

# Summary of Software Pre-Meeting

Akiya Miyamoto

25-May-2011

KEK

ILD Workshop 2011 @ LAL

# Overview

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- Goal of Software Pre-Meeting

Establish the status and open issues of the software tools with respect to the planned DBD Monte Carlo production and the definition of the simulation baseline model



- 13 talks covering

- ◆ Core tools
- ◆ Reconstructions of Tracks and Calorimeters
- ◆ PFO and Vertex tagging
- ◆ MC productions

a lot of discussion time in sessions





## Core Tools

Convener: Akiya Miyamoto (KEK)

- 10:00 **Introduction 05'**  
Speaker: Frank Gaede (DESY)
- 10:05 **iLCSoft status and plans - Grid production 20'**  
Speaker: Steve Aplin (DESY)  
Material: [Slides](#) 
- 10:25 **Technical validation of iLCSoft 15'**  
Speaker: Andre Sailer (CERN, HU Berlin)  
Material: [Slides](#) 
- 10:40 **Druid - new developments 10'**  
Speaker: Manqi Ruan (CNRS)  
Material: [Slides](#) 
- 10:50 **Mokka - News and Status of ILD\_01 15'**  
Speaker: Gabriel Musat (CNRS)  
Material: [Slides](#) 

## Tracking

Convener: Steve Aplin (DESY)

- 11:45 **Silicon Tracking 15'**  
Speaker: Alexandre CHARPY (CNRS - IN2P3 - LPNHE)
- 12:00 **FPCCD digitizer 15'**  
Speakers: daisuke kamai (tohoku university) , Akiya Mi  
Material: [Slides](#) 
- 12:15 **Topological TPC pattern recognition 10'**  
Speaker: Frank Gaede (DESY)  
Material: [Slides](#) 
- 12:25 **ILD Tracking - open issues 15'**  
Speaker: Steve Aplin (DESY)  
Material: [Slides](#) 
- 12:40 **LCFIVertexing status 15'**  
Speaker: Tomohiko Tanabe (University of Tokyo)  
Material: [Slides](#) 


## Calo and PFA

Convener: Mark Thomson (University of Cambridge)

- 14:15 **ScEcal Clustering 15'**  
Speaker: Katsushige Kotera (Shinshu University, Faculty of Science,)  
Material: [Slides](#) 
- 14:30 **PID in Pandora and Tracking efficiencies with bg 15'**  
Speaker: Jacopo Nardulli (CERN)  
Material: [Slides](#)  
- 14:45 **SDHcal software status 20'**  
Speakers: Gerald Grenier (IPN Lyon) , Manqi Ruan (CNRS)  
Material: [Slides](#)  
- 15:05 **AHCal software status 15'**  
Speaker: Shaojun (DESY) LU (DESY)  
Material: [Slides](#) 
- 15:20 **New PandoraPFA developments 15'**  
Speaker: John Marshall (University of Cambridge)  
Material: [Slides](#)  

## Software baseline

Convener: Frank Gaede (DESY)

- 16:20 **Plans for DBD event generation 15'**  
Speakers: Akiya Miyamoto (KEK) , Mikael Berggren (DESY Hamburg)  
Material: [Slides](#) 
- 16:35 **Discussion: Simulation Baseline and plans for DBD 1h30'**  
Material: [Slides](#) 

- v01-11. Mainly targeted CLIC CDR, benefit to ILD on  $\gamma\gamma \rightarrow$  hadron , etc.

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## Technical Validation of iLCSoft

