Plans for Calorimeter R&D

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LAL Orsay

- Role of Calorimeter R&D for the ILC

- Towards the technological Prototypes

- Summary and Conclusion

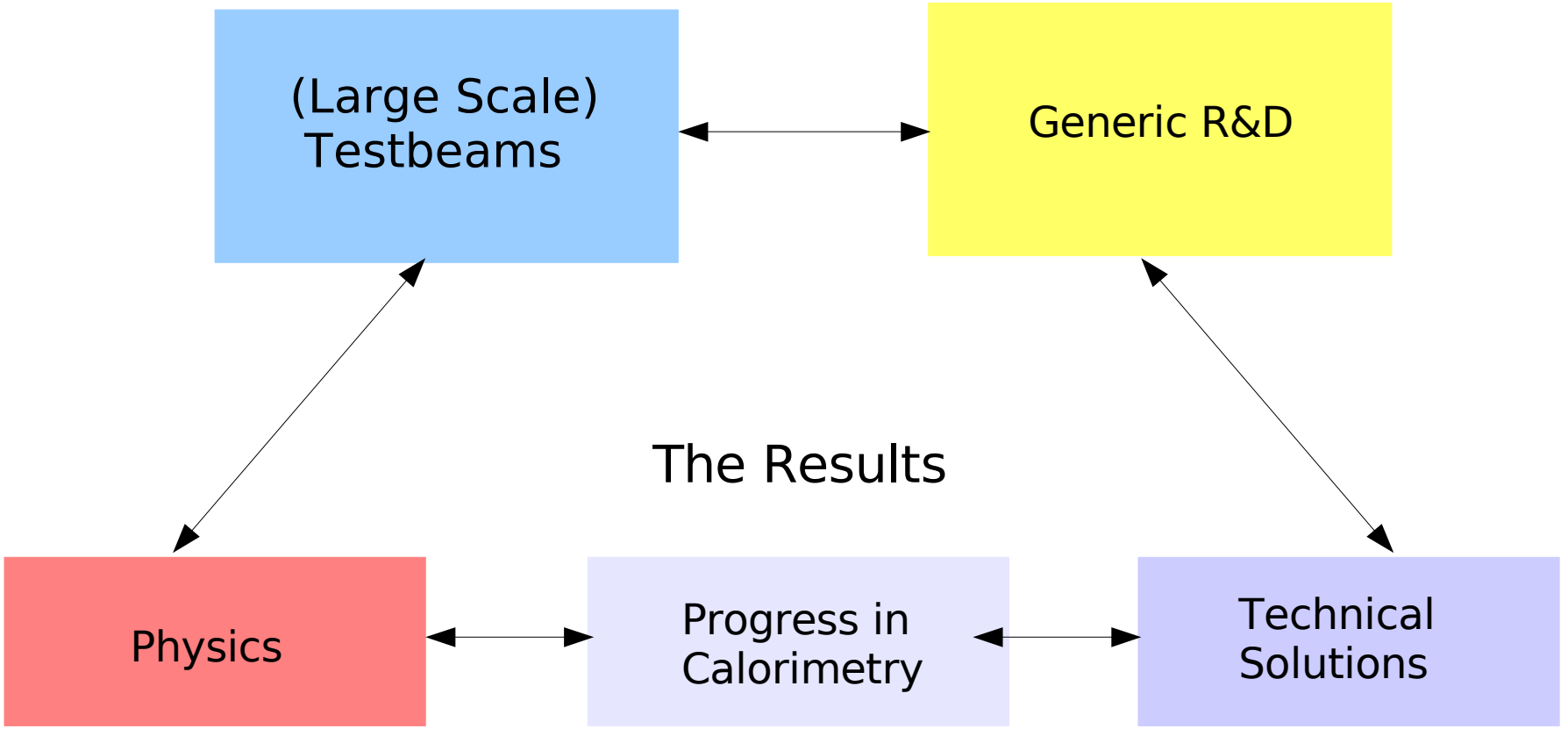
Linear Collider Workshop LCWA09 Albuquerque NM Sept./Oct. 2009

The Calo Machinery

The driving force

ILC Physics and
Detector Optimization

The Programs



All issues addressed in Calorimeter Development for the ILC

The “Logical” Way

- Concluding the “Physics Prototype Phase” - Phase CALICE I - with completion of the US-DHCAL and combined test beam at FNAL with the SiW Ecal and TCMT

Roadmap issue of TB Review meeting

- Preparing/Realising the “Technological prototype phase” - Phase CALICE II

Three/Four prototypes moving towards construction phase

- SiW Ecal prototype expected beginning of 2011
  - Mechanics issues mostly solved
  - Priority to establish VFE electronics
  - Cost for Silicon Wafers
- SDHCAL-GRPC
  - Mechanics designed but recommended for revision
  - First project to test 2nd Generation of VFE elelectronics
- DHCAL with Micromegas
  - Construction of a first 1m^2 ongoing
  - Mechanics/VFE together with SDHCAL-GRPC?
- AHCAL
  - Mechanics under study
  - Well advanced VFE

