Status of the AHCAL Papers and ongoing analysis

(DESY / Uni HH)

AHCAL main meeting, Dec 2011

Ongoing AHCAL analysis activities

5 papers in progress:

- muon calibration → Frank talk
- energy weighting → Frank talk
→ - pion response @ medium/high energy (Beni/Alex/Ivan)
→ - pion response @ medium/low energy (Nils)
- track multiplicity → Frank talk

Papers in the pipeline:

- correction of shower leakage (Ivan)
  analysis finished and documented in CAN029

Ongoing analysis at DESY:

→ - multi-particle separation with PandoraPFA (Sergey)
→ - combined response ScECAL+AHCAL+TCMT (Boris)

Upcoming Papers

1) CERN 2007: pions 8 GeV to 80 GeV in the AHCAL (only track in the ECAL) $\Rightarrow$ update of CAN26/Alex Kaplan PhD Thesis.

2) FNAL 08/09: pions 2 GeV to 30 GeV, no ECAL $\Rightarrow$ based on CAN34/Nils Feege PhD Thesis.

▶ Drafts of the **text ready**.

▶ **To do**: **re-run** both analysis, using the same software (**official**):
- data with newest steering;
- re-run MC (recently discovered Mokka bugs).

▶ Move to **Geant4.4.p02**.

▶ **Same analysis** (selection) as much as possible.

Content

▶ **Common** observables for data/MC comparison:

- energy response;
- interaction length (only CERN);
- longitudinal development;
- radial development;
- MC decomposition (e^+, e^-, protons, mesons).

▶ Additionally for FNAL paper:

- **combined plots** with CERN;
- zoom on the low-energy **transition regions** of physics lists to disentangle models (e.g. BERT vs BIC) $\Rightarrow$ possibly motivate differences.

▶ Improve systematics: new **saturation** studies (Marco).

