Software

Status, plans and timeline

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ILD Meeting Oshu, Japan

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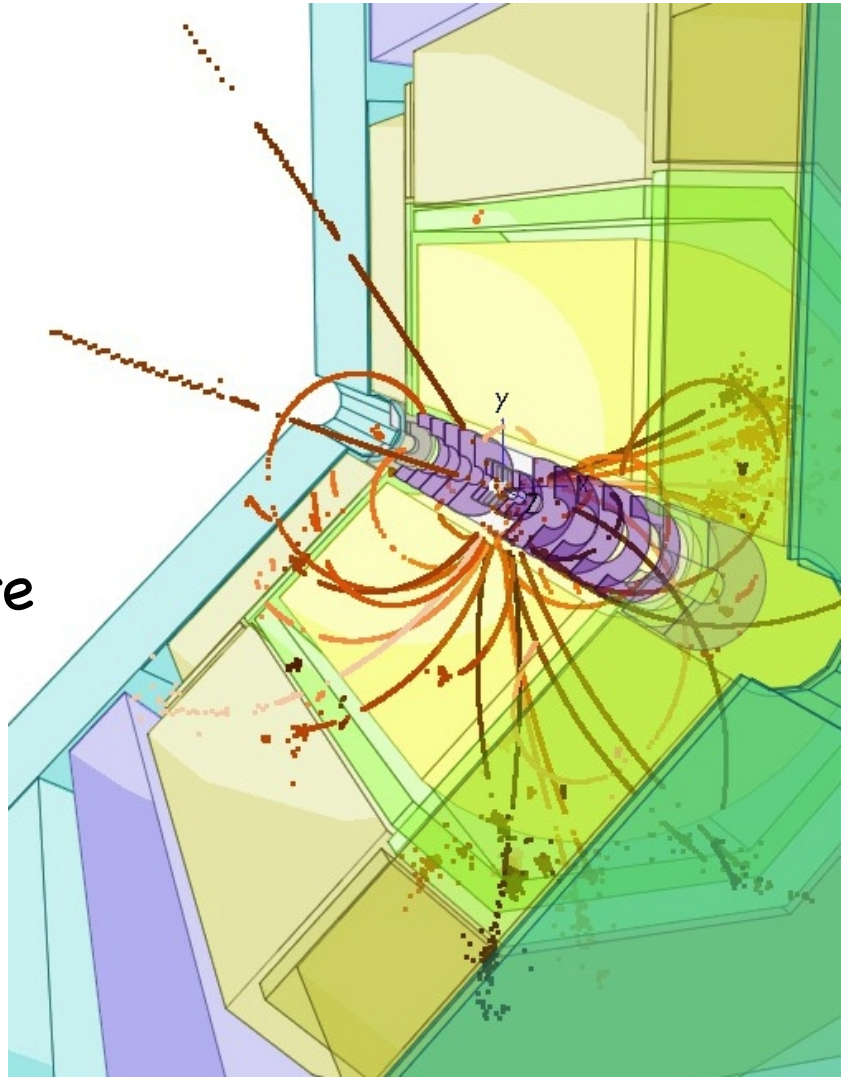
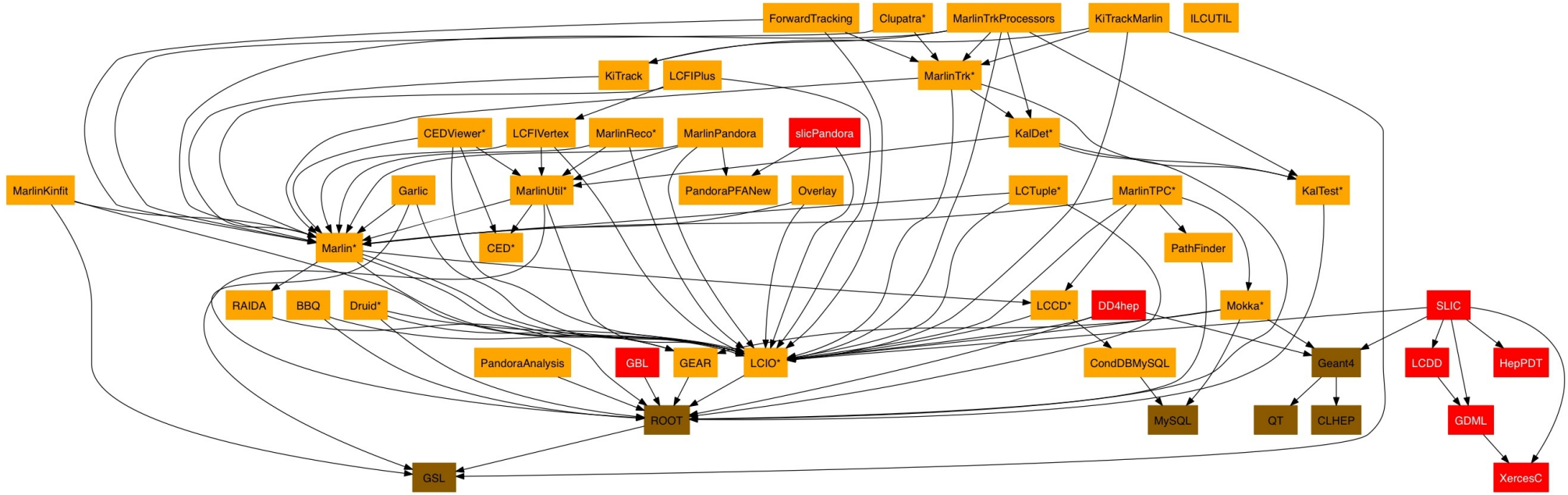
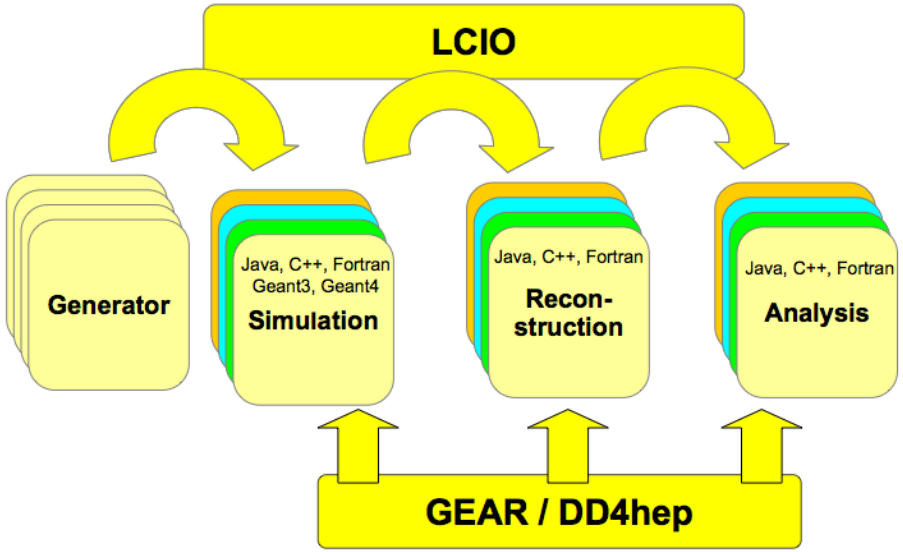
Outline