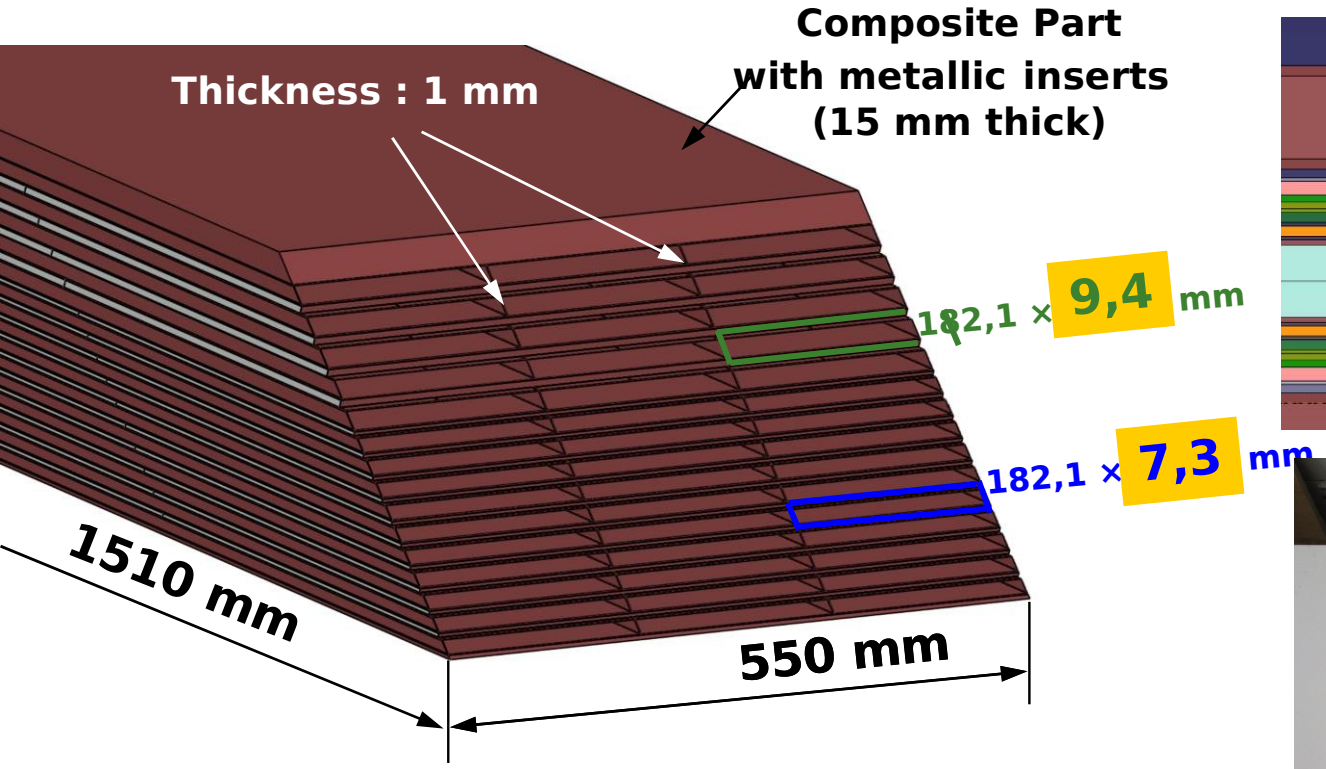
Entering the “Technological Prototype Phase” - Phase CALICE II

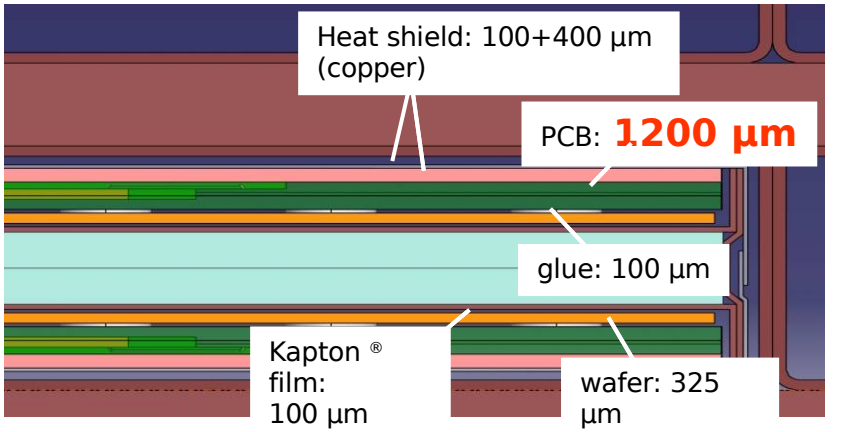
The aim is to build and operate prototypes as close as possible to what we would like to have for the ILC

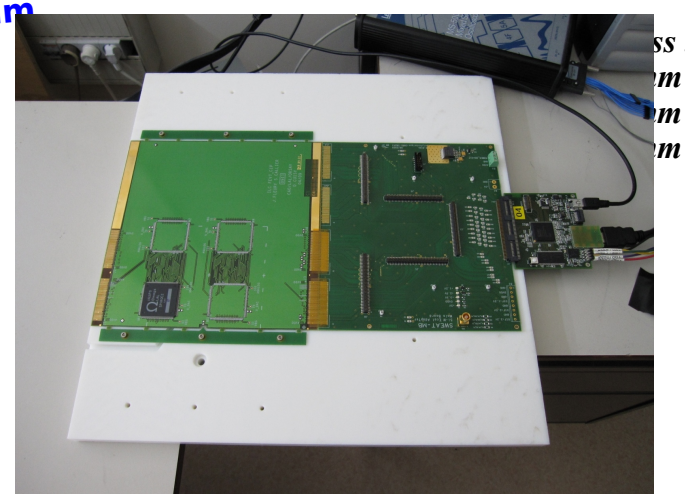
- How well do the ongoing projects meet this requirement?

