

CALOR2000

10.10.2000

Test-Beam Results for First Serial
Modules of ATLAS Hadronic
End-Cap Calorimeter

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- Module & setup description
- Electron data & comparison with MC
- Pion data & comparison with MC
- Muon data
- Summary

- HEC: 2 wheels of 32 wedges each
- LAr gap: 4×1.8 mm
- copper absorber 25 and 50 mm
- 4 longitudinal layers $\sim 10\lambda$

- TB setup: stack out of 6 HEC modules - 3 front and 3 rear
- energy scans at 15 points: A-O
- electrons and pions: energy interval 10-200 GeV
- muons 150 and 180 GeV
- 10K events per run

- cold preamplifier - pole zero - shaper - FADC
- signal peaking time ~ 50 ns
- 16 time samples at 40 MHz (25 ns)
- samples 1-5 are empty
- samples 7-11 are used for amplitude reconstruction
- amplitude: Optimal Filtering (OF)

$$A_{OF} = \vec{w}\vec{s}, \quad \vec{w} = \frac{\hat{M}\vec{f}}{\vec{f}\hat{M}\vec{f}}$$

- accuracy of A_{OF} is about 0.5%
- OF noise suppression factor

$$S_{OF} = \sigma_{noise}^{OF} / \sigma_{noise}^{raw} = 0.55 \div 0.7$$

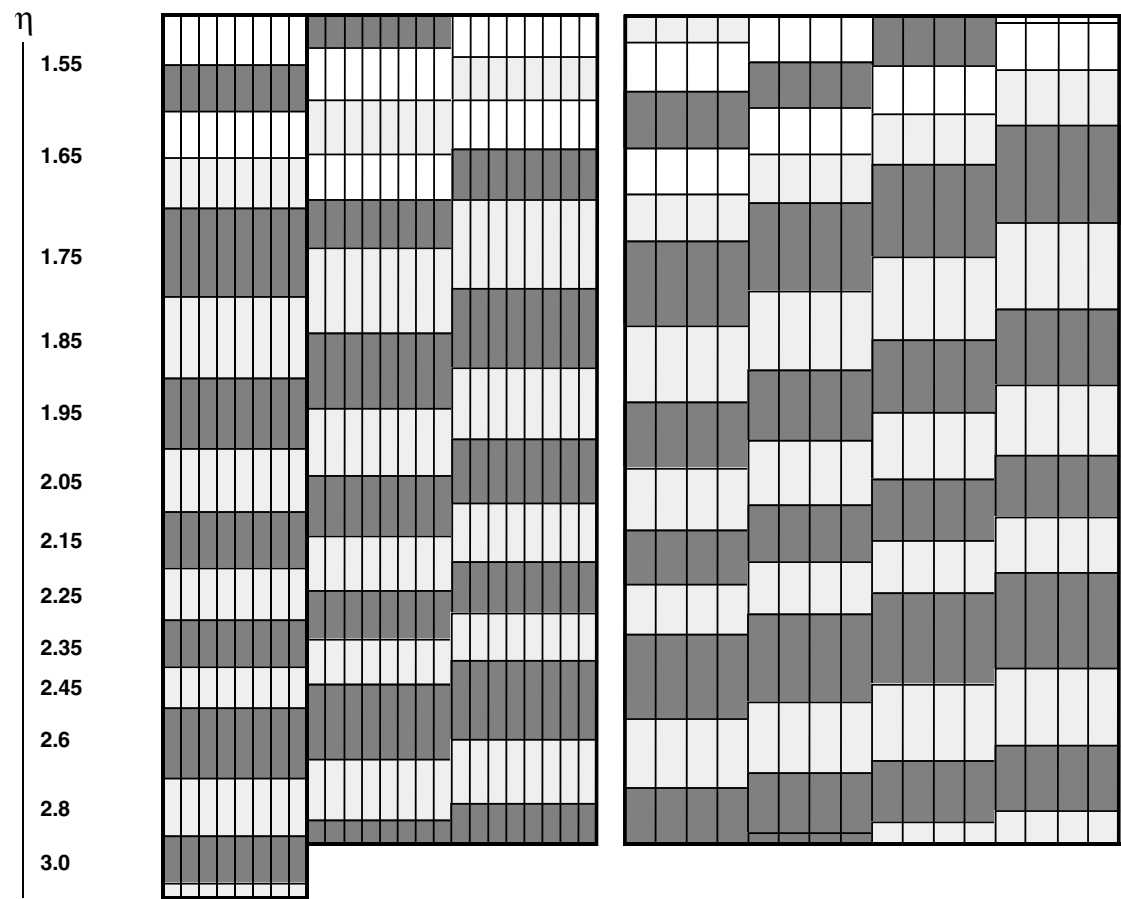
- Cluster size is fixed for each impact point: no dependence on E_{beam}
- Cluster selection for electrons (pions): *mean* cell signal greater 200(15) nA at 175(180) GeV
- Electron cluster: ~ 6 cells
- Pion cluster: 50÷60 cells
- Cluster noise:
 - OF weights for samples 1-5
 - sum through all cluster's cells
- Characteristic electron (pion) cluster noise $\sim 0.6(6.)$ GeV

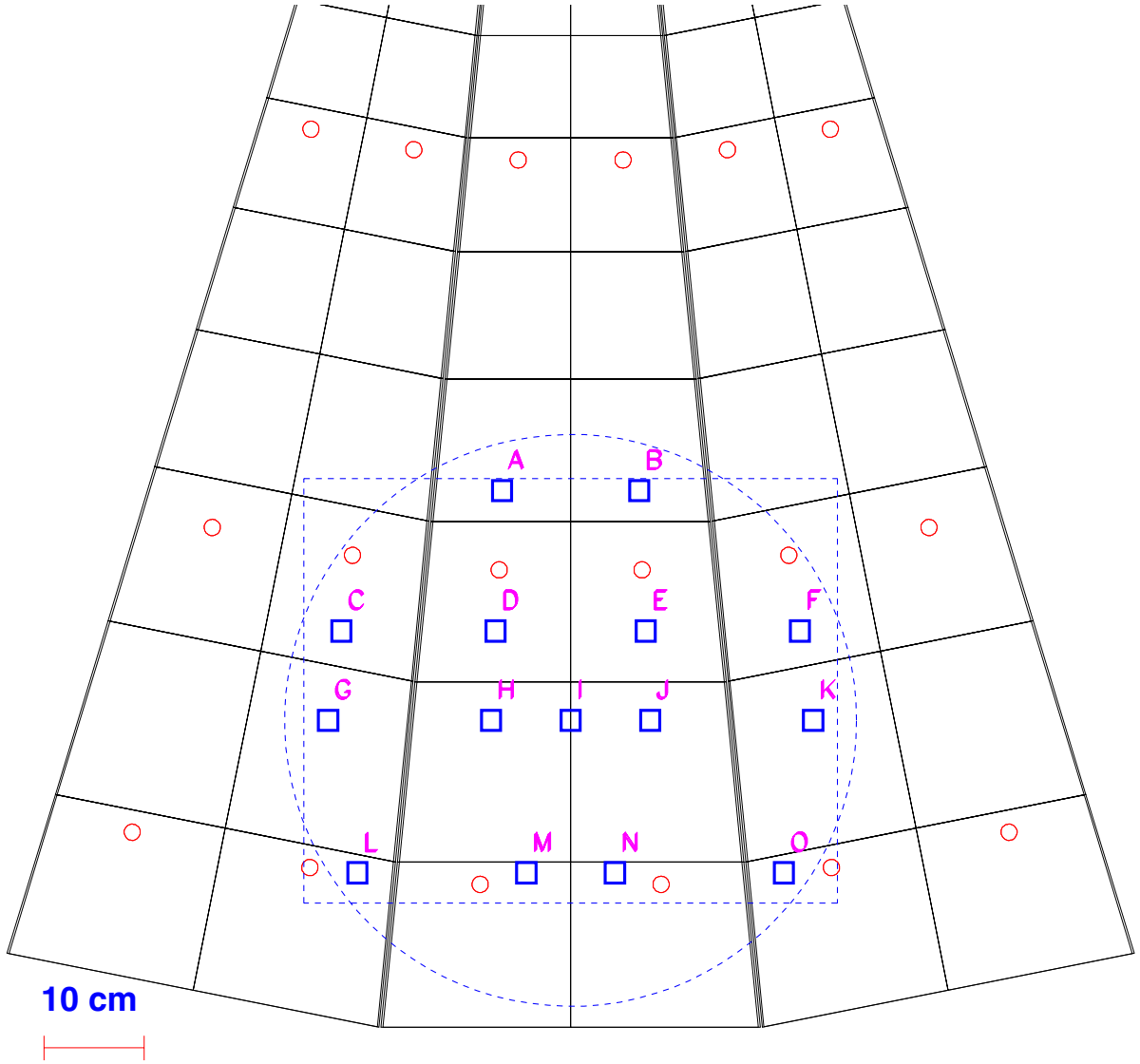
- Energy resolution: Gaussian fit in $E_0 \pm 2\sigma$ interval
- Energy dependence of resolution:
 - Noise is quadratically subtracted at each energy
 - $$\sigma(E)/E = \frac{A}{\sqrt{E}} \oplus B$$
- $$e/\pi = \frac{e/h}{1+(e/h-1)\cdot f_{\pi^0}}$$
- $$f_{\pi^0} = 1 - \left(\frac{E}{E'_0}\right)^{m-1}$$
- where $E'_0 \approx 1$ GeV and $m \approx 0.85$

