CALICE Oversight Committee

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Outline of talk

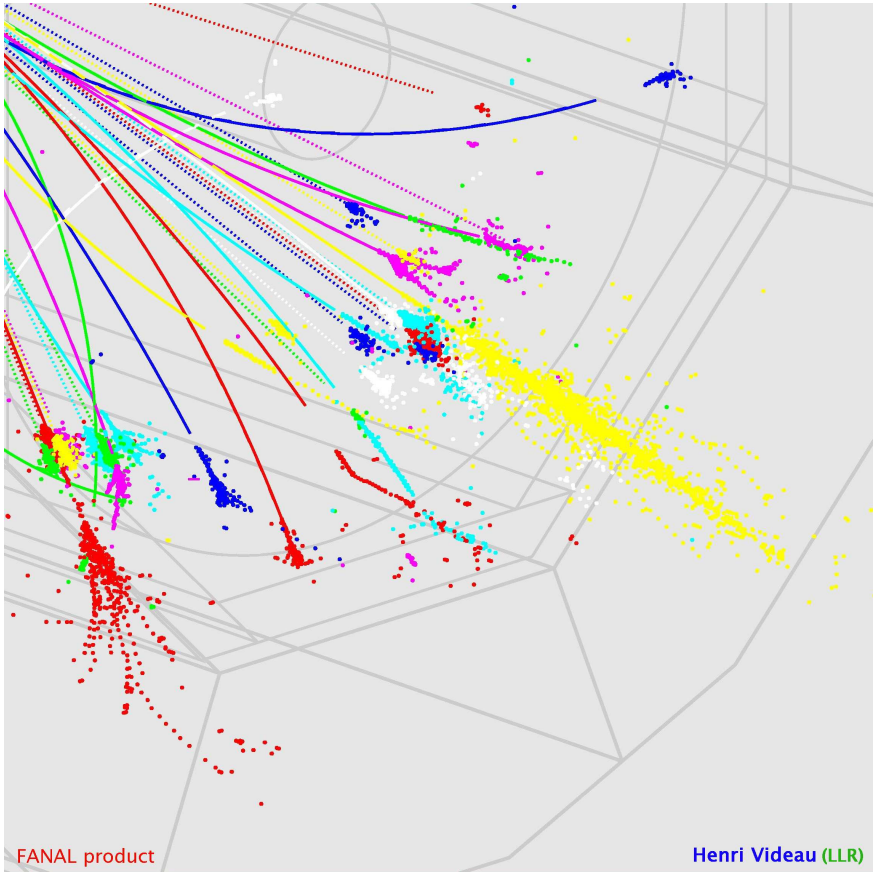
- History
- The CALICE Collaboration
- CALICE-UK
- The workpackages
  - WP1: Beam test programme
  - WP2: DAQ
  - WP3: MAPS
  - WP4: Thermal and mechanical studies
  - WP5: Physics and simulation
- UK Budget Summary
- CALICE-UK Management

History

- UK made first contact with CALICE in 2001
  - Discussions to define UK contributions
- PPRP first grant approved in Dec 2002
  - Five UK institutes
  - Did not award full bid but only period up to beam tests
  - Explicitly requested that we return for rest of funding after ~two years
  - Actual grant period: Jan03-Mar05
  - Total amount granted = £661k
- PPRP second grant approved in Jul 2005
  - Seven UK institutes
  - Extension of first grant to Mar09
  - Four new projects, grant period Oct05-Mar09
  - Total amount granted (inc WA) = £2870k
  - The subject of this Oversight Committee

ILC calorimetry

- Calorimetry is critical for the ILC
  - Physics requires excellent hadronic jet resolution
  - Thought to require "particle flow" (PFLOW, aka EFLOW) jet reconstruction
  - Measure individual particles: pattern recognition
  - Resolution dominated by "confusion" of jet energy assignment

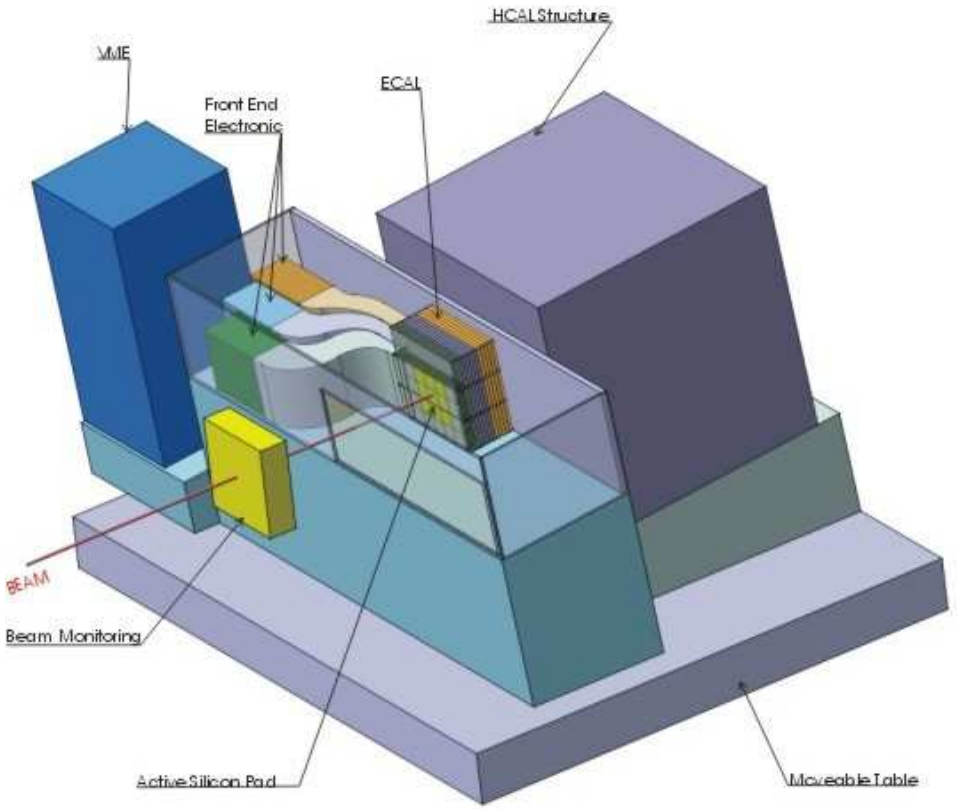


- PFLOW must be designed in from the start
  - Excellent spatial granularity and cluster separation
  - Reasonable single particle energy resolution
  - Need integrated ECAL and HCAL system