- What steps are needed to complete the prototypes

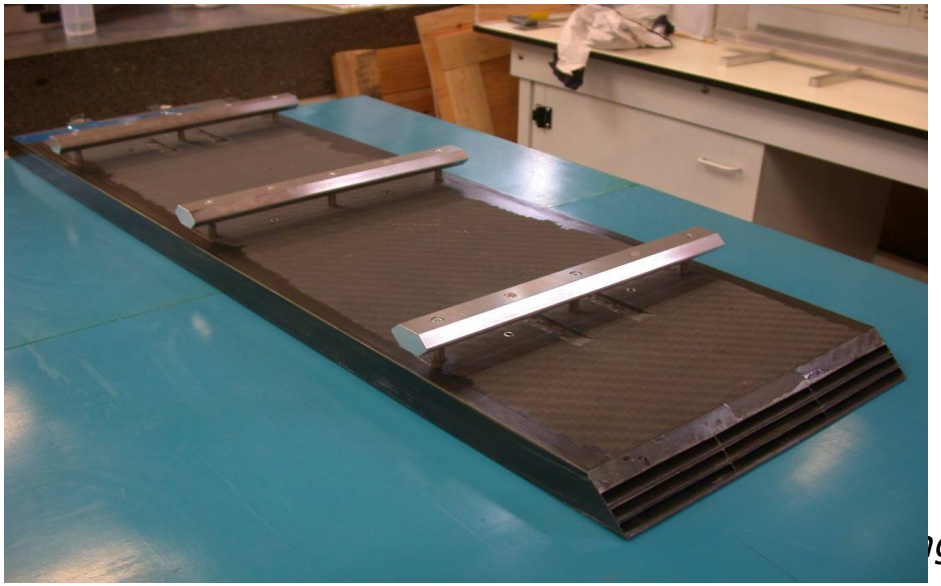
SiW Technological Prototype - EUDET Module







ss :
m (+-0.04)
m (+-0.04)
m (+-0.02)



- Design of prototype fully compliant with ILC Detector proposals!!!!
- VFE (Chips and boards) determines rhythm of project
- Cost of Silicium!!!!

The cost issue

The cost estimate of a financially viable ECAL for ILD assumes this input :

A cost at the level 2 € / cm²

Now we are at the level of 10 to 20 €/cm² Might save a bit if a big amount is ordered

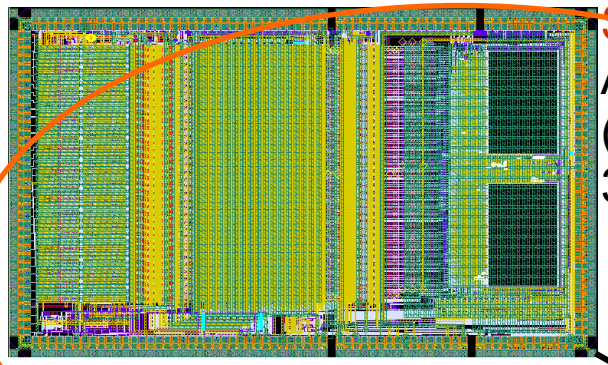
About 2500 m² of sensors needed for SiW ECAL of ILD = 300 000 sensors (actual design)

What could we do / rely on?
Savings due to the change on scale ?
Create a competition between manufacturers ?
specific production…
financial weight of our orders
Do things ourselves ?
manpower, equipment
Optimize financial impact being opportunistic ?
order when markets are low
share production among various small batches
Optimize the yield ?
Deal with consumer devices manufacturers ?
eg. OnSemi

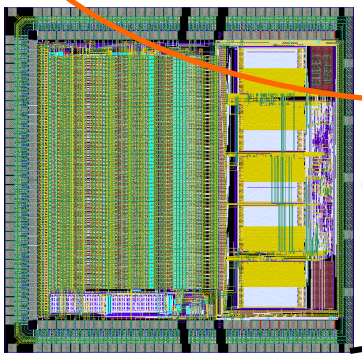
It's time to act!!!!
Top Priority in R&D in coming years!!!

ILD Meeting Oct. 2009

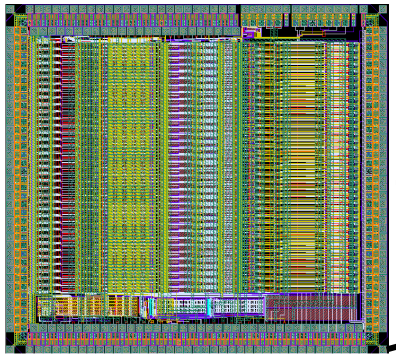
Very Front End ASICS: The 'ROC' Family



SPIROC
Analog HCAL
(SiPM)
36 ch. 32mm²



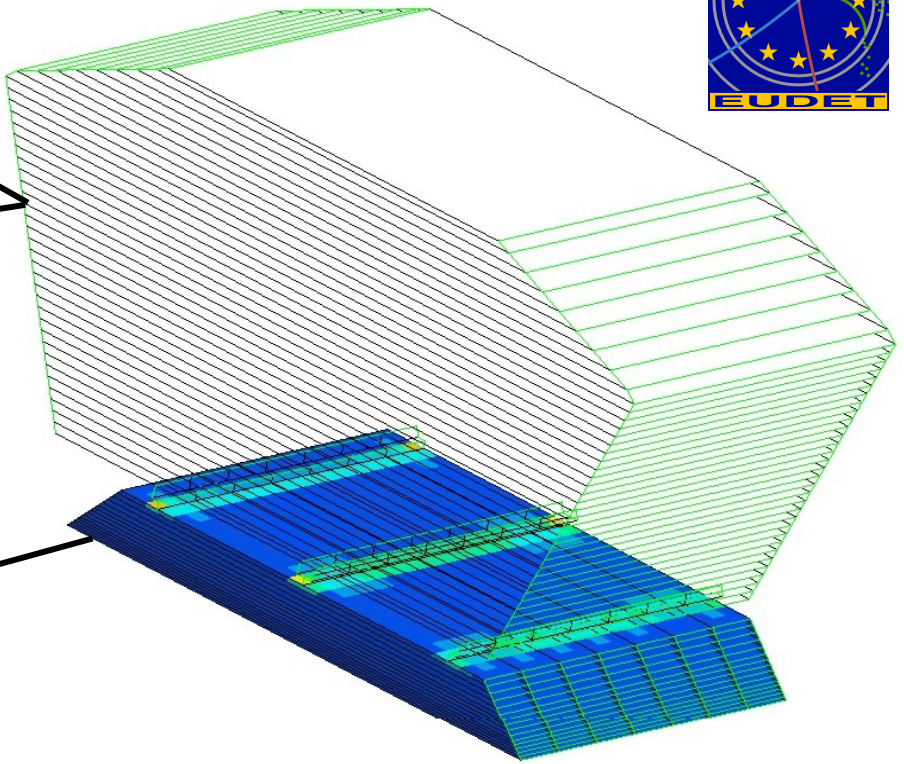
HARDROC
Digital HCAL
(RPC, μmegas or GEMs)
64 ch. 16mm²



