

# SiW Ecal Performance in FNAL Testbeam May/July Running

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LAL Orsay

- Data Collected with the Ecal
- Ecal in July running
- Collected Data and Glimpse on Quality
- Summary and Conclusion

Disclaimer: I will concentrate on the July Running  
For May Running see

<http://ilcagenda.linearcollider.org/conferenceDisplay.py?confId=2631>

Most of the work was made by Hengne Li

CALICE Collaboration Meeting Manchester/UK Sept. 2008

# The Ecal in the Testbeam ...

...simply great ....

Detector in testbeam(s) since 2005

A big 'thank you' to all the people involved in the project

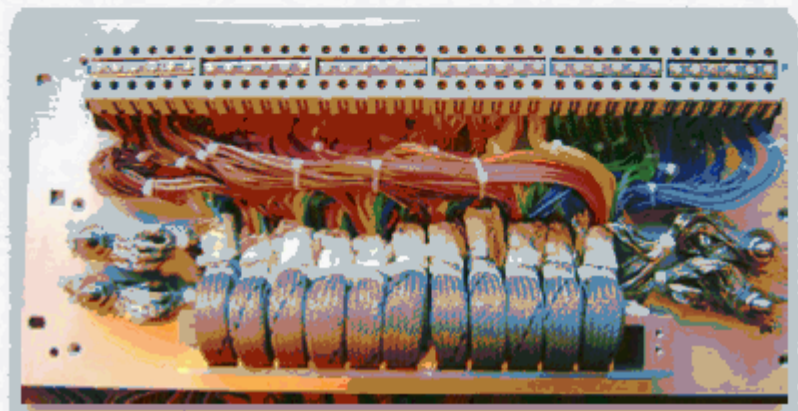
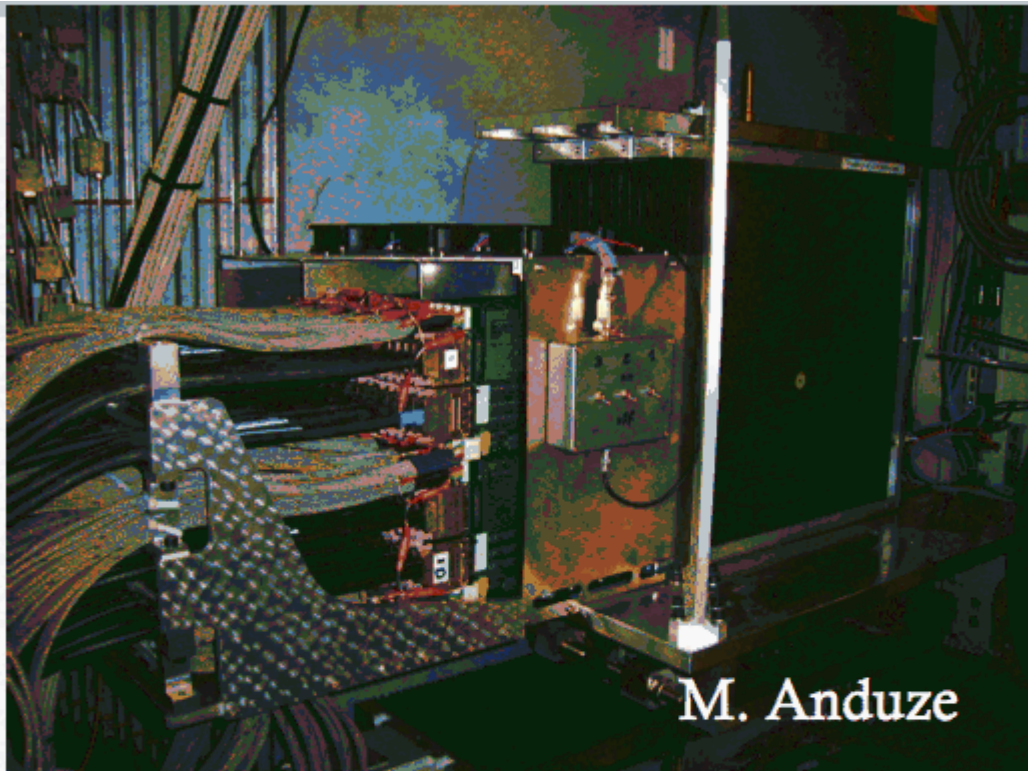
let's plunge into the details

# Ecal Configuration @ FNAL

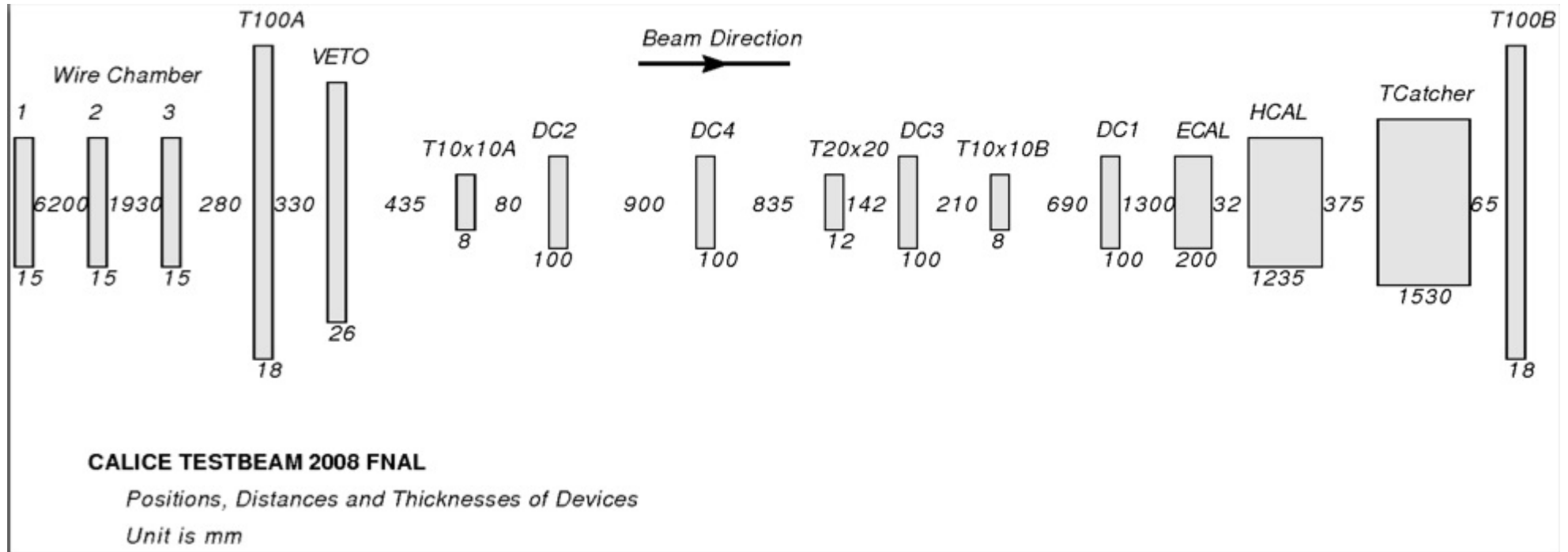
## Fully Equipped

- 3x10 Layers, Si-W
  - $0.4X_0$ ,  $0.8X_0$ ,  $1.2X_0$
  - $24X_0$  total
- Each layer 3x3 wafers
- Each wafer 6x6 pads
- 9720 channels total
  - 216 channels/PCB Center Part
  - 108 channels/PCB Bottom Part

New Patch Panel (P. CORNEBISE)



# Sketch of the beamline



A.Kaplan, H.Li

# SiW Ecal in FNAL Beamline



Ecal ready to take data by 25<sup>th</sup> of April  
as all the other CALICE Equipment