André Sailer

CERN-PH-LCD, Humboldt-Universität zu Berlin

ILD Software Pre-Meeting  
May 22, 2011

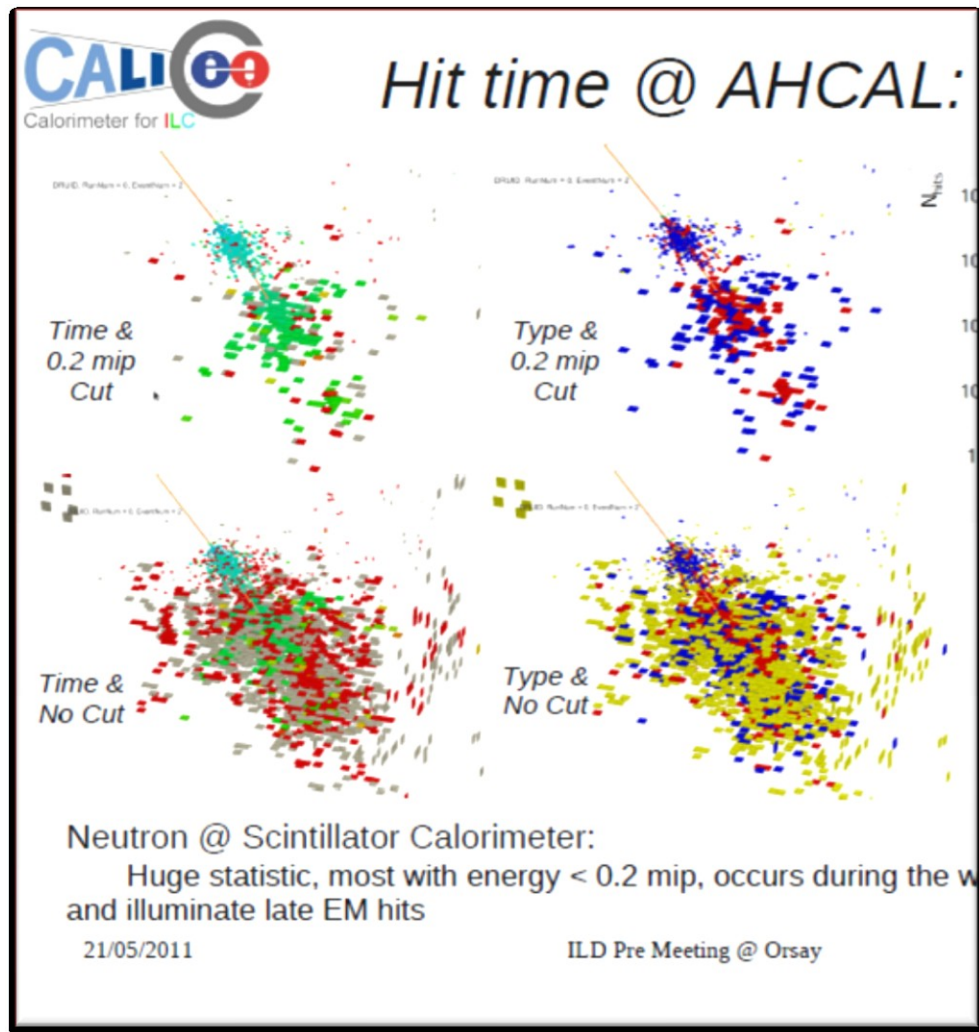
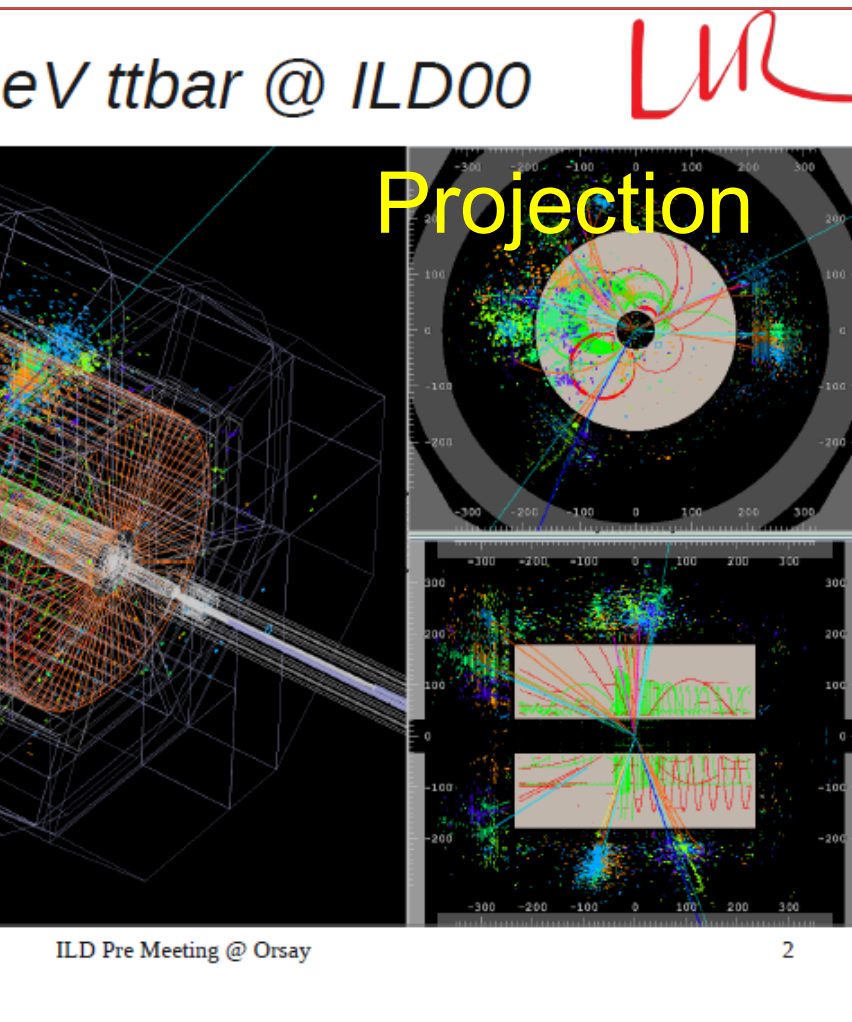
Memory leaks and bugs were fixed using commercial tools at CERN  
CPU time per events with background overlaid was reduced about 50%.

ilcsoft-v01-11 had been validated for CLIC MCProduction

- v01-11. Mainly targeted CLIC CDR, benefit to ILD on  $\gamma\gamma \rightarrow$  hadron , etc.
- LCIO: evolution of EDM
  - Many updates are planned. Will be covered by Frank
- ILCSoft build tool
  - Reduce dependencies among module
- Mass Production
  - New naming scheme has been proposed. Ex. “.” as separator , not use “+”
  - DST format :
    - LCFIVertex except vertexing : DST job  $\rightarrow$  User analysis
    - Further refinement to reduce DST format difference with SiD.
  - Production tool: refined and ready for MCPProduction.

