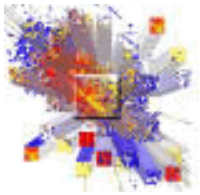
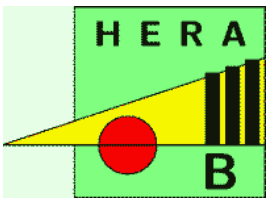


IX International Conference on Calorimetry in Particle Physics,

Annecy-France, 9-14 October 2000

HERA-B ECAL

Status and Plans



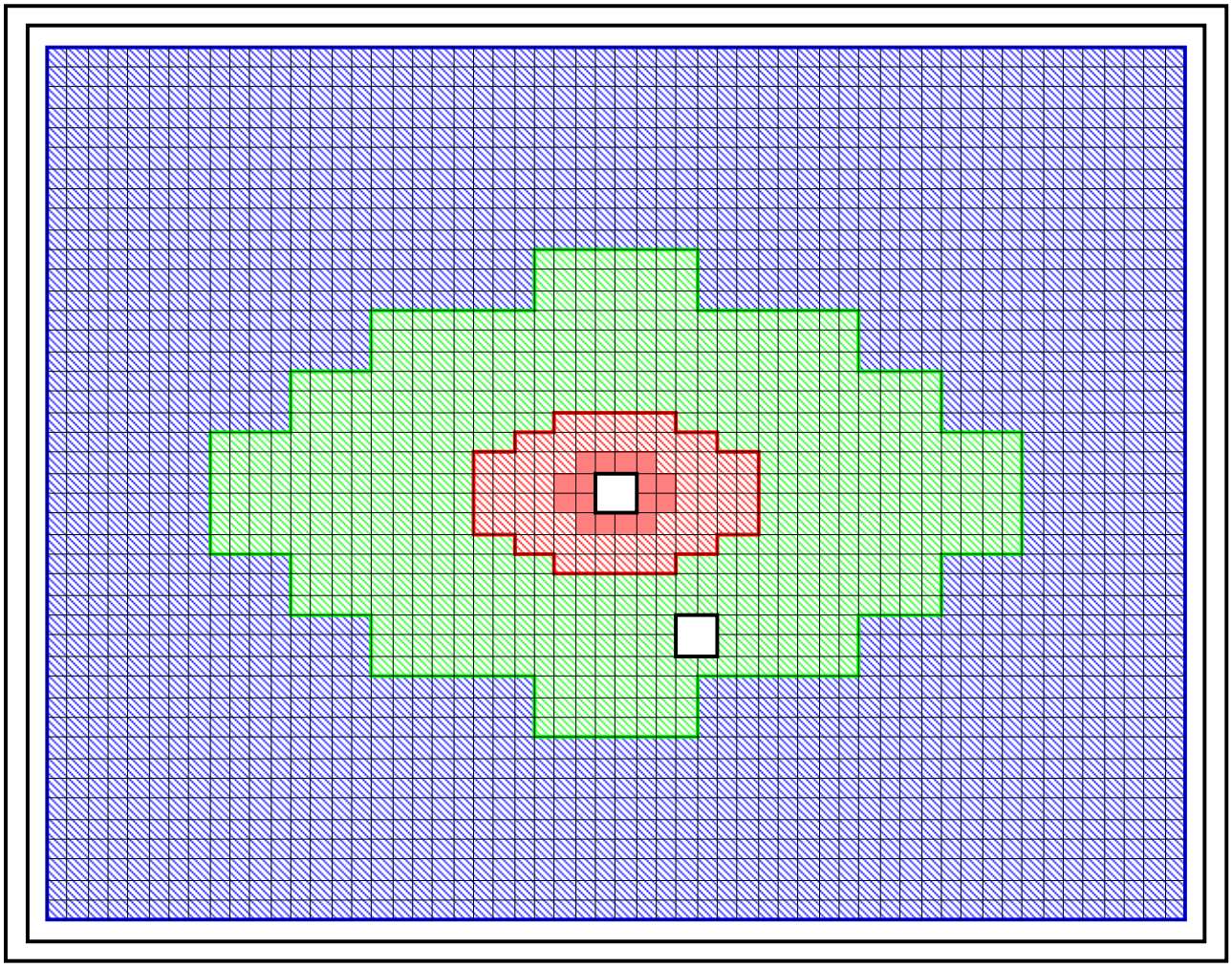
Sergey Shuvalov,
ITEP, Moscow
for ECAL group

Outline:

- **Installation status**
- **Calibration**
- **Performance**
- **Radiation damage**
- **Shutdown 2000/2001 plans**
- **Summary**

shuvalov@mail.desy.de

HERA−B ECAL



	Inner section	Middle section	Outer section
Number of channels	2100	2128	1728
Absorber	Tungsten	Lead	Lead
Volume ratio	W:Sc = 2 : 1	Pb:Sc = 3 : 6	Pb:Sc = 3 : 6
Cell size	2.24 cm x 2.24 cm	5.59 cm x 5.59 cm	11.18 cm x 11.18 cm
Moliere radius	1.42 cm	4.15 cm	4.15 cm
Depth	13 cm (23 Xo)	34 cm (20 Xo)	34 cm (20 Xo)
WLS fibre	Kuraray Y−11	BCF − 91A	BCF − 91A
PM type	R−5600 + FEU−68	FEU−84−3	FEU−84−3

shuvalov@mail.desy.de

Installation status

1. Readout electronics — COMPLETED

All the 226 Readout boards have been installed.

Inner and Middle (164 boards) were taking data since the beginning of y2k.

Outer: 40 (out of 62) boards were taking data for more than one month.

2. Pretrigger electronics — COMPLETED

All the 128 Pretrigger boards have been installed.

Inner and Middle (90 boards) were taking data since the beginning of y2k.

Outer: 24 (out of 38) boards were taking data for more than one month.

Bremms. Recovery should be available by the end of y2k.

3. Energy Inhibit Card

Inhibit to all the pretriggers on highly multiple interactions

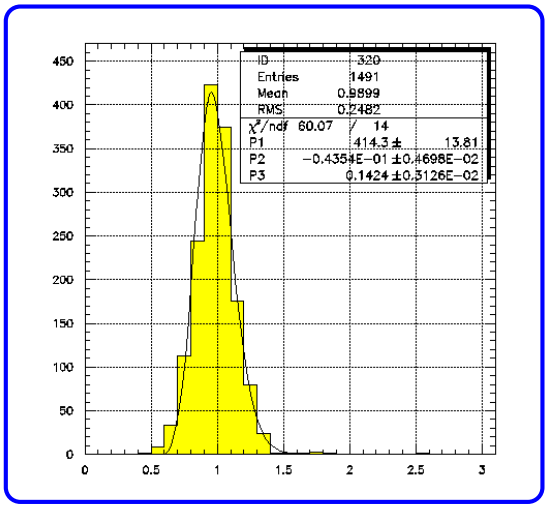
(integrated energy deposition in the Innermost ECAL).

2 boards built and available since last July. Still under test.

ECAL Calibration

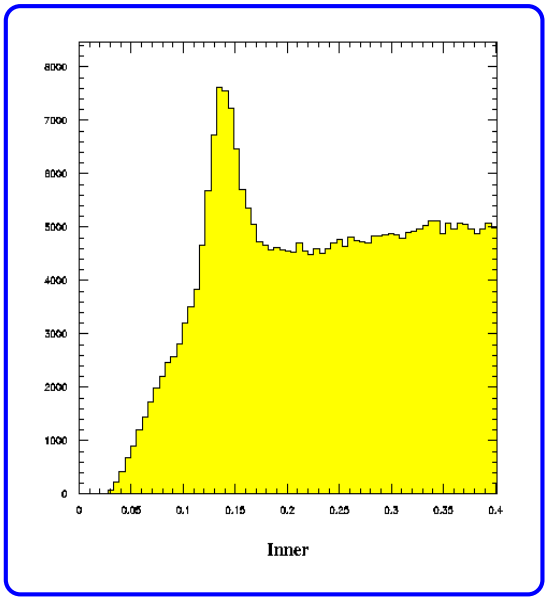
1. Initial calibration

- equalization of the channel occupancies to the Monte Carlo predicted one
- ECAL regions calibration



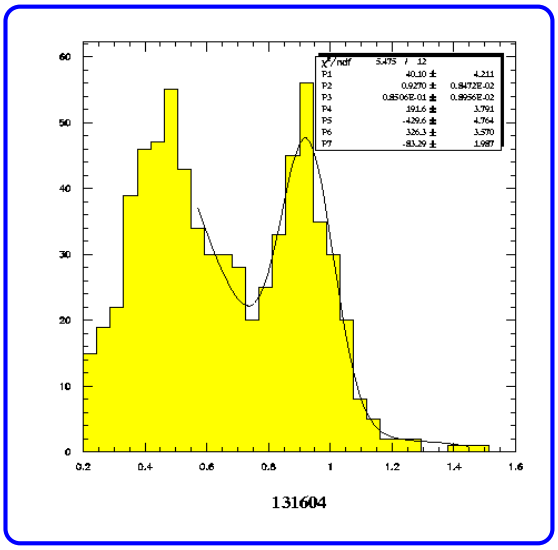
2. pi0 individual cells method

- up to now the main tool for fine ECAL calibration(up to 2%)
- does not require any external information exept the ECAL one
- the statistics necessary to calibrate the most of individual cells could be collected in few days of routine HERA-B operation