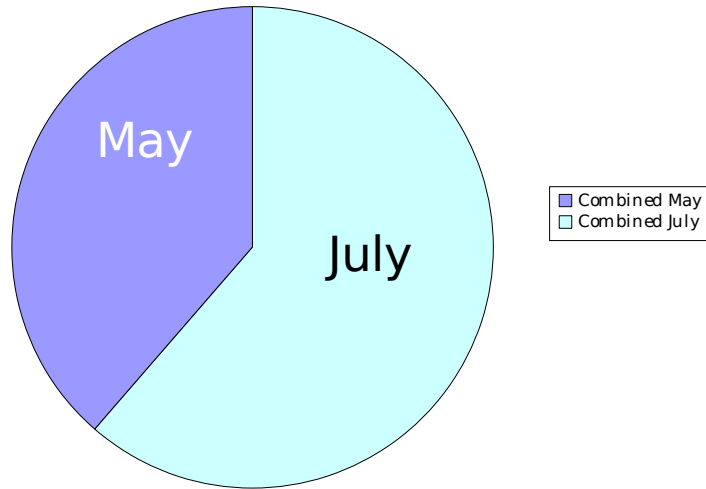
# SiW Ecal Crew @ FNAL



*Picture courtesy of I. Polak*

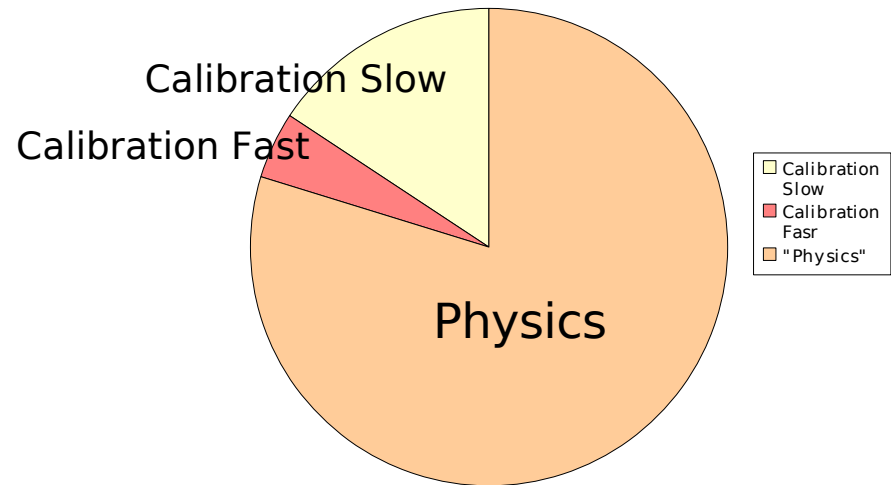
# "Luminosity" - Recorded Data

Combined Data May/July



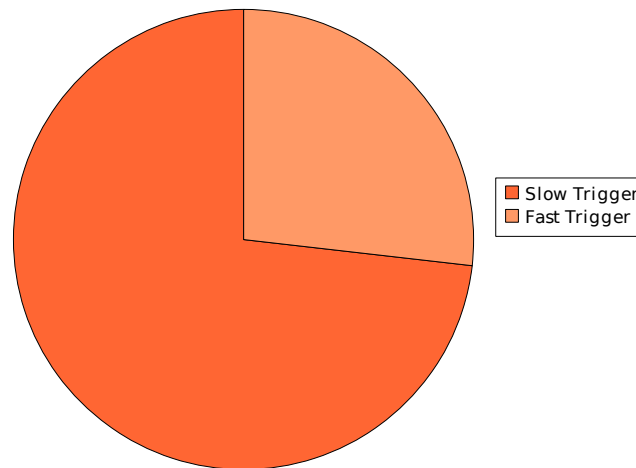
Total: 17.3 kEvens in beamData Runs

Calibration/"Physics"



~20% Calibration Data, i.e. muons

Fast/Slow Trigger Data



**All data recorded with Ecal on**

~25% with Fast Trigger (mostly e-)

*CALICE Collaboration Meeting Sept. 2008*

# Issues of Ecal Running during July

- Extensive 'repair' work beginning of July (P. Cornebise LAL)

  - Proper common ground

  - Isolation of Detector from Chassis

  - Still looks as if the power connectors

- (More or less) Quiet Running during 'Fast Trigger' data taking and initial Slow Trigger Data Taking

  - > Figure

- Noisy Layers/Pedestal Shifts back with us as we started the shifted program

  - > Figure

- Hot whether at FNAL lead Ecal Currents in Bias Voltage Supply Chain to increase beyond 250  $\mu\text{A}$

  - Ecal is expensive thermometer Gradient  $\sim 10 \mu\text{A}/\text{degC}$

  - No impact on Ecal Noise observed, steady monitoring with emcNoise runs

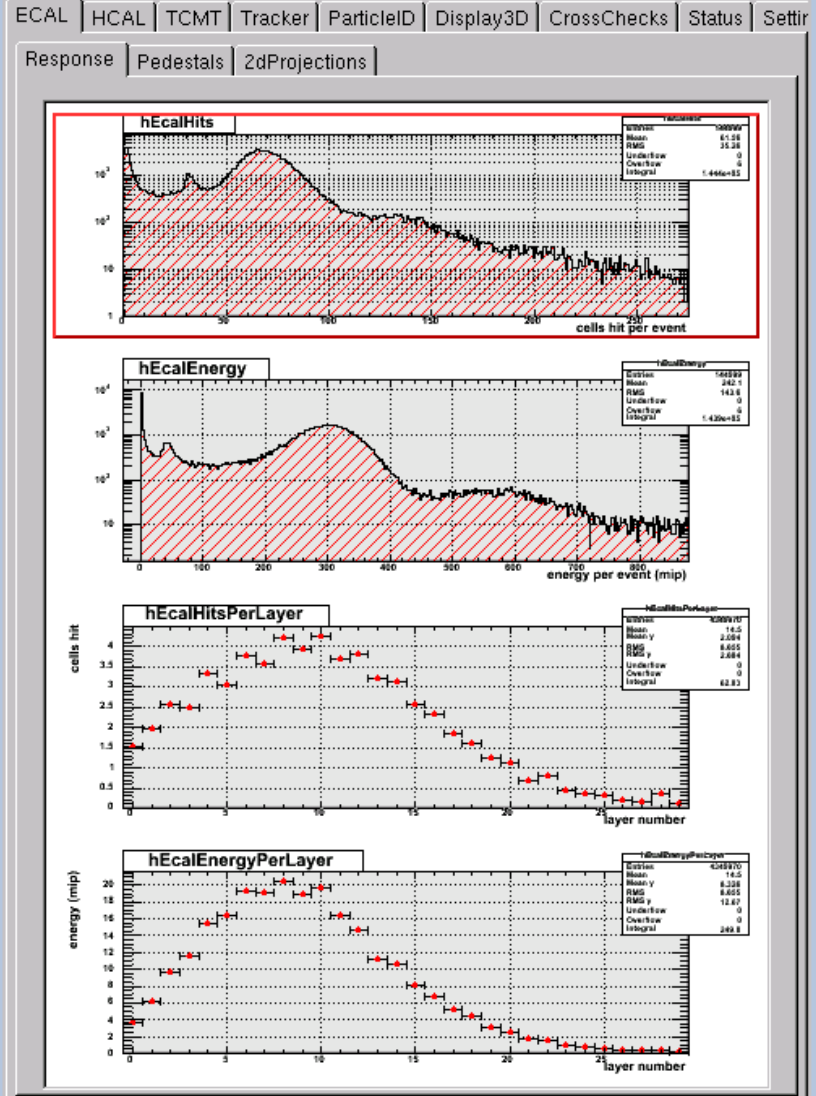
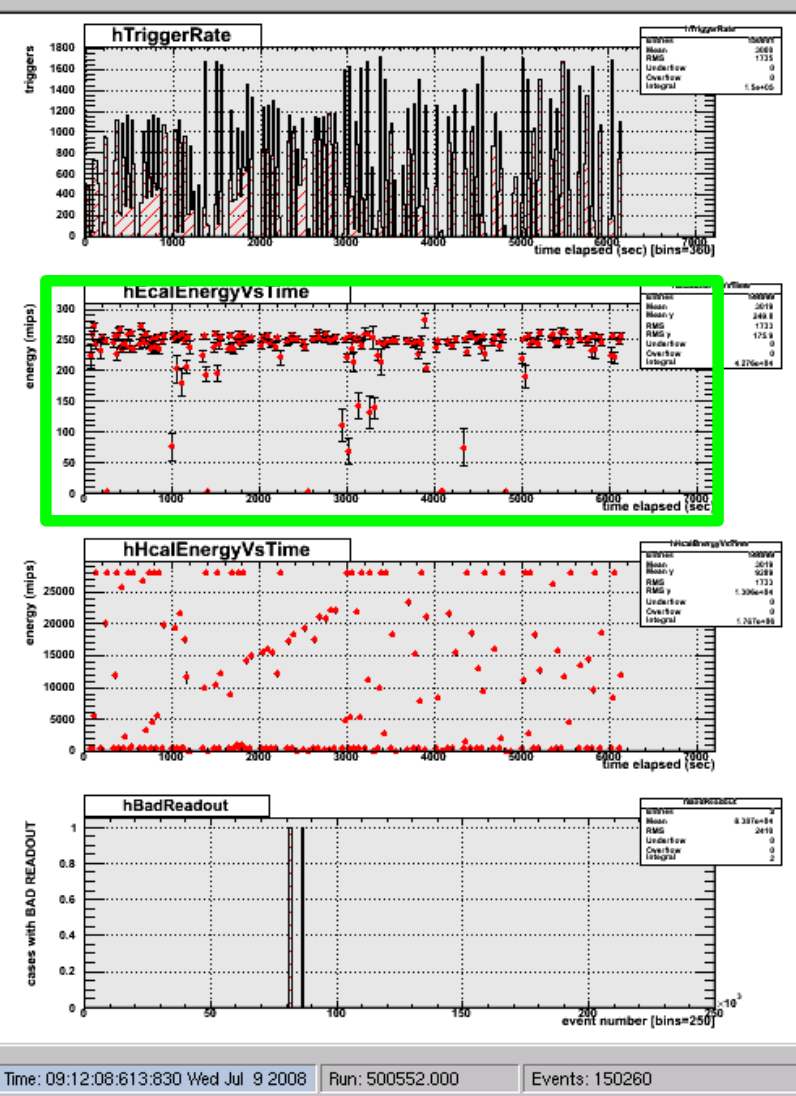
  - Night running clearly enhances the efficiency of Ecal

