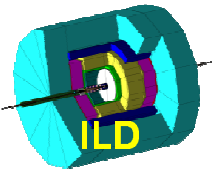
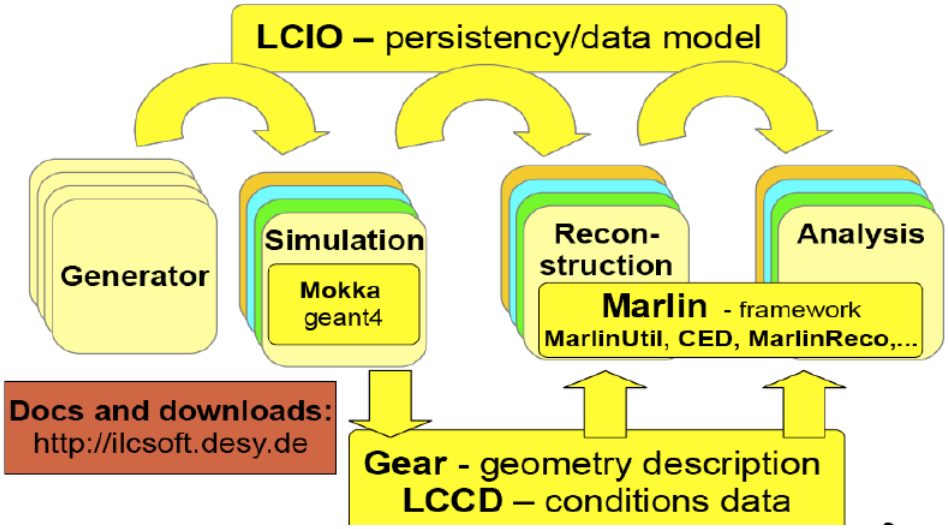


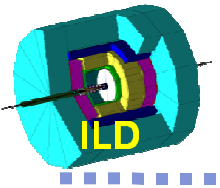
ILD Simulation Status and Plan

Akiya Miyamoto
for ILD Software group
27-March-2010, Beijing
LCWS2010

ILD Software tools

- Generators
  - Common Stdhep data
  - Whizard/PhysSim package
- **Simulation: Mokka**
  - **Geant4 application**
- Reconstruction
  - Marlin Framework
  - Reconstruction tools as Marlin Processors
  - **Digitization**
- Core tools
  - LCIO : standard for persistency format and event data model
  - Gear, LCCD, CED, …
  - Grid tools and ilcsoft-install



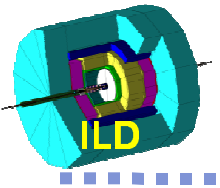


Towards 2012

- ILD software tools has been used successfully in LOI era
  - About 50M events were produced using a realistic detector model.
  - Demonstrated physics capability of ILD detector

- For studies by 2012, our tools should be shaped up to meet RD's request,
  - "Develop a realistic simulation model of the baseline design, including faults and limitation"
  - To be used for new benchmark studies

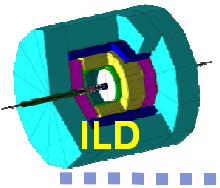
- Plan has been discussed soon after LOI approval in various occasions such as
  - ALCPG 09
  - ILD WS in Jan. 2010
  - At bi-weekly ILD Software working group meetings.



Timeline

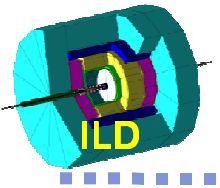
- Global plan : relative weights in each periods
  - 2012: Debug / GRID production / Analysis / Writing
  - 2011: Reconstruction / Optimize / Define baseline
  - 2010: Develop tools / Develop Simulators

- Issues being considered
  - LOI studies: detector options – little impact on physics performance
    ➔ some MC production may be started earlier?
  - Reconstruction code developments are significant work.
    - New tracking which can handle non-uniform field, background hits
    - silicon strip tracker
    - PFA for Scintillator strip ECAL, ScSiECAL
    - PFA for HCAL (Analog vs digital) x (8-16 sided vs cylinder)
  - Hardware R&D info will come later.
  - Study for DBD should be based on the best known technologies



