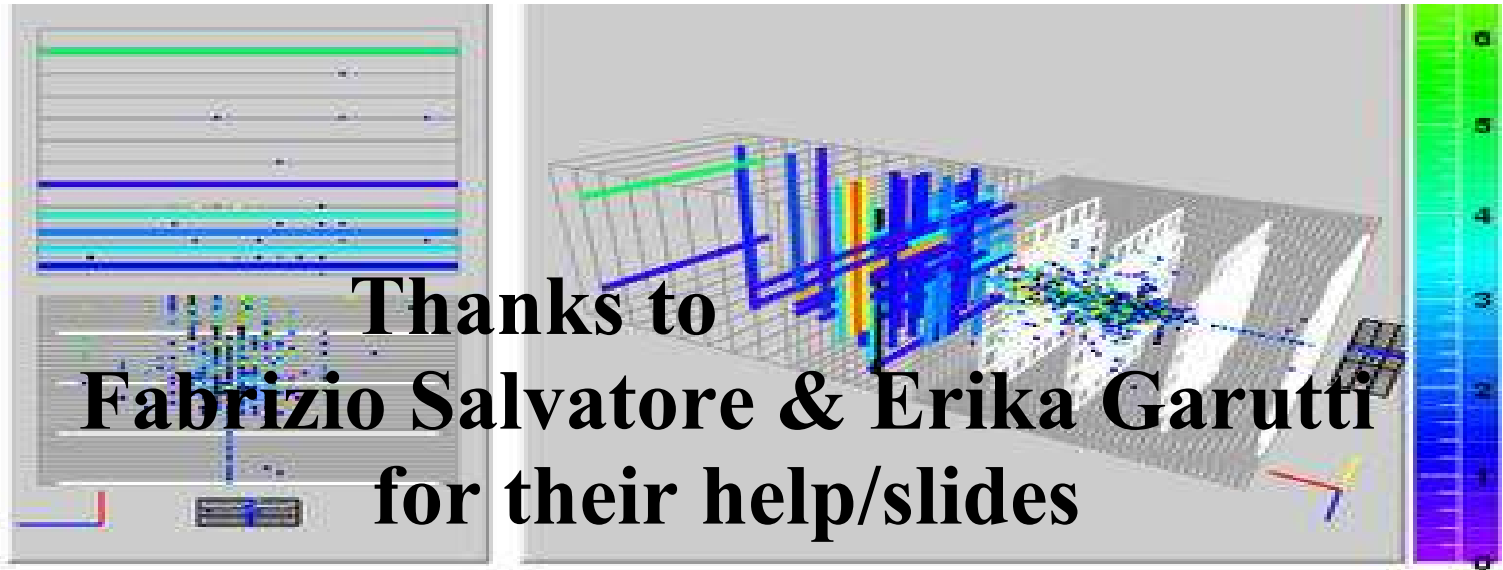


Review of 2007 CERN Test Beam

**Yoshinari Mikami
University of Birmingham**



**20th Sept 2007
CALICE-UK meeting
at University of Cambridge**

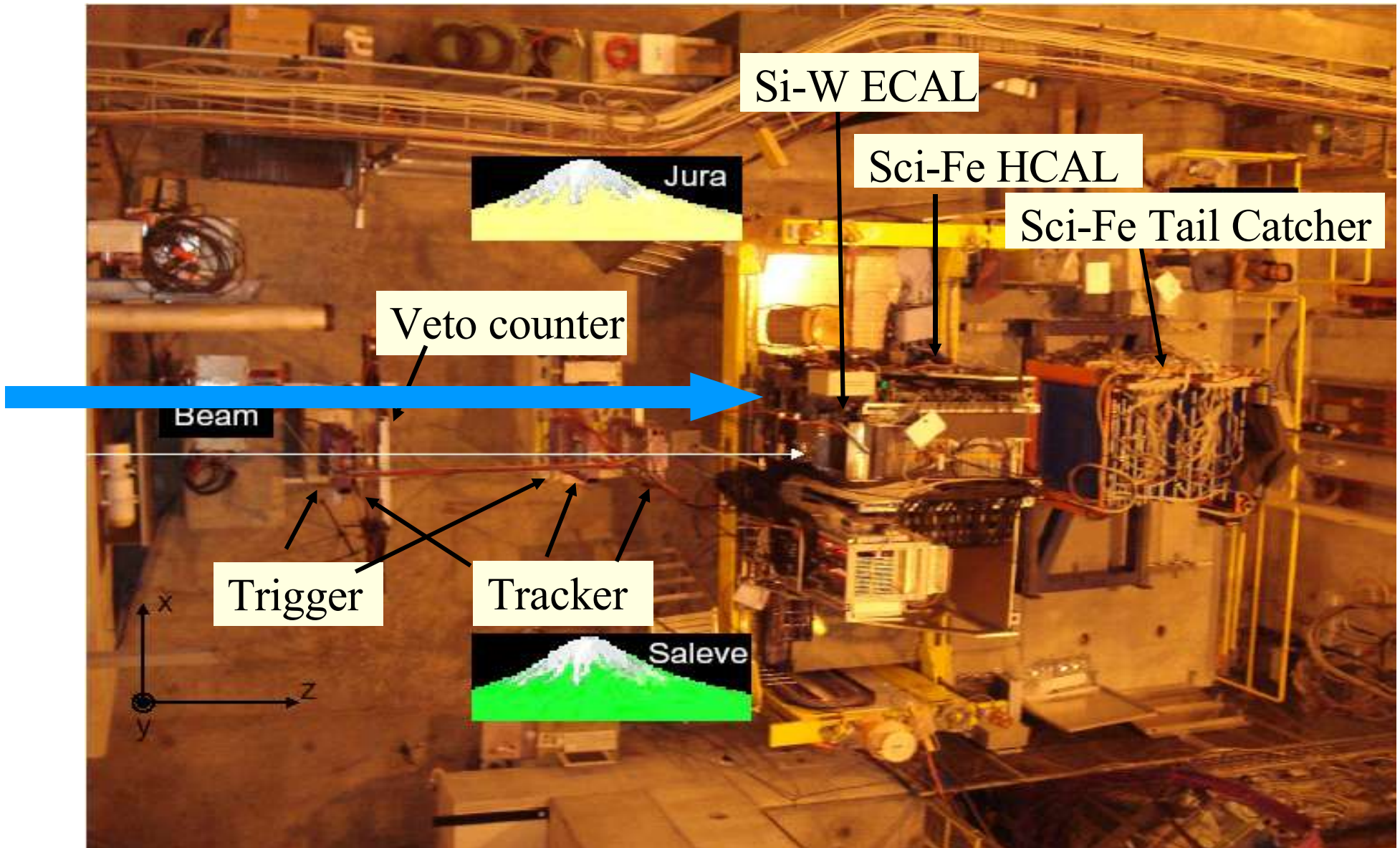


**Thanks to
Fabrizio Salvatore & Erika Garutti
for their help/slides**

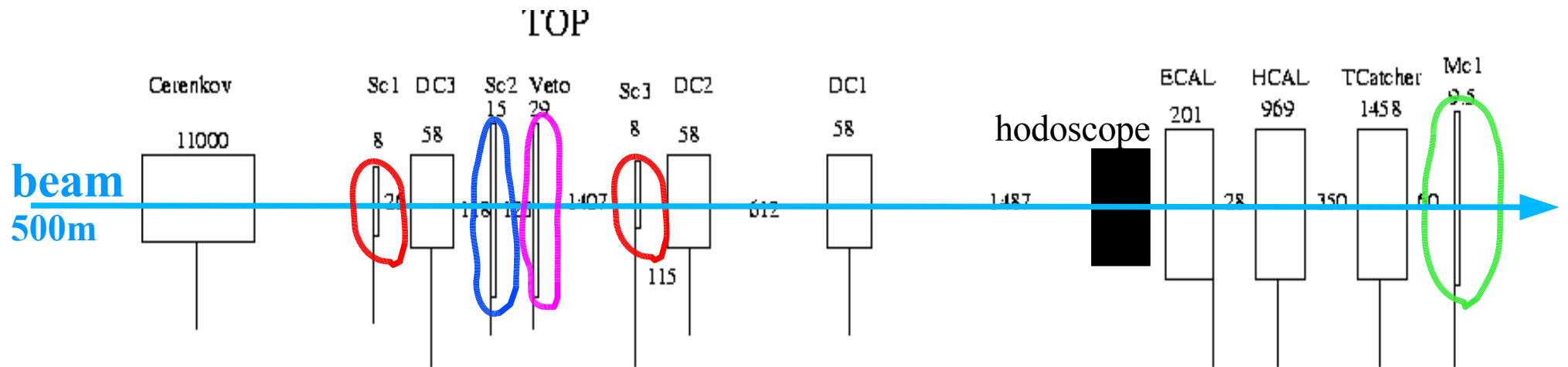
Outline

- **Test beam setup**
- **Tracker, Trigger and DAQ rates**
- **Accumulated data**
- **ECAL and HCAL raw response**
- **Summary**

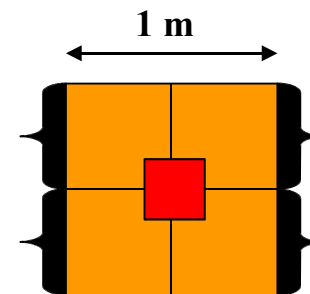
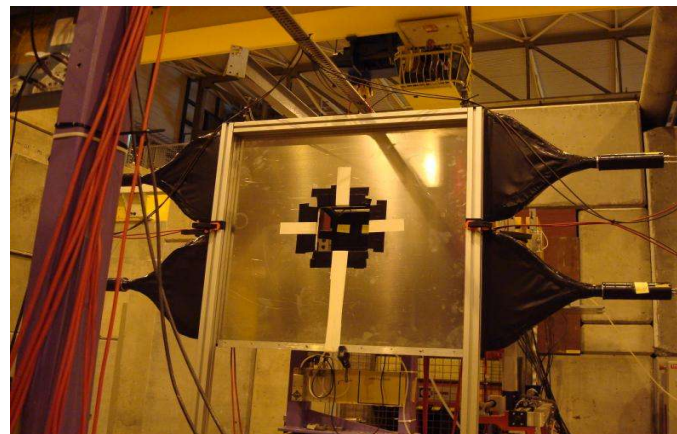
Test beam setup (bird's-eye view)



Schematic View of setup



- **Sc1+Sc3** -> two 10cmx10cm beamData trigger
- **Sc2** -> 20cmx20cm inner veto trigger
- **Outer veto** with 20cmX20cm hole in 100cmX100cm to tag double particle



