
The 2007 Calice test beam

Fabrizio Salvatore

Royal Holloway University of London

Erika Garutti

Desy

Outline

■ Installation

- The arrival at CERN
- Beam line setup
- Detector's description

■ Data taking overview

- Secondary beam energies/composition
- Energy points/position scans/angles
- Total events collected
- Summary of test beam programme

■ Detector's performances

- Trigger rate/DAQ rate/detector's up-time

■ Shifts overview

- Total data taking time
- Shifts statistic

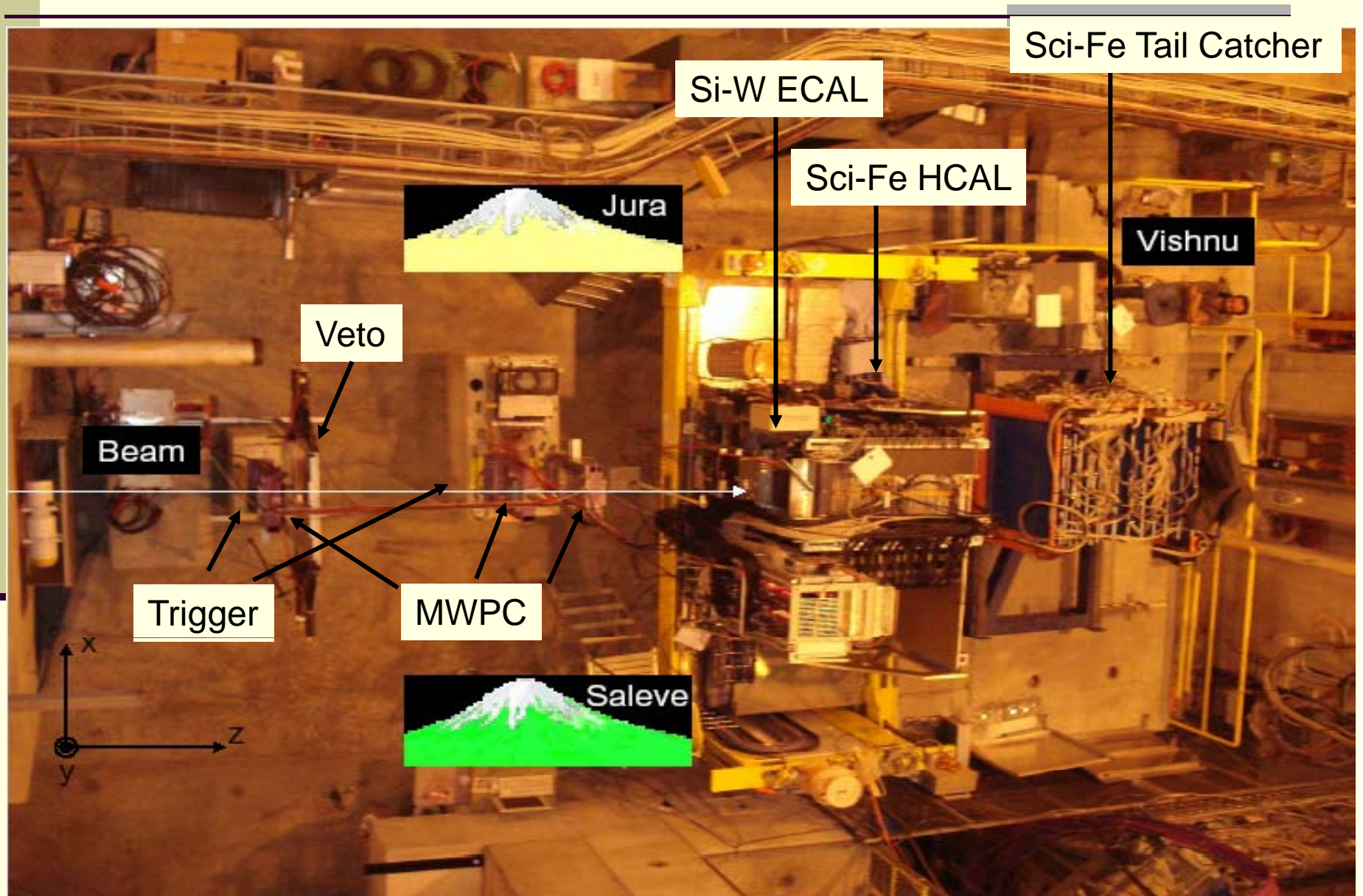
Outline

- **Installation**
 - The arrival at CERN
 - Beam line setup
 - Detector's description
- Data taking overview
 - Secondary beam energies/composition
 - Energy points/position scans/angles
 - Total events collected
 - Summary of test beam programme
- Detector's performances
 - Trigger rate/DAQ rate/detector's up-time
- Shifts overview
 - Total data taking time
 - Shifts statistic

A difficult start.....