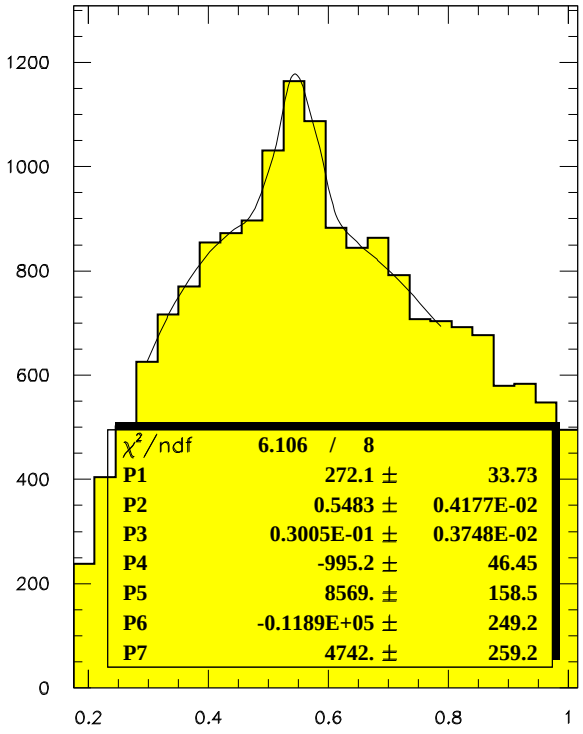
3. E/P calibration method

- the source code is already implemented in 4LT executable
- preliminary results



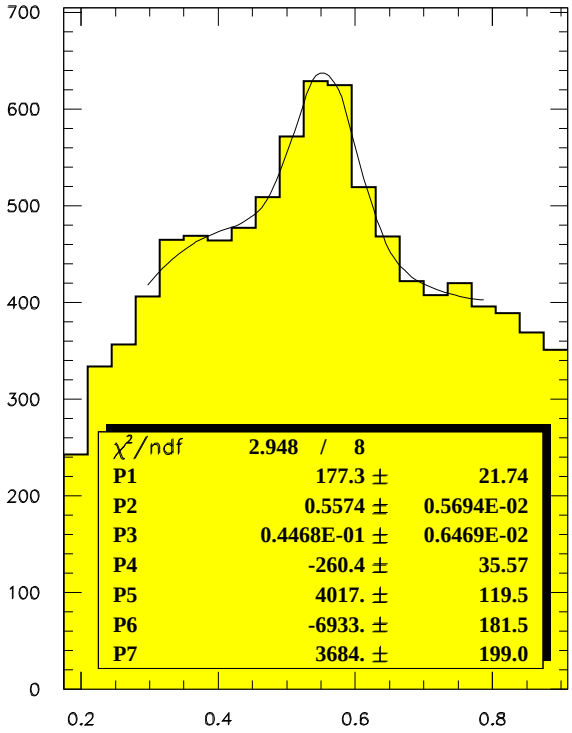
Cross check of ECAL calibration

$\eta-$signal



Inner section

Middle section



ECAL performance

1. Channel statistics:

Hot channels: 16 / 5956 = 0.26%
Dead channels: 210/5956 = 3.5%

Solvable

2. Adjustment

ECAL channels adjusted to provide up to 6 GeV transverse energy measurement

Energy range is limited to 250 GeV in the innermost region.

3. Energy resolution

Estimated from the analysis of π° peak width

Inner section: 23%/sqrt(E) + 1.7% [TDR: 17%/sqrt(E) + 1.6%]

Estimated from E/P peak width for electrons from conversions

(upper limit)

Middle section: 15%/sqrt(E) + ? [TDR: 9.5%/sqrt(E) + 1%]