Content: Longitudinal Profiles

▶ Decision to move to profiles **relative to AHCAL front face**
(rather than shower starting point):
- low efficiency at low energies in finding shower starting point;
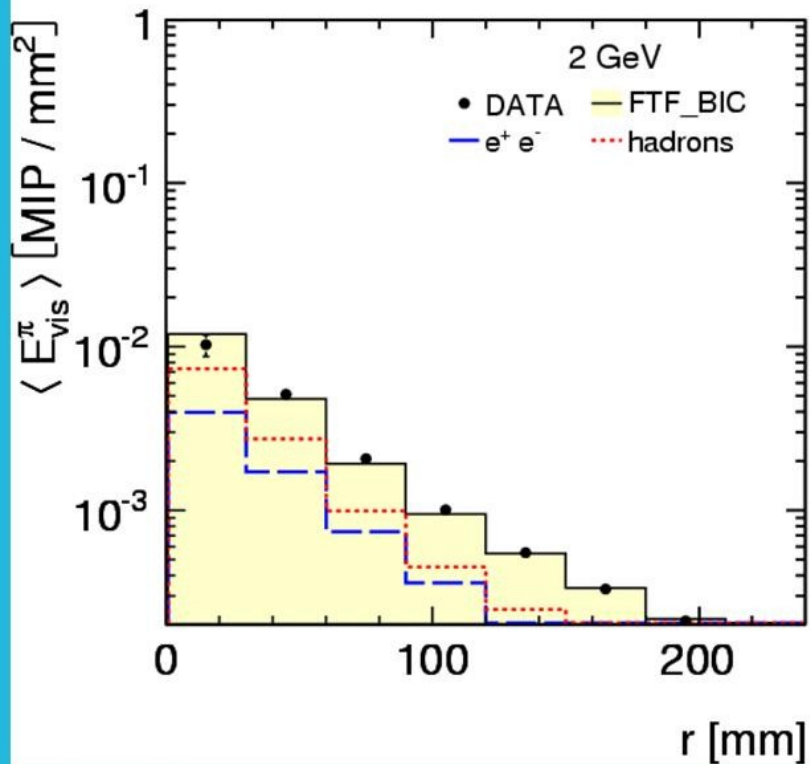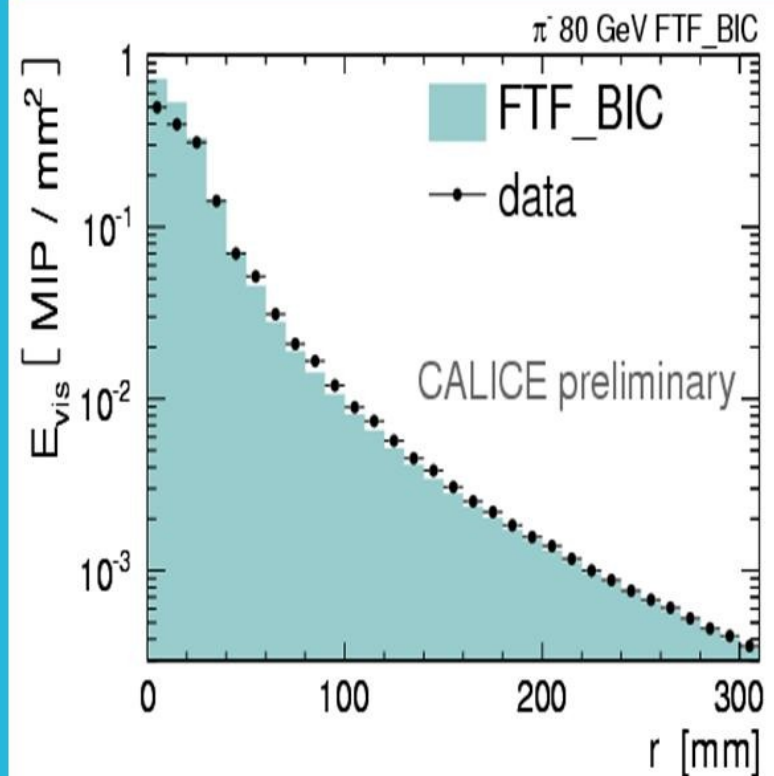- independent from first hard interaction-finder algorithm.
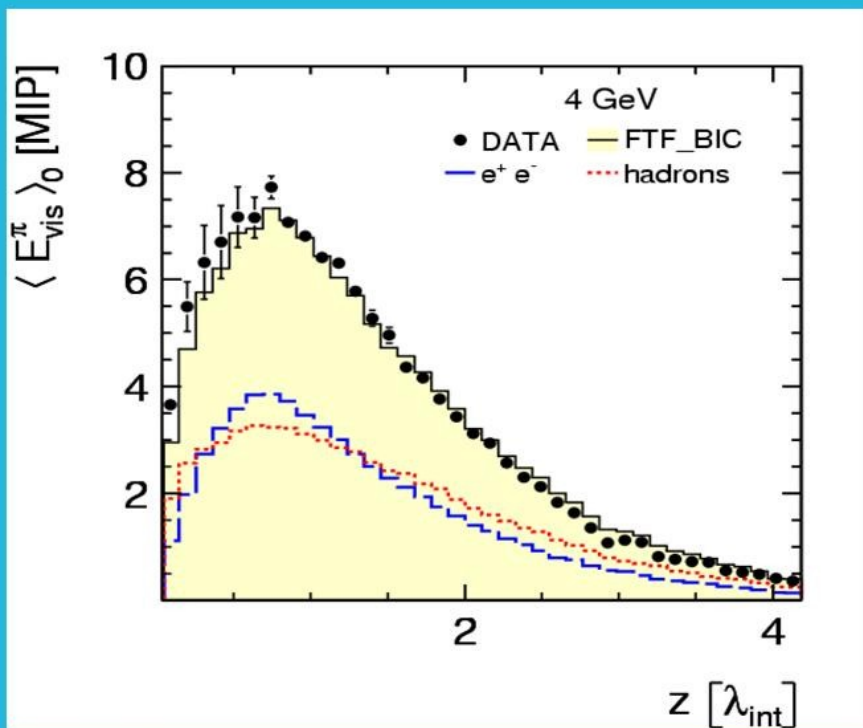
FNAL
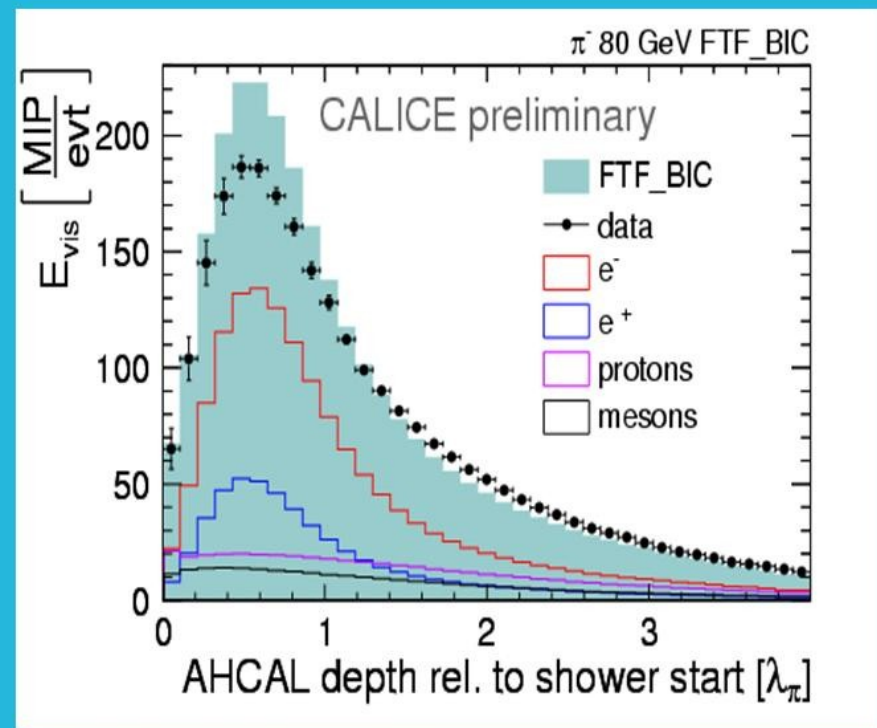
CERN/CAN26: change