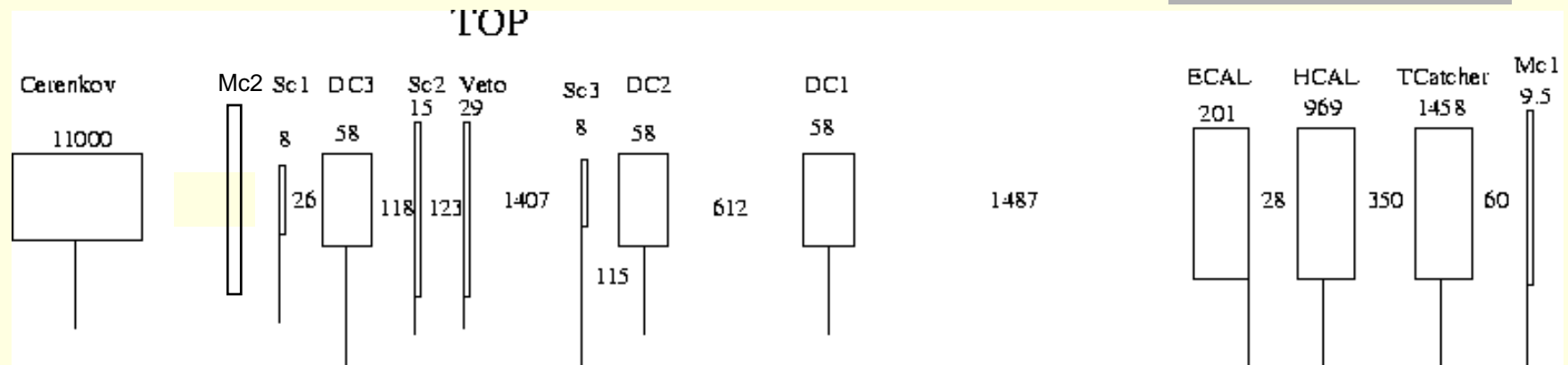
The setup two weeks later....



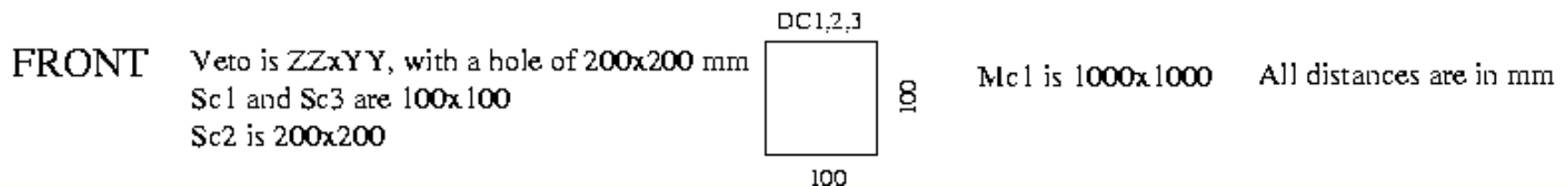
Outline

- **Installation**
 - The arrival at CERN
 - Beam line setup
 - Detector's description
- Data taking overview
 - Secondary beam energies/composition
 - Energy points/position scans/angles
 - Total events collected
 - Summary of test beam programme
- Detector's performances
 - Trigger rate/DAQ rate/detector's up-time
- Shifts overview
 - Total data taking time
 - Shifts statistic

Beam-line setup



<http://www.pp.rhul.ac.uk/~calice/fab/WWW/dataSummary.htm>



- Sc1+Sc3 -> 10x10cm beamData trigger
- Sc2 -> 20x20cm muon calibration trigger
- Mc1+Mc2 (placed on beam line only for muon calibration runs) -> 100x100cm calibration trigger

MWPCs and Veto

- Three MWPC (from CERN)
 - 50/50 Ar/CO₂ gas mixture
 - X, Y readout
 - 200 mV threshold (100 mV after August 8th)
 - Aligned wrt beam-line with 0.2 mm precision
- Veto counters
 - 4 scintillator counters
 - Total dimension: 100X100cm, with 20x20cm hole corresponding to the 20x20cm trigger scintillator