4. Spatial resolution

Estimated from the analysis of π° peak width

Inner section: 0.2 cm

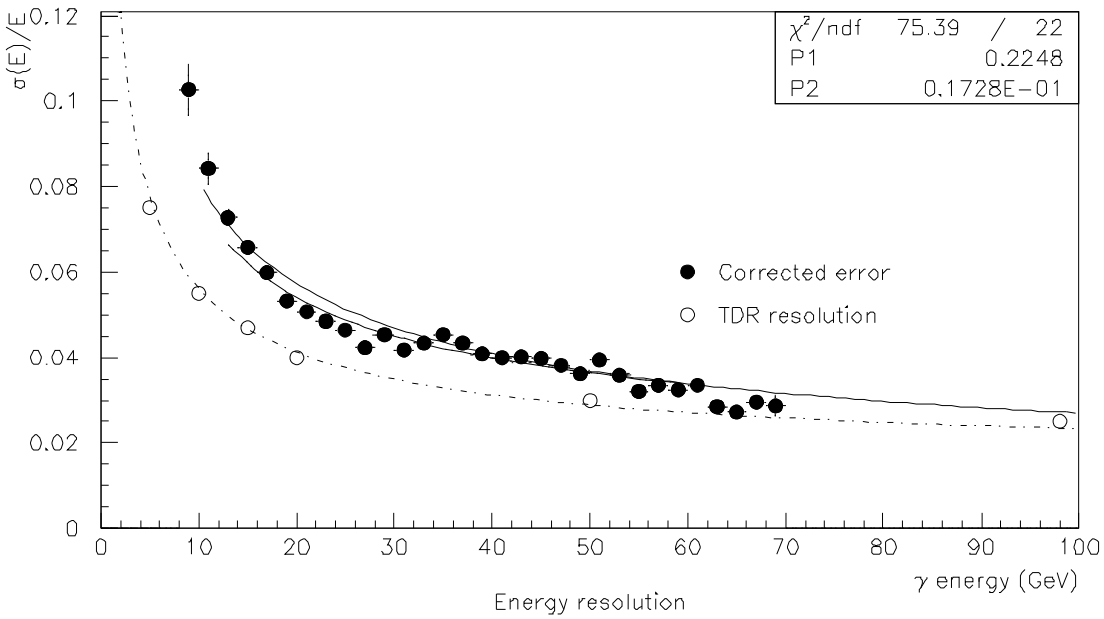
Estimated from (vertical) VDS track - ECAL cluster match

	Upper limit	FLT specs
Inner section:	0.35 cm @ 50 GeV	0.6 cm
Middle section:	0.9 cm @ 20 GeV	1.4 cm

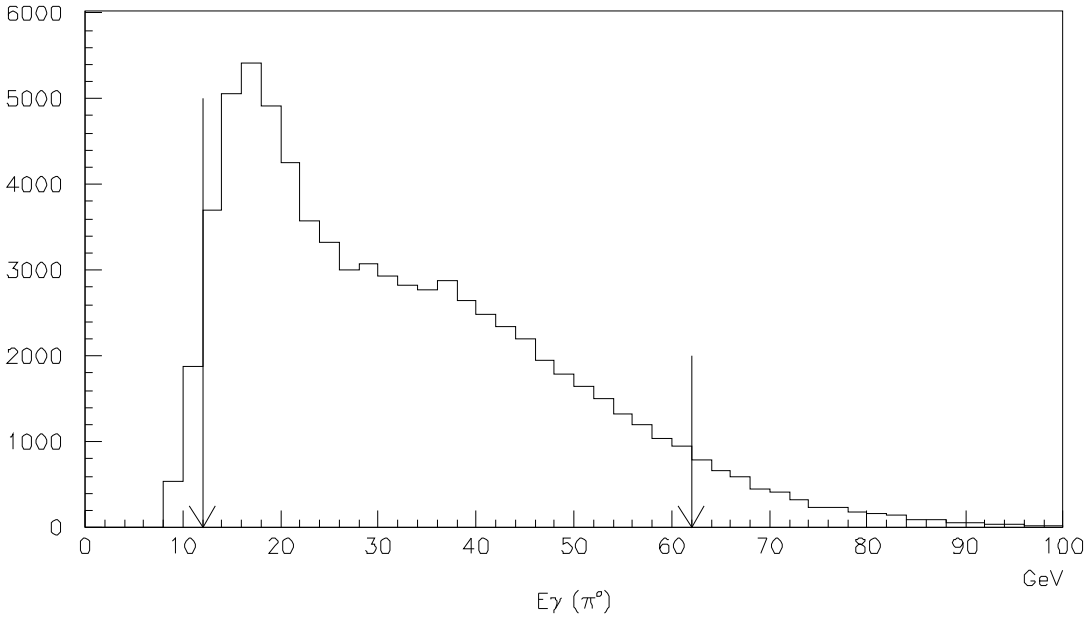
5. Stability

Better than 2% over 1.5 months.

