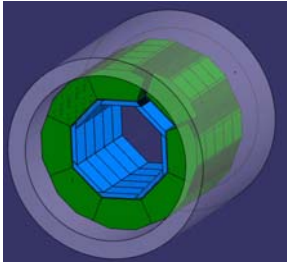# Introduction

Felix Sefkow
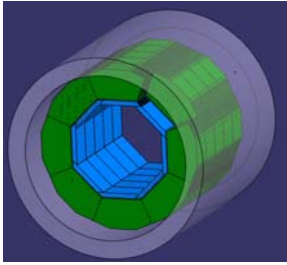
HCAL main meeting
February 14, 2006
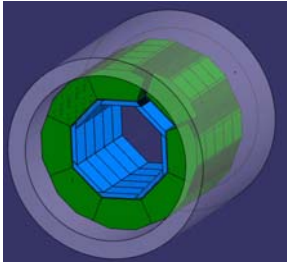
Outline

- Analysis, publications

- movable stage, commissioning

- CERN schedule 2007

- R&D issues

- Reviews

Summary so far

- Proof-of principle prototype (technology & PFLOW approach)

- Technology ✔
  – It works!
  – Successfully scaled up from "minical" by 2 orders of magnitude

- PFLOW approach
  – It makes nice pictures
  – Analysis to come – millions of events are there

HCAL
$3 \times 3 cm^2$ tiles

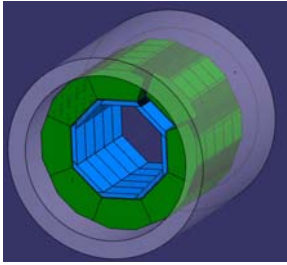ECAL
$1 cm^2$ pads

Imaging calorimetry
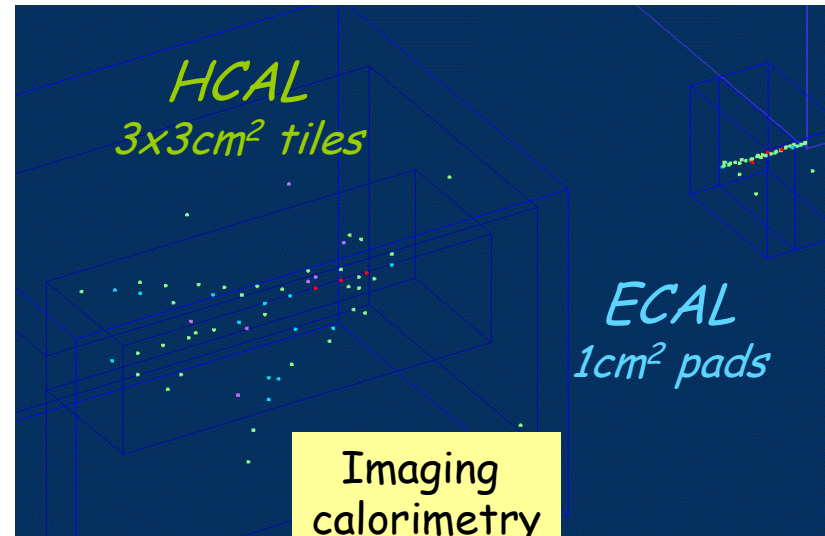
Detector studies to do now

- Calibration and calibration uncertainties
  - What limits the resolution?
- Dynamic range and non-linearity correction accuracy
  - Data and MC studies
- Stability, monitoring and corrections:
  - Cross-check methods and find most practical

- Effects of temperature and temperature gradients

- SiPM long-term studies
  - Is the response function stable?
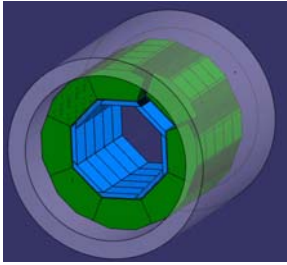
- And: Learn from scintillator ECAL
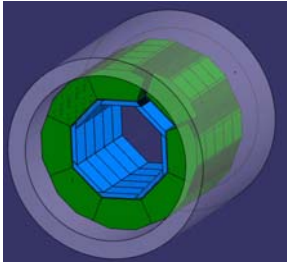
Important Help needed