ECAL, AHCAL, TCMT

- **ECAL: 54 PCBs (30 layers)**
 - 216 channels/PCB in central part and 108/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

Outline

- Installation
 - The arrival at CERN
 - Beam line setup
 - Detector's description
- **Data taking overview**
 - Secondary beam energies/composition
 - Energy points/position scans/angles
 - Total events collected
 - Summary of test beam programme
- Detector's performances
 - Trigger rate/DAQ rate/detector's up-time
- Shifts overview
 - Total data taking time
 - Shifts statistic

The H6B beam

- Excellent beam set-up

- Super-cycle:

{	14 bp/16.8 sec	day
	(17 bp/20.4 sec from 15/08)	
	12 bp/14.4 sec	night/w-e

- Secondary beam energies:

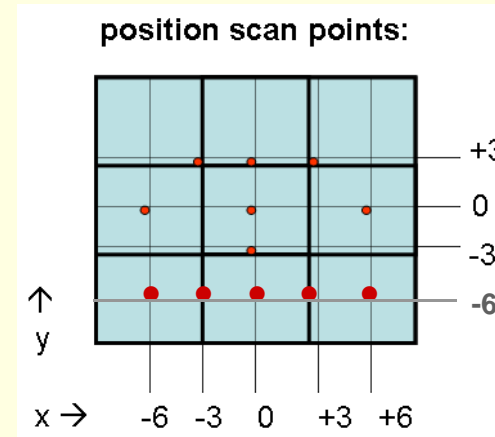
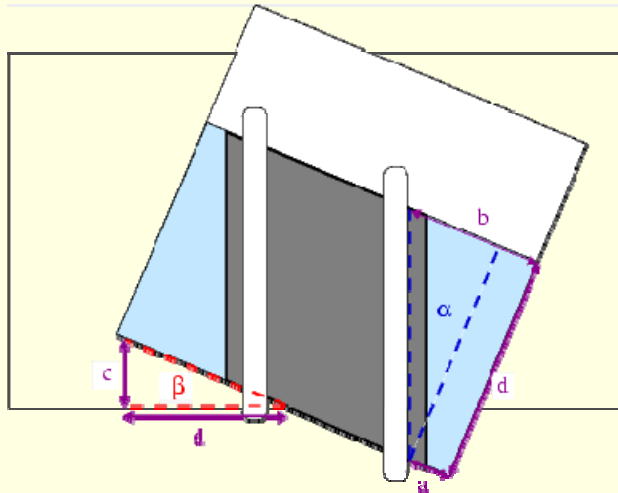
-80 GeV wobbling	π^- (40-100 GeV) and e^- (15-50 GeV)
-10 GeV wobbling	π^- and e^- (6-25 GeV)
+60 GeV wobbling	π^+ /p(30-80 GeV) and e^+ (10-50 GeV)
-130 GeV wobbling	π^- (60-180 GeV) and e^- (70-90 GeV)

Energy points and particle types

	Proposed in TB plan	Collected during TB
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
Particles	π^\pm/e^\pm	π^\pm/e^\pm /protons

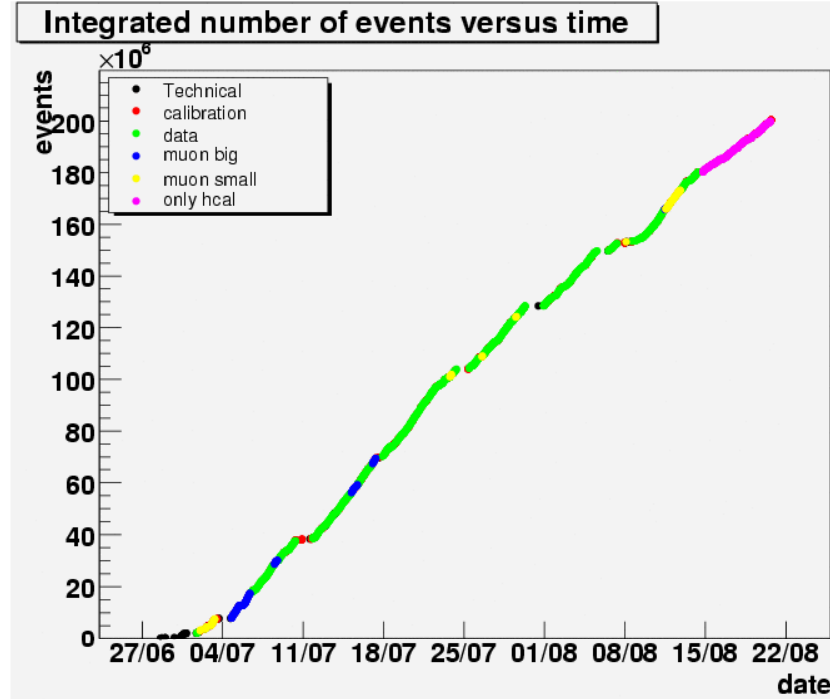
- **Beam energies extrapolated from secondary beam**
 - **Electron beam** obtained sending secondary beam on Pb target
- **π/e separation** achieved using **Cherenkov threshold** detector filled with **He gas**
 - Possible to distinguish π from e for energies from 25 to 6 GeV
- **π /proton separation** achieved using **Cherenkov** threshold detector with **N₂ gas**
 - Possible to distinguish π from protons for energies from 80 to 30 GeV