Content: Radial Profiles

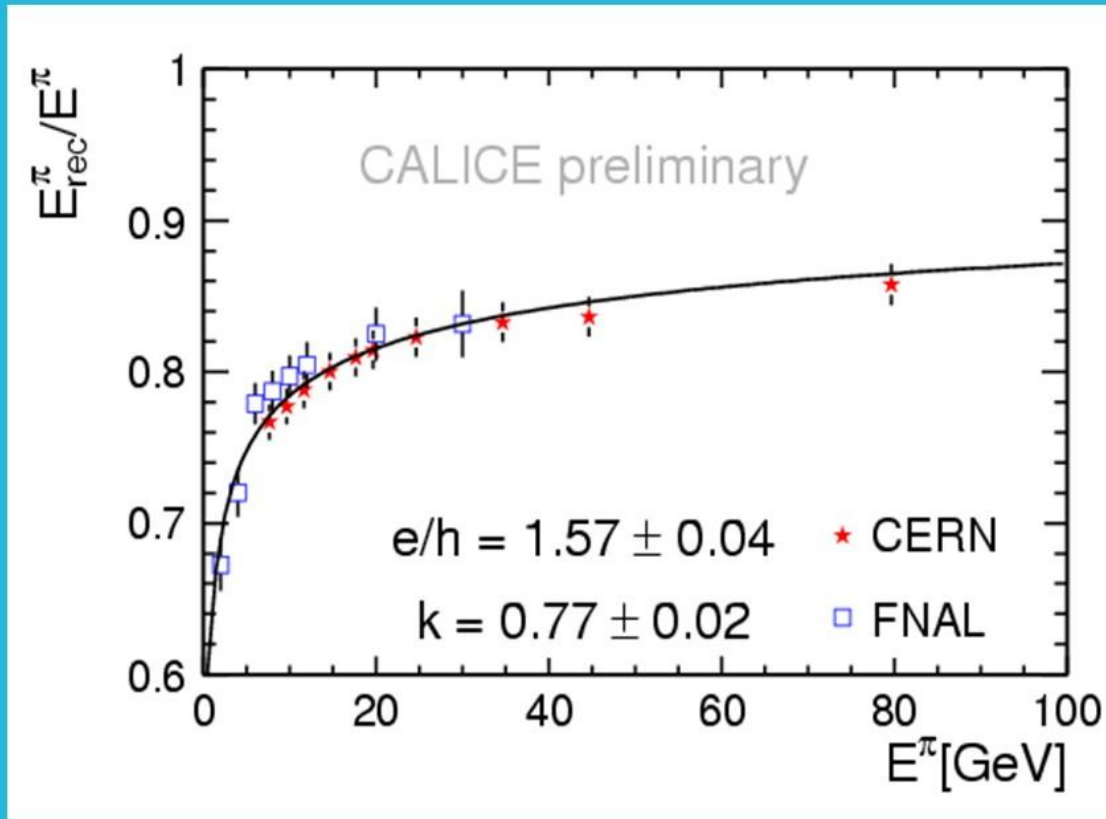▶ Move to **common** definitions and choice of the **binning**.