SKIROC
ECAL
(Si PIN diode)
64 ch. 20mm²

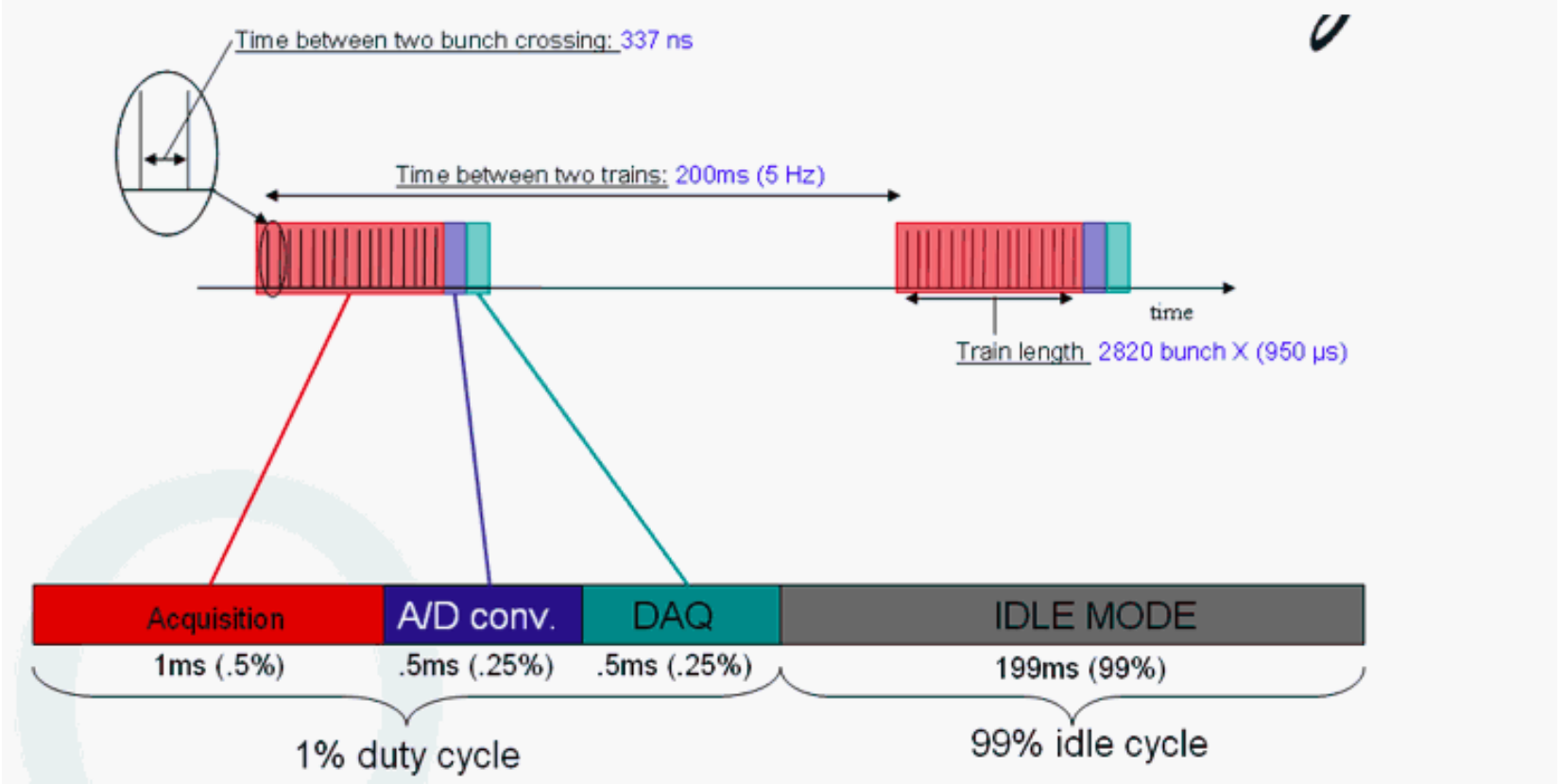
- ECAL, AHCAL, DHCAL
- Employment for μMegas?

  $O(10^2)$Smaller Signals
- Viable options DIRAC and DCAL IV



ROC family as priority for VFE Chip development !!!!
Largest Synergies

“Power Pulsing”



- The mastering of this technology is of interest for all calorimeters for the ILC

- It's studying should have very high priority in the R&D in the next two years

- Power dissipation of Chips for “physics testbeams”?

Time line of SiW Ecal

	Mechanics	Electronics	Wafers	Integration
Q3-4 '09	Thermal tests	Tests of surface bonded SPIROC2	Test 40xHammamatsu	DAQ firmware
	Prepare assembly room		Guard ring test samples	Prepare cosmic bench
Q1-2 '10	Make alveolar structure	Tests of embedded SPIROC2	Test samples	Cosmic tests w/ SPIROC2
	Make 'H' structures	SKIROC2	from other	
Q3-4 '10		PCB w/ embedded SKIROC2	companies	
				Cosmic tests w/ SKIROC2
Q1-2 '11	Slab assembly		Order wafers	Start to instrument structure
Q3-4 '11				Partially instrumented
Q1 '12				Fully instrumented

