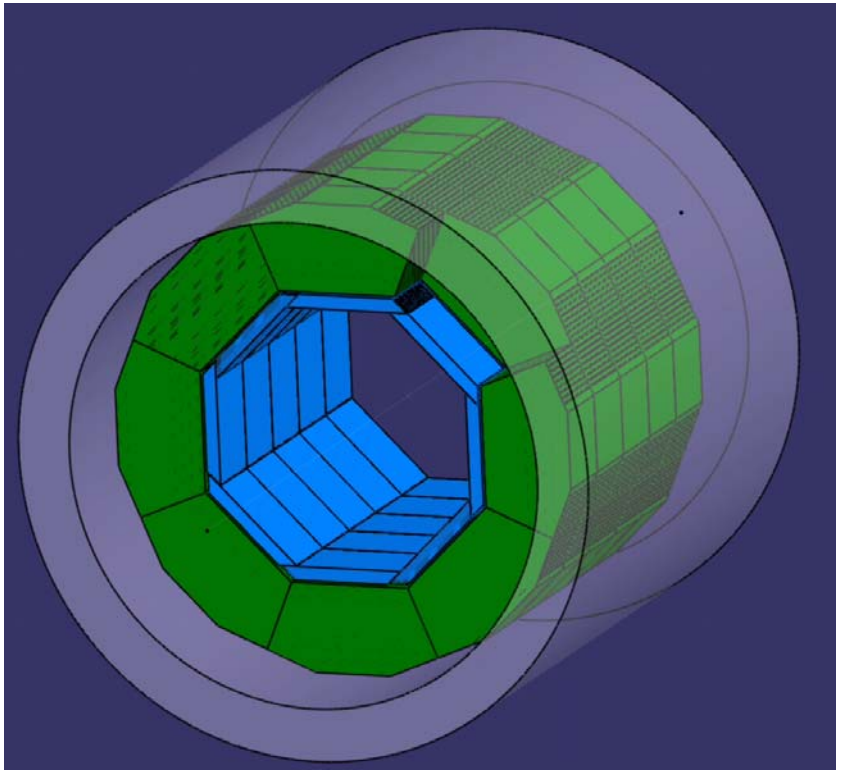
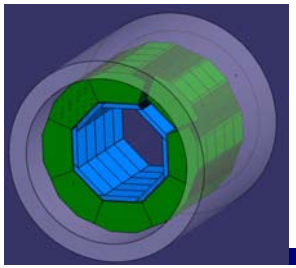


Hadron Calorimeter

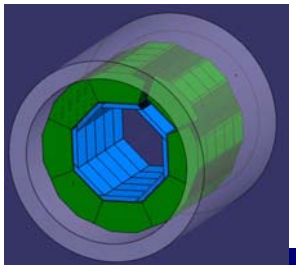
Felix Sefkow

EUDET Extended Steering Meeting
September 11, 2006



JRA 3: Calorimetry

- Activity organized in 5 tasks:
- **Electromagnetic Si W calorimeter**
  - Scalable prototype, Si sensors and electronics integration
  - *Ecole polytechnique and Prague*
- **Hadron calorimeter**
  - Scalable structure, calibration system and electronics integration
  - *DESY, Prague and Hamburg + associates: Russian groups + Bergen U.*
- **Very forward calorimeter**
  - Laser positioning systems, sensor characterization, electronics
  - *DESY, Cracow, Prague and Tel Aviv + associated*
- **Front end electronics**
  - ASICS and integration for different calo types
  - *LAL, Ecole polytechnique and DESY*
- **Data acquisition**
  - Scalable system, for prototype and as basis for common detector DAQ
  - *University College London and associated UK groups*

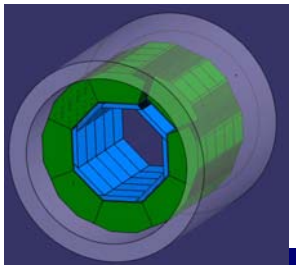


Kickoff Summary

- The goal is to propose a realistic HCAL for the ILC by the end of the decade
  - Novel concept: PFLOW imaging
  - Novel technologies: embedded SiPMs
  - Realistic = scalable + basis for costing

