DBD realization studies

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ILD Philosophy

1) Particle Flow **calorimetry**
   - "basic requirement": sep of $H \rightarrow WW/ZZ \rightarrow 4j$
     - $\sigma_Z/M_Z \sim= \sigma_W/M_W \sim= 2.7\% \oplus 2.75\sigma$ sep $\Rightarrow \sigma_E/E$ (jets) $< 3.8\%$
     - $60\%/\sqrt{E} \rightarrow 30\%/\sqrt{E} \Leftrightarrow +\sim 40\%\ \mathcal{L}$
2) Large TPC
   - Precision and low X_0 budget
   - pattern recognition
3) Precision by Silicon detectors: vertex & Calo SET
   - flavour tagging
4) Large acceptance
   - Fwd Calorimetry:
     lumi, veto, beam monitoring

- Merging of LDC & GLD $\longrightarrow$ ILD
  - "best dimension"
  - Optimisation studies

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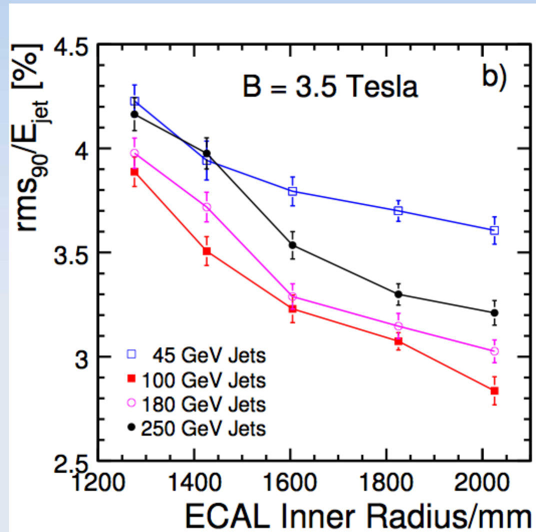
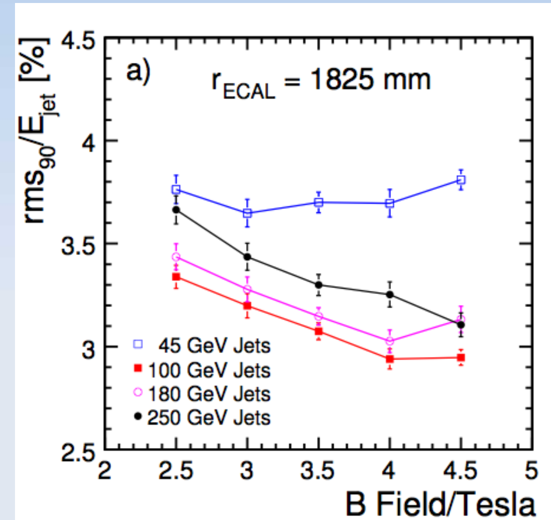
Geometry: dimensions at large

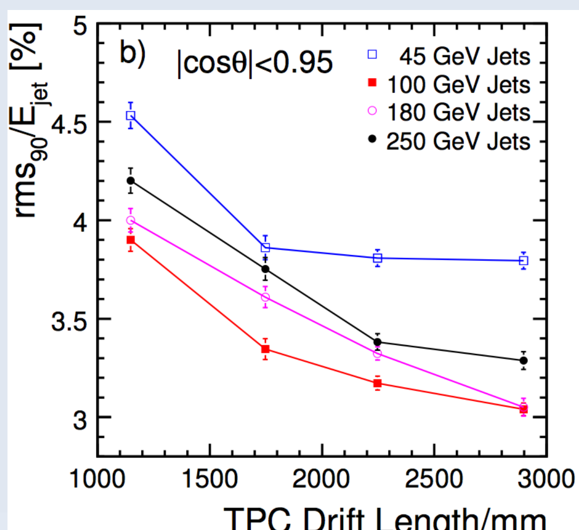
- Mix of LDC & GLD parameters
  + optimisation studies based on PandoraPFA

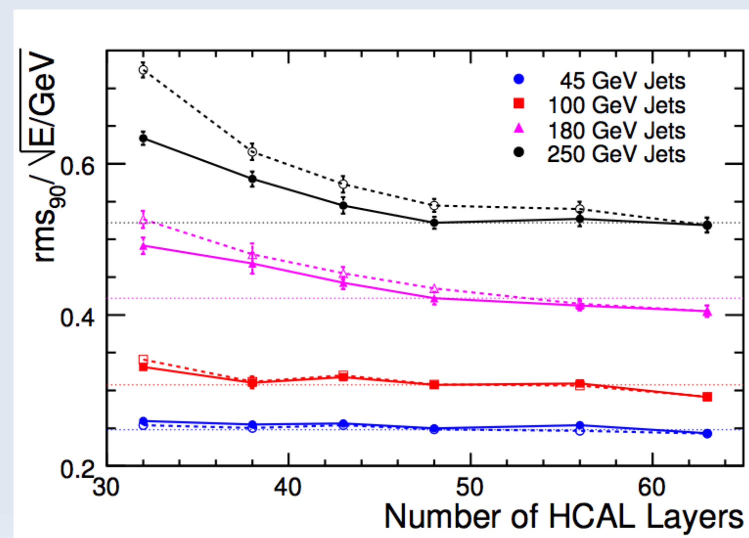
From ILD LoI

- Basic measuring rod
  - σ_{Ej}/ Ej (& Bgd) vs
    - TPC dimensions
    - Radius Magnet (HCAL thickness)
    - B field
- Other perfs:
  - τ reconstruction
  - …
- Done for the baseline (Si-W ECAL + Scint HCAL)
- **TO BE REDONE**









