Muon Peaks in the EMC

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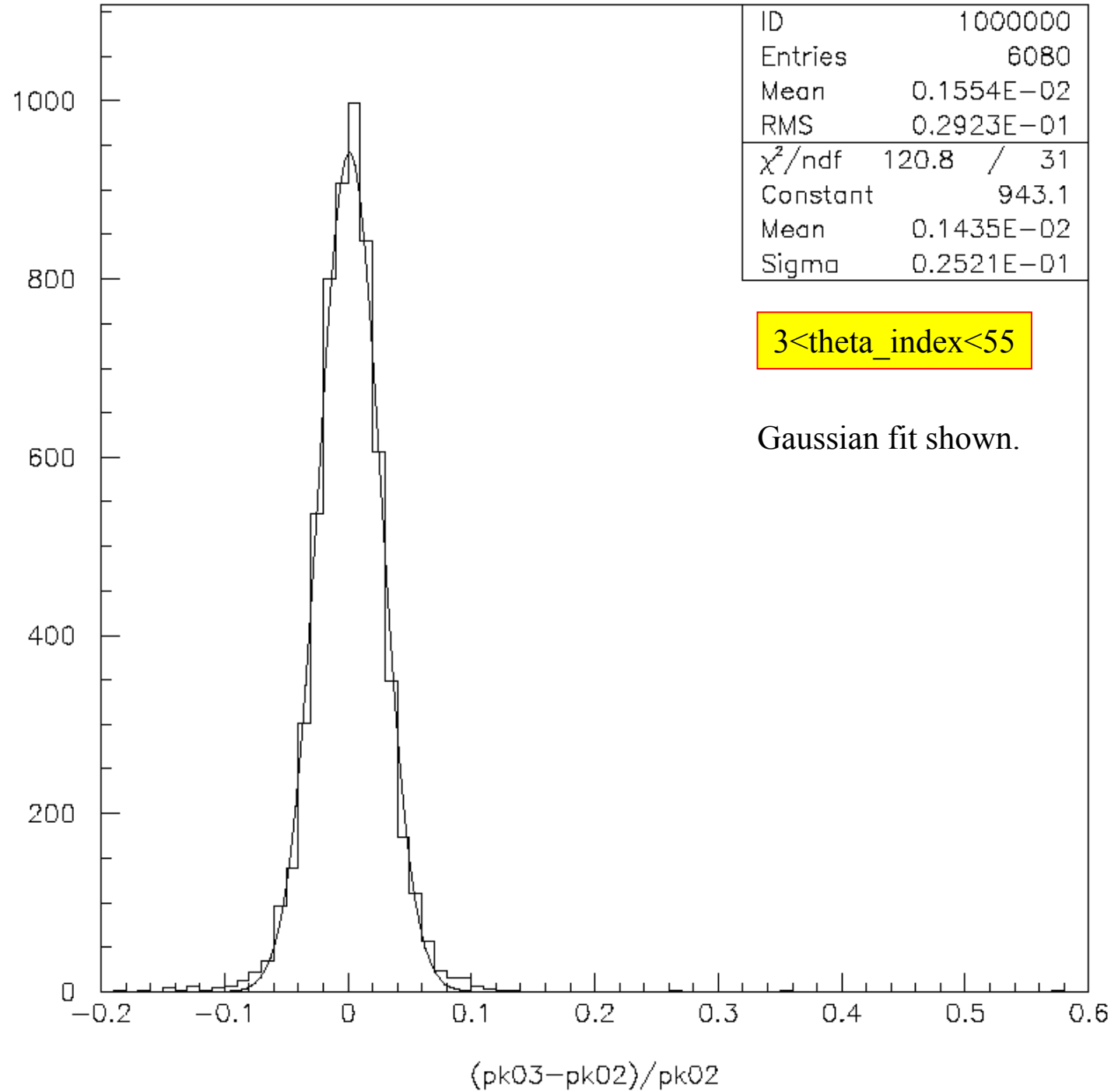
- Following up on previous comparisons of muon peaks in 2000, 2001, and 2002, it is now possible to add early Run 3 data (Dec 2002 and Jan-Feb 2003).

- As was done for May-June 2002 data, it is possible to derive correction factors for the crystals in the inner three endcap rings, to account for their lack of Bhabha calibration.