- **hodoscope** installed for initial muon runs and for ECAL chip irradiation
- **Mc1** -> 100cmx100cm calibration trigger

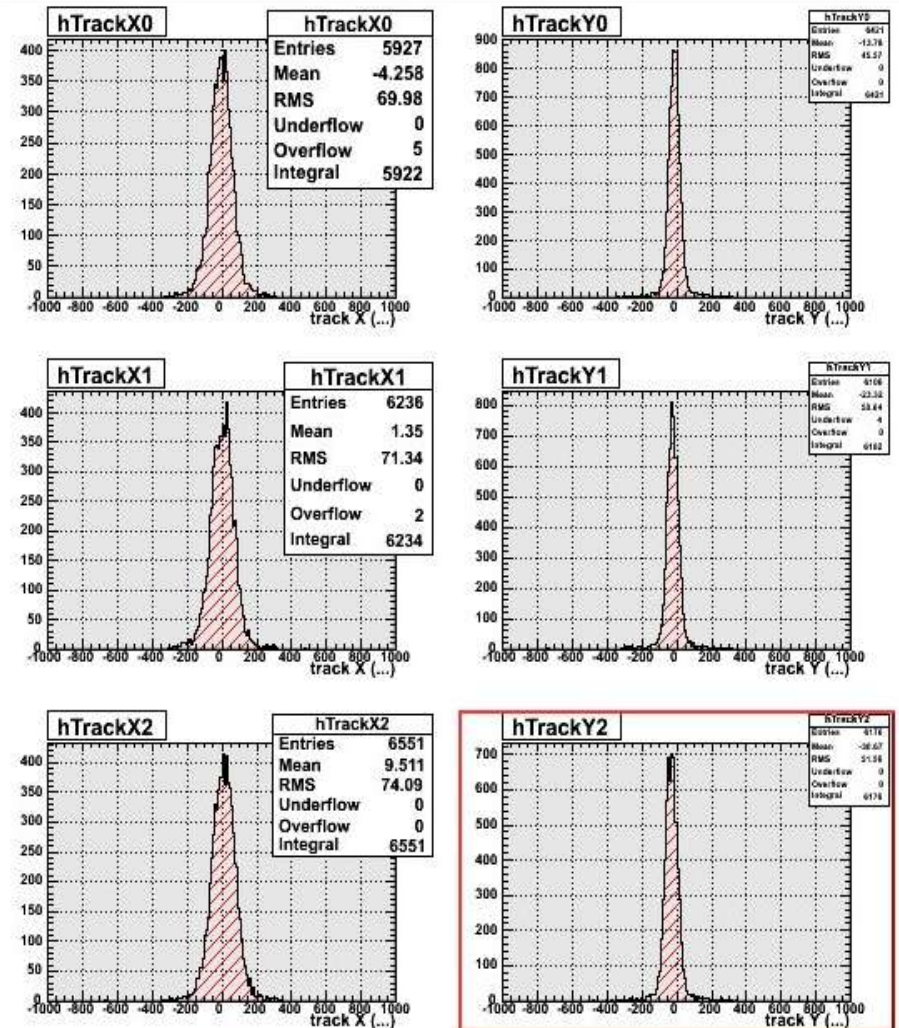
ECAL, AHCAL and TCMT setups

- **ECAL: 54 PCBs (30 layers)**
 - 216 channels/PCB in central part and 108ch/PCB in bottom part
 - Total channels: 9072
 - **Total radiation length: $24 X_0$**
- **AHCAL: 38 fully commissioned modules**
 - 30 modules with fine granularity = 216 tiles
 - 8 modules with coarse granularity = 141 tiles
 - Total channels: 7608
 - **Total interaction length: 4.5λ**
- **TCMT: 16 layers fully instrumented**
 - Alternated cassettes (from layer 2 to 16) have been staggered in X and Y
 - layer 2 = nominal; layer 3 (vert) = -1 inch in X;
 - layer 4 (hor) = +1 inch in Y; repeated up to layer 16