Manqi Ruan (LLR)

More detector models, using geometry info from GDML. But ILD\_01\_pre yet.  
New features: projection, cut on Edep, timing,



- Latest model: ILD\_01\_Pre01, ILD\_01\_Pre01fw
- Many improvements in sub-detector models

## Sub-detector improvements (I)

- New Ecal with silicon and/or scintillator sensitive layers
- Analog Hcal with electronics inside
- Pad-row-based TPC with Endplate of 25 percent X0
- Improved implementation of Sit, SET, ETD by the SiLC Collaboration
- Ftd - First mechanical design with micro-strips (disks 3,4,5,6,7) and pixel (disks 1,2) technologies by Jordi Duarte.

Gabriel Musat

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## Sub-detector improvements (II)

- New LumiCal with virtual cells (details from Bogdan Pawlik)
- LHcal implementation, as a Si/W calorimeter
- First implementation of services (cables, cooling, etc)
- Improvements in implementation of Tube, Mask, Yoke (new Muon System), BeamCal, Magnetic field (field depending on the coil and yoke parameters), Coil (using Coil Cryostat with detector instrumentation)

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## Sub-detector improvements (III)

- Available (but not included by default in the new ILD models):
  - improved implementation of digital (GRPC) Hcal (geometry suggested by Henri Videau)
  - new implementation that replaces, in the AHcal, scintillator layers (and their associate components) with GRPC layers (identical to those in the GRPC Hcal), by Ran Han.

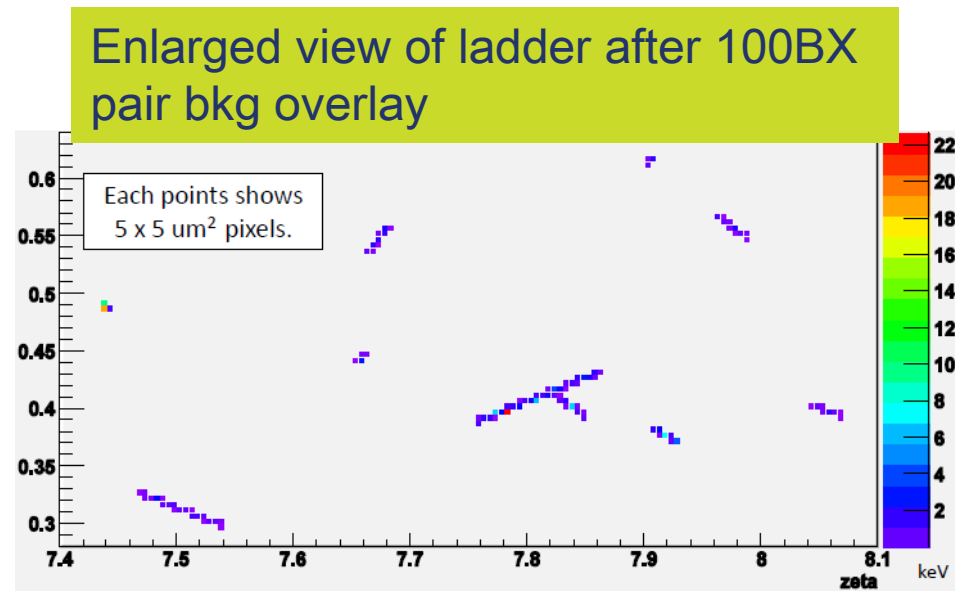
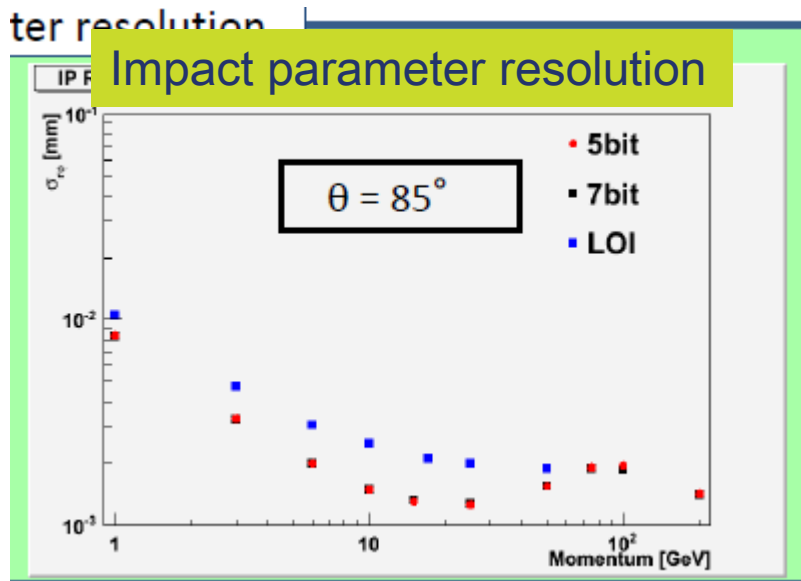
Gabriel Musat