Timeline - 2

- Conclusion at ILDWS (Jan. 2010) was
  - to postpone the exact scheduling of mass production for DBD
  - Request each sub-detector contacts to declare their plans and schedule
  - Review the progress of code developments in mid. 2010 and re-schedule a plan of mass production.
  - Limiting factor: man power for code development and running of mass production overlaps.
  - Priority in this period is in code development, especially on simulation code.
- 17 Mar. '10:
  - Correct detailed plans from sub-groups
- Mid. 2010:
  - Software meeting to review status and progress of each plans,
  - re-consider mass production schedule

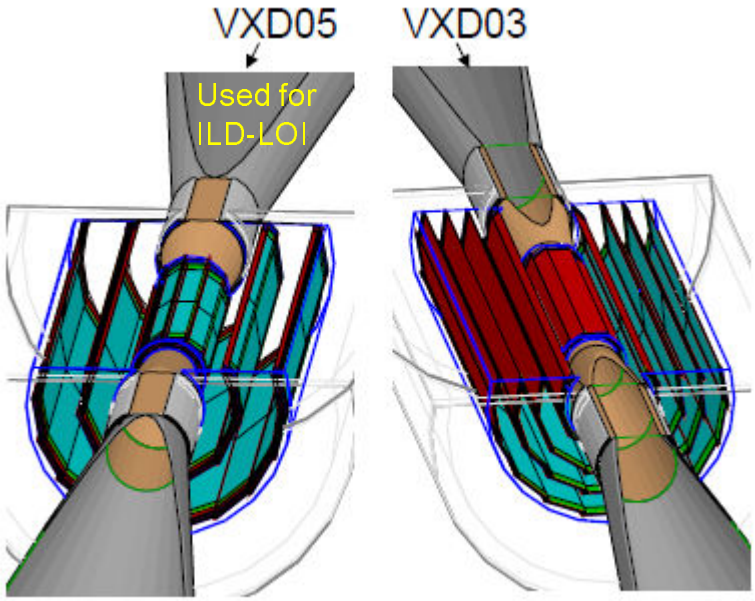


Mokka simulation

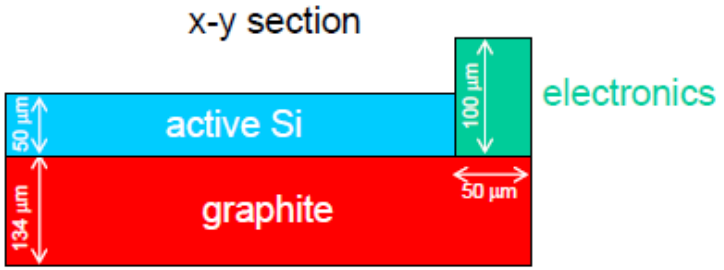
- Successfully used for LOI studies
- Currently uses Geant4 9.2
- Any big revolution or reengineering foreseen in DBD study phase
  Major activity in Mokka world ➔ develop sub-detector drivers
- PhysicsList
  - We have been using LCPhys physics list created by Dennis Wright (SLAC) several years ago
  - Since then many new physicslist are developed and prepared by Geant4 team.
  - Gean4 team is recommending QGSP_BERT_HP, but it seems to increase computing time significantly.
  - Other physicslist such as LHEP and Q6SC_CHIP have been used by CALICE people.
  - ILD wishes to use common physicslist with SiD for DBD studies.
  - we hope to have an agreement among LC community soon.

VXD in Mokka

- Two geometries are available in Mokka
  - Common to DEPFET, FPCCD, CMOS
- Cryostat is present, but
  cables and sensors are not addressed.
  ➔ to be improved for DBD
- Technology dependence:
  - May need to address thickness, pixel size, range cut, etc, for detail performance/background studies
- Digitizer
  - Smearing 3D hit points
  - DEPFET-like pixel digitizer exists.
  - CMOS-like and FPCCD-like digitizer need to be improved/developed.



