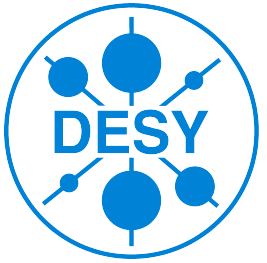
Universität Hamburg



2009 Data Taking

Nils Feege
University of Hamburg

HCAL Main Meeting, DESY, 16 July 2009

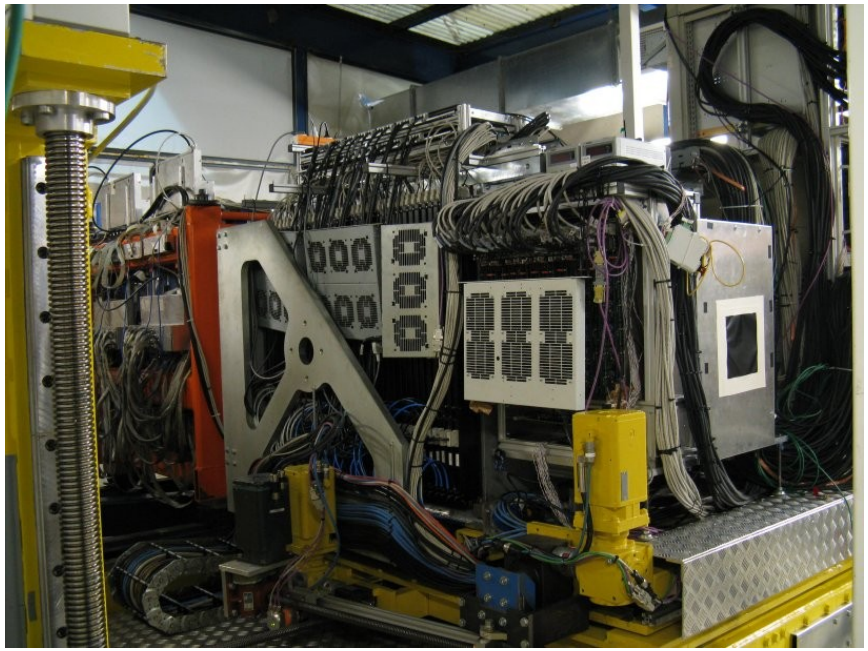
Outline

Goals and Achievements

Beam Line and Data Taking

First Look at Data

Summary and Outlook



Goals for 2009 Testbeam

- Sci – ECAL + HCAL + TCMT
  - π^- and e^- at 2-30 GeV
  - different positions and angles
  - π^0 data

- HCAL + TCMT
  - π^- at 1 – 4 GeV
  - e^- at 1 – 20 GeV
  - p at < 30 GeV
  - position and angle scans with π^- and e^-

HCAL Hadron Data

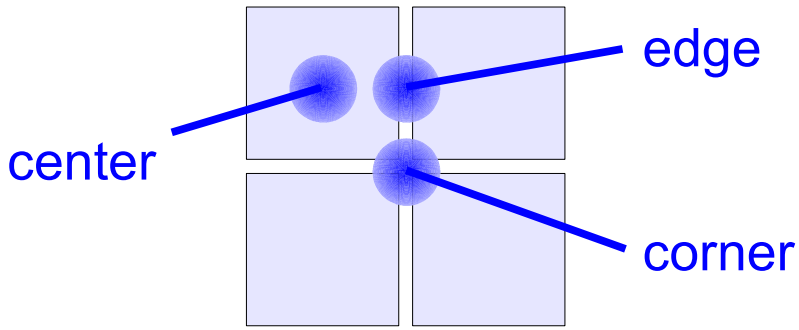
E [GeV]	particle	center	displaced	30 deg
1	π	90 k		
2	π	300 k		missing
4	π	380 k		missing
10	π		200 k	150 k
20	π		200 k	
30	π			200 k
10	p	200 k		
15	p	100 k		
120	p*	800 k		

* = parasitic beam (pixel telescope in MT6, section 1)