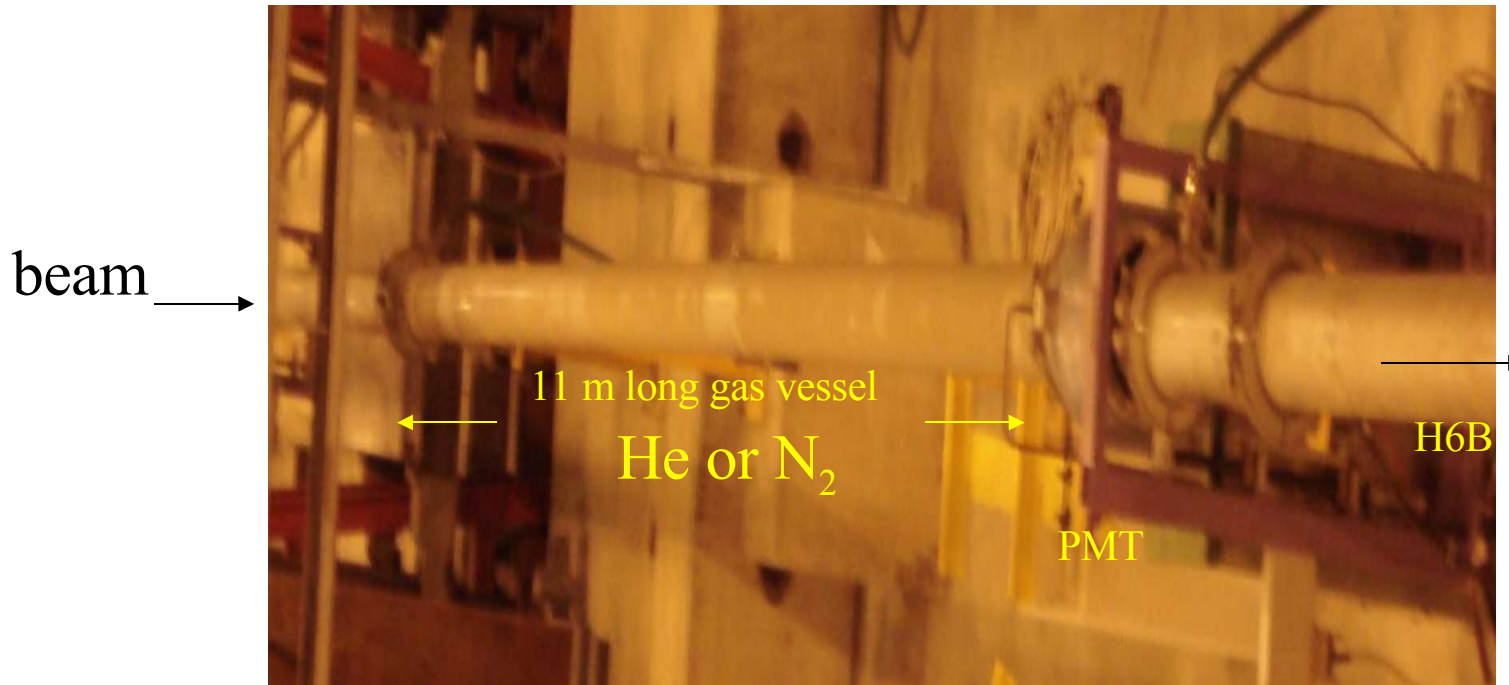
Tracker setups

- **Three multiple wire proportional chambers**

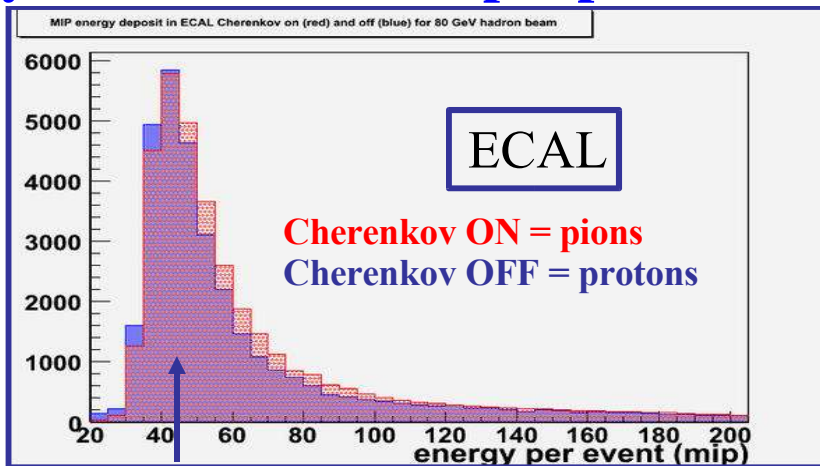
- X and Y readout
- 50/50 Ar/CO₂ gas mixture
- 200 mV (or 100mV) threshold
- **Aligned with 0.2 mm precision**



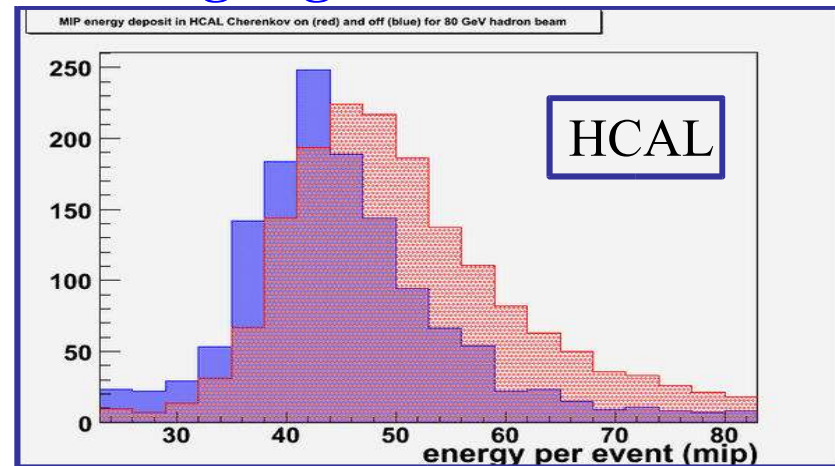
Cherenkov counter



Normally used for e tagging for energy less than 30 GeV (e/π separation with He)
This year we achieved π/p separation with nitrogen gas.



