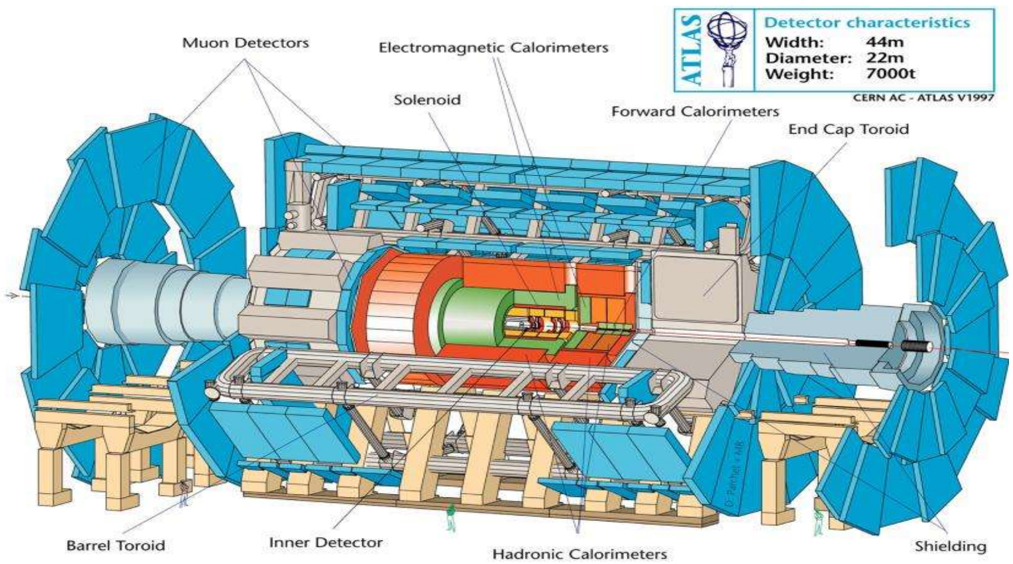
ATLAS Test Beam Analysis in Stockholm: An Overview

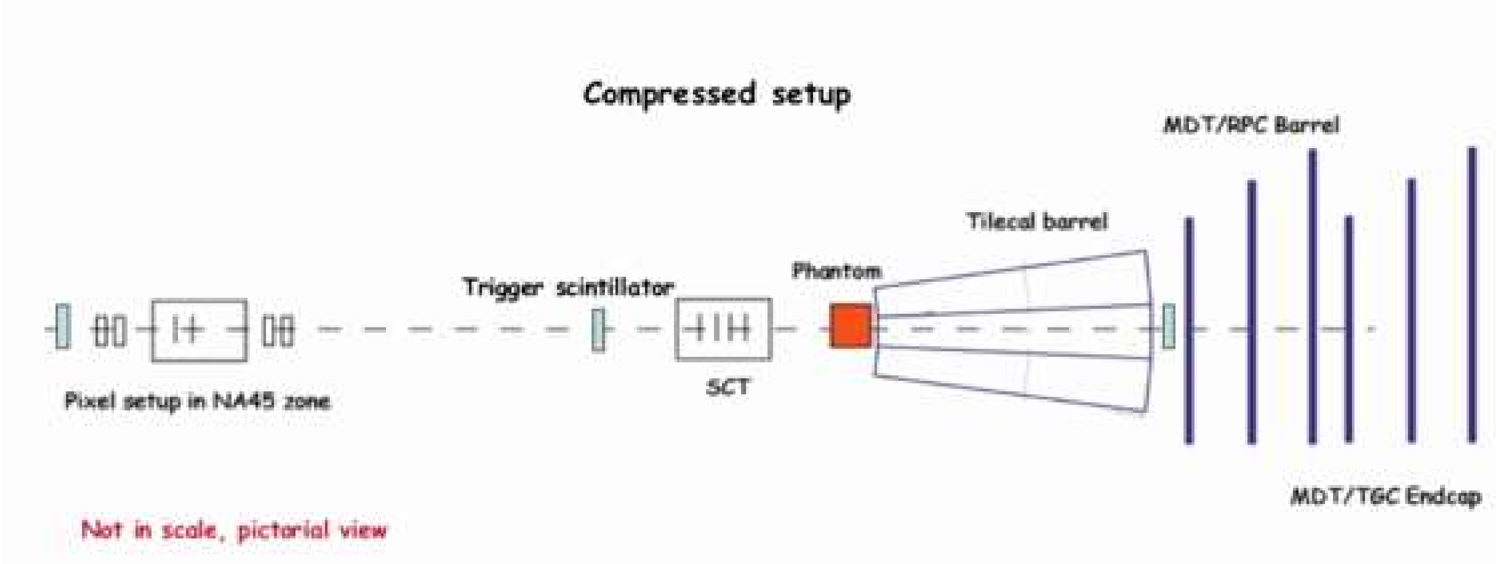
Elin Bergeås, Stockholm University

- Stand-alone test beam 2003 and before
  - test beam targeted at TileCal modules only
- Combined test beam 2004
  - test beam targeted at a "slice" of ATLAS: a piece of each subdetector present



2003 stand-alone test beam

Set-up:



A paper that summarises the test beam activities 2000 - 2003 is on its way. Will be submitted to NIM (Nuclear Instruments and Methods) soon.

