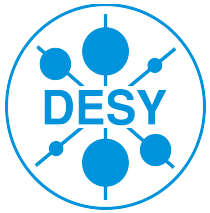
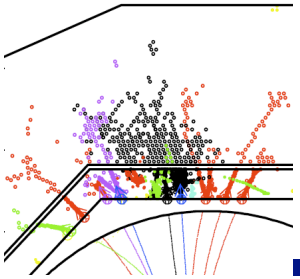
Scintillator HCAL overview

Felix Sefkow

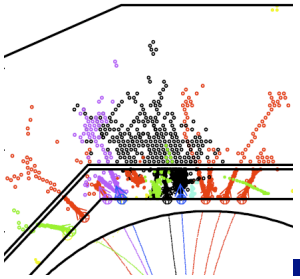


HCAL Main Meeting
DESY, January 20, 2011



Outline

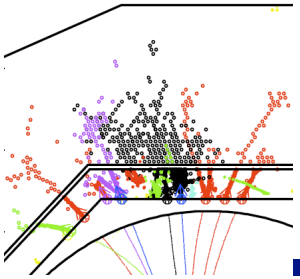
- Publications
- Towards the DBD / TDR
- Test beam plans
- The next prototype
- AIDA
- Upcoming events



Publications

- **Published:**
- Detector paper, construction & commissioning
- Electromagnetic response, validate simulation
- **In the pipeline:**
- Muon response, calibration and corrections
- Hadronic response, profiles, Géant 4 validation
- Weighting, energy resolution
- Track segments, charged multiplicity
- Two particle separation, Pandora PFLOW
- **To come:**
- Angular and position resolution
- Low energy hadrons
- Deep analysis, e.m. fraction
- Combined analysis with Sci ECAL
- Tungsten
- Your idea: _____

Wanted:
Drafts by end April (PRC)

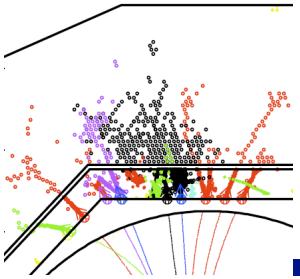


Towards DBD (TDR) and CDR

- ILC Technical Design Report with Detector Baseline Document due in 2012

- CALICE proposes technology baseline options 2nd quarter ’12
  - discussions in CALICE
  - presentation to PRC spring ’12
  - evaluation by concept groups ILD, SiD
  - PRC spring ’11: status report, ask for endorsement of plans

- CLIC Conceptual Design Report due in summer 2011
  - less ambitious than ILC TDR
  - CALICE: provide first experience with tungsten HCAL



Technology baseline

- To be discussed CALICE-wide; first attempt:
- Established performance with test beam data:
  - energy resolution, linearity, uniformity, two particle separation
- Validated simulation
  - electrons and hadrons, physics and detector
  - shower profiles: longitudinal & transverse, linearity and resolution
- Operational experience
  - dead channels, noise, stability, monitoring, calibration
- Scalable technology solutions
  - power pulsing, low volume interfaces, data reduction, mechanical structure, dead spaces, services and supplies
- Open R&D issues
  - before the first engineering prototype
  - analysis and R&D
  - cost reduction

Run plans at FNAL

J. Repond

2nd test beam: **Broadband muons** for calibration

Calorimeter not rotated
Trigger with 2 x (1 x 1 m^2 Scintillator paddles)

Energy scans (separation of positrons and pions offline using Cerenkov)

Calorimeter not rotated
Into center of calorimeter
Trigger with coincidence of 2 x (19 x 19 cm^2 Scintillator counter)

1, 2, 4, 6, 8, 12, 32, 40, 48, 60, 66 GeV/c

Will start 4 GeV/c run on Friday

Have been offered an extra week. Will most likely accept…

3rd test beam: April 2011 (ECAL + DHCAL + RPC-TCMT)

4th test beam: June 2011 (DHCAL + RPC-TCMT)

Summary and outlook

- CALICE pursues rich and coherent R&D program for highly granular calorimeters

  Highly granular calorimeters are key devices at a linear electron positron collider
  Program covers however most generic aspects of detector R&D