FNAL

CERN

Content: Energy Response

▶ Preliminary **cross-check** between two analysis (**before** common **re-running**) already encouraging.
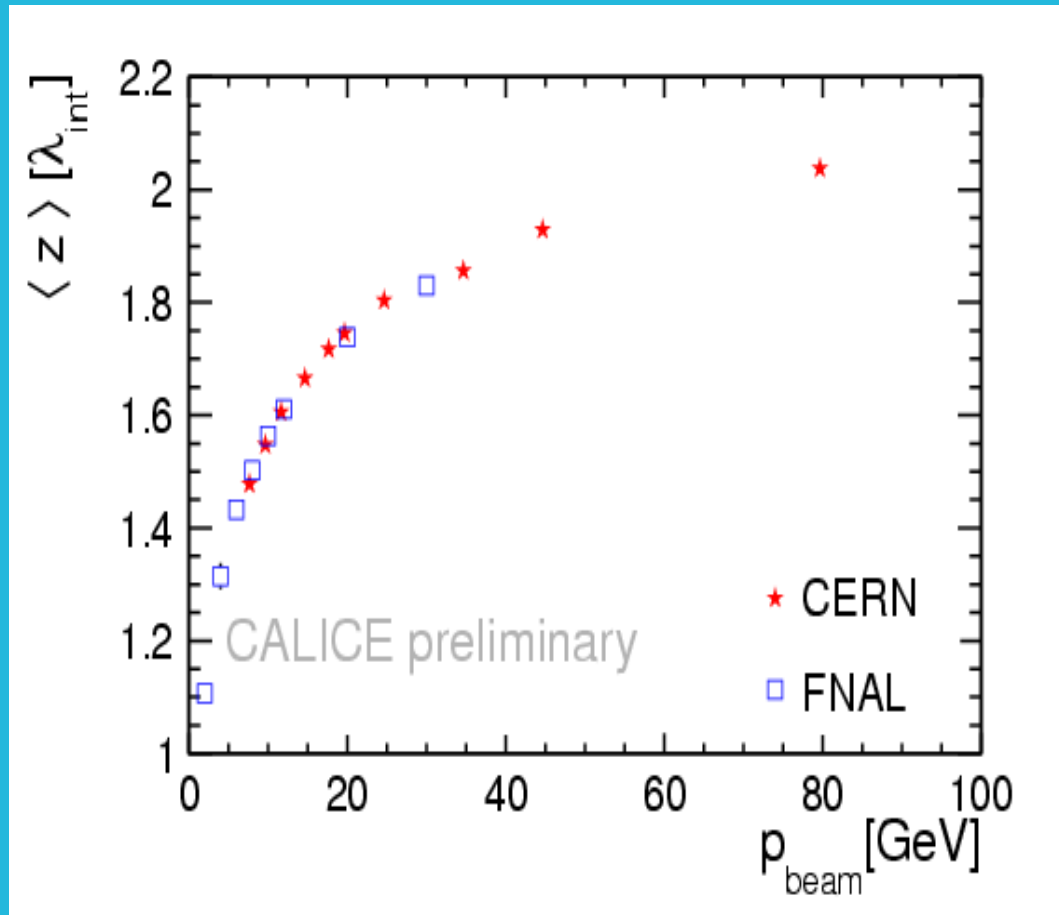

Combined fit π/e

▶ Fit to π/e energy dependence.

▶ CERN: subtract MIP in ECAL for direct comparison with FNAL.

▶ π response calibrated to the electromagnetic scale.

Further Cross-Check

CALICE preliminary

Mean-depth (longitudinal)

▶ Mean longitudinal shower depth.

▶ CERN: old analysis re-run for profiles **relative to the HCAL front face**.

▶ Good agreement.