1 MIP-like particle



Beam Setup

- **Super-cycle:** { 14 basic periods/16.8 sec day
(17 bp/20.4 sec from 15/08)
12 bp/14.4 sec night/w-e
- **Secondary beam energies:**

80 GeV wobbling	π^- (40-100 GeV) and e^- (15-50 GeV)
10 GeV wobbling	π^- and e^- (6-25 GeV)
60 GeV wobbling	π^+/p (30-80 GeV) and e^+ (10-50 GeV)
130 GeV wobbling	π^- (60-180 GeV) and e^- (70-90 GeV)

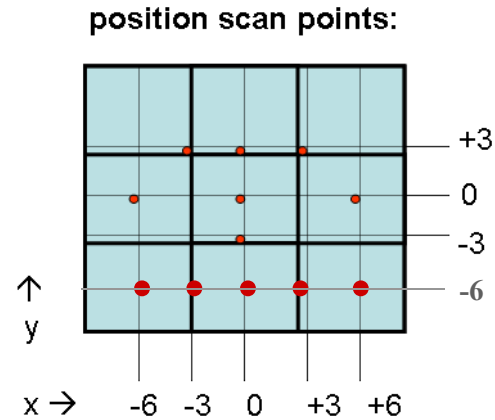
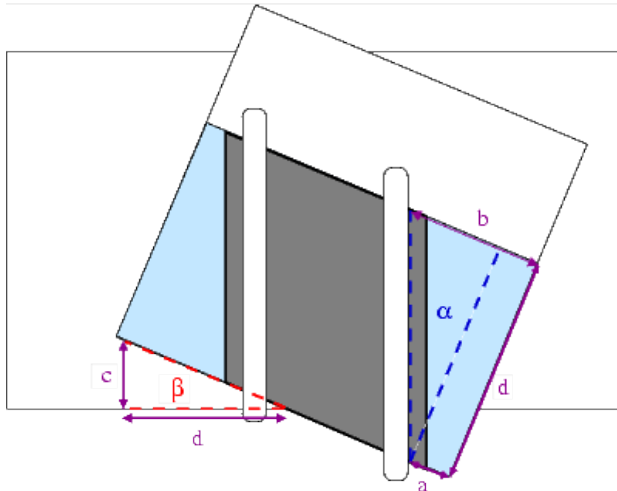
Trigger and DAQ rates

- **High energy beams (30-180 GeV)**
 - Trigger rate on 10cmx10cm set to <10k particles/spill in order to prevent damage on the detectors
 - ♦ Average rate ~8k pps
 - **DAQ rate ~70-80 Hz**
- **Low energy beams (6-25 GeV)**
 - Trigger rate on 10cmx10cm was adjusted in beam files using available collimators
 - ♦ Average rate ~ 600 pps@ 6 GeV,
~1-3k pps@ 8-25 GeV
 - **DAQ rate ~35-60 Hz**

Energy and particle type

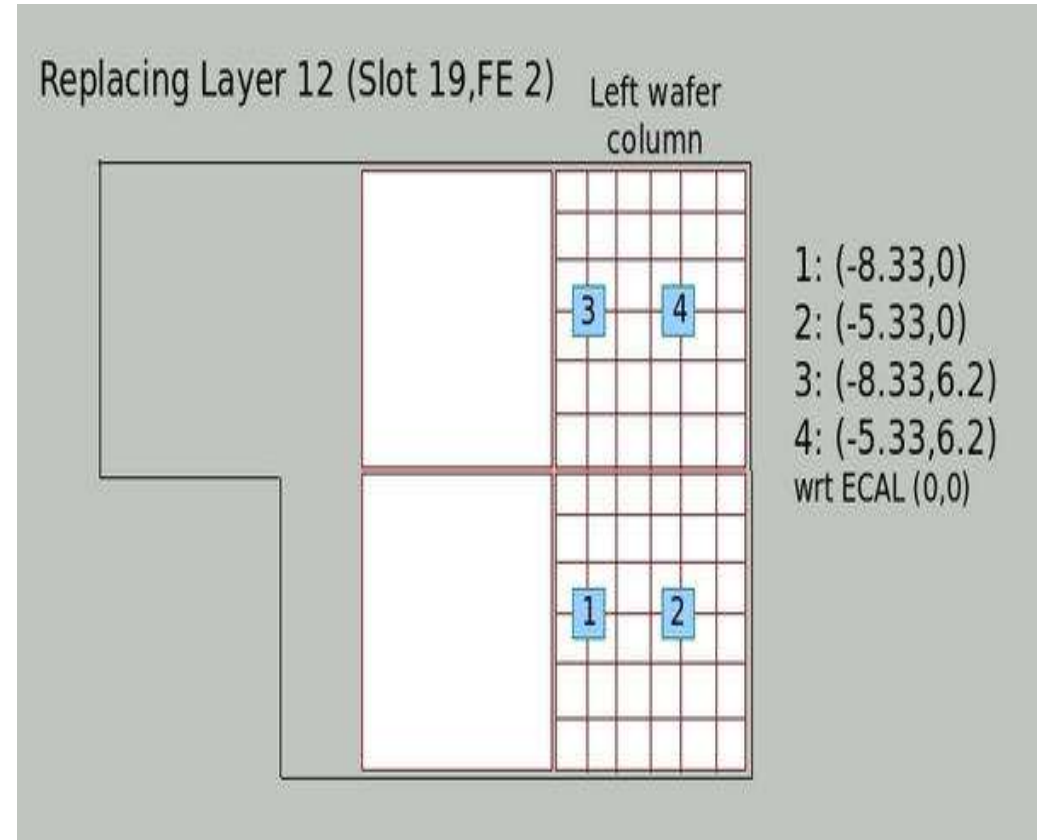
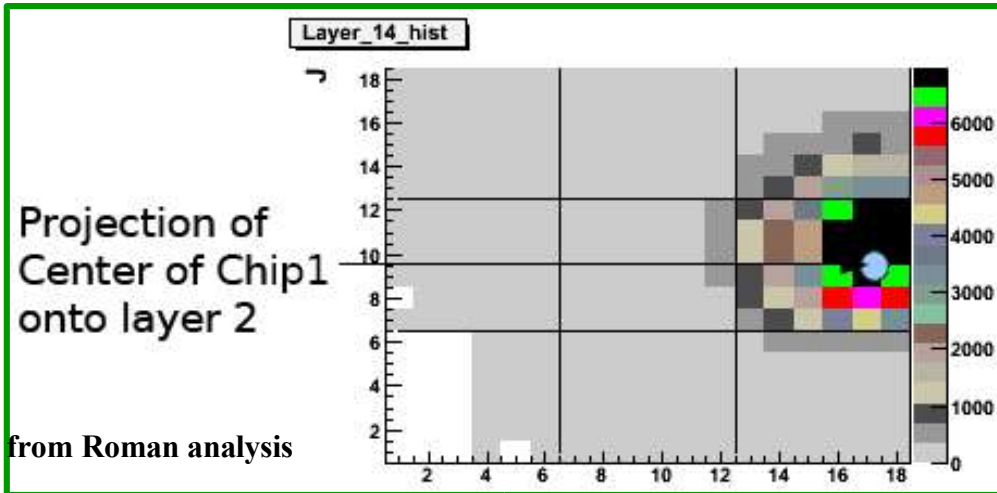
	Proposed in plan	Collected during Test Beam
Energy (GeV)	6,8,10,12,15,18,20,25,30,40,50,60,80	6,8,10,12,15,18,20,25,30,40,50,60,80,100,120,130,150,180
Particle type	π^\pm/e^\pm	$\pi^\pm/e^\pm/p$