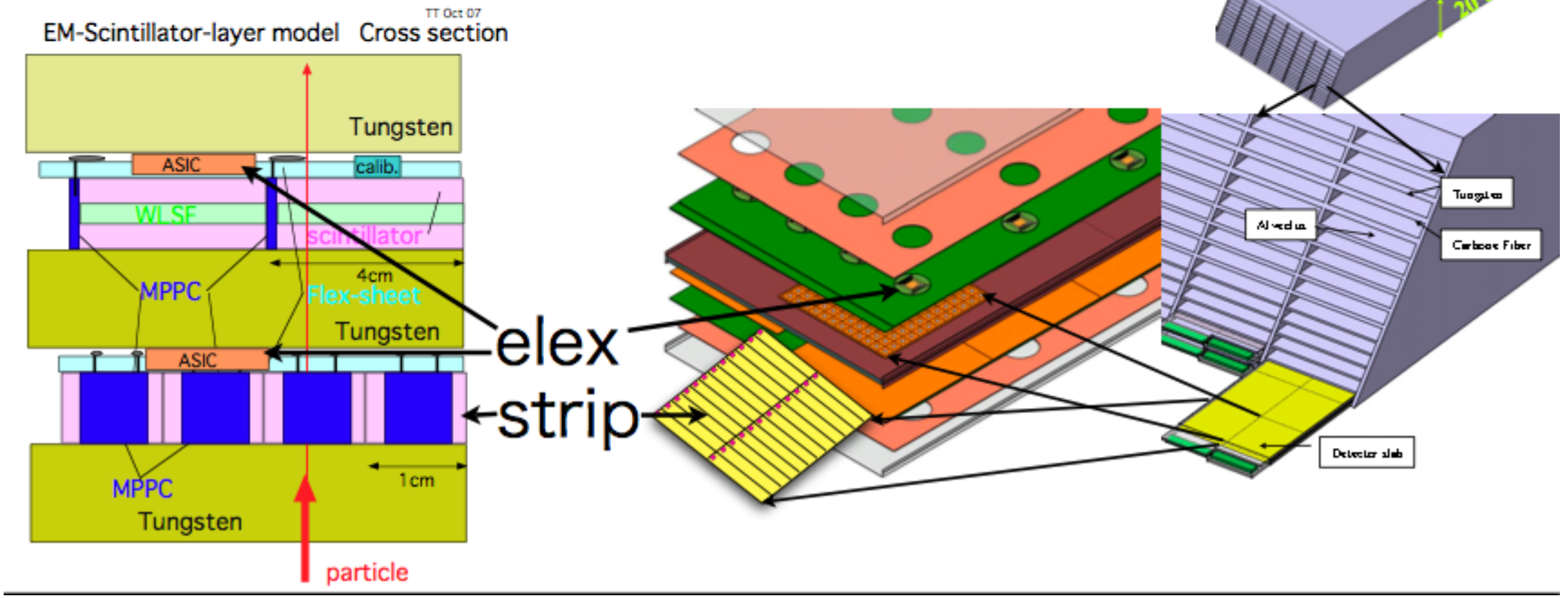
CdlT: Production Run with all ROCs beginning of 2010??

ScEcal – Synergies with other Projects

- Instrumented layer by ~2012
- AHCAL Electronics and SiW Ecal Mechanics

- Engineering of ScEcal layers should benefit from experience with EUDET Prototypes
  Re-usability of devices???

- Clear item for a collaborative effort



Entering the “Technological Prototype Phase” - Phase CALICE II

Ecal Technological Prototypes

The aim is to build and operate prototypes as close as possible to what we would like to have for the ILC

- How well do the ongoing projects meet this requirement?
  Mechanics and Electronics ok
- Where can we act as a collaboration?
  Considerable synergies
  Should ponder them now to avoid construction of two prototypes!!!!

Entering the “Technological Prototype Phase” - Phase CALICE II

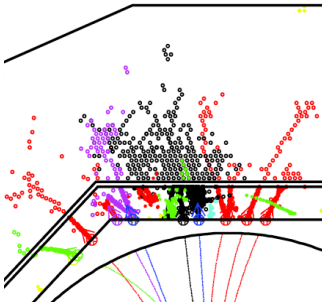
Hcal Technological Prototypes

The aim is to build and operate prototypes as close as possible to what we would like to have for the ILC

- How well do the ongoing projects meet this requirement?
  Electronics ok!!!

- What steps are needed to complete the prototypes

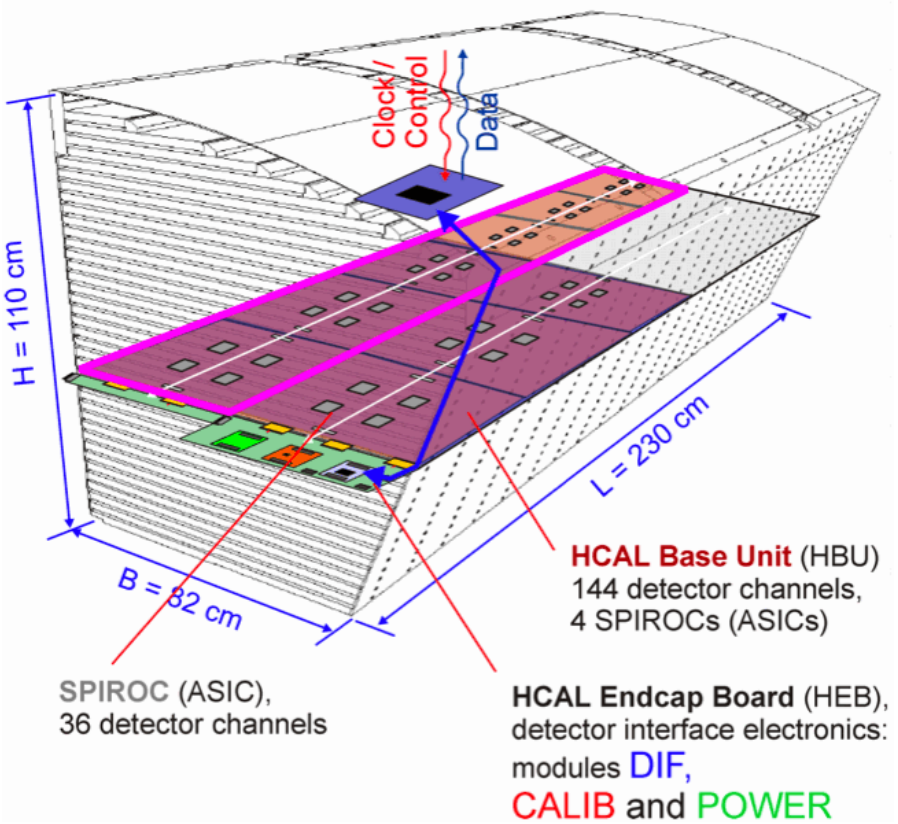
- Where can we act as a collaboration?