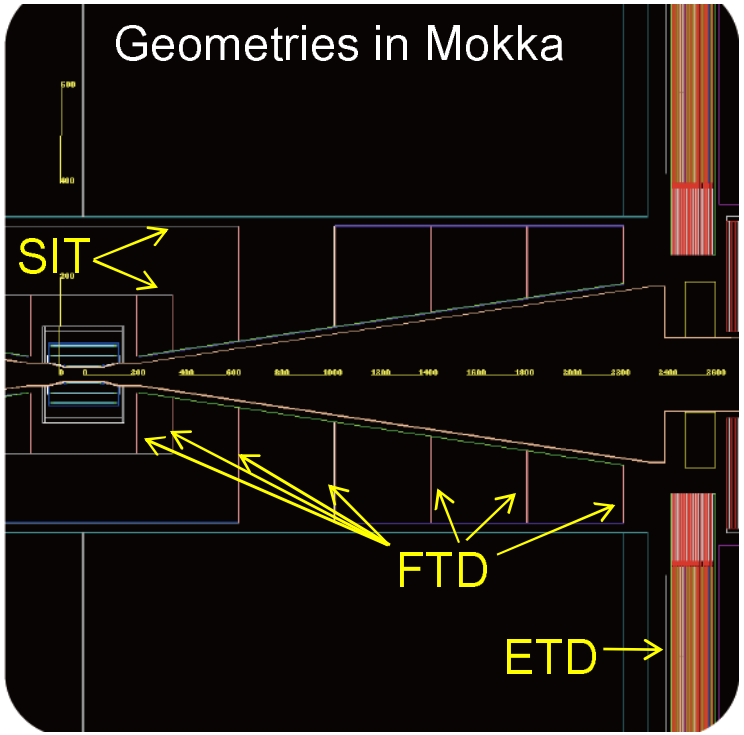
Sensor structure



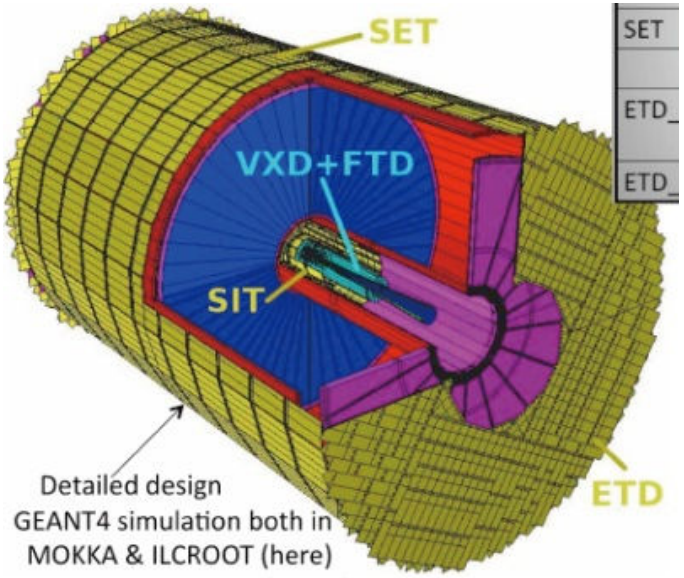
FPCCD: 27(Sat) Afternoon by K.Yoshida

Silicon Trackers

- 4 Silicon trackers in ILD: SIT, FTD, ETD, SET

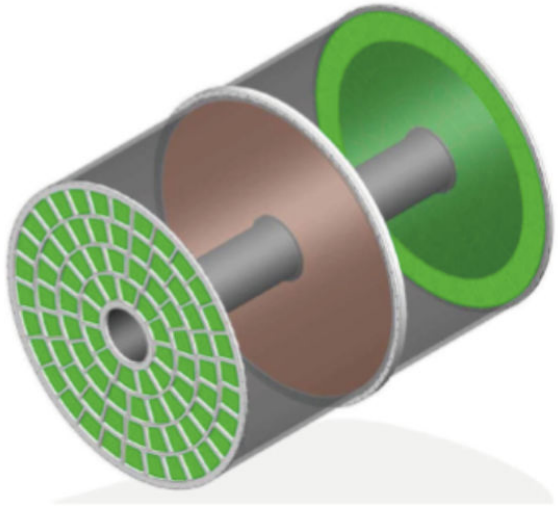


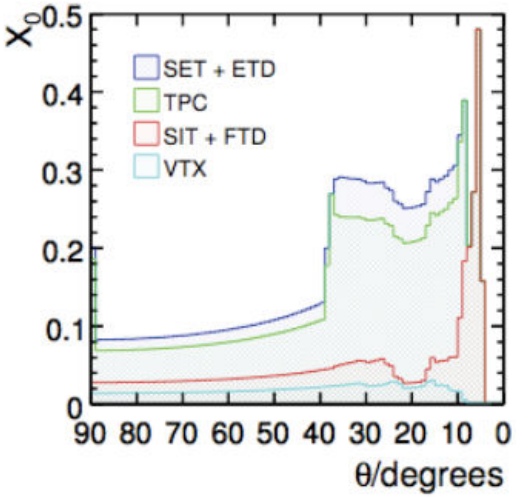
- Cylinder/Disks ➔ strip sensors
- Existing CAD design of them needs to be implemented in Mokka



