Status of Software Tools

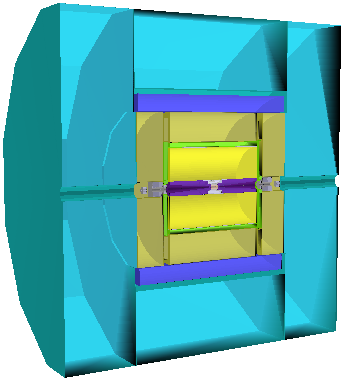
Getting ready for the MC production

F.Gaede

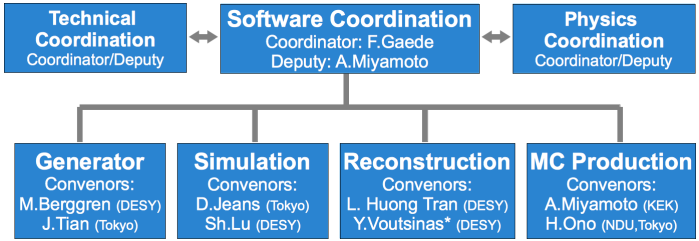
ILD Meeting, Ichinoseki Feb 21, 2018

Outline

- Introduction
- Generator
- Simulation
- Reconstruction
- Summary and Outlook



ILD Software working group



- Remi Ete proposed as successor for Y.Voutsinas
- approved by IA

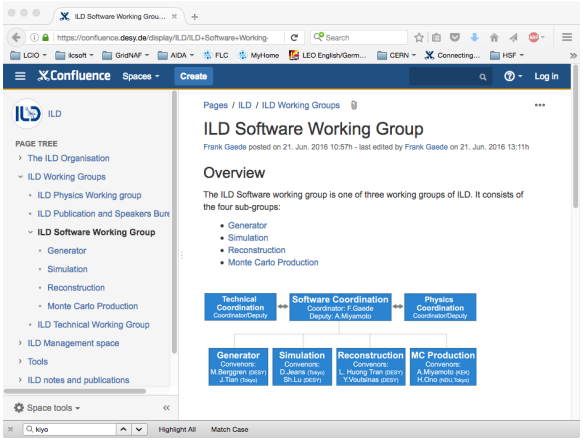
- software working group conveners hold regular (bi-)weekly phone meetings
  - monitor the progress on complete software chain
  - prepare for large scale Monte Carlo production(s)

bulk of the work in this report done by the conveners and of course other people not individually mentioned

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



Generator Status

- latest version of Whizard has **all main issues fixed**
  - W/Z mass in 4 jet events
  - ISR spectra
  - ...
- Whizard has now support for parallelisation (with MPI)
  - first tests showed roughly linear scaling w/ #CPUs
  - can speed up integration time for large sample generation considerably

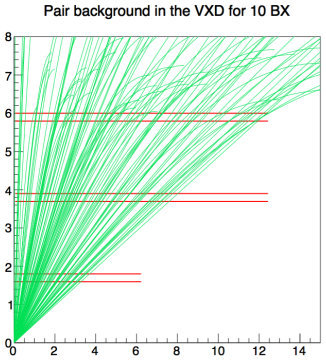
- only one important (but trivial) issue to fix
  - need to check production-scheme details (meta-data, file names and sizes, event meta data)
  - keep the input - by Geant un-modified - MCParticle collection down-stream?

status

To be ready for a mass-production during this summer seems more than probable !

