# FNAL Testbeam May/July Running Period

Roman Pöschl
LAL Orsay

- Installation Period
- Beamline at FNAL
- Collected Data and Glimpse on Quality
- Summary and Conclusion

CALICE Collaboration Meeting Manchester/UK Sept. 2008

# MTBF – Meson Testbeam Facility at Fermilab

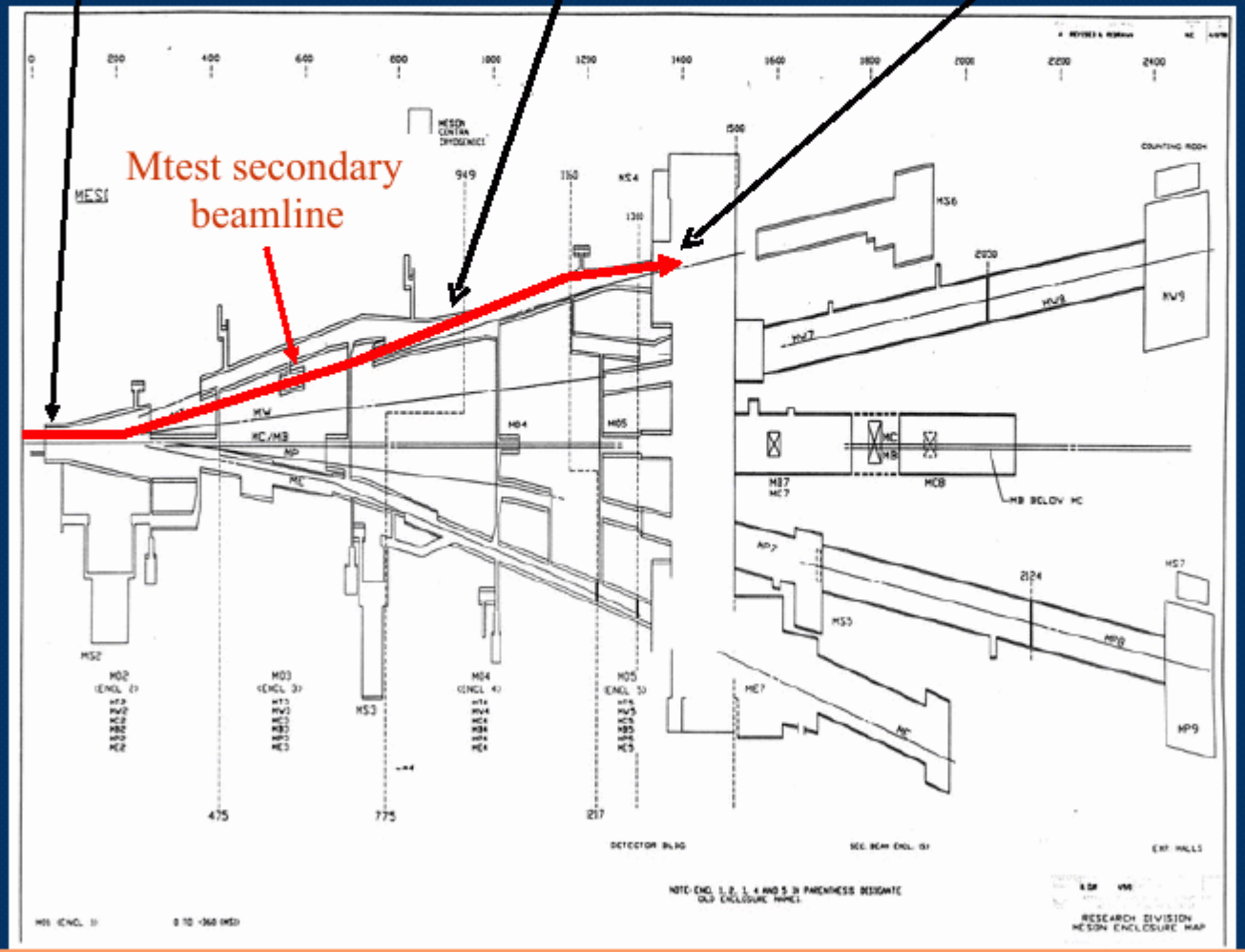

- Beam is created by a primary Proton beam of 120 GeV/c

# Test Beam Layout and Modes

Movable upstream 30 cm Al target

Movable downstream target location

Meson Test Beam Facility




**Proton Mode: 120 GeV protons transmitted through upstream target**

**Pion Mode: 8-66 GeV beam tuned for secondaries from upstream target**

**Low Energy Pion Mode: 1-32 GeV beam tuned for secondaries from downstream target**



*Picture courtesy of V. Zutshi* *CALICE Collaboration Meeting Sept. 2008*

# CALICE Testbeam at FNAL

- Installation Phase: 7/4/08 – 25/4/08

- Commissioning Phase: 28/4/08 – 7/5/08

- "Physics Runs" Phase: 7/5/08 - 27/5/08

General Running Conditions:

- Day operation – Beam between ~6m and 6pm
- Testbeam delivery interrupted by "Shot Setup"
  for TEVATRON experiments
  ~2 hours during our running
- No major machine downtime
  Some failures towards the end of the running
  Compensated by two extra half days
  on 26/5/08 and 27/5/08 – Running 6am – 12pm
  Agreement on short notice

FERMILAB provides excellent support for our running

- see above
- e.g. Extensive help during (non trivial)
  setup of computing

- Restart Phase: 1/7/08 – 4/7/08

- Calibration Runs: 4/7/08 – 9/7/08
  Calibration with Fast Trigger
  Calibration with Slow Trigger
- "Physics Runs" Phase: 9/7/08 – 1/8/08
  'Fast Trigger Running': 7/7/08 – 13/7/08
  'Slow Trigger Running': >13/7/08

General Running Conditions:

- Night operation – Beam between ~8pm and 10am
  Machine (and detectors) suffered from hot FNAL summer (up tp 42°C)
- Testbeam delivery interrupted by "Shot Setup"
  for TEVATRON experiments
  ~2 hours during our running
- Major machine downtimes (at least until 22/7/08)
  up to 50% during several days
  Partially compensated by extensions > 10am

- Downtime did cut into our program!

Concern was brought to FERMILAB Management and acknowledged.
Mostly open to extensions but also harsh cuts of beam (scheduled) on-time

# Installation at FNAL – The Start

**(1 container out of 3)**

*G. Mavromanolakis AEM Talk*

Everything arrived on time and UNDAMAGED at FNAL

*CALICE Collaboration Meeting Sept. 2008*

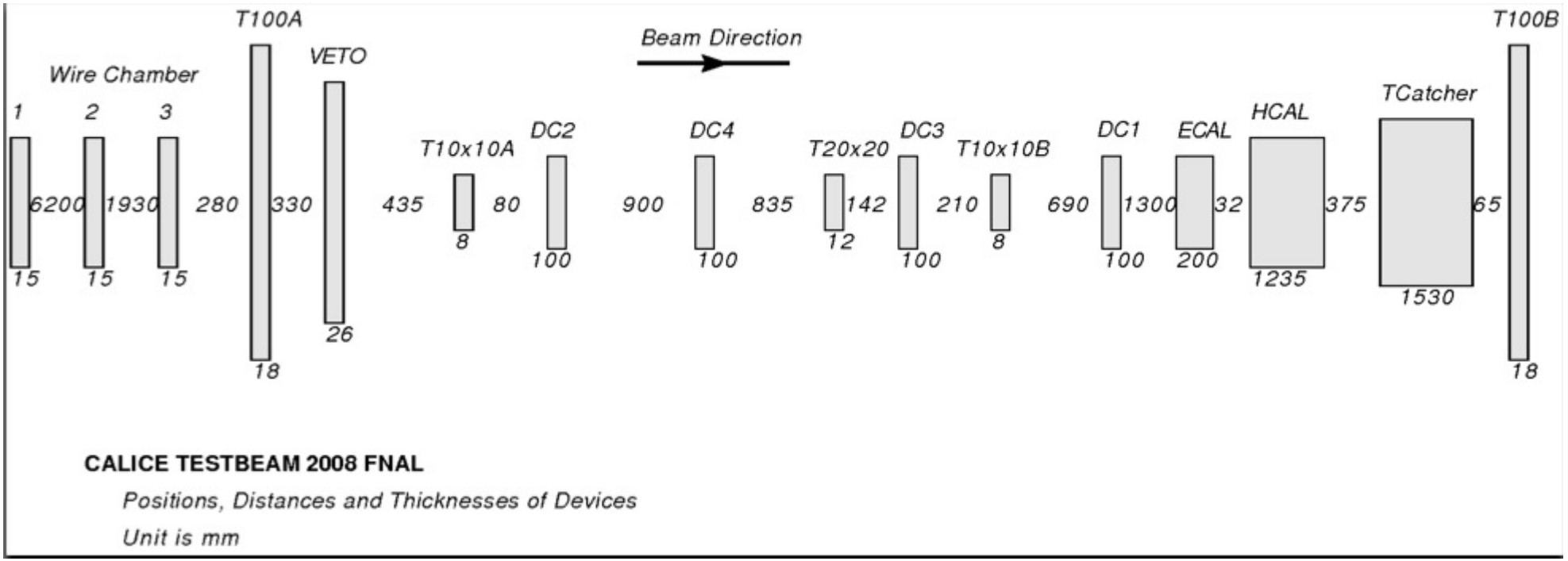
# Detector Installation

- Equipment ready by 25th of April – Ready to accept beam on the 29th of April

- Setup – Combined effort of DESY, Uni Heidelberg, NIU, LLR, LAL and FNAL

- Setup comprises SiW Ecal, Ahcal and TCMT
  plus beamline equipment

# Sketch of the beamline




*A.Kaplan, H.Li*

# Experimental Control

- Live demonstration (planned)
  Place yourself to
  http://calice-cam01.fnal.gov:8080
  http://calice-cam03.fnal.gov:8080