Very low-energy muons, 3-9 GeV – Elin Bergeås

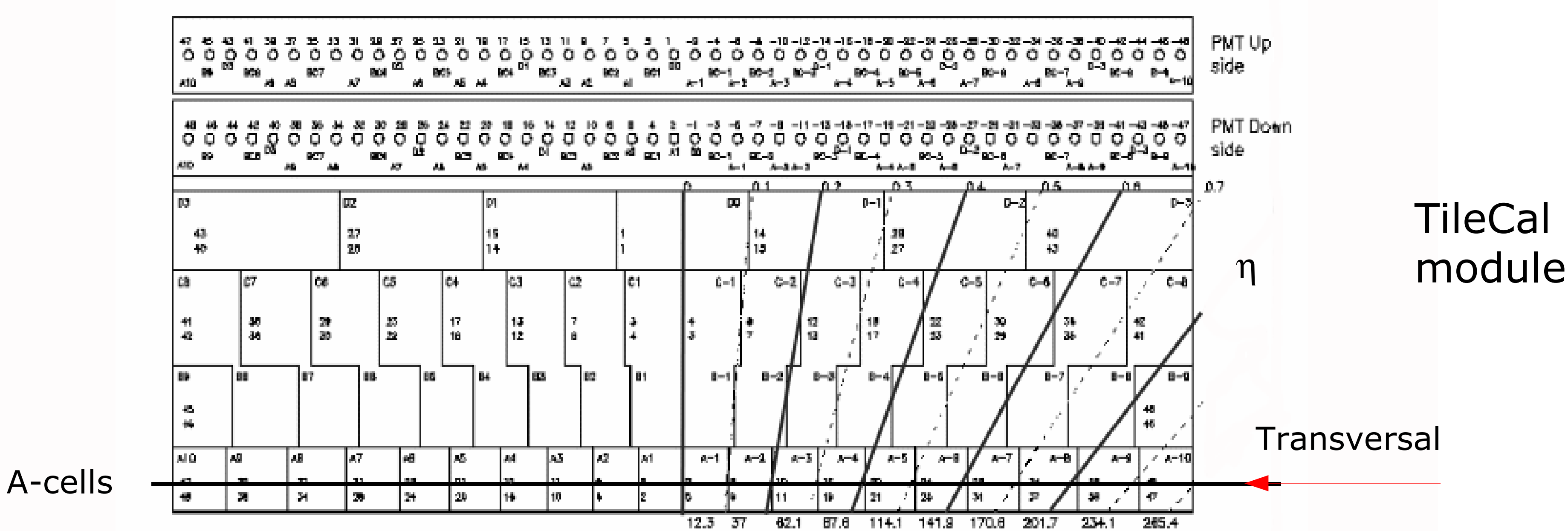
- From stand-alone test beam 2003

  Interesting questions:
- Can we separate muons from pions at this energy?
- Do simulations reproduce data correctly?

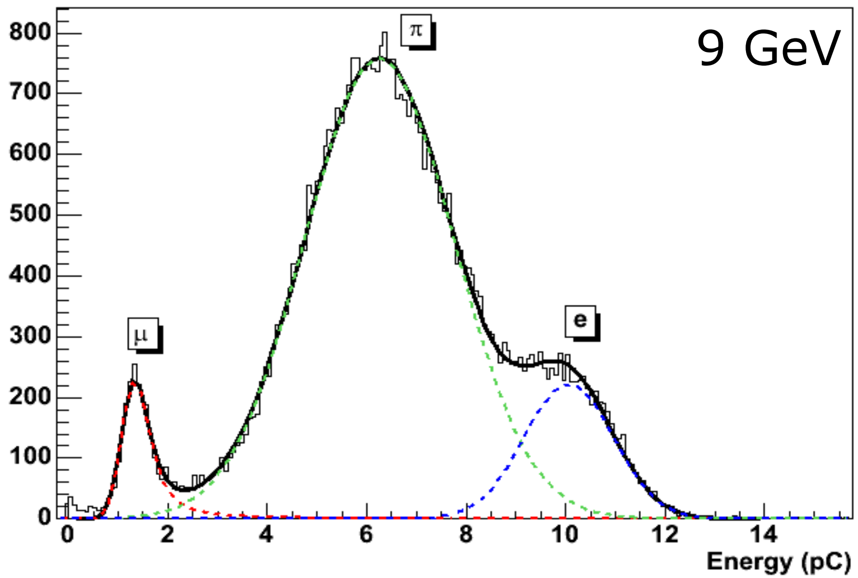
Test beam -03 data analysis

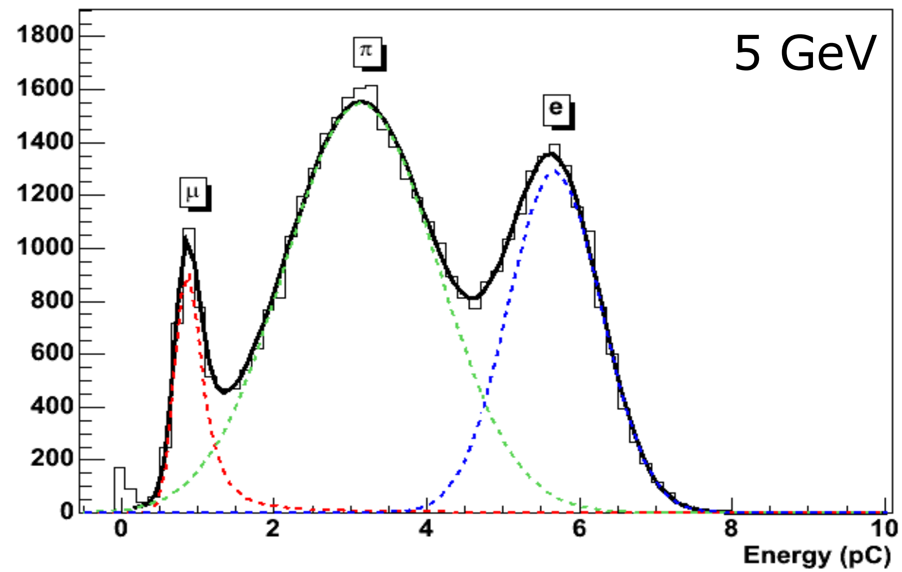
Low-energy (3-9 GeV) transversal pion beam in A-cells