The CALICE collaboration

- CALICE is the only ILC collaboration studying ECAL and HCAL in one group
  - 190 members, 32 institutes, 9 countries all 3 major ILC regions

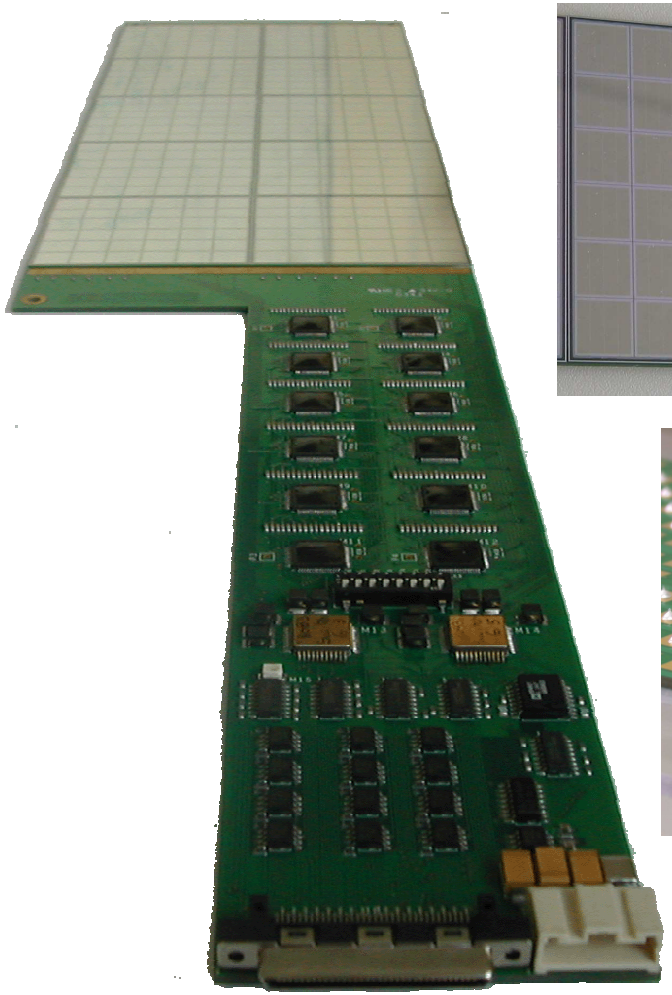
- Testing pre-prototypes of detectors in beam to verify simulation in detail
- Longer-term R&D of prototype detectors and electronics
- Using simulation to design final ILC detectors in time for TDRs in 2009

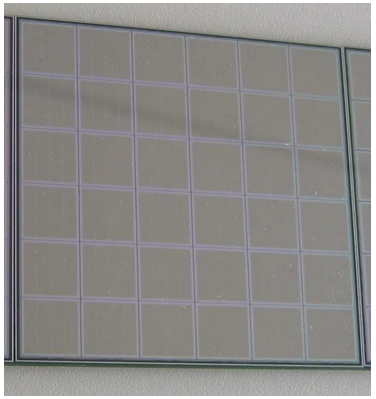


CALICE pre-prototypes

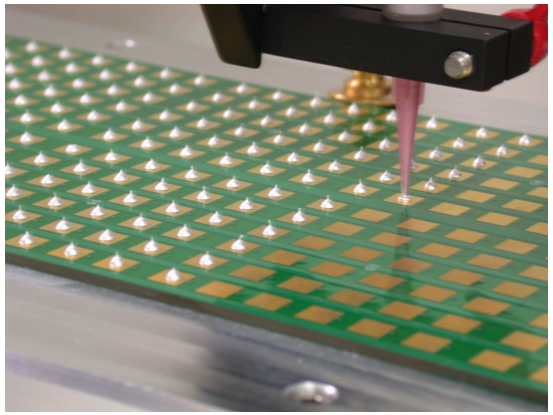
- Si-W sampling ECAL pre-prototype
  - $1\times1cm^2$ diode pads, 18×18 pads/layer, 30 layers. Total ~10k channels
  - Tungsten sheets mechanically held in carbon-fibre support. Total ~$24X_0$
- Two HCAL pre-prototypes
  - Analogue HCAL: scintillating tiles with SiPM on-tile readout: tiles vary from $3\times3cm^2$ to $12\times12cm^2$ in size, 216 tiles/layer, 40 layers. Total ~8k channels
  - Digital HCAL: RPCs or GEMs with binary readout. $1\times1cm^2$ pads, ~10k pads/layer, 40 layers. Total ~380k channels
  - Mechanical structure of steel converter common to both HCALs. 2cm thickness plates, total ~4λ
- Tail catcher/muon tagger: scintillator strips with steel
  - 1m×5cm bars, 18/layer, 16 layers. Total ~300 channels
- Beam tests of pre-prototypes scheduled for 2006-7
  - DESY, CERN and FNAL

