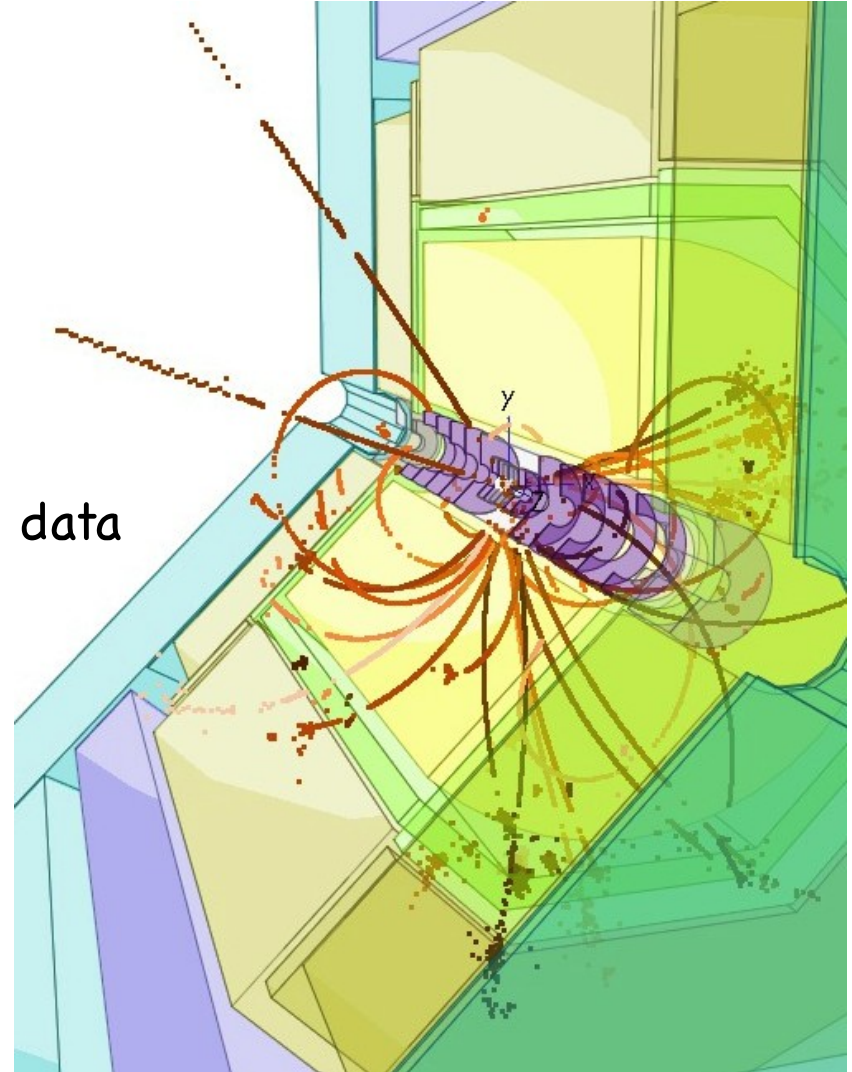


# iLCSoft – Software for the Linear Collider

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D-HEP Computing Strategy Workshop  
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# Overview