Angle and position scans

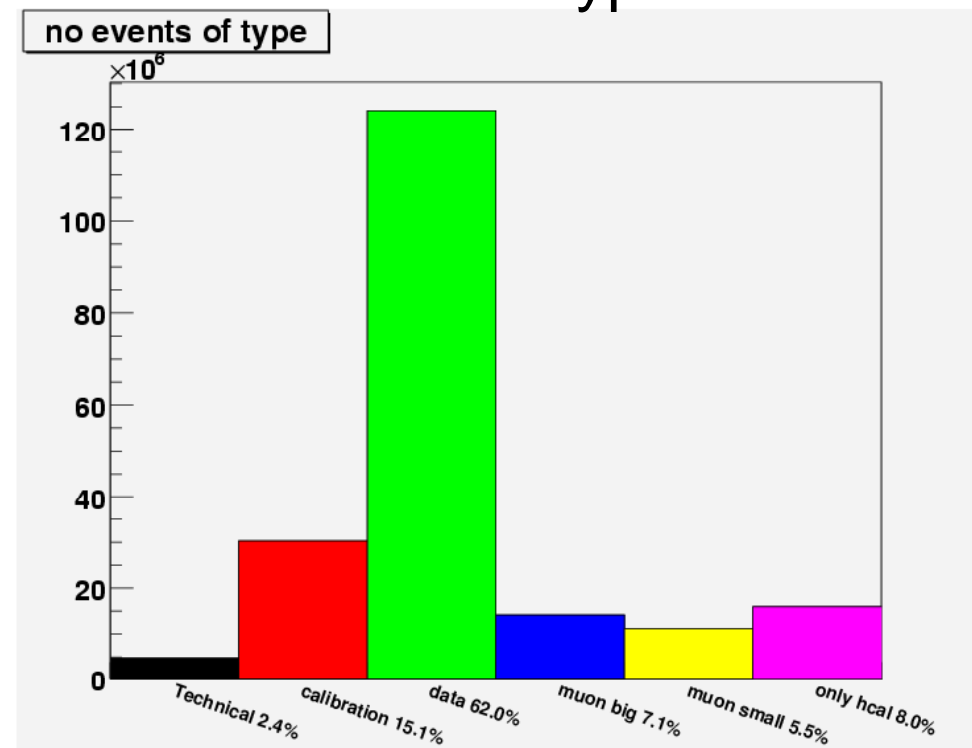


	Proposed in TB plan	Collected during TB
Angles	0, 10, 15, 20, 30	0, 10, 20, 30
Position scans	Centre of ECAL	Centre of ECAL ±6cm from ECAL centre wafer Bottom slab of ECAL (±6,0,±3cm, -3cm)
	Centre of AHCAL	Centre of AHCAL Centre of ECAL; AHCAL ±6cm off beam-line
	Inter-alveolae	Inter-alveolae (±3cm,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

Total events collected



Event Types



Integrated Luminosity

Outline

- Installation
 - The arrival at CERN
 - Beam line setup
 - Detector's description
- **Data taking overview**
 - Secondary beam energies/composition
 - Energy points/position scans/angles
 - Total events collected
 - **Summary of test beam programme**
- Detector's performances
 - Trigger rate/DAQ rate/detector's up-time
- Shifts overview
 - Total data taking time
 - Shifts statistic