Si-W ECAL pre-prototype

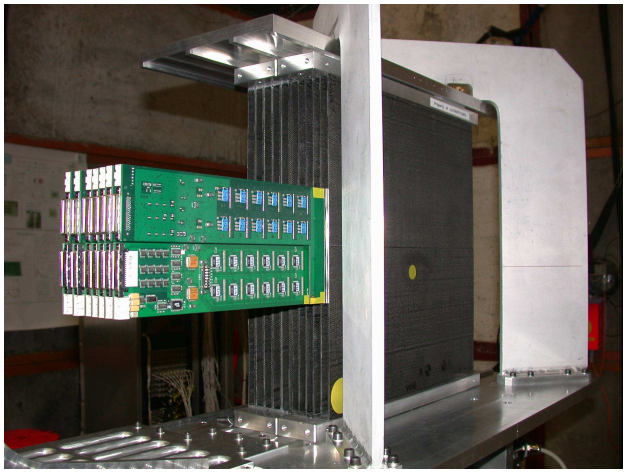




- Silicon diode pads $1\times1cm^2$
- Each wafer 6×6 array
- Each layer 18×18 array



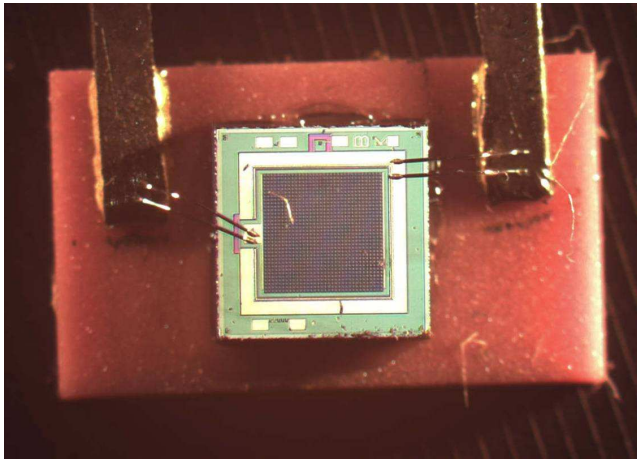
- Diode contact to PCB using conductive glue

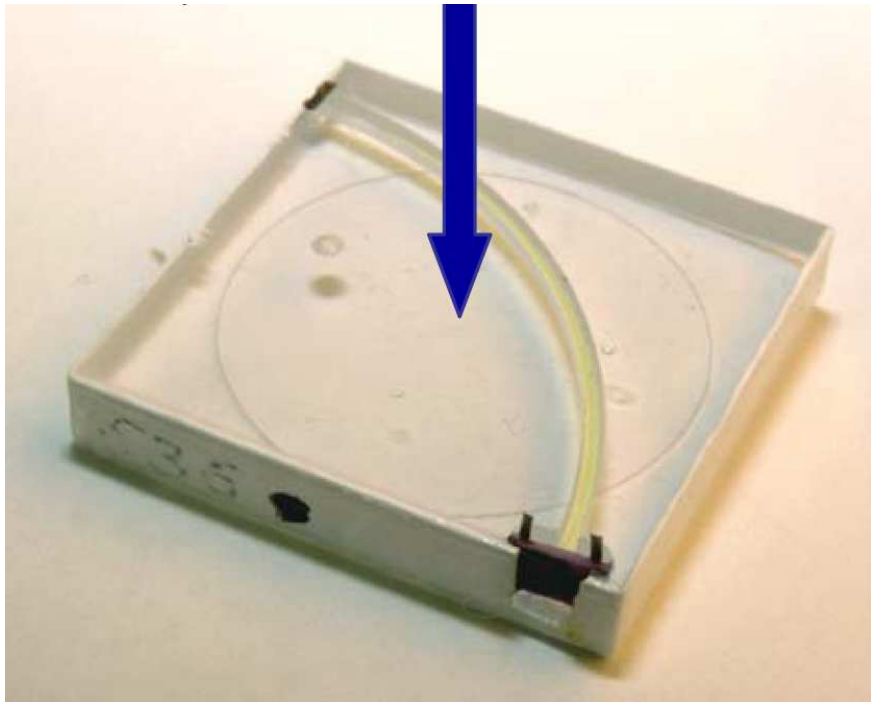


- PCBs inserted into tungsten structure
- Here at DESY beam line, Jan05

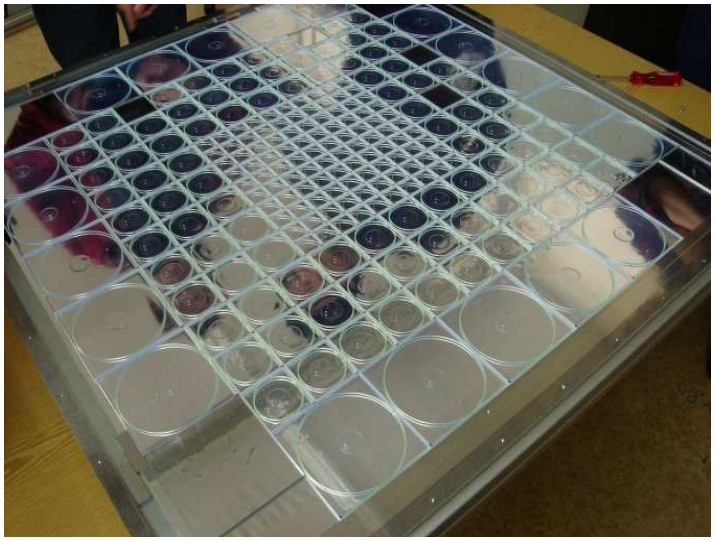
Scintillating tile AHCAL

- 3×3 cm^2 scintillator tile
- Wavelength shifting fibre
- Coupled directly to SiPM





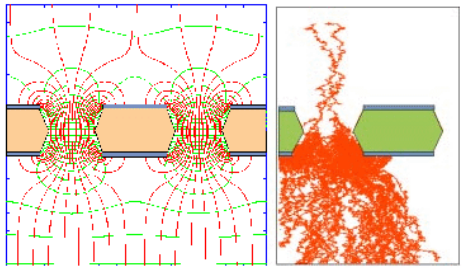
- Silicon PM: multipixel Geiger mode APDs; 1156 pixels
- Gain 10^6, bias ~ 50V, size 1 mm^2