- Ecal shipped back to Europe for repair work

  - Dead Cells in bottom part



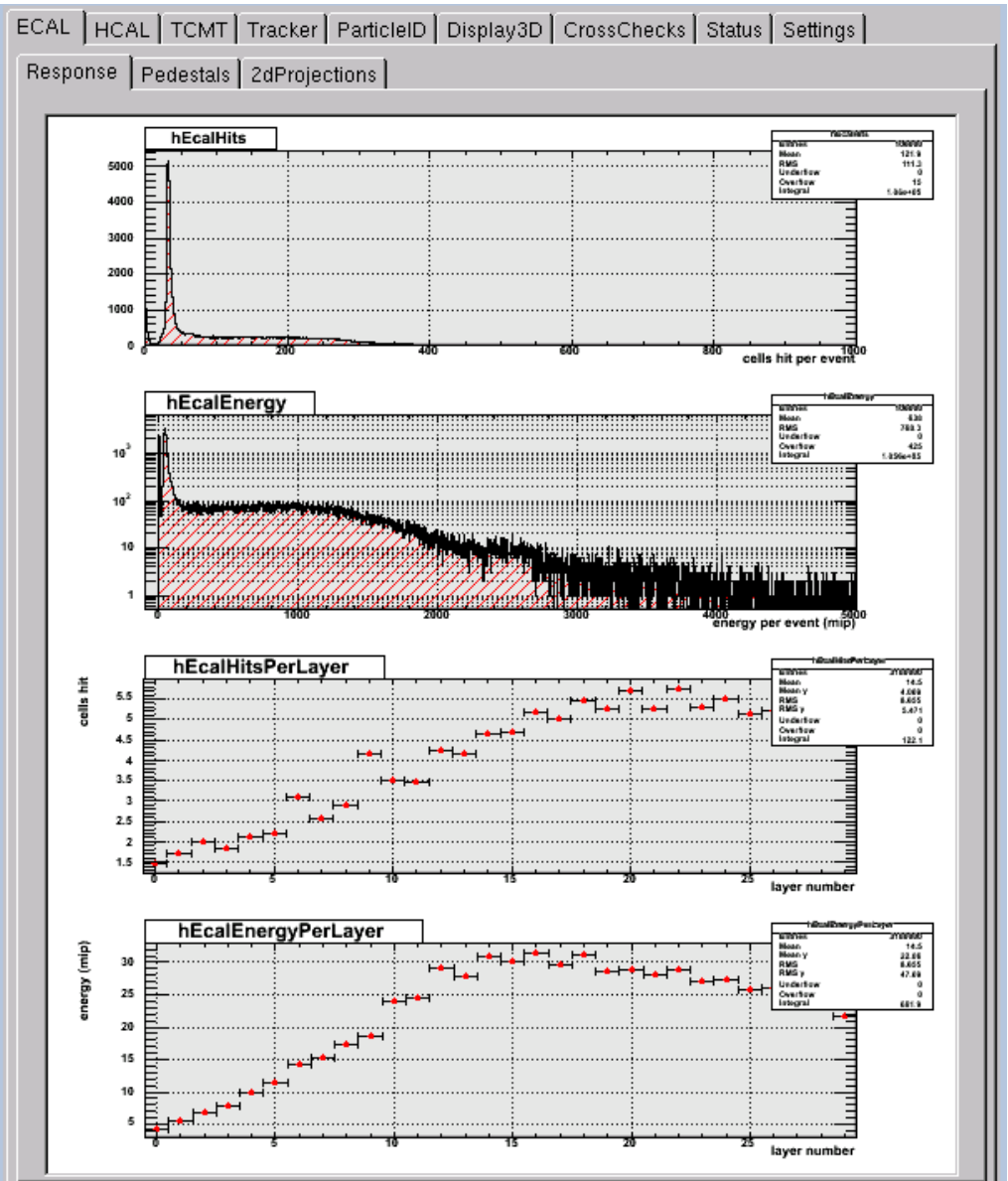
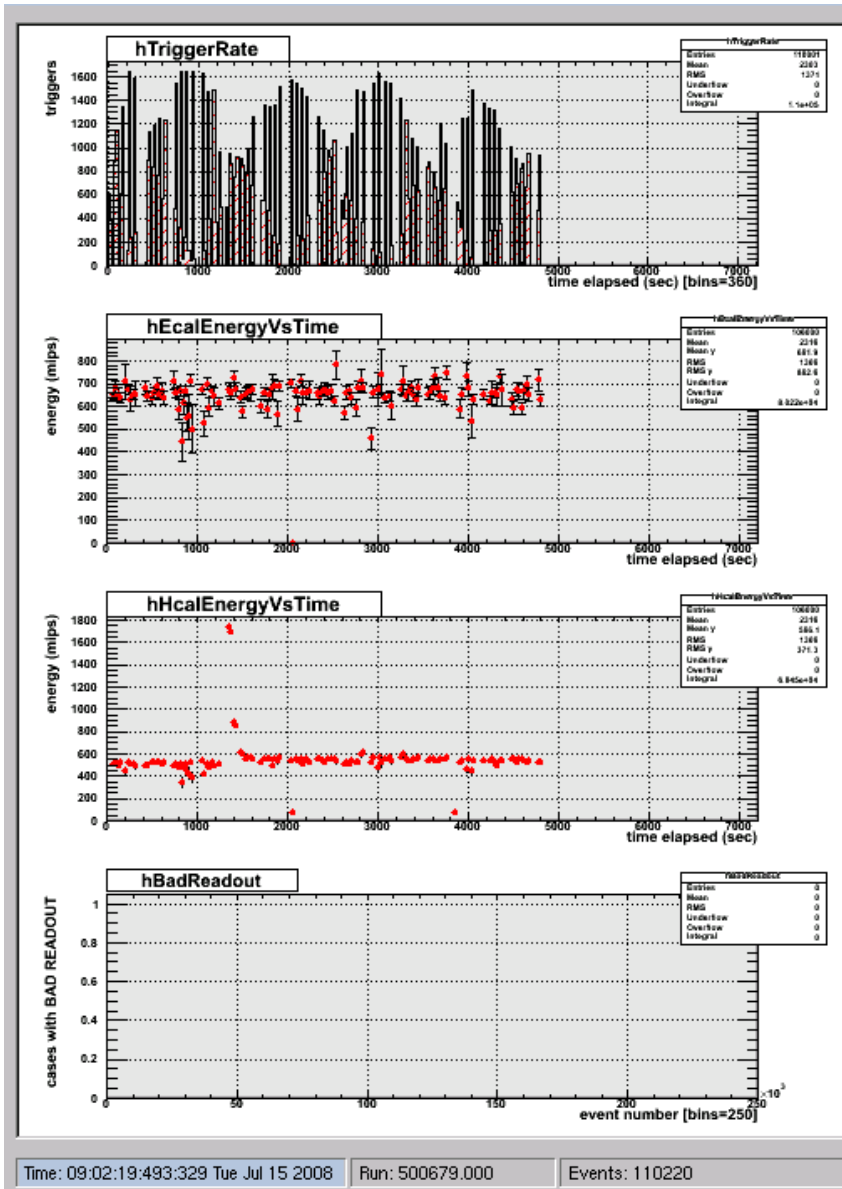
# Impressions from the Ecal Running I



Ecal Noise largely tamed  
 No noisy layers for > 90% of time

Suggest to prepare data analysis such that Events with Ped. Shifts are simply rejected not corrected