Single Crystal Muon Response

- Still use Micro
  - Run Beta job looking at Micro information
- Select ee $\rightarrow \mu\mu$
- Use muons that only hit one crystal (Crystals=1.)
  - Use rawEnergy()
  - Require position of track consistent with position of hit crystal
- Fit muon peaks with two half-gaussians
  - Perform fits for all 6580 crystals
  - Typical errors on the fit value of the peak are 3-4 MeV (about 1.5-2%)
- For Run 3, the run range used is: 32935-34772 (Dec 9, 2002-Feb 11, 2003)



3<theta_index<55

Gaussian fit shown.

Comparison of every crystal to itself, for late Run 2 and early Run 3 data.

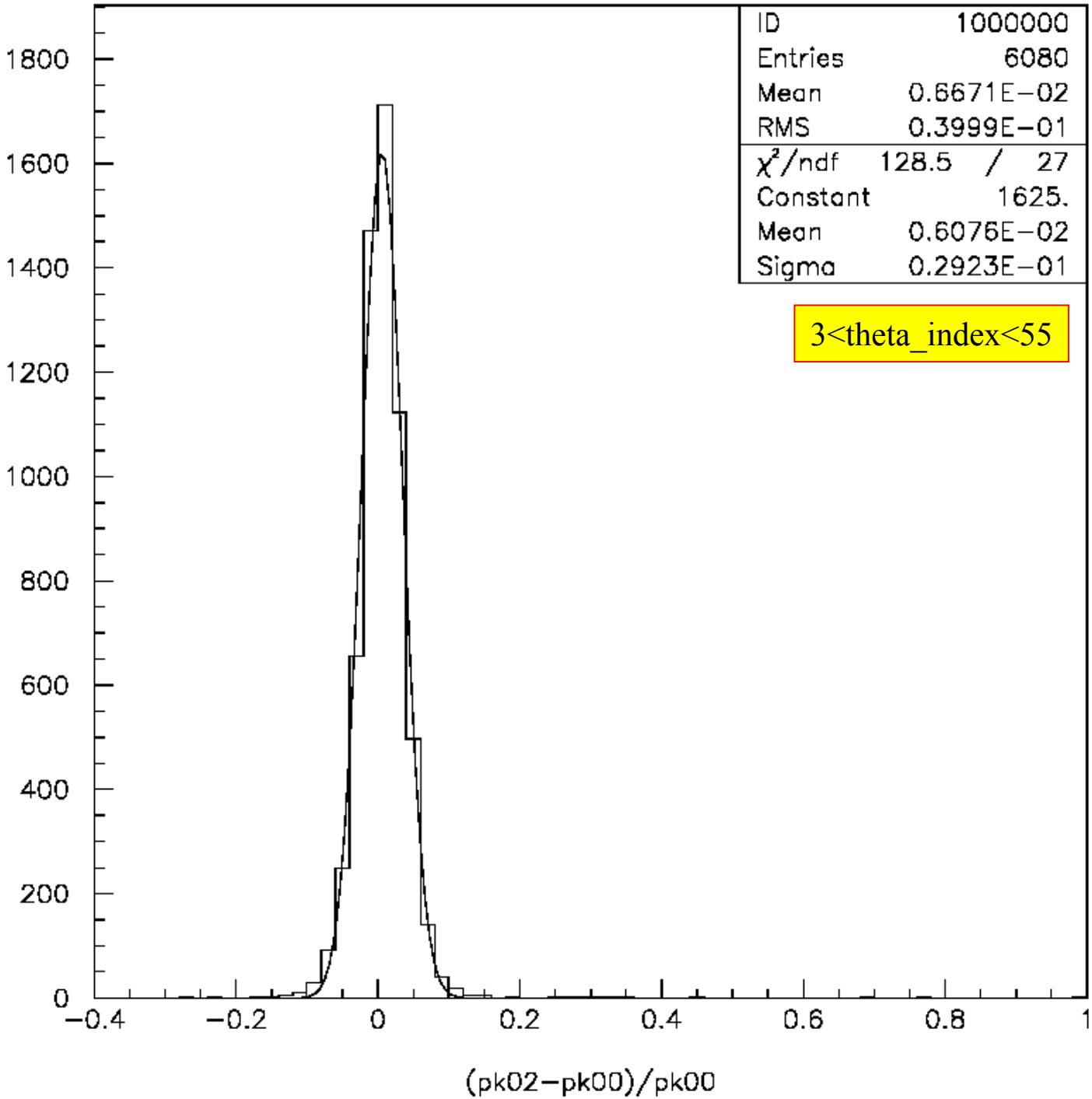
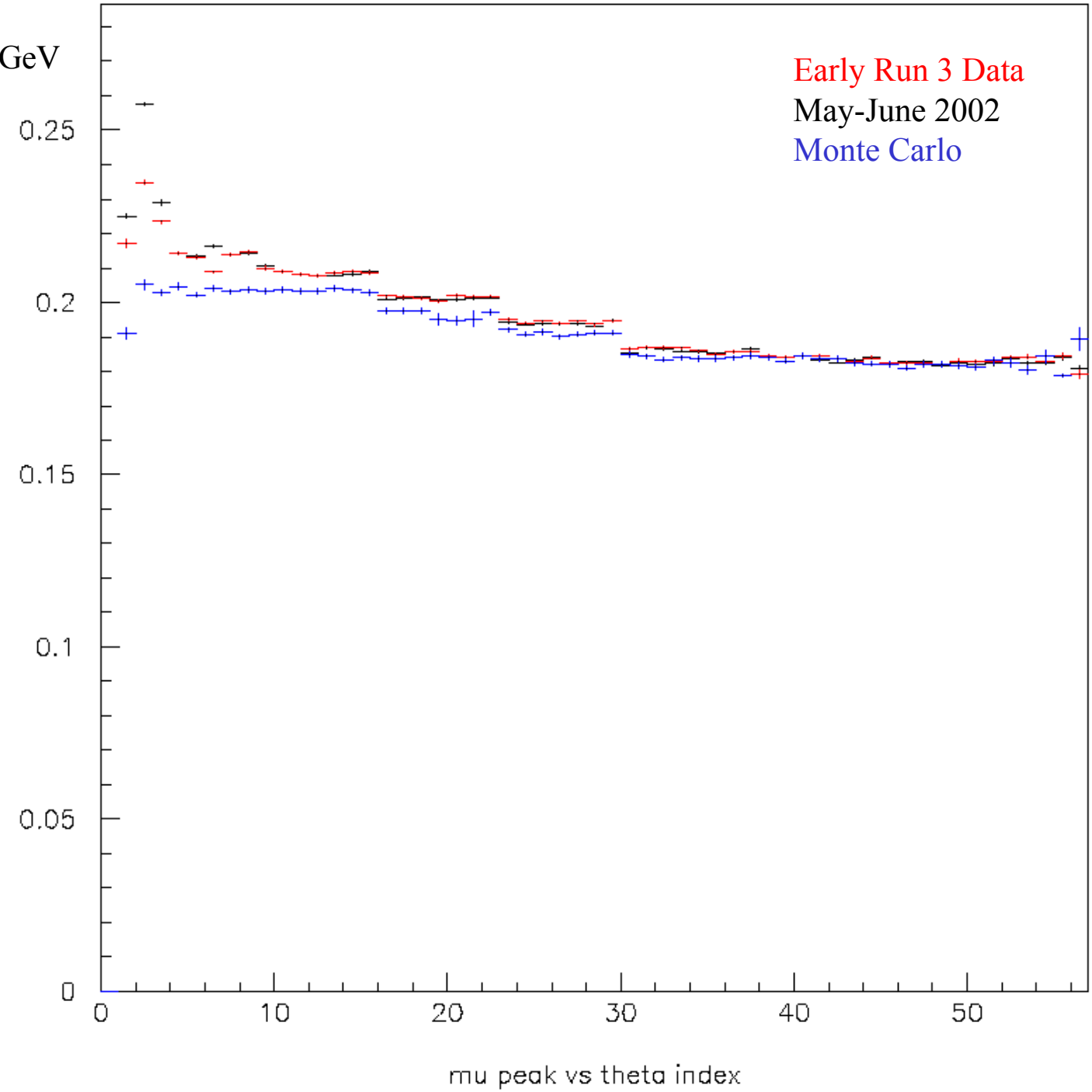


Figure shown in a Sept 2002 meeting.

Change from 2000 to 2002 (comparing each crystal to itself).



Results of fits to muon peaks for crystals grouped by theta_index.

No correction is made for crystal depth, so "steps" occur where crystal depth changes.

Mu peaks are consistent, based on the current calibration, between 2002 and 2003 (except in the first three endcap rings).