Angle and position scans



	Proposed in TB plan	Collected during TB
Angles (degrees)	0, 10, 15, 20, 30	0, 10, 20, 30
Position scans	Centre of ECAL	Centre of ECAL ±6cm from ECAL centre wafer Bottom slab of ECAL (±6,0,±3cm, -3cm)
	Centre of AHCAL	Centre of AHCAL Centre of ECAL; AHCAL ±6cm off beam-line
	Inter-alveolae	Inter-alveolae (±3cm, ±3cm)

ECAL chip irradiation



- 5 position scan for each of the 4 chips on the special ECAL slab
- 90 GeV electron beam is used
- ~1.2 M events per chip

Pion runs

	Proposed in plan (4 weeks of data taking)	Collected at the Test Beam (7 weeks of data taking)
Combined physics run: low energy π	π^- : 1M events @ 6/8/10/12/15/18/20GeV; 0 deg π^- : 500k events @ 6/10/12/15/18/20 GeV; 10, 15, 20, 30 deg	<ul style="list-style-type: none"> • 1M events @ 6 GeV, 0 deg ; • 1.8M events @ 8/10/12/15/18/20GeV, 0 deg. • 400k events @ 6/10/12/15/18/20 GeV, 10 deg; • 1M events @ 6 GeV, 20deg; • 500k events @ 8-20 GeV, 20 deg;
Combined physics run: high energy π	π^- : 1M events @ 25/30/40/50 GeV, 0 deg π^- : 500k events @ 25/30/40/50 GeV; 20, 30 deg	<ul style="list-style-type: none"> • 1.5M events @ 25/40/50/60/80/100/120/130/150/180 GeV, 0 deg; • 200k events @ 5/40/45/50/80/100 GeV, 0 deg: ECAL on beam line, AHCAL displaced by 6 cm. • 200k events @ 35/40/45/50/80/100 GeV, 10,20 deg.

Electron runs

	Proposed in plan (4 weeks of data taking)	Collected at the Test Beam (7 weeks of data taking)
ECAL physics run: low energy e	e ⁻ : 1M events @6/10/15(/20), 0 deg	<ul style="list-style-type: none"> • 1M events @ 6 GeV, 0 deg; • ~700K events @ 8/10/12/15/18/20 GeV, 0 deg. • 1M events @ 6 GeV, 20 deg; • ~400K events @ 8/10/12/15/18/20 GeV, 10, 20 deg.
ECAL physics run: high energy e		<ul style="list-style-type: none"> • ~2M events @ 25/30/40/50 GeV, 0 deg; • ~200K events @ 25/30/40/50 GeV, 10, 20 deg.
ECAL physics run (bottom layer scan): high energy e		<ul style="list-style-type: none"> • Scan of the bottom ECAL layer; ~250K events @ 90 GeV/position, 0 deg.
ECAL irradiation run: high energy e	e ⁻ : 1M events @10/50 GeV, 0 deg	<ul style="list-style-type: none"> • ~1.1M events @ 70 GeV, 0 deg; • ~5.5M events @ 90 GeV, 0 deg. Position scanning on chip.
ECAL inter-alveolae run: high energy e	e ⁻ : 300k events @20/50 GeV, 0 deg	<ul style="list-style-type: none"> • ~2M events @ 8/10/12/15/18/20/25/30/40/50 GeV, 0 deg; 6 positions.

AHCAL only and π^+ / e^+ /protons runs

	Proposed in plan (4 weeks of data taking)	Collected at the Test Beam (7 weeks of data taking)
AHCAL only run: e/π , all energies	e/π : 500k-1M events @ 6/10/15/20/25/30/40/50 GeV, 0 deg	<ul style="list-style-type: none"> • π^-: 100k events @ 8/10/12/ 15/20 GeV, 30 deg; • e^-: 100k events @ 6/10/15/20 GeV, 30 deg; • π^+: 400k events @ 10/15/20/25/ 30/40/50 GeV, 0, 10, 20, 30 deg; • e^+: 400k events @ 10/15/20/25/30/40/50 GeV, 0, 10, 20, 30 deg.
		<ul style="list-style-type: none"> • e^+: 1.5M events @ 10/15/20/25/30/40/50 GeV, 0 deg; • π^+/protons : 1.5M events @ 30/40/ 50/60/80 GeV, 0 deg: position scanning on ECAL front face.