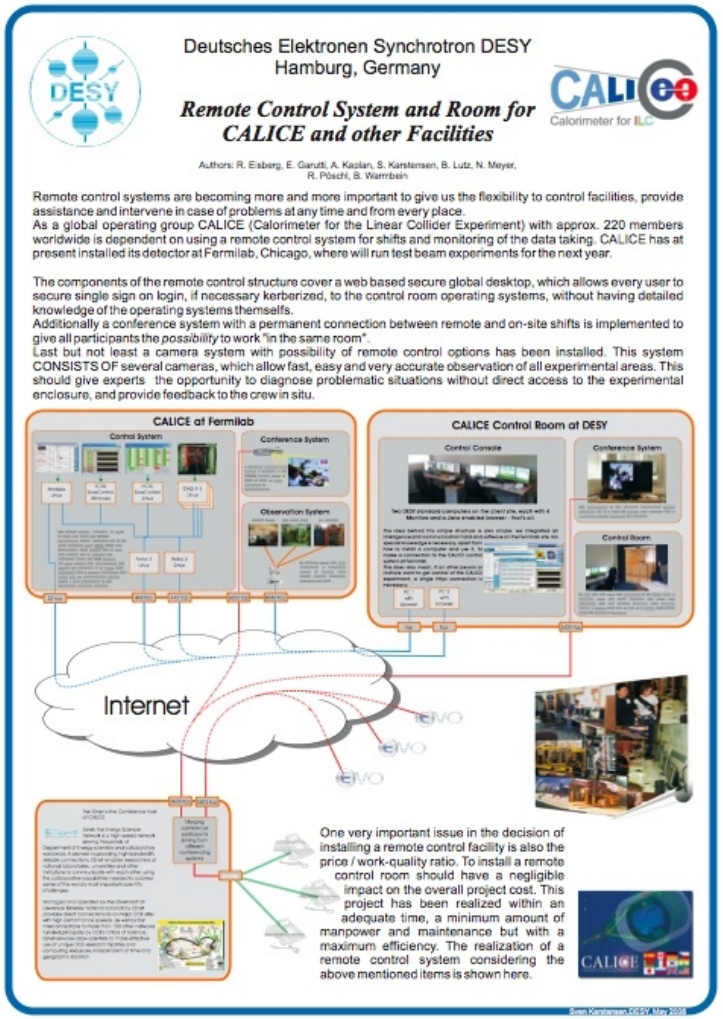
- Conferencing system

  - Daily operations meeting
  - Regular communication between calice control room at FNAL and 2nd Control room at DESY or colleagues elsewhere in the world

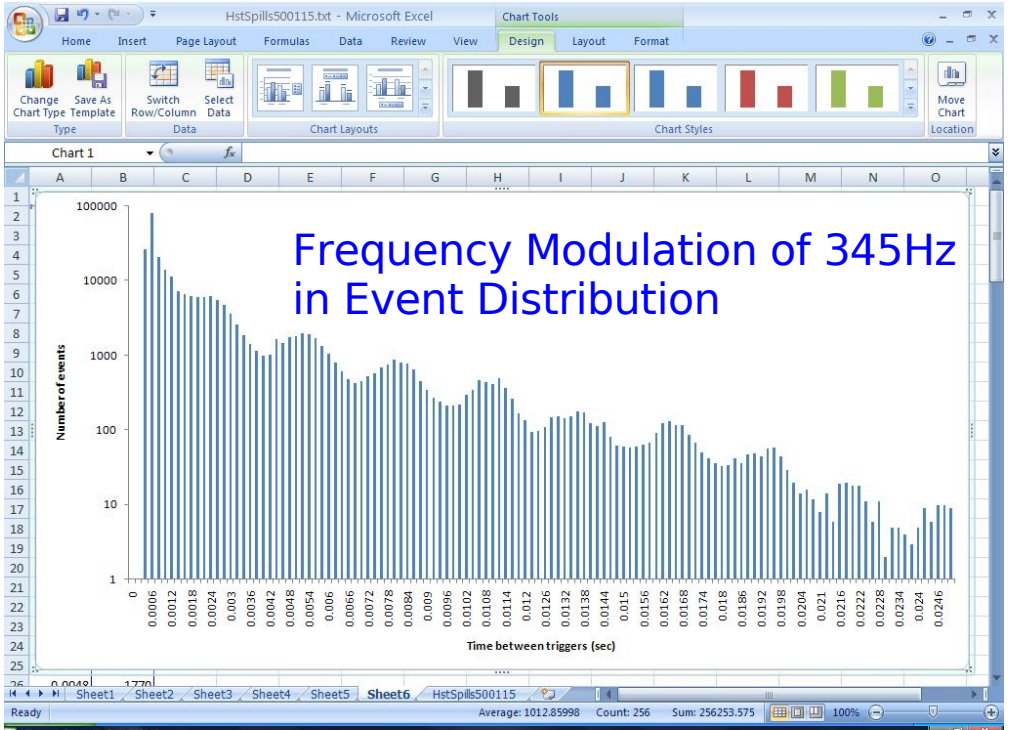
- Portal service (live demonstration planned)