Physics issues for the detector

- Physics (hadron shower) analysis will provide further input to the detector design

- Shower sub-structure resolution, two-particle separation
  - revisit granularity optimization

- Neutron sensitivity
  - Gaseous and scintillator

- Semi-digital approach

- Not yet possible: timing for PFA
  - Fast digitization (JINR electronics)
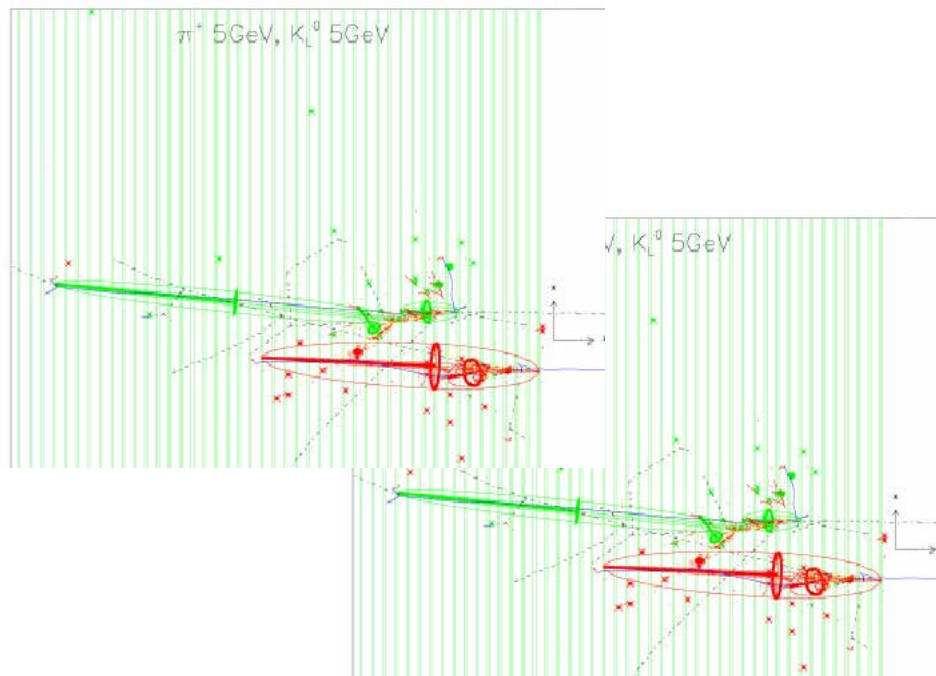 - Next version of SiPM ASIC from LAL

Hadron analysis final goals

- Detector performance (resolutions): sure!

- Test / validation of simulation 1: algorithm-independent
  - Shower profiles
  - e/pi ratio
  - Neutron response
  - Correlations within shower, substructure
  - New observables