Resolutions

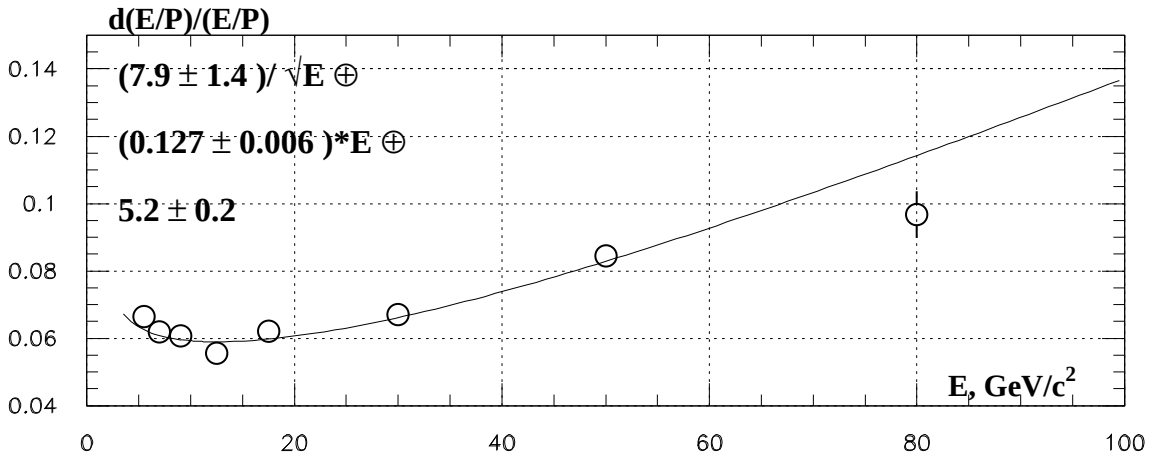


Energy resolution

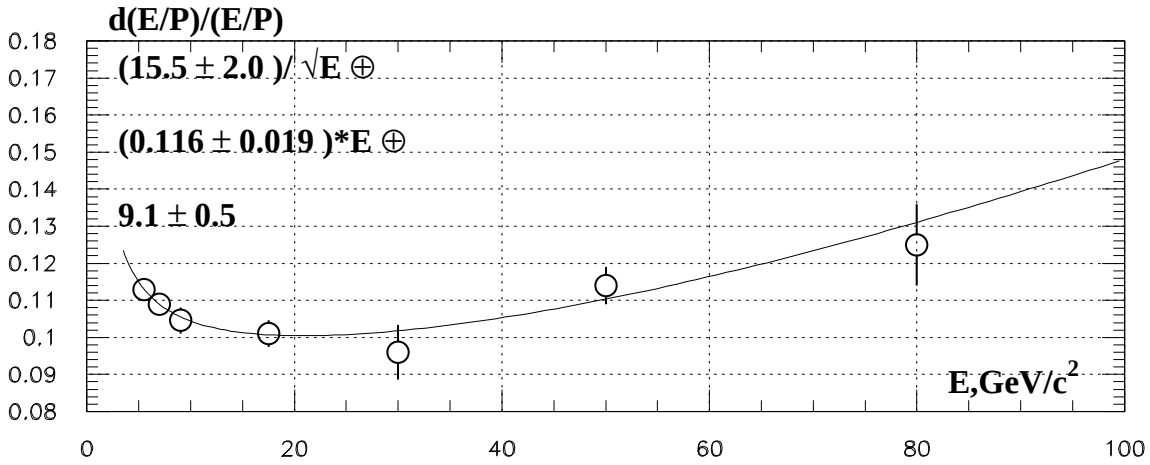


- $\sigma(E)/E = (22.5 \pm 0.5)\%/\sqrt{E} \oplus (1.7 \pm 0.3)\%$
- $\sigma_\theta = 0.2\ mrad$
- $\sigma(\gamma\gamma\ distance) = 0.3\ cm \longrightarrow \sigma_{x,y} = 0.2\ cm$