- The HCAL task – together with FEE and DAQ – will provide a framework for
  - The R&D towards a realistic detector structure
  - Connecting to the dynamic photo-sensor developments

- Feedback from the testbeam effort will be vital for the refinement of concepts in the near term conceptual phase 2006-2007



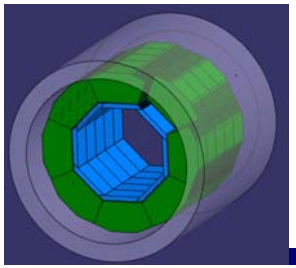
Milestones and Deliverables

06 07 08 09

ID	Task Name
163	**JRA3: CALO**
164	Concept review
165	Conceptual report
166	Design review
167	Design report
168	Production readiness review
169	Production readiness report
170	Final report
171	**Electromagnetic calorimeter**
172	Silicon sensor production
173	Silicon sensors
174	Mechanical concept development
175	Mechanical concept available
176	ECAL design and mould
177	ECAL design and mould available
178	ECAL prototype construction
179	ECAL prototype available
180	**Hadronic calorimeter**
181	HCAL mechanical concept design
182	HCAL mechanical concept available
183	HCAL design
184	HCAL design available
185	HCAL prototype construction
186	HCAL prototype available
187	VME test stand installatio
188	VME test stand available
189	HCAL calibration single channel prototype
190	HCAL calibration single channel protoype available
191	HCAL calibration multi channel prototype
192	HCAL calibration multi channel protoype available
193	HCAL calibration integration
194	HCAL calibration system available