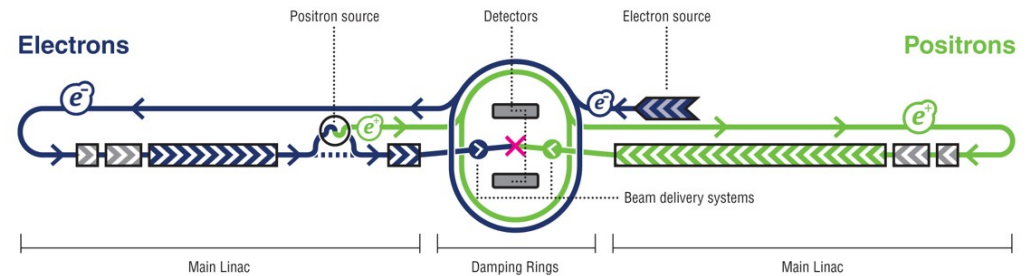
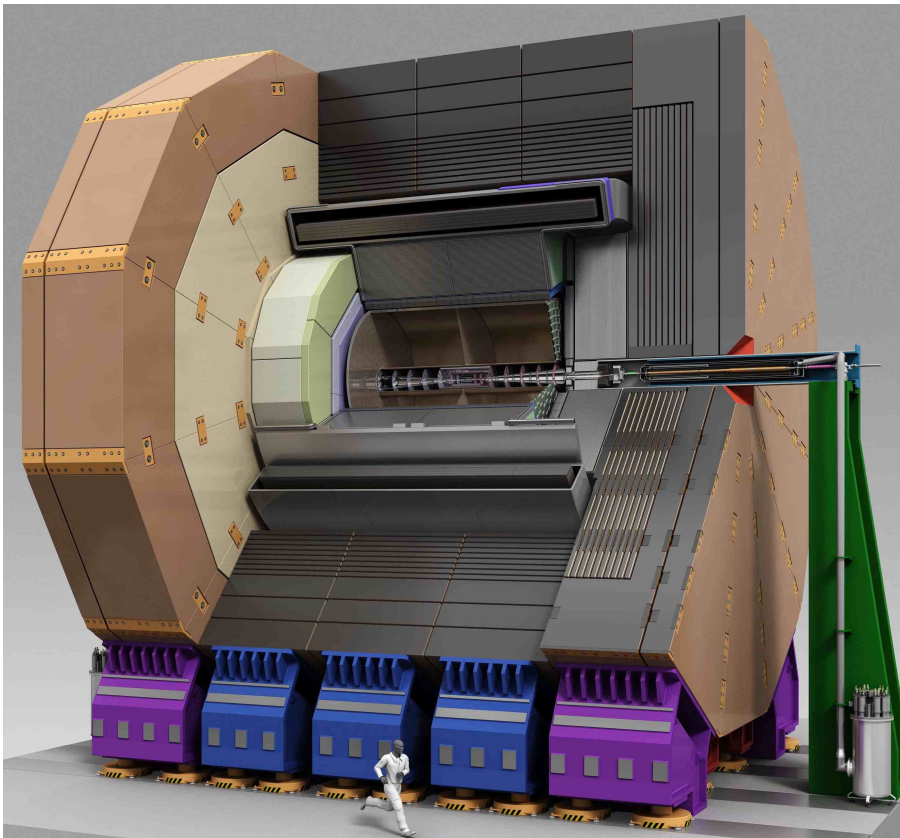
- introduction to LC
- overview of iLCSoft
- iLCSoft activities at DESY
  - core software tools
    - EDM, framework, geometry, conditions data and event display
  - tracking software
    - -> talks Ch. Rosemann, Y. Voutsinas
  - Grid production
- Summary



# Introduction: ILC & ILD

- ILC

- linear  $e^+e^-$  collider
- 250–500 GeV (1 TeV)
- super conduction RF technology
- TDRs submitted early 2013
- (soon) to be build in Japan