- Test / validation of PFA algorithm performance
  - Fragments faking neutrals ➔ double counting
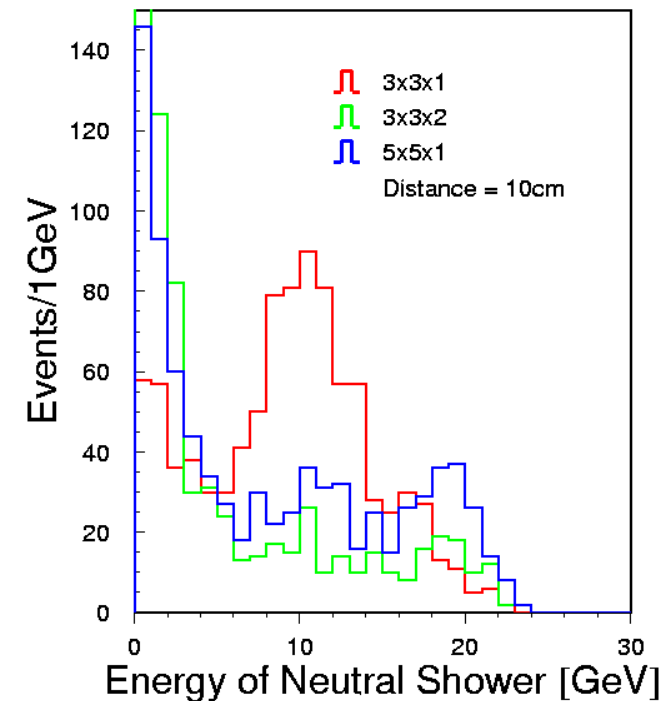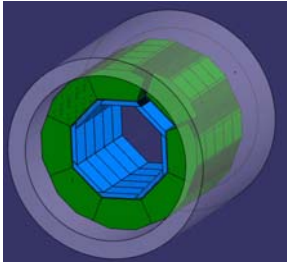 - Two-particle separation ➔ losse

Neutral shower separation

- Confusion in PFA: fakes and losses
- Evaluate losses in test beam data using event overlay technique
  - High granularity ➔ low occupancy

Two showers : π^+ 10GeV, K_L^0 10GeV

3x3x1
3x3x2
5x5x1
Distance = 10cm

Events/1GeV

Energy of Neutral Shower [GeV]

Simulation study by A.Raspereza – can be tested!
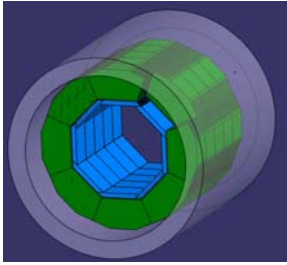
Susbtructure is there!

- First steps into "deep analysis" by V.Morgunov
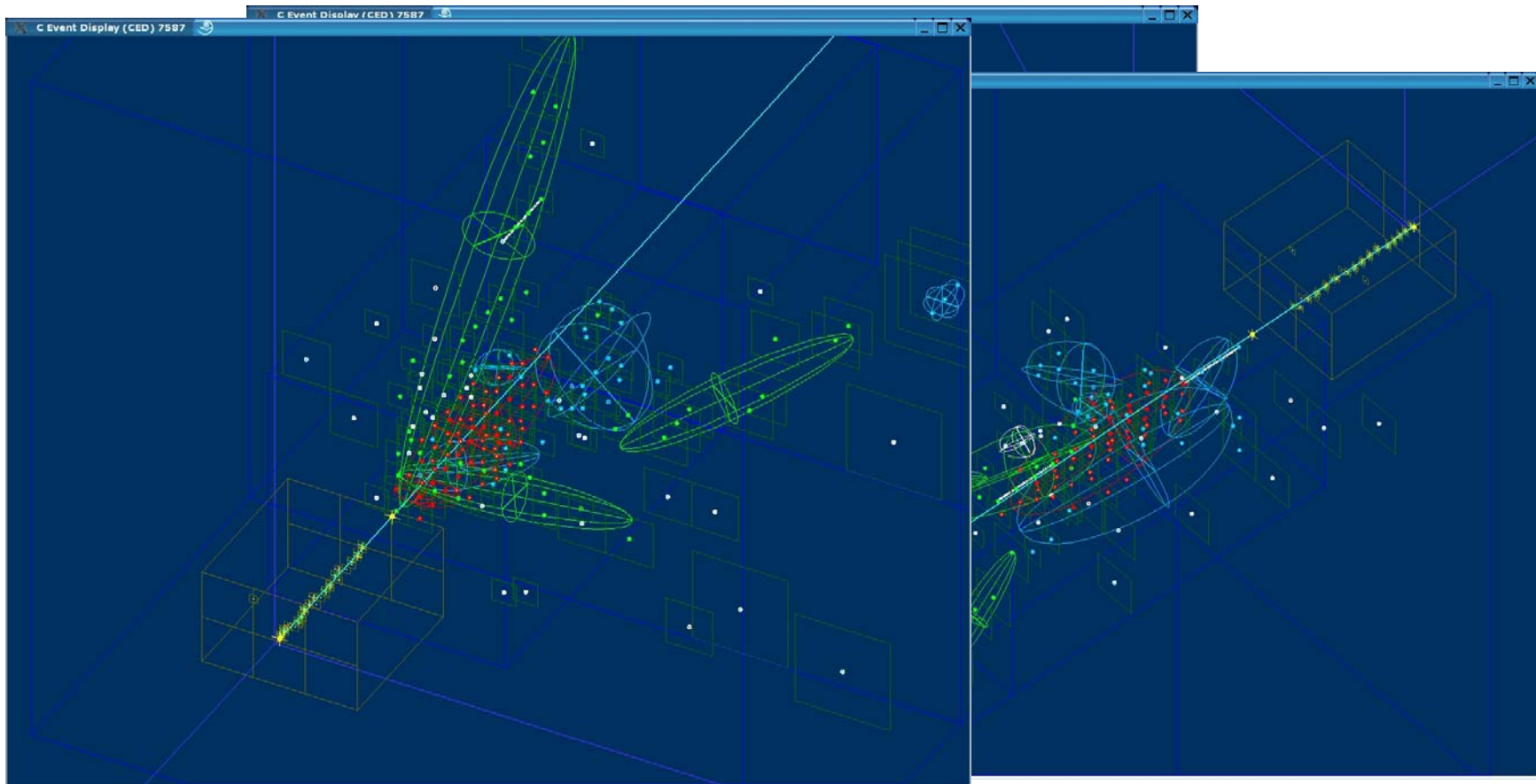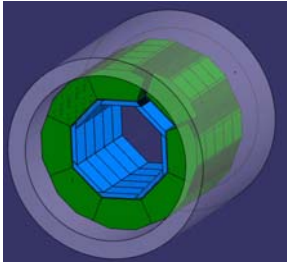
Analysis strategy