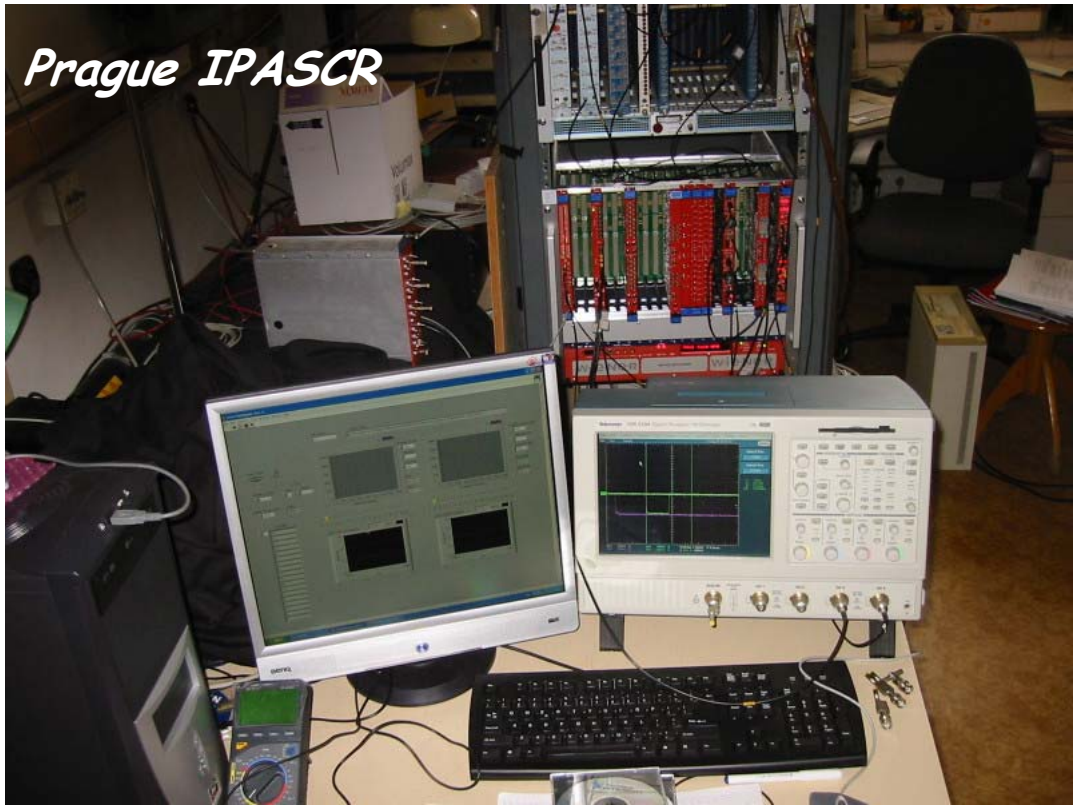
reports

Concepts, designs - and final prototypes

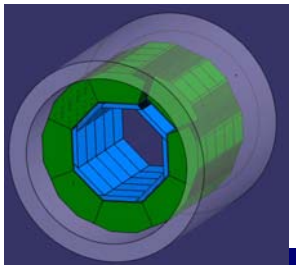


Calibration system test stand

- VME-based system For tests of optical calibration system electronics
  - Presently working with APD readout
  - Crate, ADCs, discriminators
  - Already used for tests of present testbeam equipment
- Also: complement testbeam calibration electronics



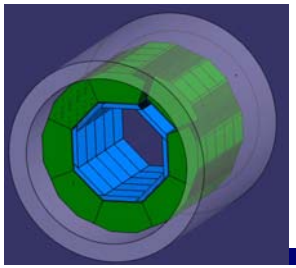
(scope, computer, NIM p/s not on EUDET bill)



Concepts roadmap

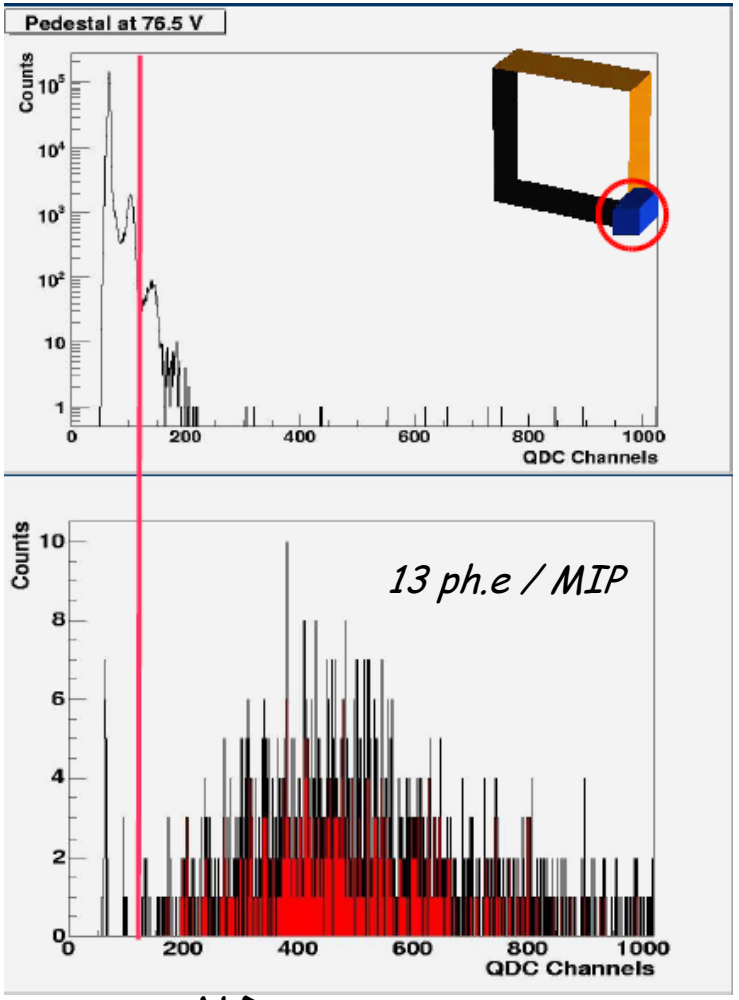
- Milestones on the horizon
  1. Mechanical concept — 9/2007
  2. Calibration electronics concept — 9/2007

- Ingredients to mechanical concept
  - Photo-sensor development — Industry
  - Photo-sensor scintillator coupling — us, and associates
  - Electronics to photo-sensor coupling — next
  - Electronics integration — then
  - Calibration concept — parallel
- Ingredients to calibration concept
  - Photo-sensor development + coupling — started
  - Testbeam experience — started