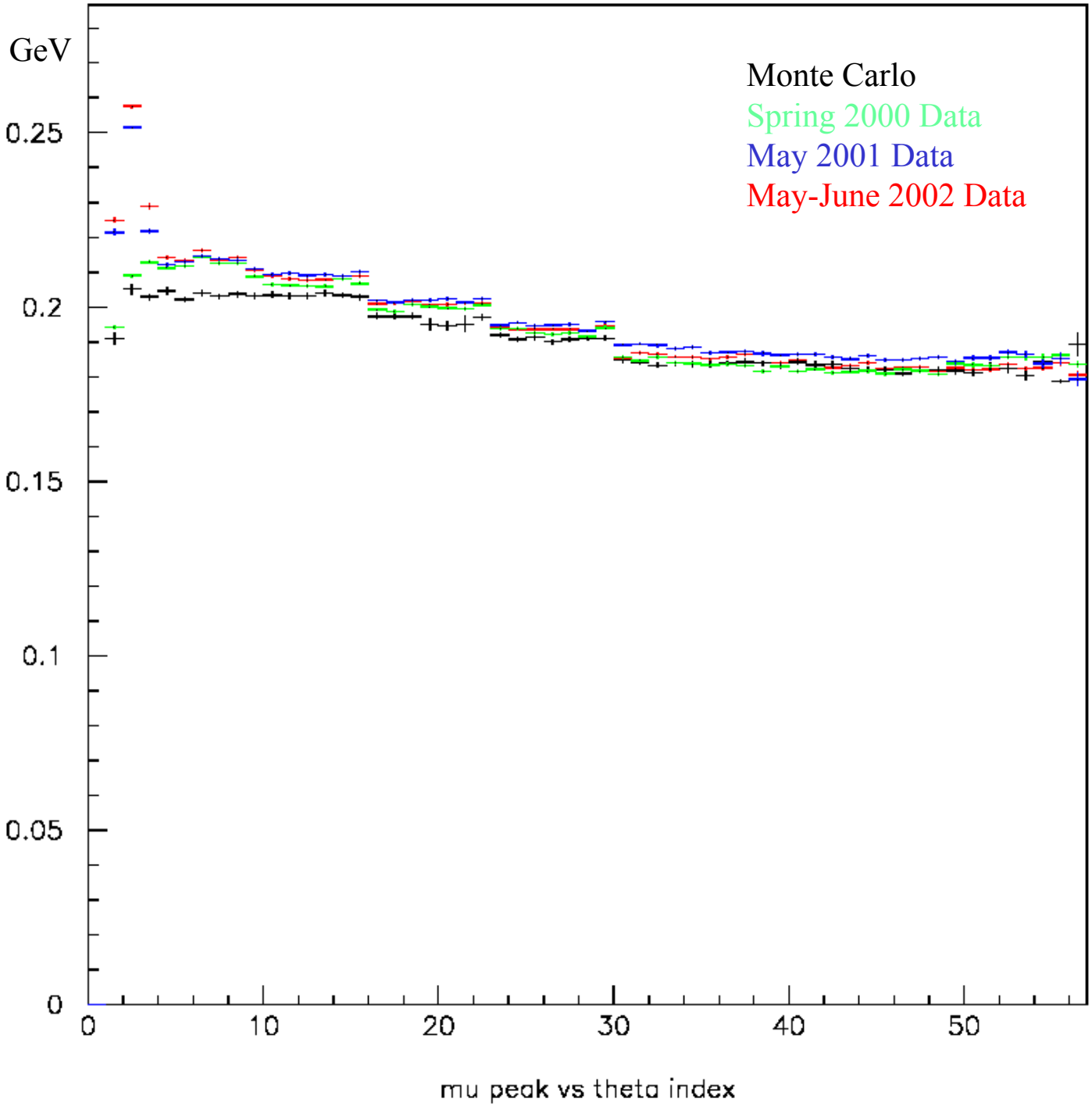


Figure shown in Sept 2002 meeting.