- Significant support by CERN for acitivities in the past

- Test beam request comprises two 1m^3 prototypes

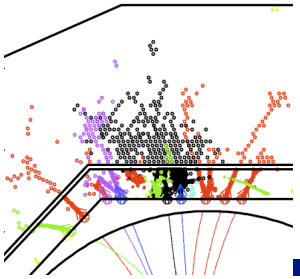
  accompanied by tests with smaller devices

Type	Particle type	Energies/GeV	Requirements	Beam time/weeks	# Triggers	Beam line
SDHCAL m^3	All types	2-100	Rate $\approx$ 100 Hz	4 (July 2011) 4 (Nov. 2011)	10^8	H2, H4, H8 (preferred)
GRPC m^2	All types	not specified	Rate $\approx$ 100 Hz	2	$3 \cdot 10^7$	H2
MICROMEGAS m^2	μ	150	<1 kHz	2 (July/Aug. 2011))	$3 \cdot 10^7$	H4
W-Hcal m^3	All types	6-300		4 (1st half of 2011) 4 (Oct. 2011)	5×10^7	H2, H4, H8 (preferred)

20 weeks in total – Request of <u>common</u> beam line (where applicable) to optimise synergies of collaboration

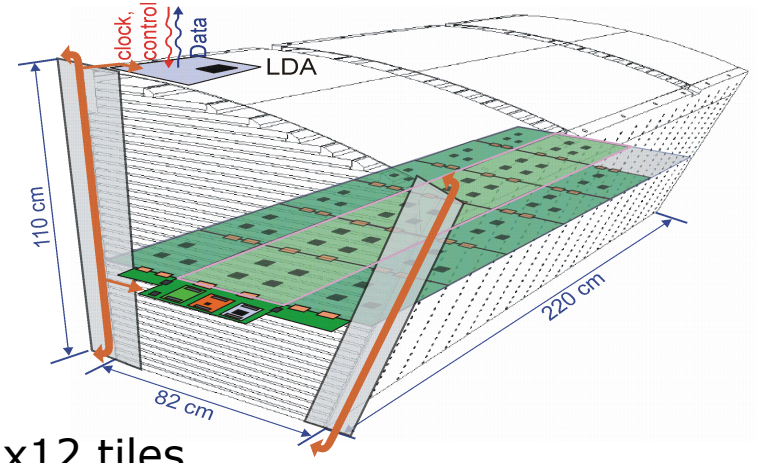
- Approval of CALICE request allows linear collider detector R&D to be in phase with time scale of european strategy for particle physics

  To be defined until the end of 2012

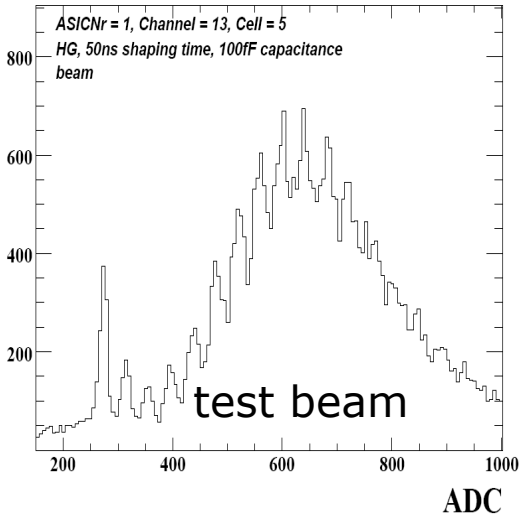


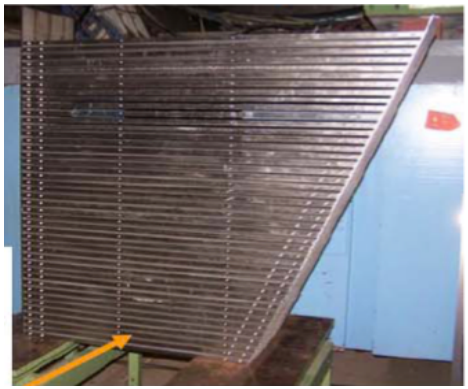
Next prototype

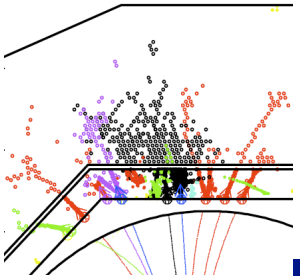
- 2nd generation prototype has integrated readout ASICs and LED system - and time measurement
- electronics development is the same, but tighter compactness requirements
- Prototype roadmap:
  - 2010: 1st HBU
  - 2011: full layer (2000 ch)
  - 2012: minical (2000 ch)
  - later: wedge
- **Tungsten HCAL**
  - 40 layers, 72x72 cm2
  - 23'000 ch