Middle ECAL section



Monte Carlo



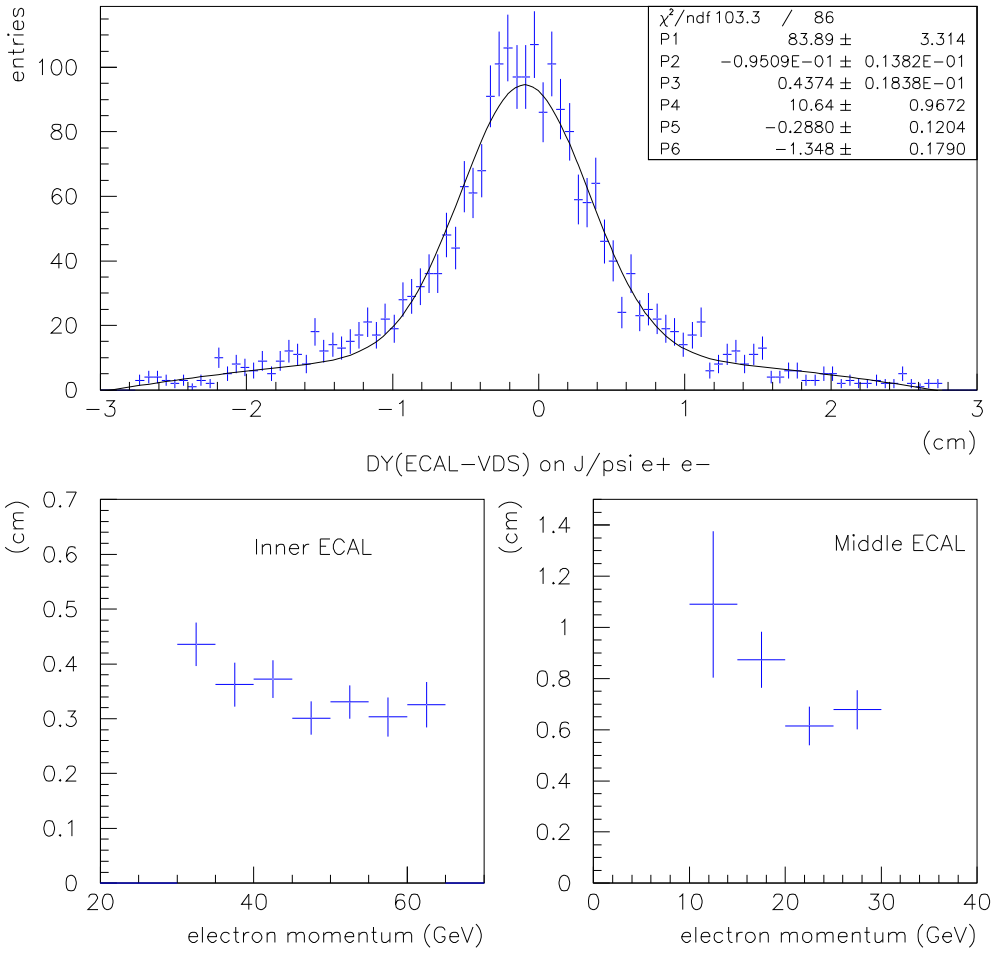
Real data

2000/10/05 12.50

Spatial resolutions

VDS tracks extrapolated to ECAL

Accuracy 0.1 cm



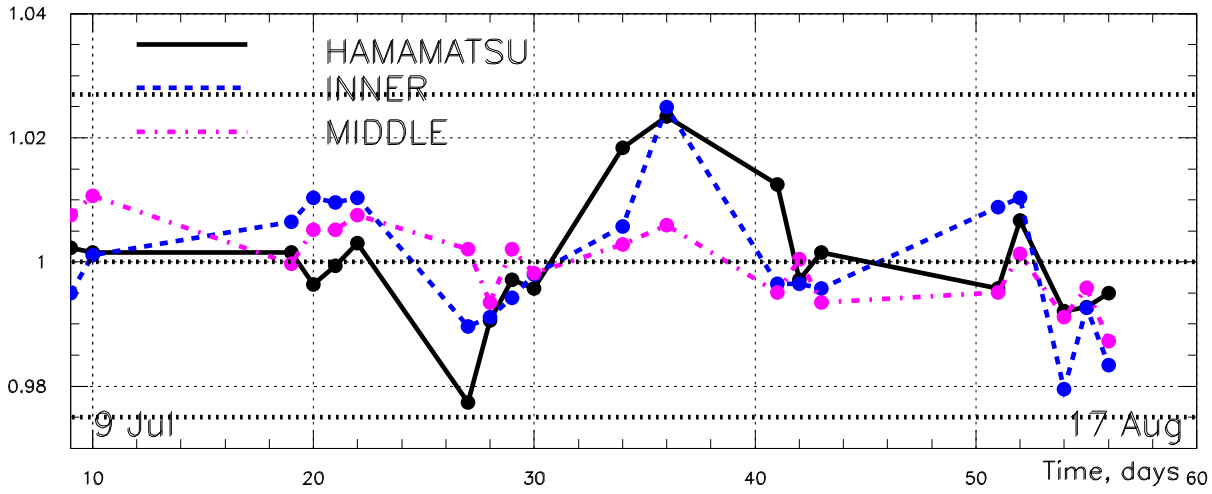
.