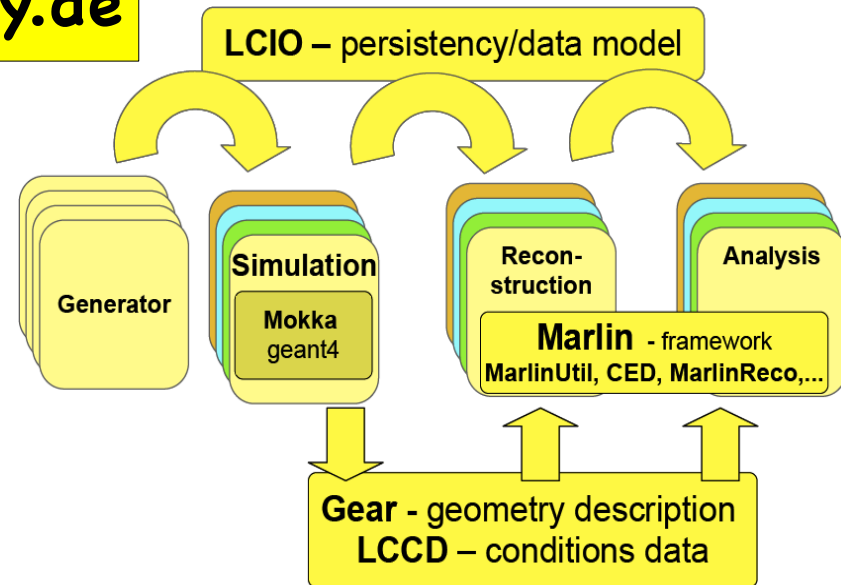
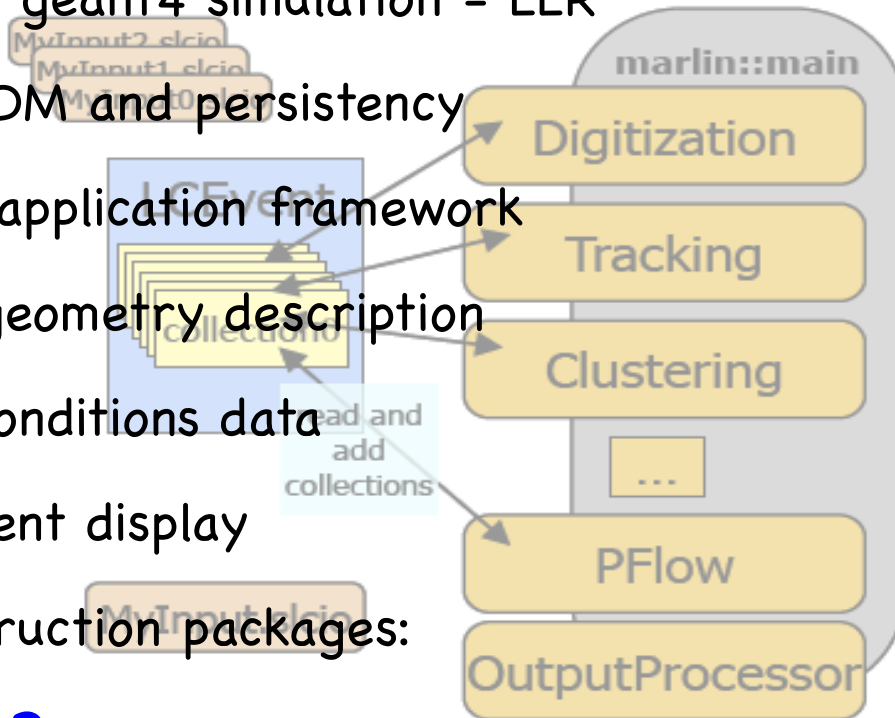
- ILD

- one of two detector concepts for the ILC (push pull)
- optimized for PFA
  - highly granular calorimeters
  - excellent momentum resolution
  - and vertexing capabilities
- other LCs and detectors
  - CLIC (0.5–3 TeV)
  - SiD
    - detector concept for ILC