- Discussions with LHC calorimeter and test beam experts
  - P.Loch (Tucson), talk by P.Schacht (MPI) at FNAL:
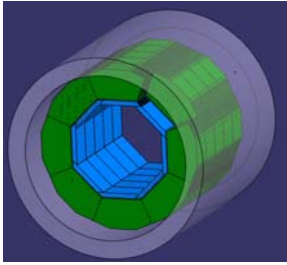- We are on the right track!

- Understanding of electromagnetic response crucial for hadron calorimetry
  - Em scale = response of ideal detector to em energy deposition
  - Simulation, link to production quality control data
- Hadronic response on em scale: this is the observable!
  - Expect 5% level agreement with simulation
    - on average, not in tails and details
  - Data MC comparisons, input to weighting schemes
  - Interesting G4 tool: energy deposition by type (em, had, invis, loss)
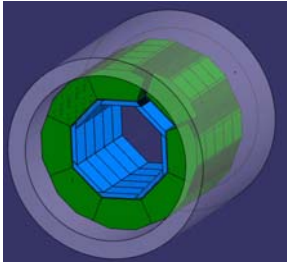
Towards LCWS'07

- Continue with strong focus on e.m response
- Concentrate on temperature and time-stable data
- Understand:
    - Calibration
    - Noise
    - Linearity
    - Resolution
    - Longitudinal profile
    - Transverse profiles
    - Stability
    - Hadron response