Generator: background overlay for MC-production

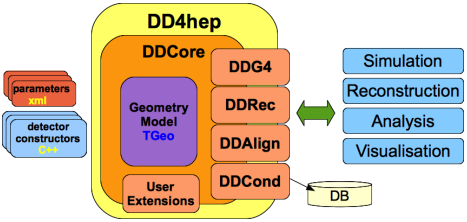
- will overlay two types of background:
- pair background
  - reconstructable e^+e^- pairs (created w/ SGV)
  - => need to simulate 100 bunch trains !
- aa_lowpt ($\gamma\gamma \rightarrow$ hadrons)
  - recently fixed generator: Γ_ρ, ...
  - prepared correct mix of bb, bw, wb, ww samples (beam/virtual γ)



- need to re-create pair-bg files for **new 250 GeV beam parameters**
- use existing TDR values/files for 500 GeV (and 350, 1000)

Simulation Tools

- have implemented a **large** (DBD-like) and a **small** ILD simulation model in DD4hep (lcgeo/ddsim)
- plan to start **asap** a large scale Monte Carlo production for these models:
  - complete SM sample @ 500 GeV
  - *stdhep*-files used in DBD
- later will add a 250 GeV sample w/ Whizard 2

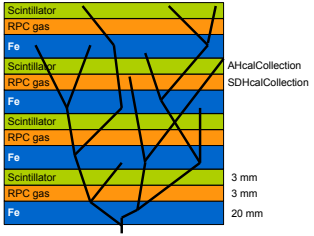


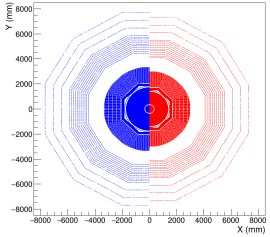
Simulation tools are read for production

- validated and tested
- two issues identified (see later)

ILD hybrid simulation

- implemented large and small models
- using a **hybrid** simulation scheme:
  - two sensitive layers per calorimeter layer
  - simulate **two technologies in one go**
  - *AHcal - SDHCal*
  - *SiEcal - SciEcal*





hybrid simulations are a new idea

- have done detailed checks to demonstrate consistent results w/ stand-alone simulations

ILD Simulation and Reconstruction Models

large model	small model	Hcal	Ecal
Simulation:			
ILD_l5_v02	ILD_s5_v02	both	both
Reconstruction:			
ILD_l5_o1_v02	ILD_s5_o1_v02	analog	silicon
ILD_l5_o2_v02	ILD_s5_o2_v02	semi-digital	silicon
ILD_l5_o3_v02	ILD_s5_o3_v02	analog	scintilator
ILD_l5_o4_v02	ILD_s5_o4_v02	semi-digital	scintilator

- will use **ILD_l/s5_o1_v02** initially for optimization samples
- produce (sub)-samples with other technologies
  - requires full digitization/reconstruction to be available
  - exists for *semi-digital* Hcal - not yet for *scintilator* Ecal

Simulation: Validation of ILD simulation model

- detector models have been validated by software contacts from R&D groups:

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

*replaced by Oliver Schaefer

simulation models have been *officially validated*

- checked dimensions and material properties
- simulated-hit maps,...

"Final" Test Production done with v01-19-05

- uds-events, E=30-500 GeV, (10k)
- $\gamma, K_L^0, \pi^0, K_S^0$, p=1-100 GeV, (20k)
- $\mu^{+-}, \pi^{+-}, e^{+-}, K^{+-}, p^{+-}$, p=0.2-150 GeV (100k)
- μ^{+-} at fixed p and θ values
- γ, 10 GeV, $\theta = 5^\circ - 14^\circ$
- aa_lowpt and pair-bg, 500GeV
- 100k events of bb, cc, qq at 91 GeV
- 100 k events of 6b, 6c, 6s, 6d, 6u at 500 GeV
- 6f_ttbar semi-leptonic and hadronic, 500 GeV
- $H \rightarrow$ invisible and $H \rightarrow WW^* \rightarrow 4q$, 500 GeV
- 2f_z_l, 500 GeV (for tau study)
- resonance calibration samples (JPsi, Eta, H)

validation and testing

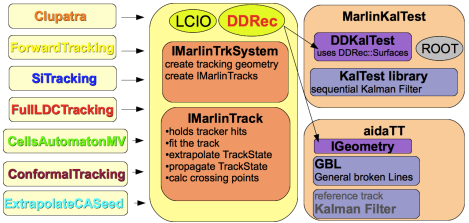
- almost all samples have been checked in details
- see talk D.Jeans

