Workshop Goals and iLCSoft Status and Open Issues

Frank Gaede, DESY
ILD Software and Optimization Workshop
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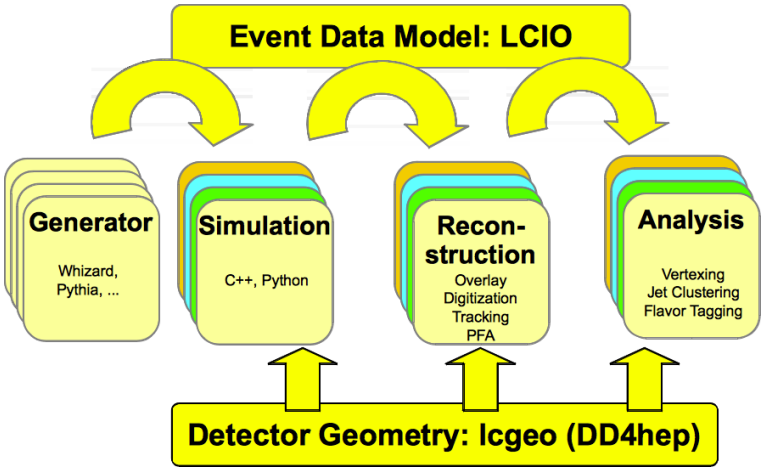
Outline

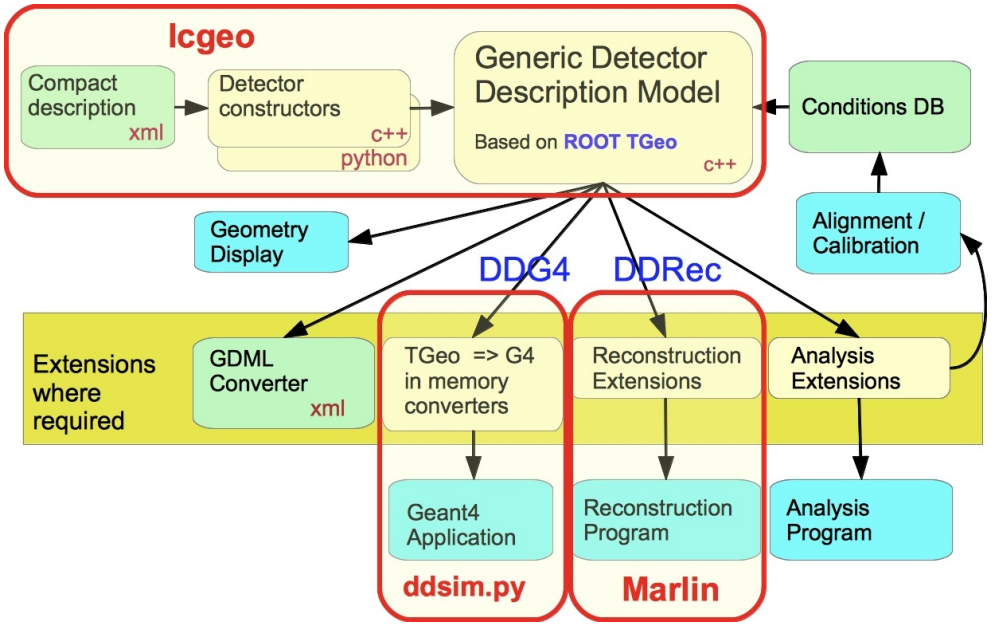
- brief introduction to new software chain
- software workshop goals for Mon./Tue.
- walk through topics with focus on open issues
  - core software
  - ilcsoft releases
  - Grid production
  - tracking tools
  - particle flow tools
  - High Level Reconstruction
  - ...