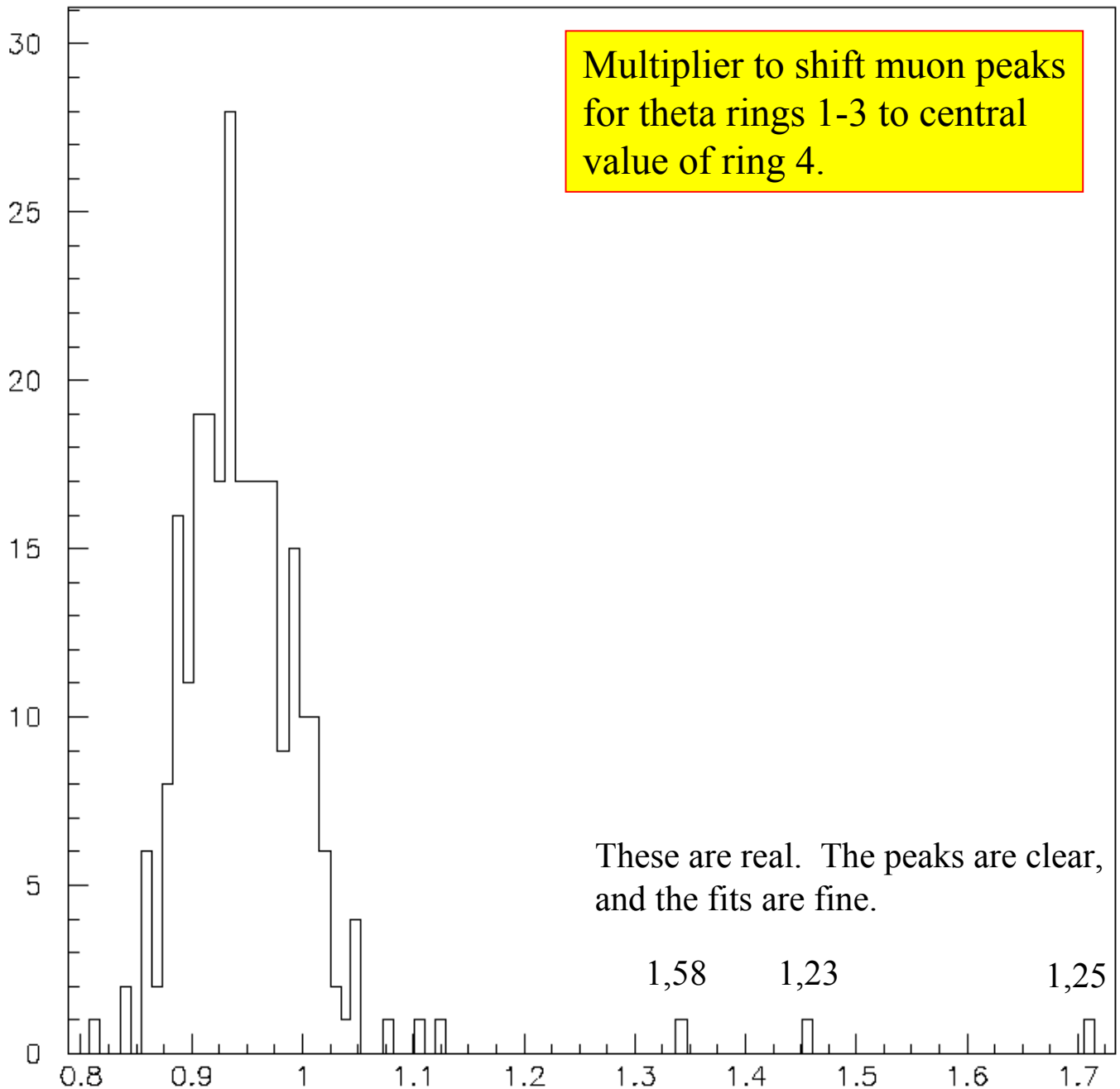
Method to “calibrate” inner three rings of endcap

