

# ILC Test Beam

*LCWS2005 at Stanford*

*March 18 – 22, 2005*

*Jae Yu*

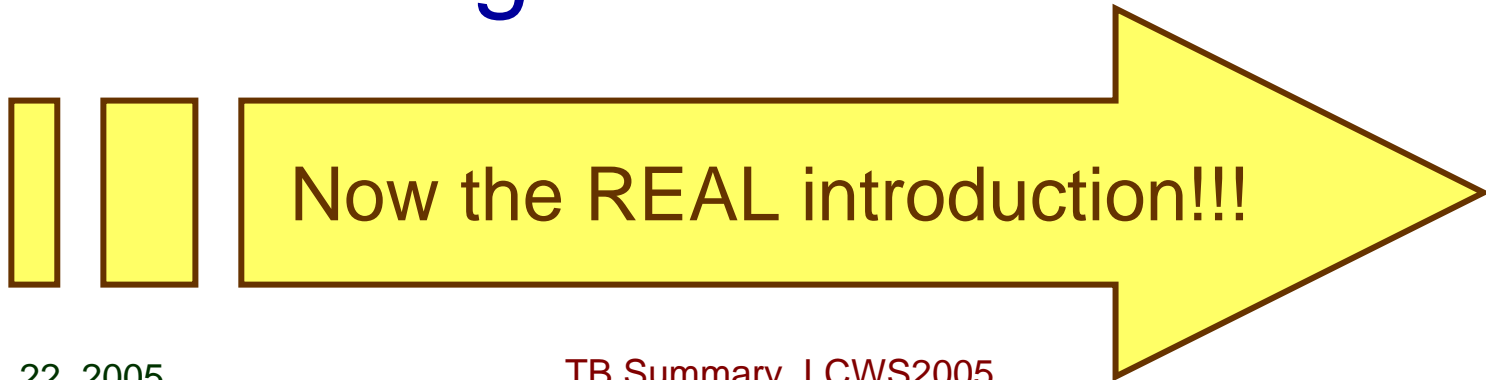
*University of Texas at Arlington*

- Introduction
- What has been happening?
- Beam Test Timeline
- World-wide TB Organization
- Conclusions

\*On behalf of the HEP group at UTA.

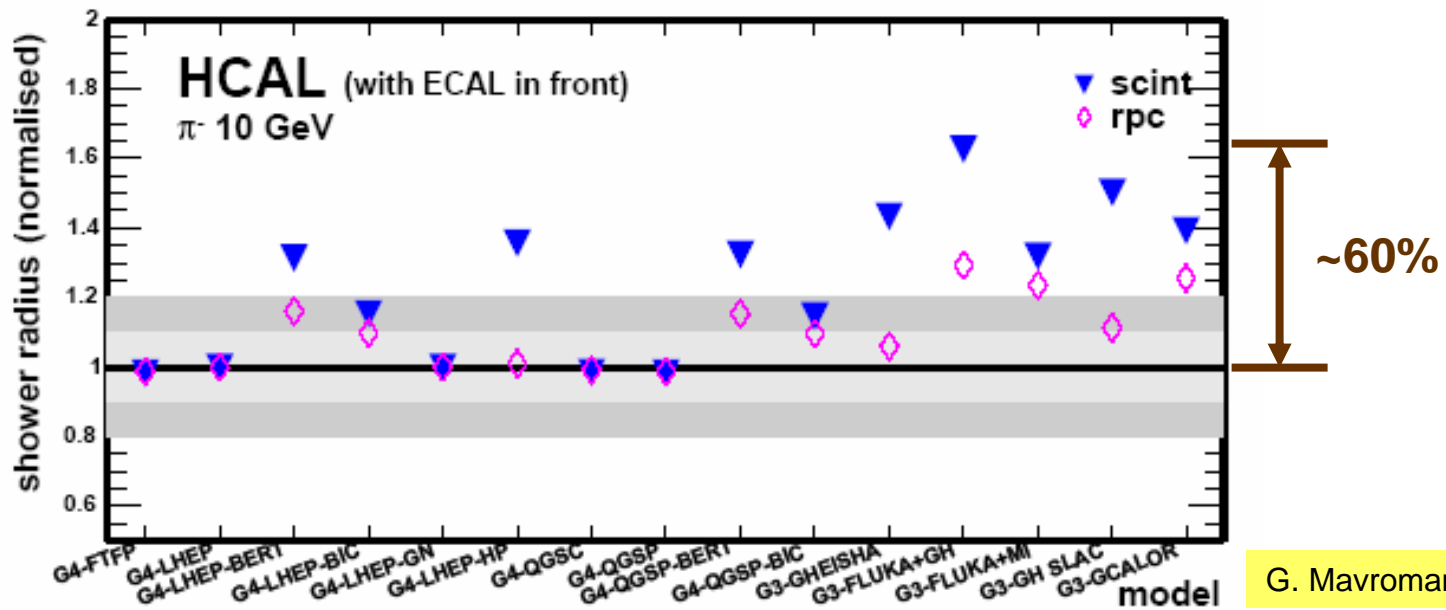
# Pre- Introduction

- There was so~~ much work done
- Can't do justice in a 15 minute talk
- I am sure I have left out some important activities
- Please forgive me of this...



# The Real Introduction

- ILC TDR timeline puts urgency on detector R&D
  - Det. CDRs by 2007, followed by LOIs in 2008
- Detector R&D activities maturing rapidly
  - Many of them need beyond-the-prototype-and-cosmic-ray testing
- PFA development also picking up speed
  - Hadronic shower behaviors need better understanding



Mar. 22

G. Mavromanolakis *et al.*

# What has been happening?

- Tremendous activities in the past year
  - Calorimeter related
    - CALICE ECAL electronics run at DESY together with Asian drift chambers
    - Korean SiW ECAL at CERN
  - Tracker TB's
  - MDI and beam instrumentation experiments
  - Etc..