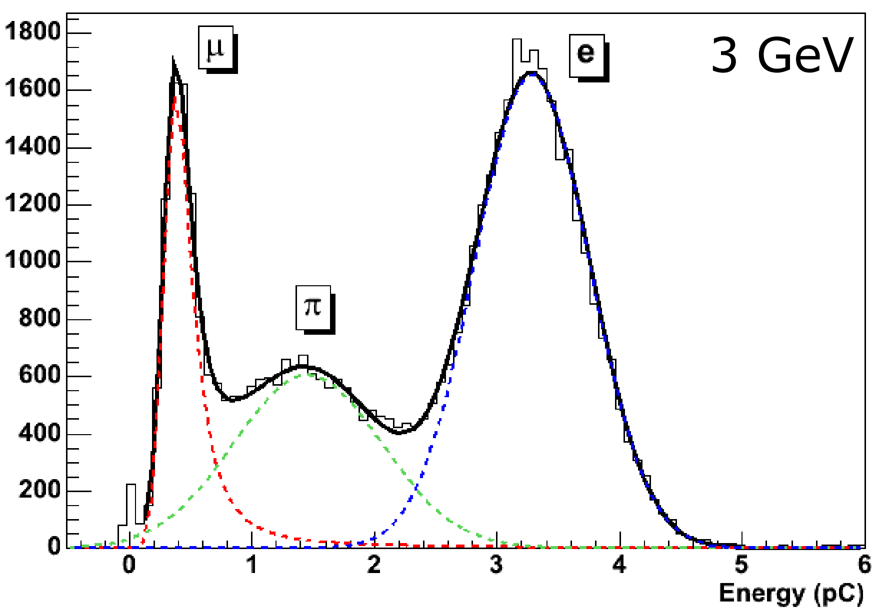
According to approximation and simulations:
9 GeV-μ should pass the module
5 GeV-μ should stop