Multi-particle separation
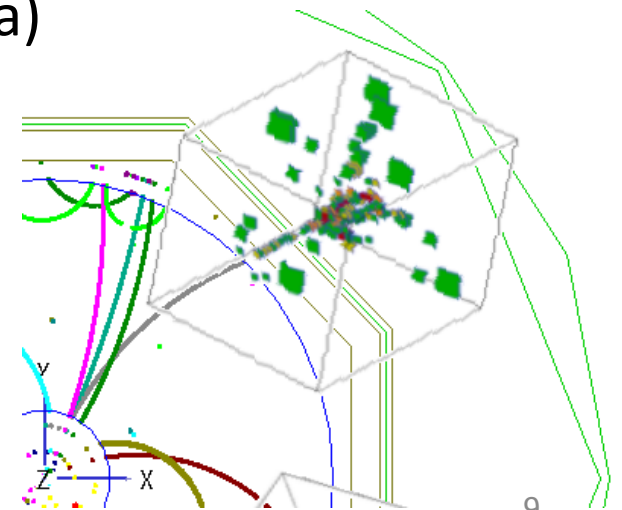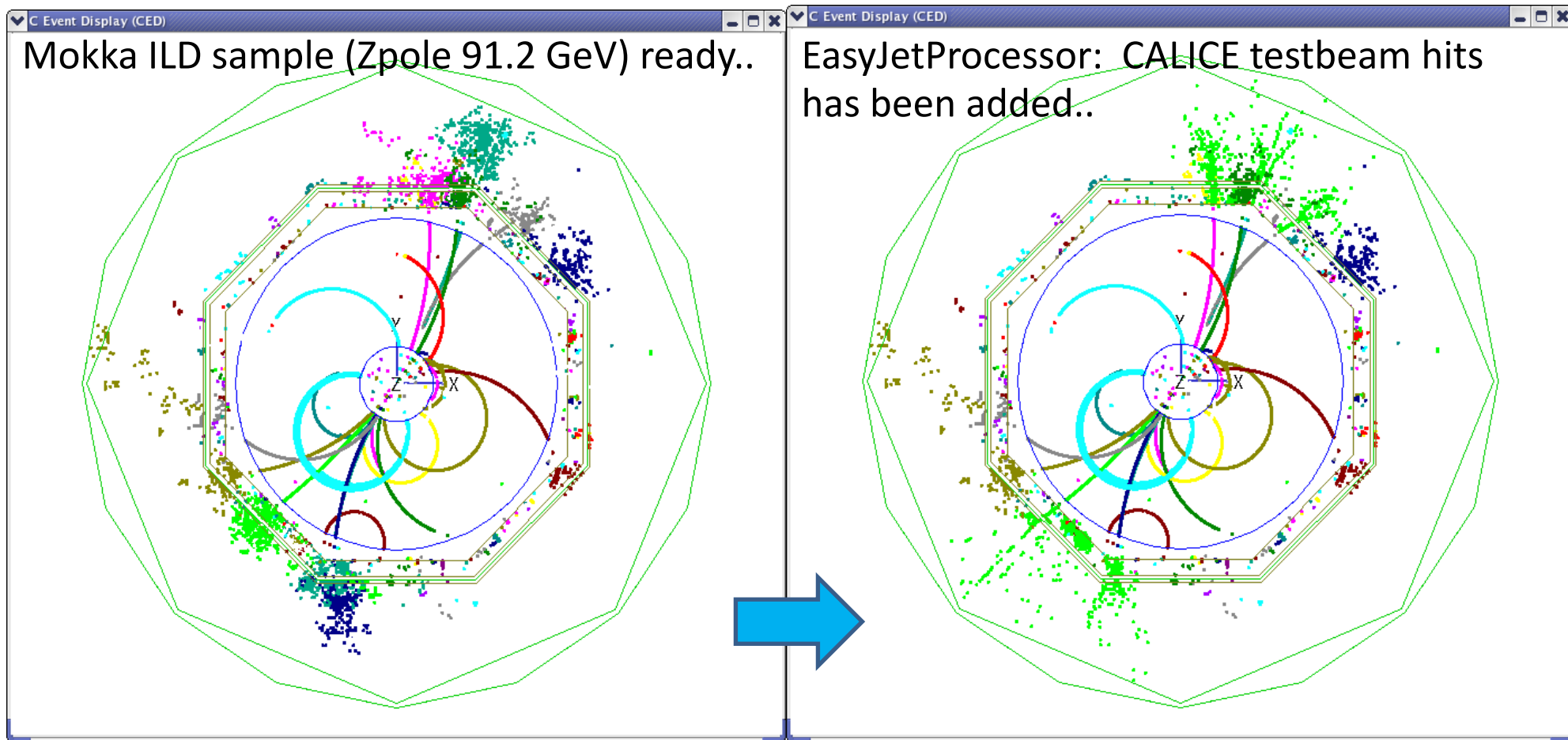
- **Substitute CALICE test beam events in a simulated ILD jet**
- **Use PandoraPFA to reconstruct the jet**
- **Compare PandoraPFA performance on true MC and MC+CALICE**

Need to develop a new tool: EasyJetProcessor.cc

- Input collections from Mokka ILD geometry
- Identify candidate particles to be replace by CALICE events
- Use CALICEOverlayPreparation Processor (Marina)

- Replace ILD ECAL with CALICE ECAL

(10x 1.4mm + 10x 2.8mm + 10x of 4.2 mm W,
   10x10mm^2 Si-cells)

Sergey Morozov (DESY)

Multi-particle separation

Mokka ILD sample (Zpole 91.2 GeV) ready..