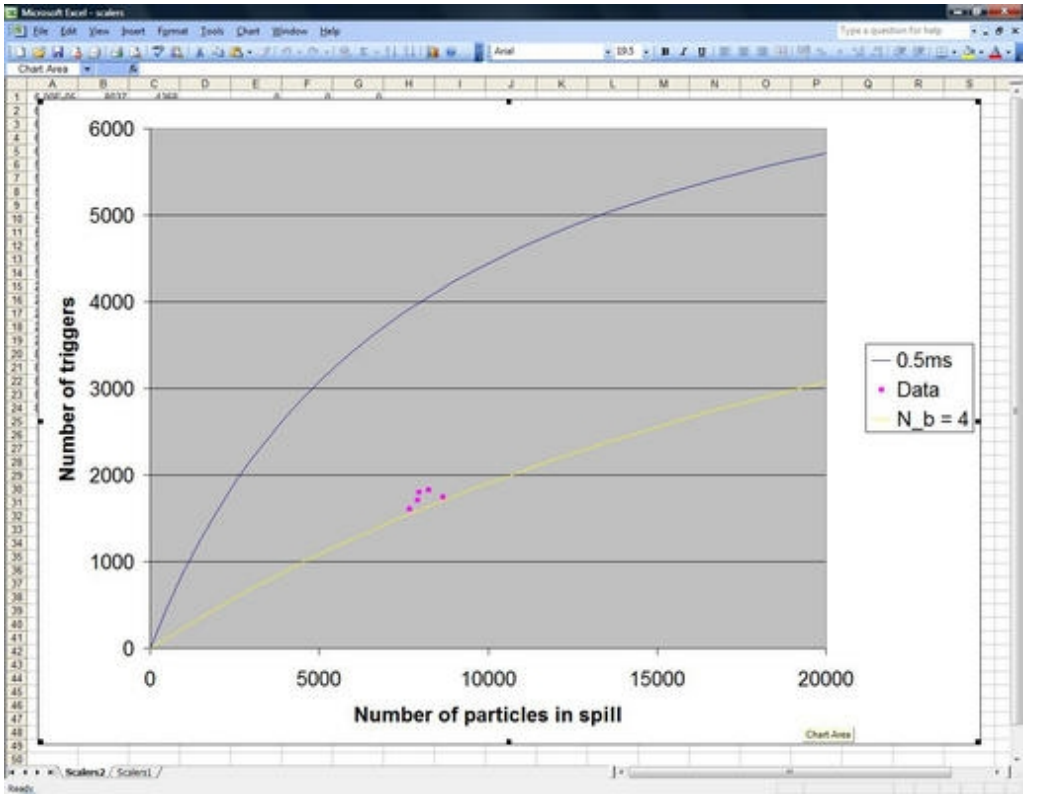
  https://calice-portal01(2).fnal.gov

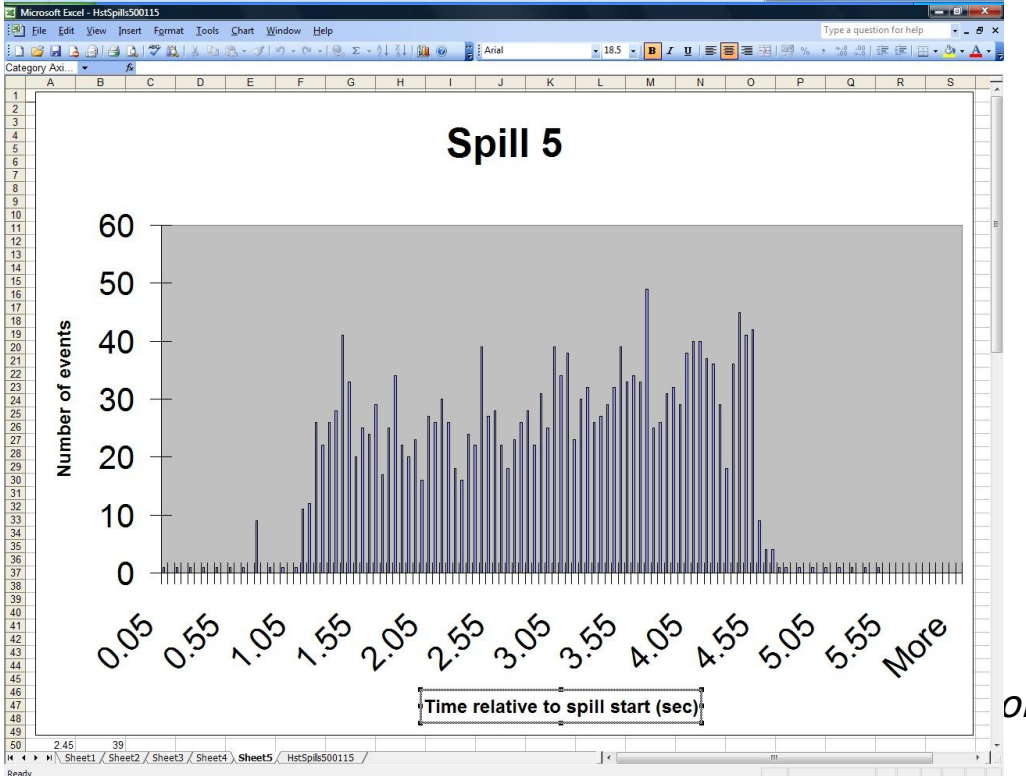
CALICE has implemented a first GDN foreseen for future ILC (and beyond) experimentation
Main responsible Sven Karstensen (DESY)



# Beam Bursts (Results from May)




- DAQ Deadtime ~0.5msec
- DAQ Buffer Limit 2000 Events
- Bursts reduce efficiency of Data Taking

*P.Dauncey, A.Kaplan*
*on Meeting Sept. 2008*

# The FNAL Beam

## Results from G4Beamline Simulation of MTest

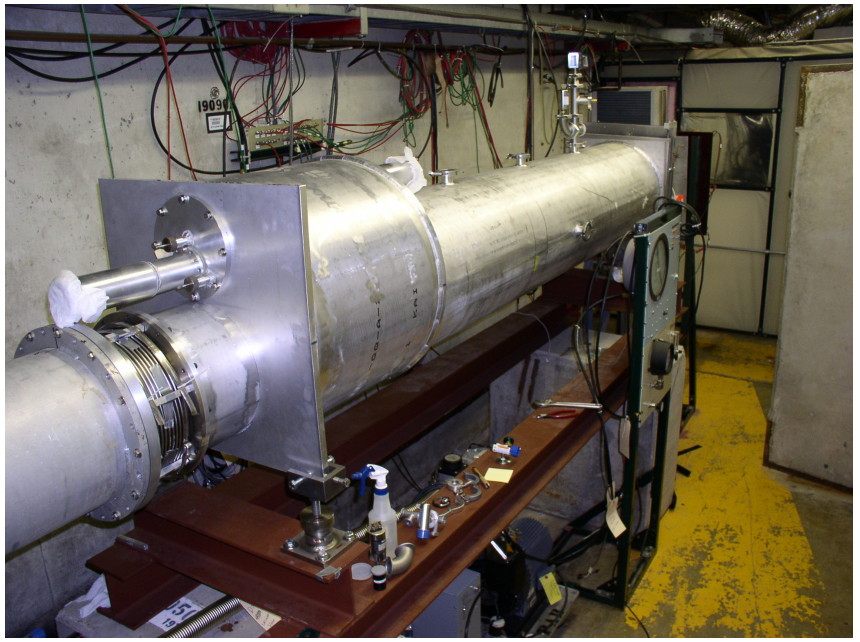
| Energy | Lead (mm) | #pions | #electrons | Ratio |
|---|---|---|---|---|
| 1 GeV | 0 | 710 | 9990 | 0.07 |
| | 0.5 | 15 | 129 | 0.12 |
| | 1 | 8 | 43 | 0.19 |
| | 2 | 5 | 6 | 0.83 |
| | 5 | 2 | 5 | 0.4 |
| 2 GeV | 0 | 2440 | 9990 | 0.24 |
| | 0.5 | 200 | 486 | 0.41 |
| | 1 | 88 | 158 | 0.56 |
| | 2 | 46 | 27 | 1.71 |
| | 5 | 10 | 1 | 10 |
| 4 GeV | 0 | 5030 | 9990 | 0.5 |
| | 0.5 | 1198 | 1585 | 0.75 |
| | 1 | 671 | 548 | 1.2 |
| | 2 | 308 | 110 | 2.8 |
| | 5 | 109 | 2 | 55 |

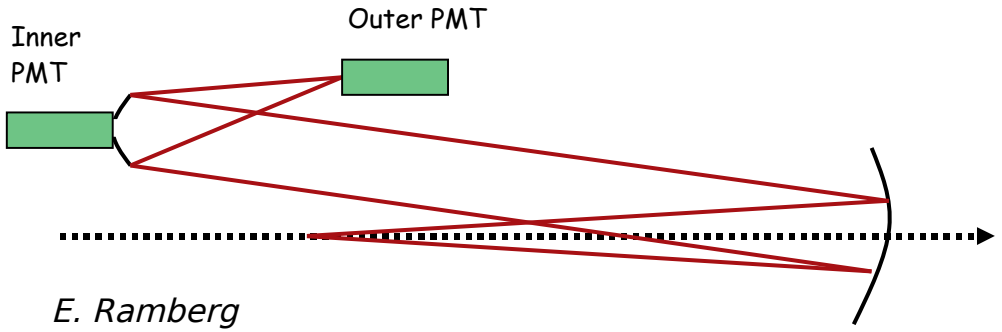
*E. Ramberg, T.Rinn*

Low rates at low particle energies

# New Differential Cerenkov counter

20m Upstream of Calice Detectors






*E. Ramberg*

Win Baker* copied design used succesfully in MIPP

Jim Kilmer in charge of construction

Counter commissioned just before CALICE arrival

Timing of signals is just fast enough to be included in CALICE trigger

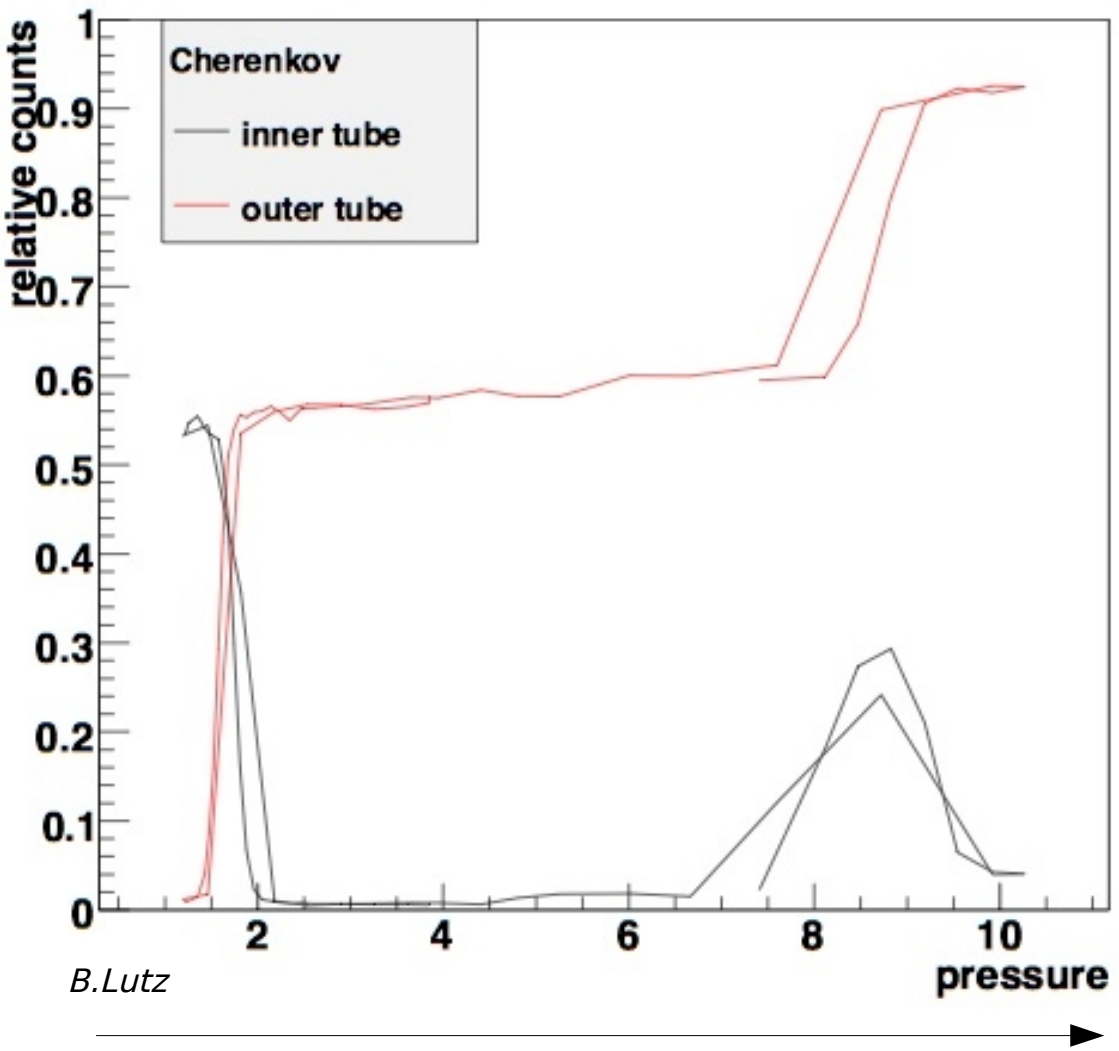
"Inner PMT" - accepts light near threshold