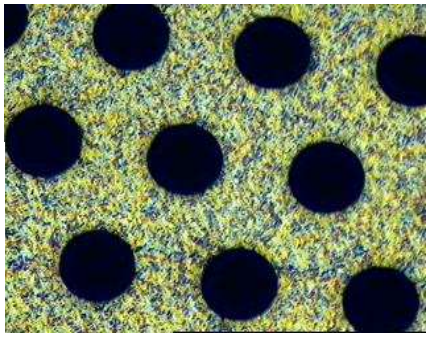


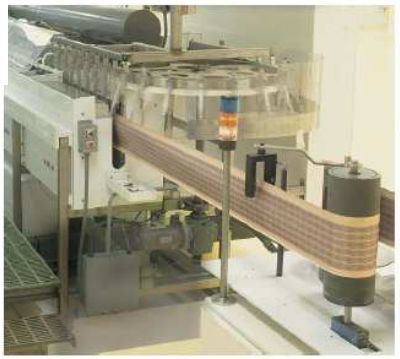
- Layer has 216 tiles total
- 3×3 cm2 central, 6×6 cm2 outer and 12×12 cm2 peripheral

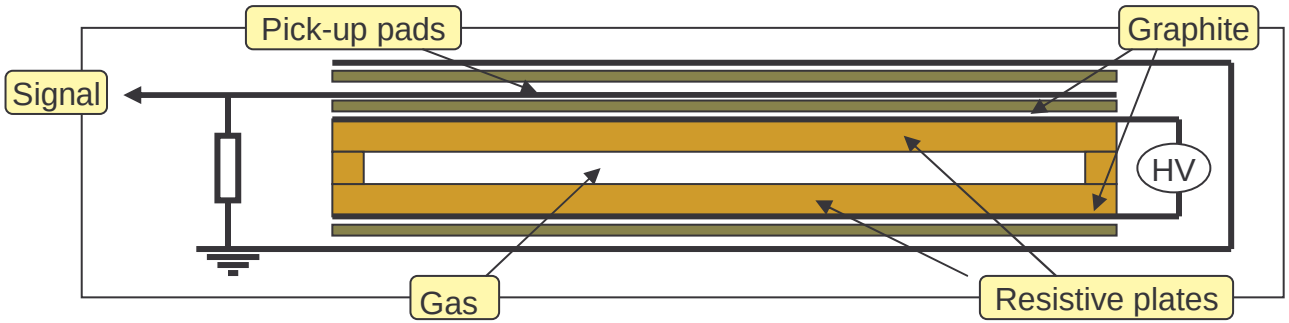
DHCAL technologies

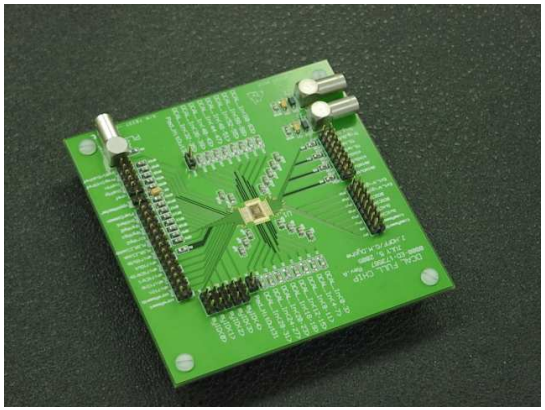
- Small cells ~ 1×1cm^2, with binary readout
- Two technology options
  - GEMs: lower operation voltage, flexible technology
  - RPCs: robustness and larger signals