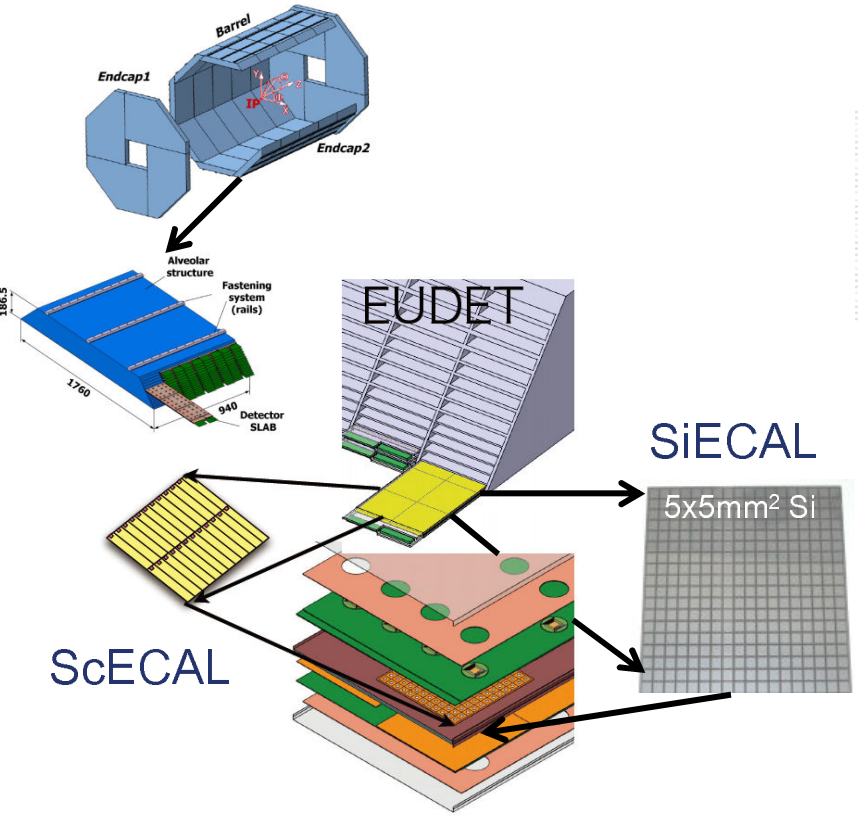
TPC

- Materials:
  - Gas- Ar/CF4/C4H10
  - Aluminum frame, Cu & mylar cathode
  - Endplate: sequential discs of G10, Cu, Air, …
  - ➔ cylinders : homogenous in phi
    (no gaps between modules)
- Materials in tracking volume is fairly realistic
- Further improved geometries for optimizations
  - More phi-dependance would be considered
  - Geometries to optimization
    - end-plate thickness: 15, 30, 45, 60% R.L.
    - TPC-ECAL gap size
- Digitization
  - Gaussian smeared by θ, ϕ, L_{drift} dependant $\sigma_{r\phi}$, σ_z