# iLCSoft framework - Overview

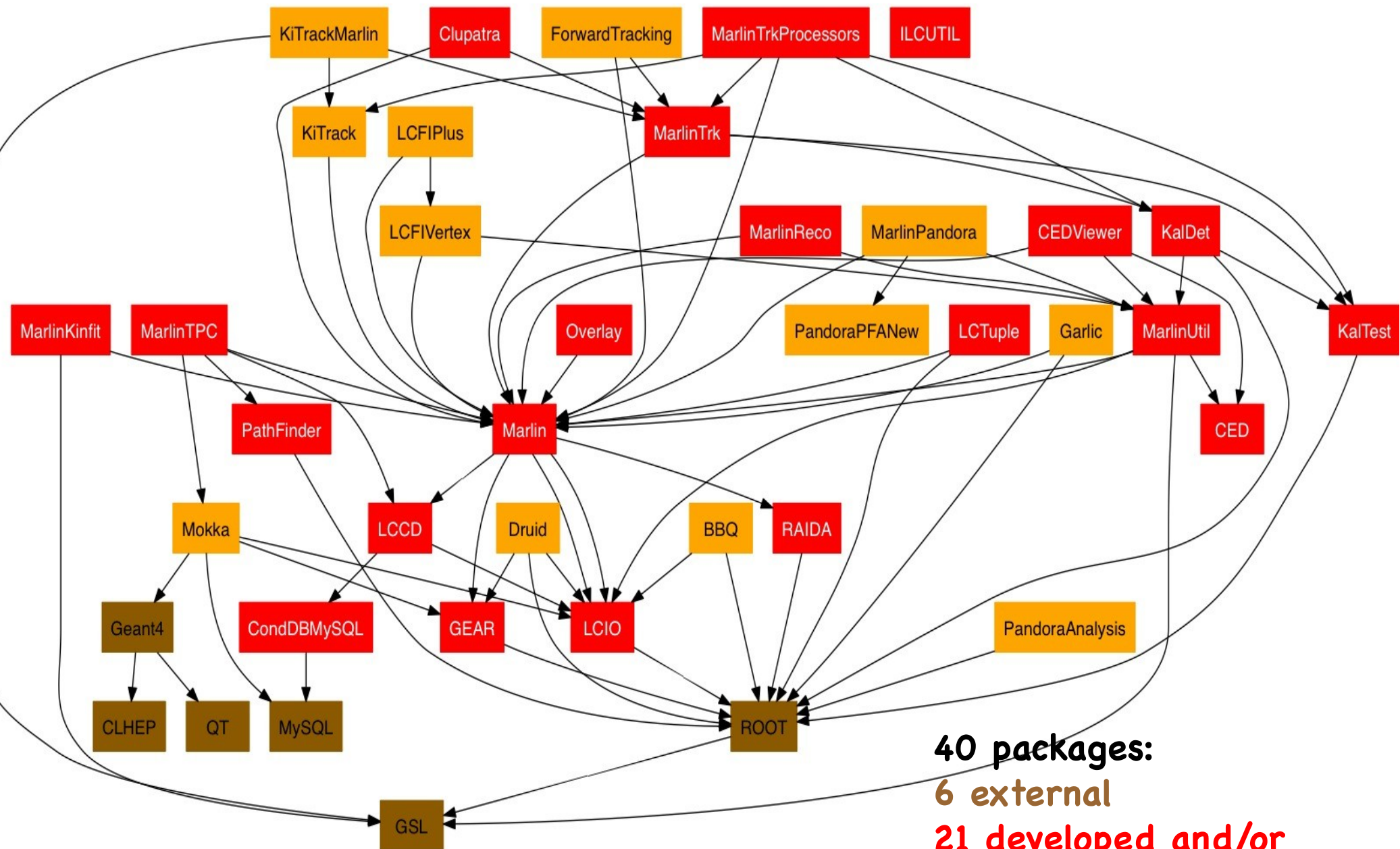
<http://ilcsoft.desy.de>

- **Mokka** geant4 simulation - LLR
- **LCIO** EDM and persistency
- **Marlin** application framework
- **GEAR** geometry description
- **LCCD** conditions data
- **CED** event display
- reconstruction packages:
  - **MarlinReco**
  - **MarlinTrk, Clupatra, ForwardTracking,...**
  - **MarlinPandoraPFA**
  - **LCFIVertex, LCFIPlus**
  - **MarlinKinFit**
- many more (see next slide)



- complete sw framework used in Monte Carlo & 'real experiments':
  - **ILD & CLIC** detector concept studies
  - **Calice, LC-TPC, EUTelescope** testbeams
- **synergies between testbeam and global detector optimization**