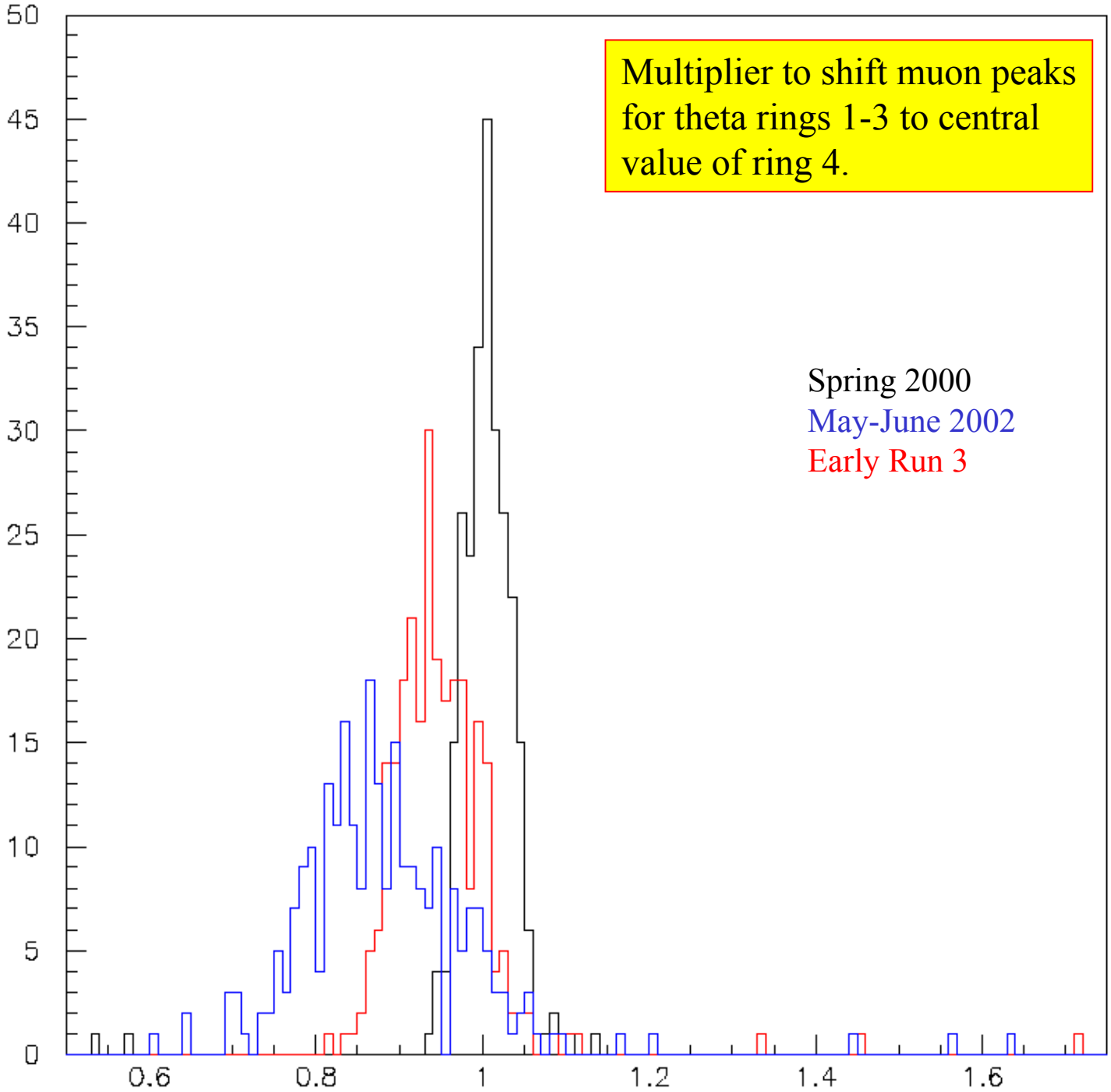
- Use muons to “transfer” the calibration from a good EMC region into the inner three rings.