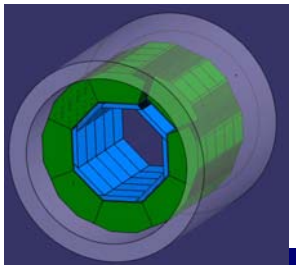


Blue-sensitive SiPMs

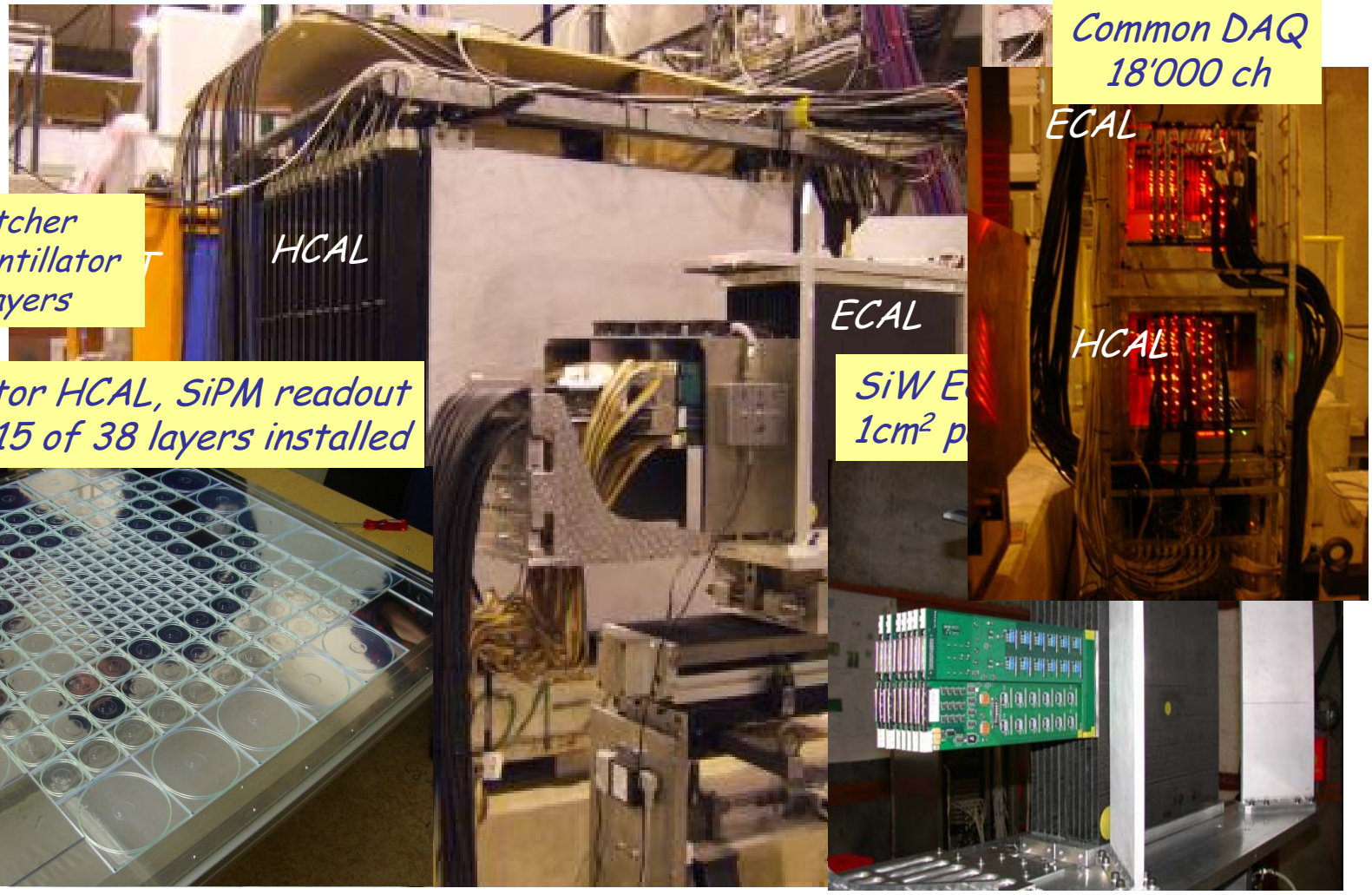
- New devices from Hamamatsu
- 400 pixels on 1mm^2, moderate crosstalk
- 2-3x more lightyield with green WLS
- ~ 6 times more with blue scintillator light
- Simplified coupling
  - **Plan test layer for testbeam**
- Or: Thinner scintillators
  - Save detector volume and cost
  - ECAL applications