# CALICE ECAL TB at DESY

## Multi-layer (30) W-Si Prototype :

- 3 independent C-W alveolar structures according to the thickness of tungsten plates (1.4, 2.8 and 4.2 mm)
- 30 detector slabs which are slid into central and bottom cells of each structure
- Active zone : 3×3 wafers × 30 layers

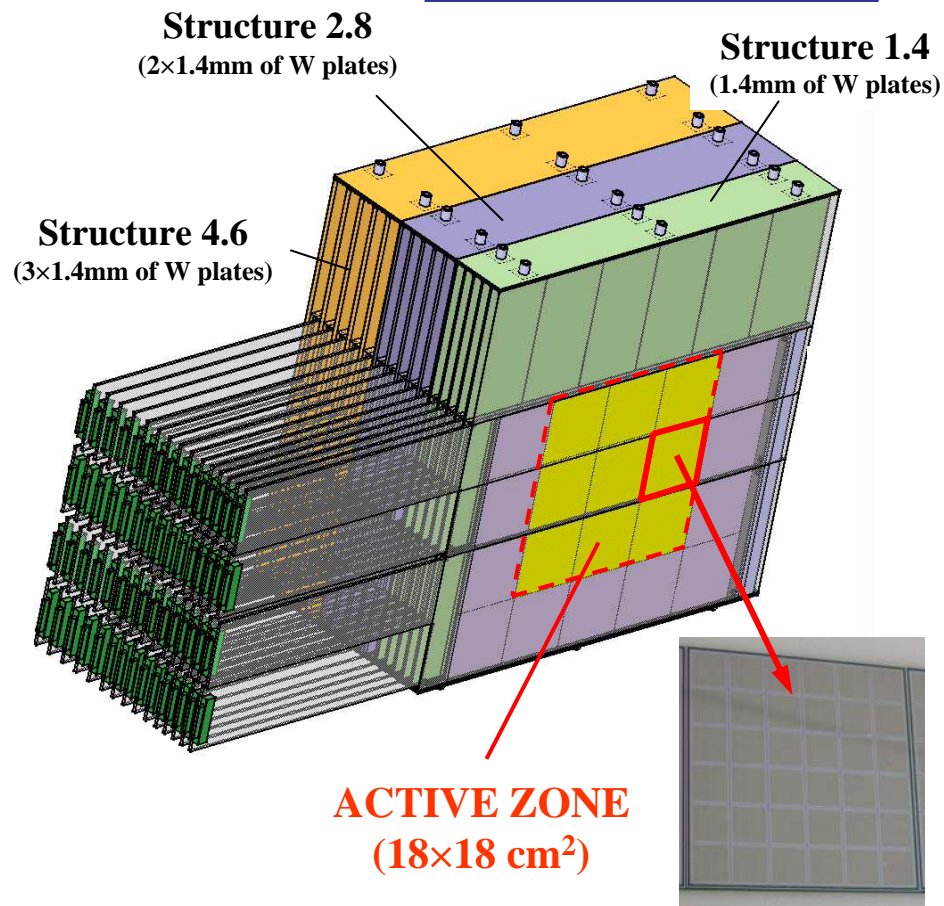
- ◆ 3 structures W-CFi (1,2,3 x1.4mm)
  - ◆ 30 « detteur slabs »
  - ◆ Dimension 200x360x360 mm
- **9720 channels in the proto.**

**G. Geycken**

Mar. 22, 2005

TB Summary, LCWS2005  
J. Yu, UTA

Design and Prod : LLR  
Integration : LLR



**270 Wafers Si with 6×6 pads (10×10 mm²)**

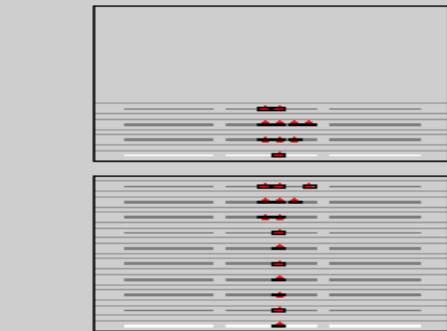
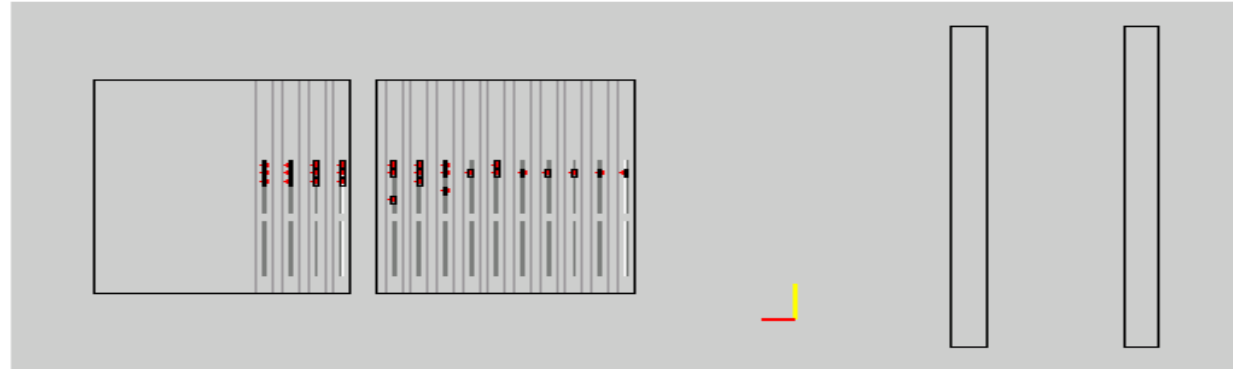
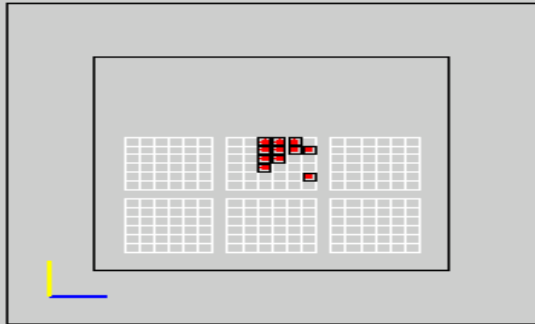
Prod : 150 MSU (Russia)  
150 IOP (Czech republic)