New ILD (simulation) software

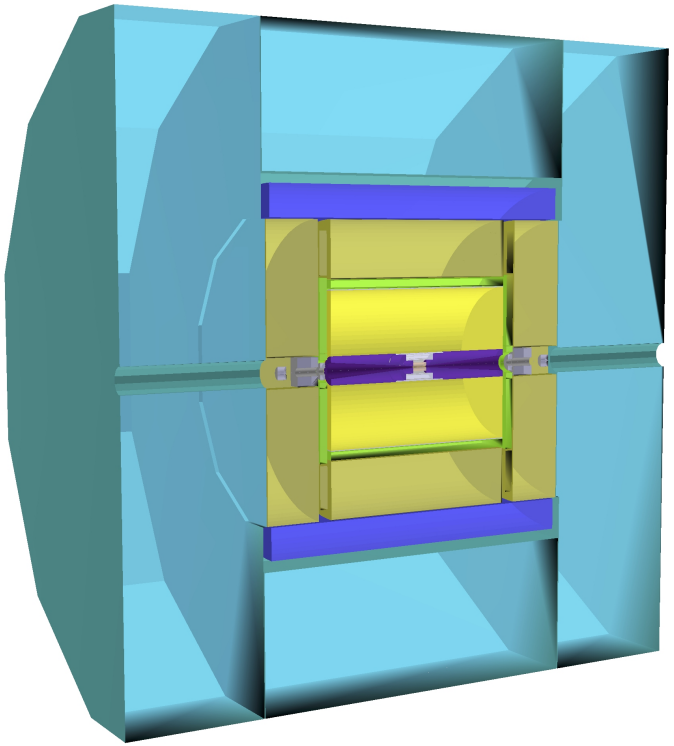
- LC community is moving towards more common software tools
- ILD decided to use the DD4hep geometry description and DDG4 for simulation
- DDRec is the interface for reconstruction
  - note: same tools used by CLIC and maybe SiD

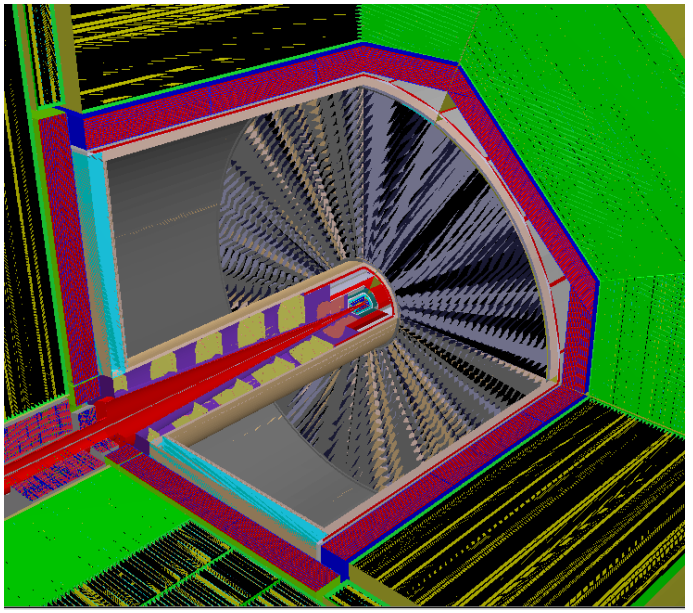
DDRec to replace GEAR





ILD simulation model in lcgeo (DD4hep)

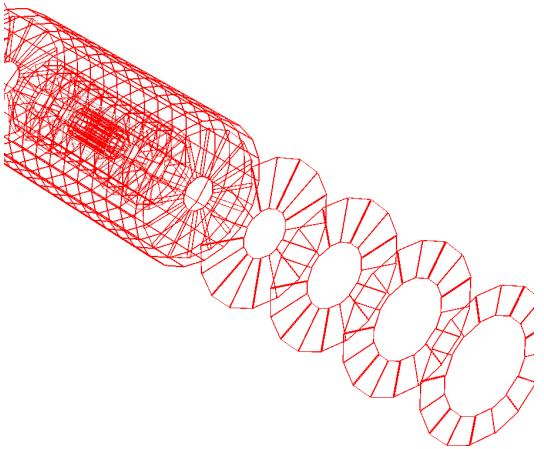




- ILD_o1_v05 Mokka model ported one-to-one to DD4hep
- introduced mandatory envelope volumes
  - validation and scaling behaviour
- model is fully functional and ready for detailed validation
- ddsim python simmulation tool in place