- Introduction
- Status: recent/ongoing developments
  - DD4hep/DDSim, aidaTT
  - Grid production tools
- towards a timeline for software ILD optimization
- Summary and Outlook



ILC software – overview





- ILD has a fully functional software framework – used successfully for LOI and DBD that can be used for physics & optimization studies
  - **Mokka, Marlin, LCIO, GEAR,…**
  - **MarlinTrk, PandoraPFA, LCFIPlus,…**

  however, not the topic of this talk …

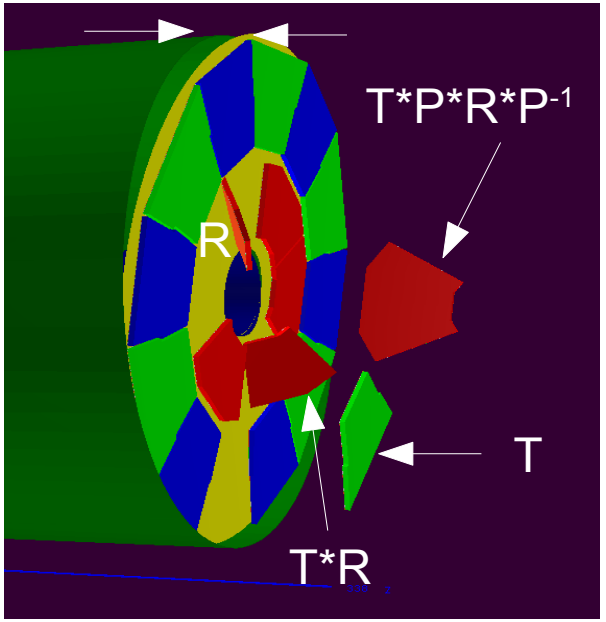
current activities in software

- at the same time: continuos process of improving software
- general agreement in LC community to move to (more) common software tools
- closeout of 2012 LC-Software Meeting:
  - a common simulation using geometry description developed in AIDA WP2
  - a common C++ tracking package in the context of AIDA WP2
- at 2013 LC-Software Meeting discussion focused on the details of how these goals can be achieved
  - agreement to use **DD4hep** as the common geometry tool
  - agreement to use **slic** as common simulation tool

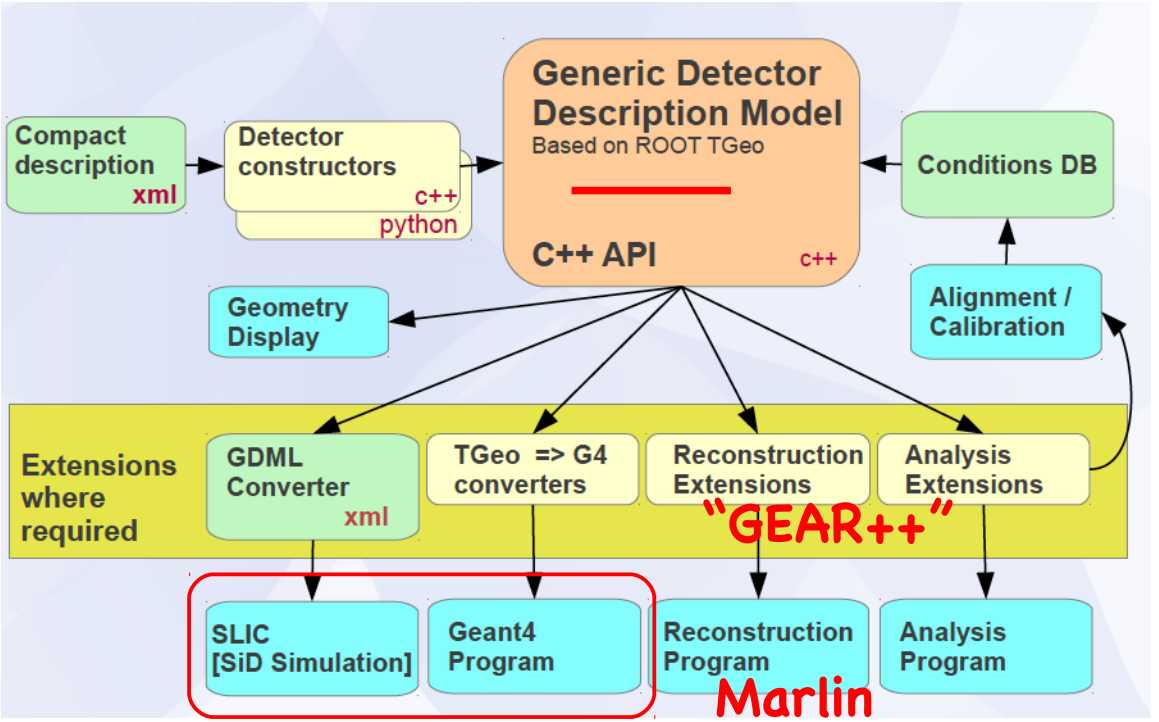
(see later this talk)