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- The services follow the plans of the integration group, but still remaining
  - ✓ sub-detectors floating in the air : inner tracker, TPC
  - ✓ missing services: VTX
- Kernel was improved in the treatment of long lived particles.
  - ✓ The use of lifetime of the pre-defined decays given by the stdhep file.
  - ✓ The lifetime of B-hadrons are not known in Geant4. Read in from the external file.



- FPCCDDigitizer creates pixel hits from SimTrackerHit, taking into account noise, landau distribution, threshold, fixed bit digitization.
- FPCCDClustering cluster pixel hits
- FPCCDOverlay overlays pair bkg of up to 800BX (memory limited)



- Pair background (SB2009-500wTF) : pixel occupancy 1.6~2.8% inner layer
- $\gamma\gamma \rightarrow$  hadrons :  $\sim 1/2000$  lower occupancy, but hits by real tracks remain

➔ planning to develop Kalman filter based track finding to investigate performance under beam backgrounds

# Topological TPC Pattern recognition

Frank Gaede

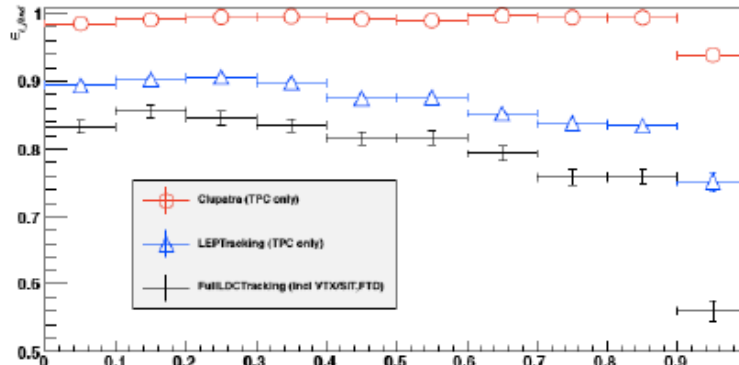
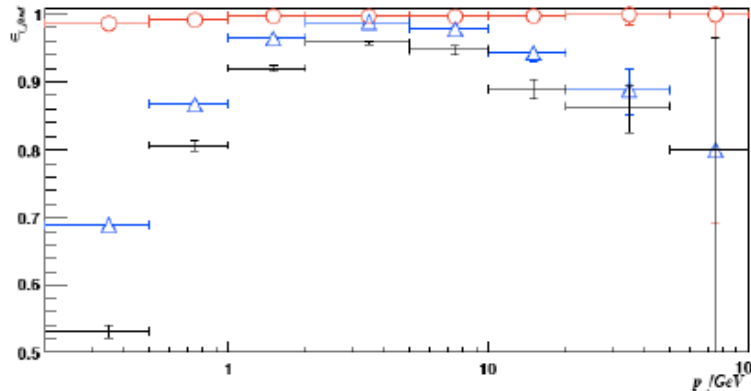
- Nearest neighbor clustering instead of classical triplet search
- Improved tracking efficiency compared to old LEP Tracking pat. rec

- Clupatra
- △ LEPTracking (TPC only)
- ⊕ FullLDCTracking (TPC+VXD)

Frank Gaede, ILDWS, SW pre-meeting, May 22, 2011

## track finding efficiency III

TPC track finding efficiency - tracks from v-zeros (In ttbar @ 500 GeV)



- non-prompt tracks
- $\rho_{vtx} > 10\text{cm}$
  - parent charge==0
  - mostly vzeros and conversions
  - > 5 TPC Hits
  - ( $p_T > 100 \text{ MeV}$ )
  - ( $|\cos(\theta)| > .99$ )

comparison to LEPTracking pattern recognition  
NB: Clupatra has no reconstructed tracks yet and no quality cuts are applied

need to study if we can gain for v0/conversion reconstruction

Significan improvement in V0 track

- New addition: IMarlinTrack
  - Provides interface to Delphi tracking and KalTest tracking
  - LCIO as Input and output format
  - User can easily access track propagator  
Ex. `PropagateLCIOToZPlane(Track *track, float z);`

- Open Issue :

- Digitization

- Currently there are no digitisers available in MarlinReco for the new SIT, SET, ETD and FTD designs present ILD\_01.
- We need these very soon if we are to move ahead with the modifications of the tracking code for use with ILD\_01.
- How can we achieve this best in a timely manner ?
- Do we need to find extra effort, or are there technical limitations in the software which are holding back this issue?