# iLCSoft packages



**40 packages:**

**6 external**

**21 developed and/or  
maintained at DESY**

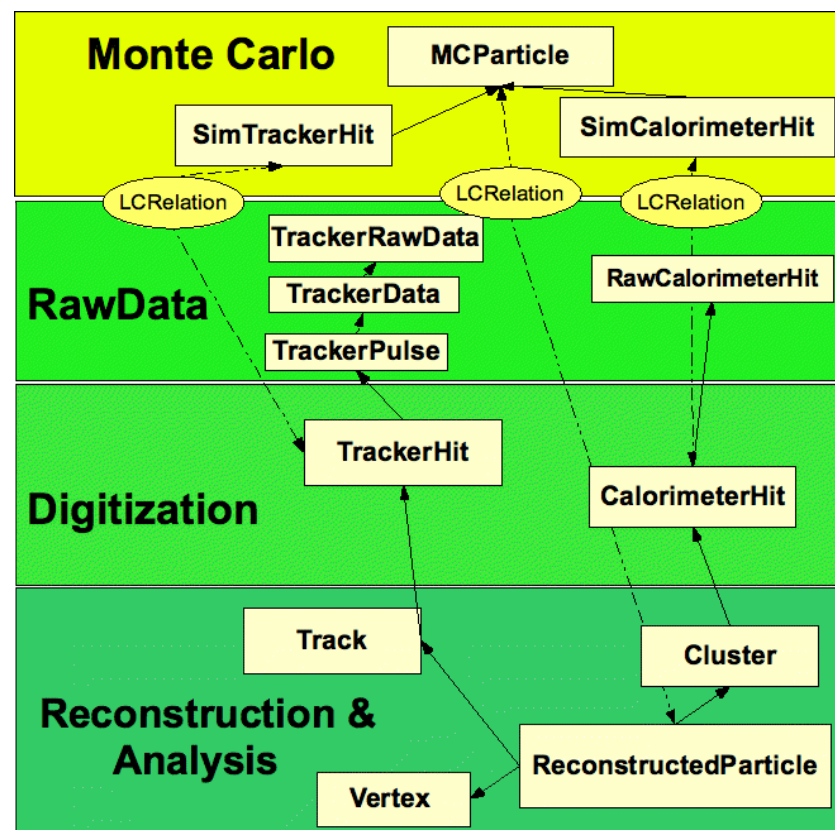
# LCIO Event Data Model

- **LCIO** is a hierarchical **Event Data Model** and **persistence** solution for Linear Collider simulation studies

- DESY/SLAC project since 2003

- **LCIO features:**

- object I/O (w/ pointer chasing)
- schema evolution
- compressed records
- EDM defined through C++ interfaces ( with Java, Python and Fortran bindings)
  - decoupled from actual I/O
- generic user objects
- no external dependencies
- optional **ROOT** dictionary
- see more at <http://lcio.desy.de>