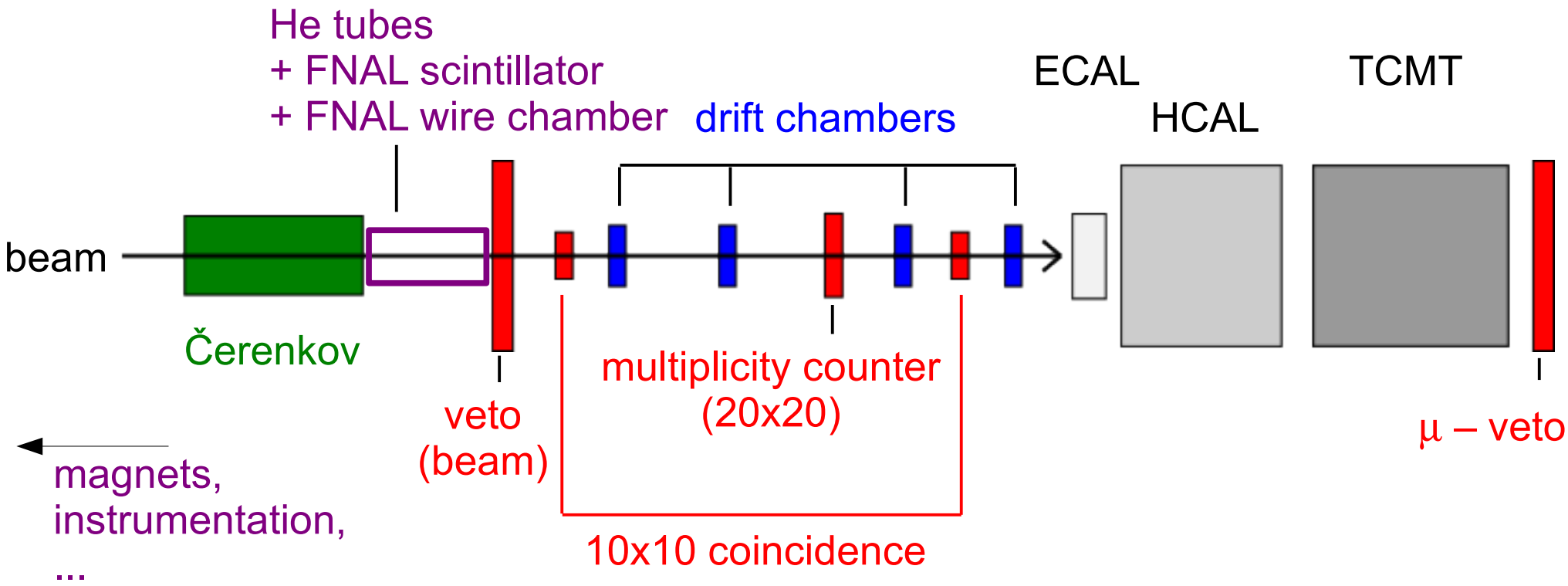
HCAL Electron Data

E [GeV]	center	edge	corner	10 deg	30 deg
1	140 k				
2	200 k			160 k	90 k
4	200 k			150 k	150 k
6	200 k			150 k	140 k
10	200 k	200 k	200 k	missing	140 k
20	200 k	100 k	100 k	130 k	200 k