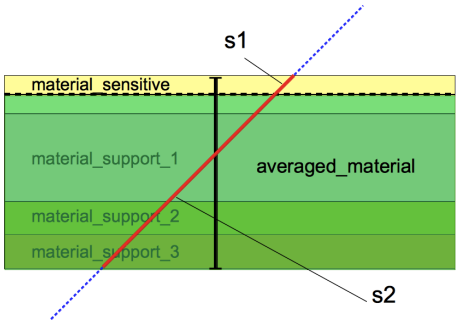
DDRec interface to geometry

- dedicated data structures for high level information
- surfaces for track reconstruction



Data Structure	Detector Type	Example
ConicalSupportData	Cones and Tubes	BeamPipe
FixedPadSizeTPCData	Cylindrical TPC	TPC
LayeredCalorimeterData	Sandwich Calorimeters	ECal, HCal, fwd Calos
ZPlanarData	Planar Silicon Trackers	VXD, SIT, SET
ZDiskPetalsData	Forward Silicon Trackers	FTD

- can create GEAR file from these
  => possibility to run 'old' reconstruction with
  only minor adaptations



- adapted reconstruction code to work with DDRec:
  - DDKalTest, aidaTT for track reconstruction
  - DDMarlinPandora to run Pandora
  => can run 'new' reconstruction w/ DD4hep only

Goals for SW Expert Meeting Mon/Tue

- review the status of the complete new software chain wrt. readiness for large scale Monte Carlo production
  - focus on ILD optimization, but address common points with CLICdp and SiD where relevant (ILCDirac, DD4hep, ddsim, DDMarlinPandora, MarlinTrk,... → almost everywhere)
- identify open issues and start addressing them and/or find people that will do so
- go through all aspects of iLCSoft and production
  - Generation, Simulation, Reconstruction, HLR
  - iLCSoft releases
  - Grid production

Programme Mon/Tue

	Monday	Tuesday
09:00-10:30	Core Tools	Calo/PFA
11:00-13:00	Simulation	HLR
14:00-15:30	Tracking	Generators & Working groups
16:00-18:00	Tutorial	Overflow and Wrap Up