- Navigation:

- Both Delphi fitting and KalTest have limitation concerning Navigation  
→ limitation concerning the current design of SIT, SET, ETD, FTD

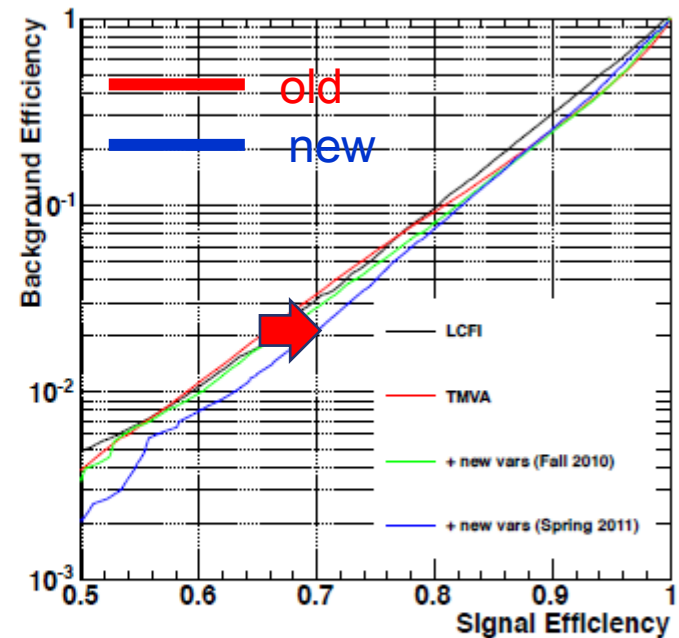
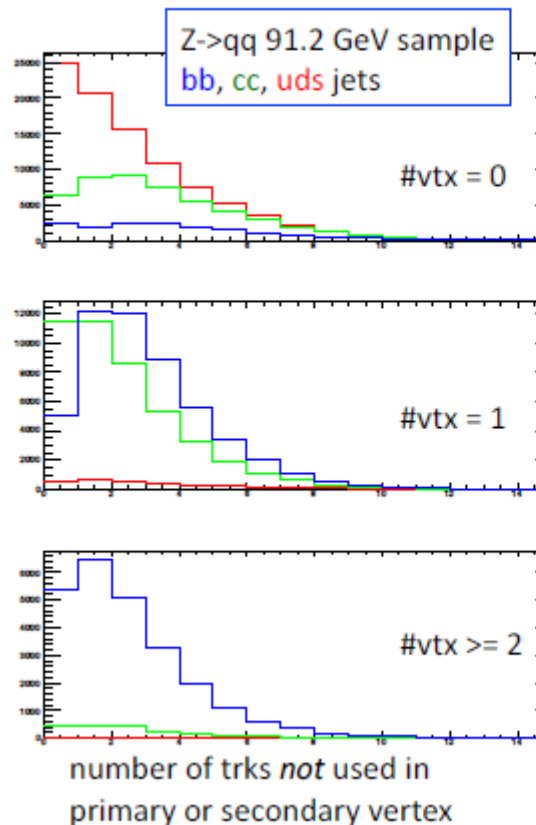
## ■ Extend LCFIVertex:

Previous: PFA → Jet clustering → Vertex Finder → Flavour Tagging → Charge Rec.

New : PFA → Vertex Finder → Jet clustering → Flavour Tagging → Charge Rec.

