Software Coordinator's Report

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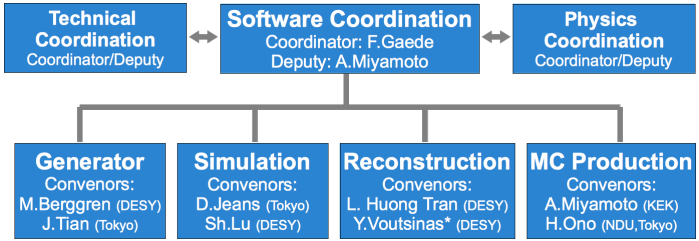
ILD Meeting, Morioka, Dec 7, 2016

Outline

- Introduction
- Simulation
  - Generator
  - Core simulation tools
  - ILD simulation models
- Reconstruction
  - Core reconstruction tools
  - Tracking and PFA performance
- Grid production and iLCSoft releases
  - ILCDirac production tools
  - v01-19
- Summary and Outlook

ILD Software working group



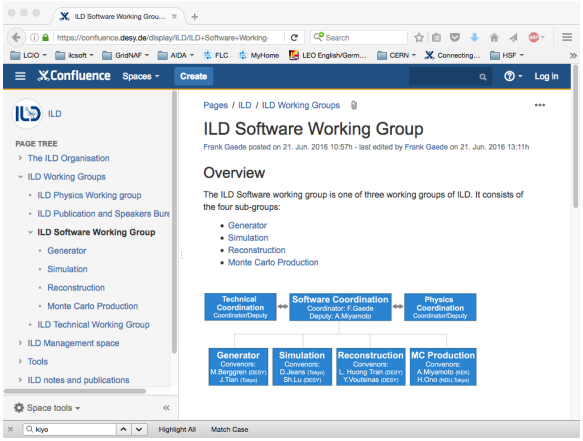
∗ Y.Voutsinas has left ILC and not yet been replaced

- software working group conveners established around Santander ILD meeting
- since then we had regular bi-weekly phone meetings to monitor the status
- **goal:** for next months: prepare the software chain for a large scale Monte Carlo production with a standard size ILD model and a newer smaller version

ILD Software working group on the Web

https://confluence.desy.de/display/ILD/ILD+Software+Working+Group

- documentation of software working group
- validation tutorials and tools
- recent performance and validation plots



Simulation

Generator

LC Generator Group meeting before LCWS2016 at Tokyo University:

- addressed known Whizard2 issues
- particle multiplicities in 4 jet events changed wrt. Whizard-1.95
  - tracked down to passing color information to Pythia
- ISR energy spectrum in 2 jet events
  - fixed
- polarization in $H \to \tau^+\tau^-$ decays (via Tauola)
  - will be fixed internally in Whizard
- and iterated on LCIO output:
- defined meta data to be stored in file
  - $\sqrt{s}$, beam spectrum, processID/Name, σ, beam particle type and polarization
- re-(de)fined the generator status word:
  - 1:stable, 2: decayed, 3: documentation, 4: incoming, 5: partons

status

expect Whizard to be well ready for a mass production in early summer 2017

DD4hep and lcgeo/ddsim

DD4hep:

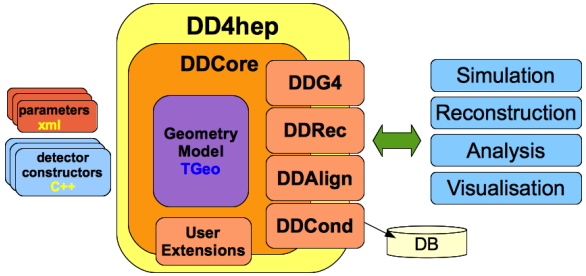
- common detector geometry description tool used by LC,FCC and evaluated at LHCb

lcgeo:

- detector geometry description for all LC concepts

ddsim:

- python application for running the simulation



status

- all tool essential feature complete with no known issues
- ongoing activity: iterate on details of ILD models

new ILD simulation models

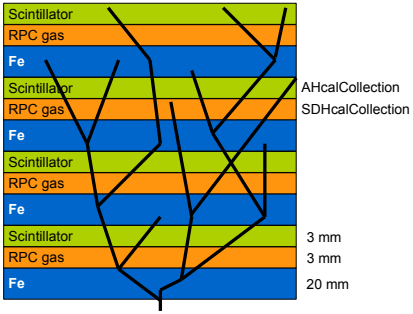
large DBD like	new smaller model	Hcal	Ecal	Hcal geometry
ILD_l1_v01	**ILD_s1_v01**	analog	SiW	Tesla
ILD_l2_v01	ILD_s2_v01	semi-digitial	SiW	Videau
ILD_l3_v01	ILD_s3_v01	analog	SciW	Tesla

- eventually will create the complete set of models
  - also additional models w/ missing Hcal technology and geometry combinations
- can be used for dedicated studies/analyses

- will use only **two models (large and small)** for large MC production
- **will have to decide on geometry and technology** to use

simulating multiple technologies

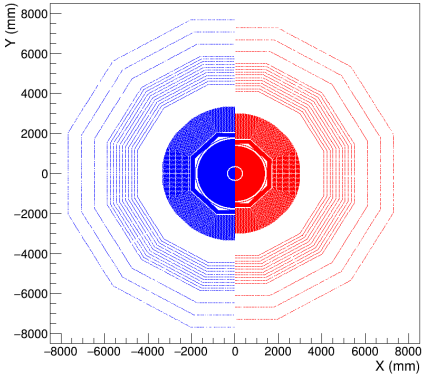
- calorimeter shower development largely defined by absorber structure
- idea to create HCal (Ecal) model with two sensitive materials
- could use in large scale MC production with little overhead in disk space
- would provide possibility to compare technologies on full physics analysis using the **same** events

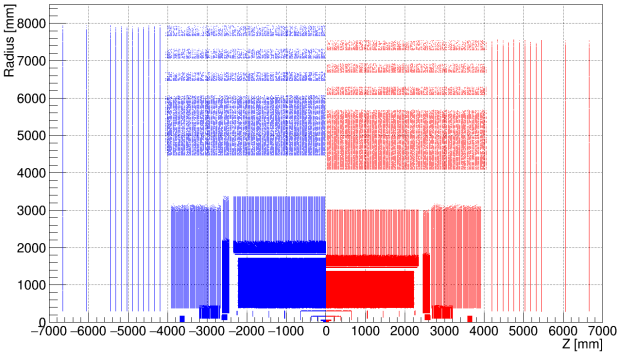


proof of concept needed:

- demonstrate that simulated showers are **equivalent** to individual technology simulation
  - work planned at Lyon

hit maps in ILD_l1_v00 and ILD_s1_v00





- both models are ready for validation
- known issue: new L^* not yet implemented

validation of ILD simulation model(s)

group	name	detectors/systems
Calo	Daniel Jeans	Ecal, Hcal
Si-Tracker	Marcel Vos	VXD, SIT, SET, FTD
VFS	Bogdan Pawlik	beamCal, LCal, LHCal
Yoke	Nicola d'Ascenzo	Muon, Coil
MDI	Karsten Buesser	beam pipe, cables, services
TPC	Dimitra Tsionou	TPC

validation process has started

- software contacts are invited to sw-conveners meeting
- last meeting started to review the validation process and tools
- will follow up in sw-conveners and ILD SW&Ana meetings

Reconstruction

core reconstruction tools: MarlinTrk and PandoraPFA

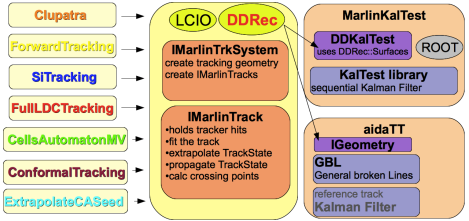
- core reconstruction for DD4hep based simulation works for quite some time now
- continuous improvement, e.g:

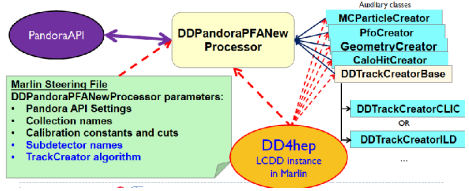
MarlinTrk:

- fixed issues in navigation
- rewrote space point finder using DDRec

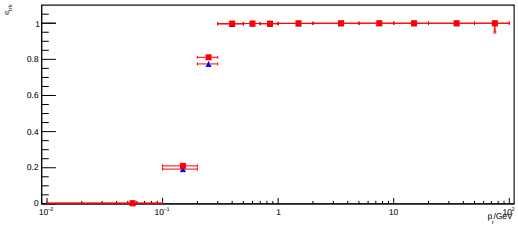
PandoraPFA

- improved photon finding
- software compensation added
- DDMarlinPandora calorimeter description improved





Tracking efficiency for ILD



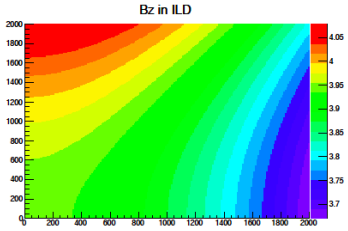
- tracking efficiency now compatible with the one used for the DBD
- partly better
- small issue at $\theta = 90\,\text{deg}$
  - needs investigation ...

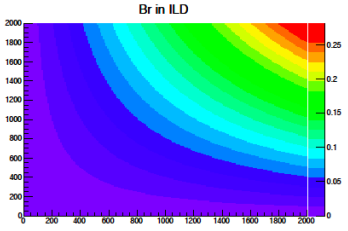
Tracking in non-homogeneous B-field

- in LOI and DBD simulation models we had a rather homogeneous solenoid field
- more recent coil design results in inhomogeneities of $>$**10%**
- will affect the track finding and fitting performance
- KalTest Kalman filter can in principle cope

To Do

- need detailed field map implemented in lcgeo
- study effect on tracking performance



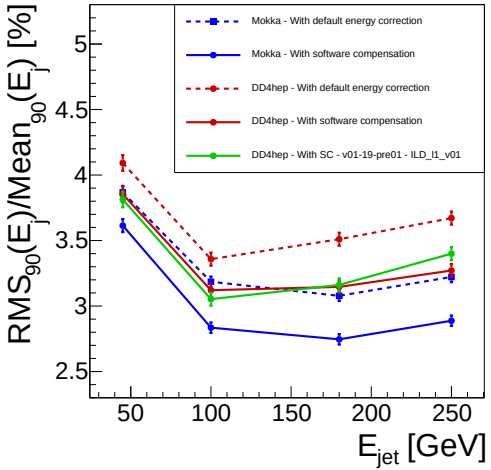


PFA performance with software compensation

- observe improved JER with SC - both for Mokka and DD4hep based reco
- JER for new reconstruction w/ DDMarlinPandora not yet at same level as old DBD reco
  - suspect technical problem in DDMarlinPandora ...

main focus of work after LCWS:

- get JER performance to same level as observed with *old* software
- address this in parallel to the simulation validation



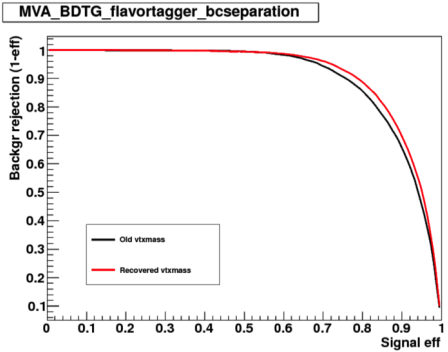
LCFIPlus

- flavor tagging and vertex finding tools

recent developments

- adaptive vertex fitting
  - assign leftover tracks to vertices
- vertex mass recovery
  - assign π^0s to vertices
- fixed issue in TMVA in ROOT 6.08
  - use ROOT ≤ 5.29 or ≥ 6.08