Summary

- cell responses to electrons are equalized with accuracy of $\pm 0.5\%$
- linearity of response for electron beam in the range 20÷200 GeV is in the limits $\pm 1.5\%$
- Energy dependence of resolution for electrons:
 - sampling term $A = 21.4 \pm 0.5\%$
(MC $21.7 \pm 0.1\%$)
 - constant term $B = 0.3 \pm 0.1\%$
(MC $0. \pm 0.3\%$)

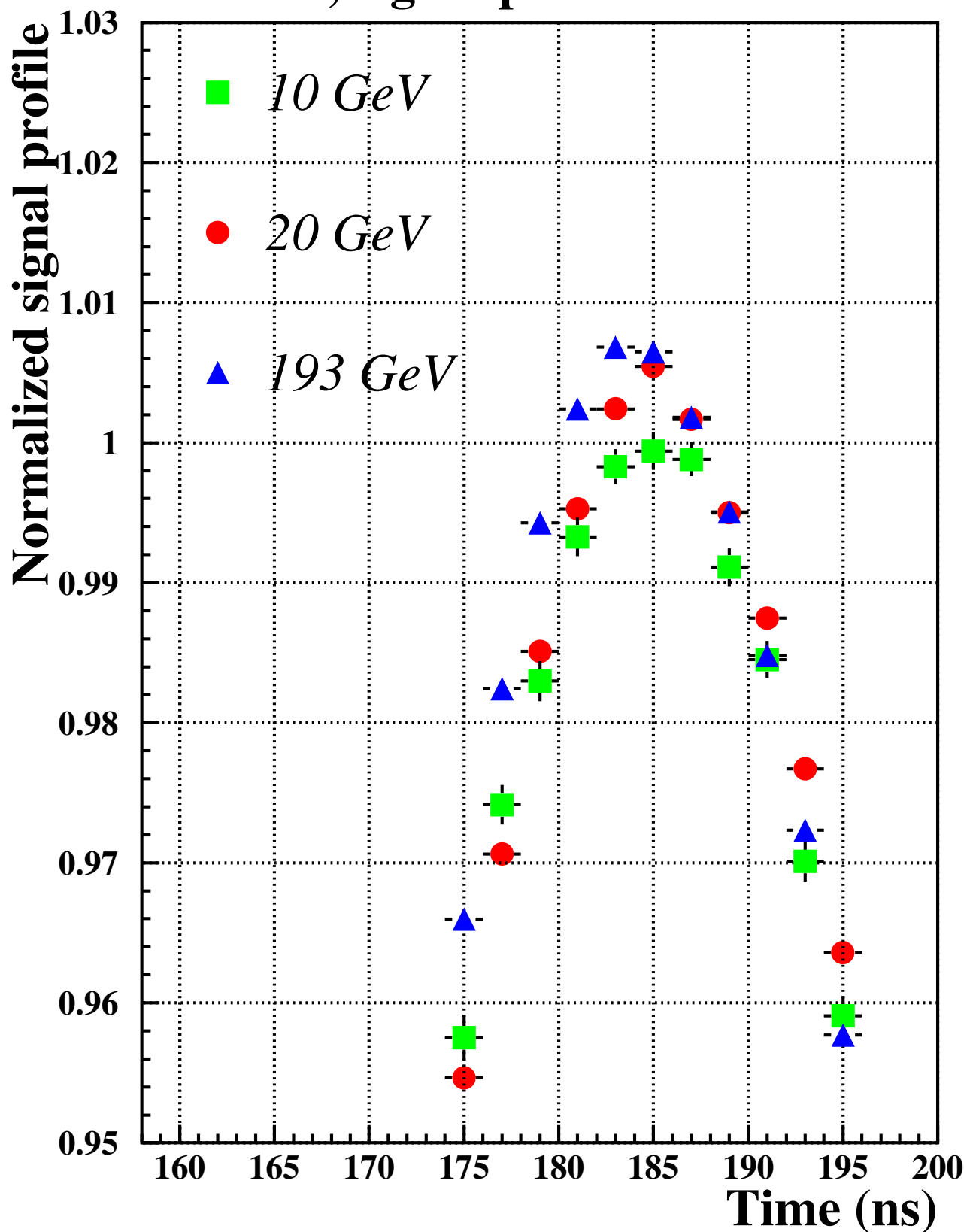
- Energy dependence of resolution for pions:
 - sampling term $A = 71.2 \pm 2\%$
(GCALOR $65.2 \pm 0.9\%$)
 - constant term $B = 6.0 \pm 0.2\%$
(GCALOR $5.0 \pm 0.1\%$)
- found e/h ratio 1.47 ± 0.05 differs from GCALOR prediction 1.32
- Muon signal to noise ratio is ~ 6