Upper limits on spatial resolutions:

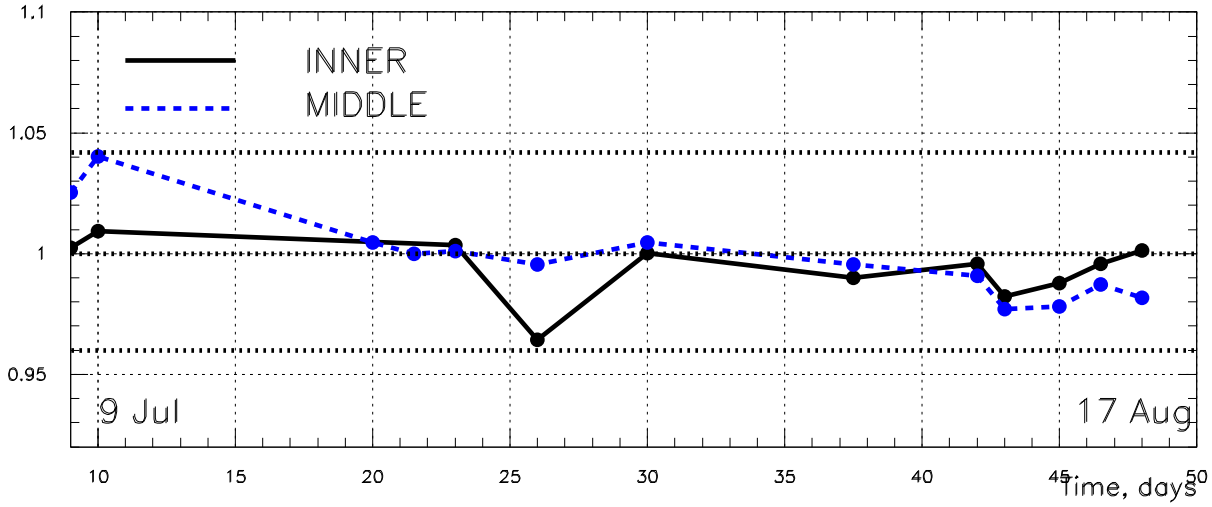
INNER (2.2 cm size) 0.35 cm @ 50 GeV

MIDDLE (5.5 cm size) 0.9 cm @ 20 GeV

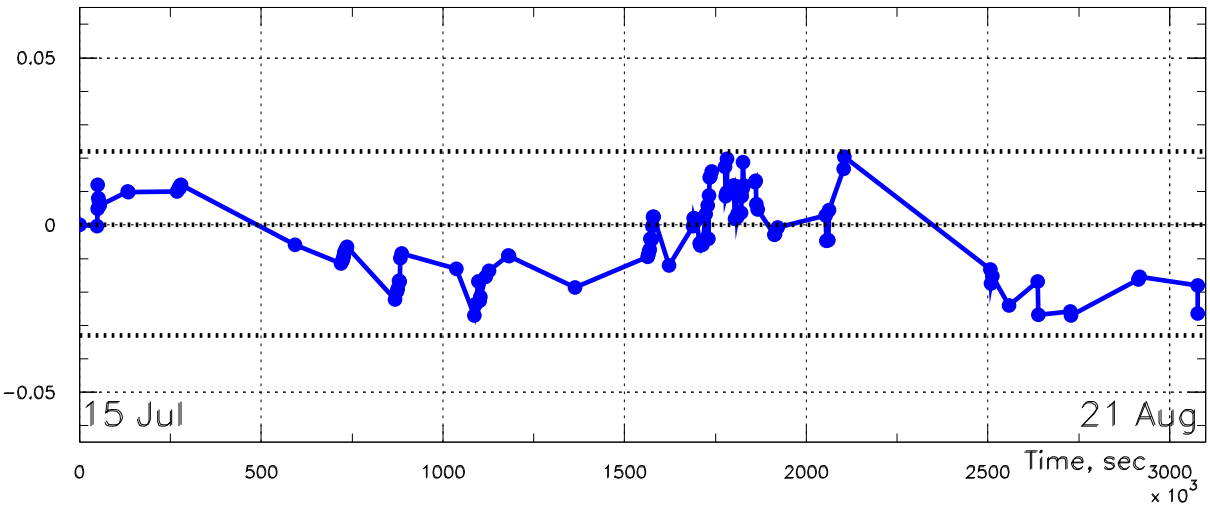
ECAL stability measurements



π^0 peak position(normalized to the one in 1 point)