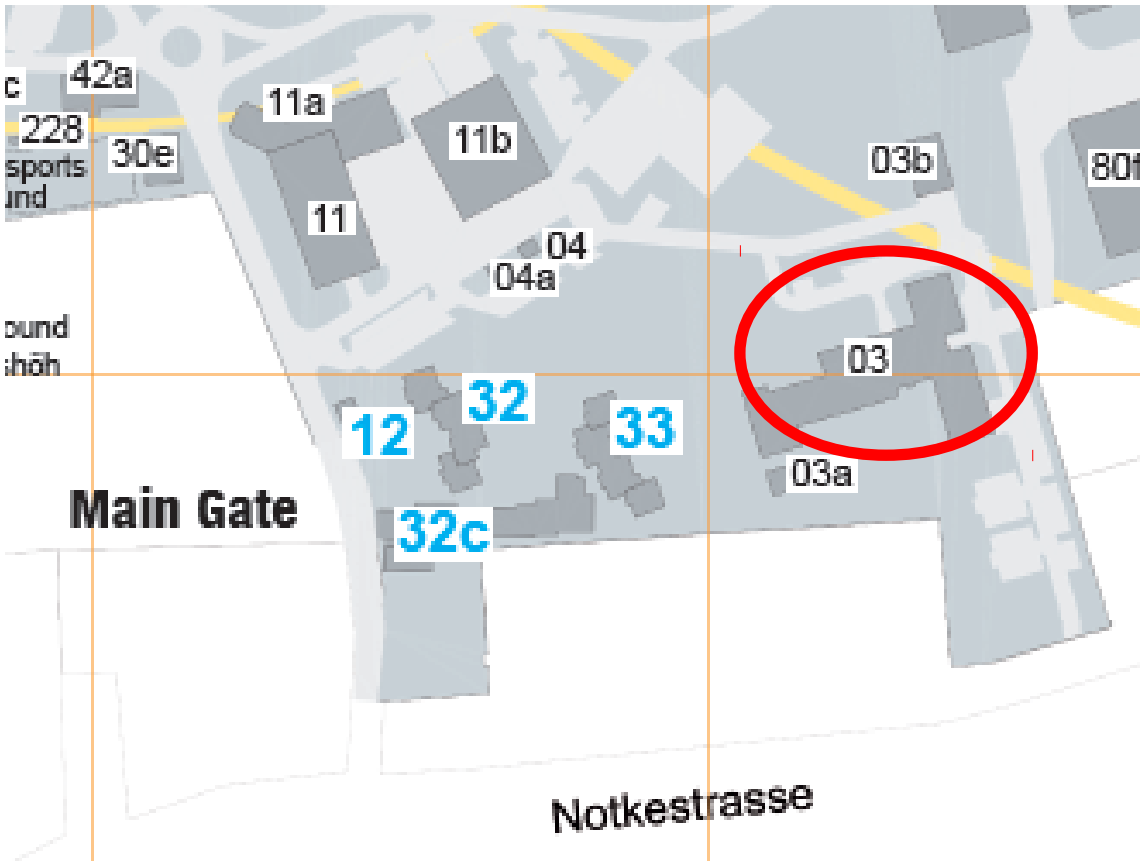
- can be somewhat flexible with agenda
  - possibly add new topics if needed
- Tue afternoon session can be used for parallel working groups/discussions

