

# The 2007 Calice test beam

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# Outline

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## n **Installation**

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

## n **Data taking overview**

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

## n **Detector's performances**

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

## n **Shifts overview**

- n Total data taking time
- n Shifts statistic

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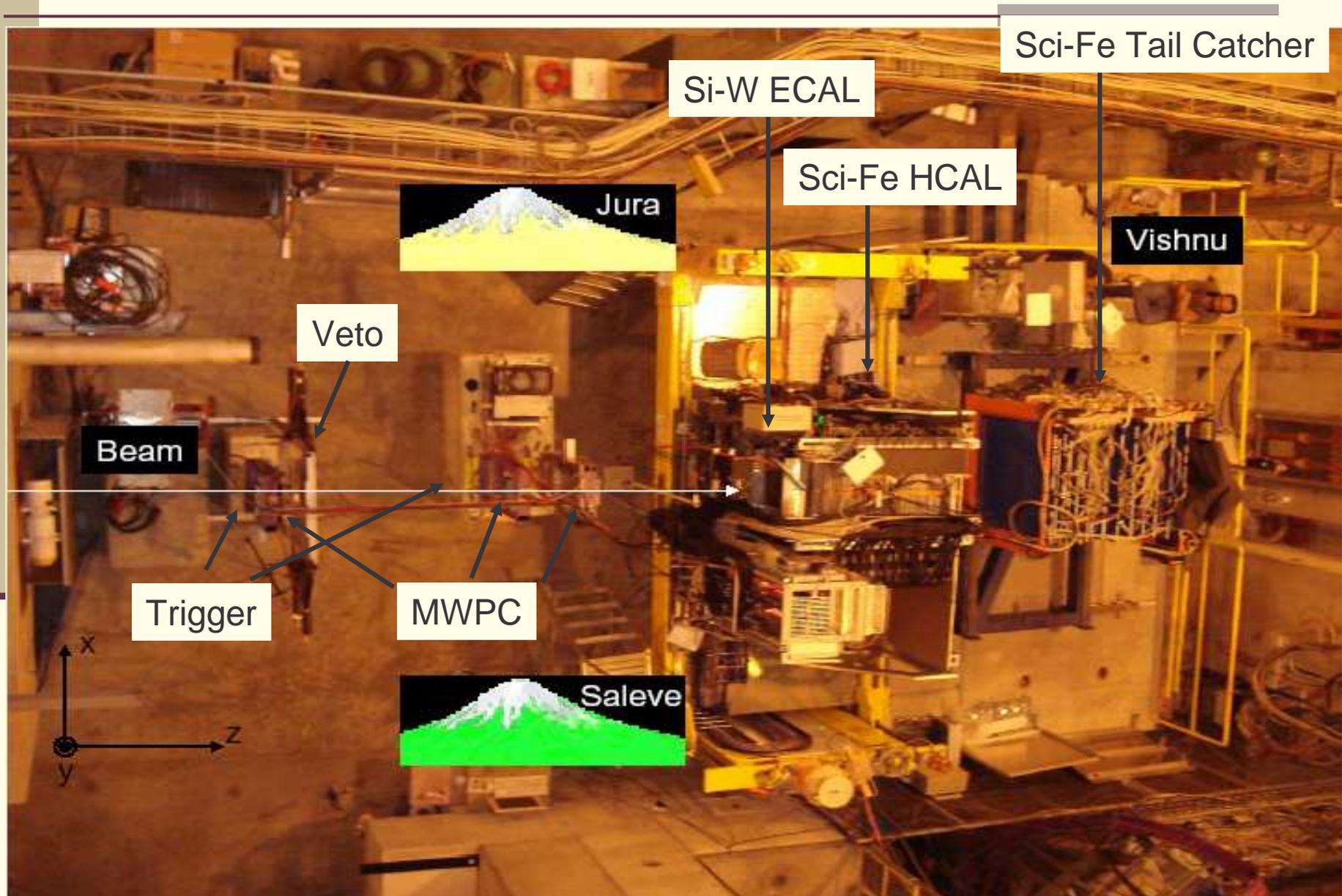
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# A difficult start.....