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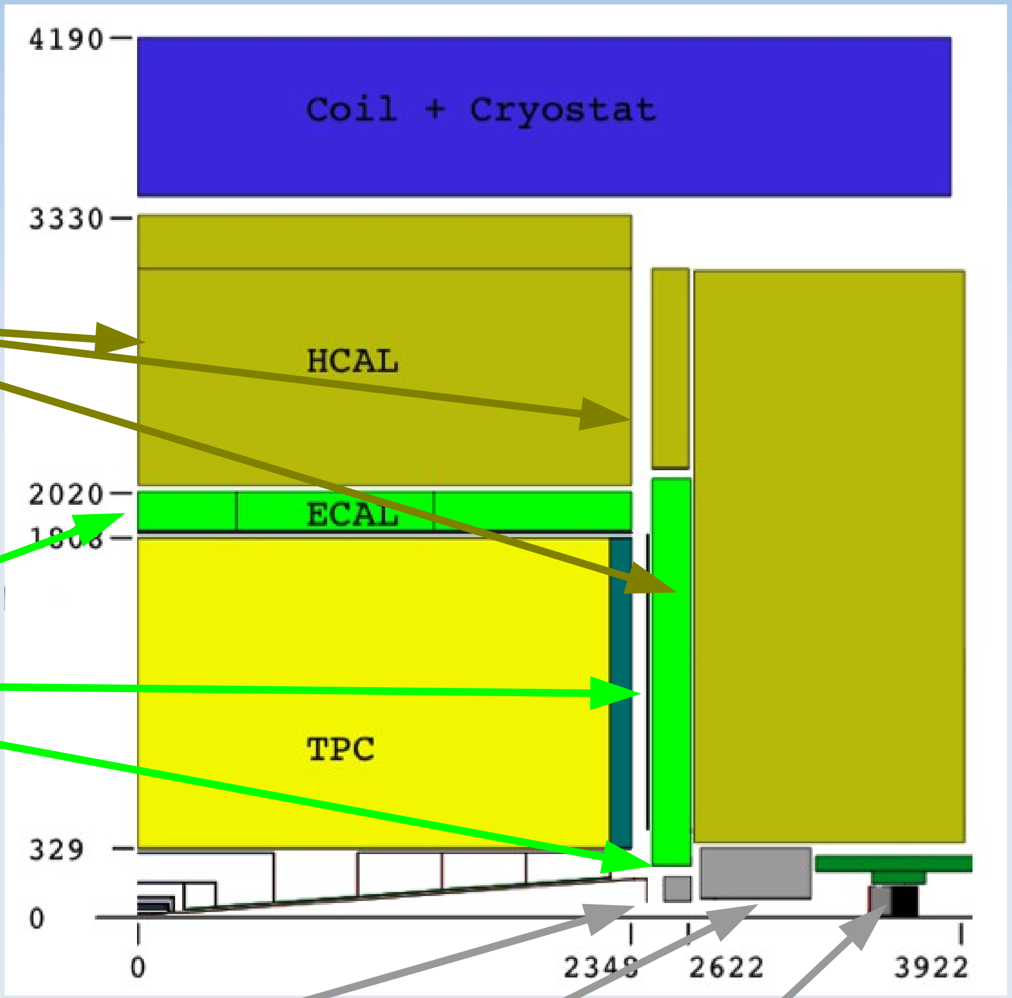
Calorimeter options

B = 3.5T

HCAL
- Analog: Scint/Fe
  - 50 Layers
  - 3×3 cm²
- Semi-Digital: Rpc/Fe
  - 48 layers...
  - 1×1 cm²

ECAL
- Si/W
  - 0.5×0.5 cm²
- Scint/W
  - 0.4×45 cm²
- Sc⊕Si/W



FCAL
- LumiCAL (Si/W); LHCAL (SiW); BeamCal (GaAs)

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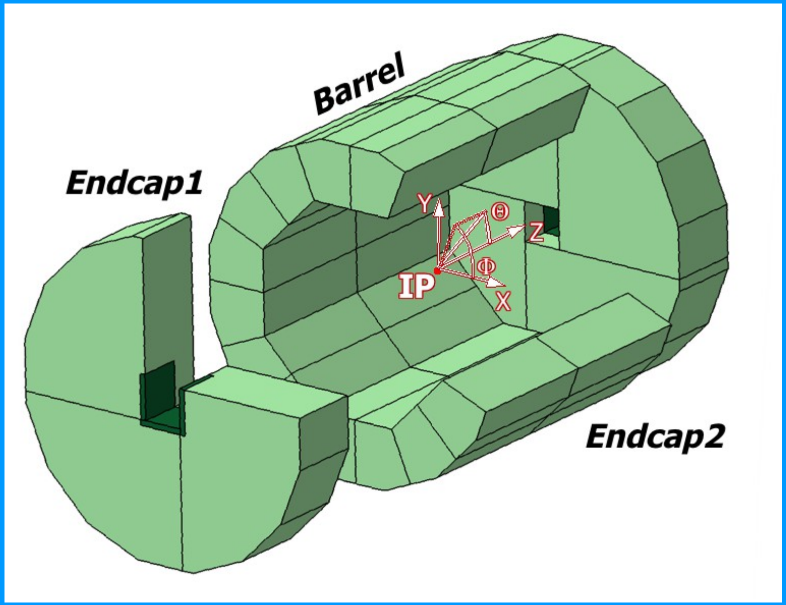
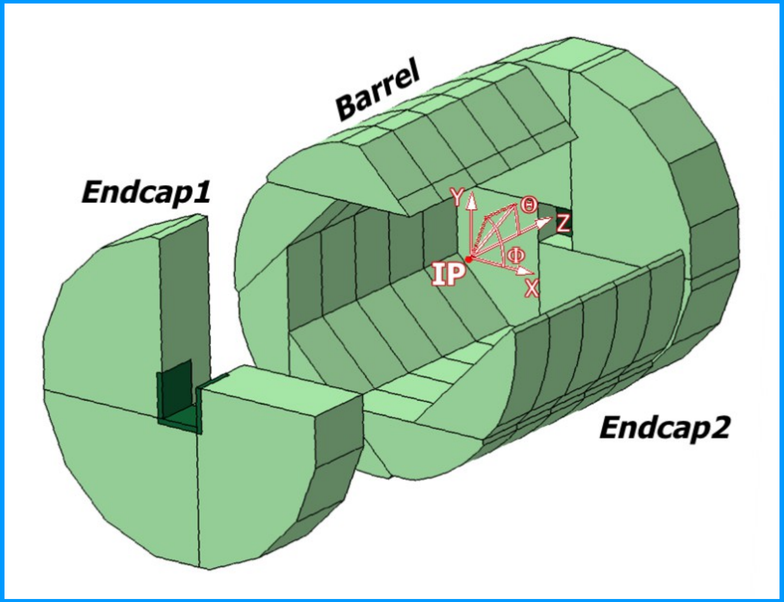
Geometries for the HCALs