"Outer PMT" - accepts light from plateau region

"Inner x OutBar" - highly specific as to particle species

Inclusion of Cerenkov Counter in Trigger to create "pure" (pion) samples

# Cerenkov Pressure Curve




Electrons

Pions

Increasing refraction index of Cerenkov Gas

Regular recording of Cerenkov Pressure Curve
Cerenkov Pressure in Calice Data Stream

# Timing of the Cerenkov Trigger

E.Garutti, B.Lutz, A.Kaplan, V. Zutshi

Due to finite propagation time Trigger Signal from Cerenkov arrives ~60 ns (~10 DAQ clock ticks) after the '10x10 coincidence' – Trigger 'working horse'

- 10x10 Trigger signal has to be delayed


Example of Coincidences between:

10x10A 10x10B
Cerenkov
100x100B (Muon Trigger)

Trigger Mix lead to “pure” pion sample at ~200 Events/Spill
Partially large muon contamination

- Particles propagate faster than Cerenkov Signal
- Trigger Latency and details of signal formation in Calice Front Electronics

⇒Risk to record detector signal in falling slope

# Data Taking at FNAL – Overview on Data and Quality

## Sources

Testbeam page by Georges:
http://www.hep.phy.cam.ac.uk/~gmavroma/calice/testbeam/testbeam.html

CALICE Elog:

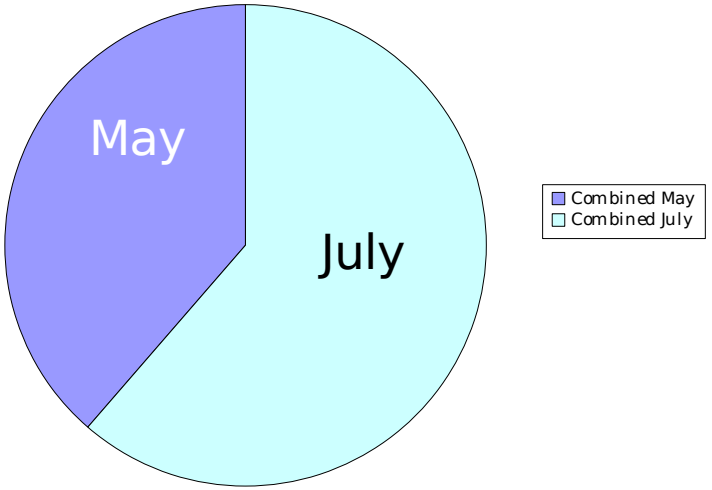
https://ttfinfo.desy.de/CALICEelog-sec/index.jsp

Own Recordings:

e.g. Run Reports as posted to the Elog

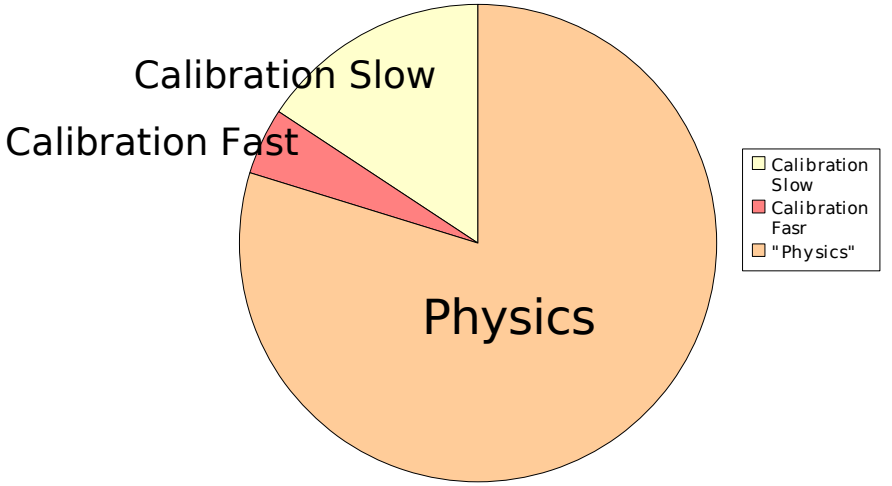
# “Luminosity” - Recorded Data

Combined Data May/July



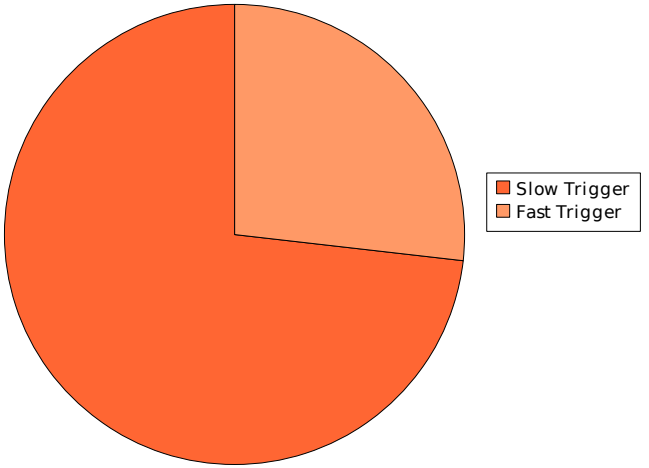

Total: 17.3 kEvens in beamData Runs

Calibration/"Physics"