Total events on disk

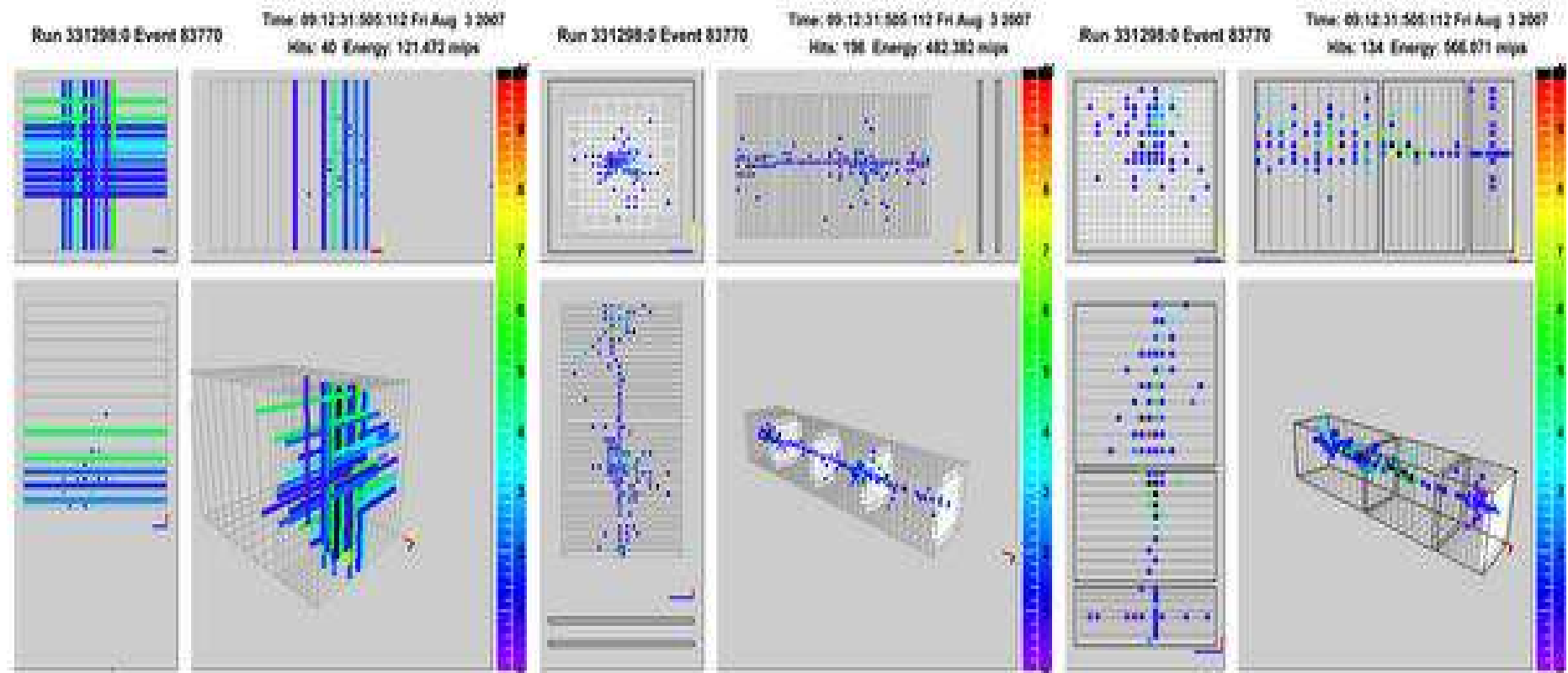
Combined ECAL+AHCAL

Last run number	33 1693
Number of runs	1 693
Combined runs to grid	1 693 (100%)
Converted runs to grid	1 693 (100%)
Disk space	8 274 GB
Disk space for converted runs	5 965 GB
Total disk space used	~14 TB

AHCAL only

Last run number	35 0395
Number of runs	395
AHCAL runs to grid	395 (100%)
Converted runs to grid	395 (100%)
Disk space	598 GB
Disk space for converted runs	369 GB
Total disk space used	~1 TB

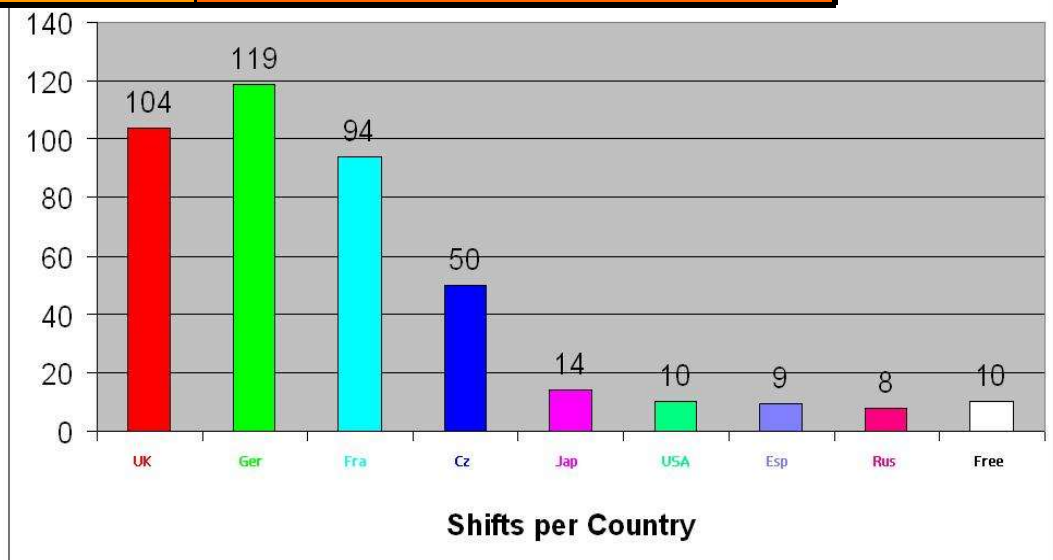
Detector performance



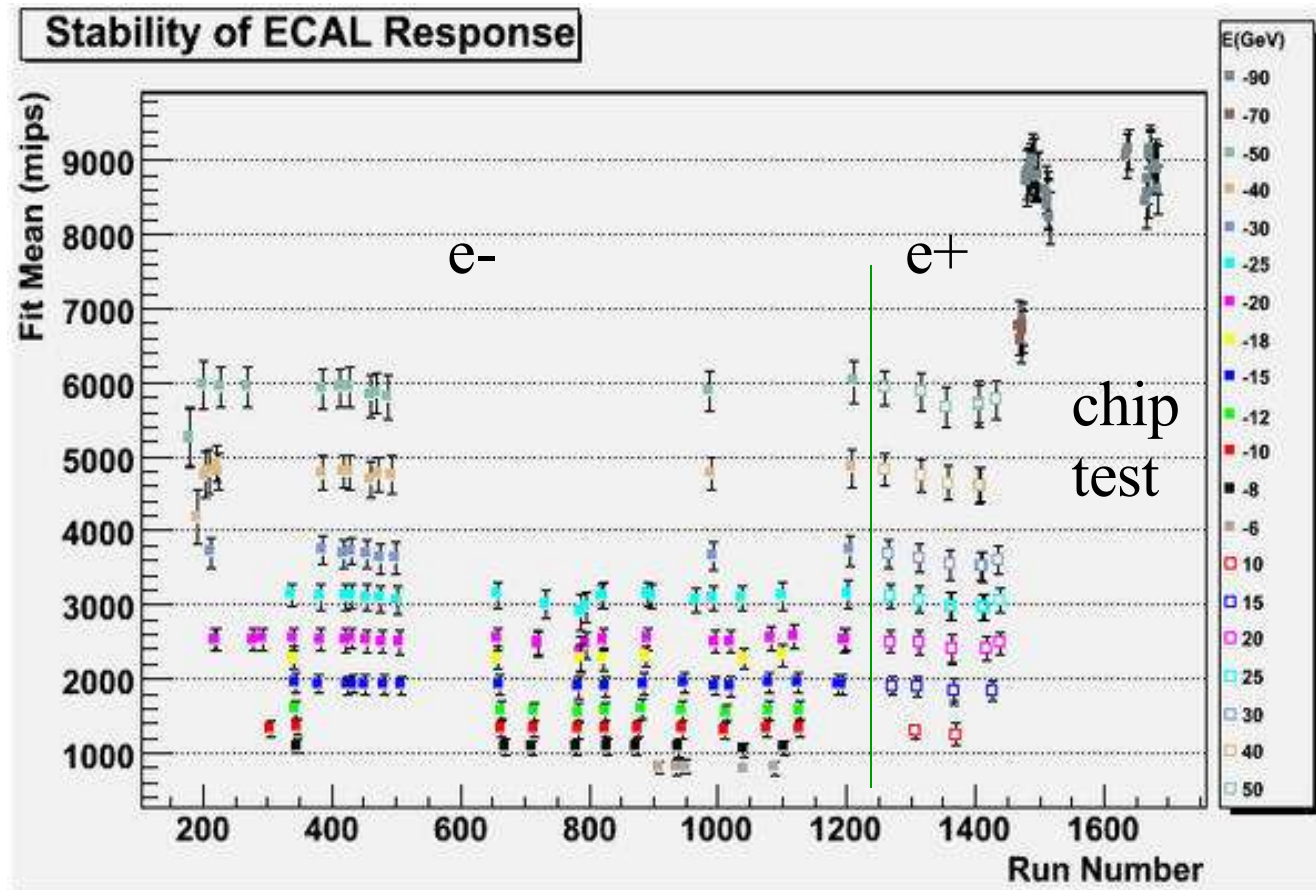
Total data taking time	7 weeks
SPS uptime	80.7 %
Beam controlled by H6B	76.1 % (94.4 % of uptime)
DAQ on beamData	60.2% (79.1 % of beam in H6B)
DAQ on calibration	7.8 %