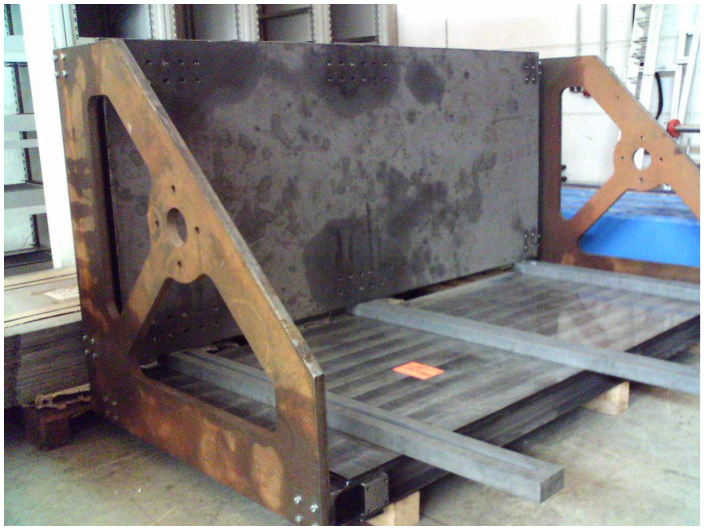


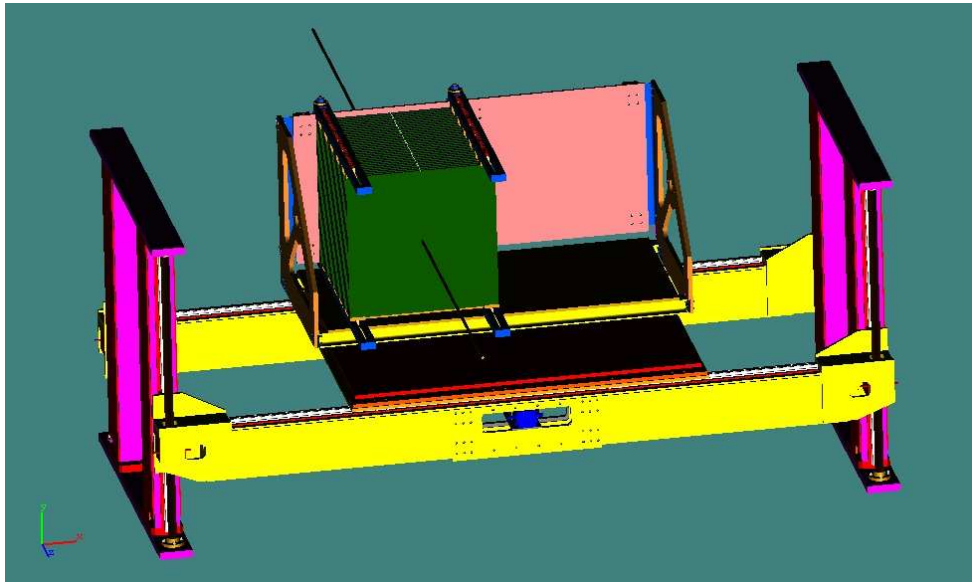


- Common prototype front end boards developed and tested
  - Schedule for production limited by US funding
- Hope to be ready for beam test in 2007

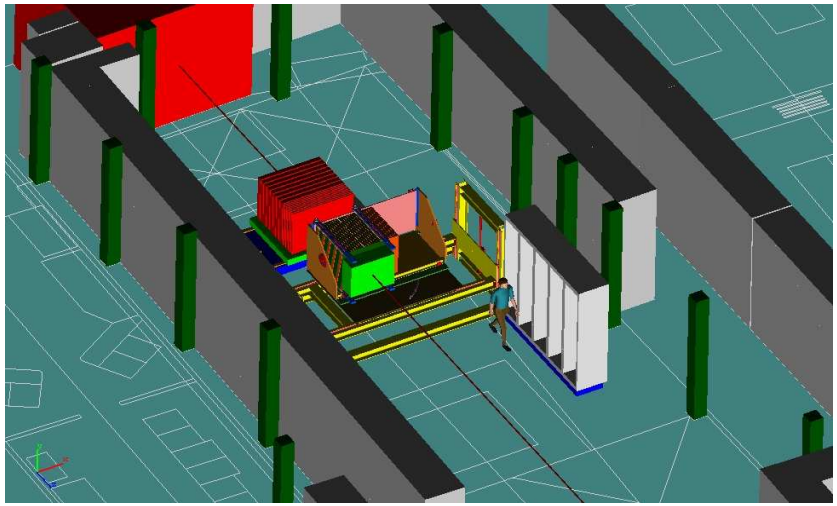
HCAL common mechanics

- Use same converter layers and mechanical support for AHCAL and DHCAL
  - Comparisons easier
- Movable table design compatible with CERN and FNAL being finalized
- Allows rotation for non-normal incidence





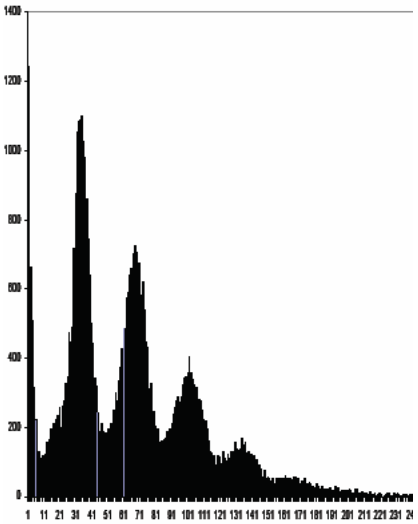
DESY



Tail catcher/muon tracker

- Scintillator strips; ~300 channels
- SiPM readout, reuse AHCAL electronics
- Stack; 8 layers × 2cm followed by 8 layers × 10cm of steel plates
- Beam test of first layer at FNAL Feb06