- Sensor agnostic

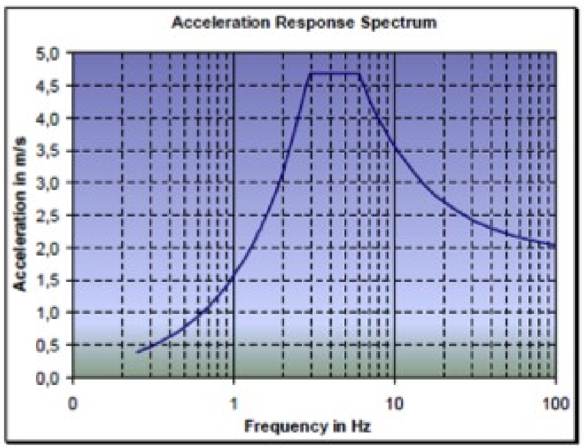
DESIGN 1 (TESLA [DESY])	DESIGN 2 (”a la Videau” [LLR, IPNL])
	
Better access to electronics	Better hermiticity
Larger radius	
	Mechanical rigidity

”Classical” challenge: sound mechanics with minimal dead mat. and inhomogeneities

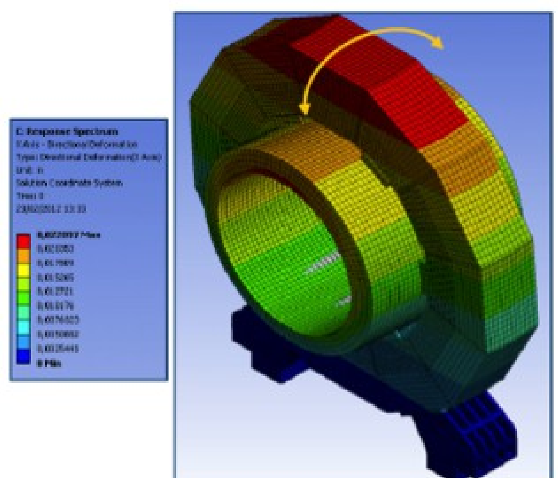
Seismic Hazard for Japanese site consideration, coil & RY behaviour

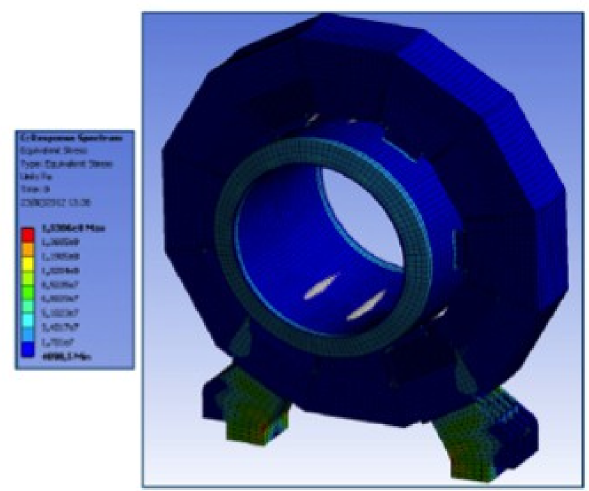
Parameters for acceleration spectrum

- Peak Ground Acceleration: 1.5 m/s^2
- Damping ratio for steel structure: 2%
- Soil type: hard soil



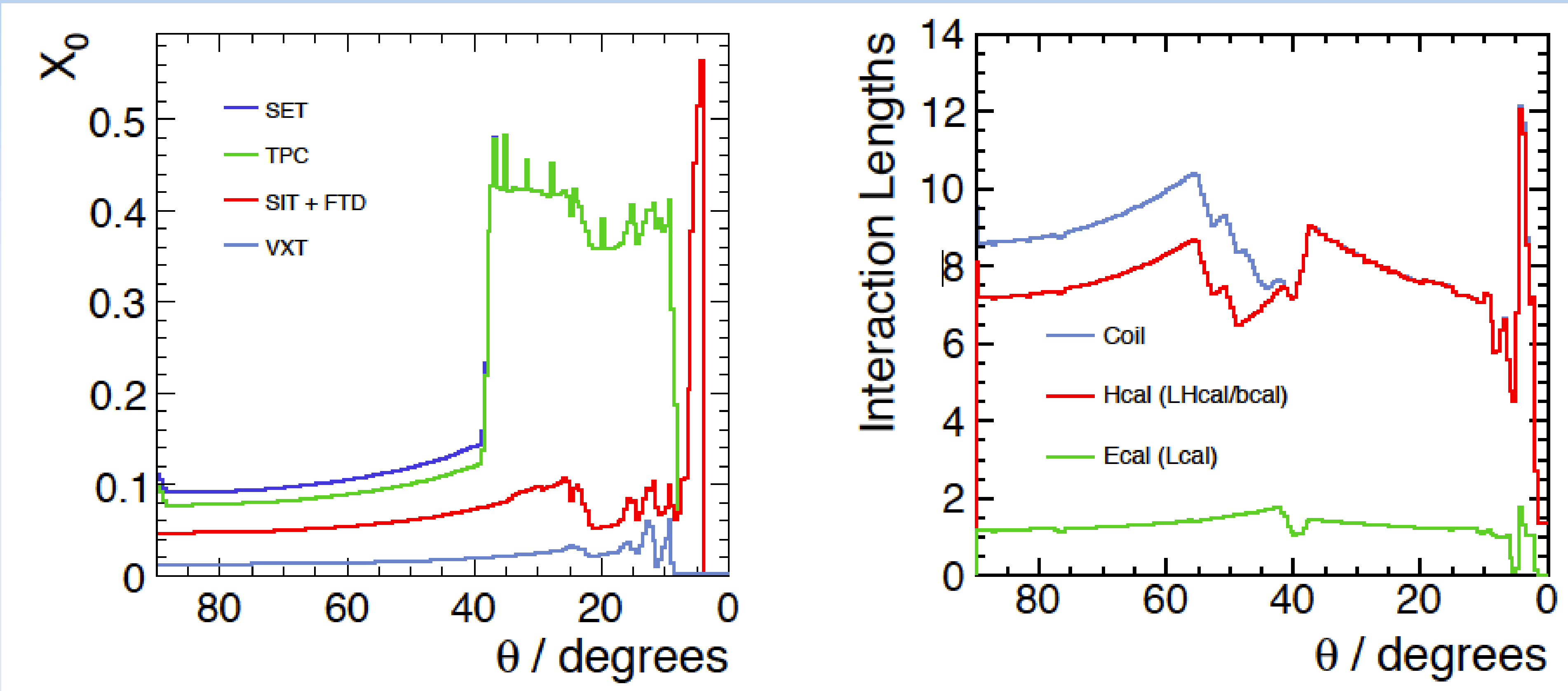
- **With the acceleration response spectrum applied along the detector axis, the fundamental mode of the structure dominates: back and forth motion of the yoke ring**
- **The max displacement is around 23mm, which is quite high**
- **The peak stress is located in the feet. The level seems acceptable but the results need to be checked with a proper design and model**
- **Attaching the 3 rings together is probably the way to go to increase the overall stiffness and reduce the peak displacement**