12x12 tiles,
36x36 cm2







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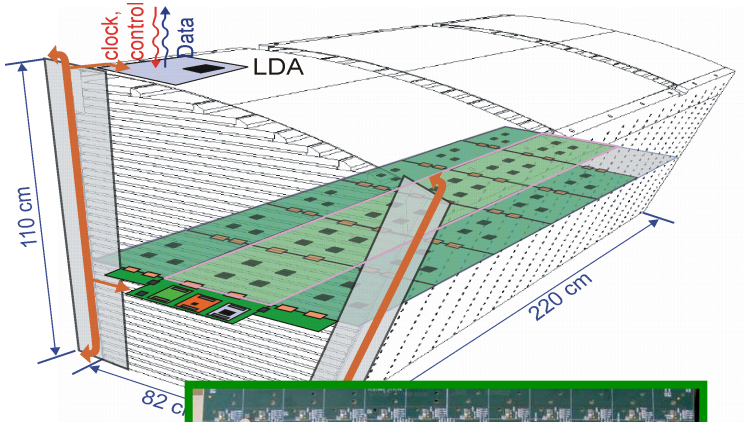

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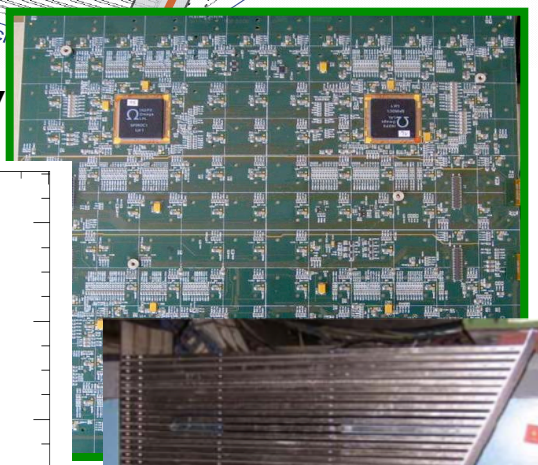
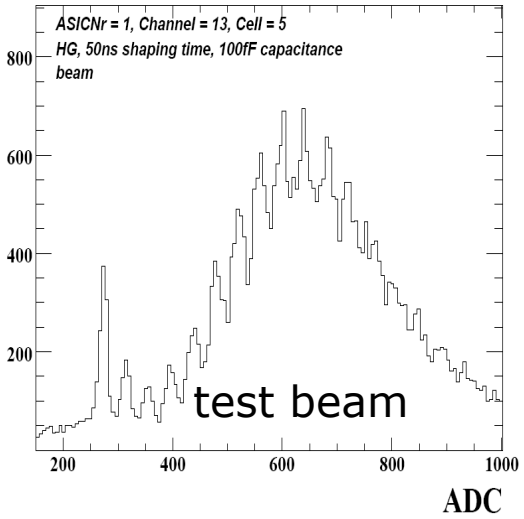
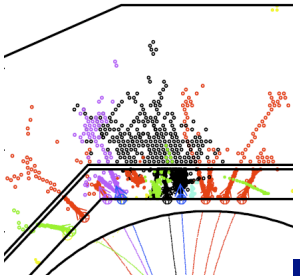






AIDA

- AHCAL within WP 9.5 (calorimetry) and 8.6 (test beam)

- CERN: tungsten engineering and optical test stand
- MPI-M: tile integration tests and SiPM development
- LAL: 3rd generation ASICs
- Heidelberg: fast timing electronics
- DESY: compact interfaces and integration
- Wuppertal: LED system development and tests
- Prague: adaptive power supplies
- Bergen: adaptive p/s, test stand and simulations

- Reviewed at previous main meeting in June, some updates today

AIDA work package 8.6

8.6 – Support for common testbeam for linear collider:

- Central contribution to the planning and design of infrastructures
- Start of technical coordination structure
  - Access & support for general information and documentation systems
- Development of common DAQ and control system

- One of the first steps: CALICE common SPSC proposal for testbeam
  - E.g. 20 weeks of time on beam in 2011

Milestones & deliverables (for CERN):

- Specification of EDMS and DAQ (month 20, del.)
- Testbeam, EDMS and DAQ commissioning. (Month 36, milestone)

AIDA work package 9.5

9.5 - Granular calorimeter infrastructure for:

- Tests of different active HCAL detection techniques in a tungsten HCAL stack
  - In a first instance tests are performed with existing scintillator planes.
- Subsequently more compact active layers based on scintillator and gaseous will be tested in the tungsten stack.