All strips fabricated and QC'ed

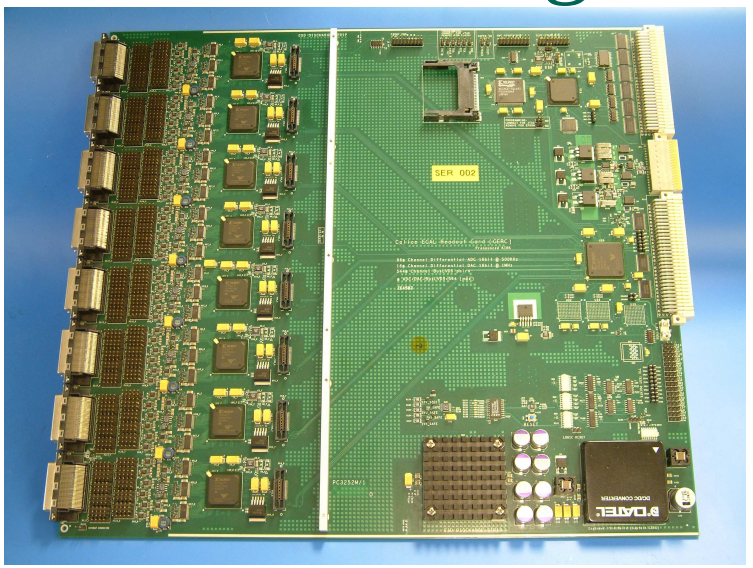


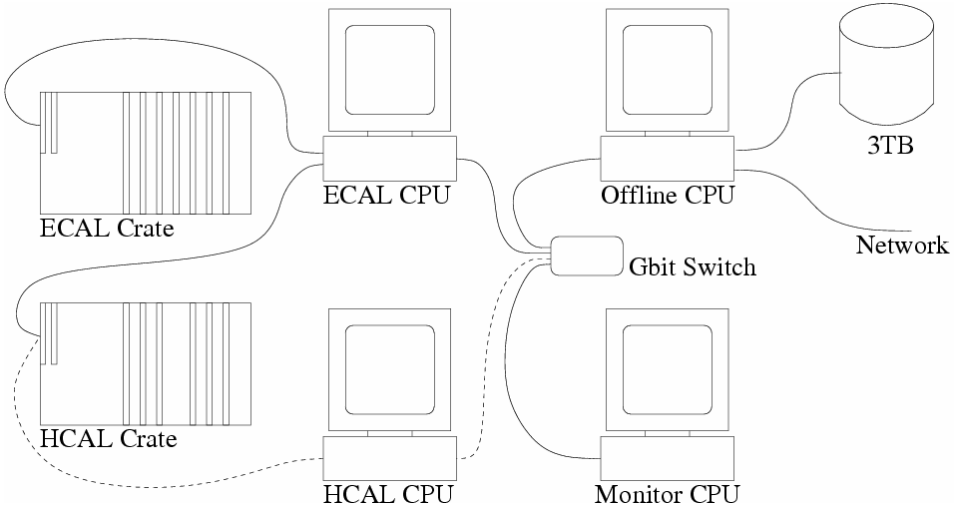
Cosmic signals

19 cassettes assembled
(w/o SiPM and LED driver)

CALICE-UK contributions from first grant

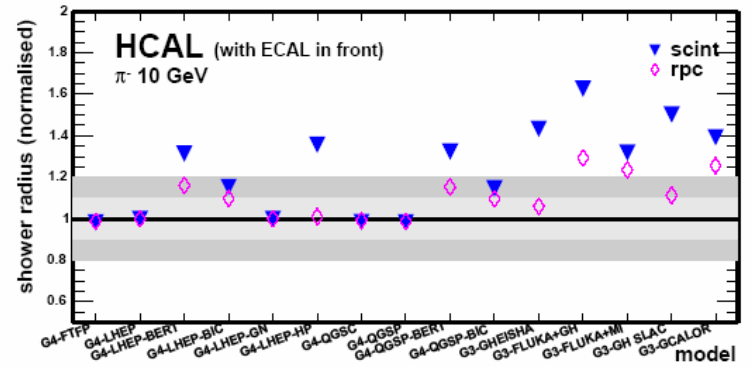
- Electronics and DAQ
  - Design and fabricate ECAL VME readout system: CRC boards have since been adopted for AHCAL readout also
  - Design DAQ and write online software system for all of CALICE



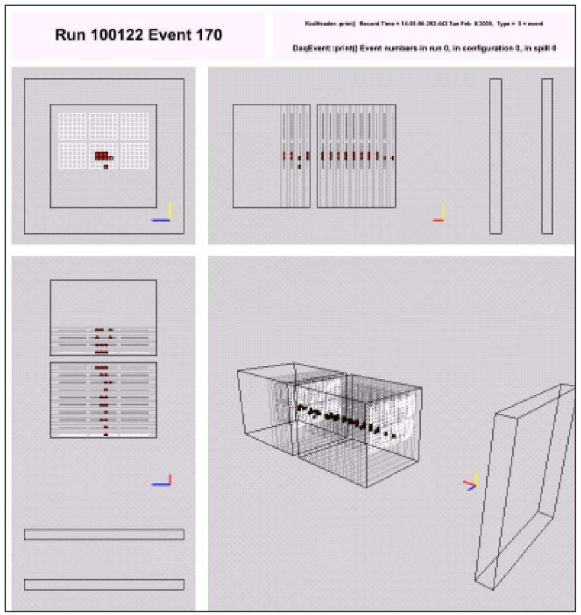


CALICE-UK contributions (cont)

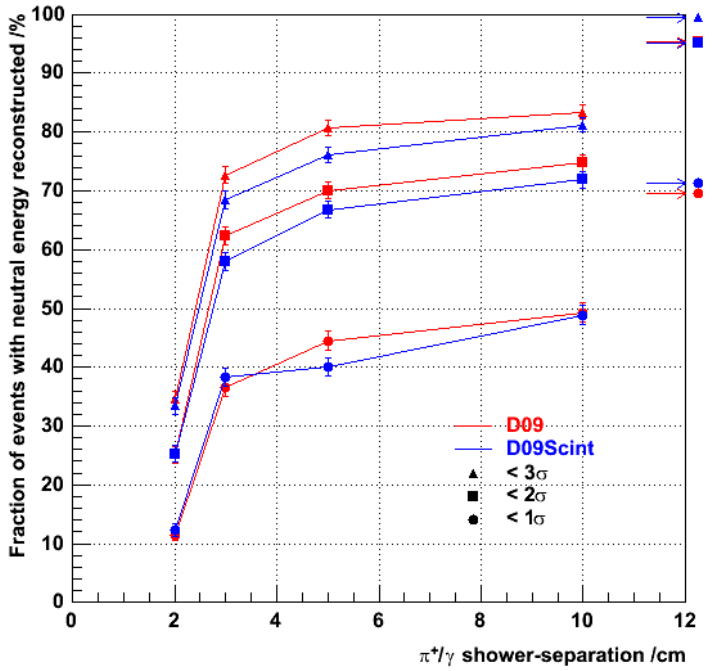
- Simulation and physics
  - Preparations for all beam tests
  - Analysis of DESY test beam data
  - Full-scale ILC physics and calorimeter PFLOW studies



- Comparison of shower models



- DESY beam test event display; some other results in OsC report



- Cluster algorithm development
  - Two-particle (π/γ) separation

CALICE-UK current grant

- Extension of beam test programme, WP1
  - From seedcorn, direct continuation of previous grant: Apr05-Mar09
  - Total cost inc WA = £319k
    - Birmingham, Cambridge, Imperial, Manchester, RHUL, UCL
- Four new workpackages
  - Delayed (and some slightly reduced) compared to proposal
  - Approval took until July 2005, so grant period: Oct05-Mar09
  - WP2: DAQ, total cost inc WA = £830k
    - Cambridge, Imperial, Manchester, RHUL, UCL
  - WP3: MAPS, total cost inc WA = £1095k
    - Birmingham, Imperial, RAL/EID. RAL/PPD, total cost
  - WP4: Thermal/mechanical, total cost inc WA = £196k
    - Manchester
  - WP5: Physics and simulation, total cost inc WA = £429k
    - Birmingham, Cambridge, Imperial, RHUL, UCL