DD4hep - overview

- **DD4hep** common detector geometry description
  - developed in AIDA WP2 (CERN, DESY)
- will be used by CLICdp, FCC and ILD (SiD?)
  - -> see talk N.Nikiforou



example: Aleph TPC
(misalignment exaggerated)



- advantages of DD4hep:
  - better, more consistent description of detector geometry with one unique source
  - possibility to simulate misalignment to study **alignment** strategies for ILD
  - cooperation w/ CLICdp (and SiD)

DD4hep geant4 interface I: SLIC

- compact geometry description in DD4hep originally inspired by the compact format used in org.lcsim
- export of detailed simulation geometry as LCDD files - extension of GDML as input to SLIC
  - rather large ascii files (e.g. ILD_o1_v05 5MB): slow start-up
- SLIC does not want to depend on DD4hep
  - overhead in package structure (and code)
  - potential issue for more complex sensitive detectors
- SLIC is fully functional and used for SiD mass productions - however, limited man power available at SLAC to support binding to DD4hep
  - current ILD_o1_v05 model in DD4hep is not working in SLIC (nested assemblies)

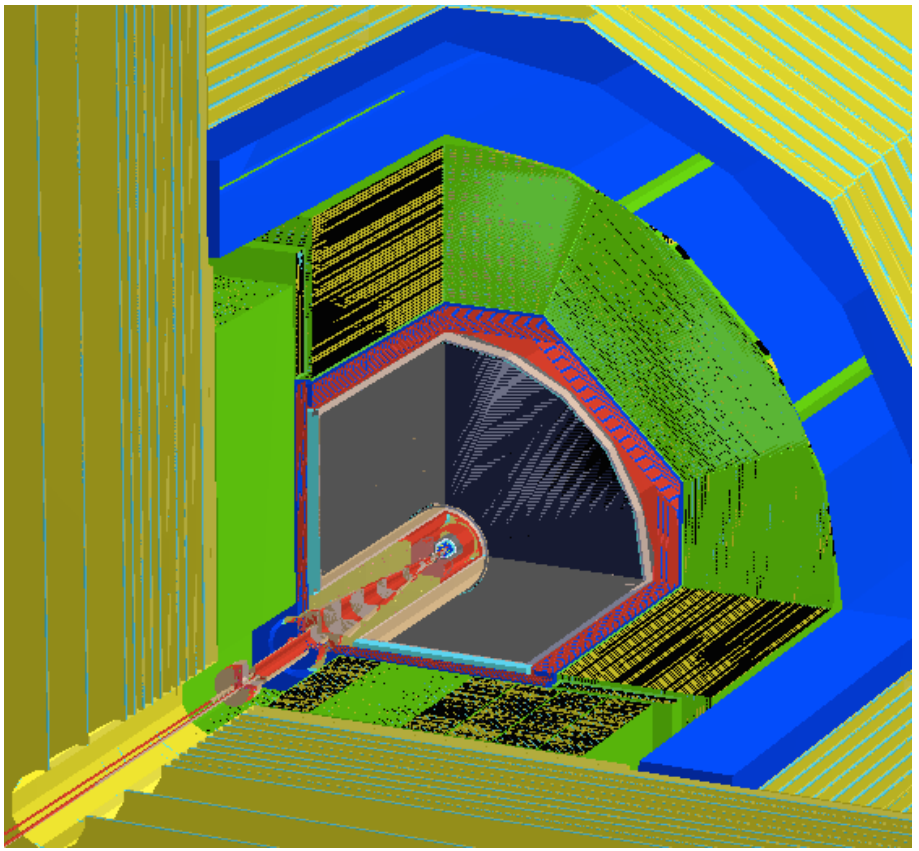
DD4hep geant4 interface II: DDG4

- in memory conversion of TGeo geometry to Geant4 geometry
- plugin mechanism for
  - sensitive detectors, Geant4 user actions : stepping, tracking,...
  - input (generator files) and output (LCIO,...)
- configure mechanism with xml, python or CINT:
  - physics lists, limits, fields,...
- some examples exist w/ simplified sensitive detectors, creation of LCIO hits (and MCParticle link)
- advantage:
  - full flexibility in sensitive detectors
  - can use extension code in simulation and reconstruction
  - supported by CERN for FCC and CLICdp