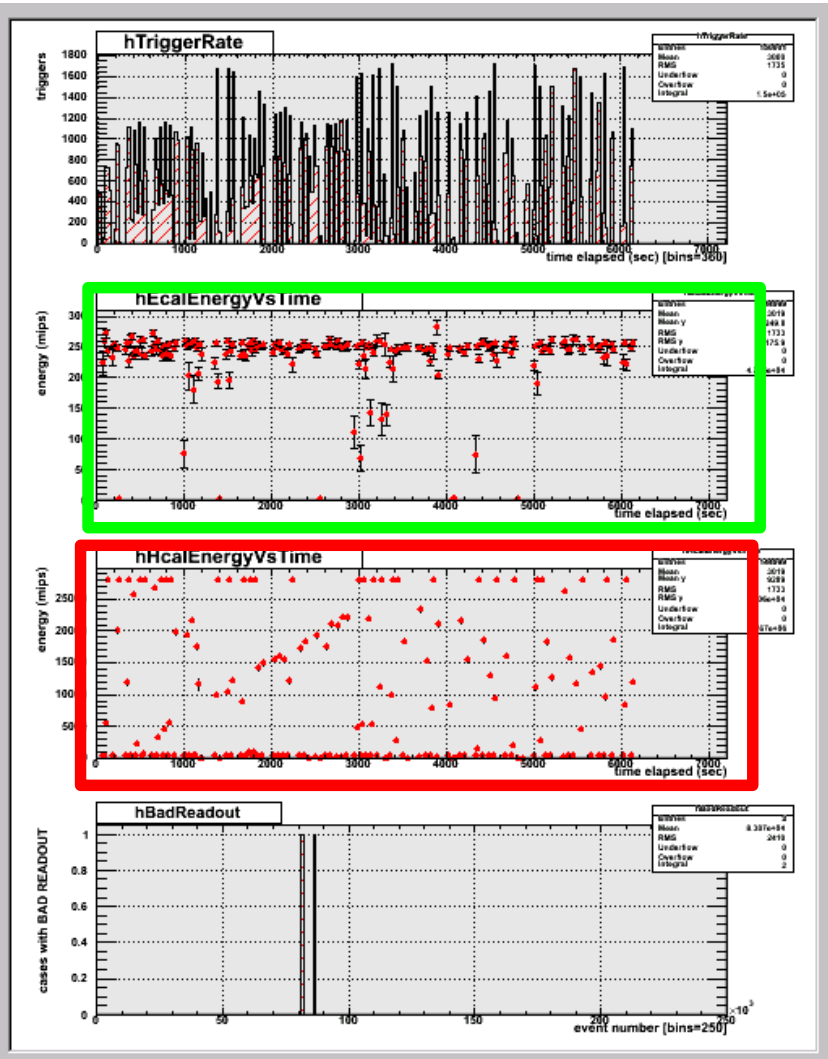

~20% Calibration Data, i.e. muons

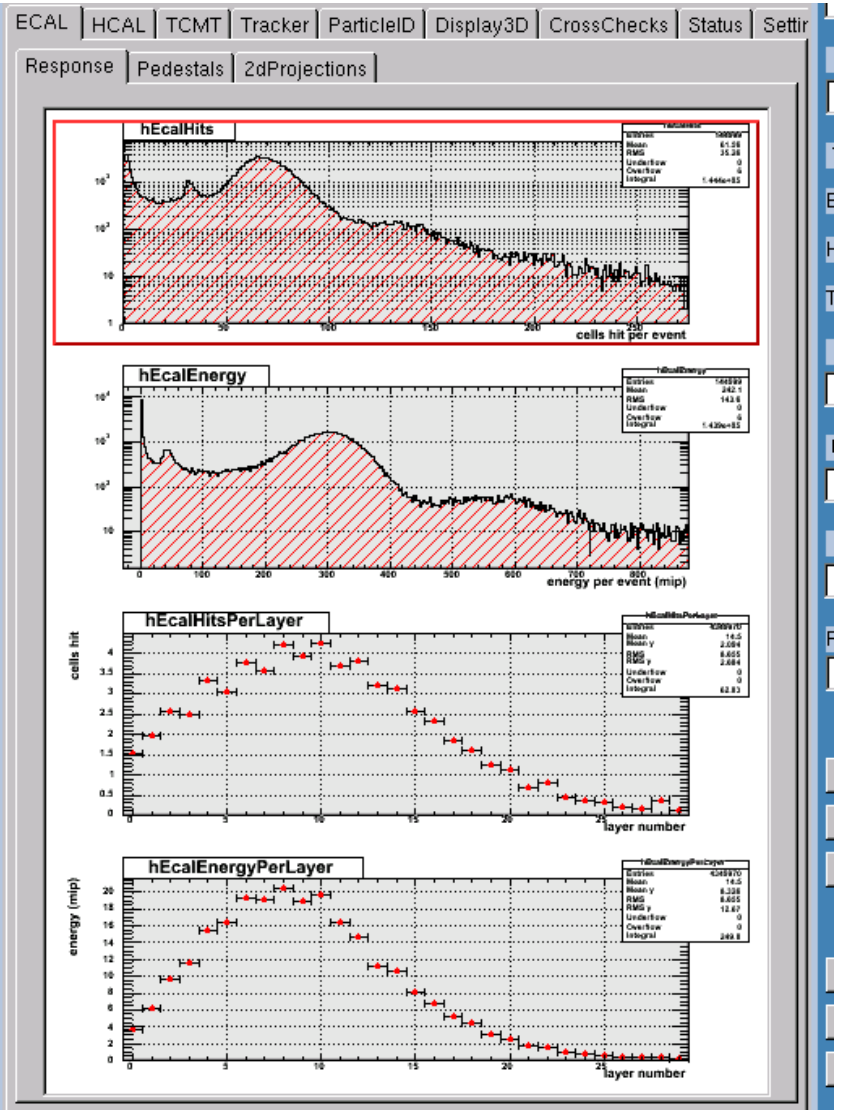
Fast/Slow Trigger Data




~25% with Fast Trigger (mostly e-)