# The setup two weeks later....



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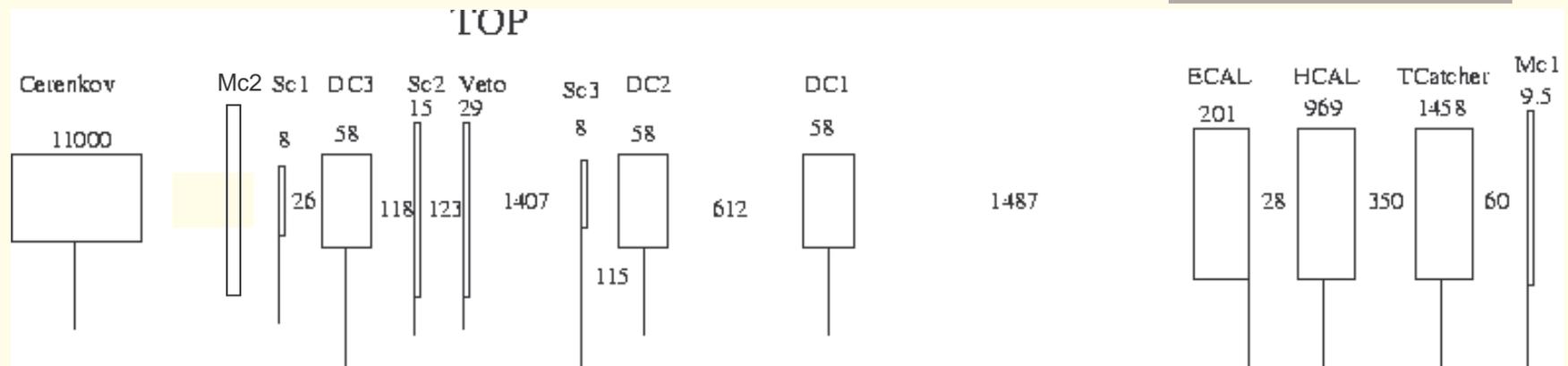
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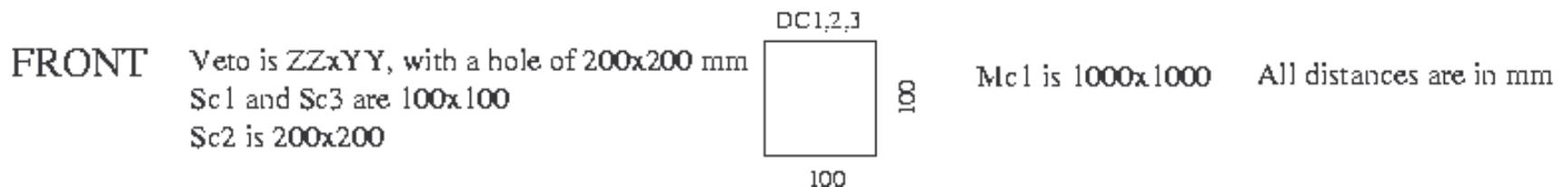
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# Beam-line setup



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



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

# MWPCs and Veto

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- n Three MWPC (from CERN)
  - n 50/50 Ar/CO<sub>2</sub> gas mixture
  - n X, Y readout
    - n 200 mV threshold (100 mV after August 8<sup>th</sup>)
  - n Aligned wrt beam-line with 0.2 mm precision
- n Veto counters
  - n 4 scintillator counters
  - n Total dimension: 100X100cm, with 20x20cm hole corresponding to the 20x20cm trigger scintillator

# ECAL, AHCAL, TCMT

- n **ECAL: 54 PCBs (30 layers)**

- n 216 channels/PCB in central part and 108/PCB in bottom part

- n Total channels: 9072

- n Total radiation length:  $24 X_0$

- n **AHCAL: 38 fully commissioned modules**

- n 30 modules with fine granularity = 216 tiles

- n 8 modules with coarse granularity = 141 tiles

- n Total channels: 7608

- n Total interaction length:  $4.5 \lambda$

- n **TCMT: 16 layers – fully instrumented**

- n Alternated cassettes (from layer 2 to 16) have been staggered in X and Y

- n layer 2 = nominal; layer 3 (vert) = -1 inch in X;

- n layer 4 (hor) = +1 inch in Y;

