Scintillator ECAL
Beam Test results

DESY March 2007
Daniel Jeans, Satoru Uozumi, KK and TT

DESY beam test results
monitoring system
calibration
preparation for the Fermi-BT
DESY Beam Test

- scintillator: 1 cm x 4.5 cm x 0.3 cm
- 468ch (18 x 26) scintillator + MPPC
- 26 layers with Tungsten 3.5mm thick
- with / without WLSF
- Kuraray (cast) or KNU (extruded) scintillator
DESY BT analysis ped.

- pedestal test
- with respect to the temperature

correlation?
DESY BT analysis trig.

- trigger counter cuts

DESY II

e+1-6GeV

Another analysis as of the note

trigger counters before (after) selection

veto counters
DESY BT analysis DC

- DC's are calibrated
- DC info. for the calibration runs

beam positions in a run

beam positions in calibrations

<table>
<thead>
<tr>
<th>abstrack_pos</th>
<th>track_pos</th>
<th>track_pos w.r.t detector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entries</td>
<td>1053901</td>
<td></td>
</tr>
<tr>
<td>Mean x</td>
<td>-8.184</td>
<td></td>
</tr>
<tr>
<td>Mean y</td>
<td>-2.879</td>
<td></td>
</tr>
<tr>
<td>RMS x</td>
<td>5.952</td>
<td></td>
</tr>
<tr>
<td>RMS y</td>
<td>9.752</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>abstrack_pos</th>
<th>track_pos</th>
<th>track_pos w.r.t detector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entries</td>
<td>1053</td>
<td></td>
</tr>
<tr>
<td>Mean x</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>Mean y</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>RMS x</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>RMS y</td>
<td>36</td>
<td></td>
</tr>
</tbody>
</table>
DESY BT analysis calib.

- strip calibration with the sc-ECAL

On a strip-by-strip basis, for a given strip, require that almost all similar strips on other layers are hit, no other strips in the same layer are hit.
DESY BT analysis calib.

- test of calibration: position dependence

use tracking info to see where positron hits strip:

split into 5 sectors

example of ADC distributions in 5 sectors of one particular strip:
DESY BT analysis calib.

- fit with Landau convoluted with Gaussian

For each sector:
- Look at fit parameters for central sector of strips (1st configuration).
- Layer number
- Strip number
- Landau M.P.V.
- Landau width
- Gaussian width

W WLSF
W/o WLSF
DESY BT analysis calib.

- check data sets with temperature

How did average temperature vary across these datasets?

Dataset ID (~ time)

Landau mpv

Landau width

One strip dies

The peak values all rise at last measurement
DESY BT analysis temp.

- temperature coefficients
- temperature dependence of calibration

(detector 0 layer 0 mean vs. temp)

calibration const

↑ 5%

(errors not real)

fit to straight line:
are slopes consistent??
DESY BT analysis beam

5 GeV position, central injection. Sum over all strips in detector

no temperature correction

ADC – no calibration
peak – peak of conv landau
mpv – of underlying landau
mean – of ADC
ave = average over all 5 9mm sections
DESY BT analysis linearity

- linearity

Linearity with several calibration definitions

- ADC
- Peak
- MPV

Beam energy
Mean
Average peak
Average MPV
Average mean

Linearity with several calibration definitions

- deviations from straight

Deviation from linearity = (measured – fitted) / fitted

1.5\% deviation

1 - 6 GeV

Have similar behavior

1 - 6 GeV
DESY BT analysis reso.

- resolutions
  resolution vs energy & calibration

\[
\frac{\sigma}{E} = \frac{13.3\%}{\sqrt{E}} \oplus 2.6\%
\]

fit by statistical convoluted with constant

---

\(\chi^2 / \text{ndf} = 0.974 / 3\)

<table>
<thead>
<tr>
<th>Prob</th>
<th>0.8076</th>
</tr>
</thead>
<tbody>
<tr>
<td>(p_0)</td>
<td>(0.1331 \pm 0.001599)</td>
</tr>
<tr>
<td>(p_1)</td>
<td>(0.02562 \pm 0.001999)</td>
</tr>
</tbody>
</table>

RMS y = 0

---

resolution = width/mean

- without inter-module calibration
- various calibrations
- no calibration

- 6 GeV
- 1 GeV

1.0/sqrt(nominal beam energy)
DESY BT analysis fit

• resolutions

Statistical term
- no calib
- peak
- mpv
- mean
- ave peak
- ave mpv
- ave mean
- ave mean+temp

Constant term
- no calib
- peak
- mpv
- mean
- ave peak
- ave mpv
- ave mean
- ave mean+temp

A bit large const. term
MPPC gain monitor

LED

acrylic strip

EM-Scintillator-layer model

Cross section

Tungsten

WLSF

MPPC

Flex-sheet

particle

LED

acrylic strip

scintillator strips

acrylic strip
acrylic strip gain monitoring

LED  acrylic strip

3mm scintillator strips

0 1 2 3 cm distance

hollow + hole

number of photo-electrons

N p.e.

10 20 30 35

distance from LED [cm]

0 2 4 6 8 10 12
summary and outlook

• progress in understanding of Beam test data

• preparation of the next Beam at Fermilab

• with monitoring system

• produce the detector end of this year

• verify pion (MIP) calibration

tungsten plate from 4 x 10cm x 10cm