# The Good and the Evil



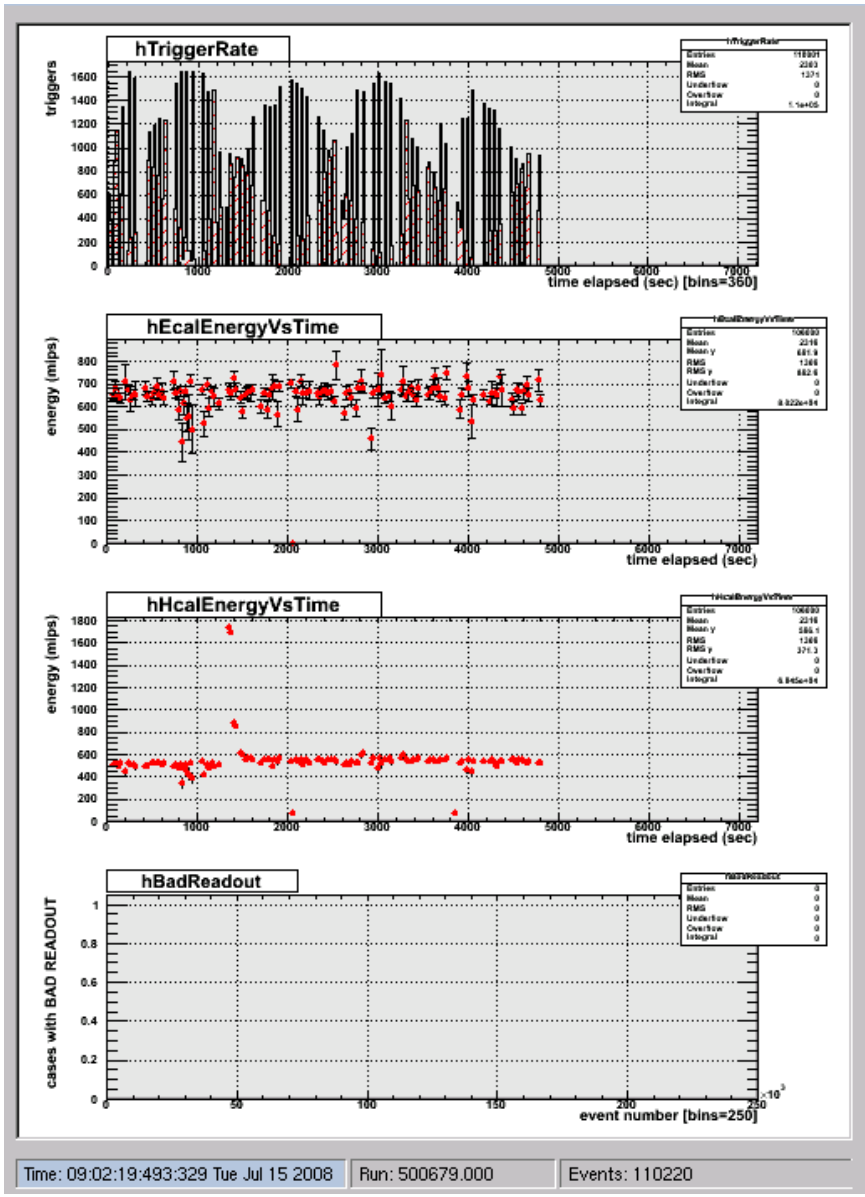

Ecal Noise largely tamed
No noisy layers for > 90% of time

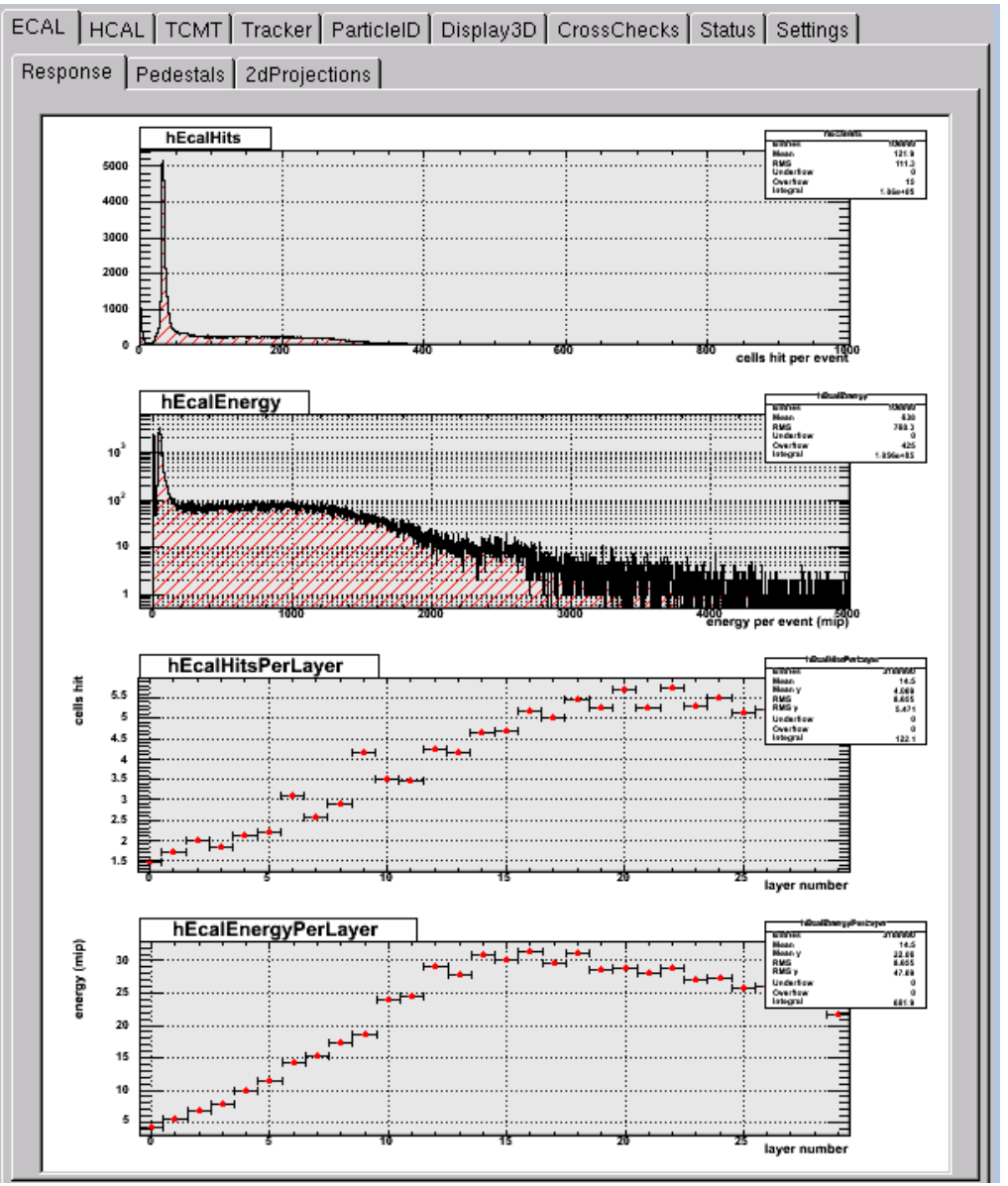
Severe r/o problem in on Hcal Crc

Debugged and Remedied by Alex/Paul

... and Cerenkov PMTs not operational during first weeks fixed by Alex/Vishnu

# The Good and the Good



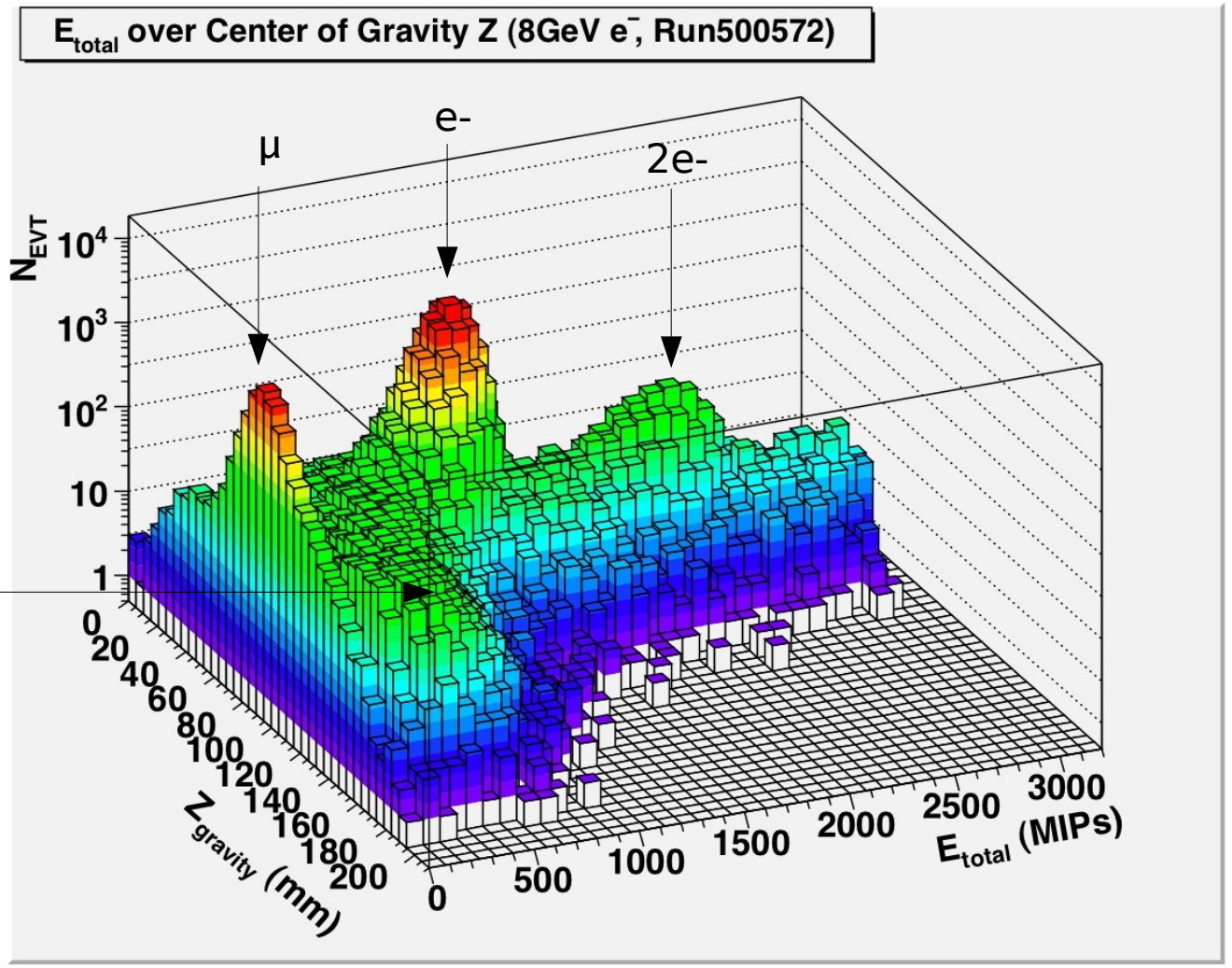




- r/o problem fixed with run 500632
- Ecal stable minor spikes
- Hcal stable
  minor problems with one HV Channel
- TCMT stable

- Cerenkov operational for pion program
- DAQ reliable
- Trackers look reasonable
- s/w computing copy and conversion run smoothly