- potential issue w/ crash under ROOT 6 is under investigation



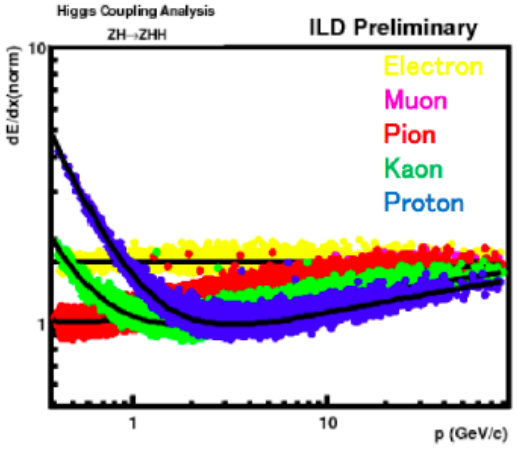
improvement of flavor tagging w/ vertex mass recovery

Other High Level Reconstruction Tools

quite a number of packages have been added or extended, e.g:

- *PIDTools:* improved Particle-ID (dE/dx (TPC), shower shapes and MVA)
- *GammaGammaCandidateFinder:* new π_0 finder
- *RealisticCaloDigi:* new DD4hep compatible calo digitizers
- *MarlinKinfit:* improved fitting with track objects

should expect improvements in physics analyses wrt. DBD



Grid production and iLCSoft releases

Monte Carlo mass production with ILCDirac

- preparing the infrastructure for the large scale Monte Carlo production on the Grid using ILCDirac
- currently focusing on optimizing the ILD production scripts together with CERN group
  - grouping of events in production jobs
  - consistent file names following ILD convention

```
sv01-17-09_lcgeo.mILD_o1_v05.E500-TDR_ws.I37494...
 Pea_lvv.eL.pB.n01_002.d_sim_7064_2.slcio
```

- will create some re-reconstruction samples with v01-17-11
- **main focus:** preparing complete chain with v01-19-xx releases

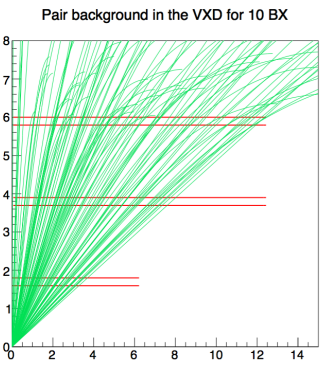
- the production system is in a good state
- minor improvement for usability needed, e.g.
  - combining the submission of several processes at once

Background overlay for Monte Carlo production

plan to overlay two types of background:

- pair background
  - e^+e^- pairs that actually are reconstructable in VXD and FTD
  - need tool to produce corresponding files (SGV)
- aa_lowpt ($\gamma\gamma \rightarrow$ hadrons)
  - recently fixed generator: Γ_ρ, ...
  - need to prepare correct mix of bb, bw, wb, ww samples (beam/virtual γ)

need to implement bg-overlay in MC production system



iLCSoft release v01-19

- first of new series of developer releases
- consistently use **-std=c++11** for all iLCSoft packages
- removed phased out packages from release
  - cernlib, (Fortran), Mokka, MarlinPandora
  - others to follow in future releases
- v01-19 requires a modern compiler, e.g. gcc 4.8 (or higher)

release of v01-19 marks major milestone:

- transition from *old* to *new* software chain completed
- will use for ILD simulation model validation
  - plan to have *frequent* developer releases v01-19-xx

Summary and Outlook

Summary

- have made transition from *old* to *new* iLCSoft with v01-19
- complete simulation and reconstruction chain works in principle
- for tracking reached performance of DBD code
- validation process of ILD simulation models has started

Outlook

- address issues observed in JER (DDMarlinPandora !?)
- continue development on generator and production tools
- have reports on validation process in sw-conveners and SW&Ana meetings