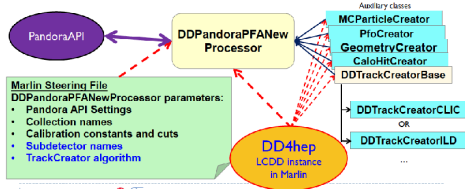
Reconstruction Tools

MarlinTrk: - tracking toolkit developped for DBD
PandoraPFA - ILC standard PFA since DBD
HLR - flavor tag, vertexing - PID (dE/dx, shower shapes)

reconstruction tools are basically in good shape

- some isues identified
- see talks R. Ete (today) and S.Lu tomorrow (and later this talk)





recent issues - some of which already fixed

Simulation: MCParticle record

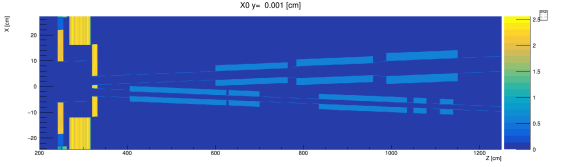
- recently identified bug in *ddsim/DDG4* that resulted in particles with **more than one parent**
  - mostly with grand daughters of *heavy particles* being assigned to their true parents as well as to their grand-parents
- caused *difficulties* in interpreting the MC-truth information
- fixed in DD4hep HEAD (M.Frank)
- also fixed inconsistent *end-points* of short lived particles/resonances (A.Sailer)

Open Issue

- need to *thoroughly* test the new MCParticle treatment

Simulation: downstream magnets missing

- missing implementation of QD0 (and other downstream magnets) in current simulation models
  - affects the background rates for *back scattering* from pair bg
  - checked with MDI people for existing design for new L*
- fix committed to GitHub (D.Jeans,S.Lu)
  - simply extend beampipe segments to magnet dimensions using *iron* as material



Open Issue

- need to get and implement reasonable **B-fields** for these magnets

Simulation and MC-Production: event meta data

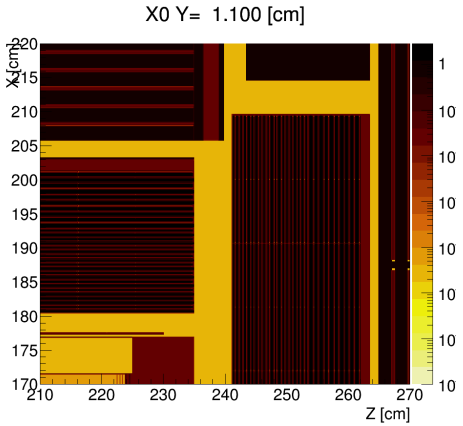
- we need certain meta data in LCEvent header
  - **processID, polarization, cross section, processName**
- and a consistent and **unique** event (and run) numbering for the MC production
- implemented possibility to specify meta data in ddsim steering files
  - difficult to use in ILCDirac scripts
  - would prefer to have solution, where this is copied from input generator file

Open - minor - Issue

- implement to copy the information from generator file to SIM-output file
- straight forward to do ...

Simulation: Calorimeter Barrel-Endcap Gap

- some recent discussion on gap between Hcal barrel and endcap in simulation models
- size of gap had been reduced somewhat in order to account for the increase of the Ecal endcap thickness
- decided in ET to not change any other detectors in simulation models just after the validation had just been finished
  - eventually need new engineering model
  - HCal Services (electronics) are implemented in current models
  - slightly smaller extend (6 cm vs 10 cm)

