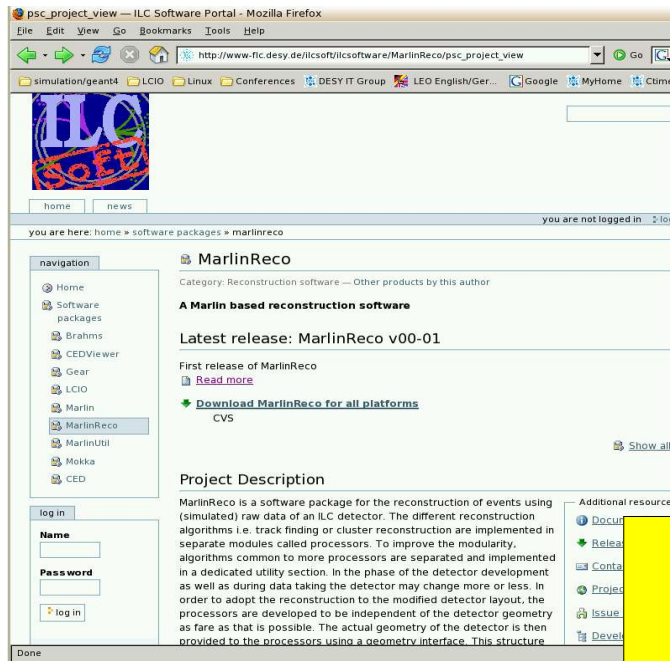
- **to do**

- more realistic track digitisation
 - new VTX Digitiser (see talk of A. Raspereza)
- vertex and forward tracking
 - new stand-alone PatRec for VTX (see talk of A. Raspereza)
- neutral / charged vertex and kink finding
- particle ID
- ...

your input / ideas are welcome !

Status of MarlinReco

- MarlinReco v00-01 available on the web
 - comprehensive manual available
- visit our **software portal**:



http://ilcsoft.desy.de
[former http://www-flc.desy.de/ilcsoft]

MarlinReco on the GRID

- 'mass production' of events on the **GRID**
 - latest Mokka v05.04, 4 detector geometries and 2 magnetic fields
 - 2 different detectors: **LDC00Sc** and **LDC01Sc**
 - LDC00Sc: 30 + 10 ECAL Layers
 - LDC01Sc: 20 + 10 ECAL Layers
 - same overall thickness of ECAL, HCAL unchanged
 - 2 different sizes of TPC: (**R**)adius and (**L**)enght
 - overall 8 'different' detectors

B field (T)	LDC01Sc (mm)		LDC00Sc (mm)	
3	R = 1380	R = 1580	R = 1690	R = 1890
	L = 2000	L = 2200	L = 2730	L = 2930
4	R = 1380	R = 1580	R = 1690	R = 1890
	L = 2000	L = 2200	L = 2730	L = 2930

MarlinReco on the GRID

- Physics processes
 - WW, Zh, uds, cb, tt @ 360, 500 and 1000 GeV
 - Z @ 91.2 GeV
- \approx **450000** events (**500 GByte**) of simulated data
- all data available on the **GRID** for ILC VO members
- meta data, logical filenames etc. stored in **MC Database**

<http://ilcsoft.desy.de>

International Linear Collider Monte Carlo Database

Search Database Browse Database

MC data files stored in database:

Run ID	Process	CM Energy [GeV]	Date of Production	B Field [T]
M-5-4_cb_1000_noisr_LDC00Sc_3.00T_r1690_12730_QGSP_BERT	e+e- -> cb	1000.0	2006-02-19	3.0
M-5-4_cb_1000_noisr_LDC00Sc_3.00T_r1890_12930_QGSP_BERT	e+e- -> cb	1000.0	2006-02-20	3.0
M-5-4_cb_1000_noisr_LDC00Sc_4.0T_r1690_12730_QGSP_BERT	e+e- -> cb	1000.0	2006-01-11	4.0
M-5-4_cb_1000_noisr_LDC00Sc_4.0T_r1890_12930_QGSP_BERT	e+e- -> cb	1000.0	2006-01-11	4.0
M-5-4_cb_1000_noisr_LDC01Sc_3.00T_r1380_12000_QGSP_BERT	e+e- -> Z0 + h0	1000.0	2006-02-22	3.0
M-5-4_cb_1000_noisr_LDC01Sc_3.00T_r1580_12200_QGSP_BERT	e+e- -> cb	1000.0	2006-02-20	3.0
M-5-4_cb_1000_noisr_LDC01Sc_4.0T_r1380_12000_QGSP_BERT	e+e- -> cb	1000.0	2006-01-12	4.0