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# The H6B beam

- n Excellent beam set-up

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

- n Secondary beam energies:

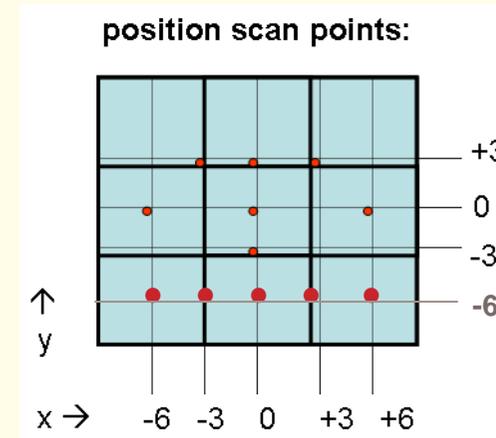
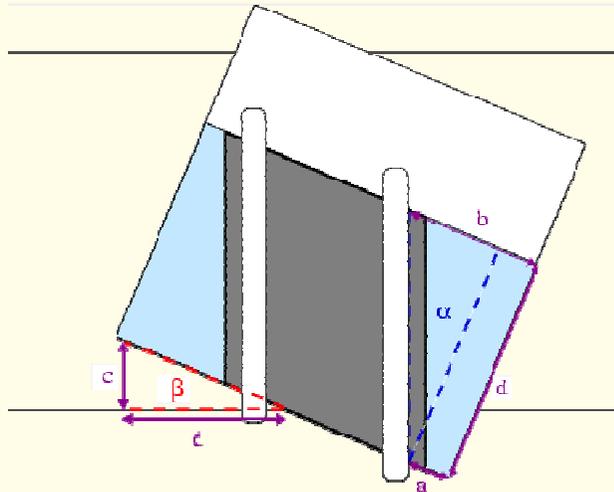
-80 GeV wobbling	$\pi^-$ (40-100 GeV) and $e^-$ (15-50 GeV)
-10 GeV wobbling	$\pi^-$ and $e^-$ (6-25 GeV)
+60 GeV wobbling	$\pi^+$ /p(30-80 GeV) and $e^+$ (10-50 GeV)
-130 GeV wobbling	$\pi^-$ (60-180 GeV) and $e^-$ (70-90 GeV)

# 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	$\pi^\pm/e^\pm$	$\pi^\pm/e^\pm$ /protons

- n **Beam energies extrapolated from secondary beam**
  - n **Electron beam** obtained sending secondary beam on Pb target
- n  **$\pi/e$  separation achieved using Cherenkov threshold detector filled with He gas**
  - n Possible to distinguish  $\pi$  from e for energies from 25 to 6 GeV
- n  **$\pi$ /proton separation achieved using Cherenkov threshold detector with N<sub>2</sub> gas**
  - n Possible to distinguish  $\pi$  from protons for energies from 80 to 30 GeV

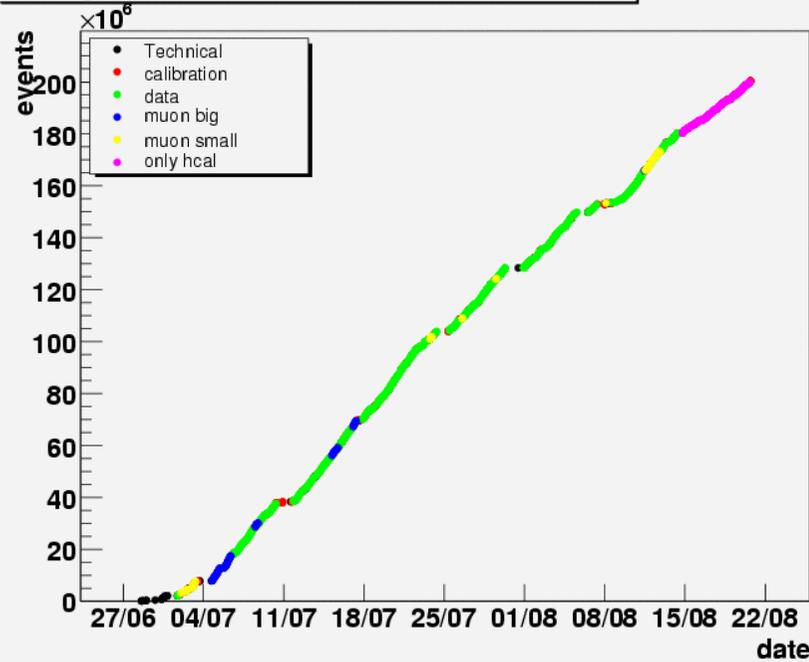
# Angle and position scans



	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)