What's in the beam? - Look at sum of energy in first cells





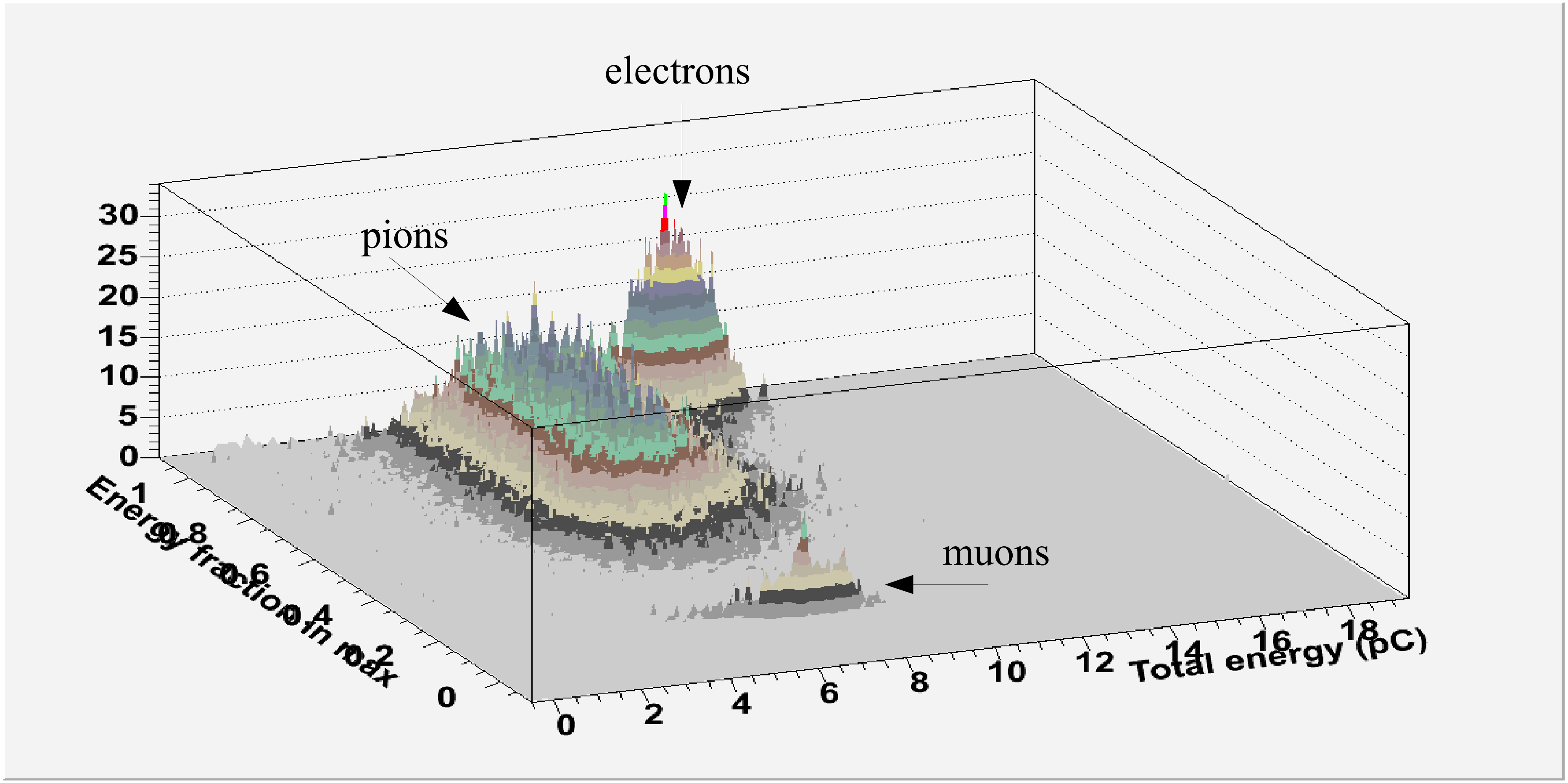


Sum of energy in first A-cells
GaussLandau + 2 Gaussians fitted to histogram

Muons, pions and electrons in beam

The μ peak also contains pions which shower late

Separate the muons - Energy scatter plot



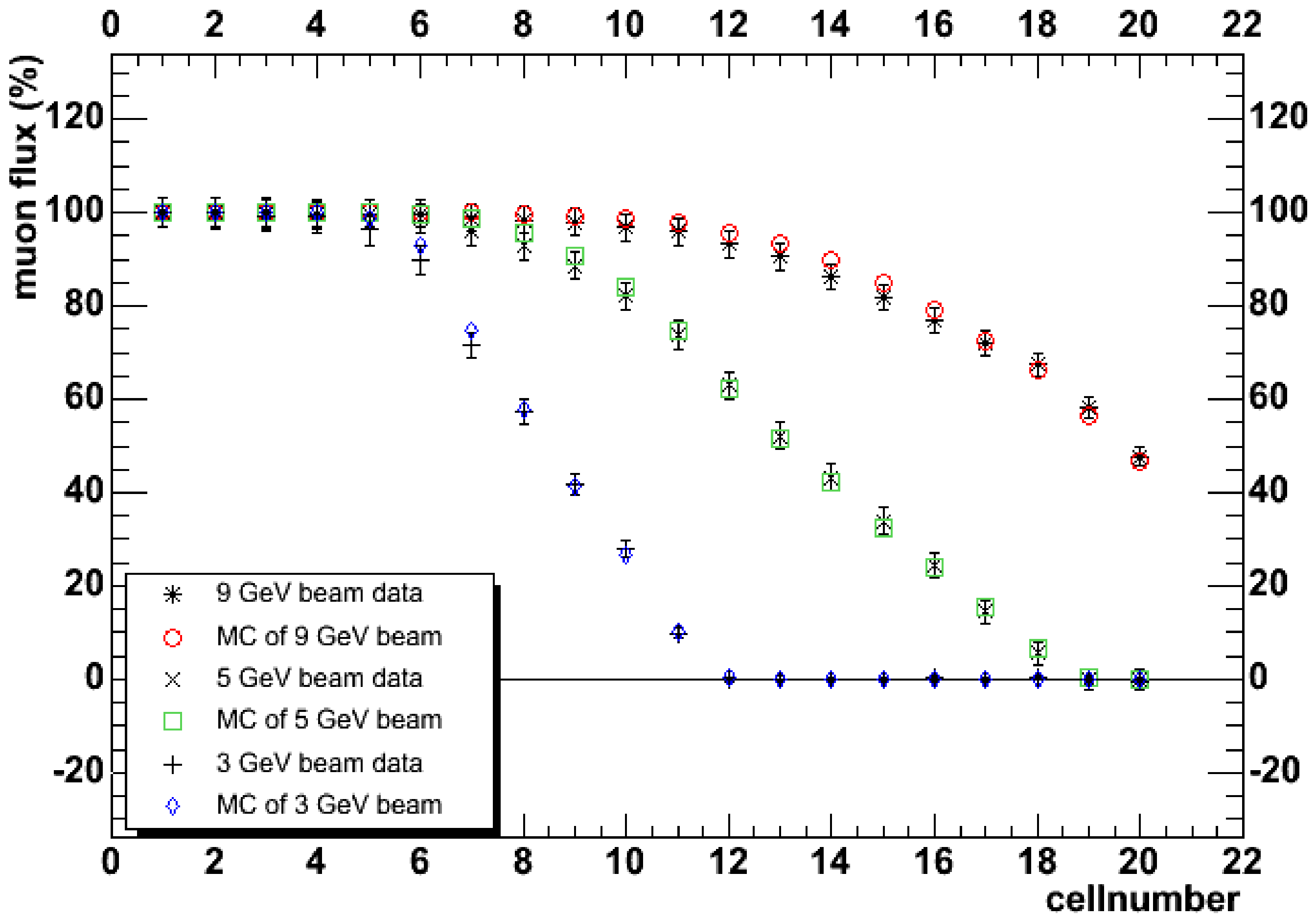
Beam energy 9 GeV.

The muons are clearly visible at the lower left corner.

Very low energy muons - Results

- pi / mu separation possible

- Data and GEANT4 simulations agree



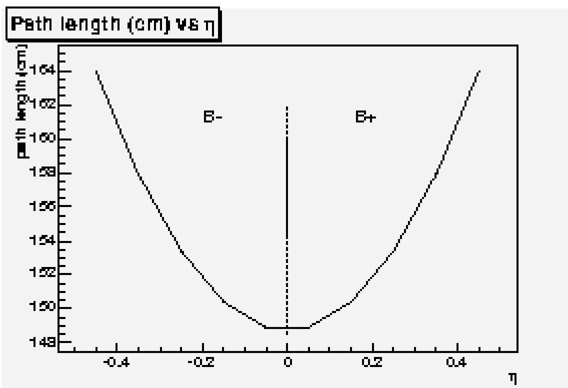
E. Bergeås, S. Hellman, K. Jon-And: *Very Low Energy Muons in ATLAS TileCal*, ATL-TILECAL-PUB-2005-001