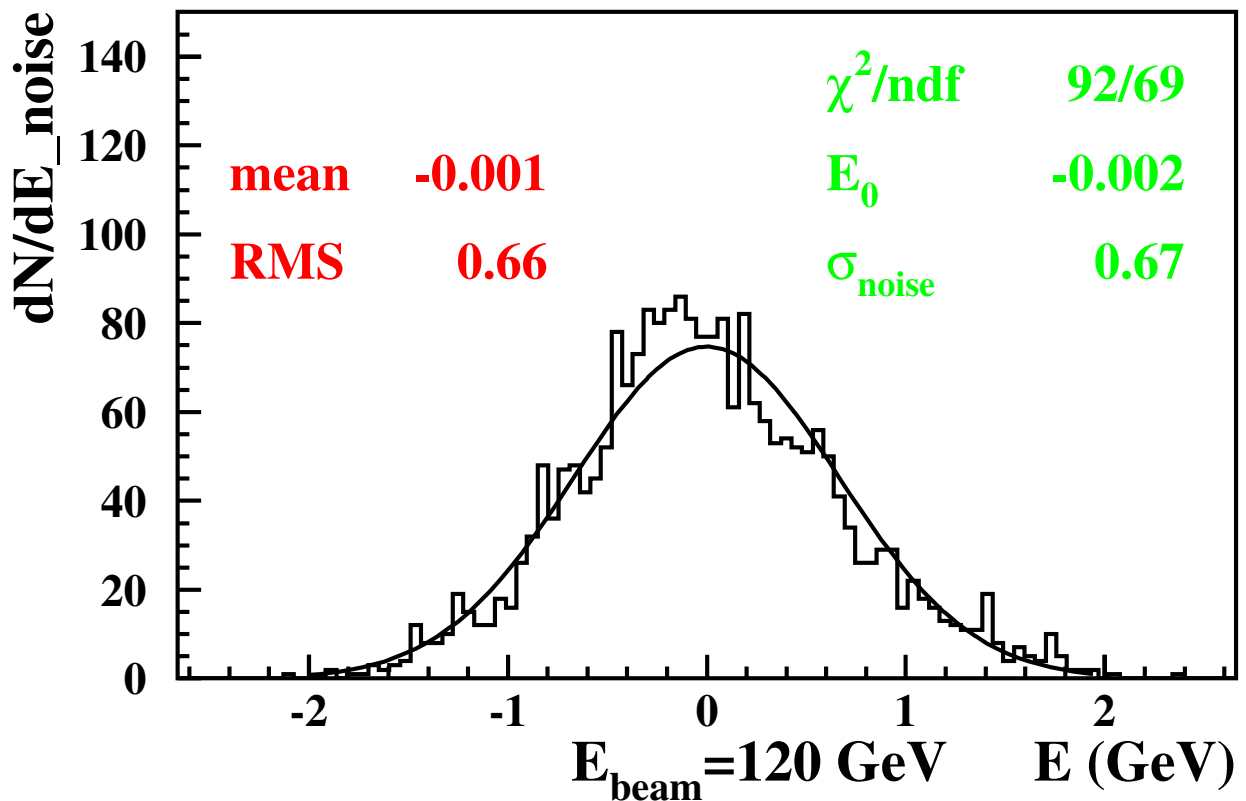
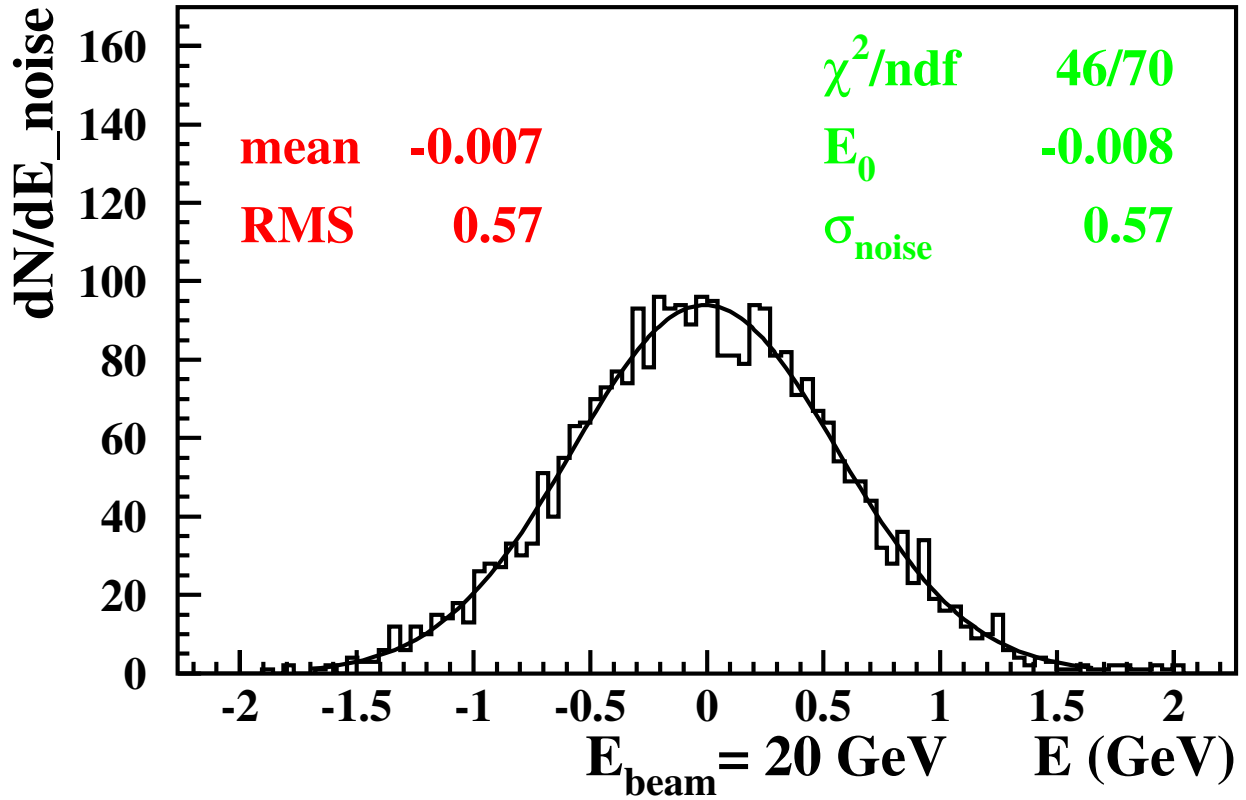


Projection on the front face of the HEC module

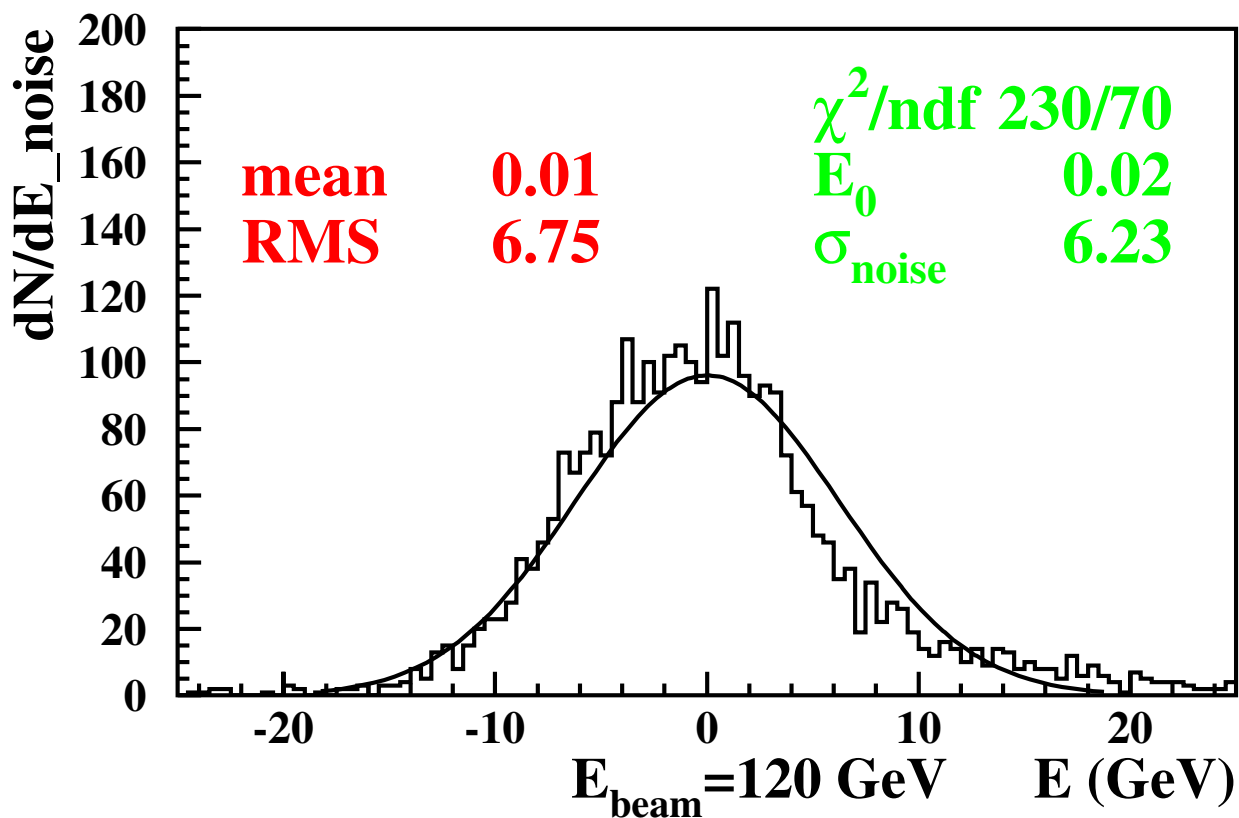
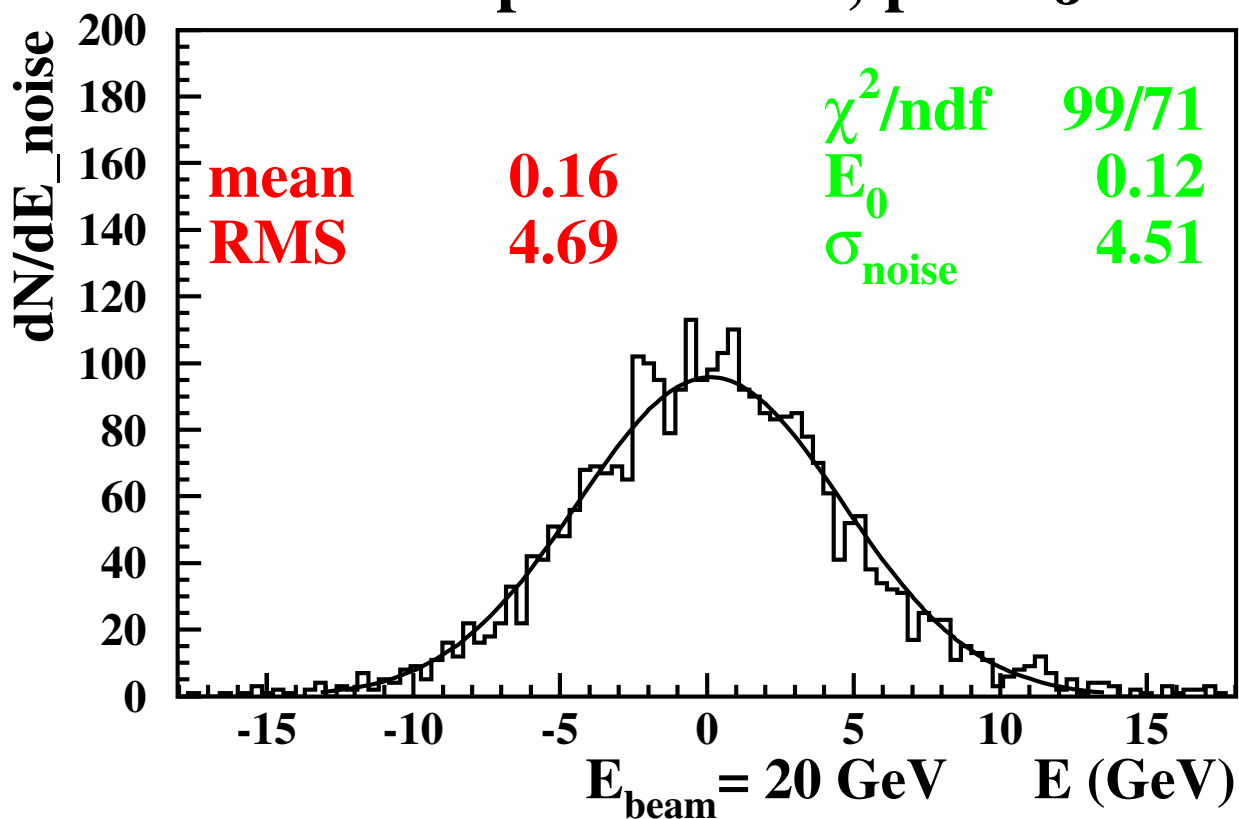
Electrons; signal profile for cell 65