# CALICE ECAL TB at DESY

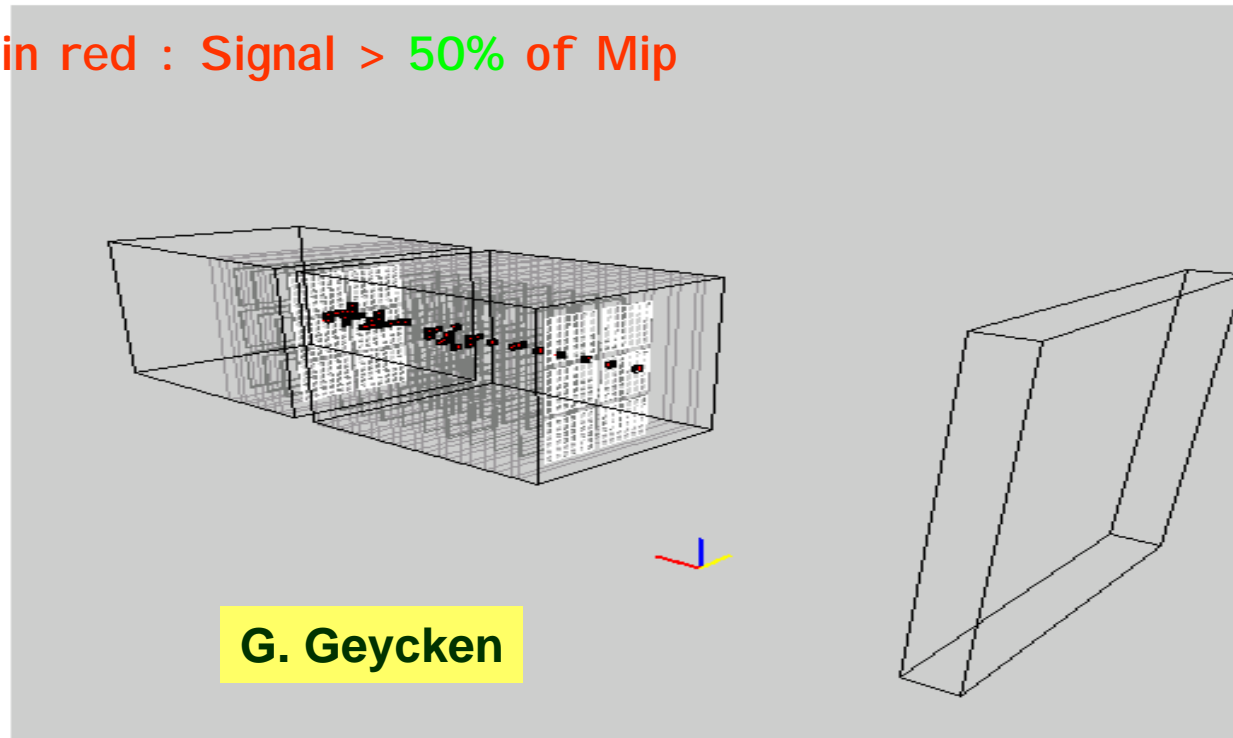
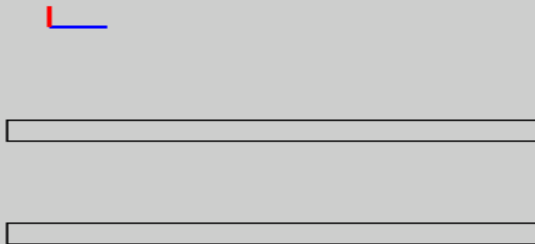
Run 100071 Event 137

RcdHeader::print() Record Time = 09:39:45:138:175 Fri Jan 28 2005, Type = 5 = event