Priority

LCWS'07

Ambition
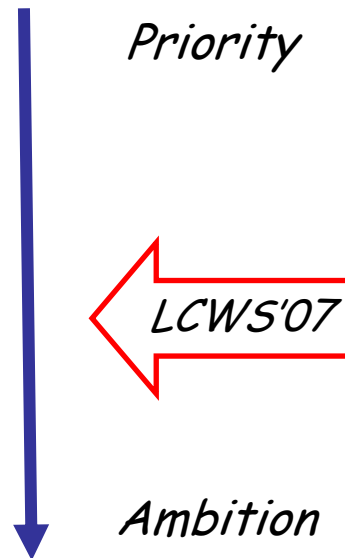
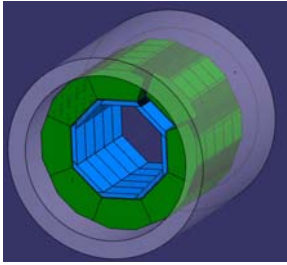# HCAL publication plans

- 2007:
  - HCAL design and em performance: two papers (?)
  - Stability and monitoring: include in paper if ready,
    - Otherwise first conference results
  - HCAL Hadron response on e.m. scale : first conference results

- 2008:
  - HCAL Hadron response, performance, first MC comparisons: paper

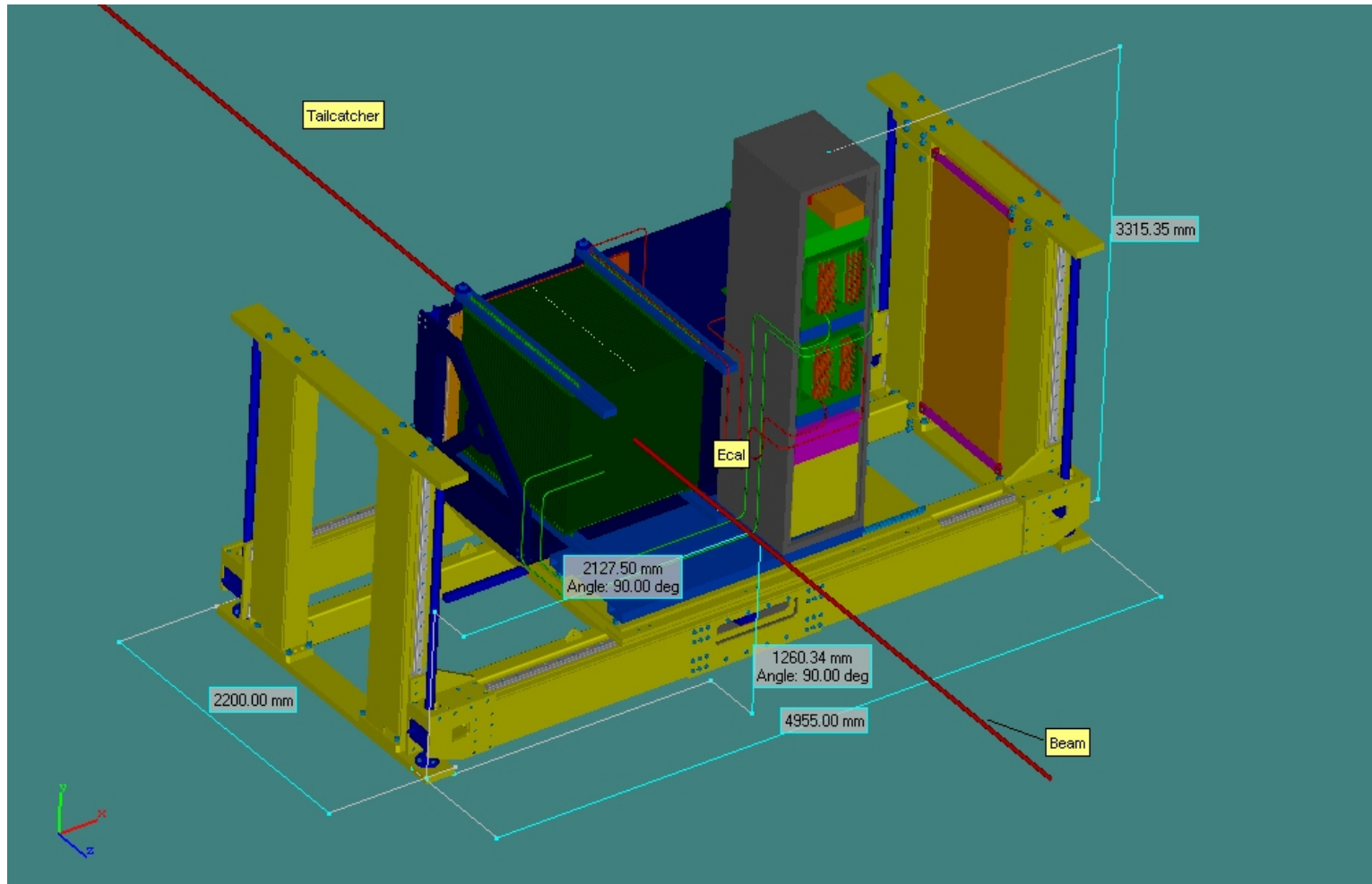- ECAL+HCAL, PFLOW studies, G4 comprehensive analysis
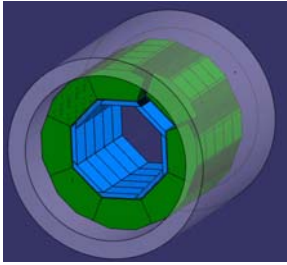 - CALICE wide