  - Improve parameterization by beam tests info.
- Detail simulation of charge correction will not be used mass production



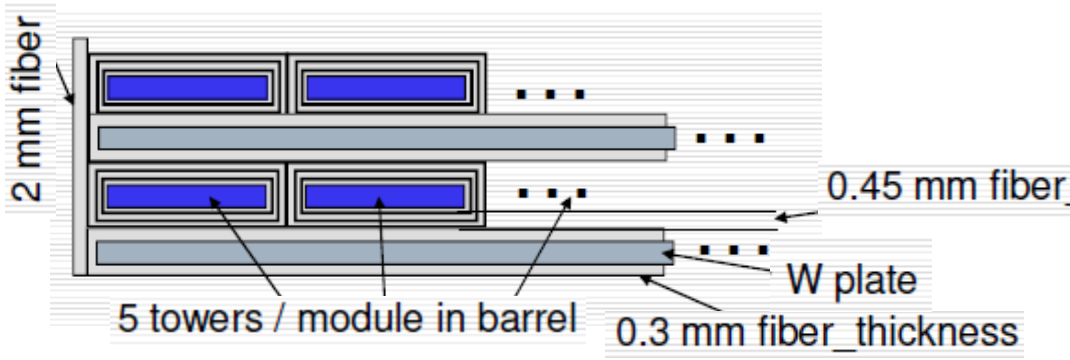


ECAL



ScECAL and SiECAL share the same structure
➔ SiScECAL

ECAL module side view : incl. dead spaces



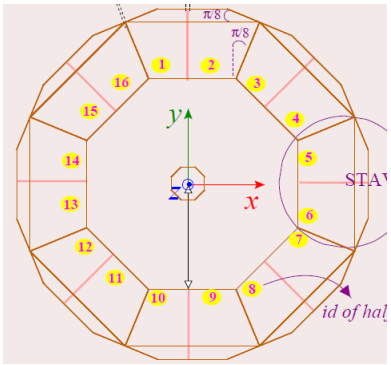
- 3 options: SiEcal, ScECAL, MAPs
  - SiECAL/MAPs : realistic geom.
  - ScECAL: Si ➔ Scinti. & ∑ tile ➔ strip

  (ScECAL study: Mon. morning, K.Kotera)
- Improvements
  - SiScECAL : work in progress
- Digitization
  - Energy deposit x calibration constant