DaqEvent::print() Event numbers in run 0, in configuration 0, in spill 0



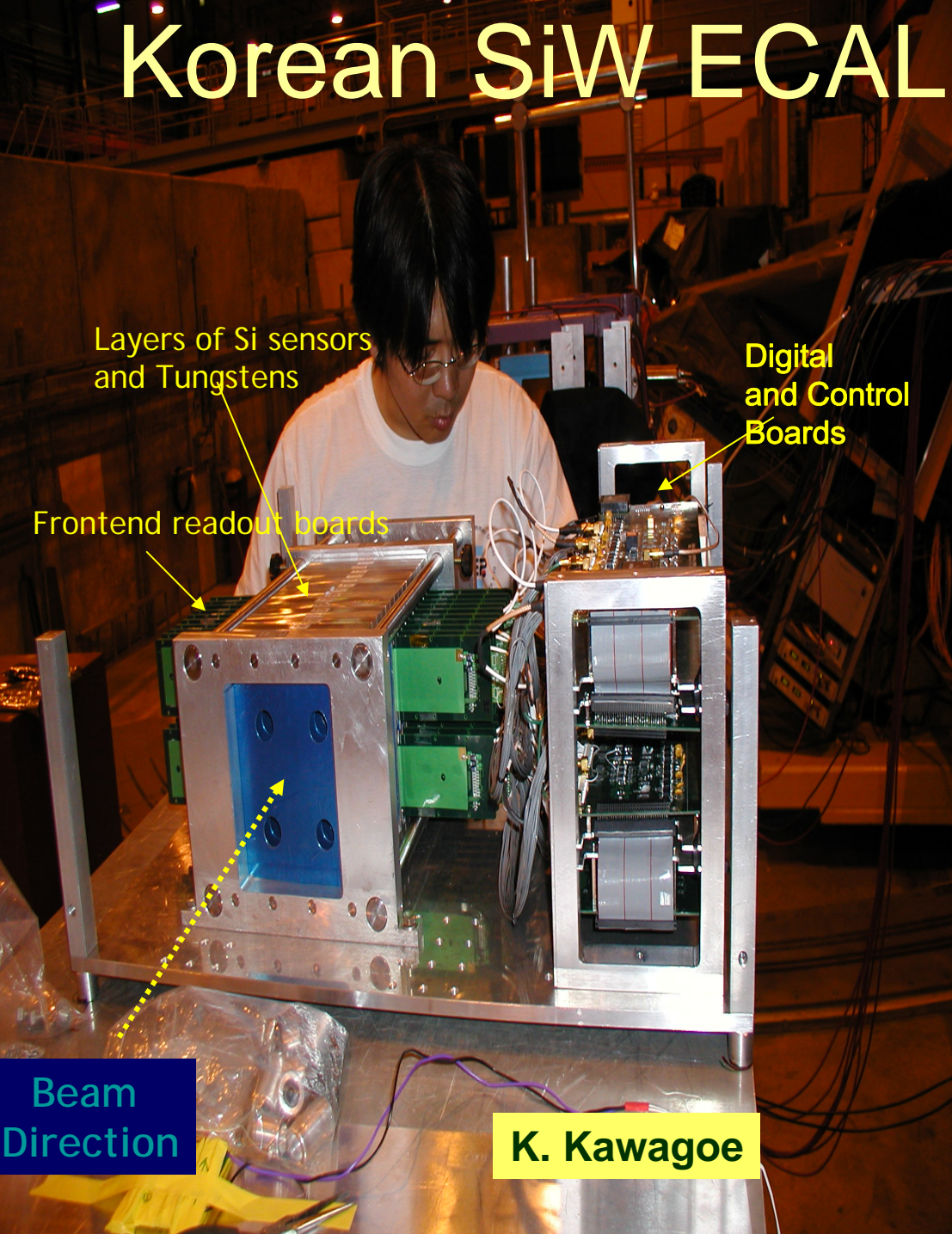
Cells in red : Signal > 50% of Mip



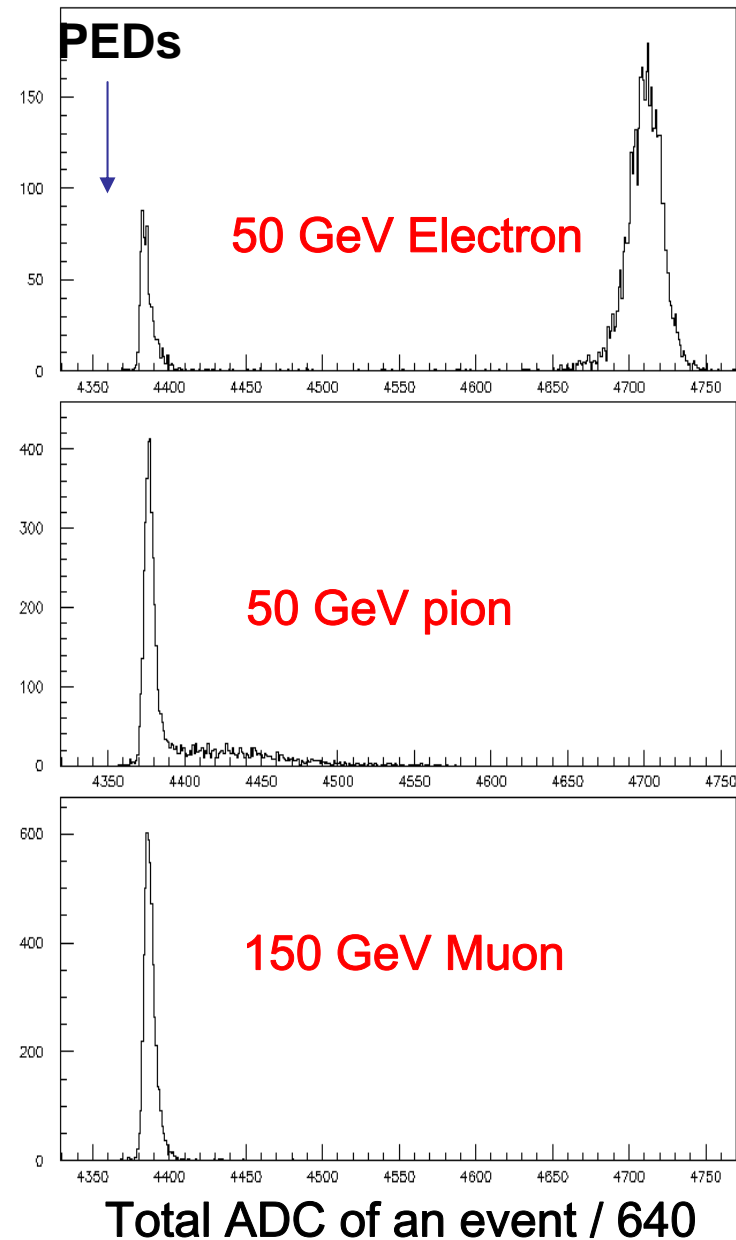
G. Geycken



# Korean SiW ECAL TB at CERN



# TB at CERN



# MDI & BI

- Europe (EUROTeV)
  - EUROTeV
    - Four beam diagnostics
    - Three beam delivery systems
  - UK LC-ABD (Linear Collider – Accelerator Beam Delivery)
- Asian
  - Laserwire (beam spot size and emittance, energy spread)
  - Nano-BPMs (for FF optics test, energy spectrometer)
  - IP Beam stabilization (FONT/FEATHER + for FF optics test)
  - Compact Final Focus optics (proposed)
- North American
  - T-474: BPM Energy Spectrometer Development
  - T-475: Synchrotron Stripe Energy Spectrometer Development
- Many more activities are in preparation