MarlinReco on the GRID

- run the reconstruction (**MarlinReco**) on the **GRID**
 - \approx 70% finished
 - yet not all data analysed
- **GRID** is a comprehensive, powerful and 'easy to use' tool

Reconstructed M_{inv} of Z^0

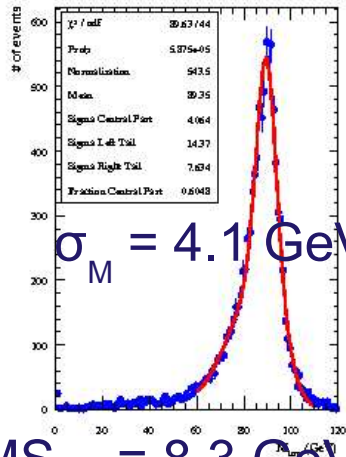
- TrackCheater used in reconstruction
- plot M_{inv} for the 4 different detectors and 2 different magnetic fields
- calculate σ_M and $RMS_{90\%}$ for them
- dependencies on Geometries / magnetic fields

Reconstructed M_{inv} of Z^0

Z pole:

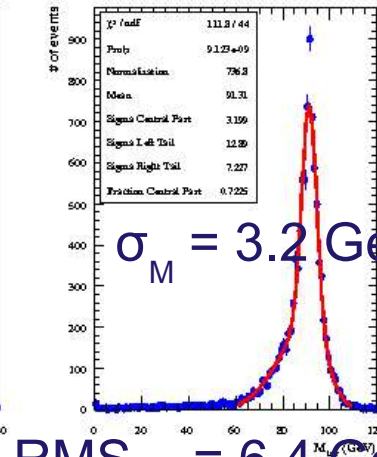
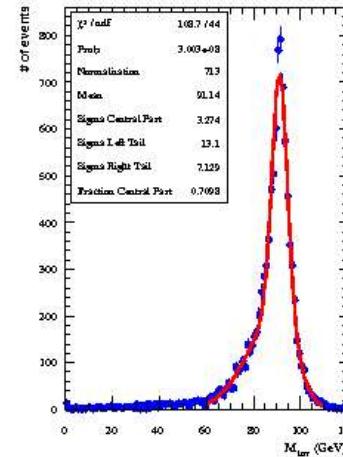
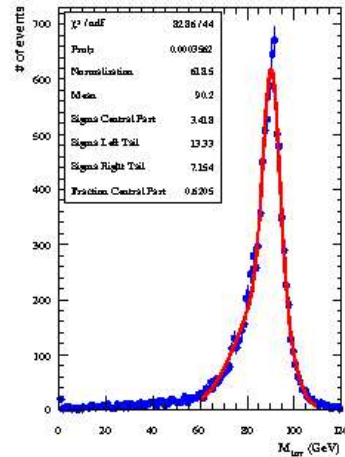
Size \rightarrow

3 T



$\sigma_M = 4.1 \text{ GeV}$

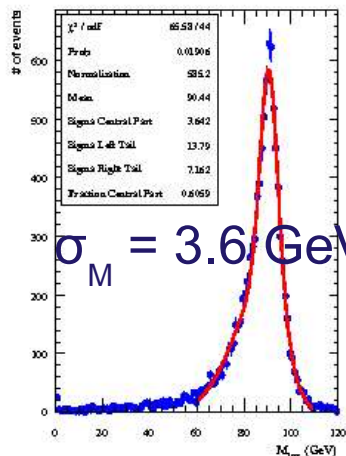
$\text{RMS}_{90\%} = 8.3 \text{ GeV}$



$\sigma_M = 3.2 \text{ GeV}$

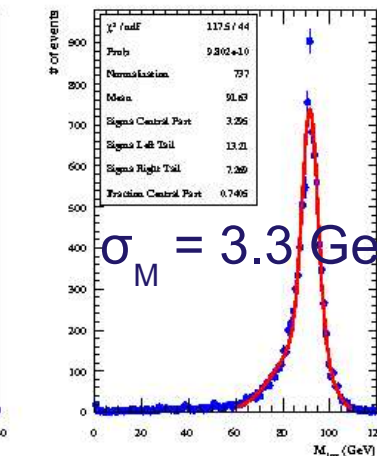
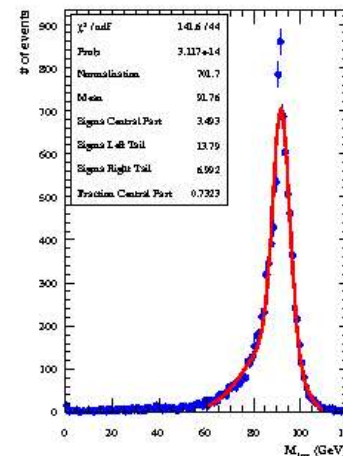
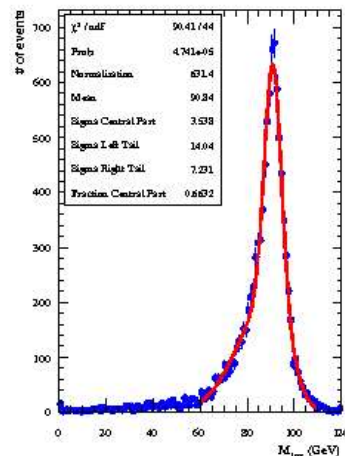
$\text{RMS}_{90\%} = 6.4 \text{ GeV}$