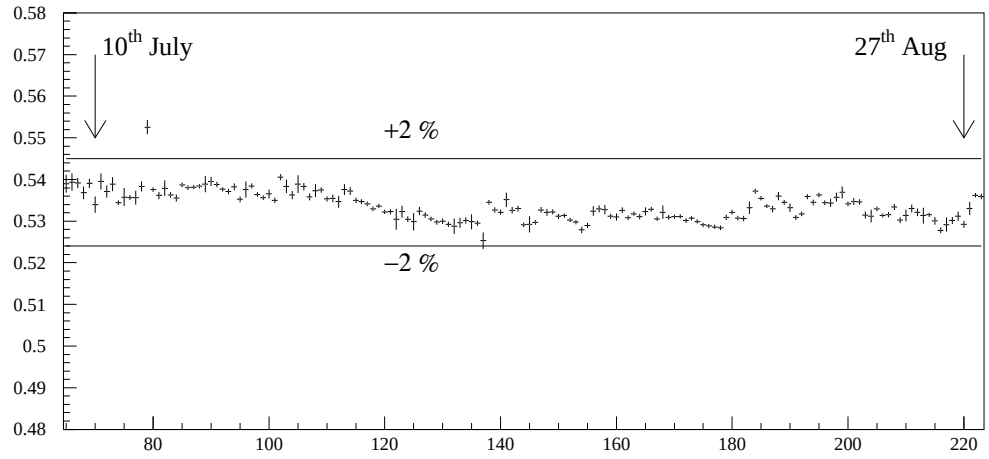


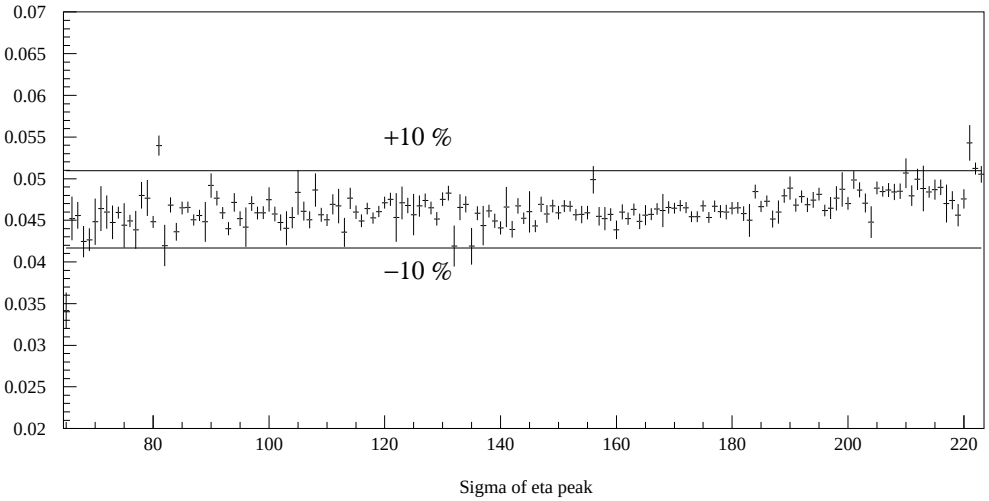
E/P peak position(normalized to the one in 1 point)



Led peak position deviation(averaged over individual channels)

July-August data





ECAL calibration stability well within 2%

Radiation damage

1. Expected annual doses

Scintillator and WLS fibers: up to 5 MRad @ showermax

Phototubes: up to 1.5 MRad for R-5600
up to 0.3 MRad for FEU-68 and preamps

2. Actual dose

~ 0.4 HERA-B years (target operation)

+ injections, beam losts

3. Module status

No degradation is observed

4. CW bases

HV control DAC chips MAX515 are damaged after 0.2-0.3 MRad

Fixed: control chips moved outside ECAL, bases provided with external reference voltage.

The rest of the bases components show no degradation.

Shutdown activities (9.2000-5.2001)

1. Radiation damage.

ECAL modules - no sign of radiation damage is observed.
Test beam measurements are foreseen.

CW-bases - innermost area (16 modules) had been upgraded to radhard version in spring 2000. The rest of INNER ECAL will be modified during shutdown.

2. Noise reduction

Improving of Readout grounding.
Modification of bases-to-R/O electronics coupling - requires intervention to practically all ECAL PMT bases and ADC analog cards.

3. Readout reliability

Connection Readout-SHARC is a critical point in the readout chain.
Production of piggy back to existing connectors and use standard flat cable connectors is foreseen.

4. Monitoring systems

LED monitoring system - an option of LED signal amplitude variation was not used due to often failures of regulated voltage power supplies.
New control scheme will be implemented.

Timing control system for the monitoring of Fast Control System adjustment and test pulse system timing is to be built.

5. Cables, spares etc.

Summary

1. HERA-B ECAL hardware and software are completed

2. The system is comissioned

3. Performance of ECAL is close to design

   Some problems still exist:

   - Radiation damage of CW bases
   - Noise
   - R/O-to-SHARC data transmission

4. Upgrade solutions exist and proved