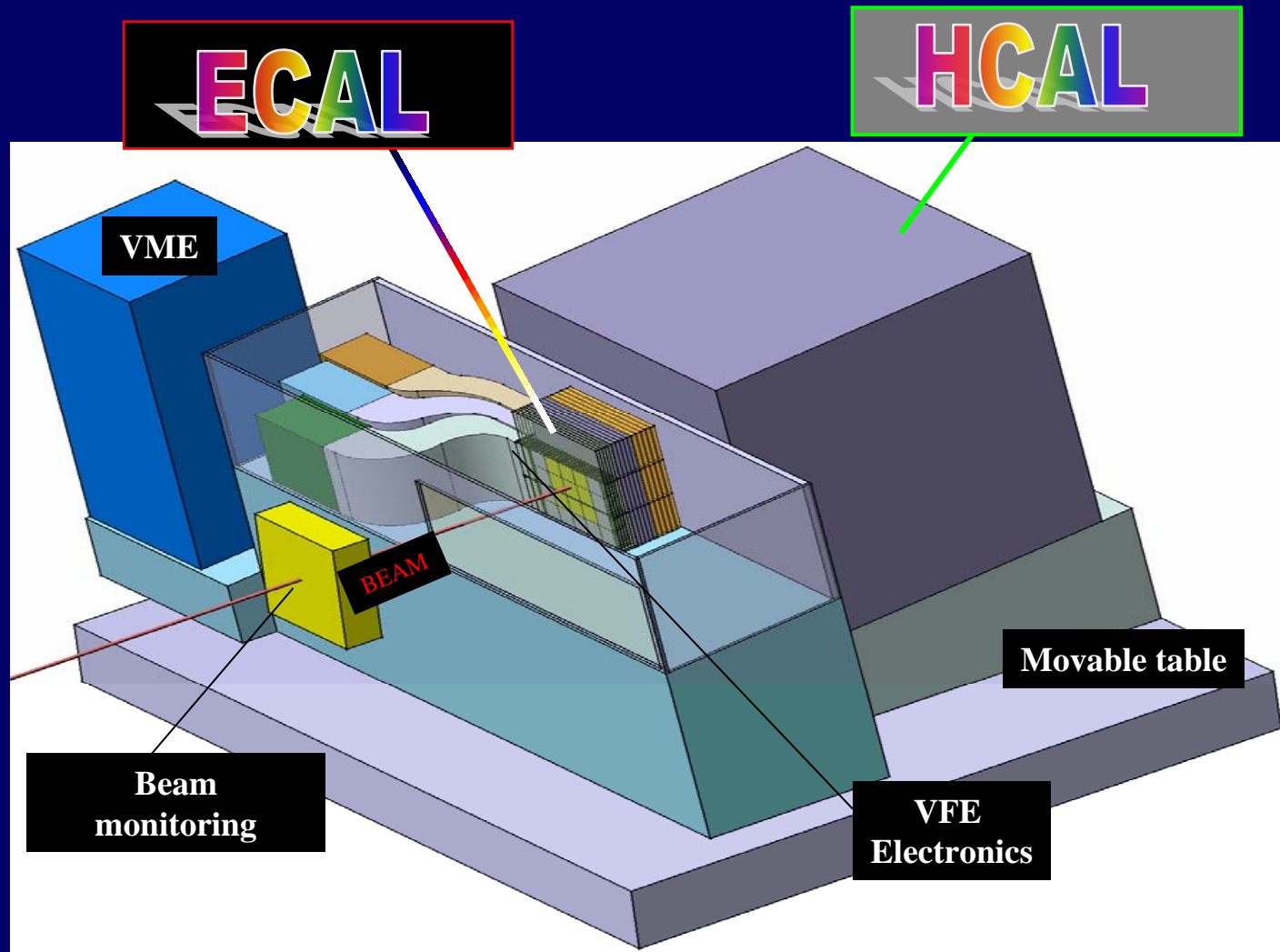
**M. Woods**



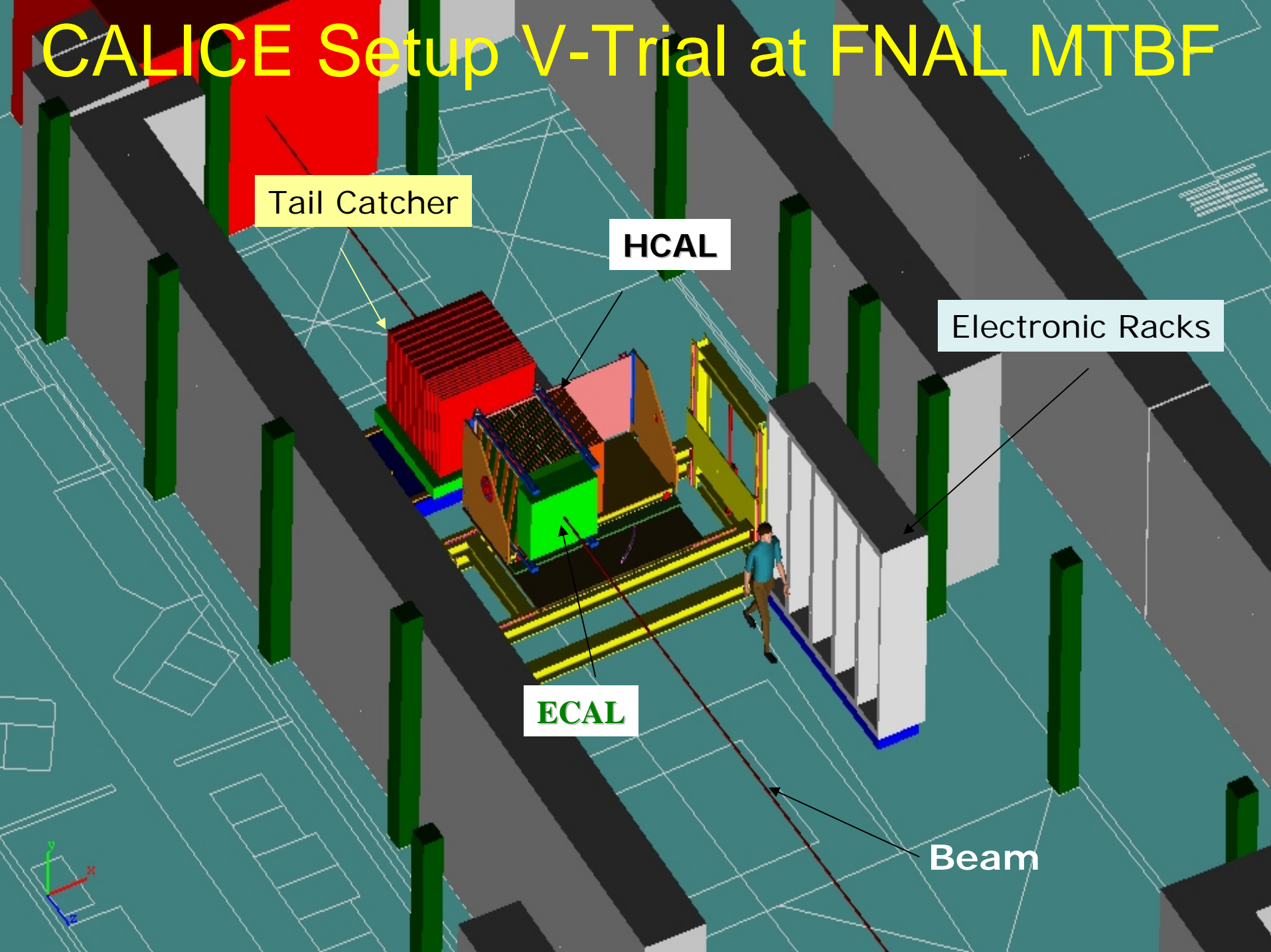
# What has been happening?

- Tremendous activities
  - Calorimeter related
    - CALICE ECAL electronics run at DESY together with Asian drift chambers
    - Korean SiW ECAL at CERN
  - Tracker TB's
  - MDI and beam instrumentation related activities
  - Etc..
- A lot of groups are preparing for TB in the next couple of years

# CALICE Combined TB



# CALICE Setup V-Trial at FNAL MTBF



# What has been happening?

- Tremendous activities
  - Calorimeter related
    - CALICE ECAL electronics run at DESY together with Asian drift chambers
    - Korean SiW ECAL at CERN
  - Tracker TB's
  - MDI and beam instrumentation related activities
  - Etc..
- A lot of groups preparing for TB in the next couple of years
- Three US Calorimeter groups (SiW Ecal, GEM and RPC DHCAL) submitted a NSF MRI proposal (\$960k) for development of TB modules
- An ILC planning document submitted to Fermilab ([FNAL-TM-2291](#))
  - FNAL directorate has asked all divisions for impact statements
- We are asked to make a presentation at FNAL PAC meeting Apr. 7 – 9

# Planning Document to FNAL



Fermilab

FNAL-TM-2201

## International Linear Collider Calorimeter/Muon Detector Test Beam Program (A Planning Document for Use of Meson Test Beam Facility at Fermilab)

February 22, 2005

J. C. Brient and J. Yu

For the ILC Calorimeter Test Beam Group

### Abstract

The linear collider requires a detector with excellent performance to fully exploit its physics potential. In particular, requirements from the measurement of hadronic jet energies indicate a goal of developing the calorimeter with an unprecedented jet energy resolution of 30%/√E or better. In order to meet this challenge, novel technologies and reconstruction techniques are being developed, which need to be tested with particle beams. The recent decision by the International Technology Recommendation Panel (ITRP) concerning the linear collider accelerator technology imposes a time scale of at most a few years for the basic detector design choices. A vigorous test beam program over the next few years is necessary to provide a solid basis for these decisions. In this regard, the International Linear Collider Calorimeter and Muon Detector Test Beam Group submit this planning document to Fermilab. The main goals of the test beam program outlined in this document are to evaluate the different choices of technologies proposed for the calorimeter and to understand, validate and improve the Monte Carlo modeling and simulation of hadronic showers. This document contains a description of fourteen distinct calorimeter and muon detector/tail-catcher groups and their requirements for specific test beam resources. This planning document also lays out time scales and institutional responsibilities for the proposed test beam program. It provides plans for the users of the Fermilab Meson Test Beam Facility, and needs for upgrades to particle energy ranges and intensities, and associated engineering and computing support services.