Software Dinner Monday

- Groeninger Brauerei
  - Willy-Brandt-Str. 47
  - 19:30

- Bus 1 (Rissen)→ Othmarschen
- S1 (Airport) → Jungfernstieg
- 10 min. walk

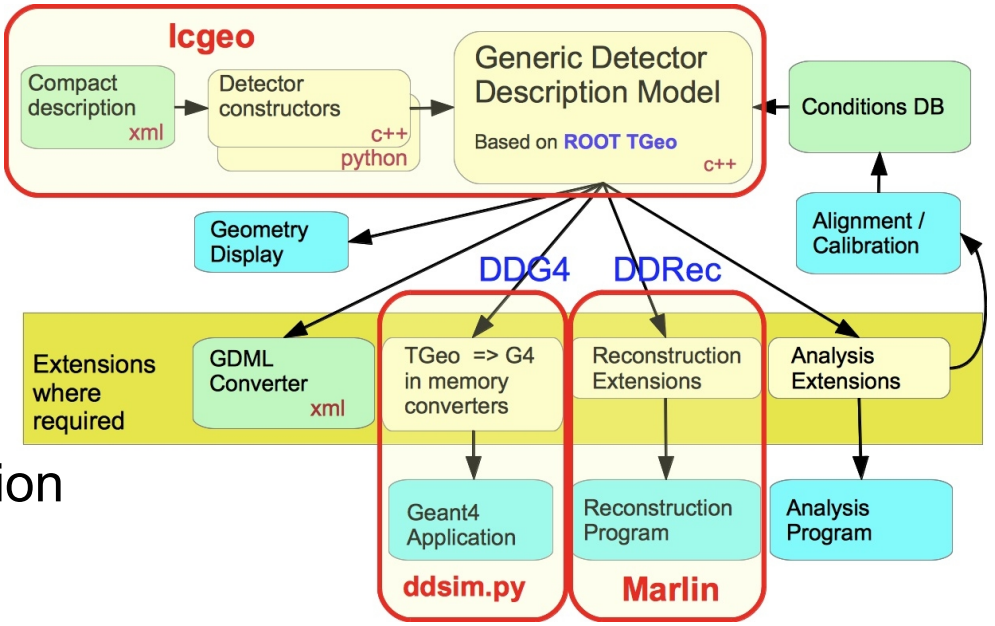
Tuesday in building 3



meeting room BAH1 - ground floor

DD4hep

- DD4hep in good shape basically feature complete
  - DDG4:
    - can configure and run Geant4 simulation
    - including physics lists, range cuts
  - DDRec
    - DetectorData structures (high level view on detectors)
      - can re-create Gear file from DD4hep model
    - Surface for track reconstruction
      - including material properties



DD4hep

- To Do
- validate Monte Carlo truth information
  - MCParticle endpoints
  - link from SimTracker(Calorimeter)Hits to correct MCParticle
  - Simulator status bits
- test (mis) alignment functionality

  → needed for studying alignment strategy for ILD
- Nice to Have
  - store complete geometry incl. extensions (Surfaces, DetectorData) in binary ROOT file

    → should allow for much faster startup of programs

lcgeo

- collection of detector constructors C++ and xml files with configuration parameters for LC
  - ILD_o1_v05
    - port of ILD simulation model w/ AHcal and SiW Ecal
    - → ILD reference simulation model a la DBD
  - ILD_o2_v05
    - ILD model w/ SDHcal option
  - CLIC_o2_v04
    - latest version of new CLIC simulation model
  - SiD_o1_v01
  - first port of sidloi3 simulation model

- all models need testing and validation

lcgeo - model validation

- need to check:
- geometrical dimensions (wrt. engineering model)
- material budget
  - X0 in tracking volume, λ in calorimeters
  - also in tracking surfaces
- check for overlaps:
  - gGeoManager->CheckOverlaps(0.001)
- hit creation:
  - hit maps: are hits in the correct position
  - hit energy spectrum
- …

ddsim

- python script to fully configure and run a Geant4 simulation for any detector in lcgeo/DD4hep geometry model using DDG4
- command line parameters and python steering files
- feature complete
- no known open issues ?

iLCSoft releases

- v01-14-01/v01-16-02 DBD production releases (2012)
- v01-17-xx : developers releases
  - only basic testing
  - provide new features for community
- latest: v01-17-09
  - prepared for this workshop
  - compatible with Mokka and DD4hep simulation
  - c++99, root-5
- need to move to ROOT 6 and c++11
  - no new features and fixes for ROOT 5
  - c++11 standard by now

iLCSoft releases plans

- also need to make transition from Gear to DDRec
  - maintaining two packages causes lots of overhead
    - DDMarlinPandora ↔ MarlinPandora, DDKalTest ↔ KalDet, ...
- will create new series of developer releases v01-19
  - drop backward compatibility with Mokka/Gear
  - start porting all packages from Gear to DDRec
  - use this as starting point for validating ILD software chain for production (also CLICdp, SiD)
  - new developments in should only be done in v01-19 !
- eventually create v01-18
  - last release compatible with Mokka-DBD simulation
  - create from v01-17-09 (branches) and HLR tools trunk
  -

ILCDirac - Grid production

- ILCDirac maintained by CERN group
- currently have CLICdp and ILD production scripts to run the software chain slightly differently
- should be able to have mostly common production chain
  - based iLCSoft releases installed in cvmfs
  - individual configuration packages: ILDConfig, CLICConfig,...
- need to understand implications
  - running generator in same job vs pre-generated stdhep/lcio
  - ...