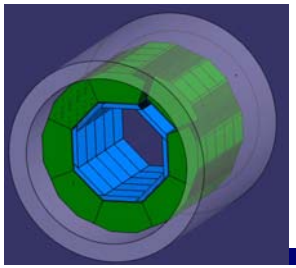


N Dascenzo



Testbeam at CERN SPS





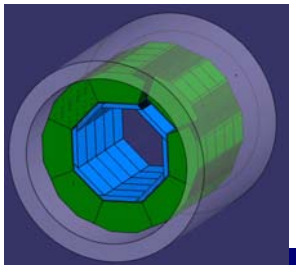
Hadron data taken

- August 25-30: ECAL + HCAL

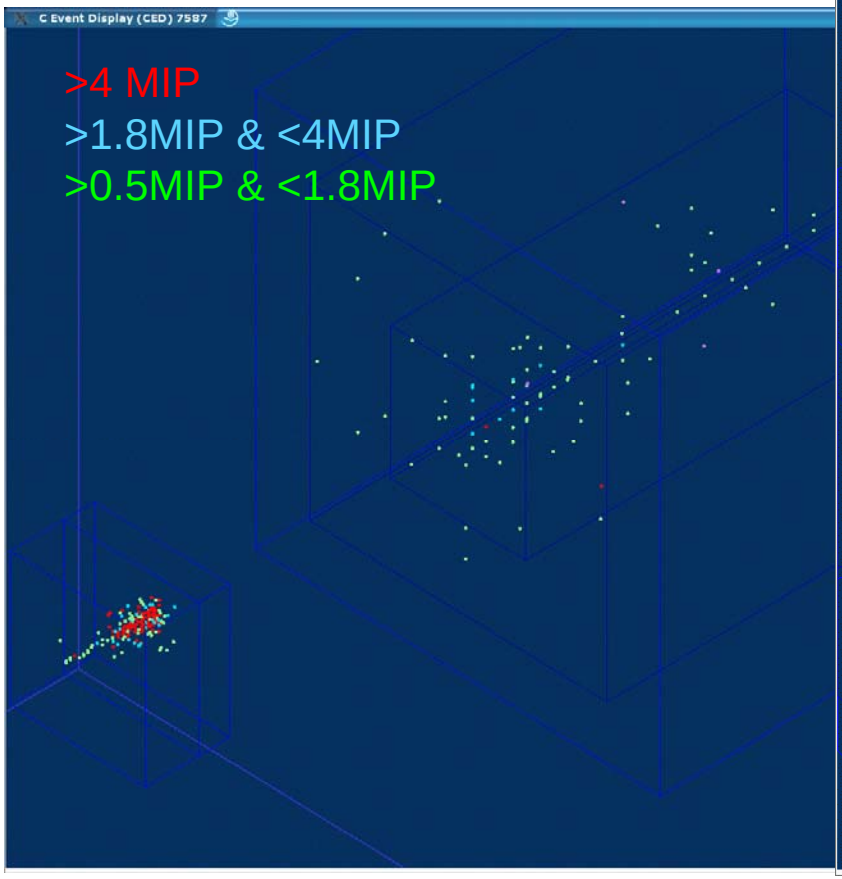
E (GeV)	Raw secondary (for beam studies)	Electron filtered (~95% pure pions)
80	~50 k	300 k + collimator tuning
60	~50 k	500 k
50	~50 k	350 k
40	~50 k	450 k
30	~50 k	380 k