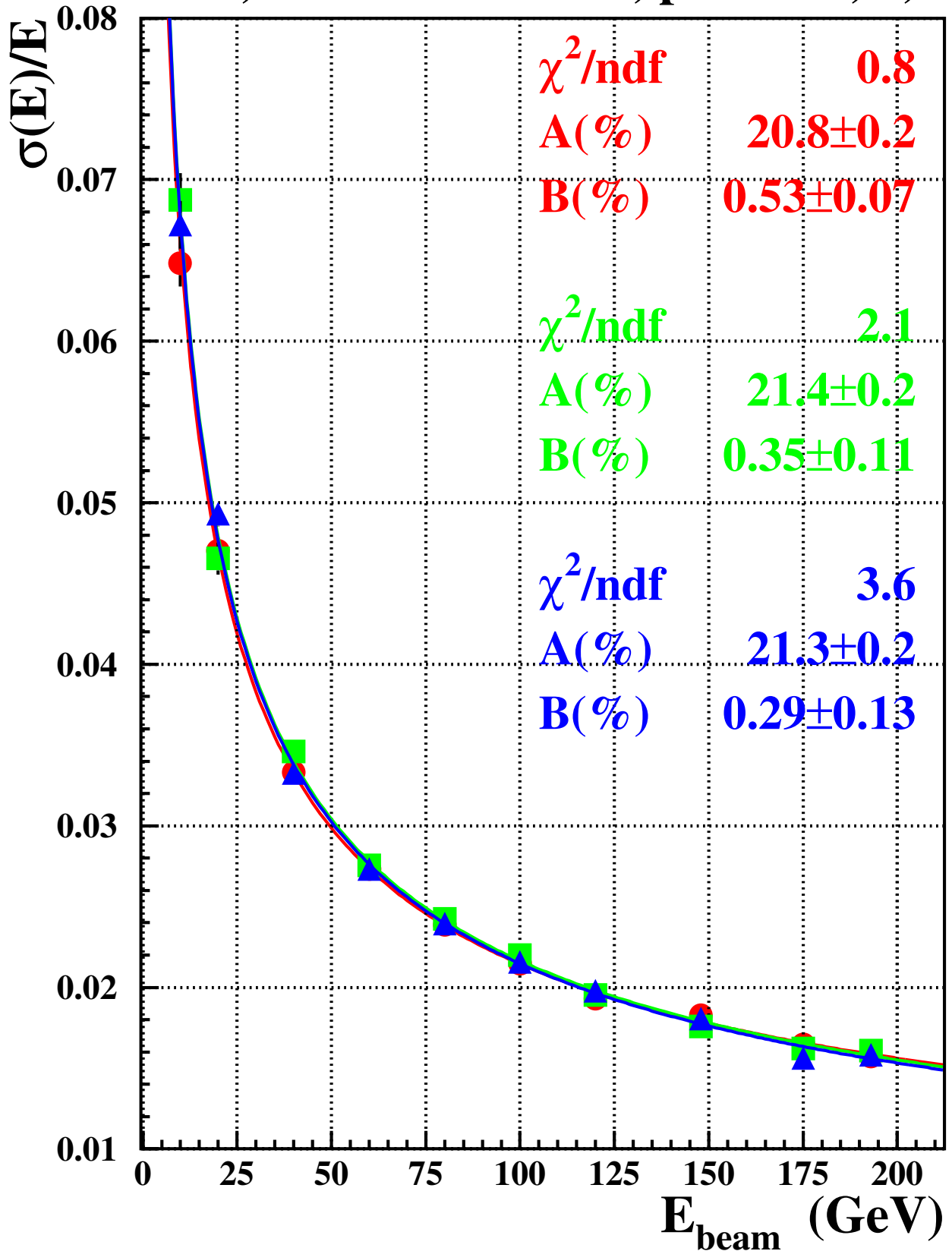
Noise in electron cluster; point G

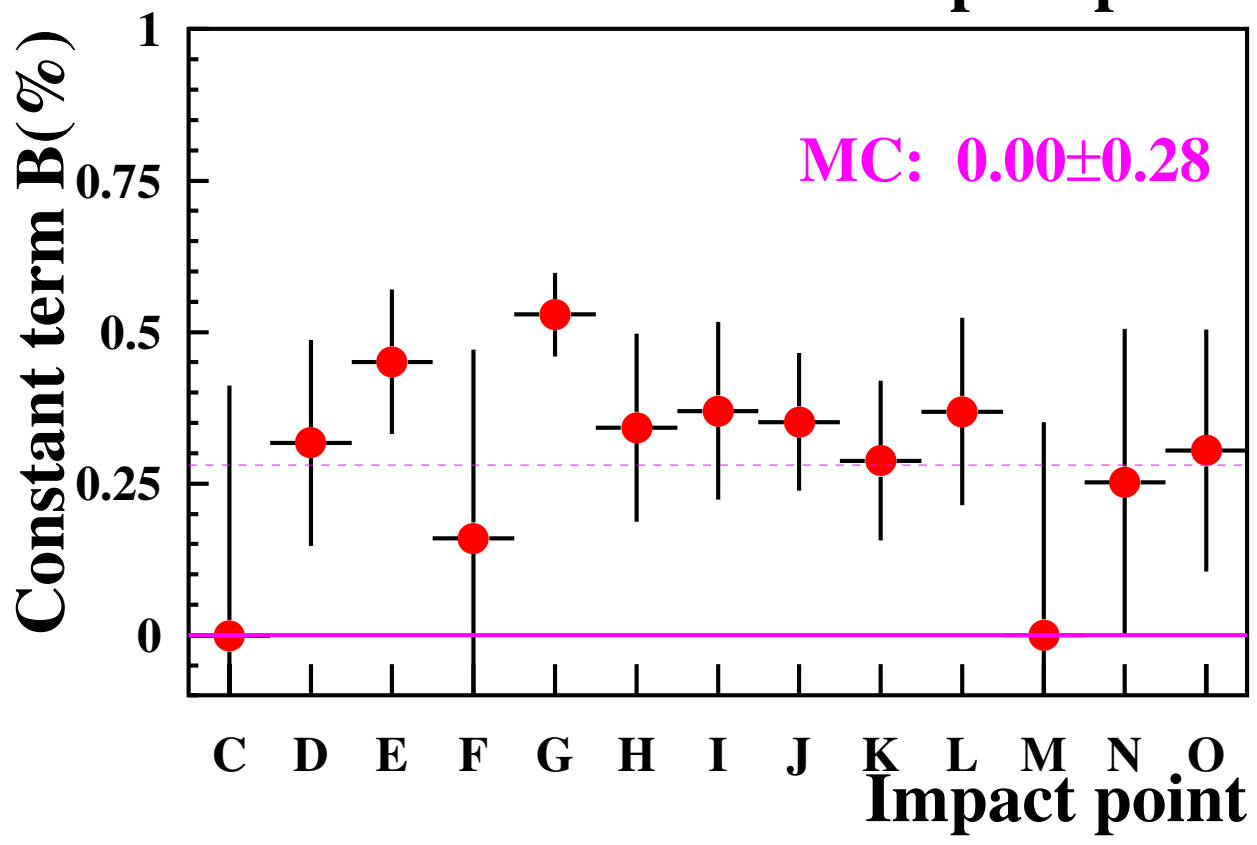
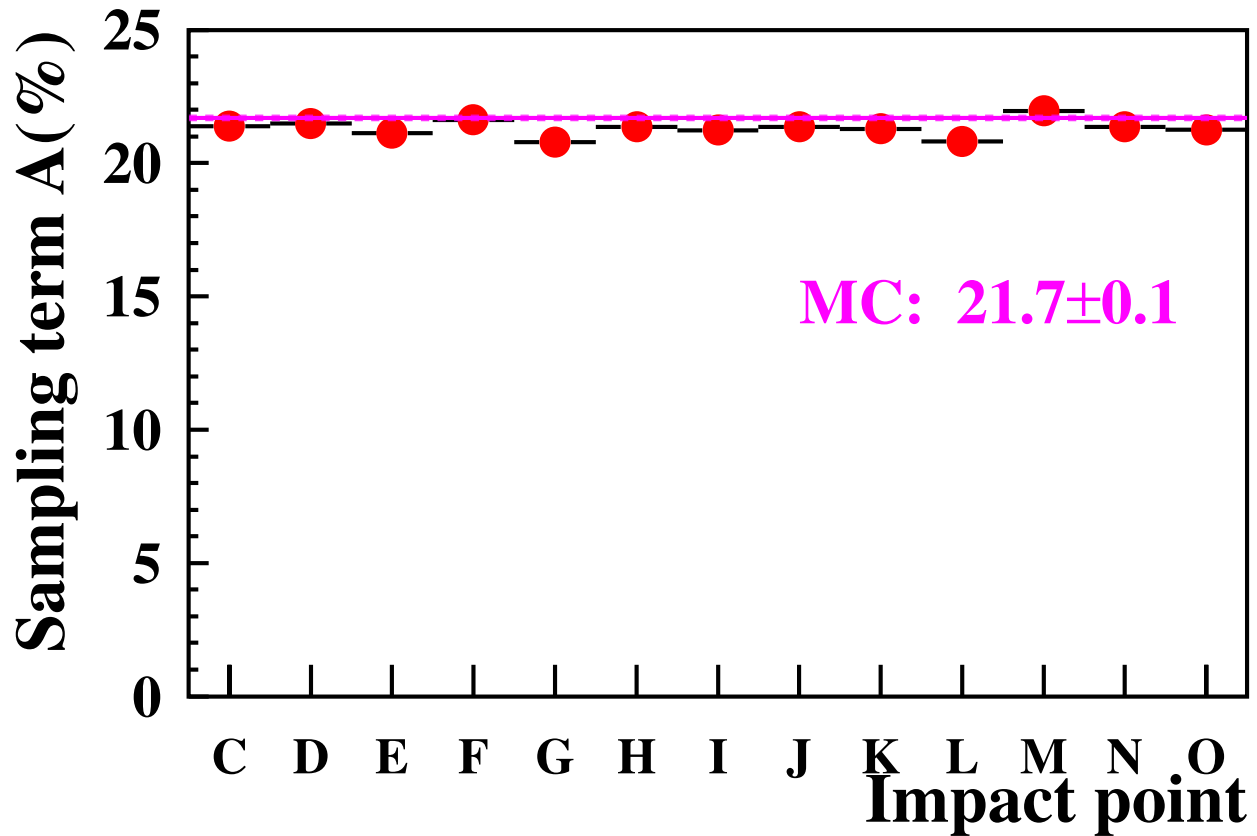