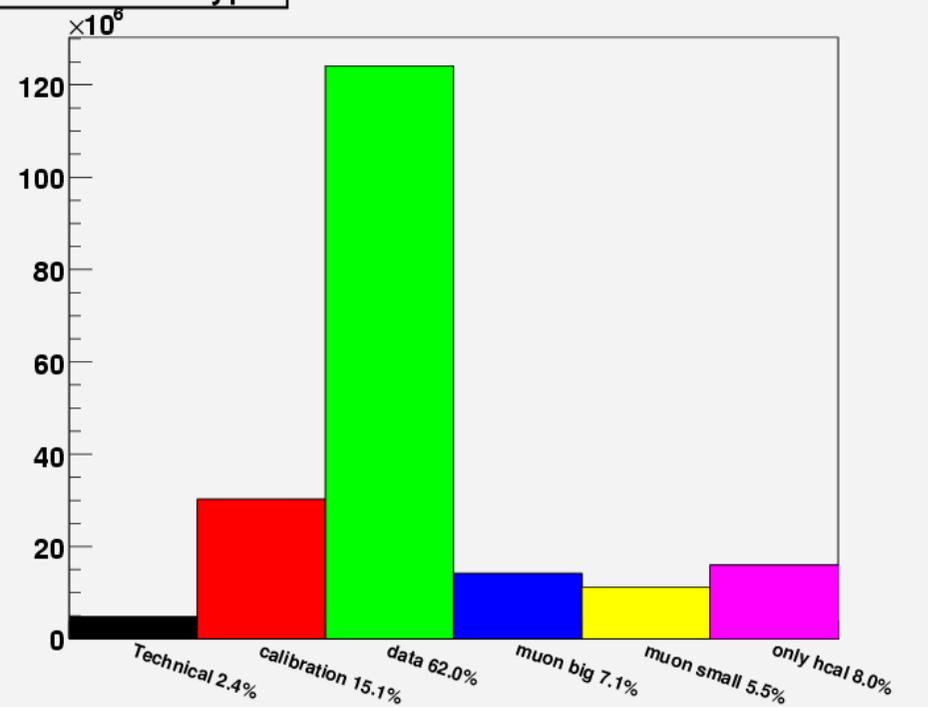
# Total events collected

Integrated number of events versus time



## Event Types

no events of type



## Integrated Luminosity

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# 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 $\pi$	$\pi^-$ : 1M evts @ 6/8/10/12/15/18/20 GeV, 0 deg  $\pi^-$ : 500K evts @ 6/10/12/15/18/20 GeV; 10, 15, 20, 30 deg	<ul style="list-style-type: none"> <li>- <math>\pi^-</math>: 1M evts @ 6 GeV, 0 deg;</li> <li>- 1.75M evts @ 8/10/12/15/18/20 GeV, 0 deg.</li> <li>- <math>\pi^-</math>: 400K evts @ 6/10/12/15/18/20 GeV, 10 deg;</li> <li>- 1M evts @ 6 GeV; 500K evts @ 8-20 GeV, 20 deg.</li> </ul>
Combined physics package: high energy $\pi$	$\pi^-$ : 1M evts @ 25/30/40/50 GeV, 0 deg  $\pi^-$ : 500K evts @ 25/30/40/50 GeV; 20, 30 deg	<ul style="list-style-type: none"> <li>- <math>\pi^-</math>: 1.5M evts @ 25/40/50/60/80/100/120/130/150/180 GeV, 0 deg;</li> <li>- 200K evts @ 5/40/45/50/80/100 GeV, 0 deg: ECAL on beam line, AHCAL displaced by 6 cm.</li> <li>- <math>\pi^-</math>: 200K evts @ 35/40/45/50/80/100 GeV, 10,20 deg.</li> </ul>