Grid production - resources

- many sites support VO ILC
  - used by ILC and CLIC
  - mostly LCG sites that provide LHC resource
  - ILC small compared to LHC (<10%)
- up to know not observed any lack of resources
- might change if large productions by more than one detector concept group are running at the same time
- → should (loosely) agree on distribution of jobs to disjoint set of sites
- for larger productions
  - might need some resource estimates
  - might need to ask for more resources/sites

Si-Tracker Digitization

- DDPlanarDigiProcessor
  - gaussian smearing
    - of mean hit position from particle's energy depositions
  - along u,v measurement directions (2D,1D)
    - taken from DDRec::Surface
  - used for all Si-Trackers (pixel, strips)
- status: no known issues
- Nice To Have
  - more detailed/realisitc Si-Digitizer
    - creating charge depositions in pixels/strips
    - would need clustering algorithm for hit creation
  - probably not for large scale MC production

TPC Digitizer

- TPCDigiProcessor
  - realistic digitizer
    - parameterized point resolution, depending on z_drift, phi_azimuth
    - double hit resolution: hits merged if dist_z,rphi < cut_z,rphi
    - expect 'true' hit position from simulation (crossing of pad-row center)
      - enforced by Geant4 volume boundary
- open issues
  - need to replace usage of Gear with DDRec
    - functionality (pad-navigation) does not exists yet → port from Gear...
  - need to implement functionality to simulate dead areas on pad plane (module boundaries)
    - don't create hits if position is on module boundary

Pattern Recognition (ILD)

- Vertex:
  - SiliconTracking_MarlinTrk (VXD, SIT, FTD)
  - FPCCDSiliconTracking_MarlinTrk (VXD, SIT)
  - (DD)CellsAutomatonMV (VXD,SIT)
- Forward
  - ForwardTracking (FTD)
- TPC: Clupatra
- Combined
  - TrackSubsetProcessor (compute subset of central and forward tracks)
  - FullLDCTracking_MarlinTrk
- Open issues
  - need to replace Gear with DDRec::Surface, DDRec::DetectorData
  - find best combination of Si-Tracking and creation of Subsets
  - review/rewrite FullLDCTracking

Track Fitting

- track fitting based on IMarlinTrk interface
  - DDKalTest (DDRec::Surfaces for KalTest Kalman filter)
  - aidaTT (DDRec::Surfaces for GBL fitter)
- Open issues
  - pull distributions not perfect yet
  - need to review/check material description
  - → see plots
- Nice to have
  - faster navigation in surface geometry (x-points w/ surfaces)
    - implement smart surface maps a la Atlas
  - re-fitting with different mass hypotheses
  - re-fitting with vertex constraint ?

V0 and Kink-Finders

- V0Finder
  - written 2008 (A.Raspereza) for LOI
    - latest improvement (up to trivial fixes) 2010 M.Thomson
- KinkFinder
  - written 2010 (M.Thomson, J.Marshall)
    - unchanged since (up to trivial fixes)
- To Do
  - review both packages
  - and potentially improve them

DDMarlinPandora - DDCaloDigitizer

N.Nikiforou

- DDMarlinPandora
  - branched from MarlinPandora to replace Gear w/ DDRec
- DDCaloDigi
  - branched from ILDCaloDigi to replace Gear w/ DDRec
- Open issues
  - keeping both in synch w/ old code → new release v01-19-xx
  - make code detector agnostic as much as possible
    → ongoing
  - validating both for all three detector concepts
    - might need special flavors for CLIC, SiD and ILD ?

Pandora Calibration

S.Green

- semi-automated procedure exists
  - requires several runs with single particles
  - with iteration on calibration constants
  - current scripts written for Cambridge batch farm
    - flavor for CERN batch farm exists
- Open Issue
  - can we improve the automated procedure by providing scripts that run with cvmfs iLCSoft releases on ILCDirac ?
  - using a standard set of single particle files
  - do we need/want a validation process for 'officially accepted' calibrations for a given model ?
    - would this be done by the Cambridge group or the detector concepts ?

Software compensation and Gap correction

L.Tran Huong

- new procedure for software compensation exists
  - how can this be best included in Pandora steering
    ↔ validated calibration/steering
- gap correction for AHcal
  - how to apply in standard reconstruction
    - after or in Pandora clustering ?