missing: position scan on second tile

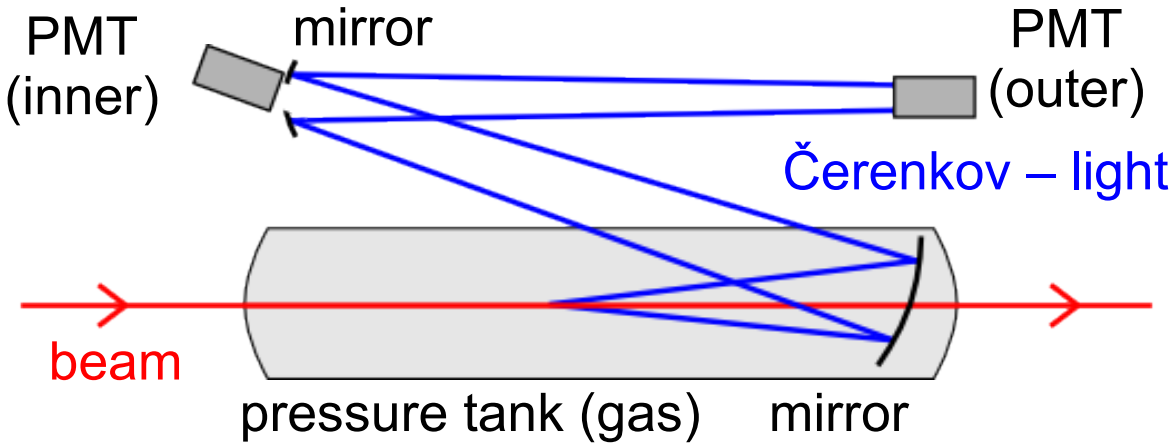


Beam Line 2009

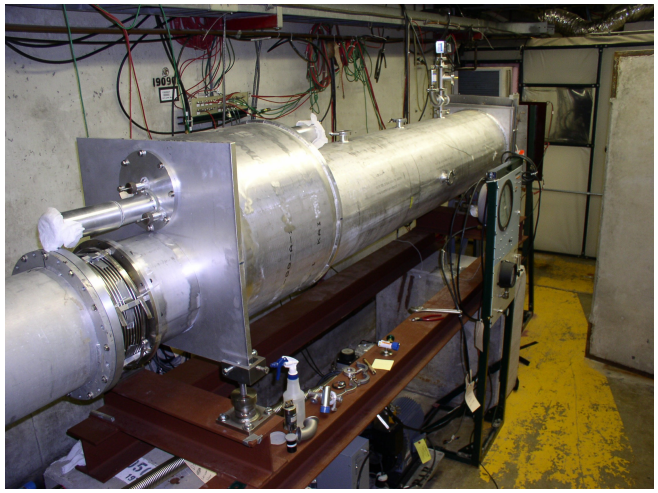


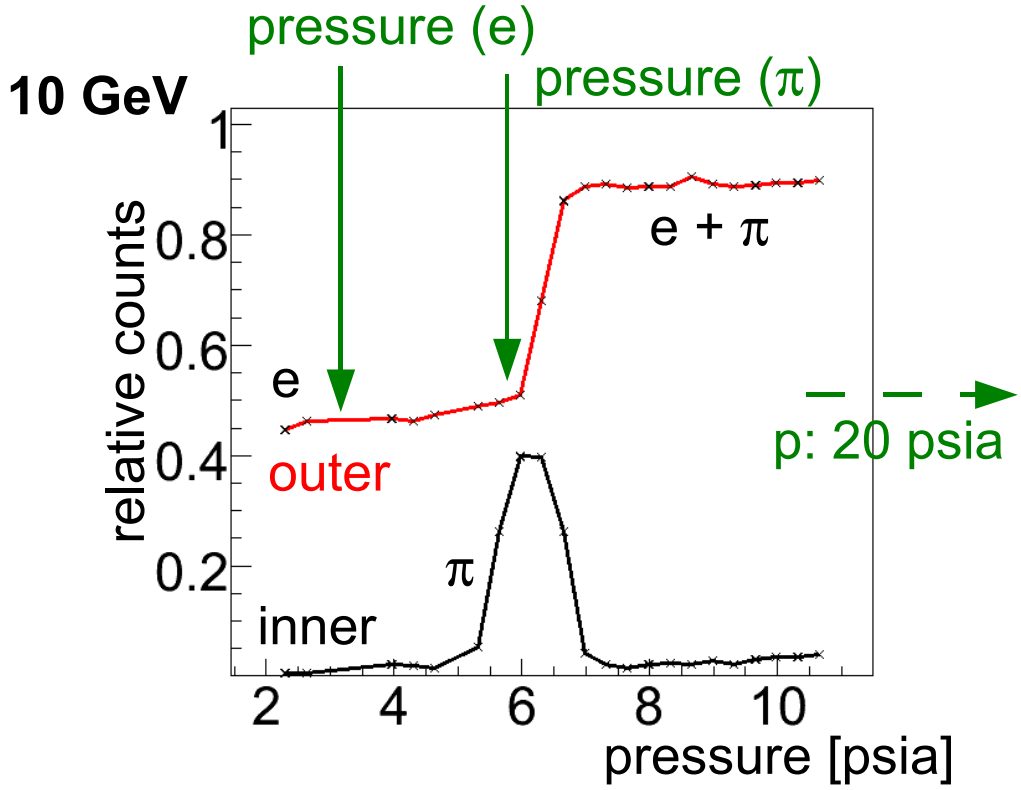
- no FNAL beam line description available for MC yet

Differential Čerenkov – Counter



Triggering on Čerenkov:
enhance π / e / p content
e.g. π content (10 GeV):
~50 % → ~90 %