Movable stage status
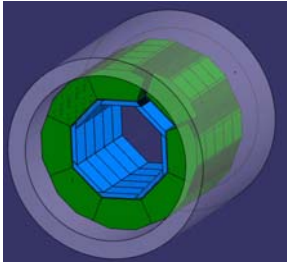
- Two weeks ago

To be ready for shipment in June

Until then

- This week 7:   lift stack support to stage
- Week 8:   prepare rack and install modules starting from ECAL side

- Week 9-10   cabling
- Week 11   ECAL integration
- Week 12-14   Electronics tests (noise and LED)
- Week 14-15   Easter
- Week 13-15   stage motion PLC programming
- Week 16-19   stage motion computer programming
- Week 22   LCWS

In parallel

- Module production (29-32 underway)
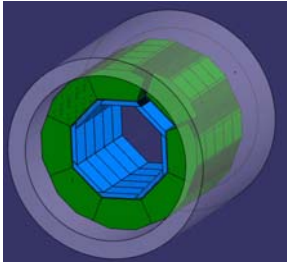- Module tests in electron beam
- Module integration

- Modify remaining VFE HABs

- Prepare transport (options)

- Prepare transport fixation raverse for stage
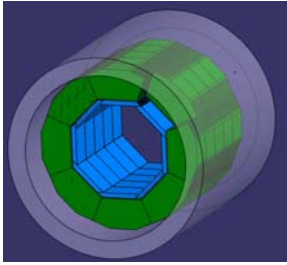- Prepare separable rack ?

- Install cooling

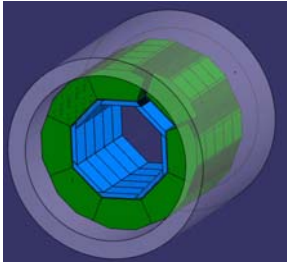- Paint the stage

Preferred test beam schedule

As communicated to CERN:

- May 28 - June 3: LCWS at DESY, CALICE set-up at display

- June 11-15: Installation at CERN
- June 18-22: Re-commissioning

- June 25 – July 8: calibration with parasitic muons

- July 9-22: First main user period

- Aug 20-Sep 2: Second main user period

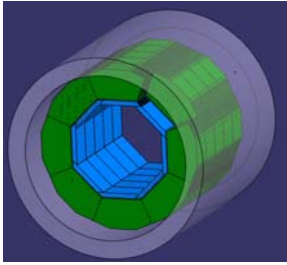- If possible: Third main user period

- 2007: CALICE at FNAL

Test beam request

- Submitted to CERN on Jan 31st

- SPSC met last week: approved

- First schedule next week

- Unofficial:
  - Installation in June possible
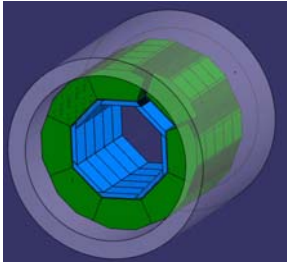 - 3rd period granted