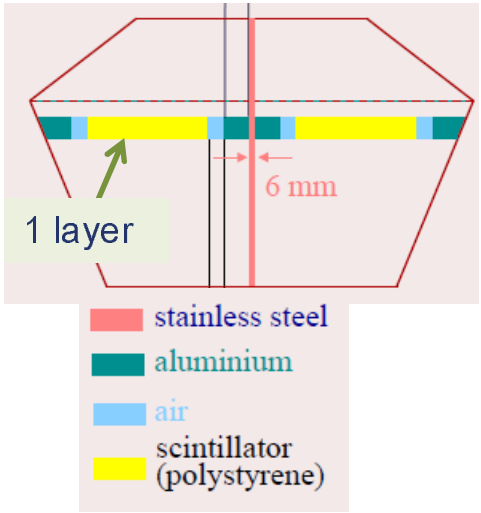
HCAL

- Analog HCAL
  Active: Scintilator

8/16-sided

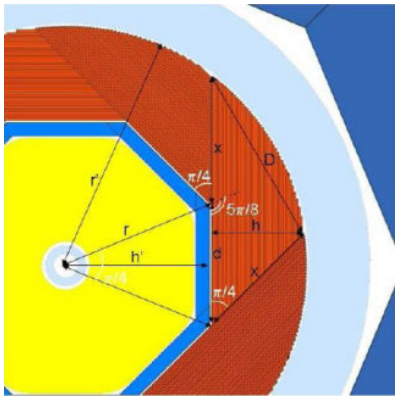


Cross section of 1 module

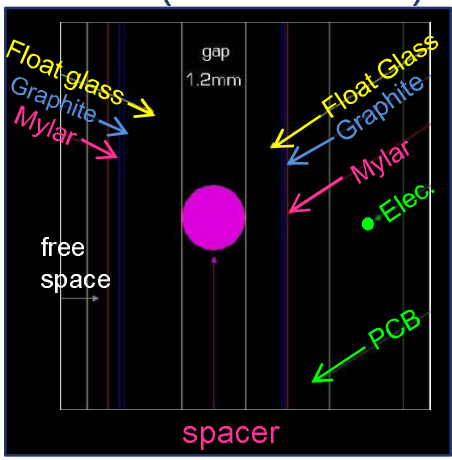


- Digital HCAL
  Active: RPC

cylindrical



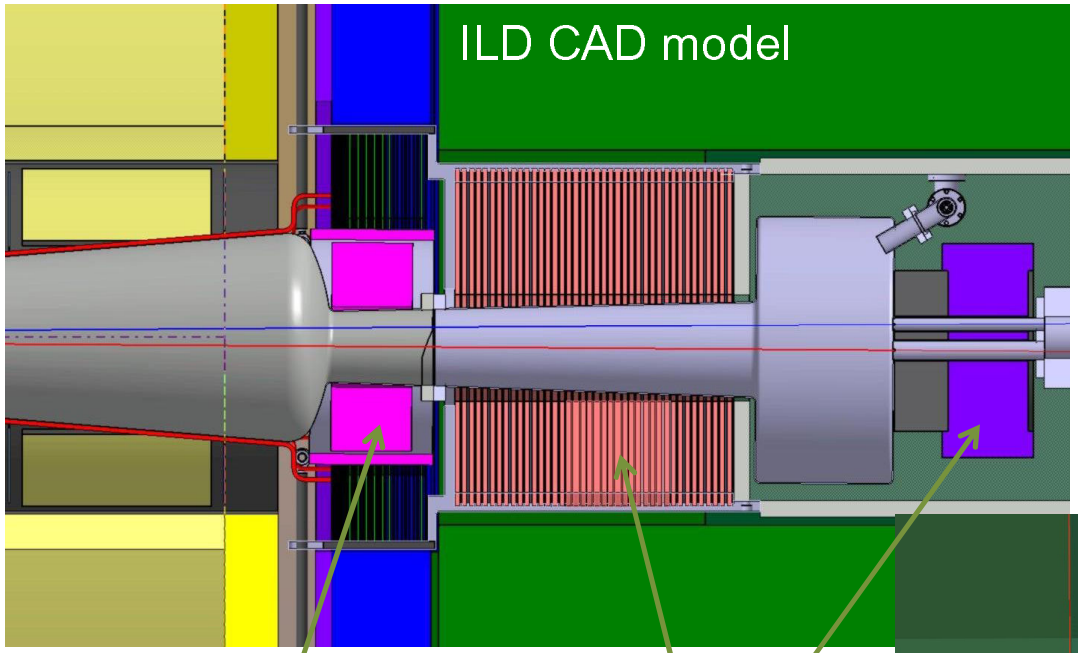
RPC (cross view)