- ✓ Good for multi-jet events
- ✓ Use TMVA for FT
  - easily add new variables

## flavor tagging

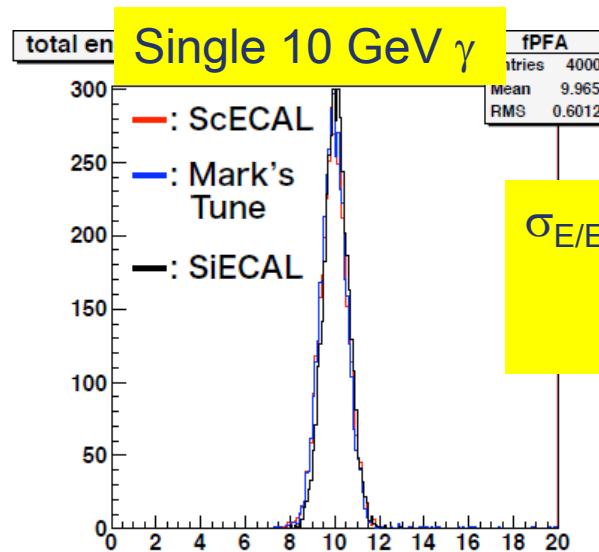
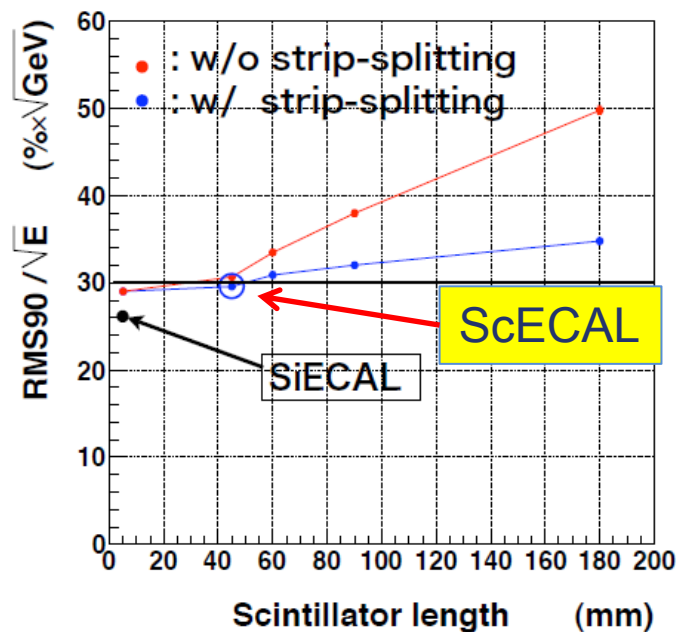


- we do much better in the high purity region
- this demonstrates that there is still information in the jet that we have not previously used
  - should be even better if we use track parameters & errors, e.g. joint probabilities with respect to secondary vertices

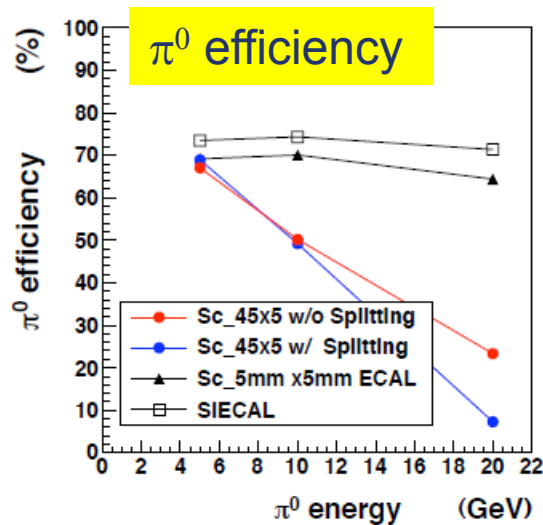
# ScECAL Clustering

Katsushige Kotera

- Study of ScECAL reconstruction with strip-splitting method
- Calibration improved: ScECAL performance closed to SiECAL



$\sigma_{E/E} = 0.488$  (old)  
 $= 0.479$  (new)  
 $= 0.471$  (SiECAL)

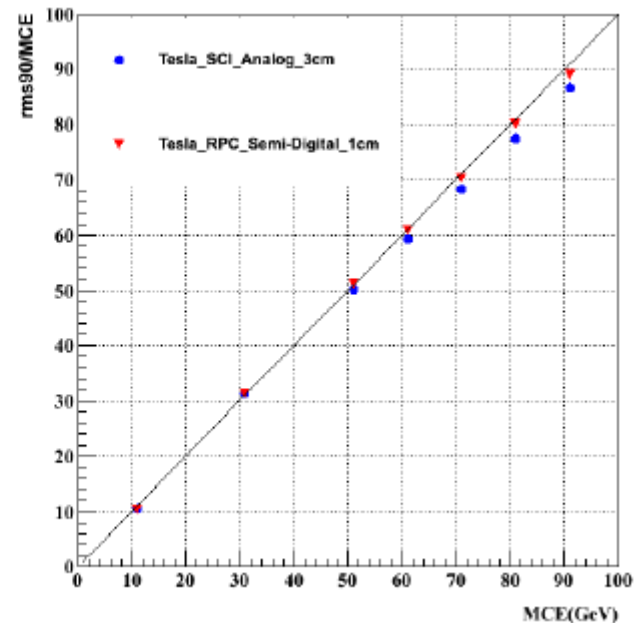
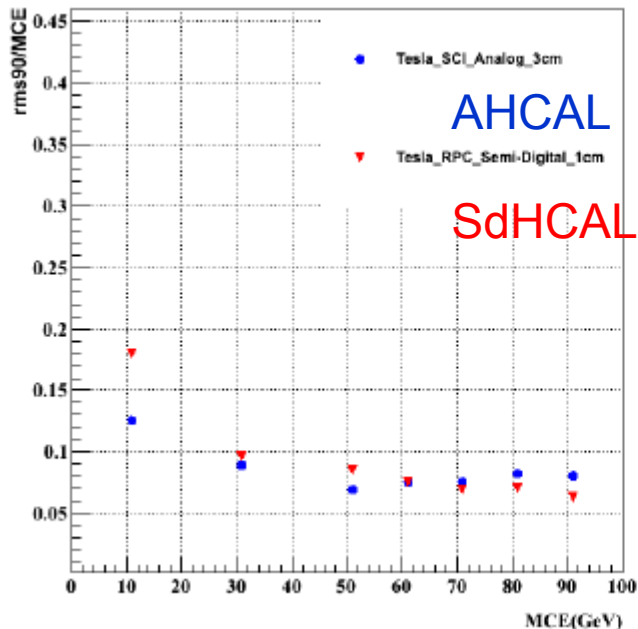