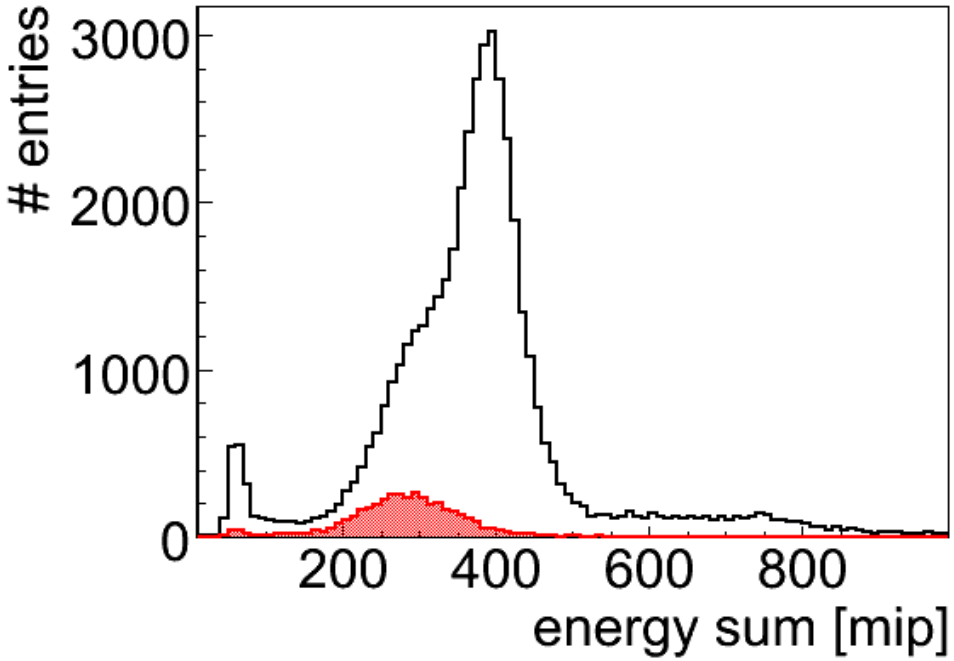




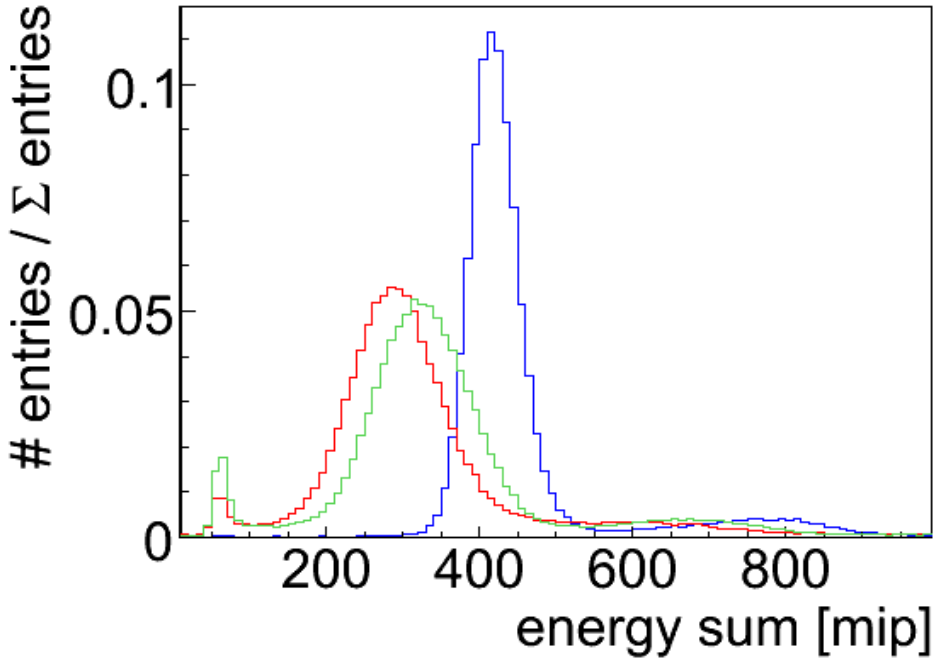
Example: Enhancing p / π / e Content

Beam energy: 10 GeV

'mixed' data



p, π and e enhanced data



- mixed → 10x10
- offline selection of p:
  - 10x10 && !C_{inner} && !C_{outer}
  - < 10 % of collected events

p → 20 psia, 10x10 && !C_{inner} && !C_{outer}

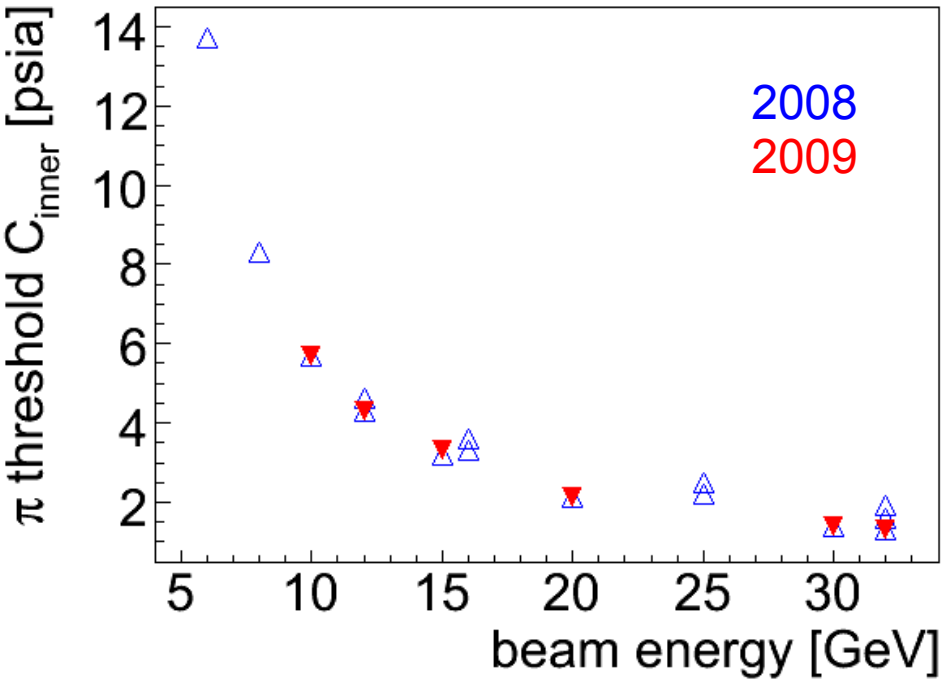
π → 5.7 psia, 10x10 && C_{inner}

e → 3 psia, 10x10 && C_{outer}

Čerenkov Operating Pressure

π (6 – 32 GeV)

- Trigger: 10x10 && C_{inner}



π (1 – 4 GeV)

- Trigger: 10x10 && ! C_{inner} && ! C_{outer}

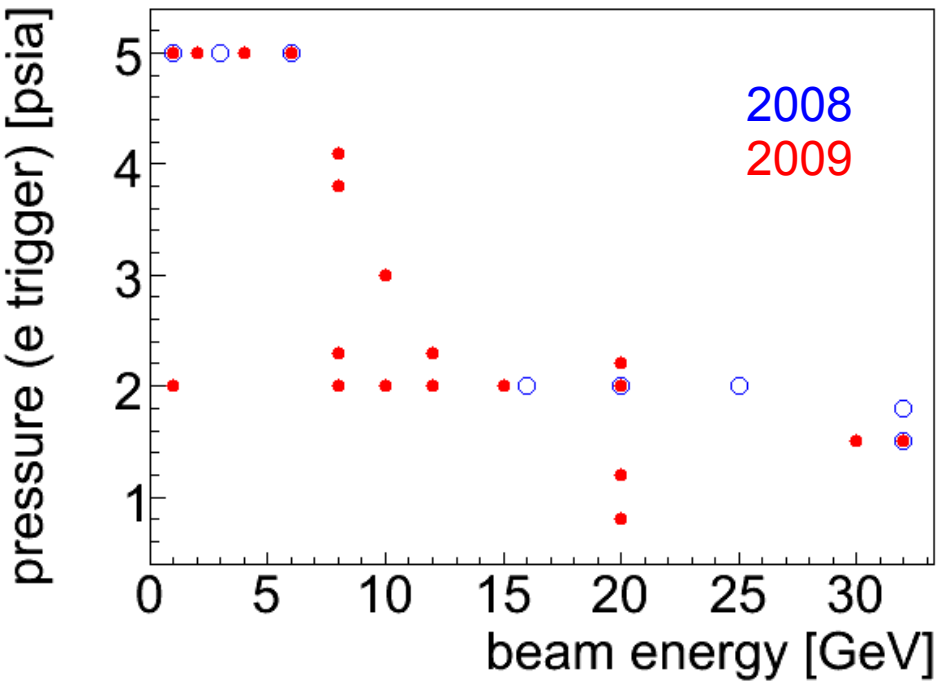
- **2008**: maximise e detection / rejection efficiency
  → operate at 20 psia