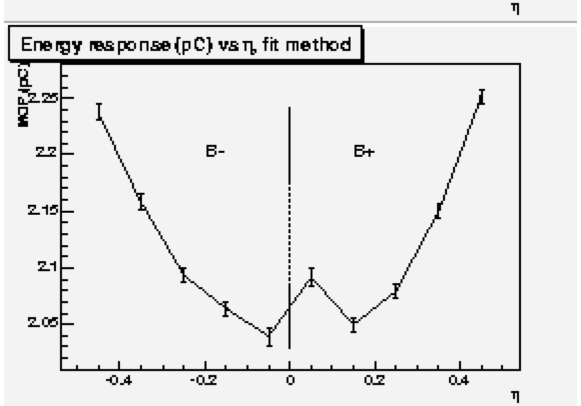
180 GeV muons - Anneli Södergren

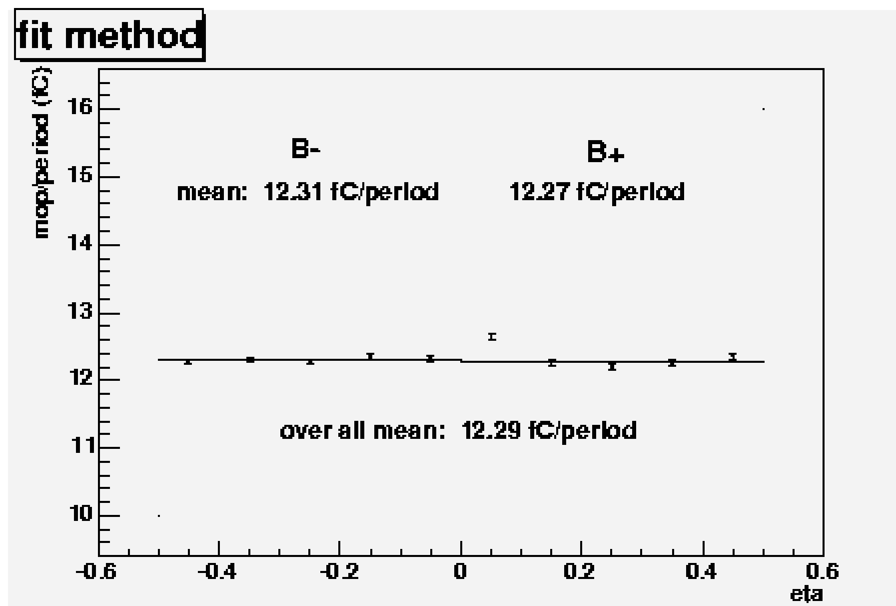
2003 TB data analysis, η and transversal beams.

Some conclusions:

- The energy response at η = +0.05 is too high (reported from other barrels modules as well)
- Uniform response
- The results are consistent with previous analyses.