Shift contribution

Data-taking weeks	7 (July 5 th to Aug 22 nd)
Total shifts	418
July shifts	247
August shifts	171

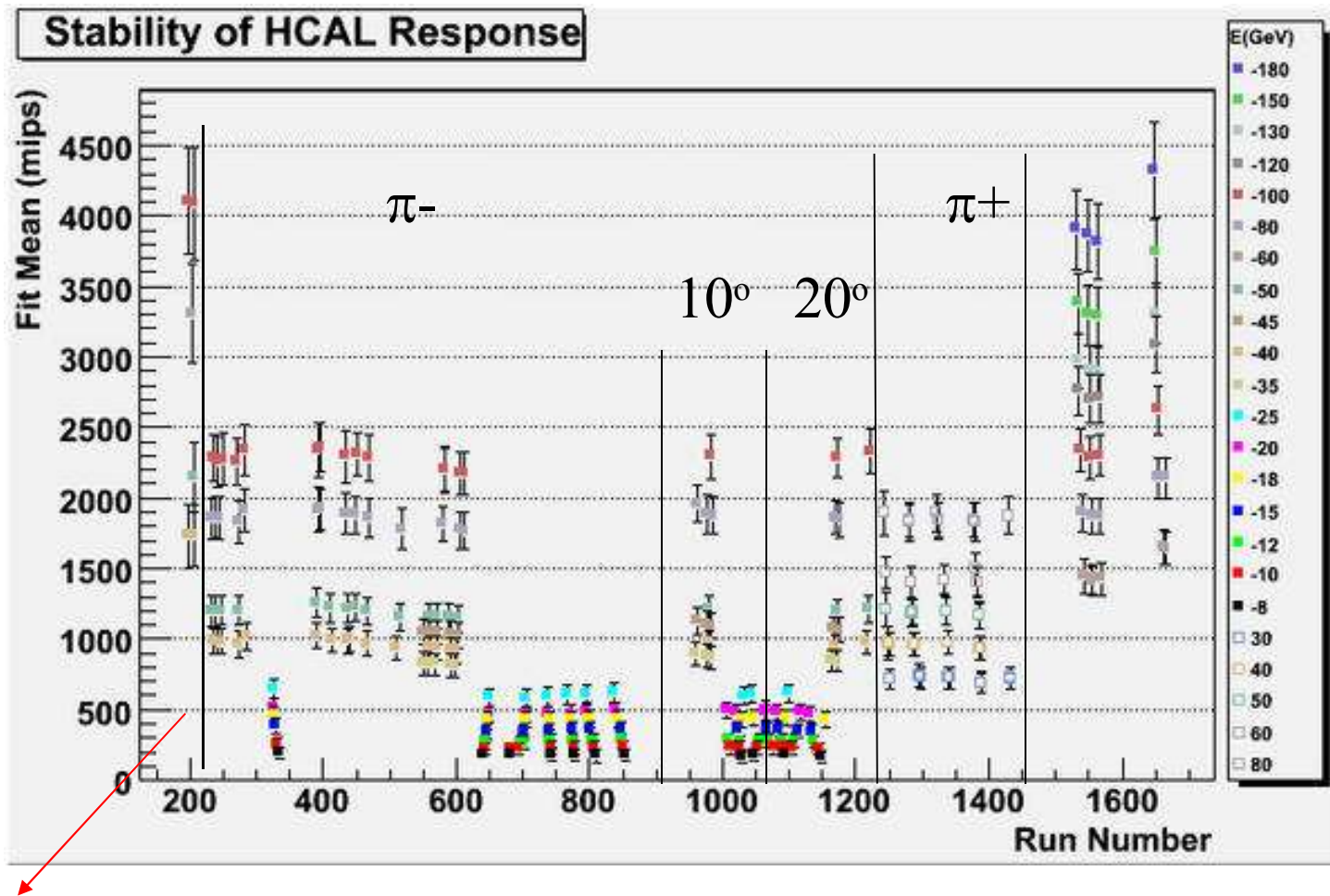


ECAL raw response (studied by shift crew, thanks to Allister!)



(No correction is applied yet)