- **2009**: minimise material (gas), multiple scattering and generation of knock – on electrons in Čerenkov to maximise π rate
  → operate at 2-5 psia

- 2009 rates for 2 Gev:
  20 psia → 320 events/spill
  5 psia → 520 events/spill

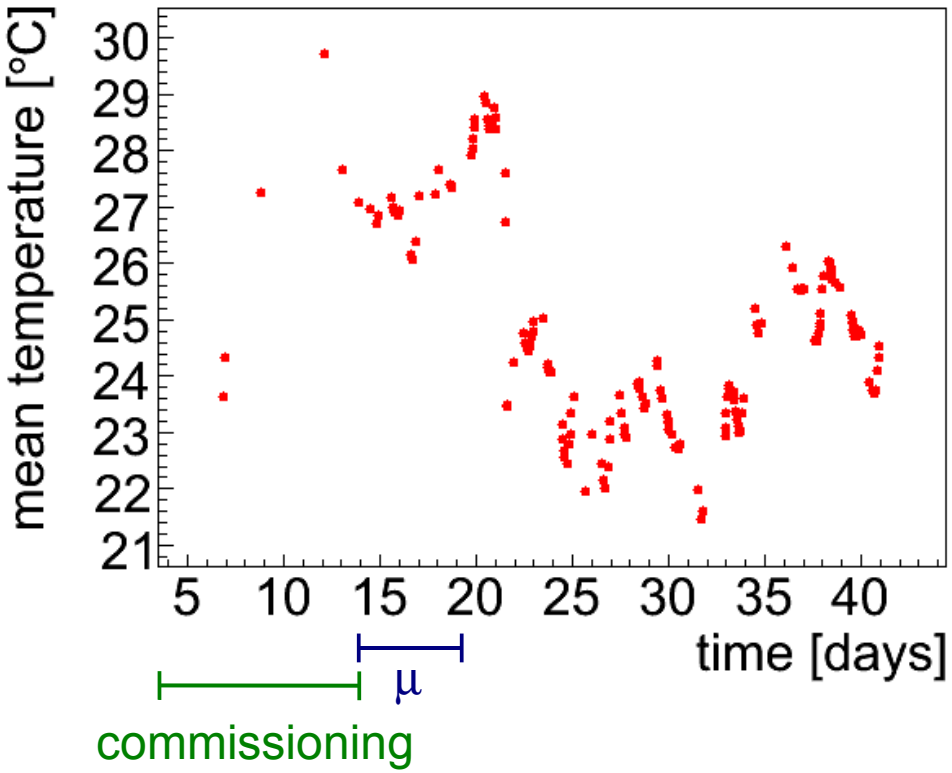
Čerenkov Operating Pressure

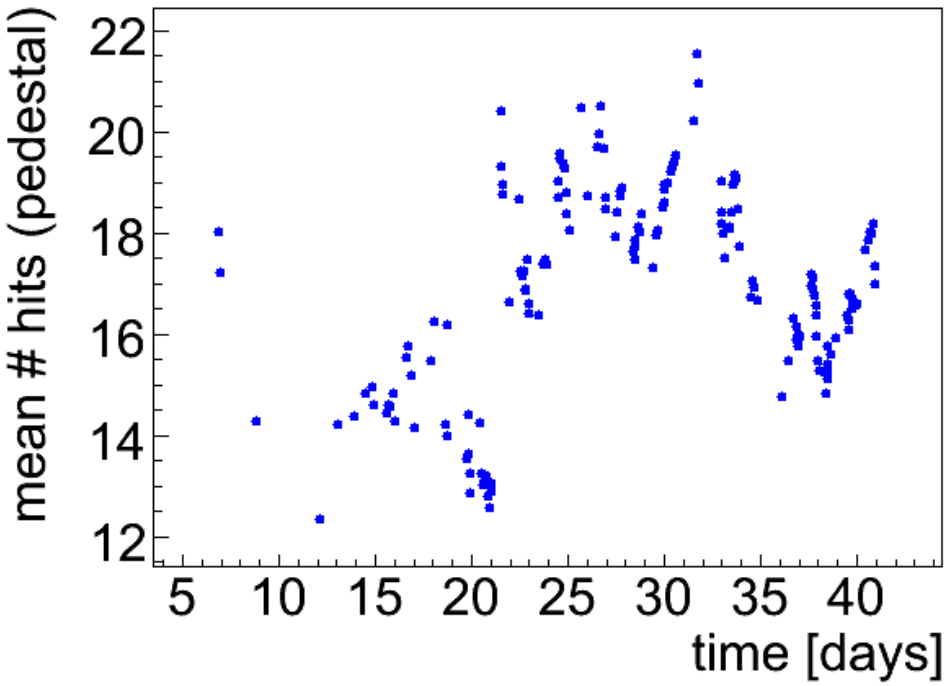
e (1 – 32 GeV)