Summary of test beam programme - I

	Proposed in TB plan (4 weeks of data taking)	Acheved at the TB (7 weeks of data taking)
Combined physics package: low energy π	π^- : 1M evts @ 6/8/10/12/15/18/20 GeV, 0 deg π^- : 500K evts @ 6/10/12/15/18/20 GeV; 10, 15, 20, 30 deg	- π^- : 1M evts @ 6 GeV, 0 deg; - 1.75M evts @ 8/10/12/15/18/20 GeV, 0 deg. - π^- : 400K evts @ 6/10/12/15/18/20 GeV, 10 deg; - 1M evts @ 6 GeV; 500K evts @ 8-20 GeV, 20 deg.
Combined physics package: high energy π	π^- : 1M evts @ 25/30/40/50 GeV, 0 deg	- π^- : 1.5M evts @ 25/40/50/60/80/100/120/130/150/180 GeV, 0 deg; - 200K evts @ 5/40/45/50/80/100 GeV, 0 deg: ECAL on beam line, AHCAL displaced by 6 cm.
	π^- : 500K evts @ 25/30/40/50 GeV; 20, 30 deg	- π^- : 200K evts @ 35/40/45/50/80/100 GeV, 10,20 deg.

Summary of test beam programme - II

	Proposed in TB plan (4 weeks of data taking)	Acheved at the TB (7 weeks of data taking)
ECAL physics package: low energy e	e ⁻ : 1M evts@6/10/15(/20), 0 deg	- e ⁻ : 1M evts @ 6 GeV, 0 deg; ~700K evts @ 8/10/12/15/ 18/20 GeV, 0 deg. - 1M evts @ 6 GeV, 20 deg; ~400K evts @ 8/10/12/15/ 18/20 GeV, 10, 20 deg.
ECAL physics package: high energy e		- e ⁻ : ~2M evts @ 25/30/ 40/50 GeV, 0 deg; - ~200K evts @ 25/30/ 40/50 GeV, 10, 20 deg.
ECAL physics package: high energy e		- e ⁻ : scan of the bottom ECAL layer; ~250K evts @ 90 GeV/pos, 0 deg.
ECAL irradiation package: high energy e	e ⁻ : 1M evts@10/50 GeV, 0 deg	- e ⁻ : ~1.1M evts@70 GeV, 0 deg; - > 5.5M events @ 90 GeV, 0 deg. Position scanning on chip.
ECAL inter-alveolae package: high energy e	e ⁻ : 300M evts@20/50 GeV, 0 deg	- e ⁻ : ~2M evts @ 8/10/12/15/18/20/25/30/40/50 GeV, 0 deg; 6 positions.

Summary of test beam programme - III

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

Total events on disk

Combined ECAL+AHCAL

Last run	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	13 TB, 927 GB

AHCAL only

Last run	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	0 TB, 967 GB

Outline

- Installation
 - The arrival at CERN
 - Beam line setup
 - Detector's description
- Data taking overview
 - Secondary beam energies/composition
 - Energy points/position scans/angles
 - Total events collected
 - Summary of test beam programme
- **Detector's performances**
 - **Trigger rate/DAQ rate/detector's up-time**
- Shifts overview
 - Total data taking time
 - Shifts statistic

Trigger/DAQ rate

- High energy beams (30-180 GeV)
 - Trigger rate on 10x10 set to <10K pps to prevent damage to the detectors
 - Average rate ~8K pps
 - DAQ rate ~70-80 Hz
- Low energy beams (6-25 GeV)
 - Trigger rate on 10x10 adjusted in beam files using available collimators
 - Average rate ~ 600 pps@ 6 GeV,
~1-3K pps@ 8-25 GeV
 - DAQ rate ~35-60 Hz

Uptime

Time since 5 th of July	4 147 200 sec
14.4s super-cycle	2 389 798 sec
16.6s (20.4s) super-cycle	889 829 sec
Power cuts	86 400 sec
Summer students	57 600 sec
$\pi/e/p$ data	1 790 698 sec
muons (100x100)	153 976 sec
muons (20x20)	131 752 sec
AHCAL only	365 195 sec
Calibration	318 447 sec
SPS uptime	79.1%
Beam controlled by H6B	76.1% (96.2% of uptime)
DAQ on beamData	62% (81.5% of beam in H6B)
DAQ on calibration	15.1%

Outline

- Installation
 - The arrival at CERN
 - Beam line setup
 - Detector's description
- Data taking overview
 - Secondary beam energies/composition
 - Energy points/position scans/angles
 - Total events collected
 - Summary of test beam programme
- Detector's performances
 - Trigger rate/DAQ rate/detector's up-time
- **Shifts overview**
 - Total data taking time
 - Shifts statistic

Shift summary

- **Fantastic response** from the whole collaboration to a **very intense TB programme**

Thank you all !!!!