From O.Fereirra (LLR)

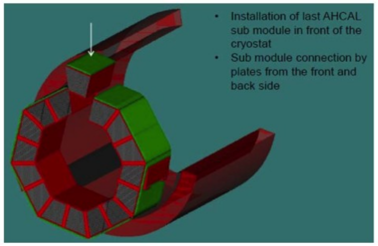
Interaction length profile (TESLA)

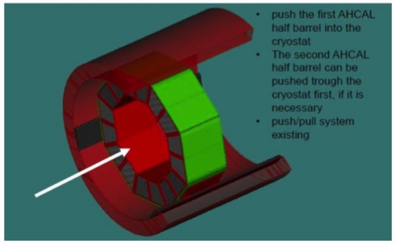


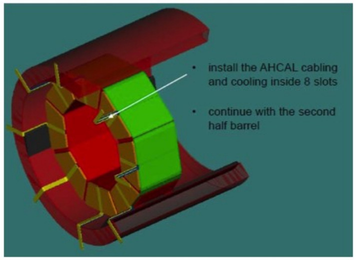
Integration studies : Procedure & tools

Courtesy of C. Clerc (ILD'2012)
(and MDI group)

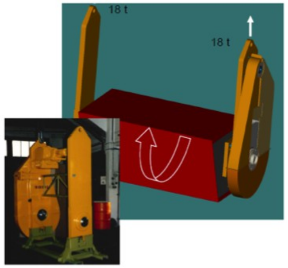
AHcal integration sequencies







Integration tooling

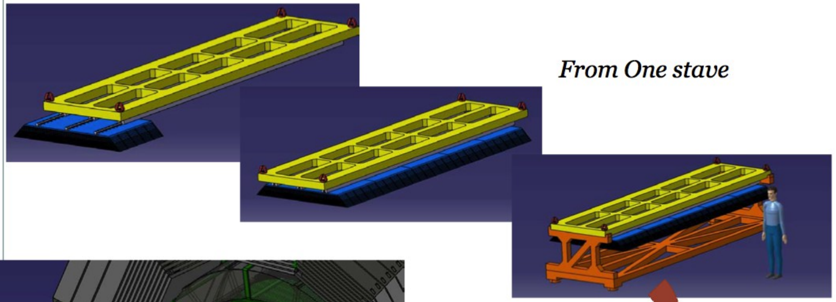


- lifting and turning tool for AHCAL barrel absorber sub-modules available
  - 2 x 18 t capacity
  - operation with 2 hooks (z angle adjustment)
  - precise motor controlled turning
  - design for adaptation for sub-modules with and without sensitive layers started
- mounting, support and insertion frame
  - one frame for everything
  - design depends on installation procedure
- push and pull tool available
  - must be modified to the rail distance and rail shape/size

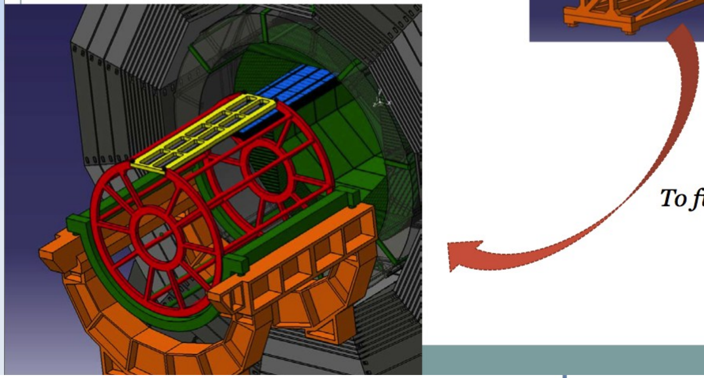
From K.Gadow(Desy)

ILD workshop 2012, Kyushu University 24 May 2012

Ecal integration scenario (Barrel)



From One stave



To full barrel ...

From M.Anduze(LLR)

24 May 2012

Task	Description / constraint		tooling	FTE	Time
1	Handling of 1 (over 40) module. Weigth :1 t	repeated 5 times	Scraft, table	2 T	9 days
2	Alignment				
3	Module 1 in position on frame			2T	
4	Stave 1 and its frame on the support structure				
5	Insertion of 375 slabs per stave. 1 Slab =10 to 15 kg alignment within alveola = 500 µm over 1.8 m			2 T	2 weeks
6	Electrical connections up to LDA boards			2 T	
7	Cooling blocks (5) up to Module edge, over LDA up to main distribution line position			2 T	
8	Electrical and cooling distribution lines on top of the stave				
9	Tests (electronic and signal)			2 T part-time	2 months

to be repeated 8 times.