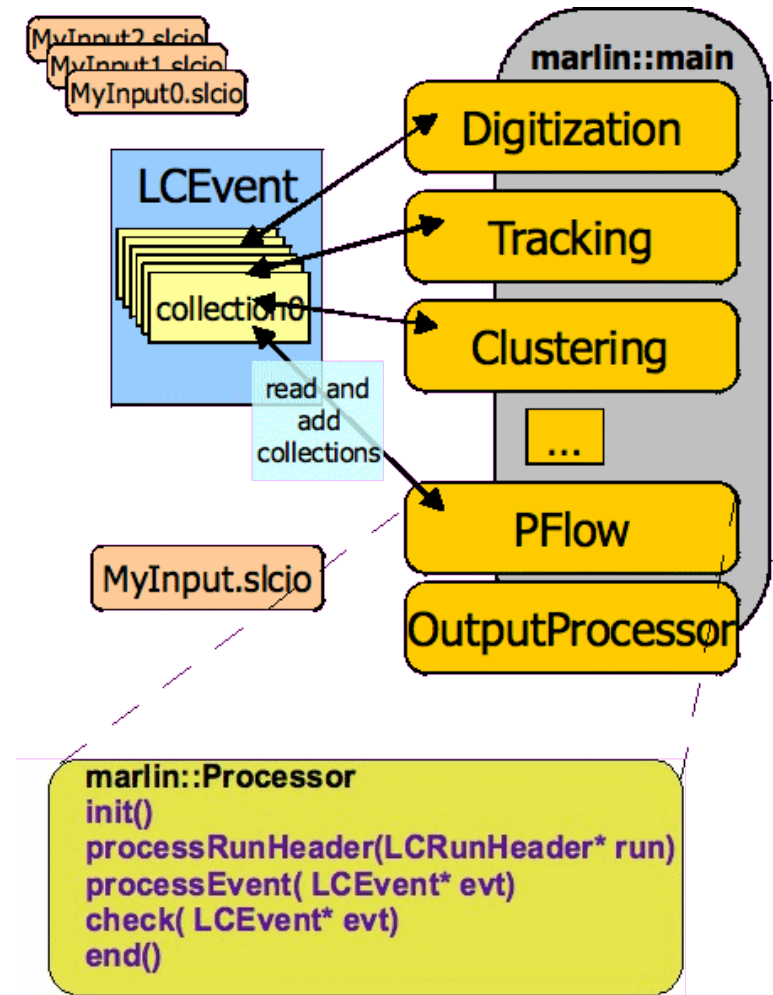


- LCIO provides common basis for Linear Collider software – used by:
  - ILD, SiD and CLIC
  - testbeam collaborations:
    - Calice, LCTPC, EUPixelTelescope,...

# Marlin framework

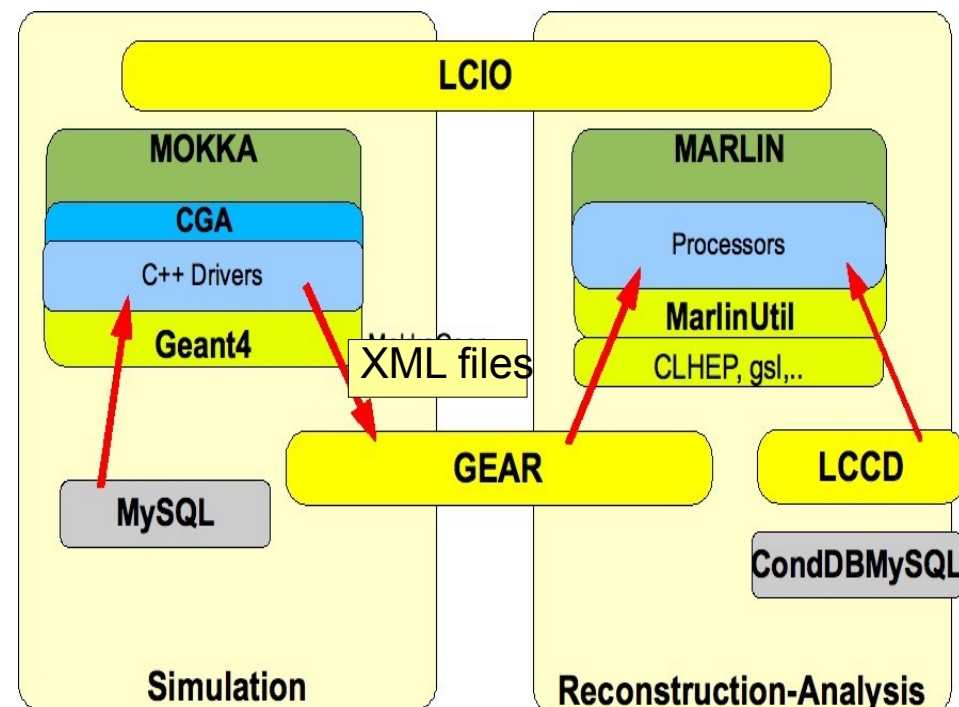
**M**odular **A**nalysis & **R**econstruction for the **LIN**ear Collider

- modular **C++ application framework**
- uses **LCIO** as persistent and transient event data model
- event data bus or white board design
- plugin mechanism for user libraries (\$MARLIN\_DLL)
- xml configuration with local/global parameters
- self documenting (steering parameters and defaults)
- consistency check event data flow



# GEAR geometry description

- detailed geometry for simulation with Mokka/geant4:
- MySQL data base with parameters
- C++ drivers per subdetector
- reconstruction:
  - **GEAR high level abstract interface:**
    - per subdetector type (Hcal,TPC,...) parameters/quantities for reco
      - geometry + some navigation
      - implementation uses xml files
    - **abstract interface for detailed geometry & materials:**
      - point properties
      - path properties
      - implementation based on geant4
        - > rather slow in reco loops