Noise in pion cluster; point J

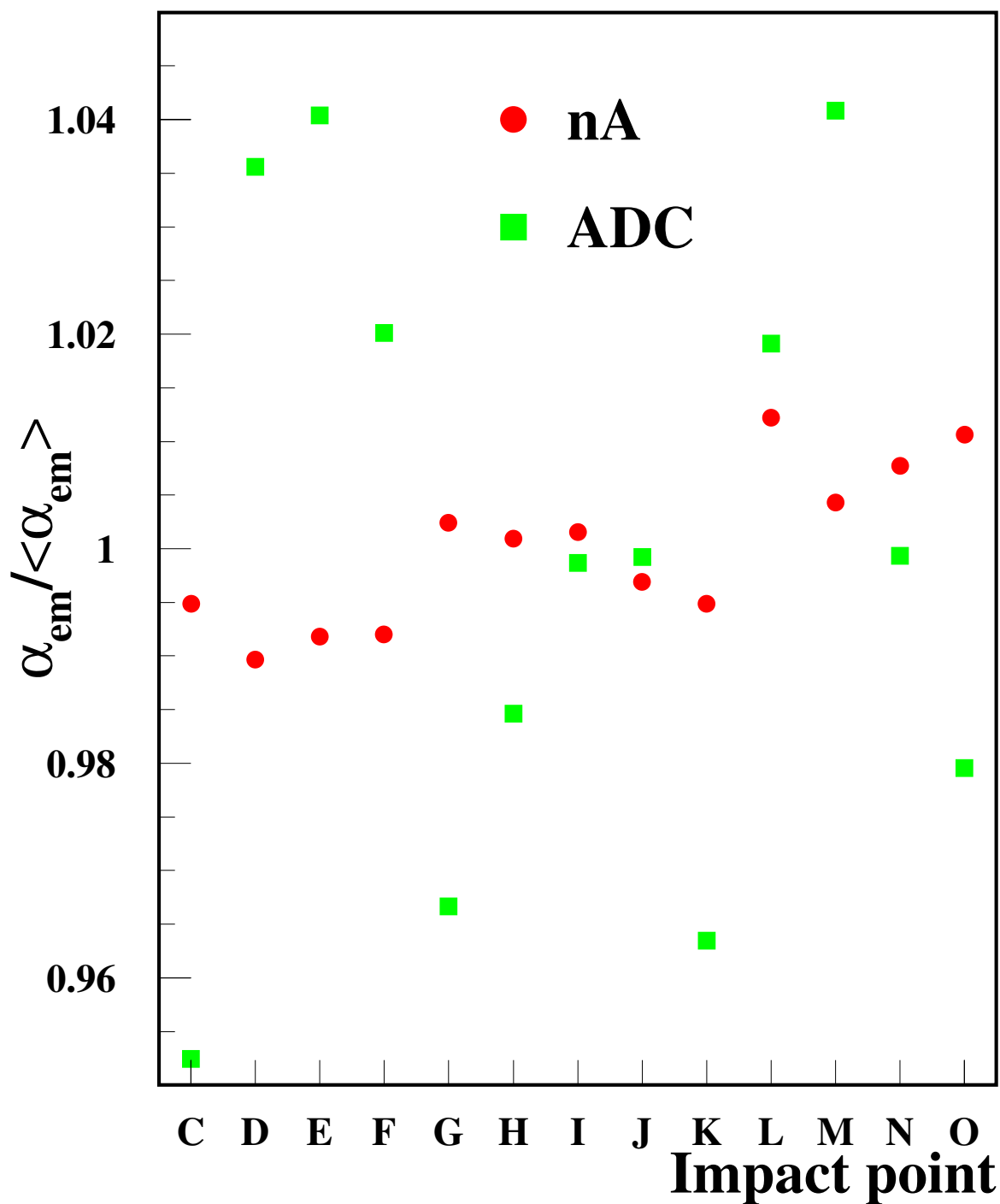


Electrons, noise subtracted, points G, J, K

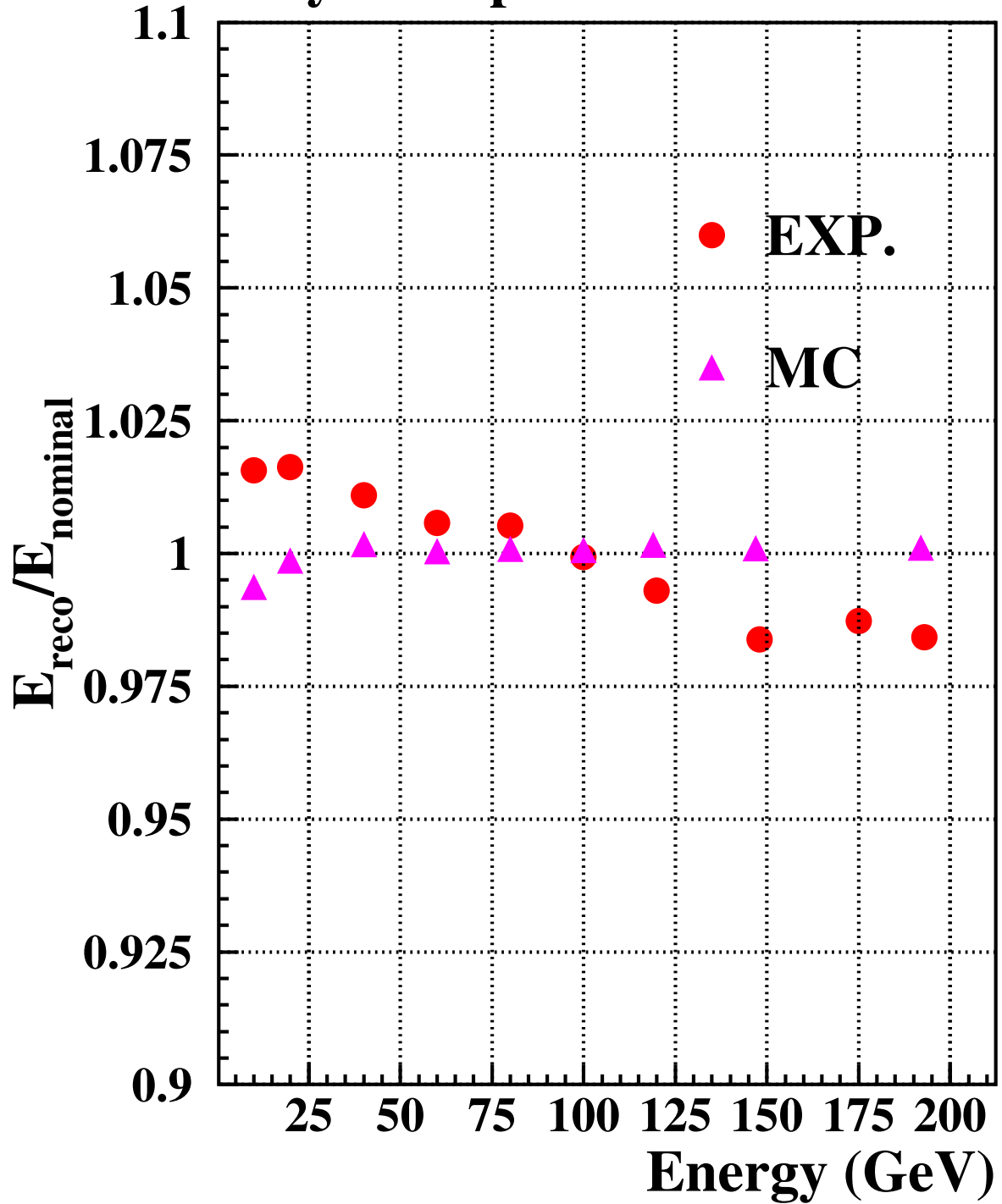




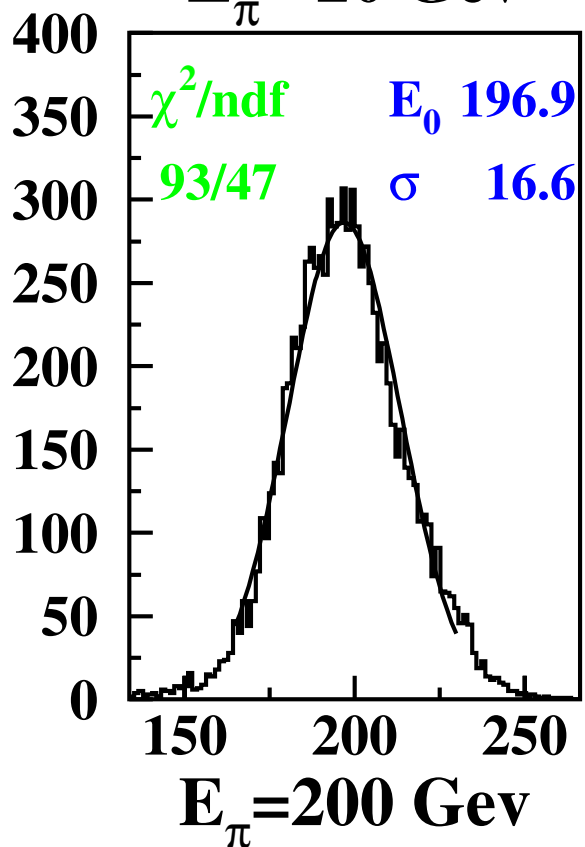