- Trigger: 10x10 && C_{outer}

Operation Stability

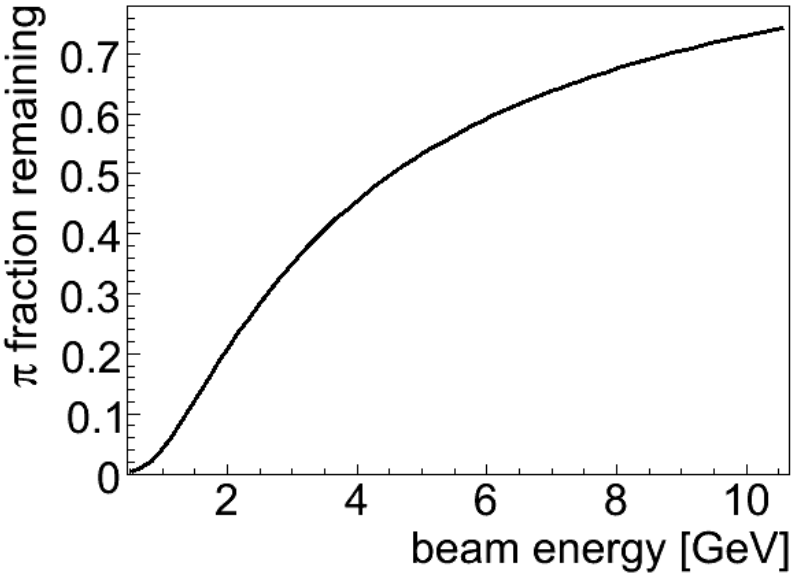




- preliminary calibration
- no temperature correction applied

Collecting Low Energy π Data

- beam composition
  - below 8 GeV: mostly electrons (90% e at 1 GeV)
- π life time
  - mean π decay length $c \cdot \tau = 7.8$ m
  - π rest mass $m_\pi = 140$ MeV
  - distance d (target MT4TGT → ECAL) ~ 175 m

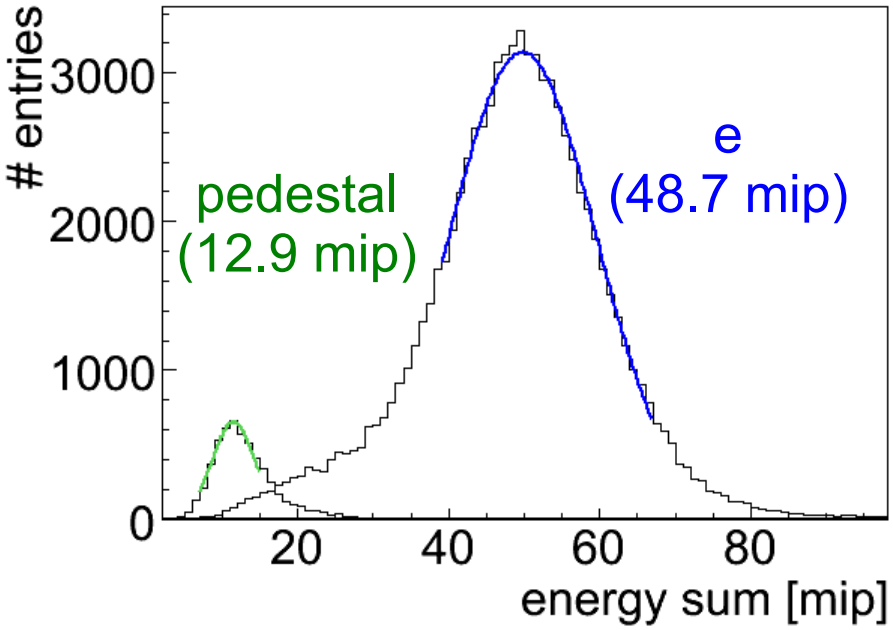


fraction of π not decaying into μ:

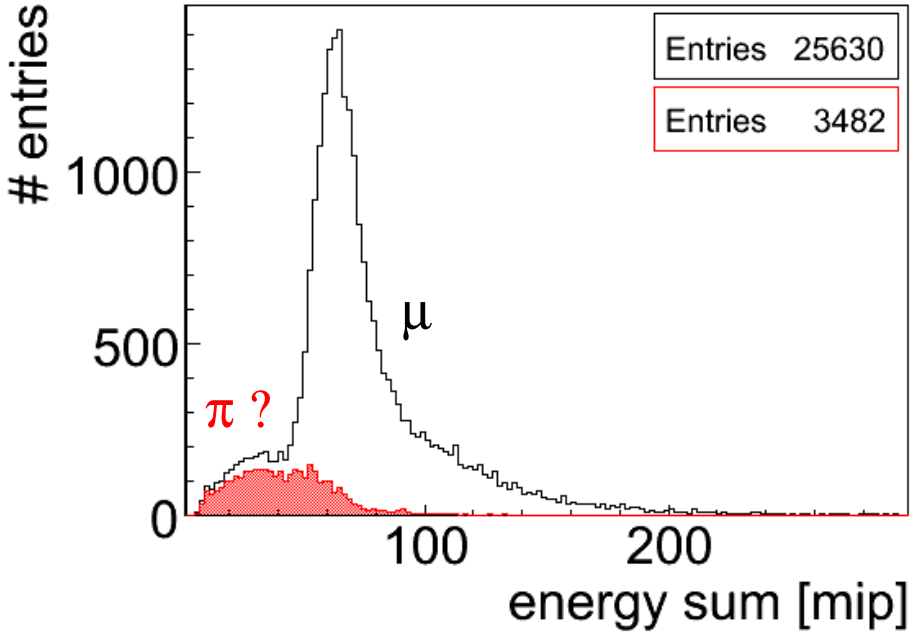
$$\exp\left(-\frac{m_\pi}{E_{beam}}\,\frac{d}{c\cdot\tau}\right)$$