EasyJetProcessor: CALICE testbeam hits has been added..
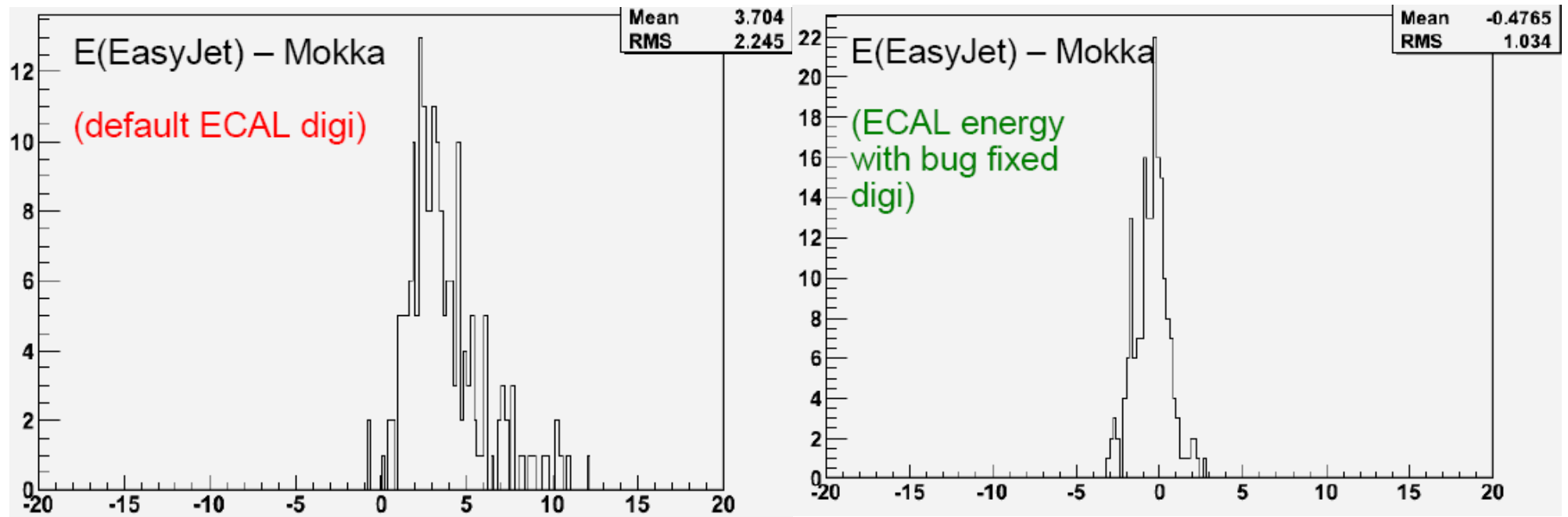
Sergey Morozov (DESY)

Multi-particle separation

Encountered obstacles

- Memory leak found in AHCAL geometry (Mokka)
  - ➜ Possibly small effect but present in all analyses

- MIP/GeV conversion factor for ECAL
  - ➜ Wrong/old number ~10% off

- Missing or wrong link to EmcCellParameters

➜ Long debugging for combined runs

Sergey Morozov (DESY)
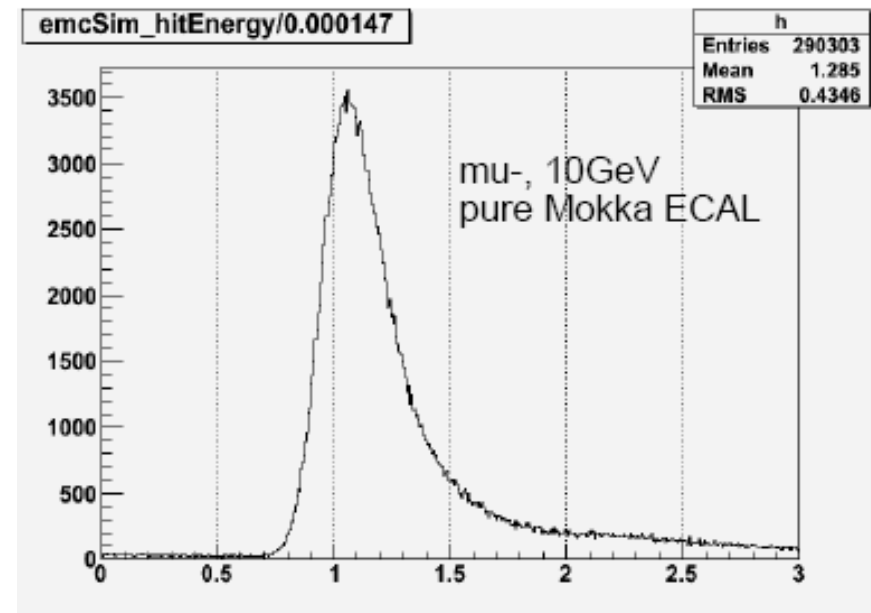
Multi-particle separation