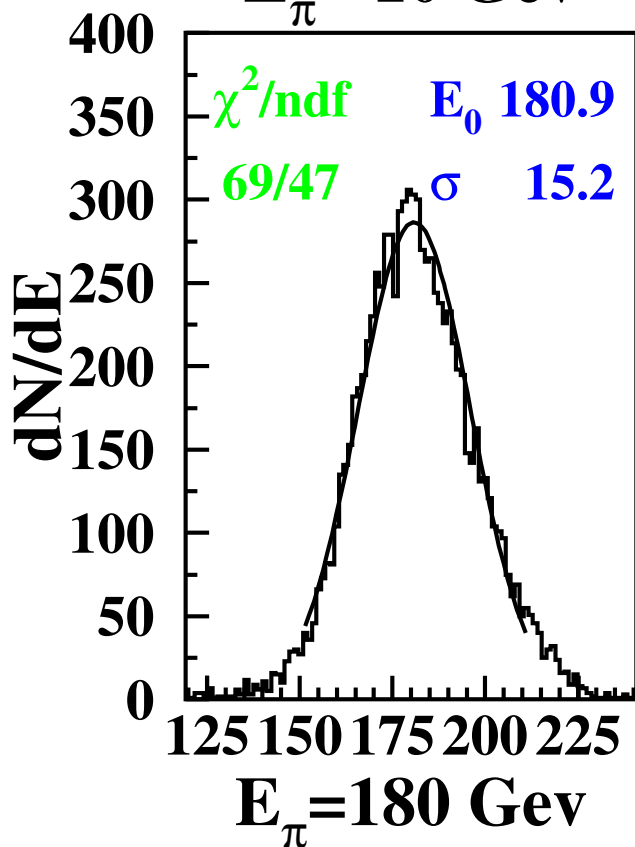
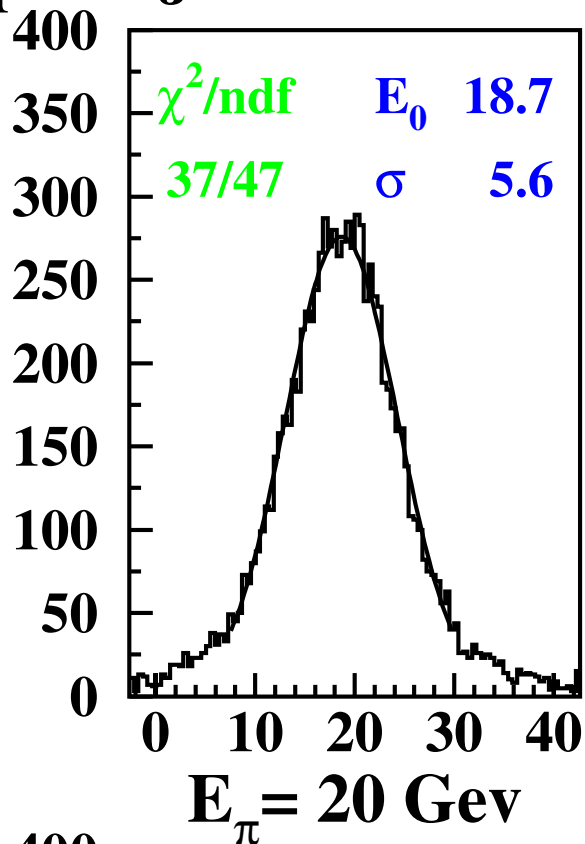
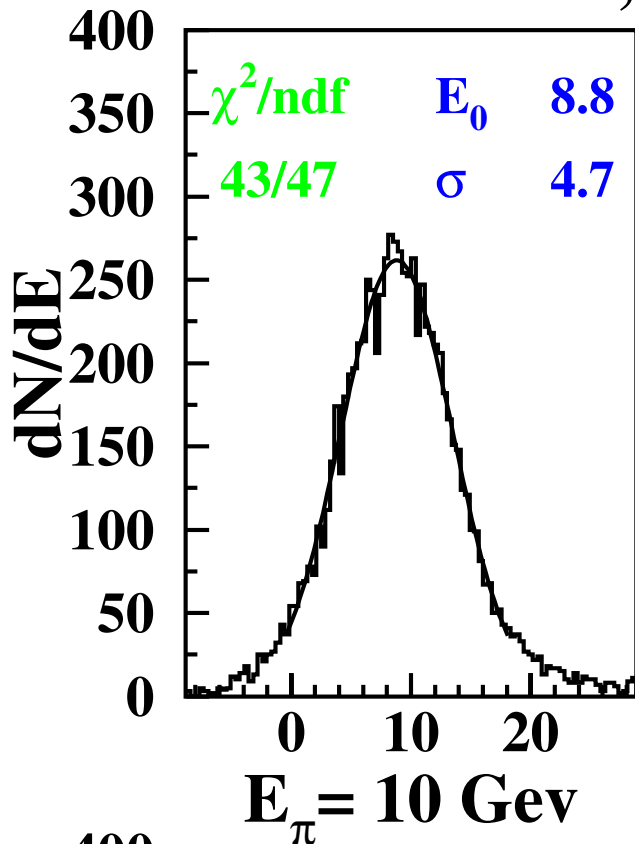
Spatial uniformity of response, electrons