Very First Look At Low Energy Data

1 GeV data (**preliminary calibration!**)



- Čerenkov: 2 psia
- Trigger: 10x10 && C_{outer}
  - ➔ electrons

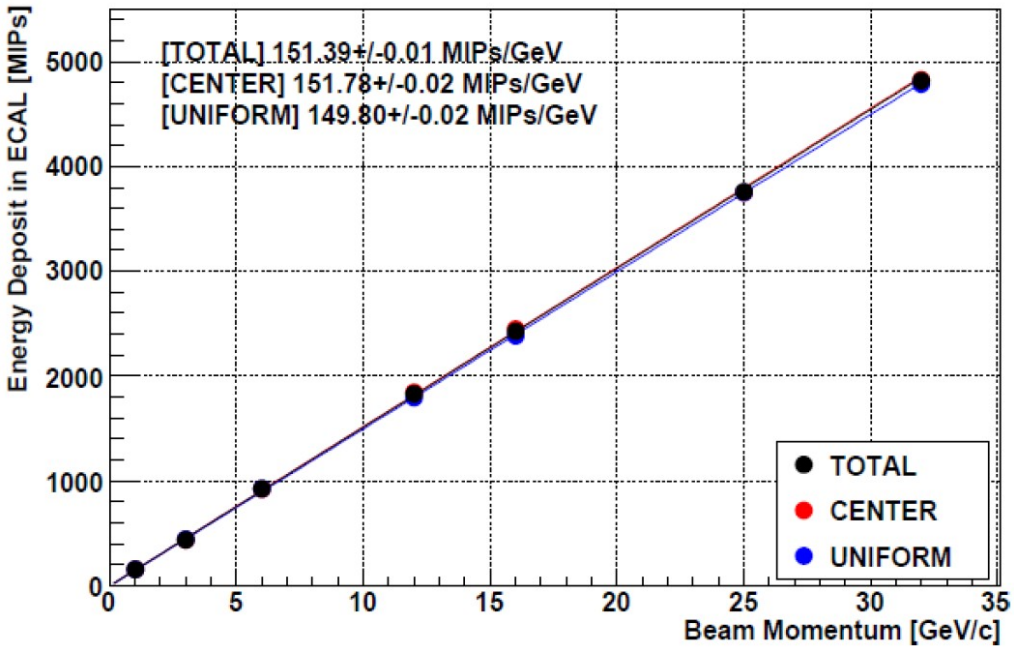


- Čerenkov: 2 psia
- Trigger: 10x10 && ! C_{inner} && ! C_{outer}
  - ➔ pions (+ muons)

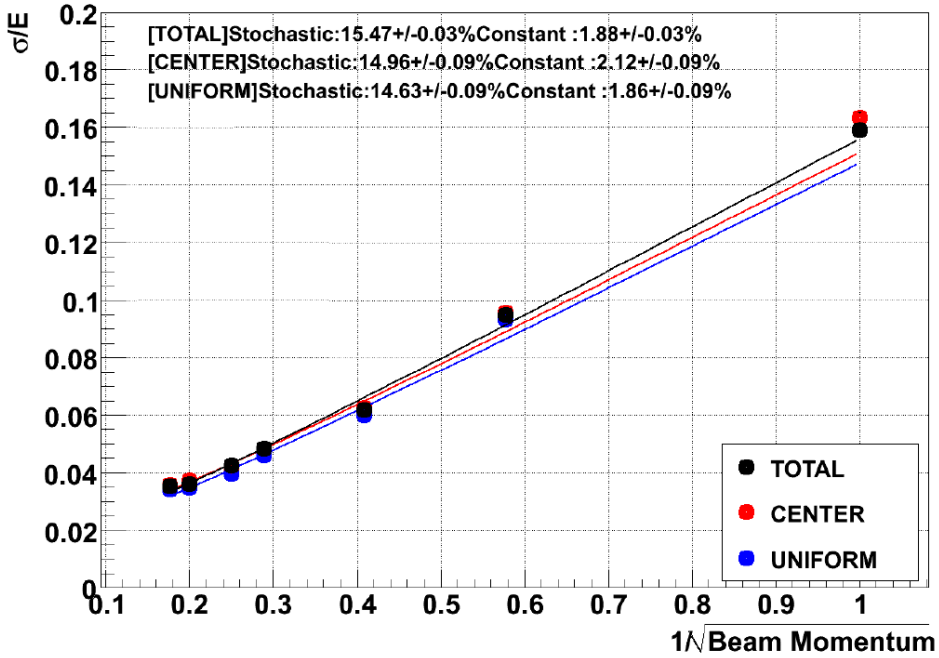
- first offline π / μ separation: require < 10 hits in TCMT