- ILD needs to decide whether to use SLIC or DDG4
- -> DDG4 seems to be more promising option

ILD_o1_v05 in DDSim

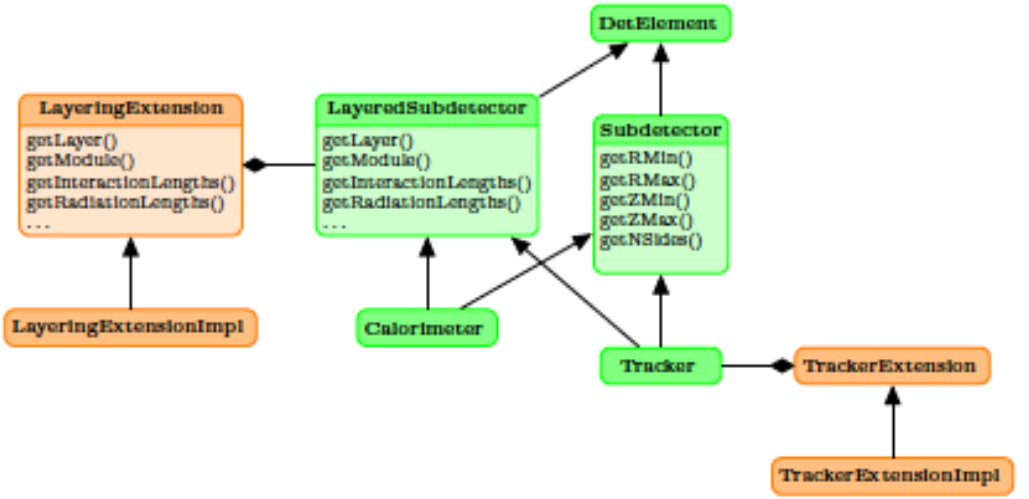
- almost complete Mokka model ILD_o1_v05 ported:
- VXD, FTD, SIT, TPC, SET, beam pipe (F.G)
- Ecal, Hcal, Yoke (Sh.Lu)
- Beamcal (A.Sailer), Lcal (M.Petric)
- so far only few sensitive detectors