R&D

- This year: EUDET module design choices
- SiPM / MPPC candidates, coupling to scintillator
- VFE ASIC design
- Calibration concept
  - Testbeam analysis
  - Hardware tests
- Readout chain
  - SiPM + SPIROC: test board
  - FE – ODR: DIF electronic proto
- Layer design
  - 15M$/mm
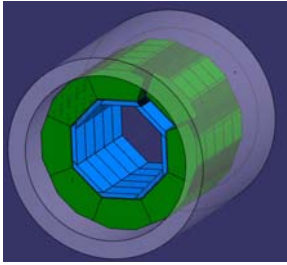- Stack design, assembly procedures

Reviews

- 2nd half of April: CALICE technical review meeting
  - prepare CERN test beam program

- At LCWS'07 (May 30-June 3) ILC calorimetry will be reviewed
  - Reviewers: WWS R&D panel and external (non-ILC) calorimeter experts
- Similar to DESY PRC case, we need to prepare
  - written report
  - Presentations
  - Funding information

Meeting dates

- May 10-12 CALICE collaboration meeting in Kobe

- October 8-10: EUDET Annual meeting at Paris

ILC testbeam worskhop at FNAL

- Good overview on facilities and plans from detector groups
  - Roadmap document in summer
  - Trk & vtx getting more active

- Warm welcome from FNAL management

- Significant participation of FNAL physicists

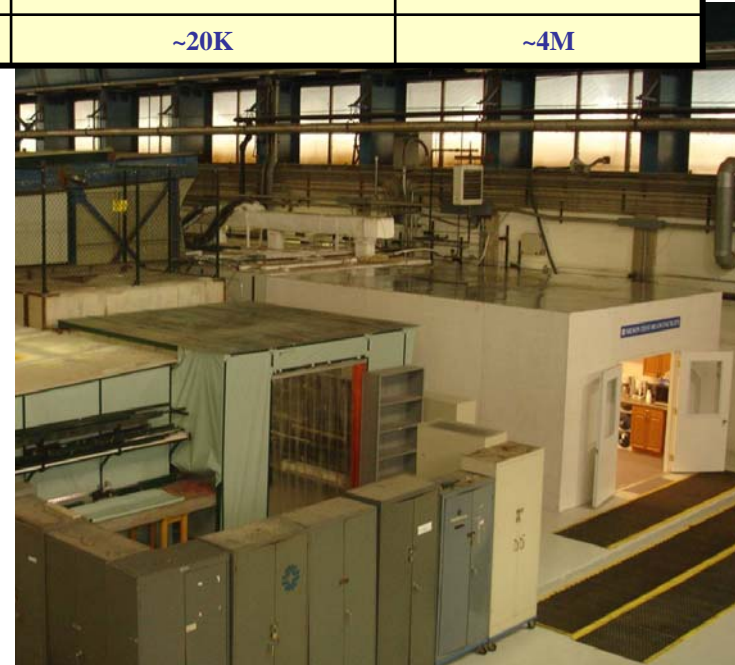**Find slides at https://conferences.fnal.gov/idtb07/**

FNAL testbeam

- MTBF upgraded
  - Move target downstream
  - get higher rates at low E
  - Flexibility in spill structure
  - Hall (roof, floor) refurbishment
  - Control room and meeting area
  - Cabling panels
  - Laser alignment system (cool!)

- M-Center
  - Possibility to obtain tagged neutral beams
  - Trigger and DAQ issues to be worked through

Energy (GeV)	Present Hadron Rate MT6SC2 per 1E12 Protons	Estimated Rate in New Design (dp/p 2%)
1	---	~1500
2	---	~50K
4	~700	~200K
8	~5K	~1.5M
16	~20K	~4M