4 T



$\sigma_M = 3.6 \text{ GeV}$

$\text{RMS}_{90\%} = 8.0 \text{ GeV}$

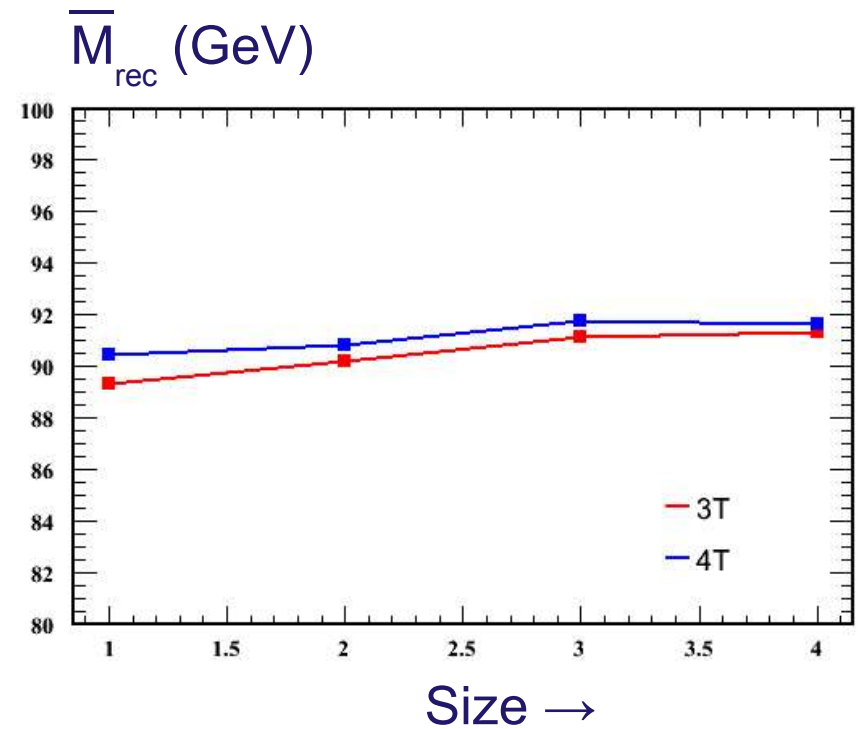
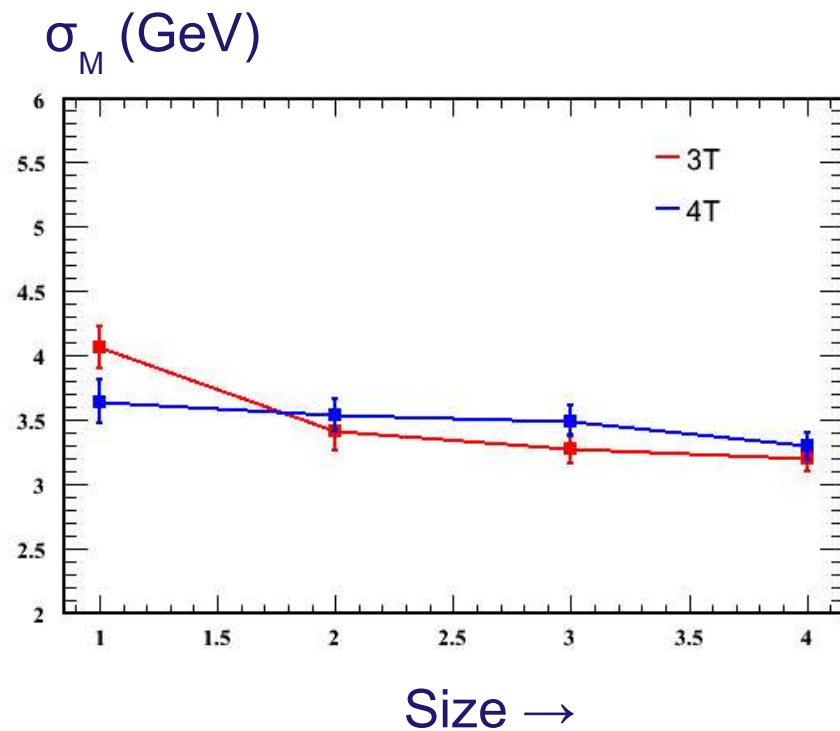