- Initial draft written at the ANL workshop in Sept.
  - As agreed at ECFA meeting
- Result of the World-wide LC CAL/Muon TB Working Group
  - Many thanks....
- Total of 25 pages w/
  - Overview of TB plans and requirements
  - Will be followed by detailed MOUs
- Submitted to FNAL on Feb. 22, 2005

**J. Repond**

Mar. 22, 2005

TB Sur

# Total of 11 Projects in the Document

Calorimeter	Project	Lead institution
<b>ECAL</b>	Silicon-Tungsten (CALICE)	LLR
	Silicon-Tungsten (US)	SLAC, Oregon
	Scintillator-Tungsten	Shinshu
	Scintillator-Tungsten	Colorado
	Scintillator-Silicon-Tungsten	Kansas
	Scintillator-Silicon-Lead	Padova
<b>HCAL</b>	Scintillator-Steel	DESY
	RPC-Steel	ITEP, ANL
	GEM-Steel	UTA
<b>Muon-detectors/tail catcher</b>	Scintillator-Steel	DESY/FNAL/NIU
	RPC-Steel	Frascati

28 institutions from 3 regions



# Beam Momentum Requirements

Particle	Energy range
Electrons	3 – 20 GeV → 1 – 20 GeV
Pions	3 – 66 GeV → 1 – 66 GeV
Protons	3 – 66 GeV, 120 GeV
Muons	3 – 20 GeV, momentum selected
Muons	Not momentum selected

Both polarities

Rates in part not to exceed 100 Hz

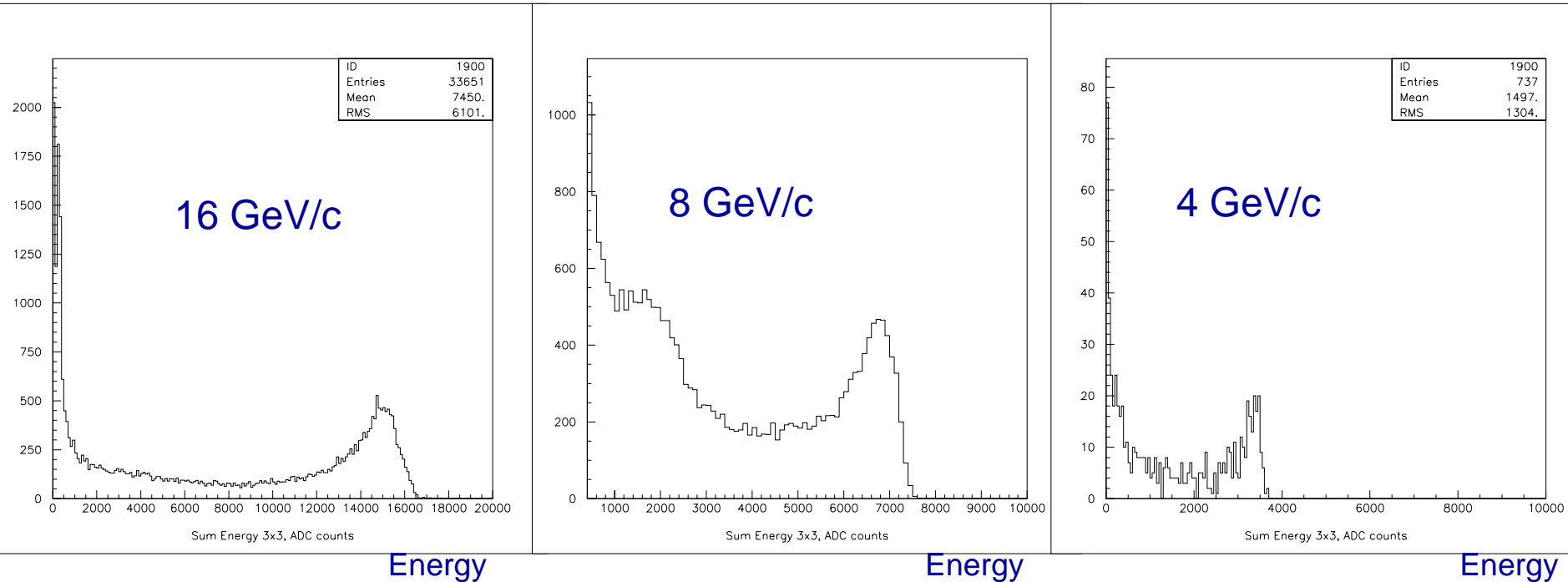
**J. Repond**

# TB Facilities

- MTBF has been receiving beam for about a year
  - Electrons of energies 4 – 16 GeV observed
- First large contact between CALICE and FNAL made this past Wednesday
  - Some concerns with MTBF pointed out to the lab
    - Experimental Area related
    - Duty factor: one 5 sec slow spill every 2 min starting April 05
    - Late arrival time of beam element triggers (200ns)
    - Beam tune optimization
  - Will work with Fermilab on these concerns
- Fermilab beam will be shut down for DØ and CDF upgrades starting Oct. for 2 – 4 mos.
- Possibility of test beam availability at CERN being raised and will be investigated