Milestones & deliverables (for CERN):

- Gas system, control & bench structure (month 20, milestone)
- Integrated infrastructure for calorimetry (month 40, del.)
- Report of comparison of GEANT4 sim & testbeam (month 46, del.)

Technical plan – (PH-LCD)

Task 8.6 - CERN support for common testbeam:

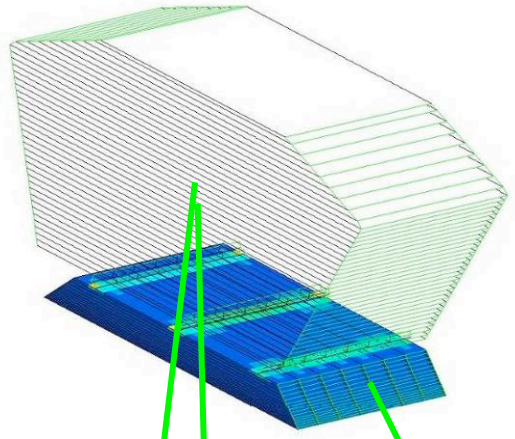
- Database (à la EDMS) for technical drawings
- Wire chambers, for beam definition
- Special (i.e. big) scintillators for HCAL calibration purposes

Task 9.5 - Granular calorimeter infrastructure:

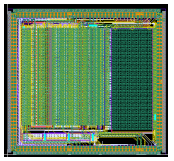
- Readout infrastructure with picoscopes for T3B and gasRPC
- First version of bench structure for HCAL support has been constructed
  - Needs to be extended for a tail-catcher, triggering & positioning
  - At the moment a support frame for the trigger setup is in front: needs to be moved, and ECAL bench needs to be installed
  - Entire frame is to be made movable

WP9.5: electronics readout

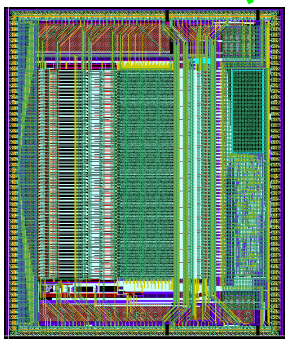
- 2nd generation of ROC chips: produced in March 2010
  - auto-trigger, analog storage, digitization and token-ring readout
  - Include power pulsing : <1 % duty cycle
  - Optimize commonalities within EUDET (readout, DAQ…)
- Prototyping of the 3rd generation of ROC chips
  - New Slow Control (using I2C link)
  - New digital part: independant channels
  - New TDC (step=100 ps)
- Production of the 3rd generation chips: need of additionnal (external) funding
- Milestones: Report in 30 months



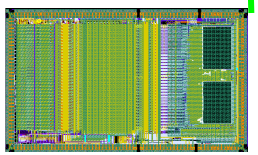
HARDROC2
SDHCAL RPC
64 ch 16 mm²

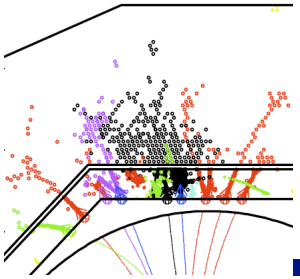


SKIROC2
ECAL Si
64 ch. 70 mm²



SPIROC2
AHCAL SiPM
36 ch 30 mm²





Upcoming events

- CALICE Electronics and DAQ meeting, LLR, Feb 9
- AIDA kick-off meeting at CERN, Feb 16-18
- ALCPG11, Eugene, OR, Mar 19-23
- CALICE report to DESY PRC, Apr 18
- CALICE collaboration meeting Shinshu, May 19-21
  - ILD meeting at KEK May 23-25

Back-up slides