Workpackage 1: Beam test programme

- Hardware, firmware and software preparations
  - Hardware effectively complete
  - Firmware and software still under development
- DESY low energy electron beam test, Apr-Jun this year
  - Sole users of beam line for three months
  - ECAL plus few AHCAL layers
- CERN electron and hadron beam test, Jul-Oct this year
  - 5.5 weeks total for ECAL-only, AHCAL-only and combined runs
  - New opportunity since proposal; had assumed no beam at CERN in 2006
- FNAL hadron beam test, throughout 2007
  - Schedule not yet defined
  - AHCAL, DHCAL comparisons, all combined runs with ECAL

Workpackage 1: Concerns

- ECAL wafer production (France)
  - No high quality wafers made into PCBs since early 2005 (until this week!)
  - Currently have 16 layers, populated with 3×2 wafers ~ 35% of ECAL
  - Small Moliere radius means 3×2 wafers sufficient for electron studies…
  - …but need 3×3 wafers per layer for CERN hadron beams, Jul06
  - Need full depth for shower containment in both cases
- DHCAL funding (US)
  - Readout electronics designed and prototyped
  - No secured funding for production; bid currently being considered
  - Considering using CRC VME system to reduce cost (~20%)
- CERN beam time is short
  - Bid for 8 weeks, granted only 5.5 weeks; backlog from no beam in 2005
  - In particular, combined run period reduced from 4 to 2 weeks
  - Target of 10^8 events and event rate of 100Hz; ~12 days continuous
  - Realistic running includes beam down time, online problems, setup time, etc.

Workpackage 1: Resources

- DESY beam test was originally planned for FY05/06
  - Now slipped to FY06/07 due to wafer delays
  - £20k travel, £6k shipping and M&O pushed into FY06/07
- CERN and FNAL beam tests
  - £40k travel assigned; assume total £30k in FY06/07, £30k in FY07/08
  - Shortened CERN beam time so likely to underspend.
  - Budgeted for all beam tests at FNAL but CERN likely to be cheaper.
  - However, FNAL beam test duration unclear so CERN savings will give some contingency
- Remaining requisitions
  - Halogen-free cables for CERN: 100 euro/cable, 70 cables = 7k euros
  - TDC and ADC for CERN beam line drift chambers and Cherenkov, ~£5k?
  - Can be met within M&O in next FY but then no contingency for FNAL

Workpackage 2: DAQ

- Five semi-independent tasks
  - PPRP delayed most by ~6 months, also reduced scope of one
- Not trying to build an ILC ECAL DAQ system
  - Have identified bottlenecks and issues
  - Tackling those to understand overall system architecture
  - Aim to contribute DAQ section to TDRs in 2009
- EUDET grant caused some (good!) complications
  - UK part: 330k euro for Jan06-Dec09
  - Expanded scope of work, more than reinstated reduced scope
  - Requires even closer cooperation with French groups; good relations from WP1 ECAL work already
- Main EUDET aim to build a full-size "Module 0"
  - ~10-20k channels; will be tested in beam, around 2008/9
  - UK needs to provide working DAQ system (and effort to run it)

Workpackage 2: DAQ (cont)

- Current status
  - Most tasks are still at feasibility study/literature search level
  - One is not yet active as paced by French ASIC development schedule
- Short term future work
  - Build a short version of a readout PCB
  - Test commercial PCI cards, including in PC network
  - Start work on failsafe FPGA reprogramming
- Expenditure
  - Effort use is on budget
  - Requisitions at low level; some delays due to realignment from EUDET
  - Travel will be mainly UK: extra EUDET travel from EUDET funds
- Division of EUDET funds still to be decided
  - Extra effort must go to help run Module 0 DAQ system
- No major issues or concerns so far

Workpackage 3: MAPS

- Monolithic active pixel sensors
  - Readout circuit integrated into particle sensor. Binary readout; DECAL!
- Current status
  - Getting towards the end of the feasibility study; no showstoppers found
  - Small (25μm) pixel sensor simulations done
- Short term future work
  - Move to real sensor design; Preliminary Design Review at end Apr
  - Upgrade sensor simulation farm to allow larger (50μm) pixel simulations
  - Get detailed physics simulation working, including charge sharing, etc.
- Expenditure
  - EID effort: by definition is to budget
  - Only requisition expense was laptop for new RA
  - Travel is only in the UK at present
- No major issues or concerns so far

Workpackage 4: Thermal/mechanical

- Significantly cut back and delayed by PPRP
  - Minimal startup so far; work gets going in next FY
- Two main subtasks
  - Thermal modeling and glue studies
- Also now working on ECAL endcap design
  - Academic effort only (D.Bailey) so no impact on PPRP costings
- Resources
  - No requisitions expenditure in FY05/06
  - Only Manchester RG effort: on budget by definition
  - Travel needed for collaboration meetings with French mechanics group
- Smallest workpackage, at very preliminary stage
- No major issues or concerns so far

Workpackage 5: Physics and simulation

- Four major tasks
  - PFLOW algorithms, Global ILC detector design, other workpackage support, physics studies
- Slow start; WP5 most impacted by slow start of RAs
  - However, recent progress in several areas
- Short term future work
  - Systematic comparison of PFLOW algorithms
  - Physics benchmarking of initial detector designs
  - Implement MAPS detailed simulation
  - Present results on physics analysis
- Expenditure
  - Only requisition expense was laptop for new RA
  - Travel is significant as need to present work regularly outside the UK
- No major issues or concerns so far