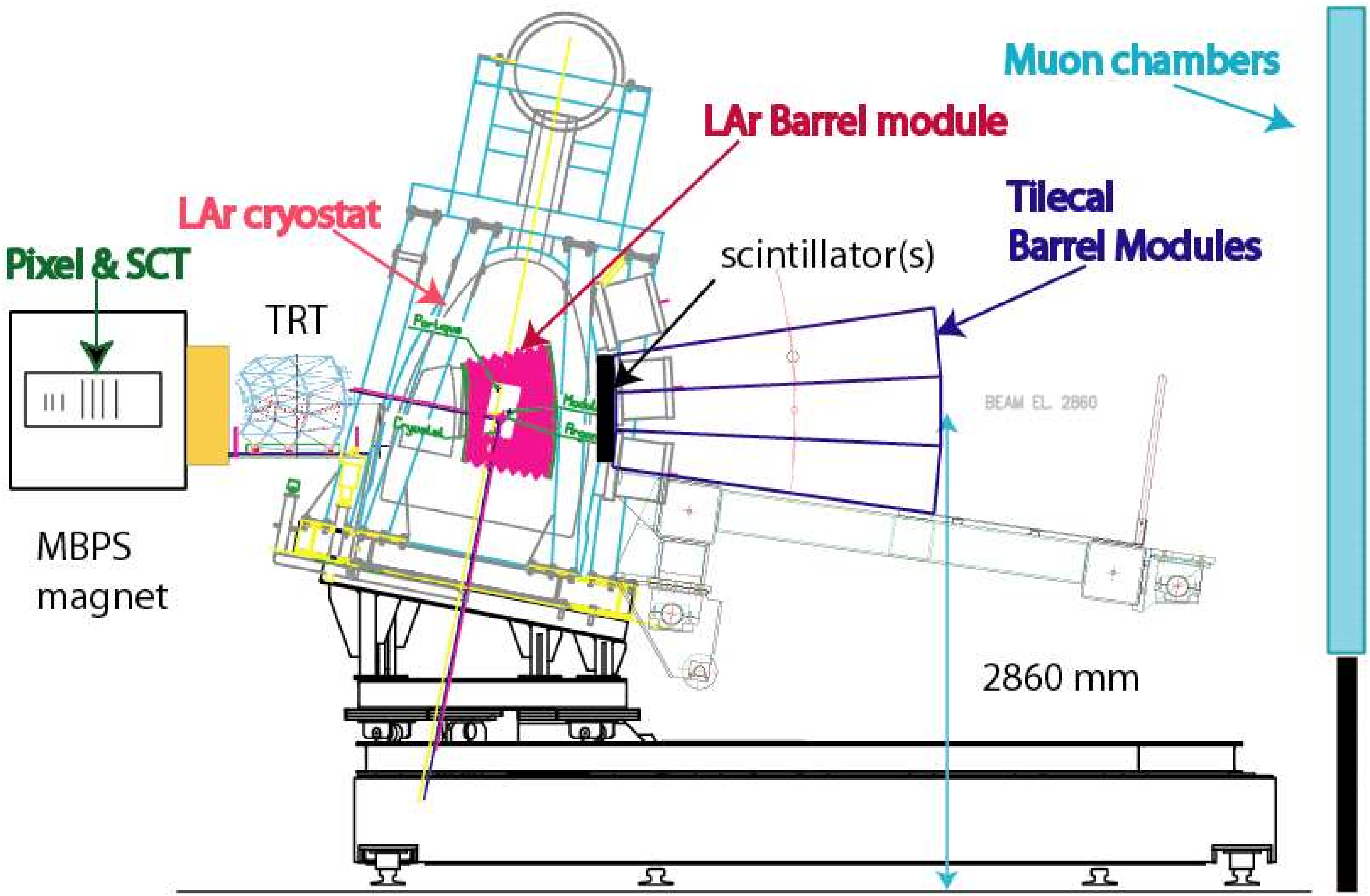






Anneli's diploma thesis:
`/afs/physto.se/home/a/annsod/public/`

2004 combined test beam setup



Pions from combined test beam-04 – Per Johansson

Combined test beam, but data from TileCal only

- Select pions which give a mip signal i EM calorimeter
- We must understand each part separately first

Interesting calorimeter properties to study:

- Energy resolution (σ / E)
- Linearity (E / E_{beam} for various energies)
- e / h ratio