# Electrons at MBTF

## Measurements with BTeV EMCAL prototype w/o CC tags



2% electrons  
~90/spill

10% electrons  
~40/spill

25% electrons  
~10-20/spill

Significant material (air, counters) in beam line  
Needs vacuum (44 feet), helium bag

**Easily factor of 2 improvement**

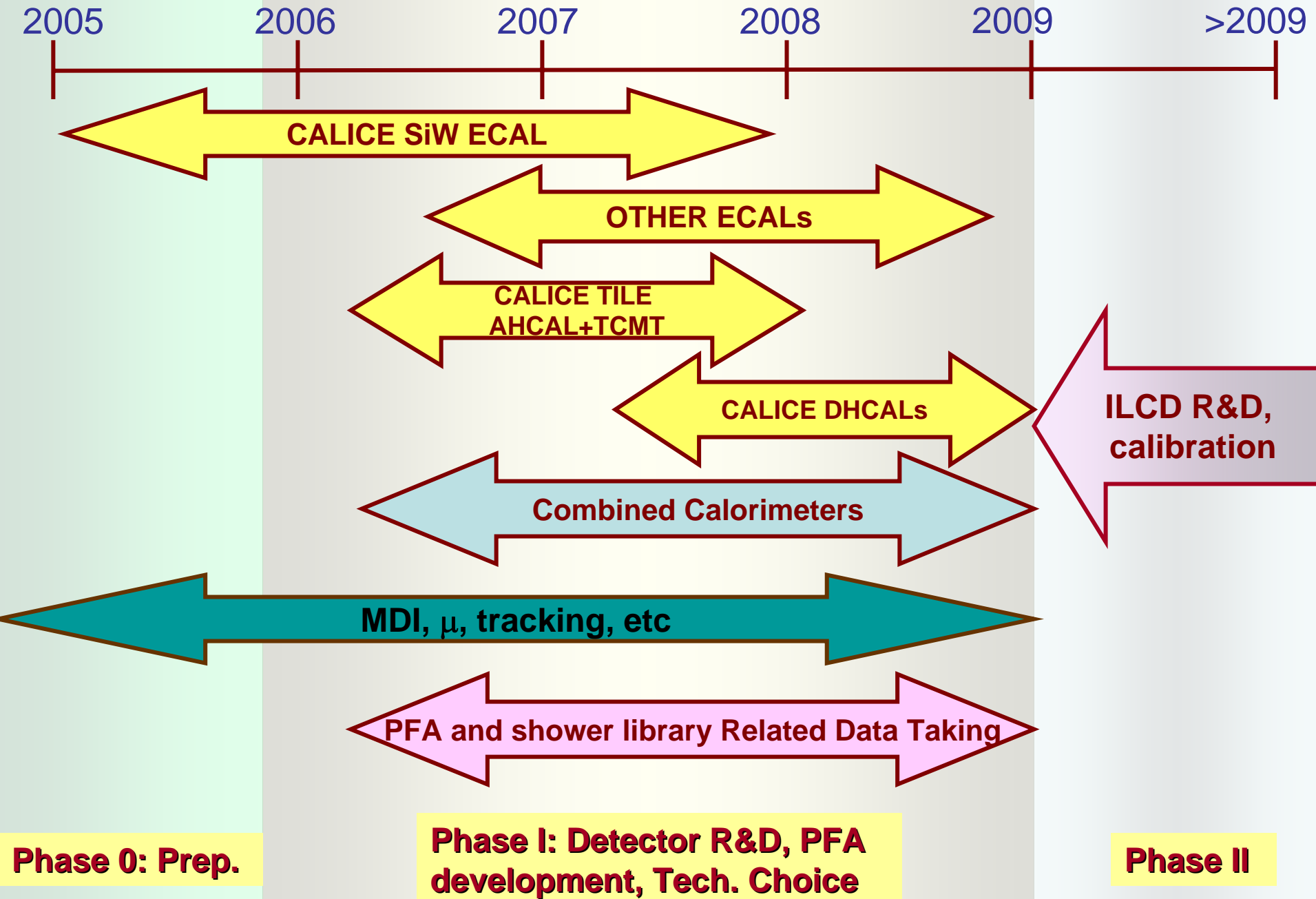
**J. Repond**

# VTX, Tracking and Muons

- VTX and Tracking group plans to put down requirements for beam tests
  - Less stringent beam requirement compared to CAL
    - Broader facility options
    - But still need to specify requirements
  - Massimo Caccia and Dave Bailey will collect the requirements and put together a draft by Snowmass
- Tail Catcher and Muon Detectors
  - One TC and two separate muon prototypes in preparation

**D. Bailey, H.E.Fisk**

# Timeline of Beam Tests



# World-wide TB Organization

- Regional TB contacts
  - Europe: F. Sefkow & V. Vrba
  - Asia: K. Kawagoe
  - North America: G. Fisk & J. Yu
- Given the anticipated degree of TB efforts, the regional contacts agreed to
  - Teleconference every 6 weeks to keep each other posted on regional efforts and coordinate
  - An incremental update to the status document released last fall
  - Your help for informing us is greatly appreciated



# Conclusions

- Tremendous amount of activities
  - Anticipated to increase dramatically
  - Though US CALTB activities rely heavily on availability of funds
- Limited number of facilities for a combined calorimeter beam tests
  - CERN possibility to be investigated
- VTX and Tracking integration effort begun
  - Requirement document by Snowmass
- Fermilab is working closely with LC TB community
- WW coordination effort to pick up momentum