# Impressions from the Ecal Running II



# Runs with Fast Trigger - "Ecal Program"

Trigger : 20x20

## CALIBRATION RUNS

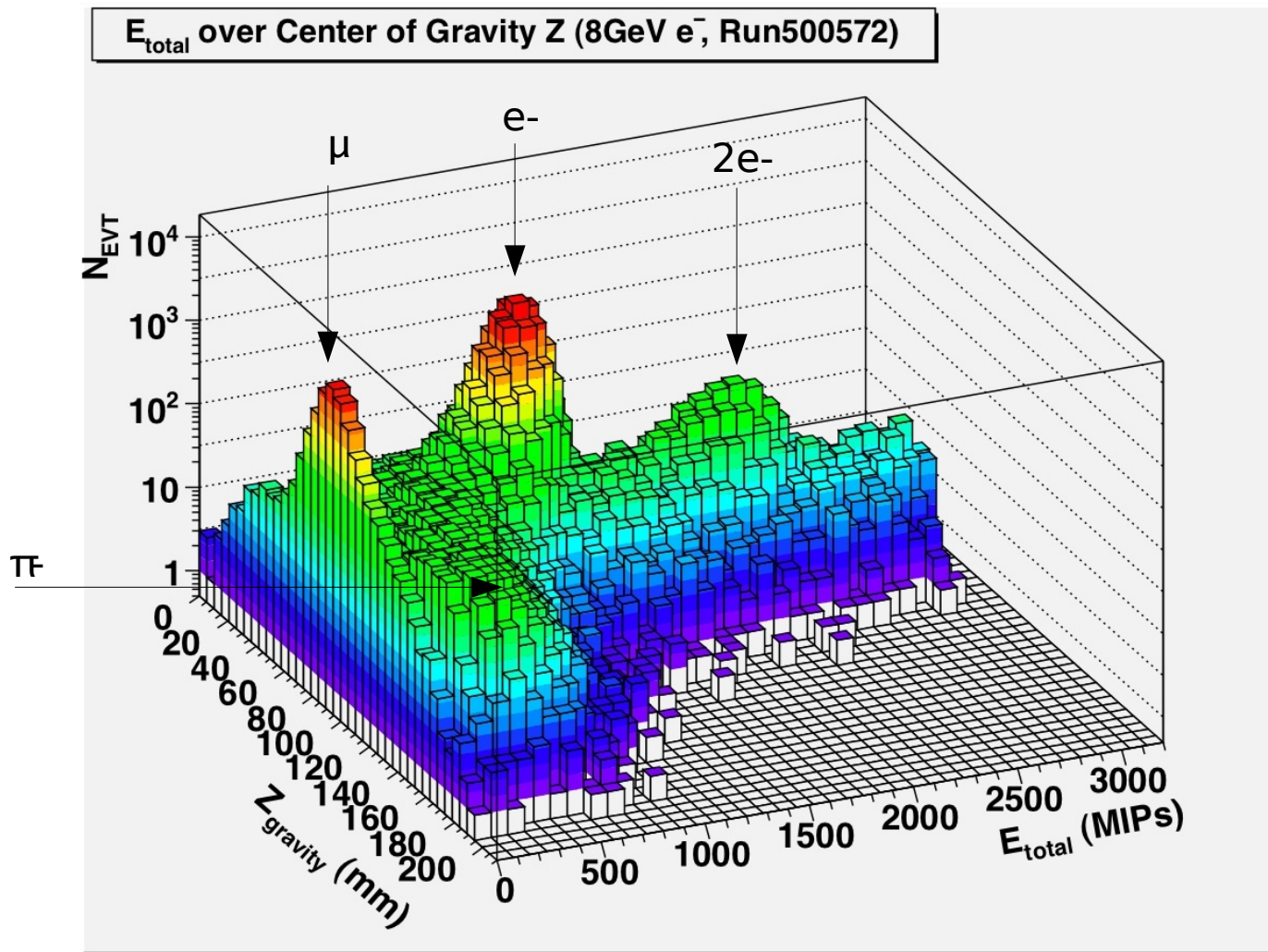
		Run Number	Nevent
muon	32GeV	500518, 500529, 500531, 500532	207k

## ELECTRON RUNS

		Run Number	Nevent After Reconstruction
e-	1GeV	500541, 500542, 500550	207k
	2GeV	500551, 500552	177k
	4GeV	500553, 500555, 500556, 500558	171k
	6GeV	500561	150k
	8GeV	500572, 500573	126k
	12GeV	500612	183k
	20GeV	500630, 500631	196k
e+	1GeV	500574, 500575	85k
	2GeV	500593	114k
	4GeV	500594	118k
	6GeV	500596	107k
	8GeV	500597, 500599, 500602, 500604	226k
	12GeV	500605, 500606, 500608, 500609	267k
	20GeV	500627, 500628, 500629	257k

# General Remarks on DQ

## Ecal spectrum

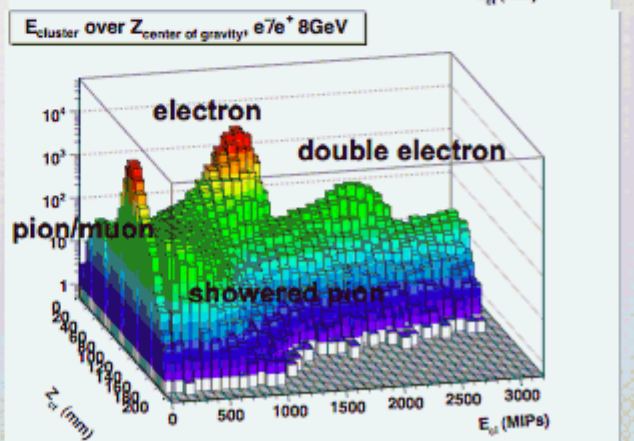
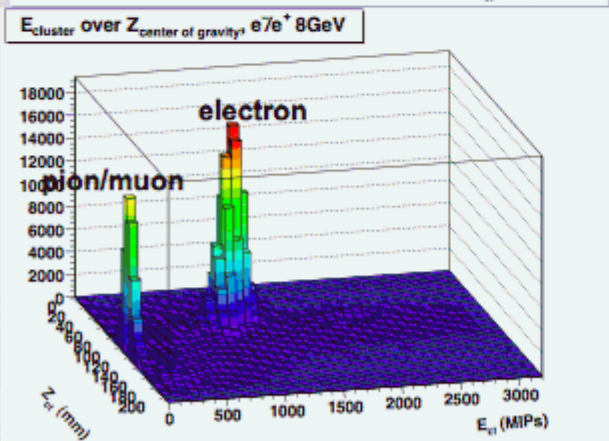
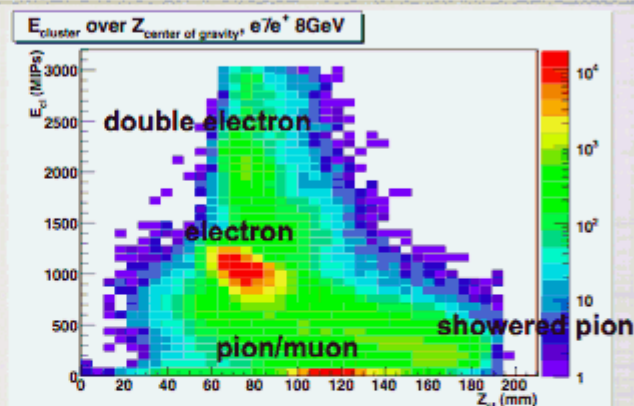
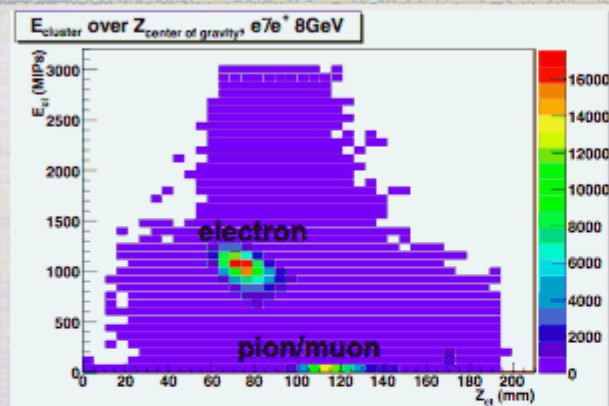


Hengne Li, LAL

- Large  $\mu$  contamination
- Multiparticle events (e.g. up to 5  $\pi$ 's)
- Where Cerenkov is missing Ecal can be used to separate particles

# ELECTRON SELECTION

- Cluster Energy over Center of Gravity Z: 8GeV e-/e+ as an example



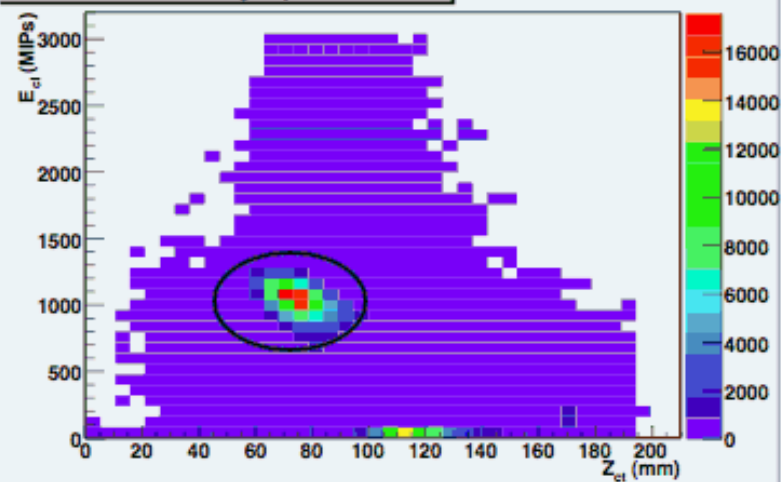
5

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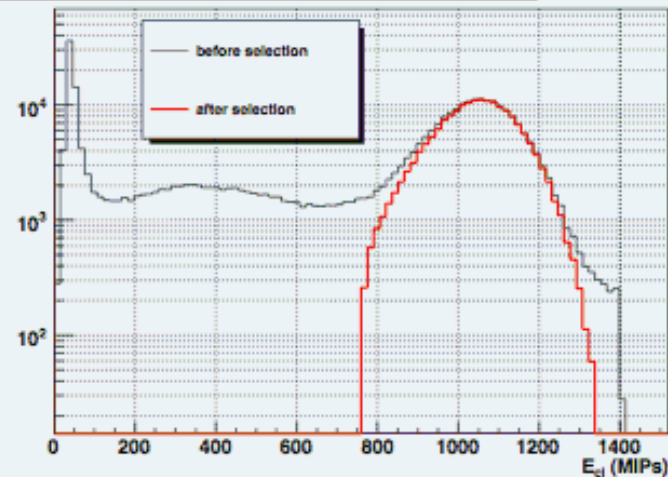
# ELECTRON SELECTION