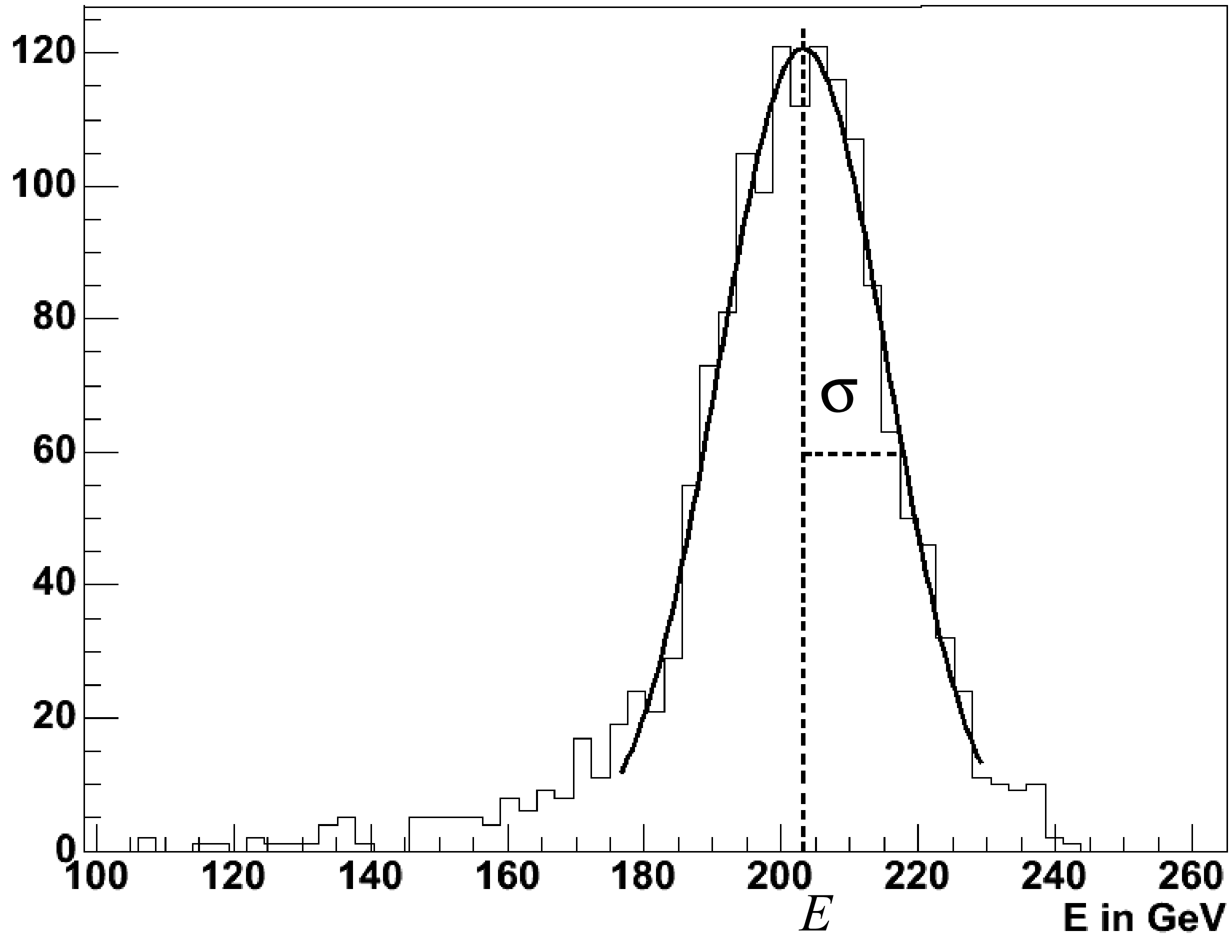
Energy resolution

For a calorimeter, the resolution σ / E is given by the formula

$$\frac{\sigma}{E} = \frac{a}{\sqrt{E}} \oplus b \oplus \frac{c}{E}$$

where σ is the standard deviation and a, b, c parameters

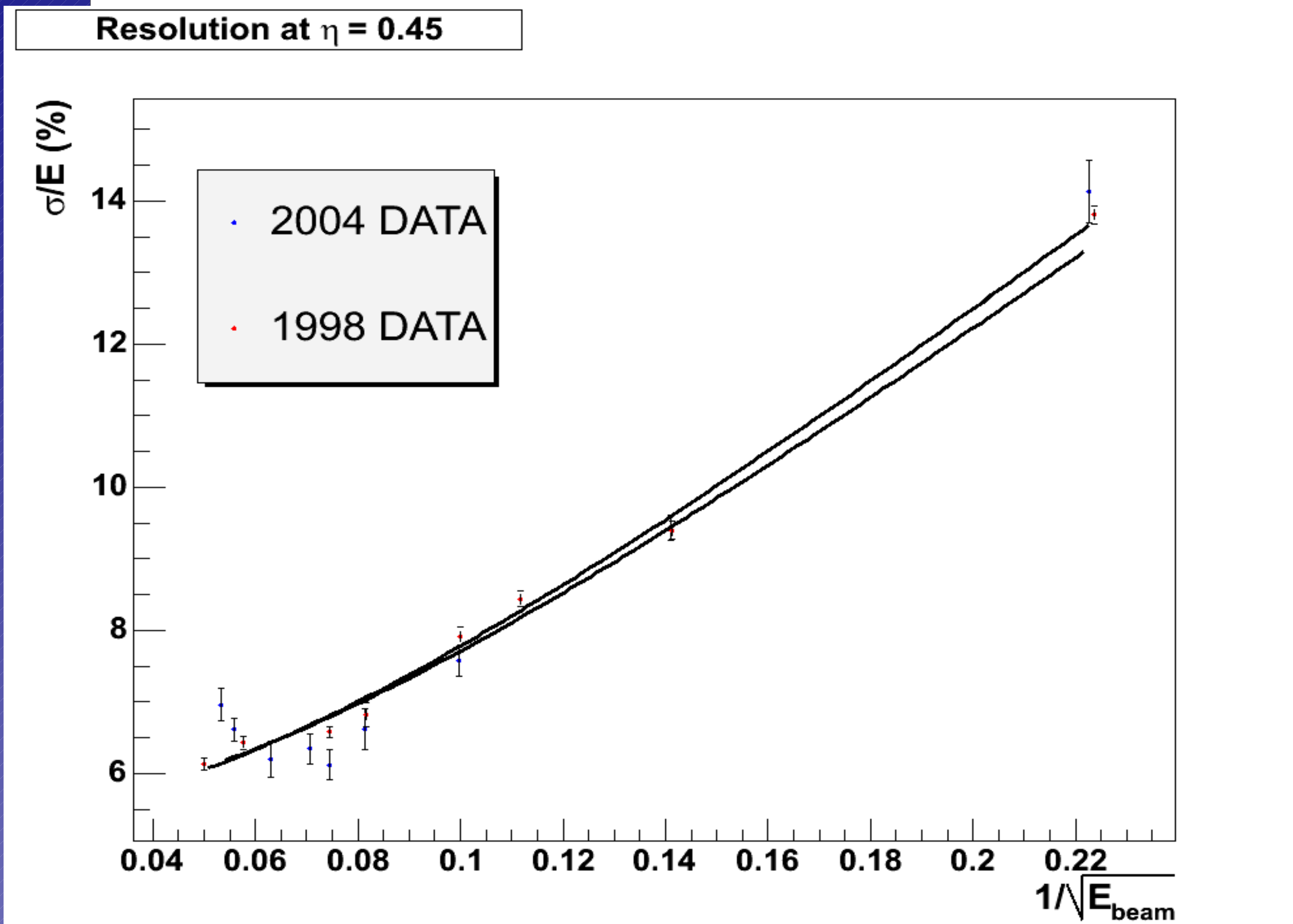
(The figure shows the energy depo-sition of pions in TileCal, beam energy 250 GeV, from 2004 data)



Energy resolution (2) - Per Johansson

$$\frac{\sigma}{E} = \frac{a}{\sqrt{E}} \oplus b \oplus \frac{c}{E}$$ for various η.

Per's analysis of -04 data (blue) compared with -98 data (red)



1998:

$a = 56.5 \pm 0.7 \quad b = 5.4 \pm 0.1$

2004:

$a = 54.8 \pm 0.7 \quad b = 5.4 \pm 0.1$

$c = 0.06$

Combined and stand-alone test beam data seem compatible. a, b within expected intervals