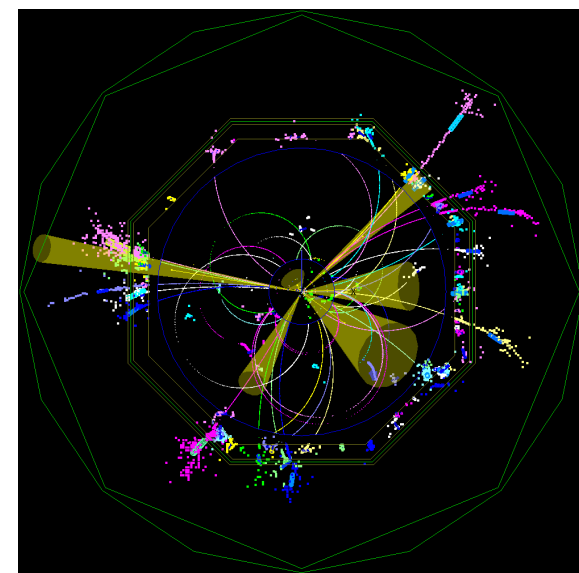
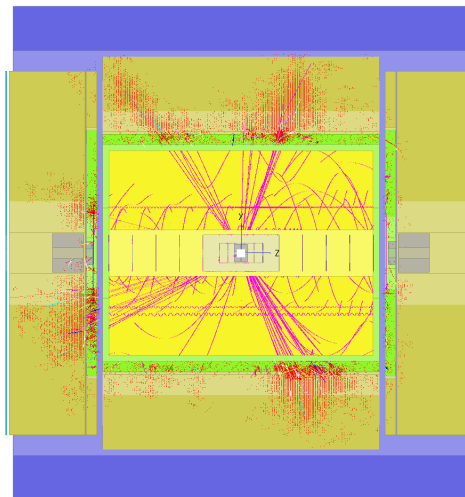
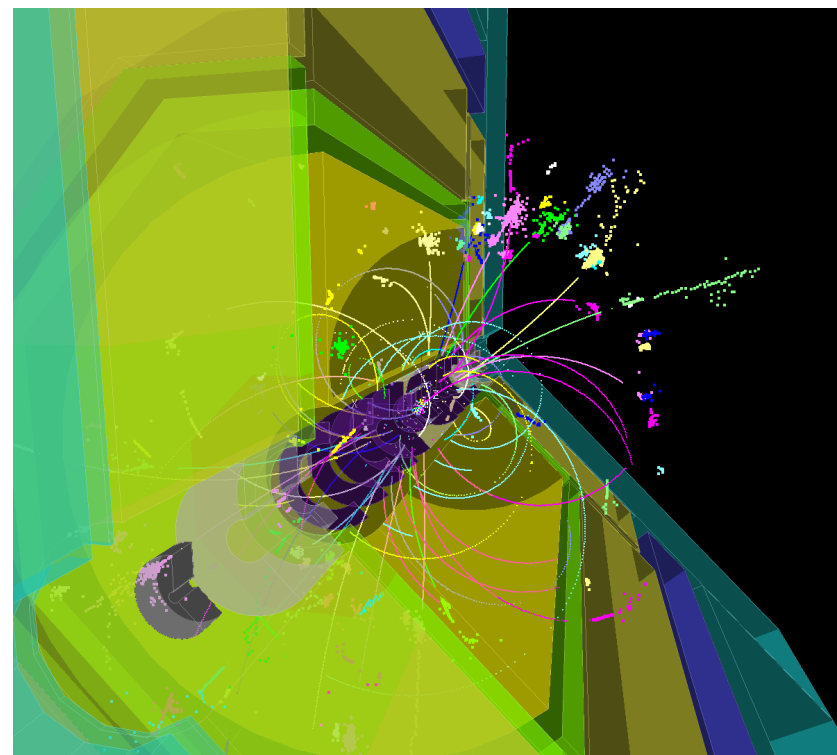