- **Reasonable cluster energy in ECAL after bug fixing**

All tools available …

　　　　　　　　　 … analysis in progress

Sergey Morozov (DESY)

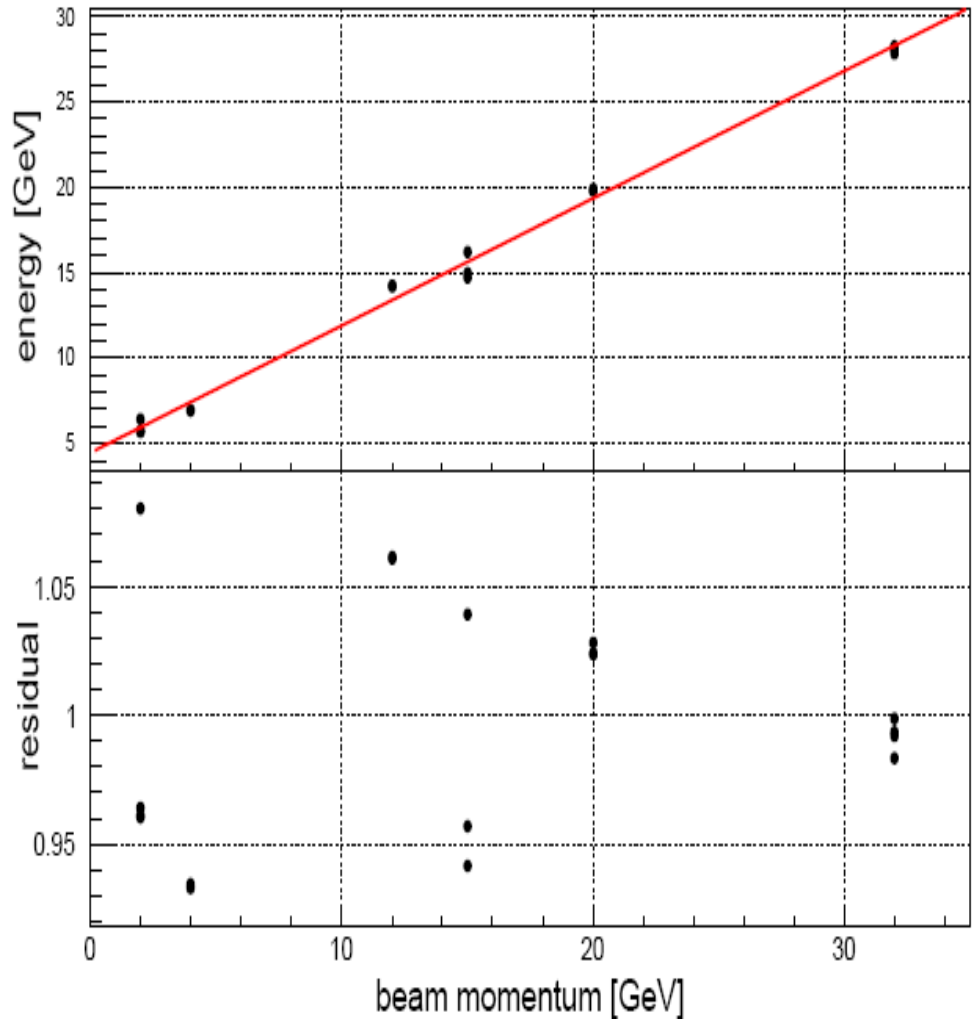# Combined response of ScECAL+AHCAL

First analysis combining ScECAL, AHCAL and TCMT

- Large part of the code still under development
- Preliminary calibration
- First step: **constant** weights determination