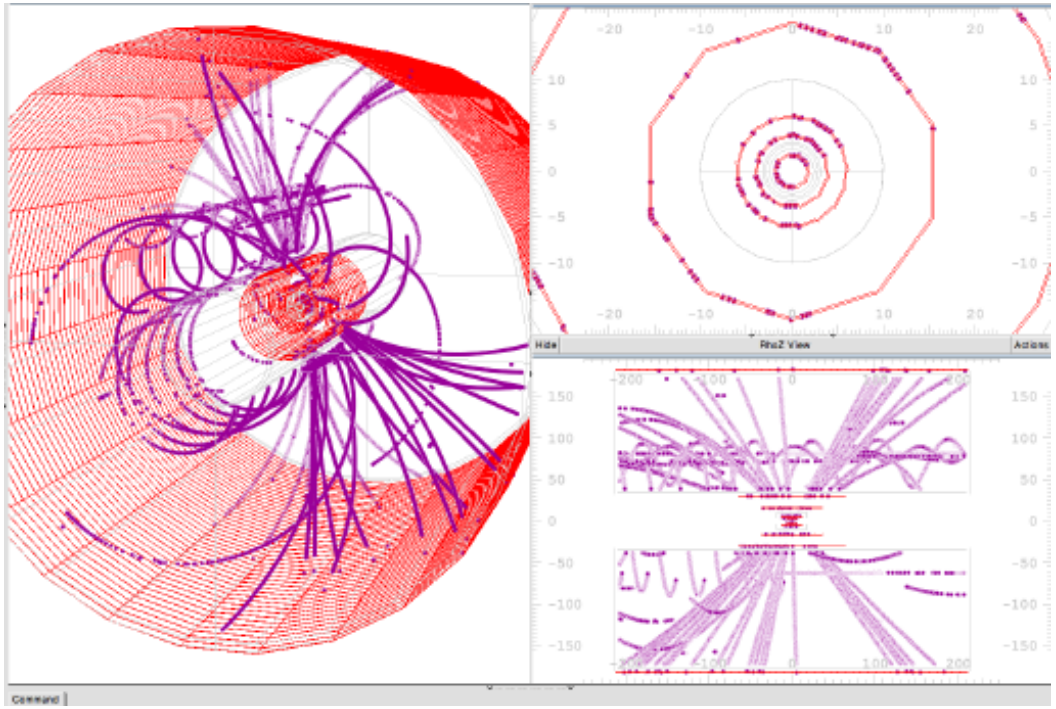


- To Do:
- reconstruction interface (GEAR++)
- implement missing sub-detector
  - LHcal (ongoing)
- implement sensitive detectors
  - (SLIC vs. DDG4 !!)
- test and validate everything
- => major effort for ILD
- => need dedicated experts for every sub-detector from R&D groups (as for LOI/DBD)

DD4hep interface to reconstruction

- extension mechanism is used to define interface for reconstruction
- calorimeters and trackers defined as LayeredSubdetectors
  - use to eventually replace GEAR
  - work in progress ...
- for tracking additional Surfaces provide:
  - u,v,normal and origin
  - inner and outer (averaged) material incl. thickness
- -> planes and cylinders allow for simple navigation in detector geometry for the tracking