- Define Ellipse: 
$$\frac{(E_{cl} - E_{mean})^2}{(3 \times \sigma_E)^2} + \frac{(Z_{cg} - Z_{mean})^2}{(3 \times \sigma_Z)^2} < 1$$

$E_{cluster}$  over  $Z_{center\ of\ gravity}$ ,  $e\bar{e}$  8GeV



Energy Spectrum of Selected Electron,  $e\bar{e}$  8GeV

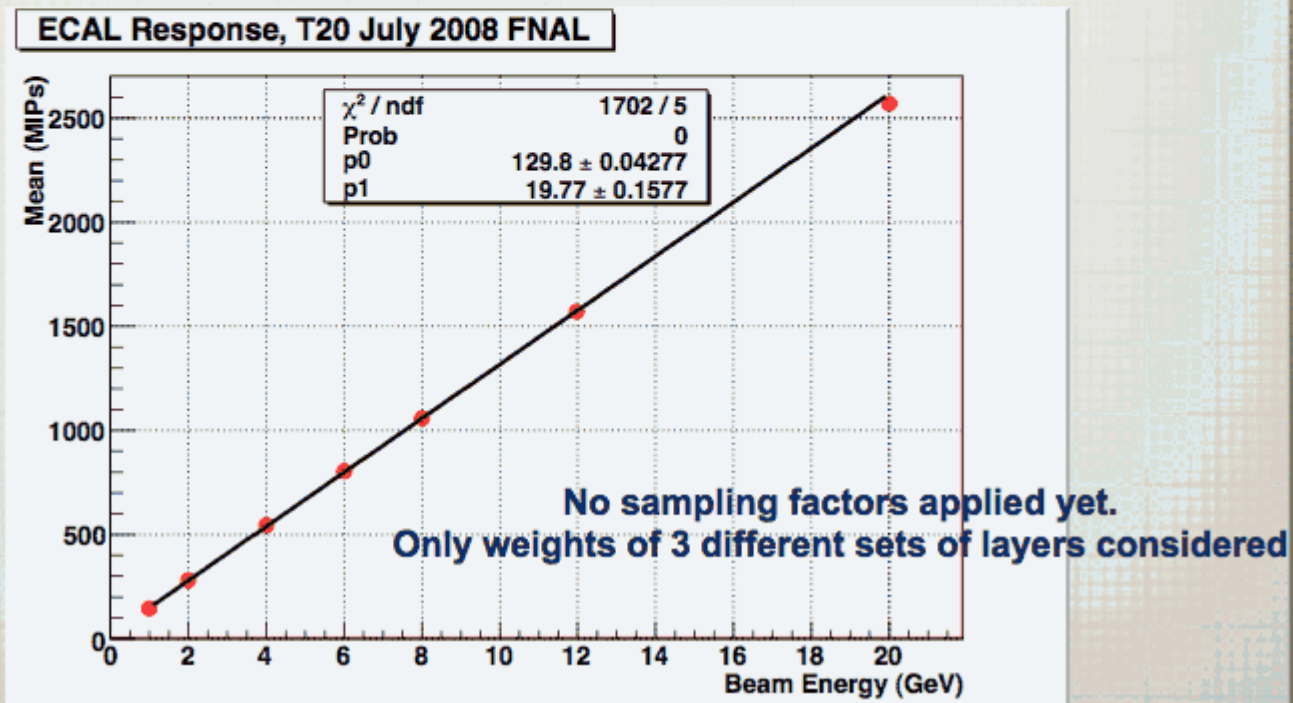


- Fitting Results:

	Before selection	After Selection
E mean (MIPs)	1051.37	1054.36
E sigma (MIPs)	96.59	93.64

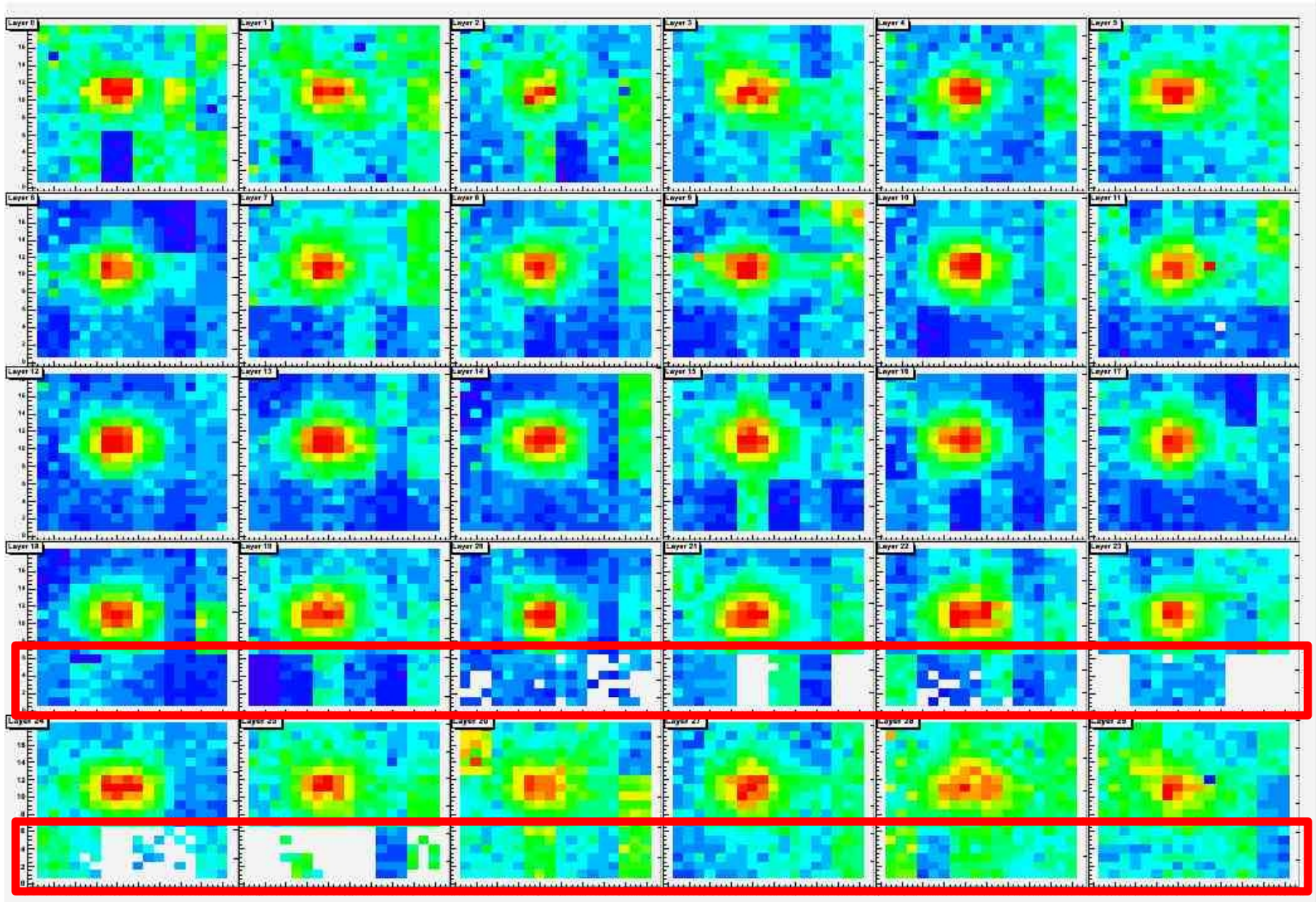
# RESPONSE

- Fit Result:  $E_{mean}(MIP) = 129.8E_{beam}(GeV) + 19.77$



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# Hit Maps ...