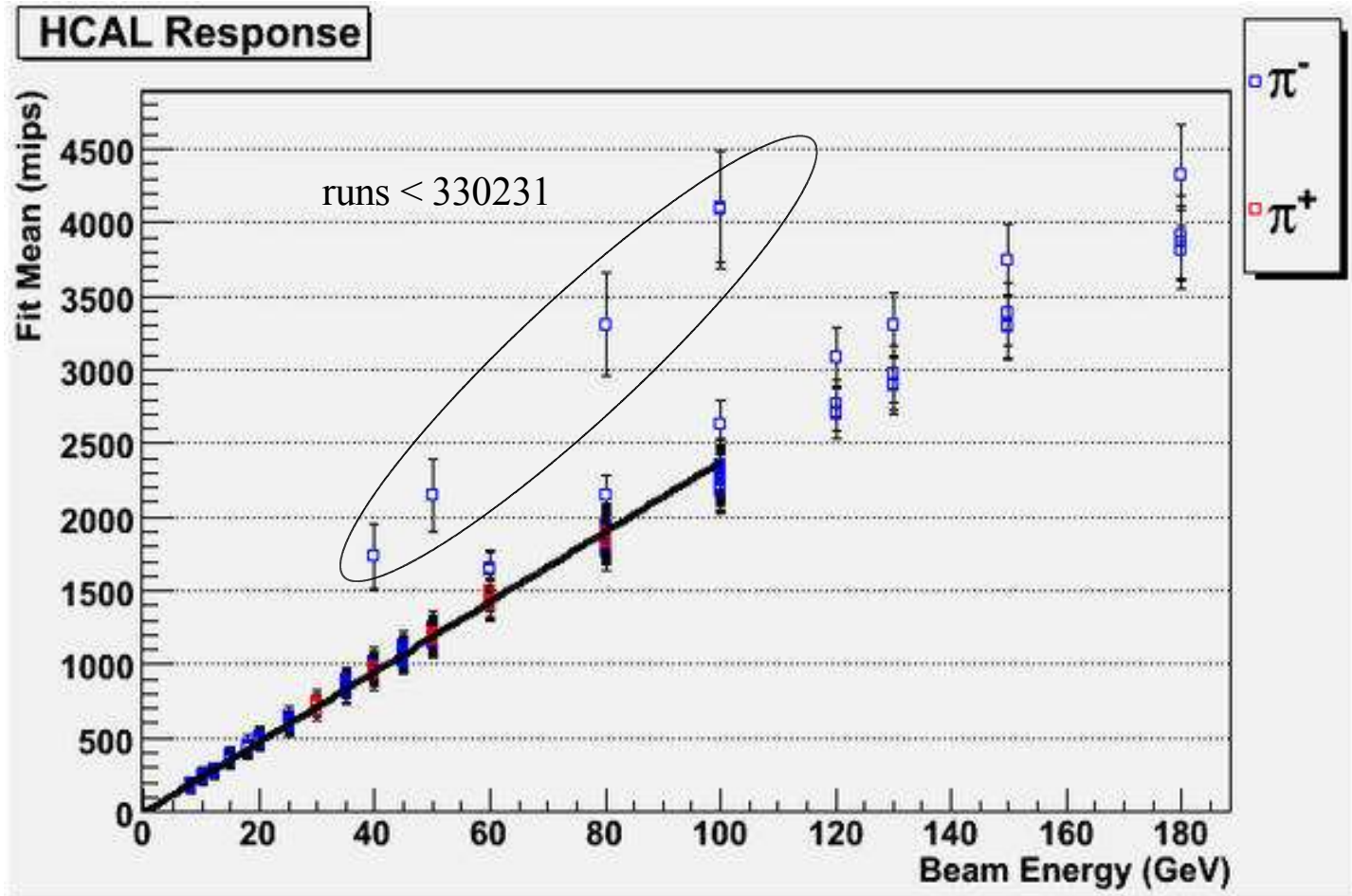
AHCAL raw response



runs < 330231 marked as odd
HCAL longitudinal profile

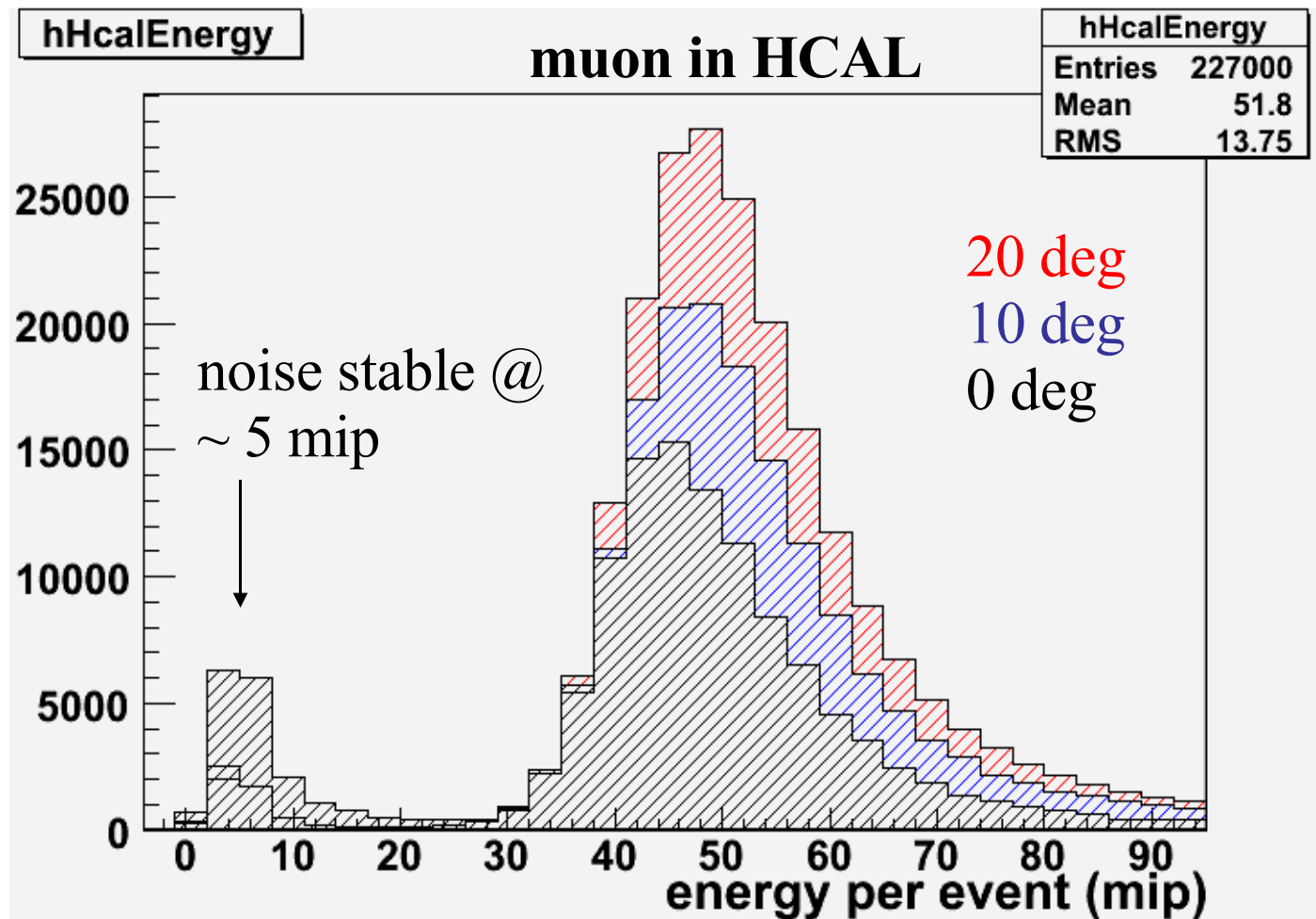
(No correction is applied yet)

AHCAL raw linearity



(No correction is applied yet)

First look on μ calibration run in HCAL



Summary

- **2007 CERN Test Beam program was very successful !!**
- **Thank you for all of your contribution !**
- **~15TB data is now ready for analyzing.**