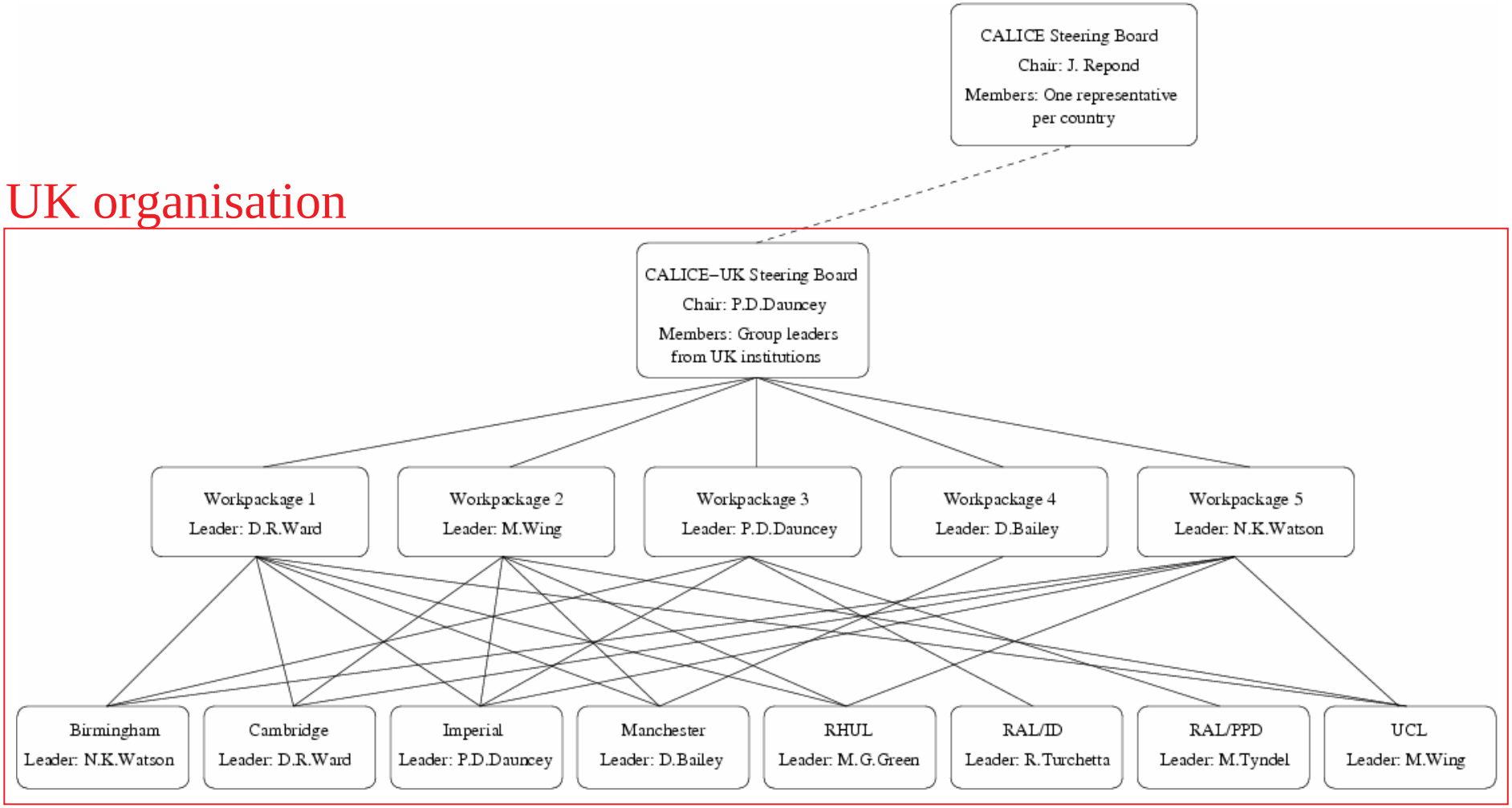
Budget summary

- Effort: the three new RAs started late
  - Delays in approval of grant until July, RAs due to start in October
  - They started Nov-Feb; all still on 3-year posts
  - Costs shifted from FY05/06 to FY08/09; indexation costs more, ~£5k
  - EID and University RG effort on budget so far by definition
- Requisitions underspent
  - WP1: No beam test so M&O slid by a year, ~£5k
  - WP2: EUDET grant reshaped programme; resulted in some delay, ~£5k
- Travel underspent
  - WP1: Effectively all due to beam test delay, slide by a year, ~£20k
  - Travel not budgeted by WP but by institute: any trip often covers multiple WP tasks; other underspend ~£5k
  - Division into WPs for OsC nominal: purely proportional to effort in WP
- All adjustments between WPs at the O(<£10k) level
  - No problems foreseen at this point

CALICE-UK management organisation

- For a (smallish) project of our size, the “Oversight and Management of PPARC Projects” document describes several roles:
  - Principal Investigator: scientific leader
  - Project Management Committee: internal oversight and control
  - Project Manager: responsible to PI for delivery
  - Project Sponsor: designated PPARC representative
- We have different labels and a somewhat different structure
  - UK Spokesperson is Paul Dauncey, equivalent to Principal Investigator
  - UK Spokesperson chairs the UK Steering Board, equivalent to the Project Management Committee
  - However, responsibility and management of the individual workpackages is delegated to the Workpackage Leaders, so effectively resulting in five Project Managers
  - We have not been told the name of our Project Sponsor

CALICE-UK organogram



Summary

- The major beam test programme is about to start in earnest
  - Our equipment was produced on budget
  - The hardware is ready and the firmware and software are converging
- The longer-term R&D workpackages are in the start-up period
  - Only six months into the 3.5 year grant
  - Delays in approval meant late appointments of RAs
  - Less progress than scheduled made in several areas; hopefully a temporary hiccup now RAs are in place
  - No milestones have been scheduled to be reached yet, but there are several before or around the next Oversight Committee meeting
- The project is effectively on budget so far
  - Still early days but no financial issues identified so far