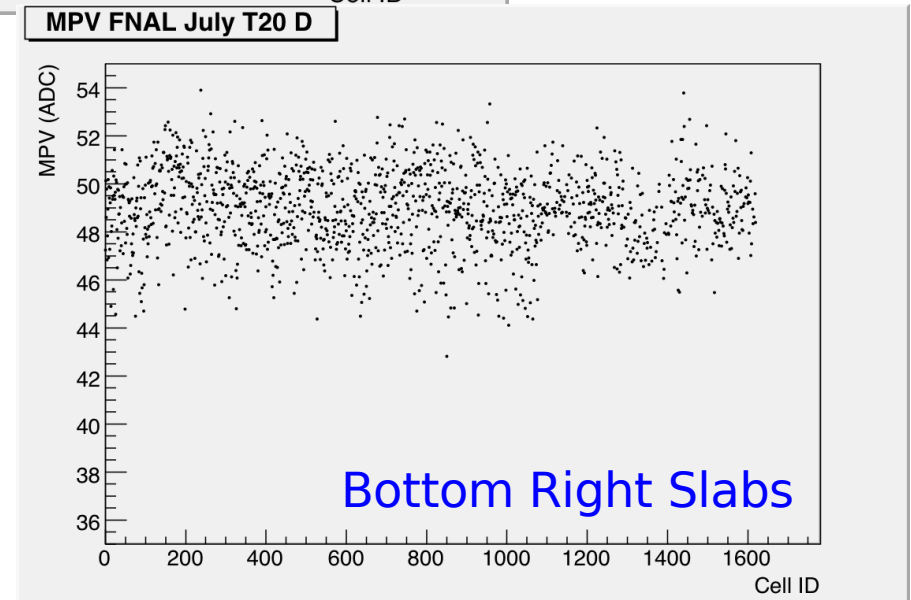
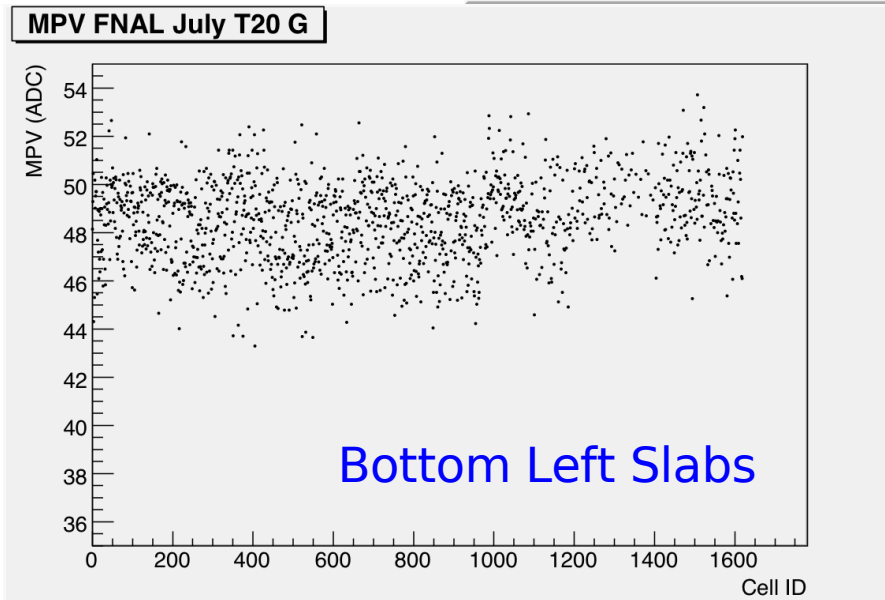
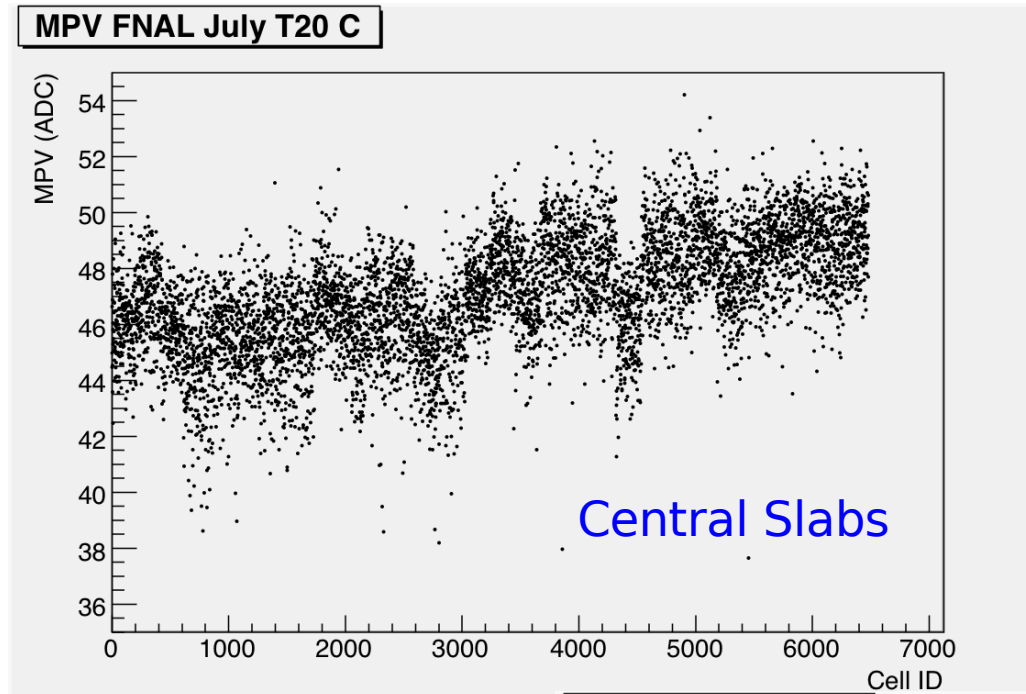
Marcel Reinhard, LLR

Dead Cells in bottom layers – Main reason for repatriation of Ecal

CALICE Collaboration Meeting Sept. 2008



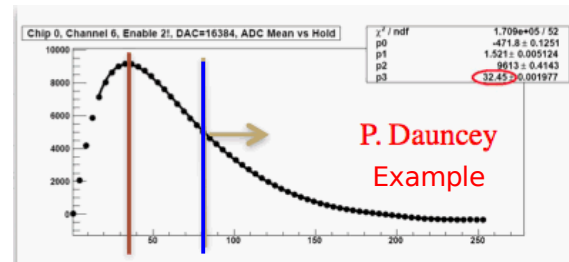
# First Steps towards Calibration (“Fast Trigger” Mode)



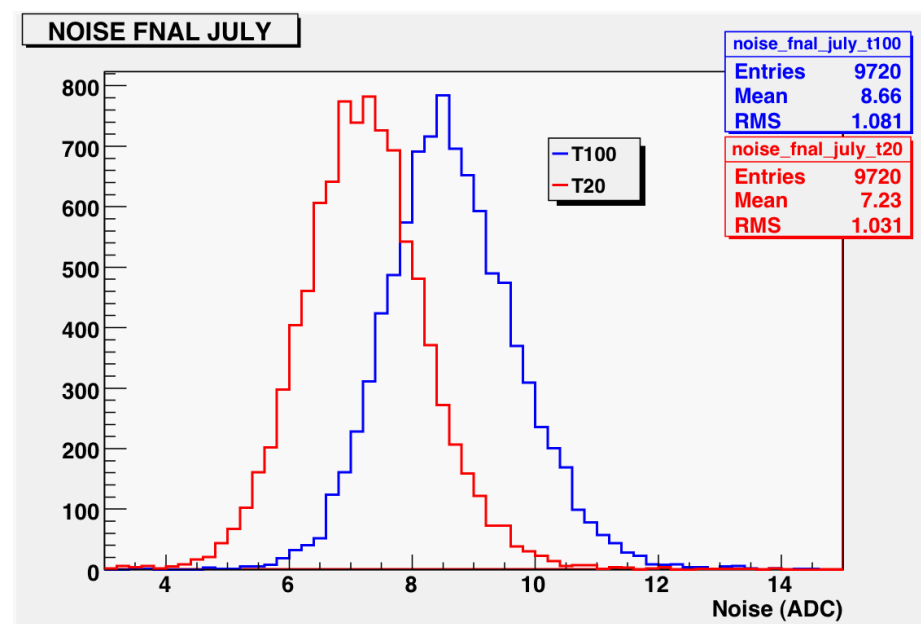
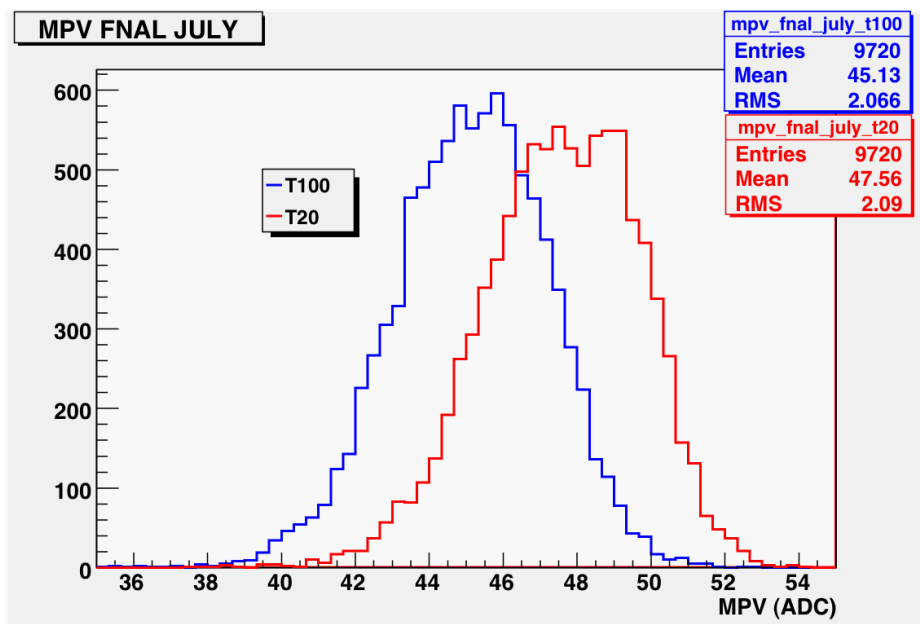
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# Running at Different Hold Values