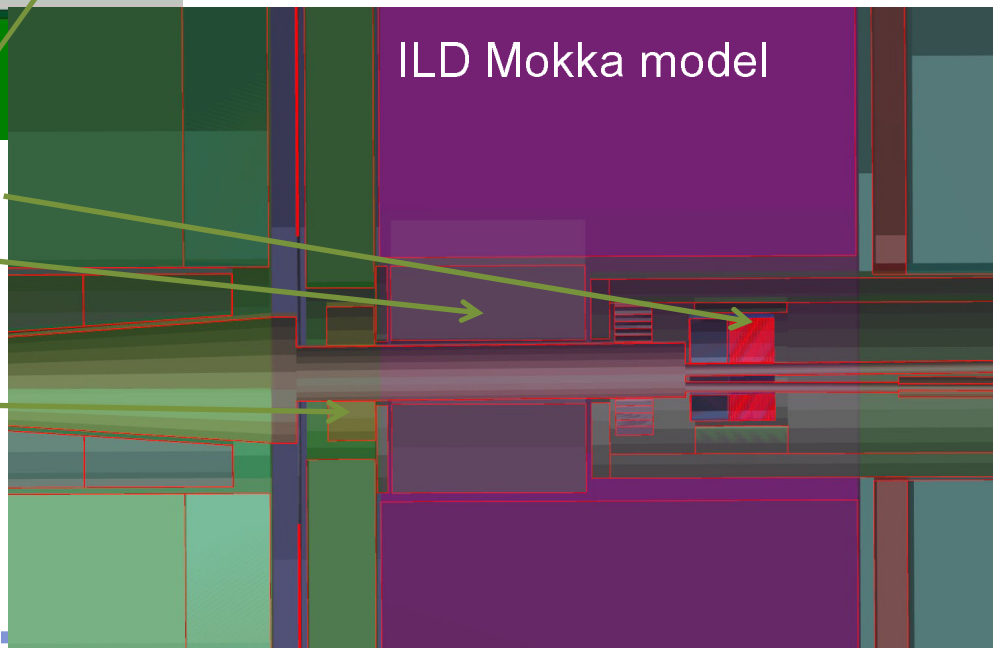
- Realistic geometry already implemented in Mokka
- Optimizations :
  - 8/16-sided vs cylindrical & scintillator vs RPC
  - thickness (# layers), gaps, tail catchers, absorber materials,

SemiDHCAL study: (Sat) by Manqi, AHCAL study: 29(mon) by Angela

Forward detectors in Mokka



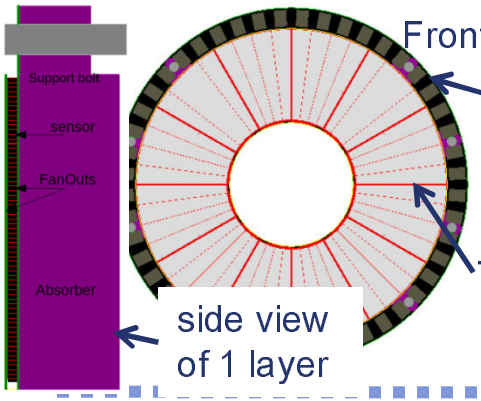
- Consists of LCAL, BCAL, LHCAL, Beam tube and Masks
- Mokka model ~ CAD model, but CAD model will evolve with time and Mokka model needs to follow