AHCAL Technical prototype

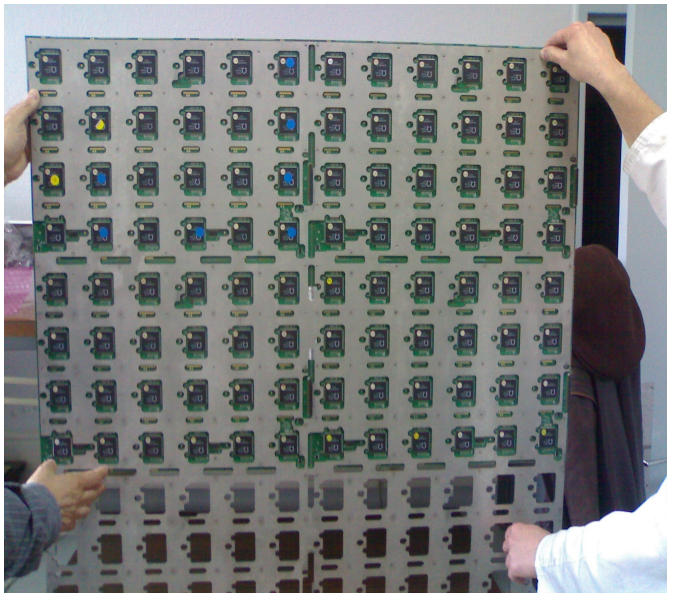
- Towards a scalable and compact detector
  - Realistic proposal: costing
- Embedded front end ASICS
- Mechanical structure with minimum dead space
- Options for scintillator and photo-sensor integration

- Technical challenge:
  - Stability with power pulsing and online zero suppression



SDHCAL GRPC

Preparation for the 1M^3 technological prototype

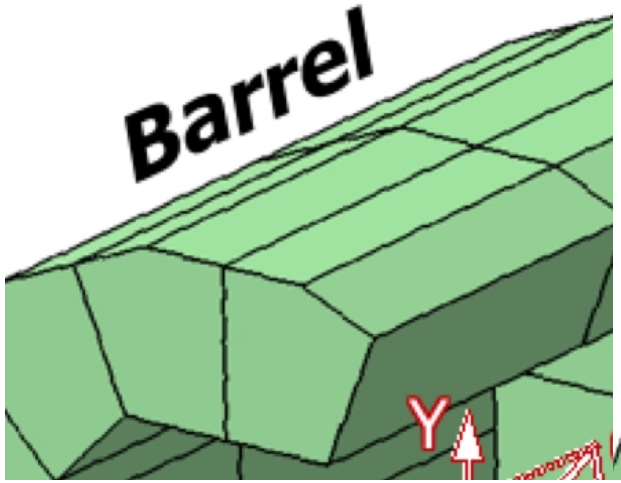


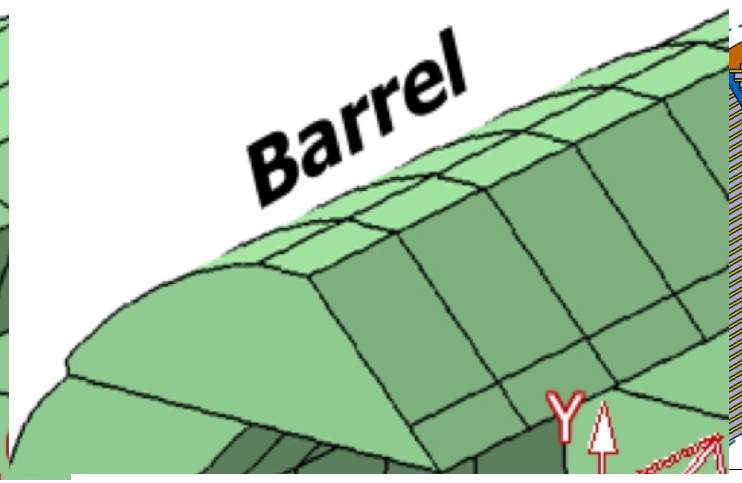
Technological prototype :
40 planes of 1M^2 :
16mm s.steel absorber
4mm s.steel support
6mm GRPC

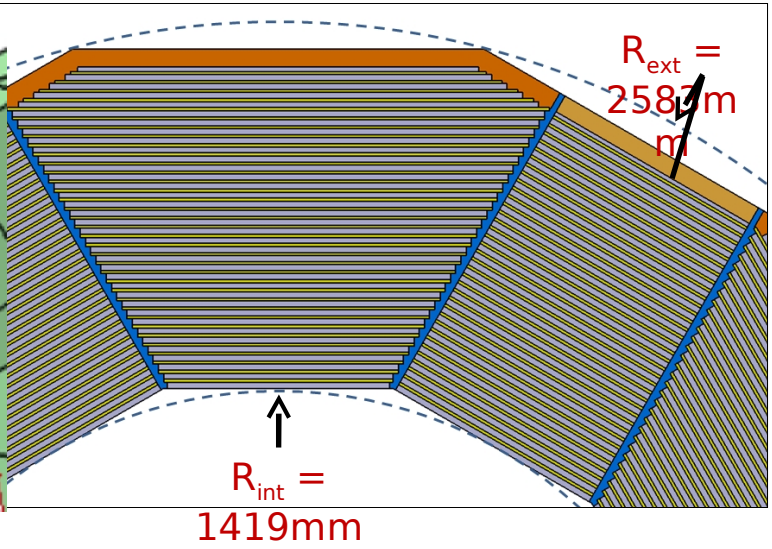
Important points:

- Mechanical structure and cooling system
- Detector construction and quality control
- ASIC production and quality control
- High voltage system
- Gas distribution system
- DAQ system

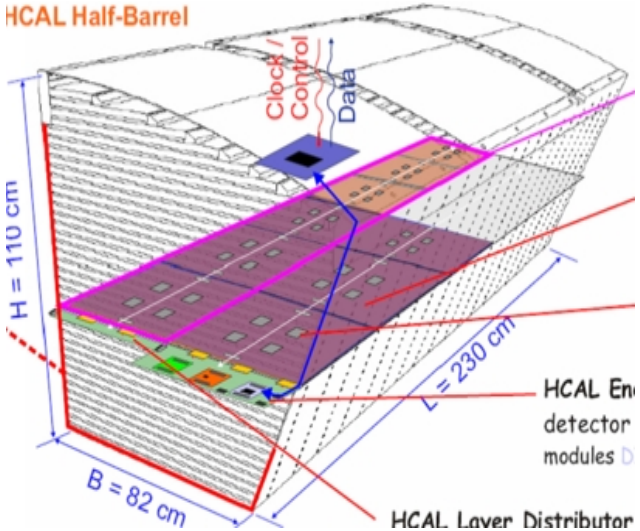
Mechanics ... Well it depends



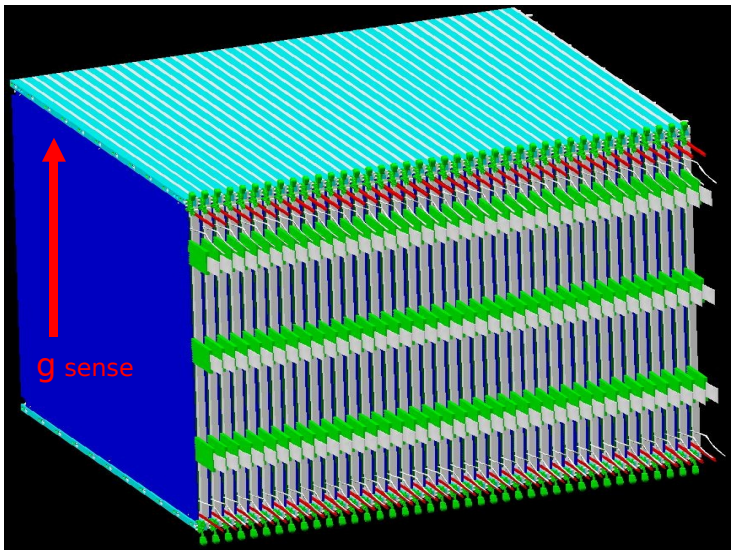




AHCAL Techprototype will It be built similar?

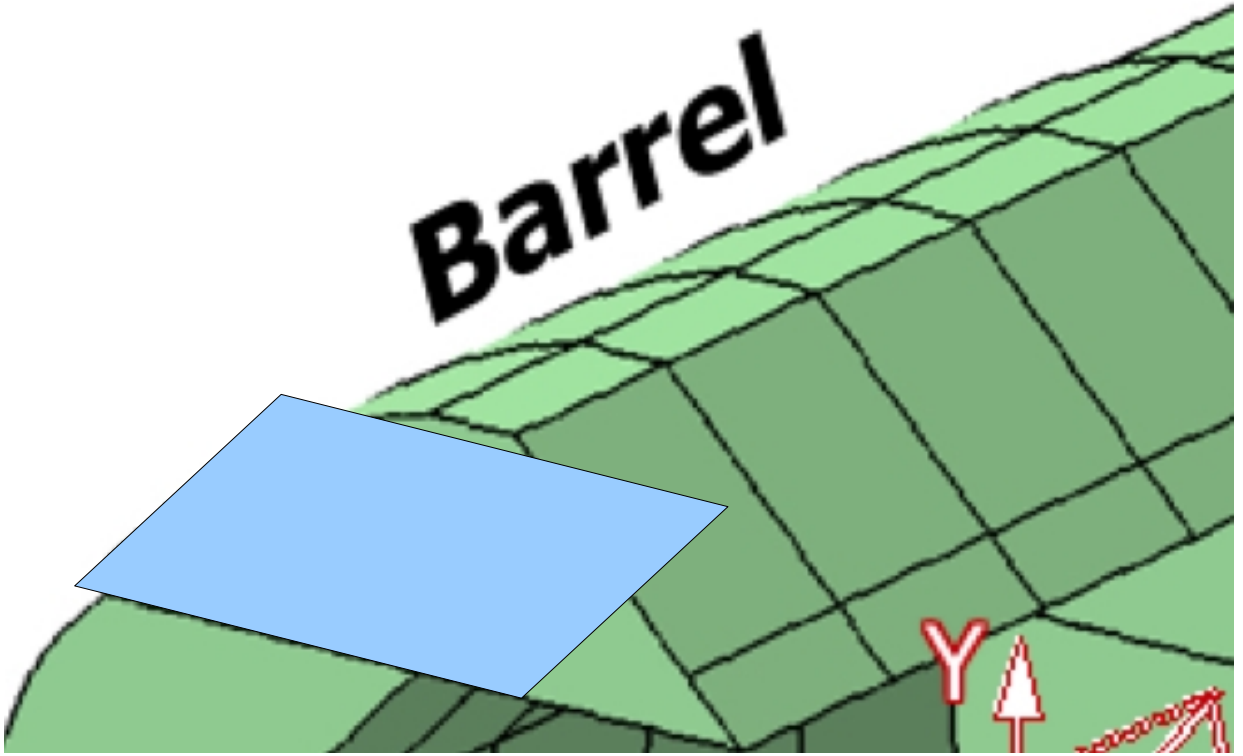


Cubic meter for DCHAL Technical prototype



If at all similar to SiD proposal

Revision of DHCAL Mechanics



- Installation in detector would require Self supporting structure

- Parallelogram instead of square?