Have to take data at “non”-optimal hold position due to delay of Cerenkov Signal



## Analysis of Muon Runs



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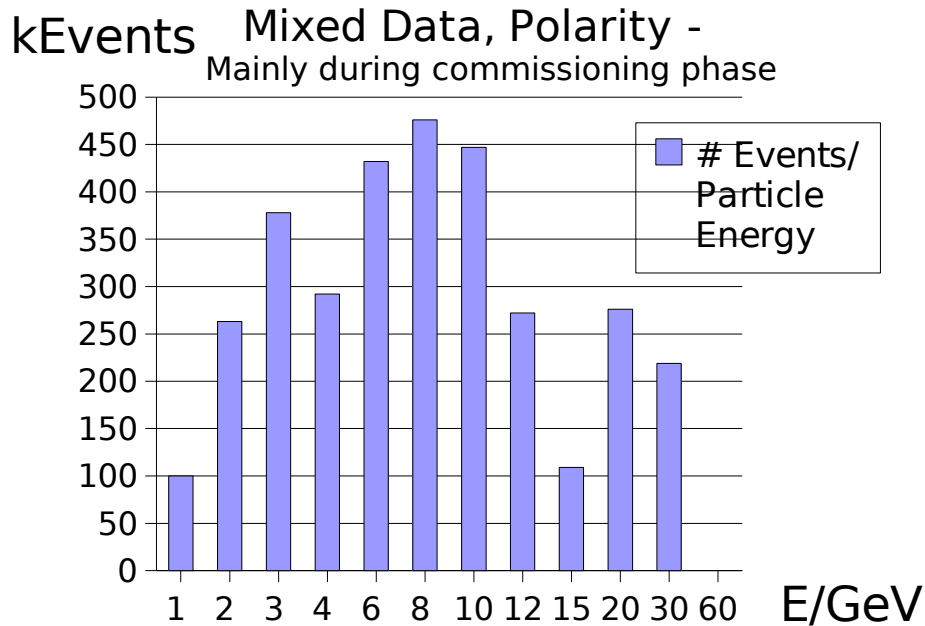
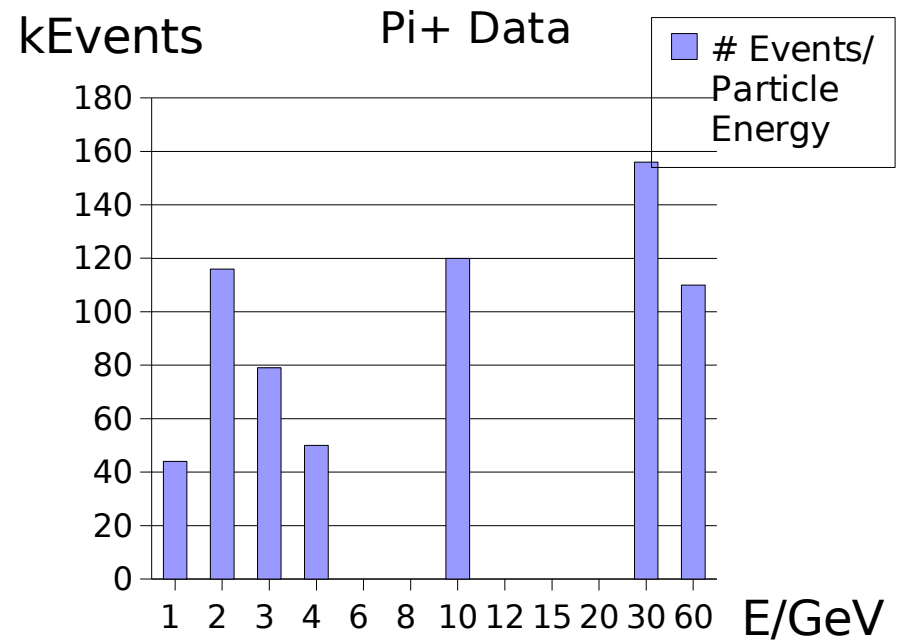
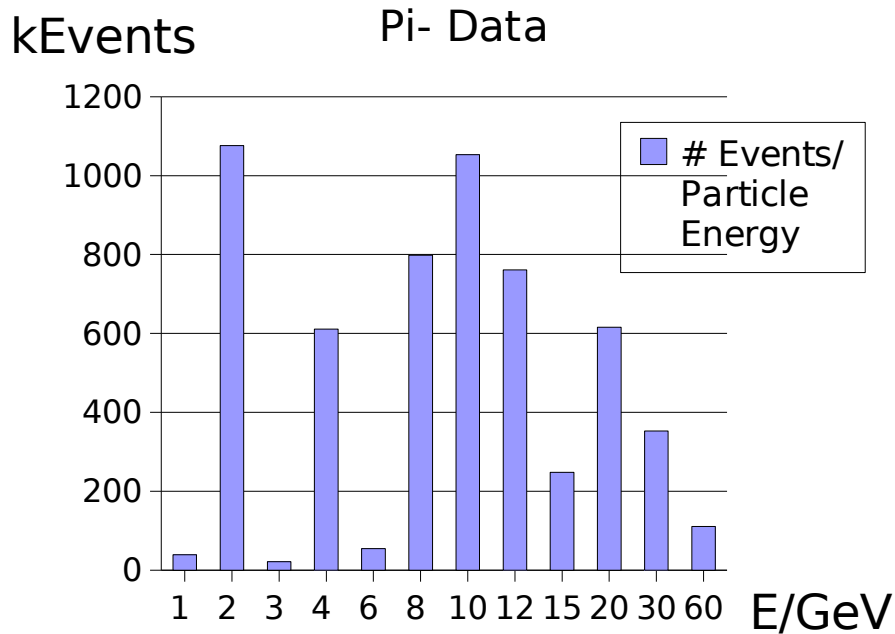
- Larger MIP value when running “on-hold- peak”, as expected
- Noise 20% larger when running “off-hold-peak” very large effect, not understood (expect ~1%)

## Summary and Conclusion

- Successful data taking with SiW Ecal at FNAL  
17.3 Mio. Triggers recorded with Ecal
- No Pedestal Shifts for a large fraction of the data
- Calibration for 2008 is on its way
- Hold Story needs to be understood  
Valuable Reference sample at “optimal” hold value  
“Fast Trigger” Running
- Ecal shipped back to Europe for maintenance/repair work  
Grounding and Connector Issues  
Dead (?) Cells in Lower Slabs
- (Getting) Ready for Data Taking with the DHCAL