Some parts can be done in parallel

(depends on the available manpower, because not the same qualification) :

Tasks 1-4 of stave (n+1) and Tasks 5 to 9 of the stave (n)

Needed space :

For a stave assembly : 7*4 m^2

Per Beam , for storage : 6*3 m^2

Stave (fully equipped)+ frame + support

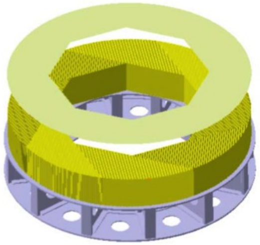
about 12 t

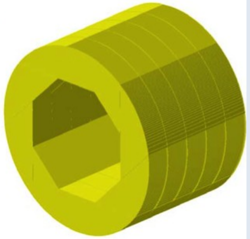
ILD MDI session, Kyushu University 21 May 2012

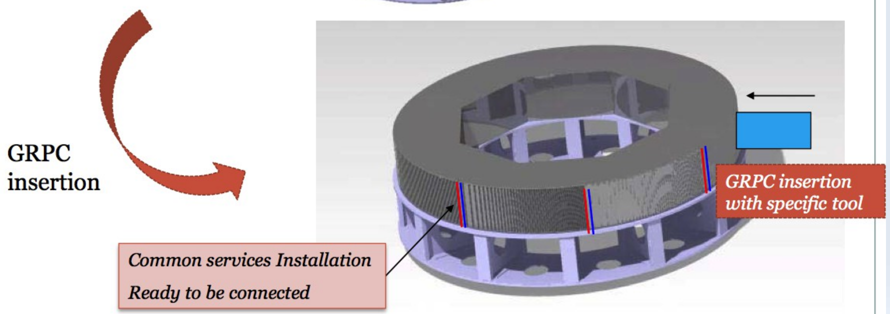
SDHcal integration studies : the 5 wheels concept .

Building SCENARIO :

- 8x48 in position on specific tool
- 1 face put down
- 8*48 plates welded on one face
- One other tool in place
- 180° rotation
- 8*48 plates welded on this other face







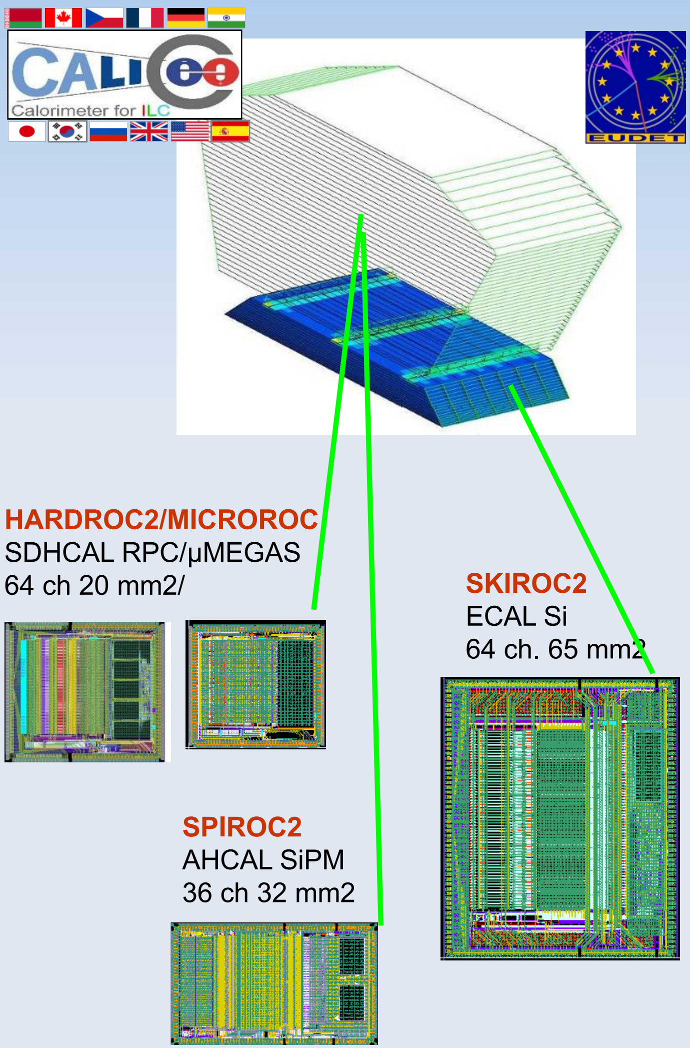
From J.C.Ianigro (IPNL)

These studies include estimation of :

- the timescale (assembly hall and experimental area
- Manpower
- Needed space for Assembly, test, storage & integration work
- Tooling

Challenges of high granularity for calorimeters

- High number of channels ~ 10^8
  - Calibration
  - Readout
    - Triggering
- Embedded Electronics,
  - Heat
    ⇒ Power-Pulsed modes with DT of ~≤1% [1ms every 200ms]
    - Stability;
    - Pulsed currents ⇒ Vibrations ⇒ aging
      - PCB design; Cable geometry
  - Zero Suppr. by Auto-triggering
    ⇒ (Gain) Stability ⇒ Monitoring
    - Calibration DB
  - Local Storage ⇒ Noise taming
  - Radiation hardness & interactions ✔
- Industrialisation
  - **TO BE DONE**