$\sigma_M = 3.3 \text{ GeV}$

$\text{RMS}_{90\%} = 6.4 \text{ GeV}$

Reconstructed M_{inv} of Z^0

Z pole:



Reconstructed M_{inv} of Z^0

- Z reconstruction looks reasonable
 - good to compare different algorithms in a certain parameter range
 - nice 'benchmark' plot
 - **NOT** appropriate for detector optimisation
 - CM energy too small (physics processes at 500 GeV)
 - σ_M not depending on Geometry (within errors)
 - not so large number of tracks and clusters
 - not so many overlapping clusters
- need WW, Zh or ttbar @ 500 GeV and 1000 GeV

ttbar @ 500 GeV

- calculate $\sum E_{\text{rec}} - \sum E_{\text{avail}}$
 - simple sum over all calorimeter cells (see talk of V. Morgunov)
 - σ_E for 500 GeV ttbar: **12.6 GeV** (LDC00Sc, 4T)
 - σ_E of PFlow reconstruction with BRAHMS (SNARK)
 - σ_E for 500 GeV ttbar: **9 GeV**
 - energy resolutions of reconstruction with MarlinReco
 - σ_E for 500 GeV ttbar: **25.2 GeV** (LDC00Sc, 4T)
- problem in reconstruction code
- **not applicable** for **detector optimisation** (same problem for WW)
 - PFlow concept is **not** the reason (see SNARK)
 - **might** be a fundamental problem of the cluster-based approach

PROBLEM

Summary

- Marlin is a flexible and light-weighted **SW framework**
 - uses LCIO
- MarlinReco is a **reconstruction toolkit** for the ILC
 - full set of needed processors
 - extensible → use / combine with other processors
 - reconstruction of 'mass data' on the GRID
- Reconstruction works **fine for Z Pole**
- **problems** with the reconstruction for **ttbar @ 500 GeV**
 - studies are ongoing

please feedback to:
ilcsoft@desy.de

Thanks to all developers:
S. Aplin, F. Gaede, T. Kraemer, P. Krstonosic
A. Raspereza (MPI Munich), J. Samson,
H. Albrecht, D. Martsch, A. Vogel
and V. Morgunov

Backup Slides ...

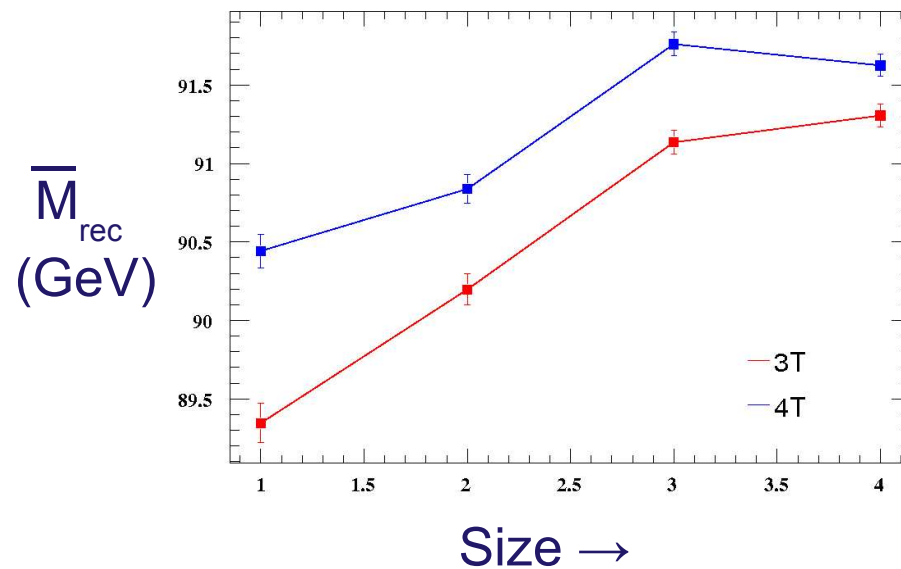
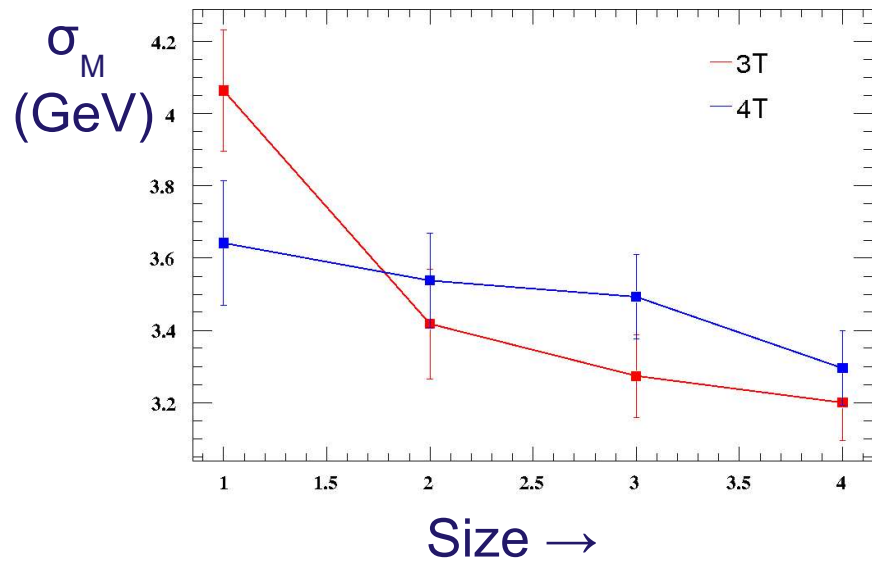
Marlin