# 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 <sup>-</sup> : 1M evts @ 6/10/15(/20), 0 deg	- e <sup>-</sup> : 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 <sup>-</sup> : ~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 <sup>-</sup> : scan of the bottom ECAL layer; ~250K evts @ 90 GeV/pos, 0 deg.
ECAL irradiation package: high energy e	e <sup>-</sup> : 1M evts @ 10/50 GeV, 0 deg	- e <sup>-</sup> : ~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 <sup>-</sup> : 300M evts @ 20/50 GeV, 0 deg	- e <sup>-</sup> : ~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: $e/\pi$ , all energies	$e/\pi$ : 500-1M evts @ 6/10/15/20/25/30/40/50 GeV, 0 deg	<ul style="list-style-type: none"> <li>- <math>\pi^-</math>: 100K evts @ 8/10/12/ 15/20 GeV, 30 deg;</li> <li>- <math>e^-</math>: 100K evts @ 6/10/15/20 GeV, 30 deg;</li> <li>- <math>\pi^+</math>: 400K evts @ 10/15/20/25/ 30/40/50 GeV, 0, 10, 20, 30 deg;</li> <li>- <math>e^+</math>: 400K evts @ 10/15/20/25/ 30/40/50 GeV, 0, 10, 20, 30 deg.</li> </ul>
$\pi^+/e^+$ /protons		<ul style="list-style-type: none"> <li>- <math>e^+</math>: 1.5M evts @ 10/15/20/25/30/ 40/50 GeV, 0 deg;</li> <li>- <math>\pi^+</math>/protons 1.5M evts @ 30/40/ 50/60/80 GeV, 0 deg: position scanning on ECAL front face.</li> </ul>

# 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

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# Trigger/DAQ rate

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

# Uptime

Time since 5 <sup>th</sup> 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%

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# Shift summary

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

**Thank you all !!!!**

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

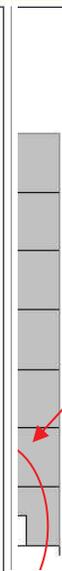
[http://www.pp.rhul.ac.uk/~calice/fab/WWW/shift\\_schedule\\_2007.php](http://www.pp.rhul.ac.uk/~calice/fab/WWW/shift_schedule_2007.php)

# Total shifts



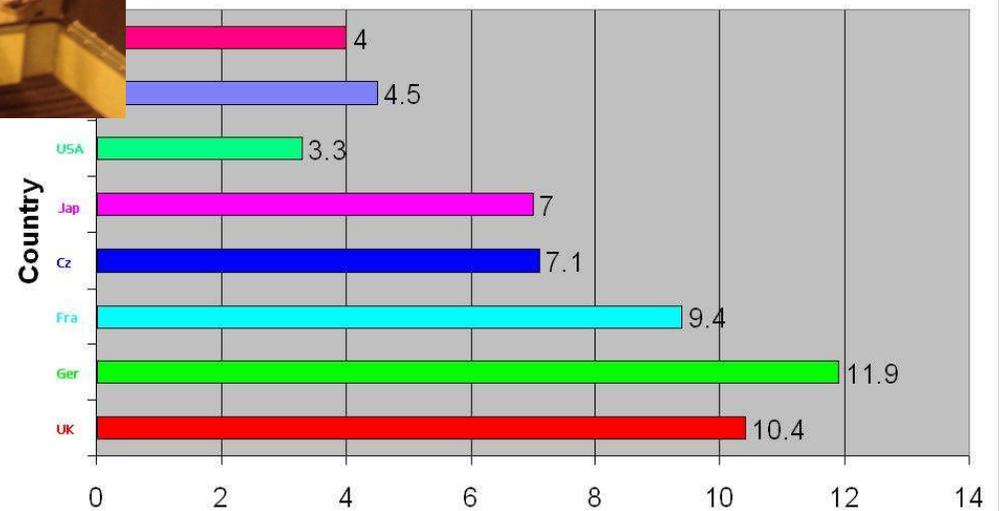
462 people making shifts !

F. Salvatore, RHUL



Very few empty slots !

Shifts per Person



# Summary

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- n This year's test beam has been an incredible success !
- n 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
- n The participation in the test beam has been incredible and full of enthusiasm from everyone in the collaboration
- n 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 !**