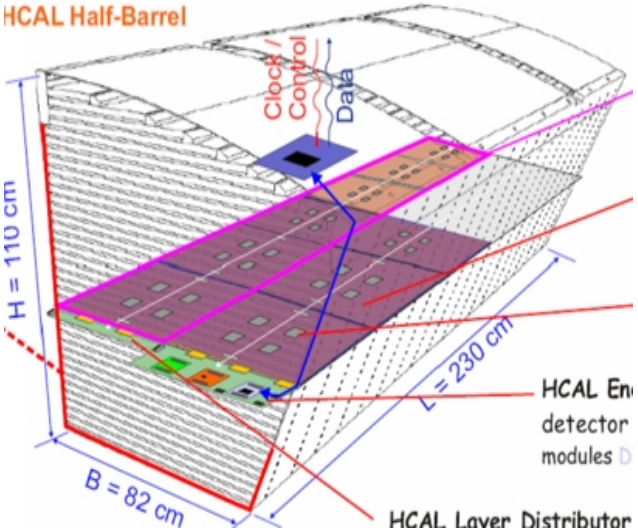
  Would Approximate one half of the DHCAL Module

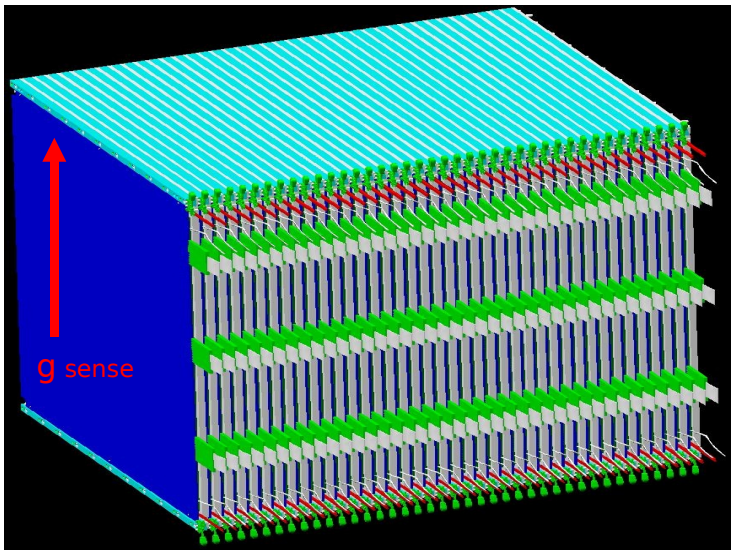
  What is the principle problem to make modules with different length?

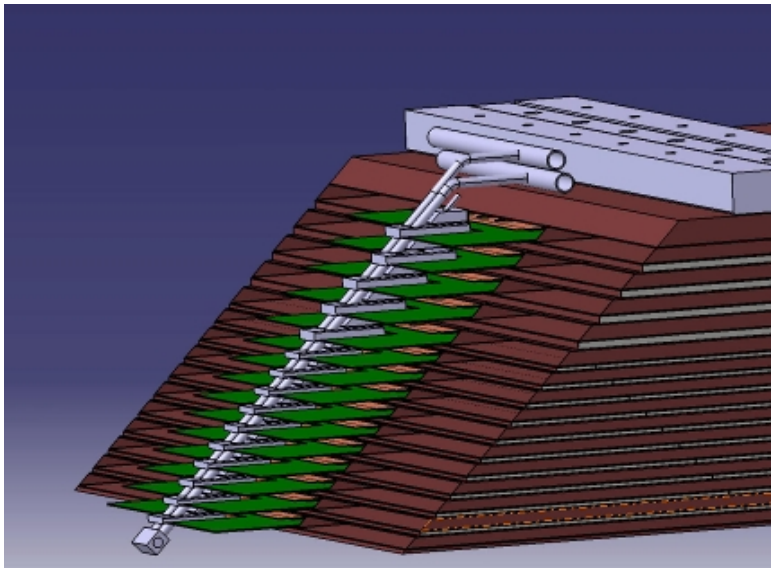
- The prototype(s) will be with us until roughly 2015

  Accomodation of long layers?

Detector Integration Issues







Discussion has started within CALICE

Timelines for (HCAL) Detectors - Roadmap

DHCAL

1m2 “Phase”

Operation
pf 1st 1m2 in Testbeam
Decision of Chips in Testbeam
Check out of Electronics
Final Layout of Mechanics
First power pulsing

Production Phase

Towards the full scale prototype
Production and system Check
How many layers of each species?
Final DAQ Commissioning

During that time we need to develop a working interface online - offline

Testbeam Phase

Large Scale Testbeam Technological Program to be defined

Physics Program to be defined
Data taking rate O(100Hz) from VFE
Issues for continous operation

SiW Ecal enters the game

Today — 1/7/10 — 1/7/11

AHCAL

Prototype System

SiPM, SPIROC et al.

First power pulsing?

Full Layer Phase

Vertical Stacking to allow small physics running with electrons

Running in ILD mode?

Final DAQ Commissioning

Towards Full Module

Mechanics test
Production of full module

Conclusions and Outlook

- Priority to conclude 'Physics Prototype Phase – CALICE I – with combined testbeam SiW Ecal, US-DHCAL and TCMT
  => Comparable data sets within common s/w framework

- CALICE continues to have a rich R&D programm and enters a phase in challenging technologies for ILC faces their realisation

- It is explicitly in the interest of CALICE to investigate several detector technologies

- Points for (new) collaboration/sharing of knowledge could have been identified and we should benefit from that

- Working Document on “Future Calice Projects” exists

- Projects in early stages:
  - DECAL
  - Start of discussion on Hcal with tungsten absorbers
    Re-use of existing CALICE stack !?
  Going to learn more at this meeting