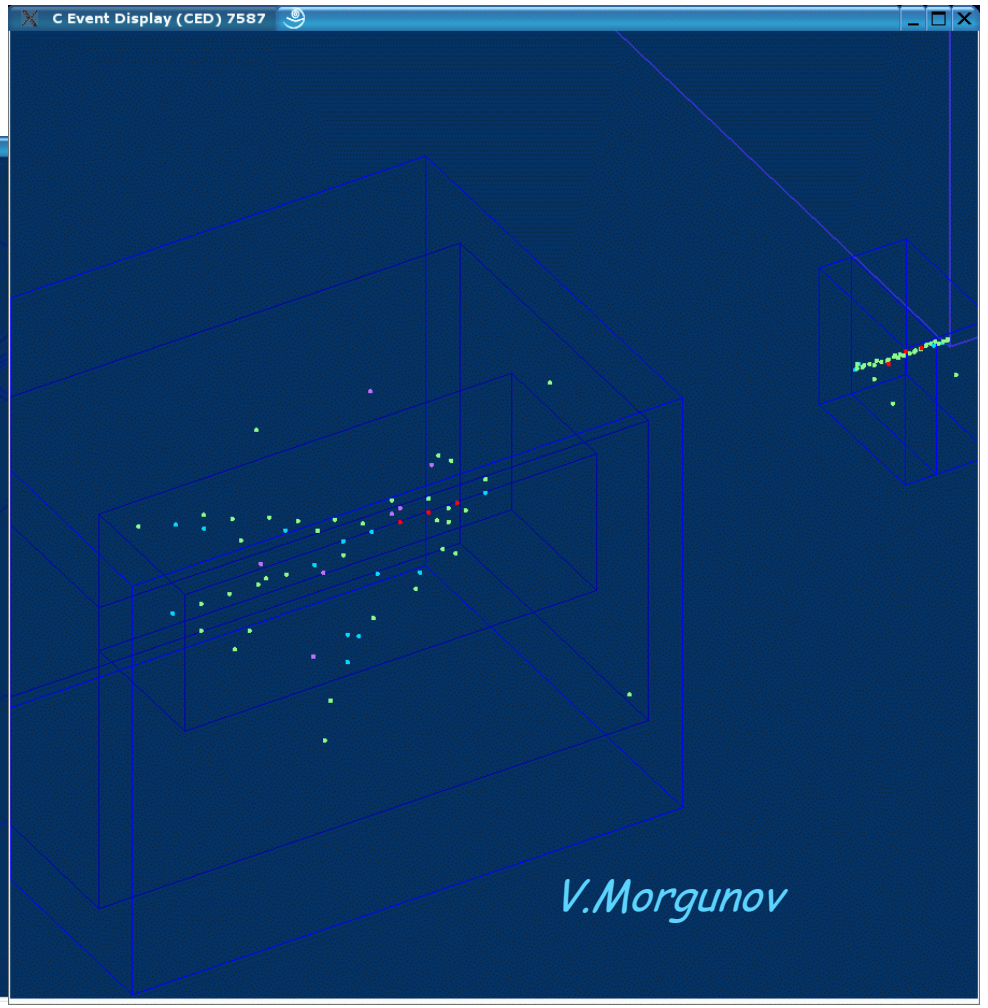
- September 1-4: HCAL alone
  - Low energy data (6, 10, 20 GeV)
  - High energy 30…80 GeV: about 500k e, 1M pi at each point

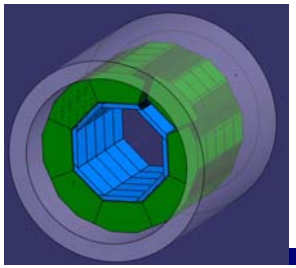
- More than 10 million events, with and mostly without ECAL