- enforce only one source of geometry:
  - write xml files from Mokka C++ drivers
  - read xml files in Marlin reco job
- slightly 'odd' procedure to have geometry defined in simulation program

new project **DD4hep**  
-> talk Ch. Rosemann

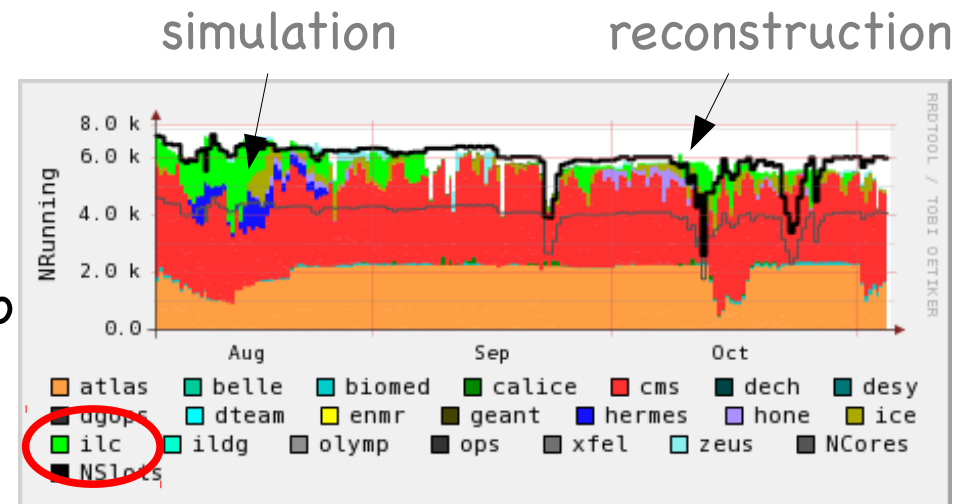
# CED event display

- fast client-server event display
- based on OpenGL (glut)
- some features:
  - 3d transparent surfaces
  - cut open detector
  - save/reload display settings
  - projections: r-phi, r-z
  - toggle view of detectors, hit collections, axes, ...
- binding for LC read
  - GEAR for geometry
  - LCIO for hits, tracks, clusters
- detailed [User Manual](#)



# Grid production for ILC @ DESY

- DESY serves as **T0 for ILD and ILC test beam** activities
- coordinate central productions (e.g. DBD)
- Grid software installations (now cvmfs)
- productions system (in future use **ILCDIRAC** maintained by CERN)
- example DBD production
  - simulated and fully reconstructed **>20M events**
  - in 50k simulation and 10k reconstruction jobs
  - **largest fraction done at DESY**
- some benchmarks:
  - sim: 5–9 min / event
  - rec: 30–60 sec / event \* (w/o background)
  - rec: 45–210 sec / event \* (w/ background)



usage of Grid @ DESY still  
rather small compared to LHC

# other iLCSoft activities at DESY

- release management of iLCSoft:
  - integrate all sw packages, provide build and install tools, afs reference installations, release documentation, roll out of releases
- provide code repository for all iLCSoft packages:
  - SVN server at Zeuthen
- operate iLCSoft web-portal with documentation
  - <http://ilcsoft.desy.de>
- provide nightly build and test system
- provide conditions data toolkit (and DB) : LCCD
- development and maintenance of tracking software
  - MarlinReco (digitizers), MarlinTrk, Clupatra,...
- ...

# plans and ongoing work

- development of new geometry description tool **DD4hep** - together with CERN SFT - replace GEAR eventually
- development of a generic track fitting and finding toolkit **aidaTT** to improve tracking software (CPU) performance
  - both done in AIDA WP2
- move to a new geant4 simulation application for the next round of ILD detector optimization
- collaboration with CLIC, SiD and others on **common LC and HEP software** tools
- currently preparing a Horizon2020 proposal (AIDA-2) with a software work package:
  - improved EDM/persistency with high performance I/O
  - add multithreading capabilities to core tools
  - parallel version of Marlin

# Conclusion – Outlook

- DESY group is very active in LC software development and computing in almost all areas of the event processing
  - EDM, framework, geometry, track reconstruction, conditions data, event display, Grid computing, software integration and installation,...
- (one of) the largest groups in LC software
- manpower is rather limited: one staff + 2-3 post docs
- heavily rely on third party funding
- would be very interested to collaborate with other institutes in Germany on software and participate in a possible D-HEP software project