## Backup Slides

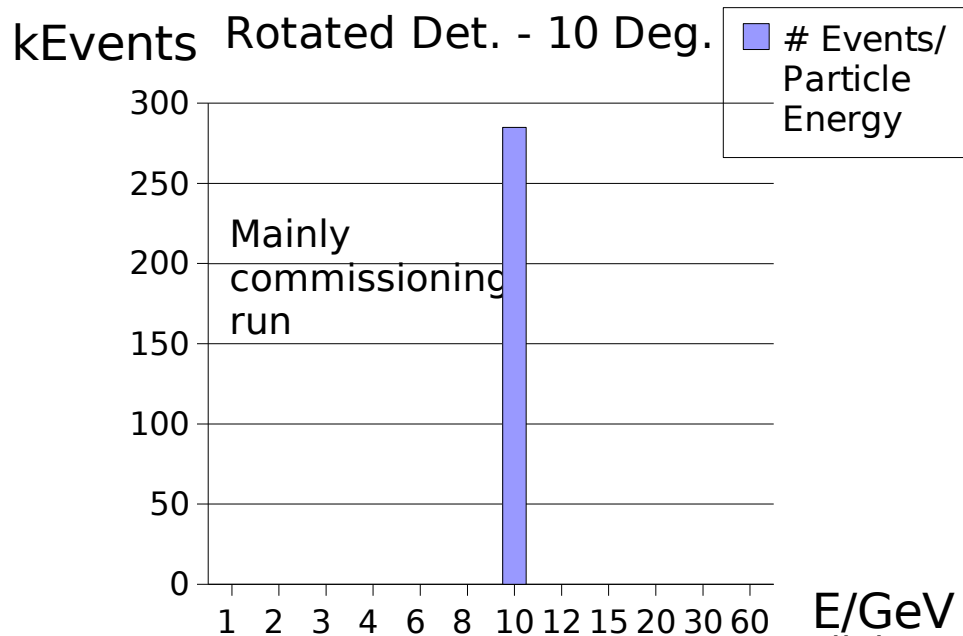
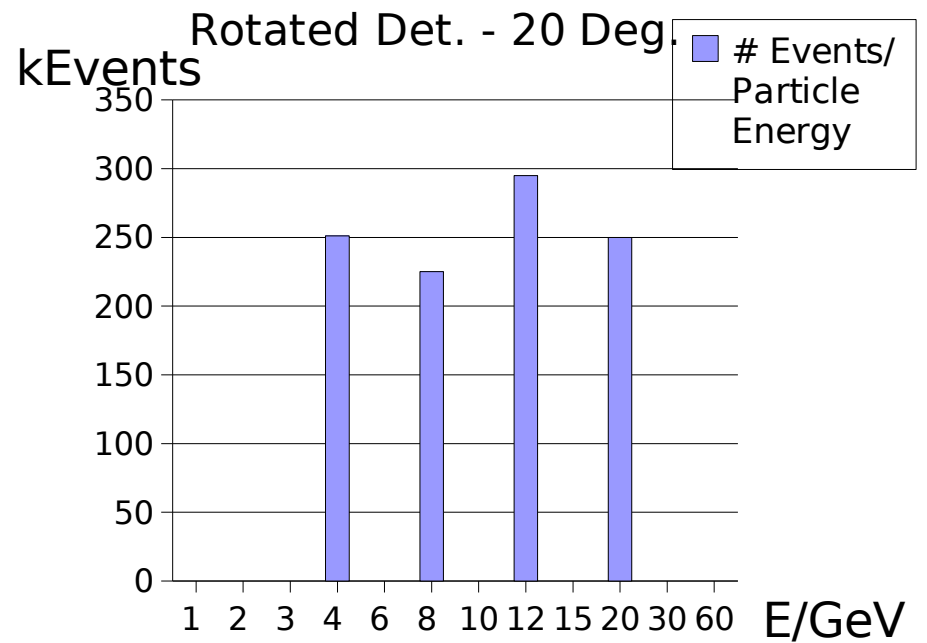
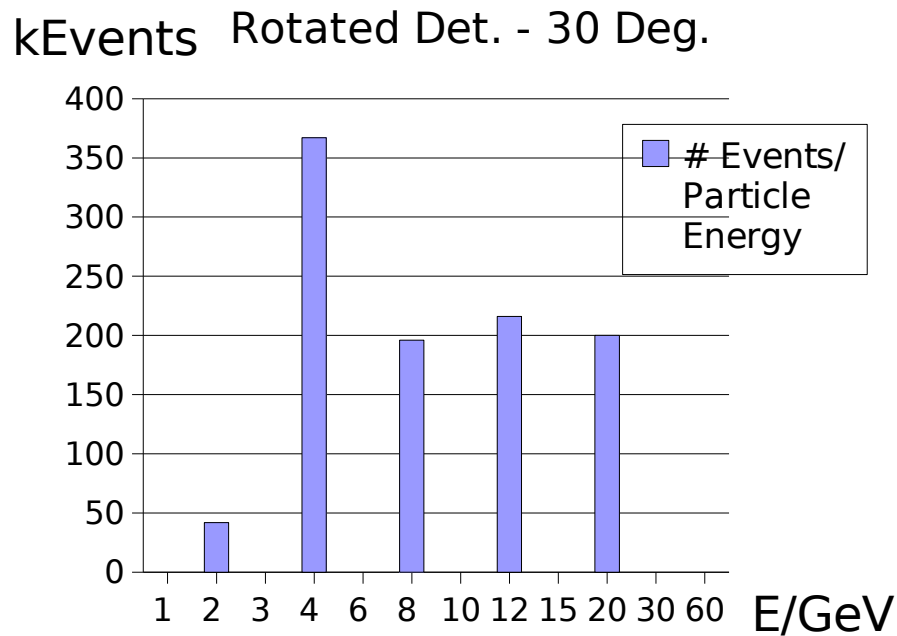
# Breakdown of recorded data I – Slow Trigger



Managed to accumulate hadron data at both polarities

Significant larger sample at negative polarities

# Breakdown of recorded data II – Slow Trigger/"Special" Data



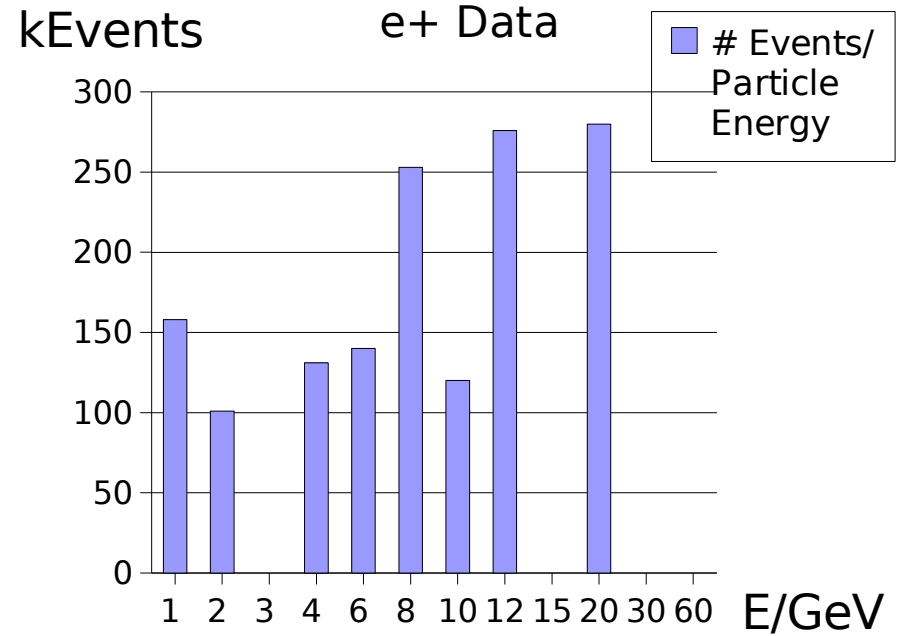
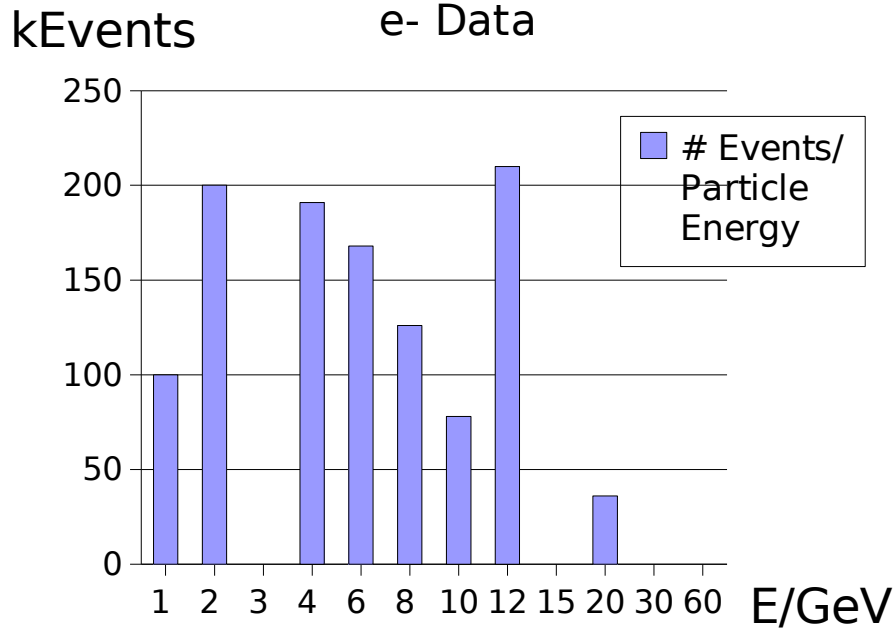
Rotation program suffered most from significant beam down time

Still, considerable amount of data collected

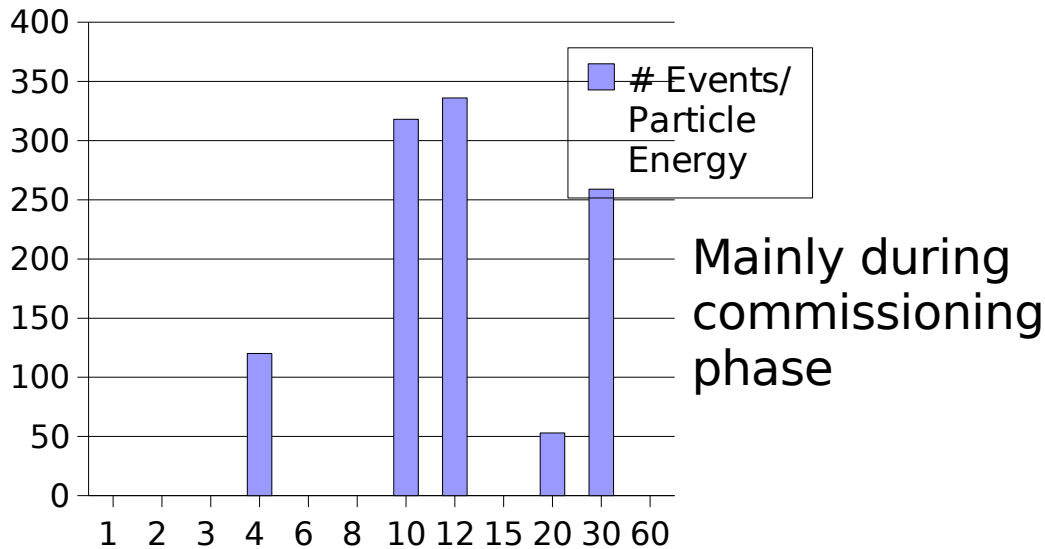
To this adds a shifted detector program with total ~500k Triggers at 10 and 30 GeV and high energy proton running

160k Events

# Breakdown of recorded data III – Fast Trigger



**Mixed Data, Polarity +/-**



Mainly during commissioning phase

Considerable samples at small energies with fully equipped Ecal

Pion content increases gradually with increasing energy