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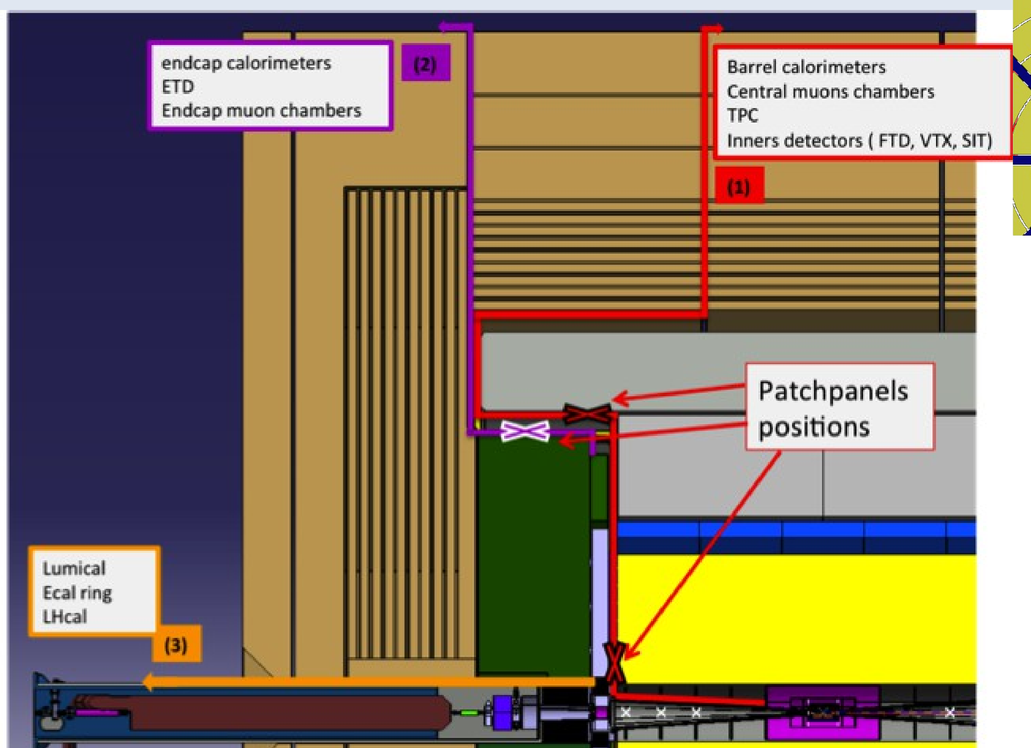
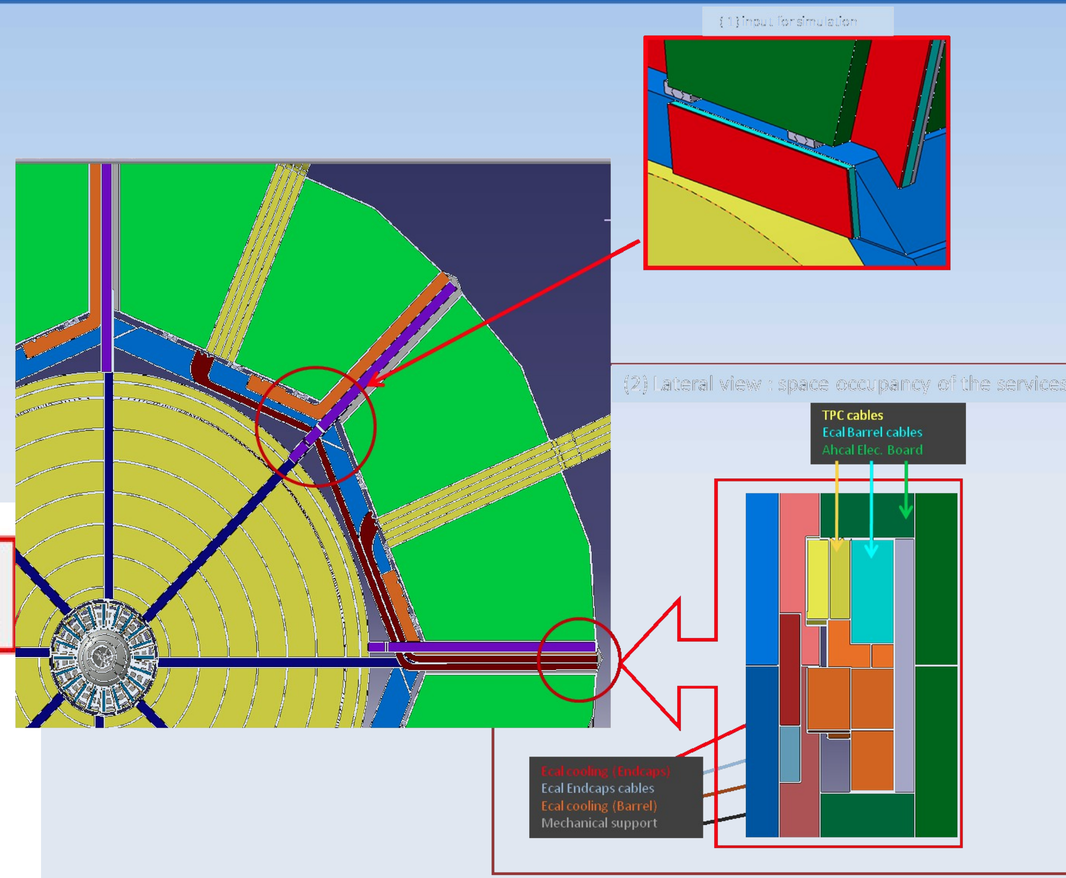
Integration & Services: Power

- Cabling
  - Power Pulsing ⇒ local energy storage
  - Power studies
    - Need of an optimized Front-End Electronics