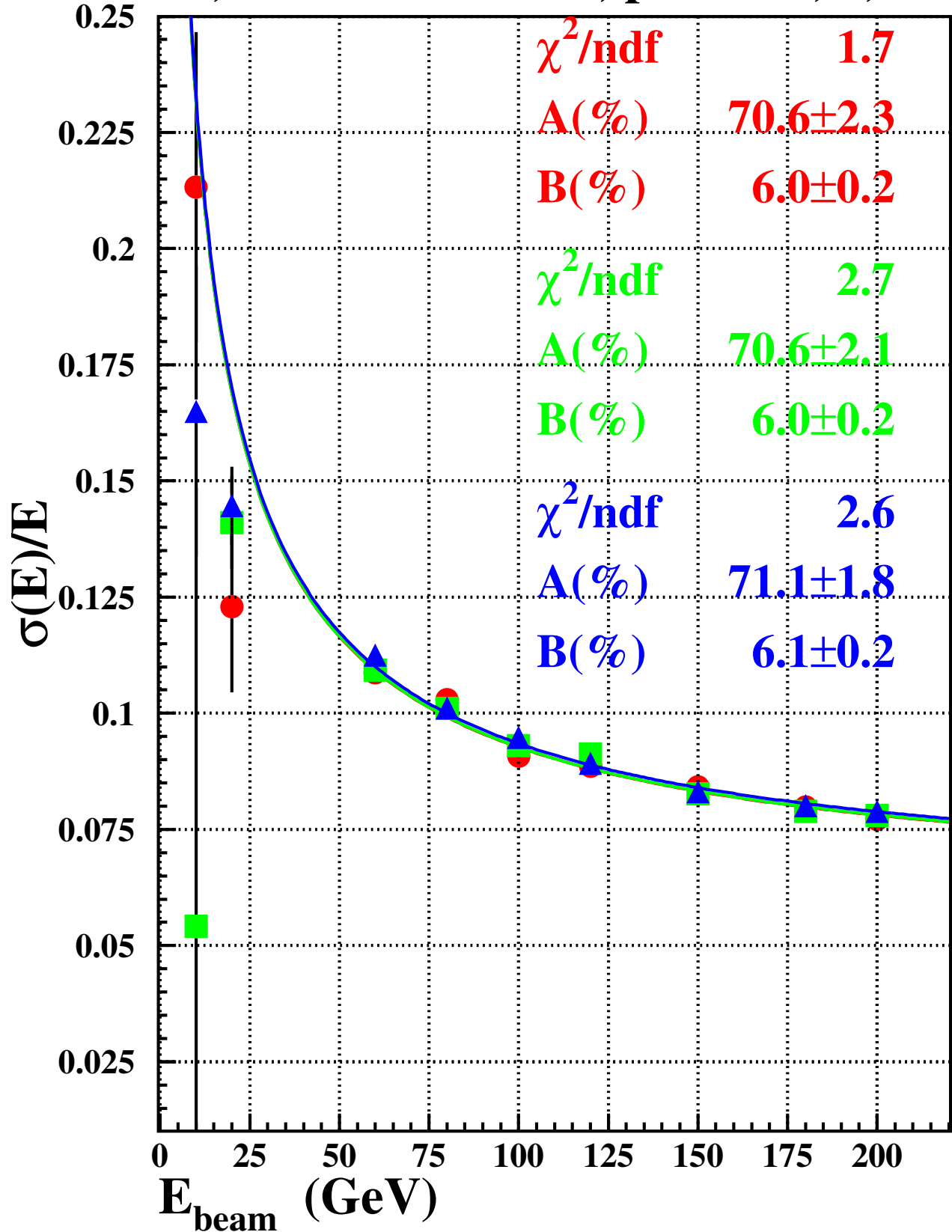
Linearity of response for electrons



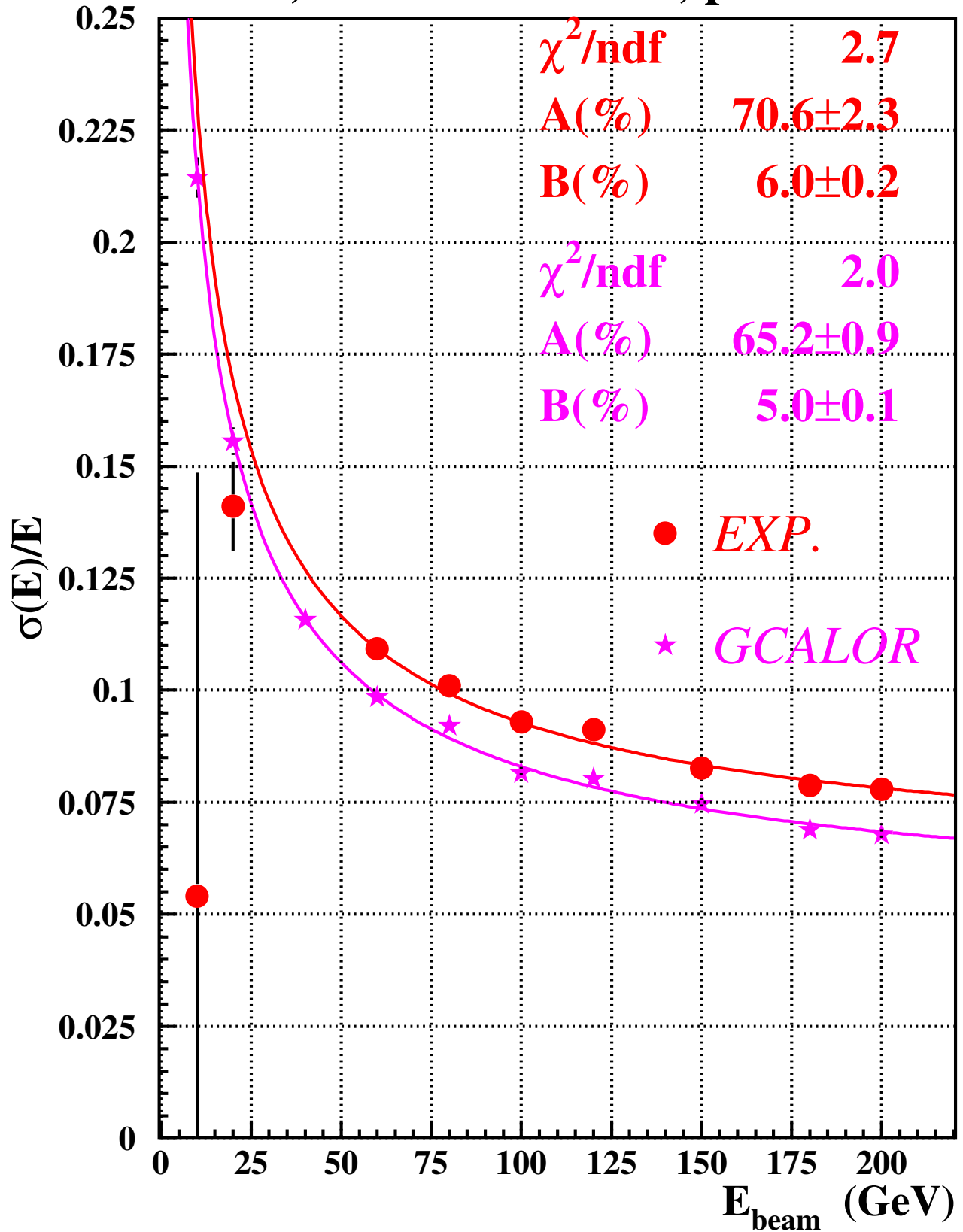
Pions, point J



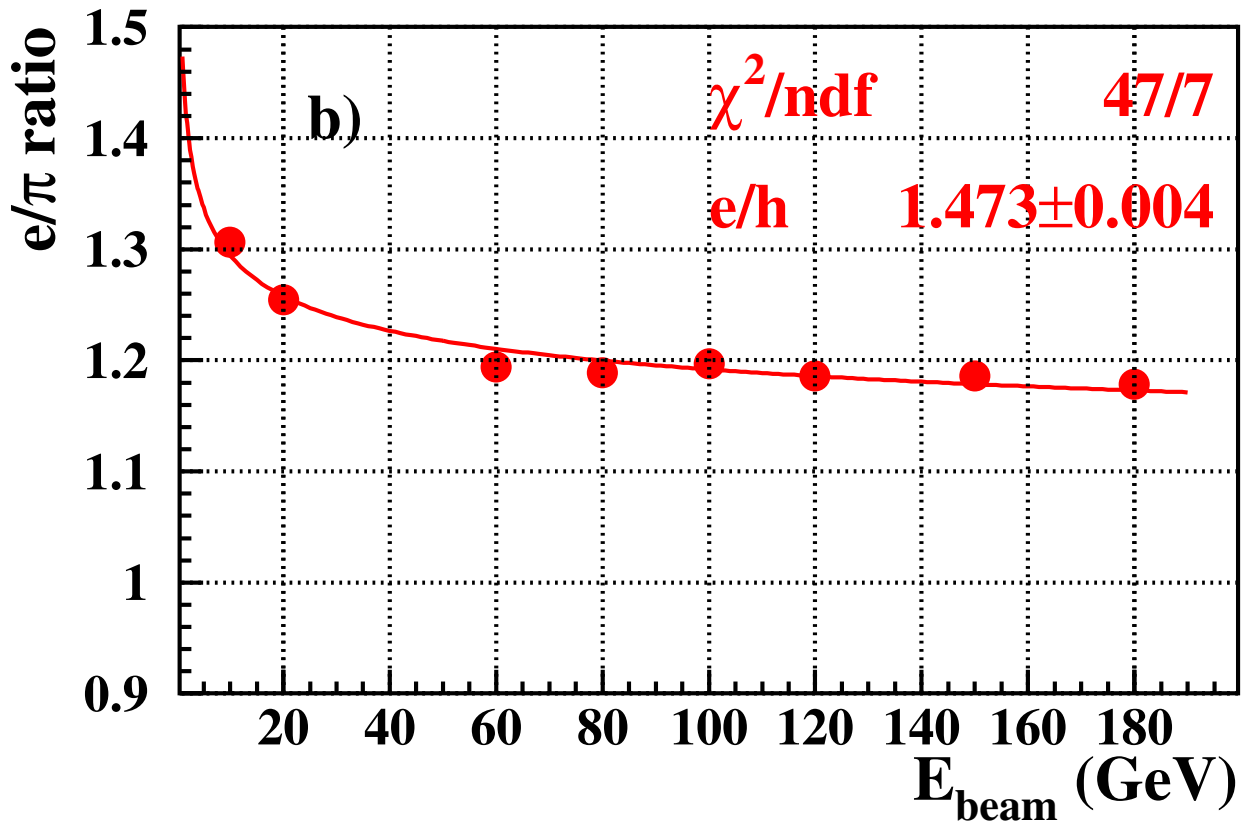