Still a room to tune photon separation

# SDHcal software status

Gerald Grenier

- Geometry
  - Sensitive detector very detailed
  - Overall geometry: Tesla and Videau geometries were implemented
  - Missing in Mokka : Endcaps and Endcap rings missing. no cables nor services.
- Digitization
  - Progresses in simulating induced charge
  - Multiplicity simulation requires track position in cells. Feature missing in LCIO. Technical solution to be chosen.
- Reconstruction : Update of Pandora has started



# AHCAL software status

Shaojun

- With respect to LOI, more realism by inclusion of electronics and services

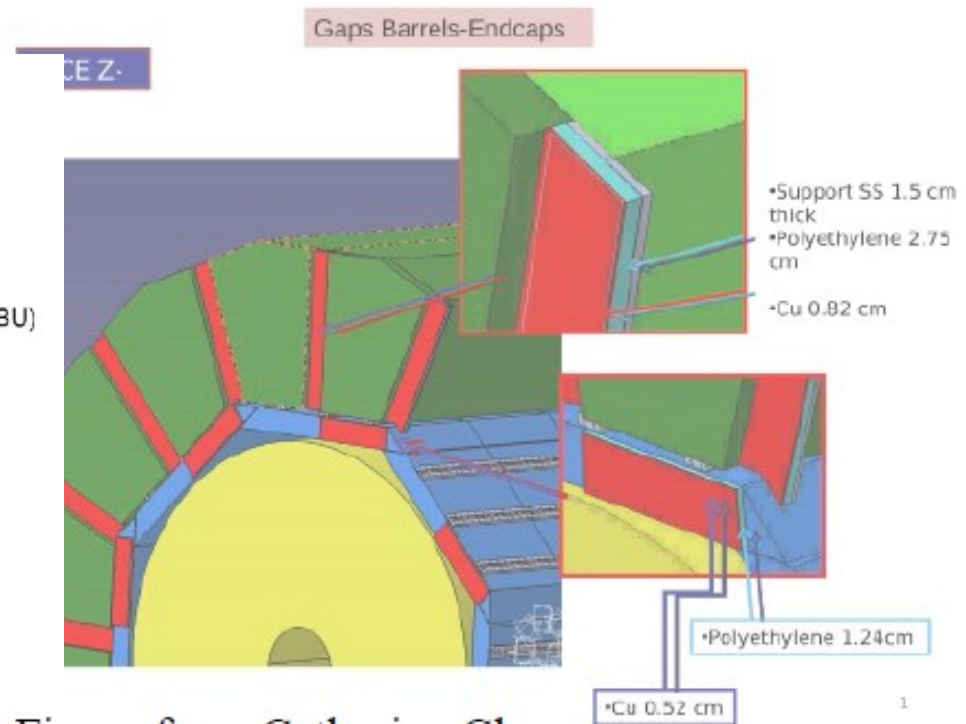
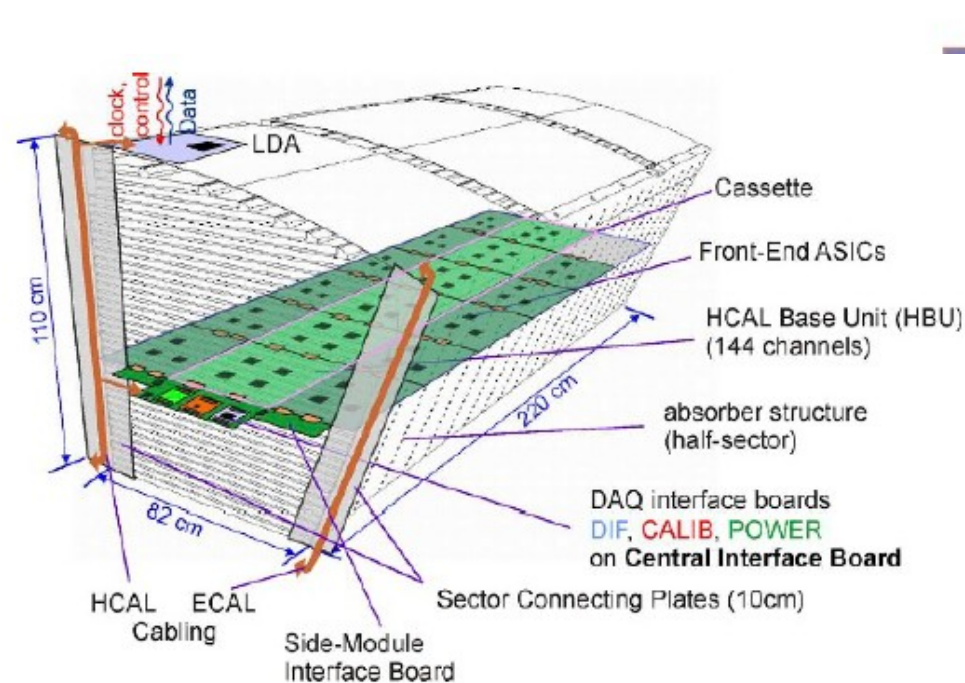