# General Remarks on DQ

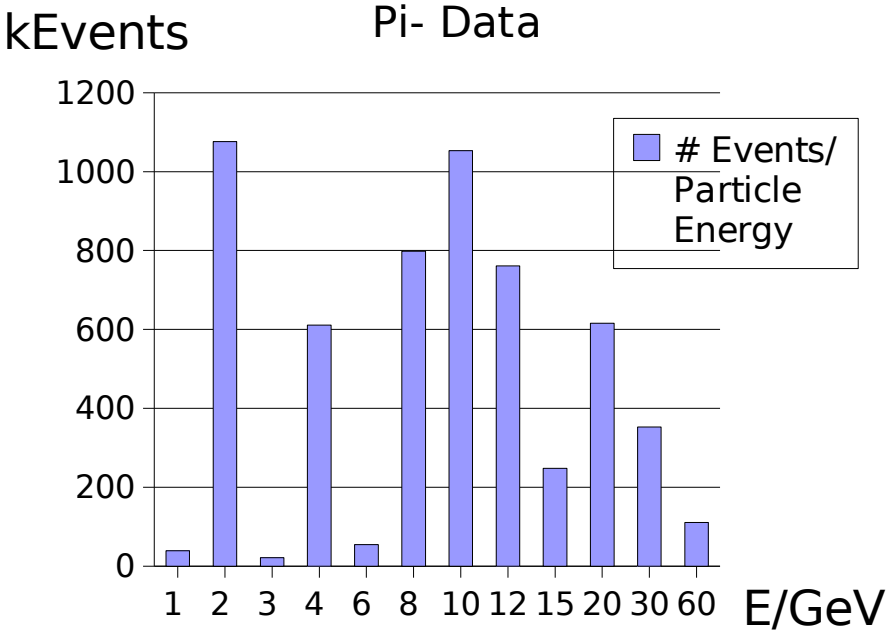
## Ecal spectrum

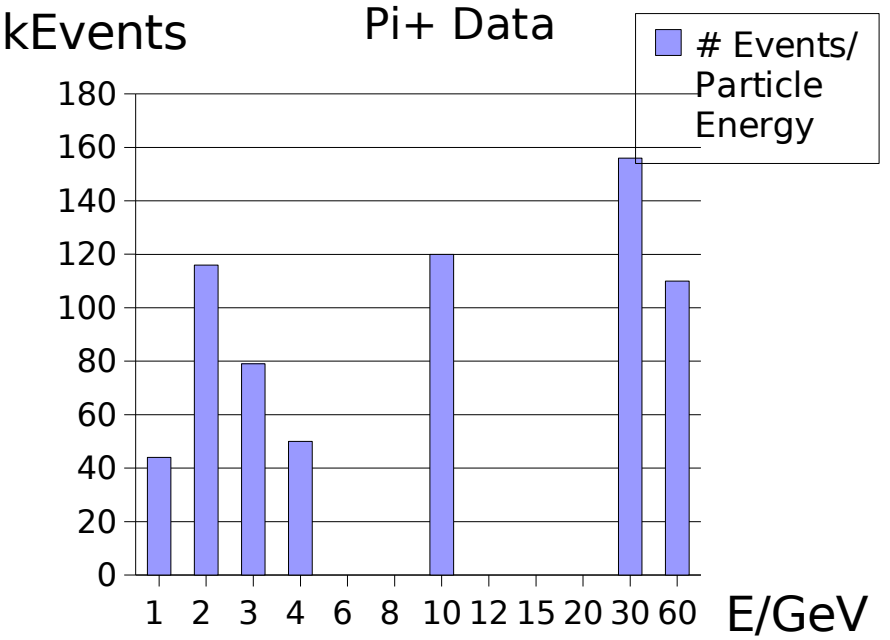


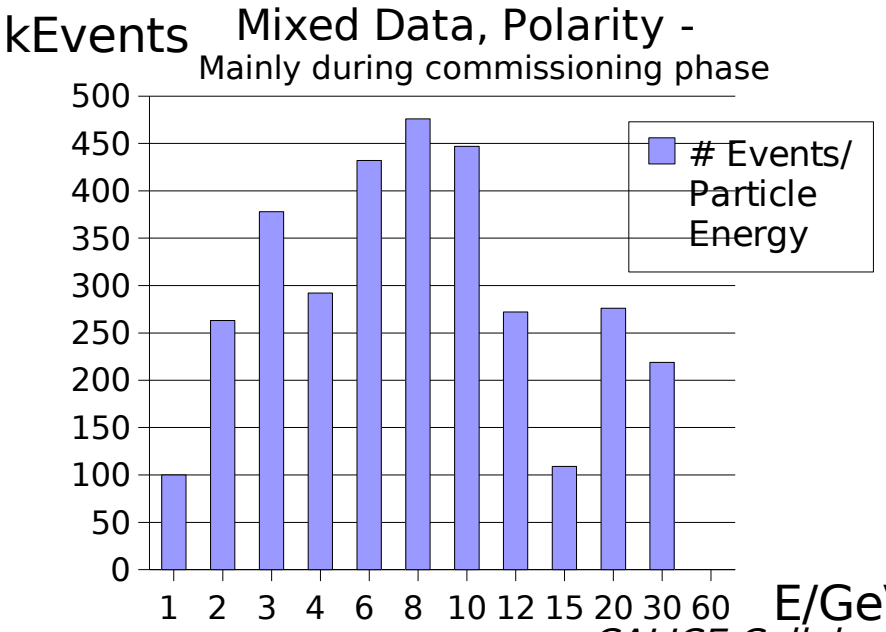

*Hengne Li, LAL*

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

# Breakdown of recorded data I – Slow Trigger



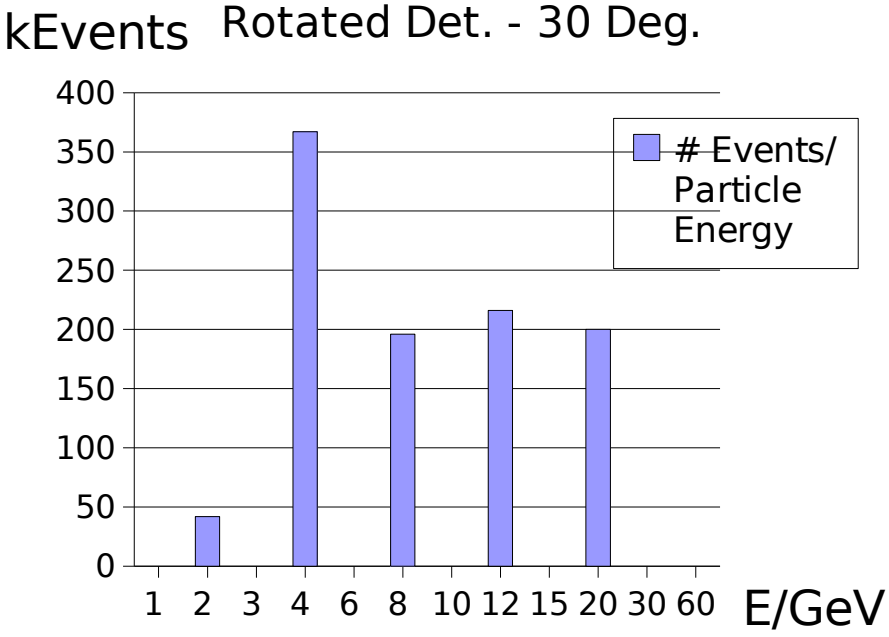



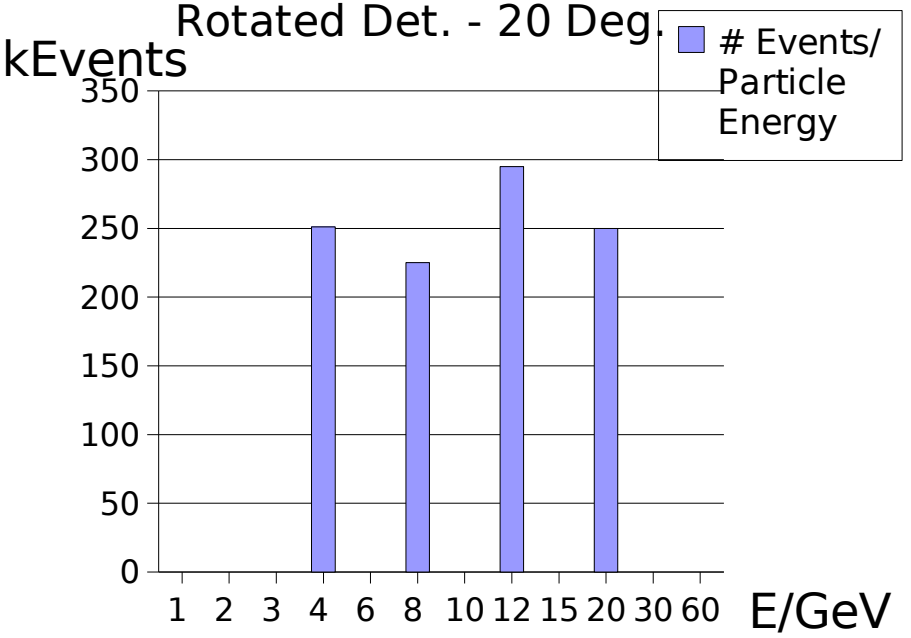



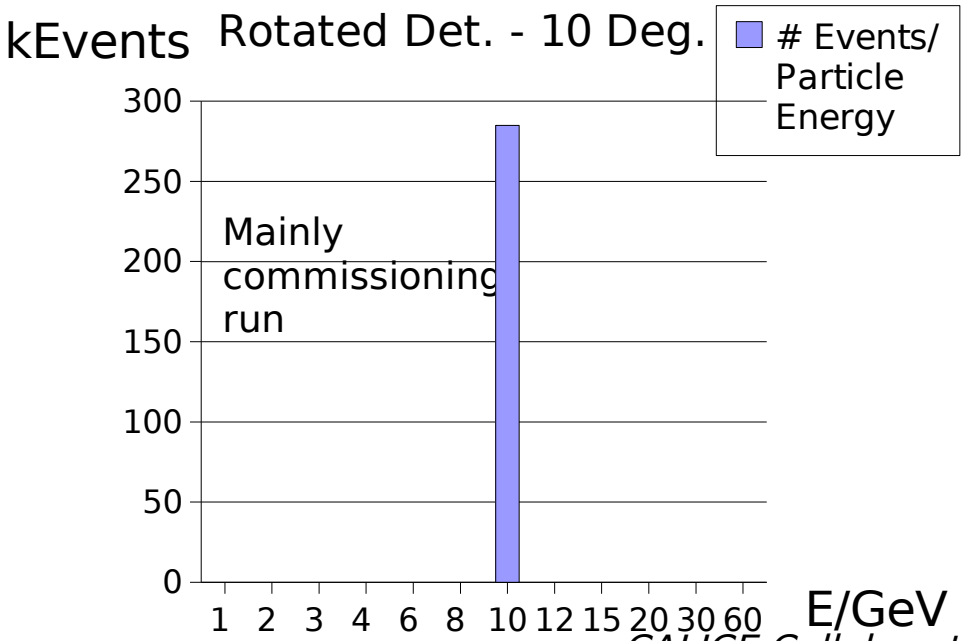

Managed to accumulate hadron data at both polarities

Significant larger sample at negative polarities

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



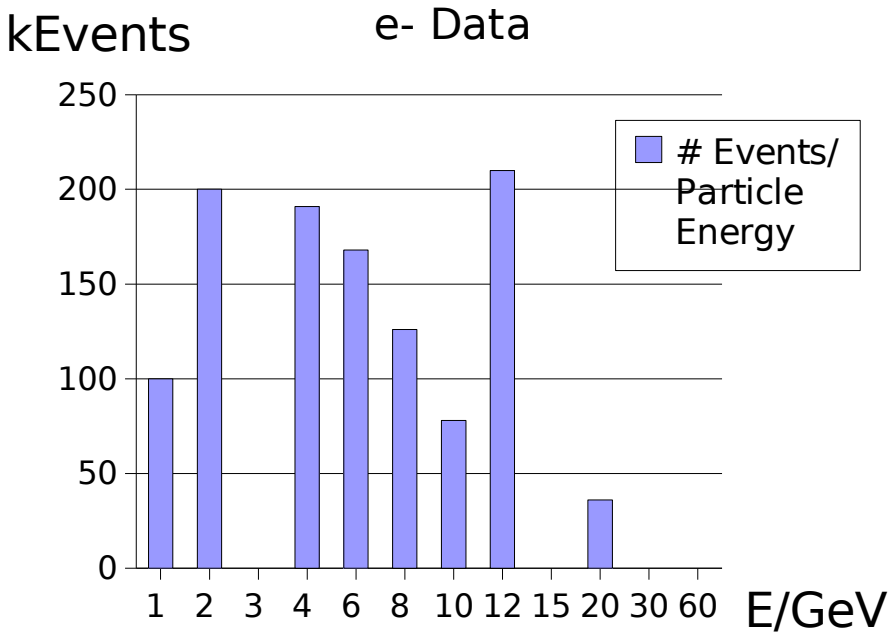



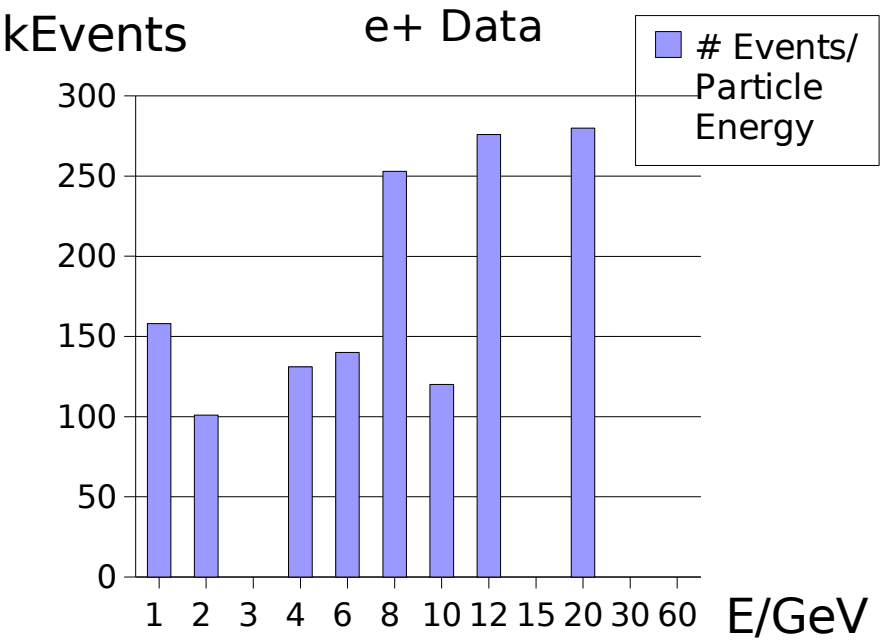

Rotation program suffered most from significant beam down time

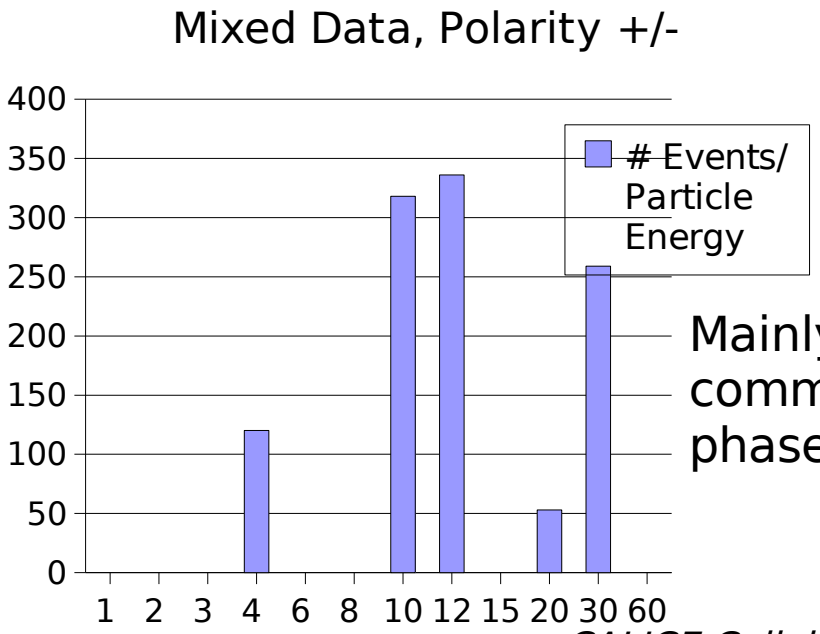
Still, considerable amount of data collected

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




Mainly during commissioning phase

Considerable samples at small energies with fully equipped Ecal

Pion content increases gradually with increasing energy

# Run Plan – Accomplishments

4.-7. July: Muon Calib. accomplished 9/7/08
At two different holds

8.-9.July: Dedicated Ecal Running accomplished 13/7/08
with trigger optimized Ecal

> 9. July: Running with slow trigger

10.-16. July: Completion of accomplished 20/7/08
(low energy) pion program

17. July: Running with Hcal and Ecal accomplished 22/7/08
shifted w.r.t beam and to each other

18.-24. July: Running at rotated position accomplished 26/7/08
10 (20) and 30 degrees 20 and 30 Degrees
Cover the full energy range
(but not all points)

25.-26.July: Spare Time for
combined program
or low energy proton running

27. July – 1. August Hcal Only Running

# Calice Shift Plan FNAL 2008

| | May 08 | May 09 | May 10 | May 11 | May 12 | May 13 | May 14 |
|---|---|---|---|---|---|---|---|
| 19:00-06:00 | | | | | | | |
| 06:00-12:30 | | | | | | | |
| ECAL | M. Reinhard | M. Reinhard | M. Reinhard | M. Reinhard | M. Reinhard | M. Reinhard | M. Reinhard |
| HCAL | N. Feege | N.Feege | N.Feege | N. Feege | N.Feege | N. Feege | N. Feege |
| analysis | N. Meyer | N. Meyer | N. Meyer | R. Fabbri | R. Fabbri | R. Fabbri | R. Fabbri |
| 12:30-19:00 | | | | | | | |
| ECAL | J. Puerta | J. Puerta | J. Puerta | J. Puerta | J. Puerta | J. Puerta | F. Morisseau |
| HCAL | B. Lutz | B. Lutz | B. Lutz | B. Lutz | G. Eigen | G.Eigen | G.Eigen |
| analysis | J. Repond | J. Repond | L.Xia | L. Xia | F. Simon | F. Simon | F. Simon |

Remote Shifts from DESY