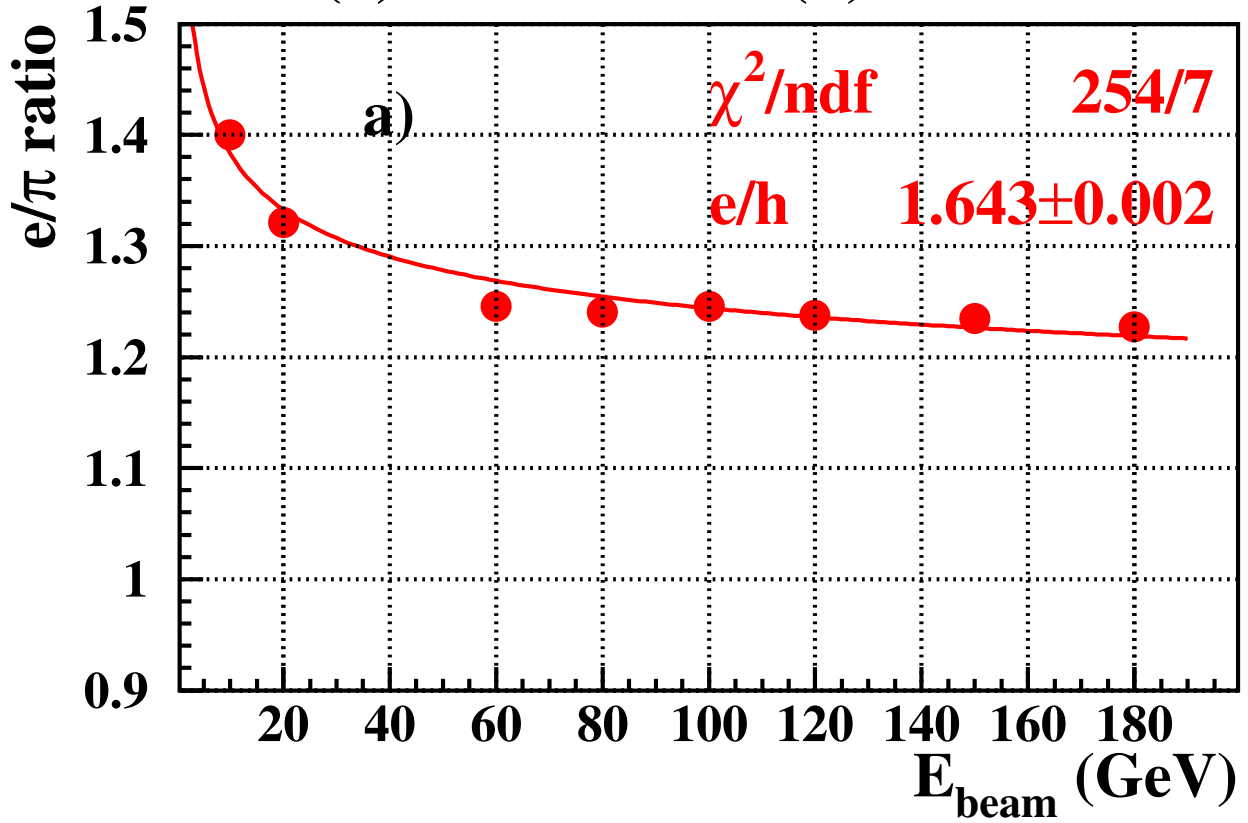
Pions, noise subtracted, points G, J, K



Pions, noise subtracted, point J



Row (a) & corrected (b) e/ π ratio



Muon 180 GeV