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

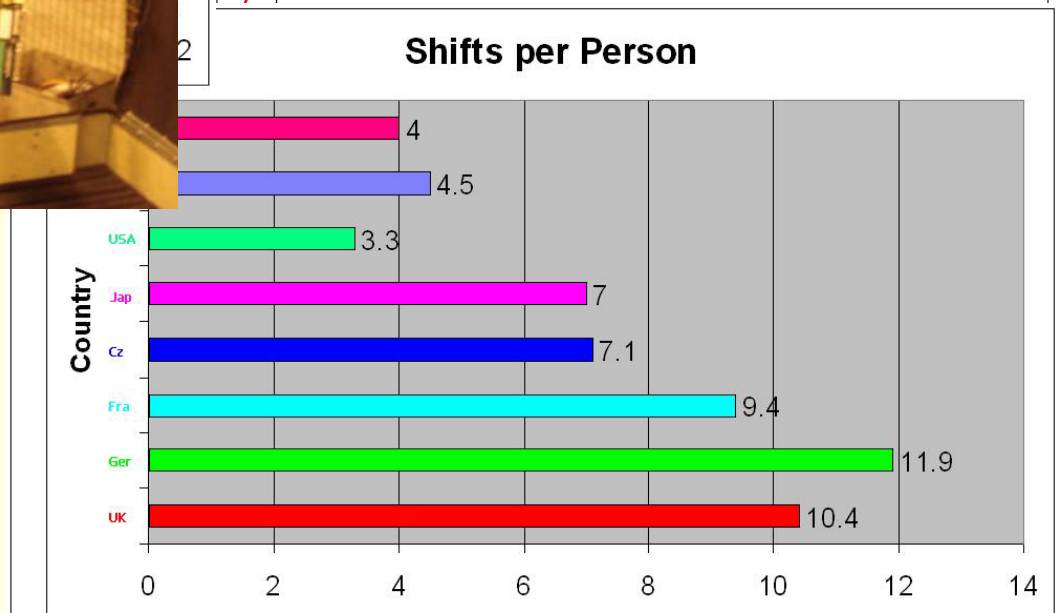
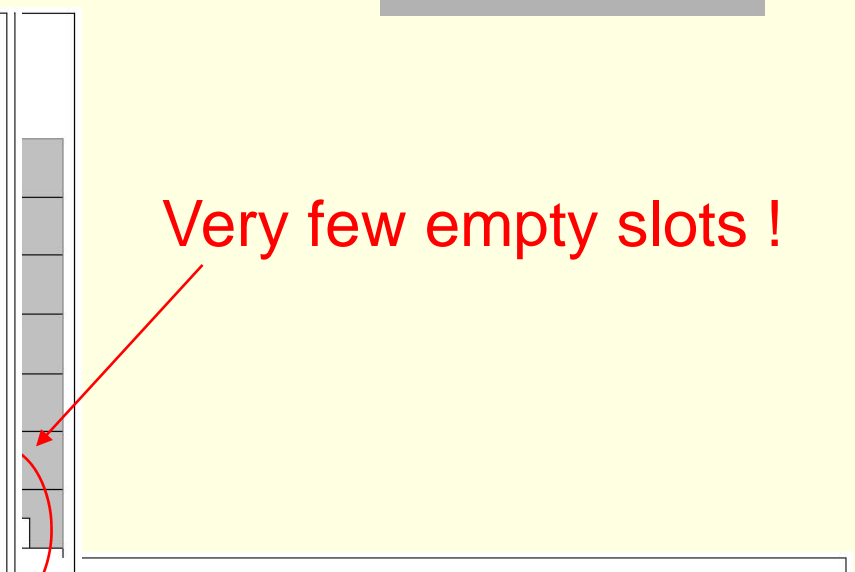
http://www.pp.rhul.ac.uk/~calice/fab/WWW/shift_schedule_2007.php

Total shifts



462 people making shifts !

F. Salvatore, RHUL



Summary

- This year's test beam has been an incredible success !
- The programme presented in April has been completely fulfilled, thanks to the hard work of everyone involved and to the extra weeks given to us by CERN
- The participation in the test beam has been incredible and full of enthusiasm from everyone in the collaboration
- We have ~14 TB of data available on the grid ready to be analyzed

Let's make the final push and publish our incredible results !