Pi0 reconstruction

G.Wilson

- new algorithm for pi0, eta, eta` reconstruction
  - GammaGammaCandidateFinder
  - GammaGammaSolutionFinder
  - DistilledPFOCreator
- creates list of pi0, eta, eta`
- creates distilled PFO list
  - replace photons with gamma-gamma candidates
- Open issue
  - should this be the standard PFO list (or alternative)
  - can we provide default steering for this or is this analysis dependent ?

    → see discussion on DST files

PID Tools

M.Kurata, S.Lukic

- LikelihoodPIDProcessor - combines
  - dEdX
  - Cluster-Shapes
  - low momentum pi/mu separation
- Open issues
  - need finalization for standard reco ?
    - or run by users in individual analyses
  - currently reviewed by S.Lukic
  - ...

Vertex Charge

S.Bilokin

- status ?
- open issues ?
- include in standard reconstruction ?
  - interplay with tracking and vertexing
- ...

Four Vector Covariance Matrix

M.Berggren

- Add4MomCovMatrixCharged
  - adds covariance to 4 vector of charged particles
  - computed from tracks covariance matrix
- AddClusterProperties
  - computes cluster position and direction from PCA
  - adds covariance to 4 vector of neutral particles
- Open issues
  - other methods of cluster position (gammas) ?
  - error on cluster energies ?
    - e.g. after pi0 reconstruction
  - ...

MC-Truth information

M.Berggren

- RecoMCTruthLinker
  - creates weighted LCRelation
    - MCParticles ↔ Clusters
    - MCParticles ↔ Tracks
    - MCParticles ↔ ReconstructedParticles (PFOs)
  - two directions:
    - fraction of energy/hits from MCParticle used in this reco object
    - fraction of energy/hits created by this MCParticle used in this reco object
- Open issues
  - rather special treatment of MCTruth information as written by Mokka (incl. workaround for bugs)
  - possibly different treatment needed for lcgeo/ddsim
  - try to avoid split in DDRecoMCTruthLinker

Standard Reconstruction and DSTs

- for ILD in ILDConfig/StandardConfig:
  - ./current/bbudsc_3evt_stdreco.xml
  - ./lcgeo_current/bbudsc_3evt_stdreco_dd4hep.xml
- open issues
  - already slightly out of synch
    - some modifications (results from HLR workshop) added to the old stdreco but not yet to the new
  - need review and finalize new reconstruction
    - need to finalize tracking processors, calibrations,...
- DST files
  - review collections (next slide)
  - should try and have agreement on DST content across detector concepts !?

current DST collection for ILD

Collection name	type	comment
BCALClusters	Cluster	
BCALParticles	ReconstructedParticle	
BuildUpVertex	Vertex	
BuildUpVertex_RP	ReconstructedParticle	
BuildUpVertex_V0	Vertex	
BuildUpVertex_V0_RP	ReconstructedParticle	
ClusterMCTruthLink	LCRelation	
KinkRecoParticles	ReconstructedParticle	
KinkVertices	Vertex	
MCParticlesSkimmed	MCParticle	
MCTruthClusterLink	LCRelation	
MCTruthMarlinTrkTracksLink	LCRelation	
MCTruthRecoLink	LCRelation	
MarlinTrkTracks	Track	
MarlinTrkTracksMCTruthLink	LCRelation	
PandoraClusters	Cluster	
PandoraPFOs	ReconstructedParticle	
PrimaryVertex	Vertex	
PrimaryVertex_RP	ReconstructedParticle	
RecoMCTruthLink	LCRelation	

background simulation

- need to properly simulate
- gamma gamma to hadron bg
  - modified Peskin/Barklow generator for low Ecms
  - can use Pythia to lower energies
  - ongoing studies
- pair background
  - guinea pig files for TDR 500 exists
  - can not overlay complete bg files for large production
  - need to create MCParticle files real reconstructable tracks and overlay these