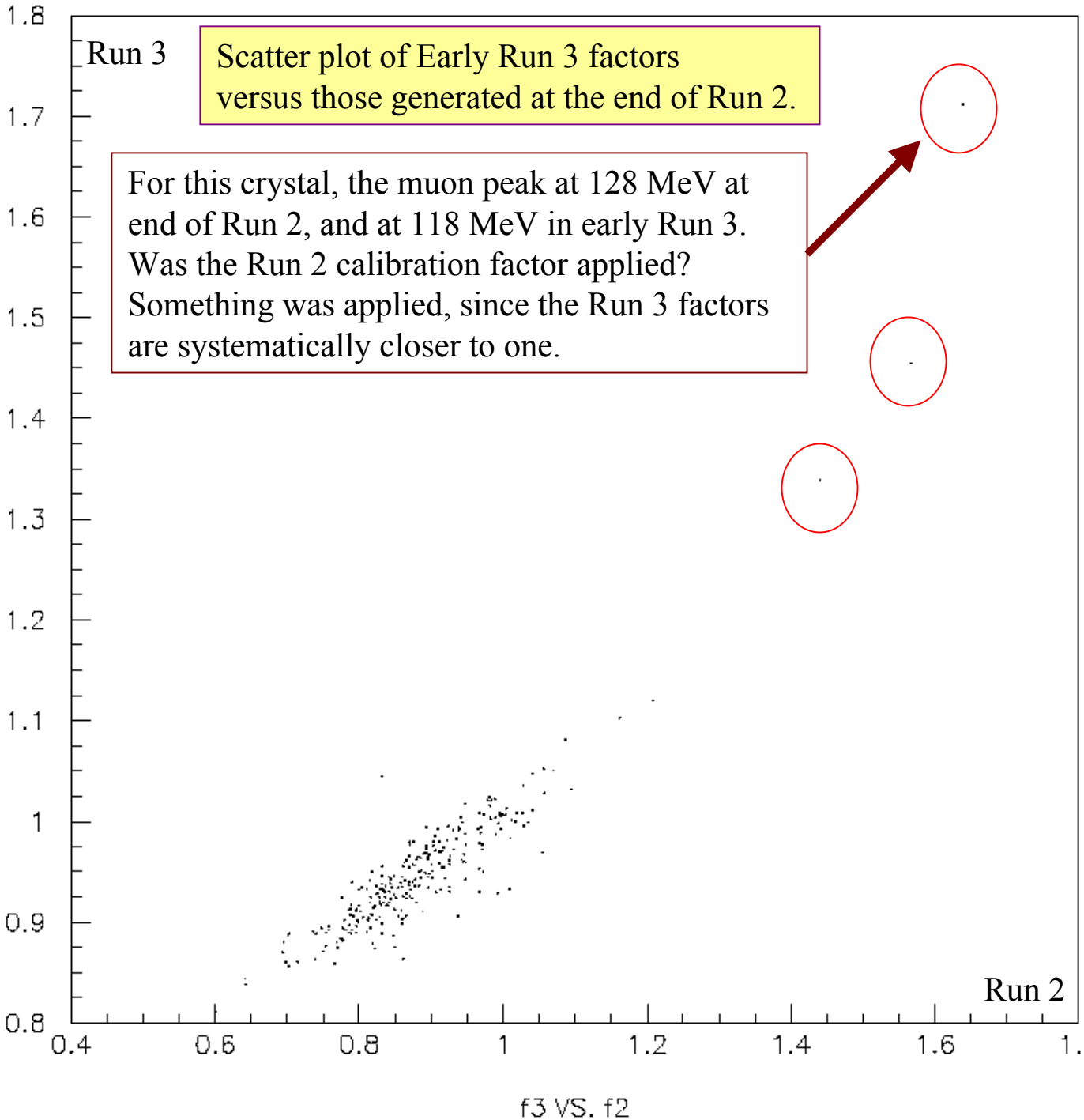
- Use ring 4 as the normalization for the calibration (e.g., similar radiation damage and negligible momentum difference for muons).
  - Using muon peaks, determine the central value for ring 4

- Calculate factors for each crystal in rings 1-3 to shift the peak for that crystal to the central value for ring 4.
  - Since ring 1 has shorter crystals, ring 1 is shifted to (ring 4)*(16.5/17.5)

- The precision of this method is limited to the few percent level by the uncertainty in muon peaks for individual crystals, but for rings 1-3, this is a substantial improvement.


Run 3 Early Data
Multiplier to shift muon peaks for theta rings 1-3 to central value of ring 4.
These are real. The peaks are clear, and the fits are fine.
1,58
1,23
1,25
30
25
20
15
10
5
0
0.8
0.9
1
1.1
1.2
1.3
1.4
1.5
1.6
1.7


Multiplier to shift muon peaks for theta rings 1-3 to central value of ring 4.
Spring 2000
May-June 2002
Early Run 3
50
45
40
35
30
25
20
15
10
5
0
0.6
0.8
1
1.2
1.4
1.6



The high degree of correlation is surprising.

Over a short time span, one expects light yield/gain changes to be small and fairly random. Over long times, effects like radiation damage introduce systematic drifts.

It is not likely that these three crystals lose half their signal every time I look at them. Also, the strong correlations for "normal" crystals would imply rapid systematic trends.

Apparently the method is flawed. I suspect it is because we are applying the logarithmic energy interpolation to muon factors as if they were true Bhabha constants.

Summary

- Muon peaks in Run 3 data, as measured with respect to the current calibration, are consistent with those observed in earlier data.

- Correction factors have been generated for theta_index = 1, 2, 3.

- The endcap muon calibration needs to be rethought, since the current implementation seems to have a basic problem.