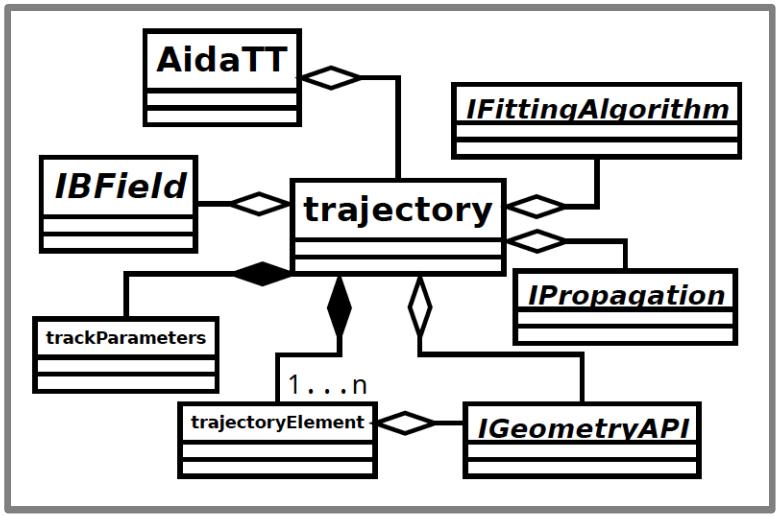




aidaTT - tracking toolkit

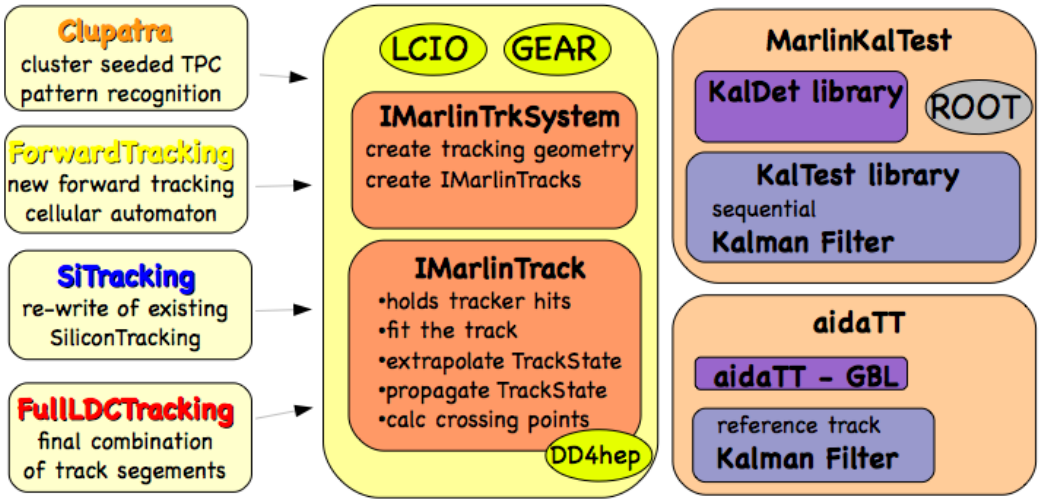
C.Rosemann

- tracking tool developed in AIDA WP2
- use interface to DD4hep geometry
- surfaces in detector model for material effects and navigation (not yet)
  - see talk Y.Voutsinas



https://svnsrv.desy.de/desy/aidasoft/aidaTT/trunk

- goal:
- implement MarlinTrk interface to transparently use Kalman-Filter or GeneralBrokenLines
- needed e.g. for Millepede alignment tool



- status: GBL currently finalized

ILD Monte Carlo production

- in transition phase from GridProd system used for DBD mass production to ILCDirac - maintained by CLICdp group
- Shaojun Lu has taken over role of ILD Monte Carlo production coordinator from Eduard
- ILCDirac is already used successfully by individual users for their specific physics sample production
- central Monte Carlo production is much more involved:
  - bookkeeping of samples to process, data catalogue, load sharing between Grid sites, ...
- ongoing task to adapt CLIC production scripts to ILD
  - will use new cvmfs software installations on the GRID
  - support from KEK for this task (T.Calancha)

Towards a timeline for software I

- ingredients and missing items needed for defining a timeline for ILD software development:
  - need to have first functional version of ILD_o1_v05 in DD4hep/DDSim
  - need functional interface to reconstruction (GEAR++)
  - need testing and validation
  - define the ILD optimization models - how many (2-3) ?
    - reference detector + smaller detectors ...
  - implement these models
  - need testing and validation
  - define the physics benchmarks/data samples that need to be processed
    - 250 GeV, 350 GeV, 500 GeV full SM ?
  - finalize the Grid production infrastructure w/ ILCDirac
  - adapt reconstruction to new models
  - need testing and validation
  - estimate the CPU (and storage) needs
  - the actual Monte Carlo mass production
  - ...

Towards a timeline for software II

- a first very rough estimate of the effort involved:

item:	estimated effort*	comment
first version of ILD_o1_v05 in DD4hep	1 pm	by LCWS ?
interface to reconstruction	1 pm	
testing and validation	2 pm	
define ILD optimization models	1 pm	start at ILD meeting
implement these models	3 pm	# models ?
testing and validation	3 pm	# models
define physics benchmarks	1 pm	
Grid production infrastructure	1 pm	
Grid Monte Carlo simulation	1 pm (3 months)	# channels/processes, # CPUs
adapt reconstruction (incl. testing)	2 pm	
Grid reconstruction	1 pm (1 month)	
Total	18 pm	

*pm: full time person month

the actual calendar time that is needed, depends on the number of (experienced) people that are available for the tasks

Summary & Outlook

- ILD will use DD4hep geometry description for simulation and reconstruction
- first version of ILD_o1_v05 in DD4hep on its way
- need to decide which simulation application to use and develop further: SLIC vs DDG4
- to finalize the timeline for the software work for ILD optimization, we need to:
  - decide on number and layout of ILD optimization models
  - decide on physics benchmarks and samples to be created w/ these models
  - identify people that can contribute to the effort
  - implement, test and validate these models