New LCAL driver

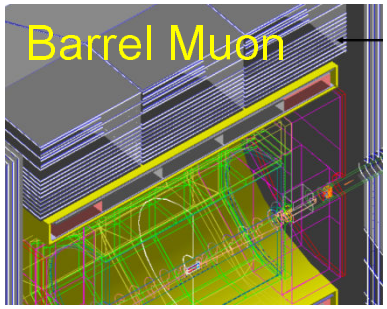
BCAL

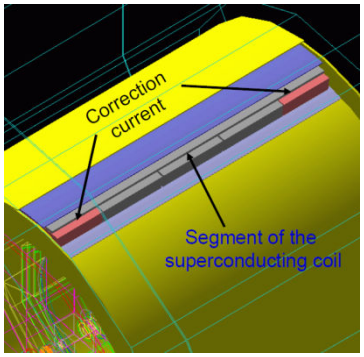
LHCAL

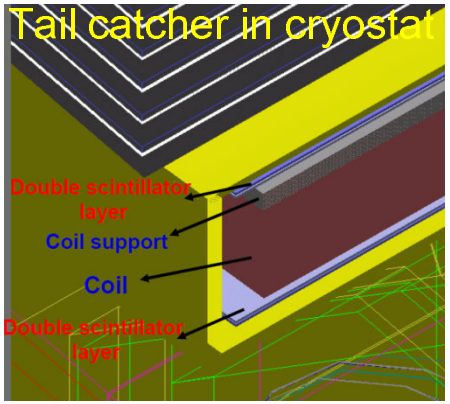


Muon system, Coil and Yoke

- Updated version of the Muon system has been prepared.
  Fairly detailed geometry, waiting integration in the central code







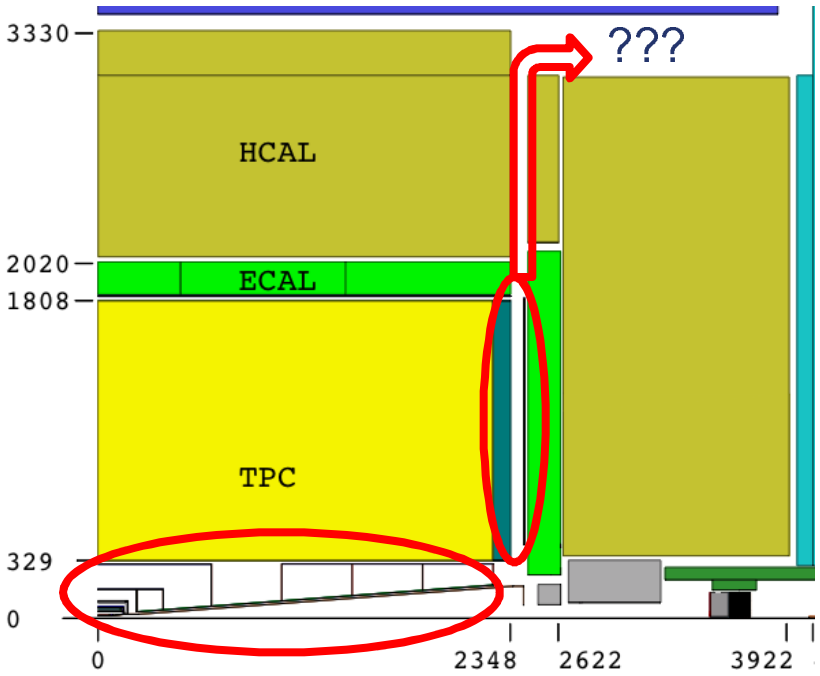
- Magnetic field
  - For LOI study,
    - uniform Solenoid field for physics study
    - approximated anti-DID field for background study
  - For DBD
    - Better anti-DID field map is necessary for performance study, at least.
    - Uniform field or realistic anti-DID:
      - need to consider balance among
        code readiness, CPU penalty, improvements in reality, ……

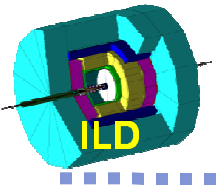
Cables/Services

- Cables, services, dead materials for data out/power in/cooling/gas flow
- sub-detector drivers implements their own materials.
- To address materials in sub-detector boundaries, small WG has been setup within ILD for
  - coordination between sub-detectors/optional detectors
  - defining layout and material budgets

  ➔Implementation in Mokka will follow

Mokka: Inner part of ILD





Summary

- Realistic ILD model was used for ILD LOI study
- Geometry of ILD in Mokka will be improved further
  - adding new knowledge from hardware studies
  - implementing realistic cables and services
  - for optimization of detector parameters
- A plan is
  - to update Mokka soon in order to provide inputs to reconstructions
  - progress will be reviewed by mid. 2010, then MC production plan will be re-considered.

BACKUP