Hadron events

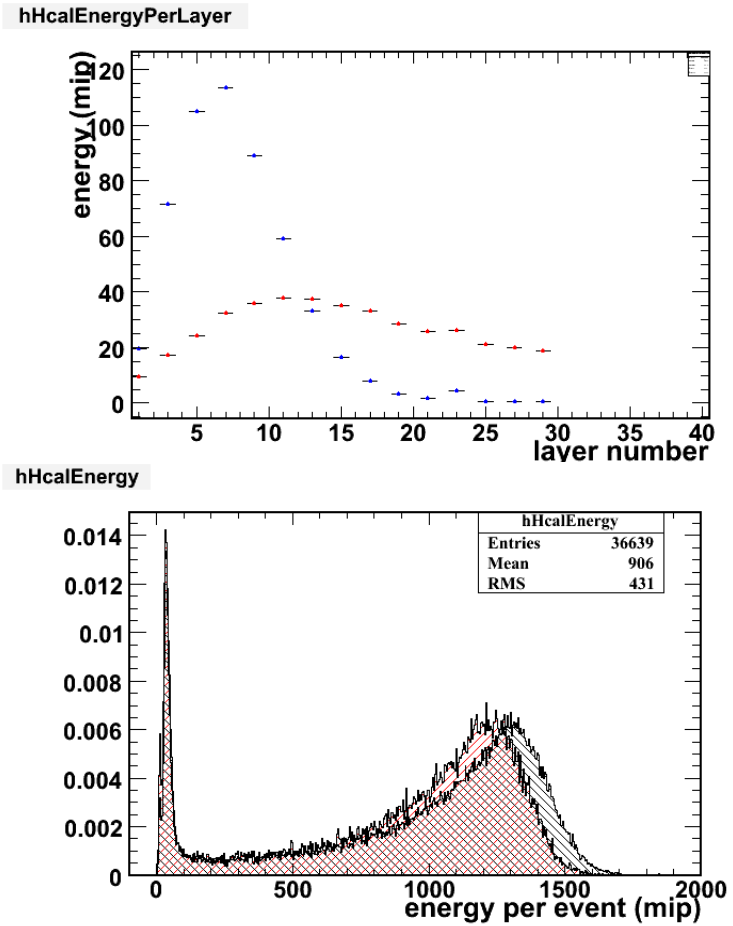




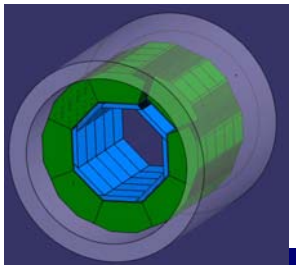


Analysis started

- Hadron and electron shower profiles
  - Electron data allow detailed verification of detector understanding and calibration accuracy
- Detector response studies for varied operating conditions
  - Modify bias as substitute for temperature variations
  - Some coherent noise observed, under study
    - Needs some engineering resources



Marius Groll (UHAM)

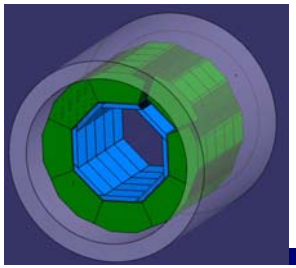


HCAL outlook

- Layer production:
  - Module 20 done
  - Module 21-22 in prduction
  - Module 23-24: tiles received
- ➔ expect 2/3 of detector for October run

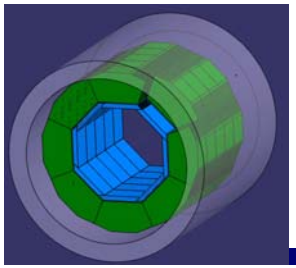
- October 12-24 ECAL + HCAL + TCMT
  - Combined particle flow reconstruction

- Movable stage:
  - Delayed (base plate manufacturing, assembly)
  - Will not be available for October run
  - Blocks engineering resources for mechanical concept



Progress summary

- R&D around new photo-sensors underway
  - R&D roadmap to be laid out
- Real test beam data are starting to roll in
- Detector analysis started
- EUDET concept and schedule largely driven by testbeam
  - Operational experience
  - Engineering resources
  - ➔ schedule risk



Financial information

- Consumables:
  - Only IOPACSR
    - Allocated: 12k, Spent:15.5k
- Staff:
  - DESY
    - Allocated 31k, Spent: 0, expect 8k
  - IOPASCR
    - Alllocated 6k, Spent: 0, expect to start in 2007
- Travel:
  - Monitored by institute; to be sub-discriminated by task?