| | Thursday May 15 | Friday May 16 | Saturday May 17 | Sunday May 18 | Monday May 19 | Tuesday May 20 | Wednesday May 21 |
|---|---|---|---|---|---|---|---|
| 19:00-06:00 | | | | | | | |
| 06:00-12:30 | | | | | | | |
| ECAL | B. Mustapha | B. Mustapha | B. Mustapha | B. Mustapha | L. Morin | L. Morin | L. Morin |
| HCAL | H. Li | H. Li | N. Wattime | N. Wattim | N. Wattime | N. Wattim | P. Dublet |
| analysis | O. Wendt | N. D'Ascenzo | N. D'Ascenzo | N. D'Ascenzo | E. Garutti | E. Garutti | E. Garutti |
| 12:30-19:00 | | | | | | | |
| ECAL | F. Morisseau | F. Morisseau | F. Morisseau | F. Morisseau | F. Morisseau | F. Morisseau | F. Morisseau |
| HCAL | G. Eigen | J. Zalesak | J. Zalesak | J. Zalesak | J. Zalesak | J.Zalesak | J.Zalesak |
| analysis | F. Simon | F. Simon | F. Simon | L. Xia | B. Mustapha | B. Mustapha | B. Mustapha |

| | Thursday May 22 | Friday May 23 | Saturday May 24 | Sunday May 25 | Monday May 26 | Tuesday May 27 | Wednesday May 28 |
|---|---|---|---|---|---|---|---|
| 19:00-06:00 | | | | | | | |
| 06:00-12:30 | | | | | | | |
| ECAL | L. Morin | L. Morin | L. Morin | L. Morin | L. Morin | L. Morin | |
| HCAL | S. Magill | S. Magill | G. Wilson | S. Magill | G. Wilson | G. Wilson | |
| analysis | E. Garutti | O. Wendt | O. Wendt | O. Wendt | S. Richter | S. Richter | |
| 12:30-19:00 | | | | | | | |

*E.Garutti*

Broad Participation in Shifts – (Once more) a great pleasure

Apologizes to those not appearing in the screen shot

# Summary and Conclusions

- Two Running periods with SiW Ecal, Ahcal and TCMT
  ~17 Mio. Triggers in Physics Runs
  Concentration on low energetic hadrons
  Valuable low energy e +/- sample for Ecal

- July period suffered from considerable beam downtime
  Still strong support by FNAL in all aspects of the running
  Planning with spare days reduced impact on program

- Collaboration CALICE <-> FNAL and CALICE lead to efficient start up of running
  Effort of CALICE Collaboration well acknowledged by FNAL
  Citation E.Ramberg: “You showed me things about the beam I wasn't aware of”
  “You guys can be poud of your experiment”
  “You brought in the equipment I was waiting for”

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Dear Erik and George et al,
Thanks for giving presentations on the Testbeam infrastructure and
                  the CALICE results.

                  They looked great! And I would like to congratulate and
                  thank every one of you who was involved in this effort.


                  All the very best,
                  Young-Kee
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