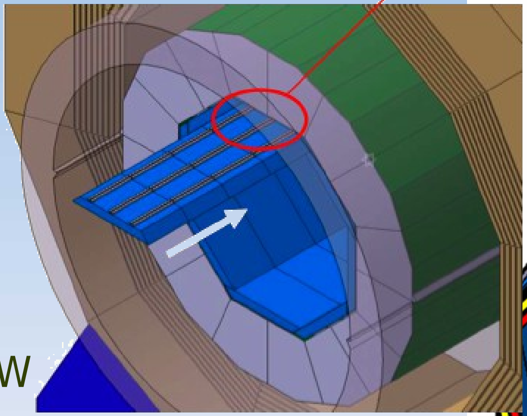


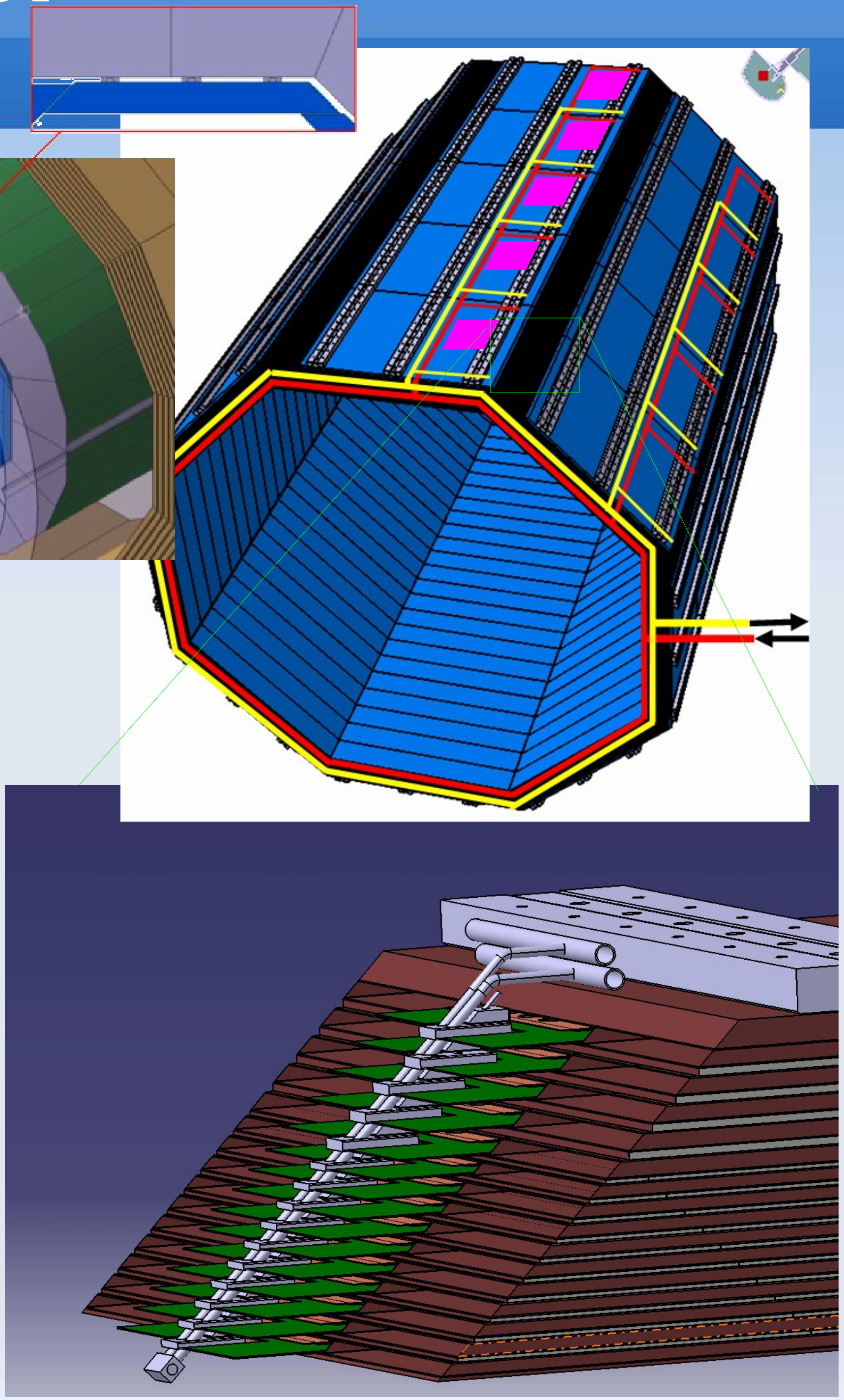


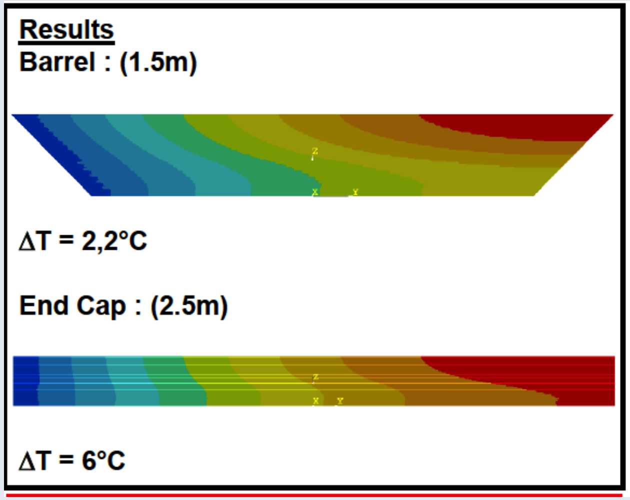
- Simulation
  - Simplified model in Mokka

Integration & services: Cooling

- Services & cabling
  - cooling philosophy
    - Each detector should remove its own heat
    - ECAL 120 Mch × 25µW ⇒ 3 kW
      - with 200 gain from Power Pulsing
  - DAQ
    - 1 Concentrator board per Module
      + power
      + capacitors