Linearity - Per Johansson

Linearity, E / E_{beam}

Per's analysis of

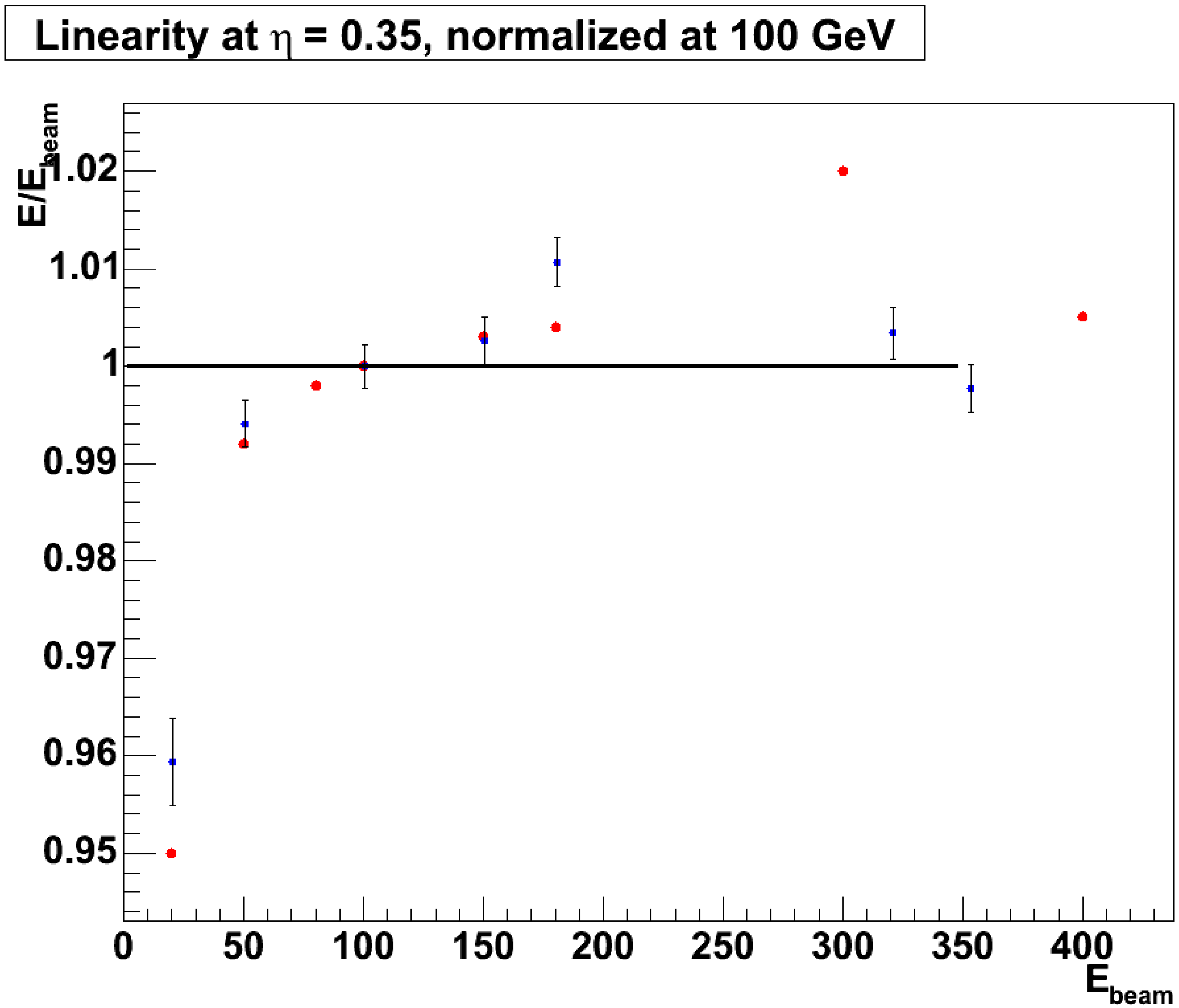
-04 data (blue)

compared with

-98 data (red)

Conclusion:

Linearity seems OK



Pions from stand-alone test beam: e/h ratio

Definition: Given constant E_{beam}, $\frac{e}{h} \equiv \frac{\text{deposited electron energy}}{\text{deposited hadron energy}}$

What is the *e*/*h* ratio for the calorimeter?

Examples from NIM paper (test beam -96 and -99)

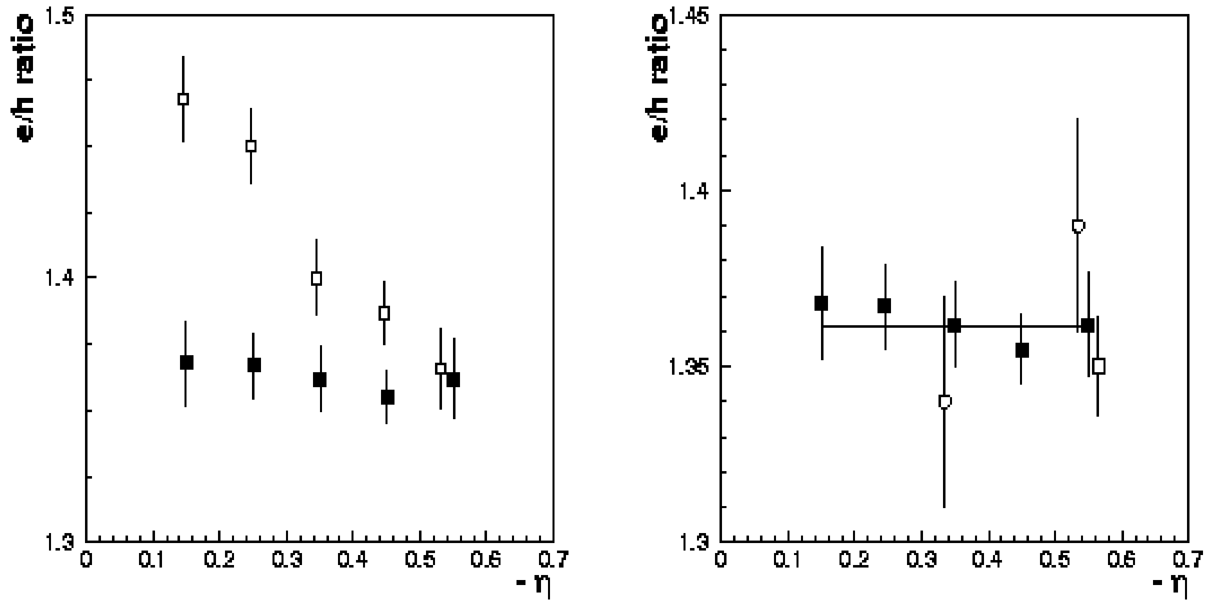


Fig. 11. The e/h ratios as a function of η. Left: The values with the energy leakage corrections (black boxes) and without ones (open boxes). Right: The values for the Module0 at 1999 (black boxes), Module0 at 1996 (open boxes) and 1 m prototype modules (circles).

Test beam analysis future in Stockholm

- Analysis of combined test beam data, using weighting techniques (EM calorimeter + TileCal energy)
- Hadron calibration