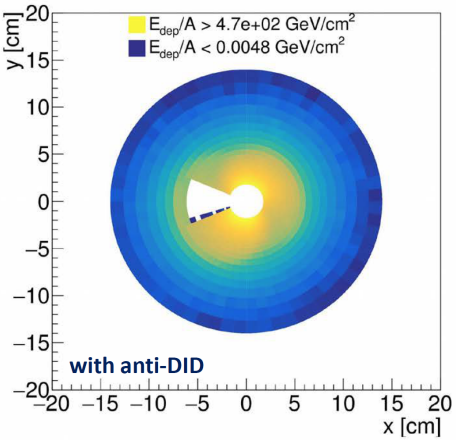


BeamCal Reconstruction

- new BeamCalReco is currently disabled
- need *parameter tuning* which requires complete simulation of *pair-bg in BeamCal*
- could use recent results from S.Lukic
  - missing downstream magnets (should be OK)
  - no tuning of anti-DID (OK ??)
- or find person to finalize pair-bg study

Open Issue

- need decision on how to proceed
- need to find man power to implement accordingly



Reconstruction: Si-Tracking algorithm

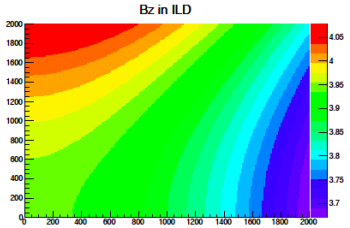
- there are several pattern recognition methods available in iLCSoft that can be used for the inner Si-trackers of ILD
- show somewhat different performances
- see talk by S.Lu tomorrow

Open issue

- need decision soon (*now*) in order to allow enough time for testing

Reconstruction: more realistic tracking studies

- standard tracking performance plots are created with homogeneous B-Field and w/o pair background overlayed
- to be used for large scale Monte Carlo production for detector optimization and physics studies
- detailed field map implemented in lcgeo
  - KalTest Kalman filter can cope



Open Issue

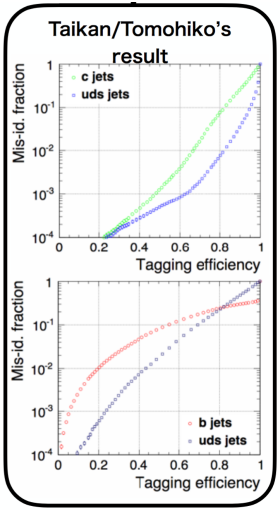
- study tracking performance with pair bg overlay and realistic field map
  - can be *factorized from main production* (assuming that it will work)
- need to create models with **realistic field maps**

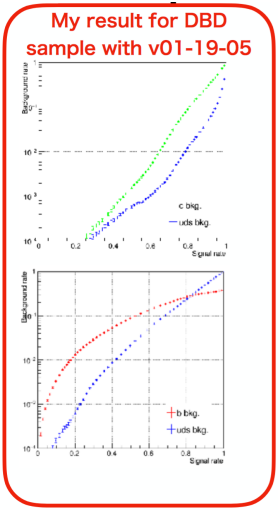
Reconstruction: LCFIPlus - Vertexing

- *LCFIPlus* vertexing is run centrally
- observed small degradation of flavor tag in v01-19-05
  - not clear if this is *significant*
- might need re-tuning of *vertexing parameters* (new bg-overlay)
  - also study with different Si-Tracking algorithms

Open Issue

- need to understand potential issue w/ the *vertexing* and fix it





Summary and Outlook

- new software chain is in a fairly good state - validated and rather well tested
- some open issues identified that need to be addressed *eventually*
  - implement QD0 and other forward magnets (incl. fields)
  - needed for pair bg and detailed tracking studies
- issues that are **critical** to be solved before we start the production:
  - tuning of new BeamCal reconstruction (wrt. pair-bg)
  - decide on which tracking algorithm to use for Si-tracker
  - understand (and fix) potential issue in LCFIPlus vertexing

discussion

- tradeoff between *getting it right* and planned time line to start the optimization production **asap**