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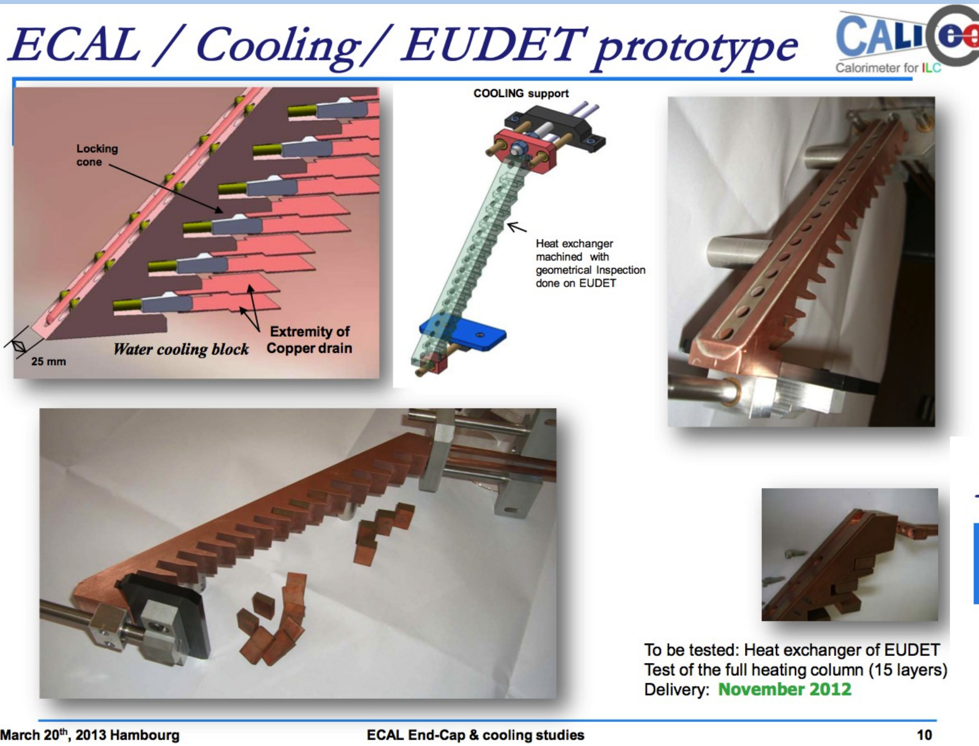
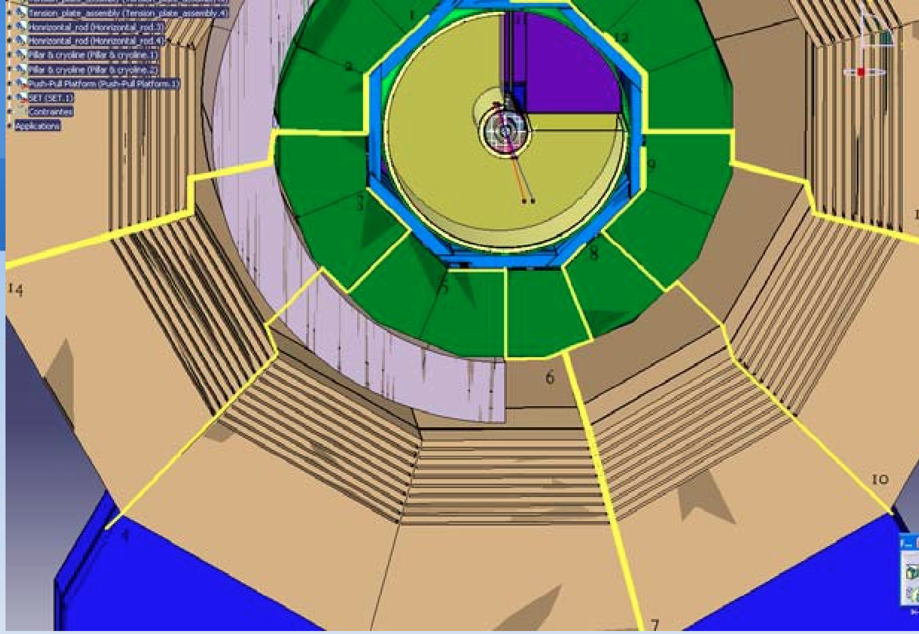
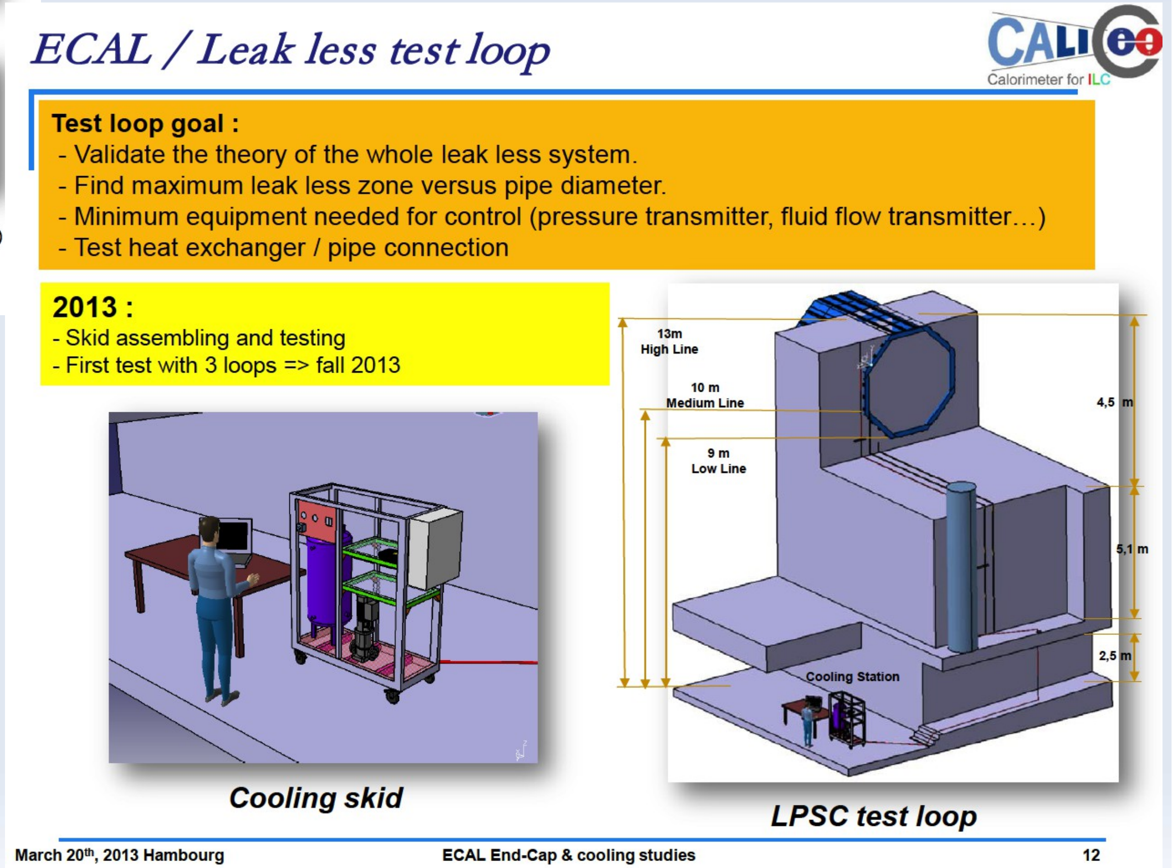
Global Leakless Cooling system





Pipe Path



Courtesy of Julien GIRAUD, Denis GRONDIN (LPSC)

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DAQ & data flux

- DAQ structure fixed
  - concentrator board on detector
- on-going work
  - (DAQ for TB)
  - Protocols
  - Stability
  - Extensibility (LDA with 50 layers)
- Still to be done
  - mecanichs (and local links).
  - power consumption

DAQ electronics: GDCC

Link Data Agregator (LDA):

- difficult to maintain firmware (Xilinx licence is needed for Ethernet interface, current version is obsolete; understanidng of packet management requires reverse engineering)
- not sufficiently reliable (grounding, shielding, connections)

Gigabit Data Concatrator Card (GDCC) will replace LDA. Same software, reuse of some hardware parts.

First iteration of tests has been performed, a few bugs resolved → next iteration in May. Main source of packet losses (1-2%, bug in LDA) is discovered and understood.

Plan: final version in July for tests, decision on production in September.

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Outlook

- Lot of engineering work in the conception of the ILD calorimetry since the LOI; good part of it in DBD

- Redo the optimization studies
  - for 250-500 GeV (is 1000 GeV)
    - Current model still a mix of GLC and LDC...
    - ⇔ with improving SW...

- Still much work on
  - mechanics (vibrations),
  - integration procedure,
  - cooling,
  - power,
  - VFE zero suppression
  - DAQ
  - ...

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