Sci – W ECAL: Some Results

linearity (electrons)



energy resolution

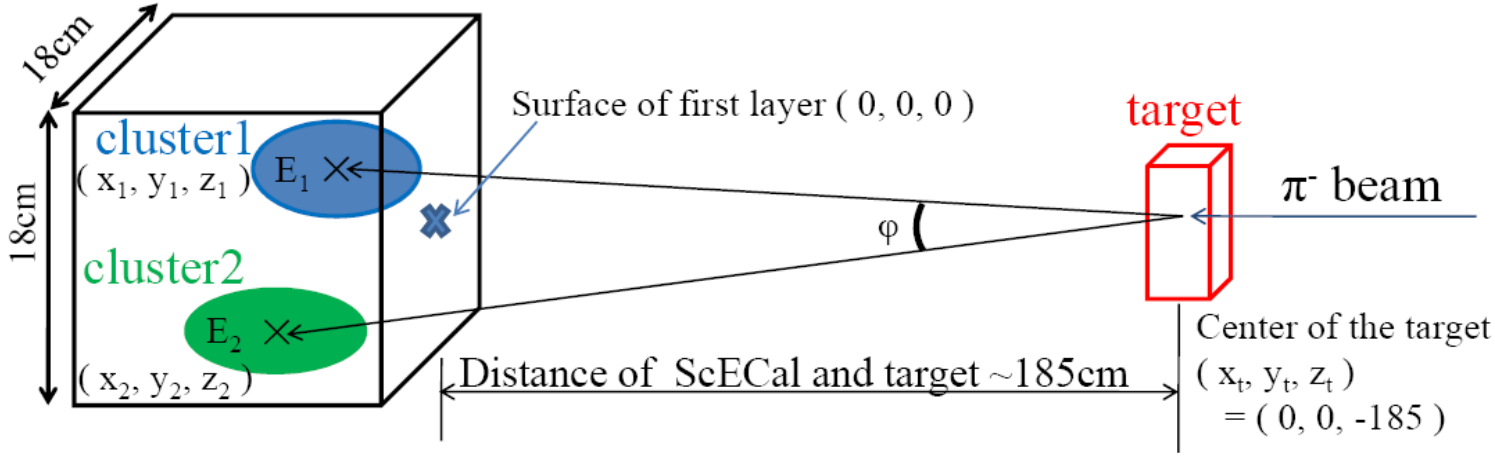


Fluctuation of deviation:

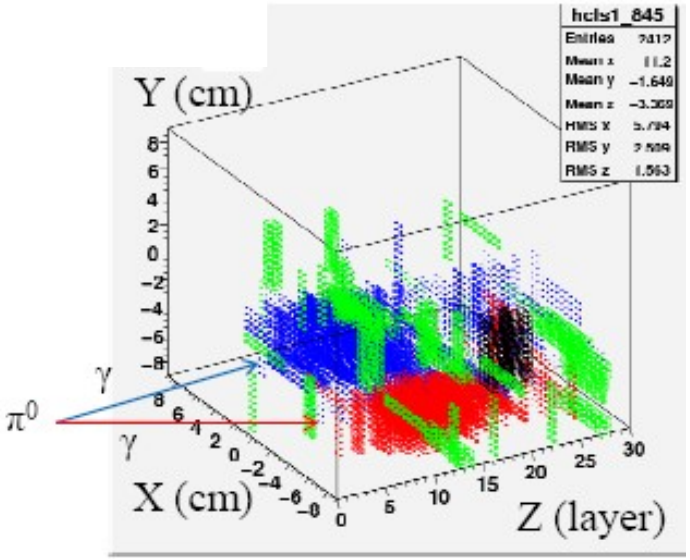
- < 5 % (all energies)
- < 2 % (≥ 12 GeV)

$$\frac{\sigma}{E} = \frac{15.47\ \%}{\sqrt{E}} \oplus 1.88\ \%$$

Sci – W ECAL: π^0 Reconstruction

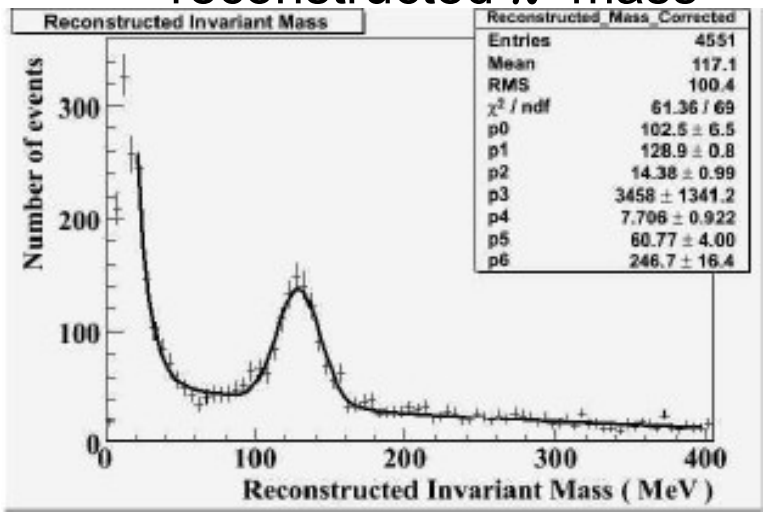


(Invariant Mass) = sqrt(2*E_1*E_2*(1-cos(φ)))



← real event

reconstructed π^0 mass



Summary / Outlook

- data taking period 2009 was a success
- stable operation of Sci – ECAL, HCAL, TCMT
- Čerenkov trigger worked fine
- analysis of FNAL data has started
  - many things that can be done, e.g.
    - low energy data analysis / comparison to MC
    - particle flow studies with shifted detector
  - many things that have to be done, e.g.
    - final calibration and temperature corrections
    - beam line description in MC