Use **PFlow** algorithm for event **reconstruction** at the ILC

- different PFlow algorithms available
- detector optimisation studies ongoing (Geometries, B-Field)
- need a **simple, flexible** and **lightweighted** SW framework
- easy to install, use and **modify / expand**
- use widely accepted OO-language: **C++**
- based on international ILC data format: **LCIO**

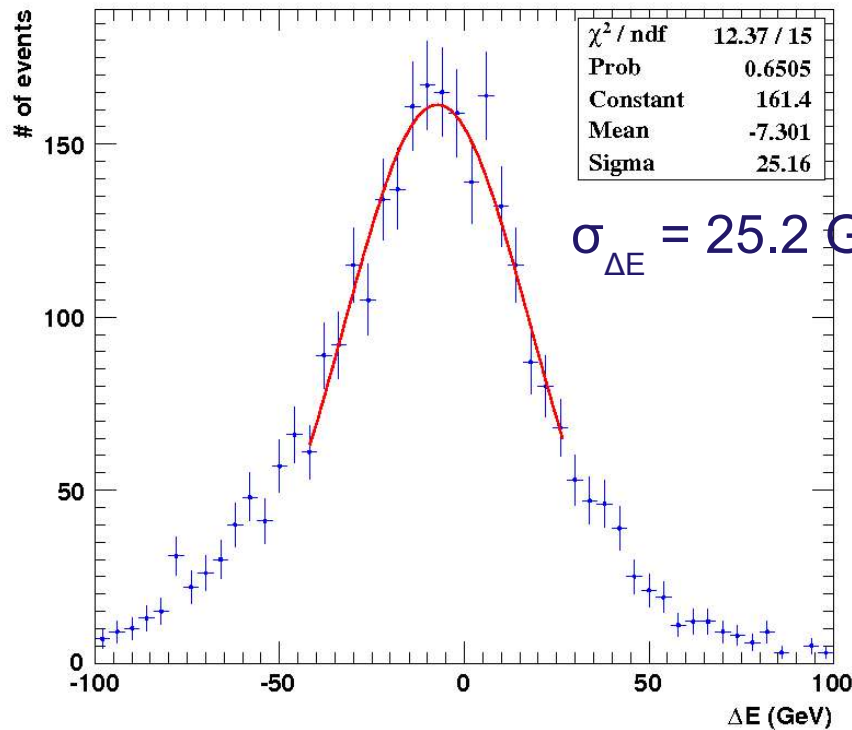
Reconstructed M_{inv} of Z^0

Z pole:



$t\bar{t}$ @ 500 GeV

Calculate whole energy per event and compare it with MC energy



$$(\sum E_{\text{rec}} - \sum E_{\text{MC}})$$

preliminary

$$(\sum E_{\text{Calo}} - \sum E_{\text{MC}})$$

$$\sigma_{\Delta E} = 12.6 \text{ GeV}$$