Figure from Catherine Clerc

- Tested and debugged Mokka driver exists
- Digitizer and reconstruction code are part of the standard reconstruction chain



## CLIC\_ILD particle identification and tracking performance

J. Nardulli

**This talk in 2 parts:**  
→Particle-ID performance: efficiencies, purities and mis-identification rate  
→Tracking performance: efficiency and fake rate

22/5/2011 Particle-ID and Tracking performance in CLIC\_ILD 1/27

- Particle Identification performance
  - Efficiency and purity of e, m, g, p, e were above 90%
  - Mistag rate > 2% for 100~500 GeV particles.
  - e mistag rate is high, tagged as pion
- Tracking efficiency with Single muon:
  - Tracking efficiency ~ 100%.
  - Fake rate ~ 10% when backgrounds were overlaid





## Summary

### Development of Pandora continues at a rather rapid pace:

- **Active development on going.**
  - ✓ restructuring of Pandora code,
  - ✓ forced clustering,
  - ✓ reclustering monitoring,
  - ✓ reducing CPU time
- **Improved the resolution of high energy jet**
- **Performance of ILD\_01\_pre is yet to be tested.**
- A photon reconstruction algorithm has been implemented, which aims to fully reconstruct and tag photons and remove them from the subsequent Pandora reconstruction.
- The photon reconstruction algorithm proves beneficial at high energies and the current jet energy performance figures are the best ever obtained for the ILD00 detector model.

# Plan for DBD event generation

Mikael Berggren

- Whizard tool has been updated to use for ILC DBD event generation
    - New features: correct CKM, color/spin info, OPAL tune frag. parameters
    - Number of processes are reduced significantly by aliasing
  - Waiting official 1 TeV parameters for final sample production
  - Tentative samples
    - WW ( 4 fermions ) has been produced [ Mikael Berggren]
    - $\nu\nu H$  : will be prepared soon [Tim Marklow]
    - ttH : difficult by Whizard. Looking for alternative solution (AM)
- larger scale test of the physics of new Whizard version and new fragmentation tune will be needed

# ILD\_01 status and open issue

- Beam pipe
  - First design exist, but not final
- B field
  - Simple map for mass production
  - realistic map for BG studies
- Physics List
  - Use QGSP\_BERT
- VXD
  - realistic models for 3 double layers and 5 layers exist
  - Services are not final
    - Be support, connector box, ..
  - Baseline : CMOS or FPCCD
    - Same geometry in Mokka
    - Differences in digitizers
- FTD
  - More realistic design in Mokka – rotated wafer
  - Can we develop digitizer and tracking for this in time ?
  - might need to fall back to simpler model
- SIT,SET, ETD, ETD
  - Realistic and detailed sim exist in Mokka.
  - Cables and services sufficient ?
  - no digitization and tracking yet
  - might need to fall back to simpler model
- TPC
  - realistic model exists
  - cables and support implemented
  - new tracking works fine.

# ILD\_01 status and open issue - continued

- ECAL
  - realistic driver exists for both Sci&Si ECAL and mixed config.
  - cabling and services implemented
  - **baseline: Si or Sci?**
    - **mixed config. not studied**
- HCAL
  - realistic driver exists for AHCAL and SDHCAL
  - two geometries for dHCAL
  - cabling and services implemented
  - **baseline: AHCAL or SDHCAL**
- Muon
  - Model used for LOI increased realism
  - Another model has been used in CLIC study
  - **baseline needs to be defined**
    - **strips vs tiles ?**
    - **instrumented coil ?**
- BeamCal
  - new engineering design exists
  - implemented in Mokka
- LCAL
  - new realistic driver exists
  - including support, cooling
- LHCAL
  - exists in Mokka, but no real design exists

# Summary

- A lot of interaction during the meeting.  
It was a very fruitful meeting
- Simulation: ILD\_01\_pre and other models.
  - ✓ Improved the realism of the model.
  - ✓ Still some services are missing
    - Waiting info. from hardware side
- Reconstruction
  - ✓ Lack of work on silicon tracking for new geom.
  - ✓ Progresses in many area.
  - ✓ The validation of new models, ILD\_01\_pre and variants, is yet to be done.