Boris Bulanek (Charles Uni., Prague)
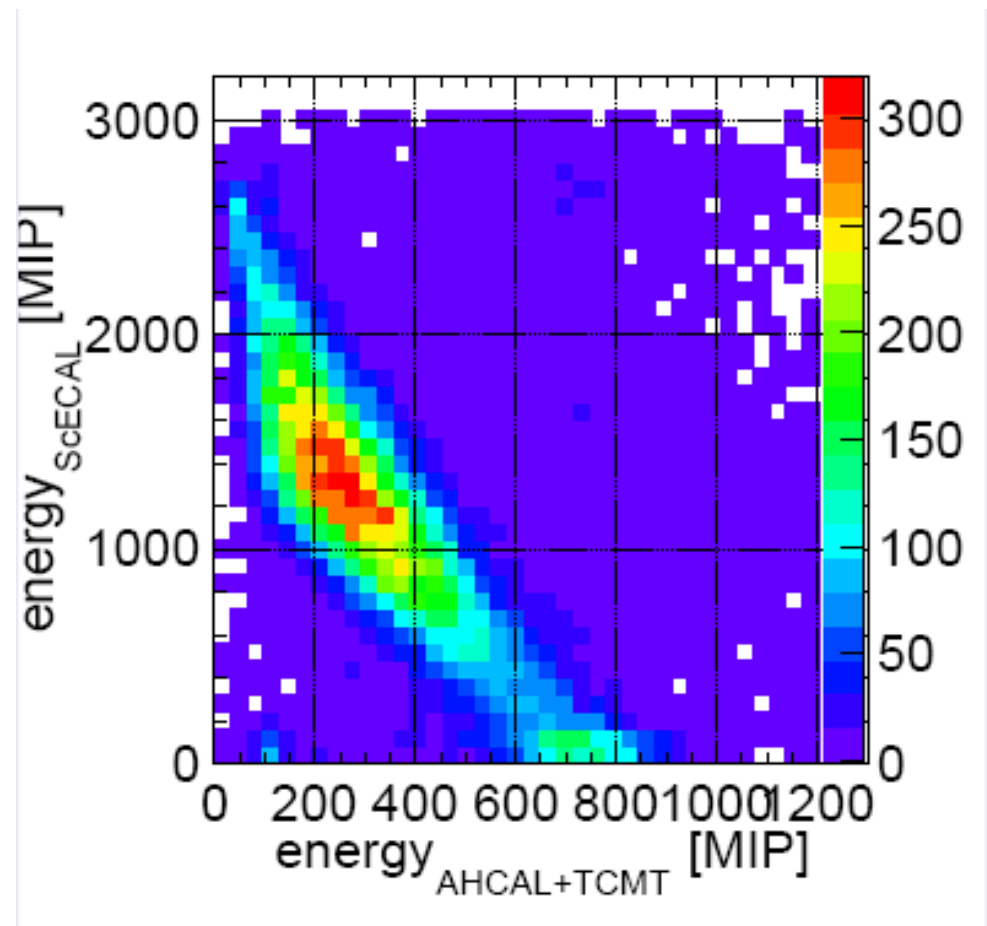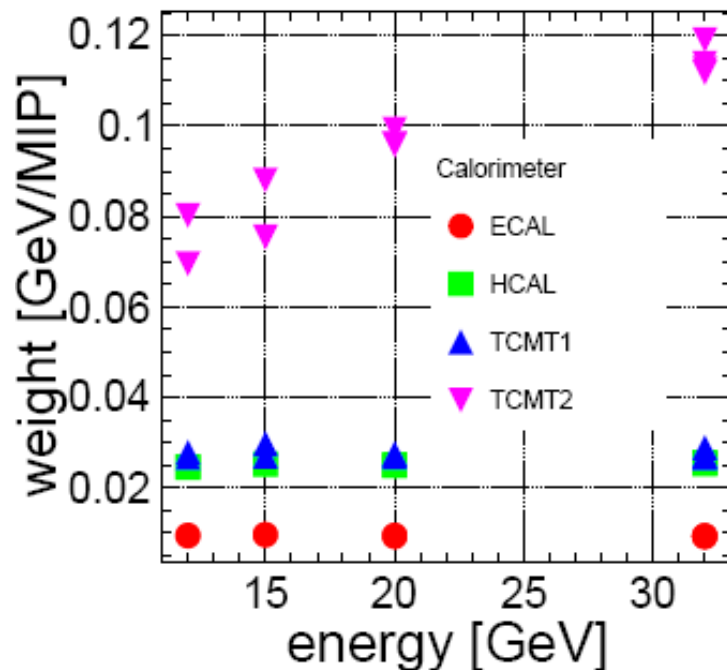
Combined response of ScECAL+AHCAL

VERY Preliminary

- Using energy independent constant weights for ScECAL, AHCAL and TCMT1 (in agreement with CAN029)
- Energy dependent constant weight for TCMT2

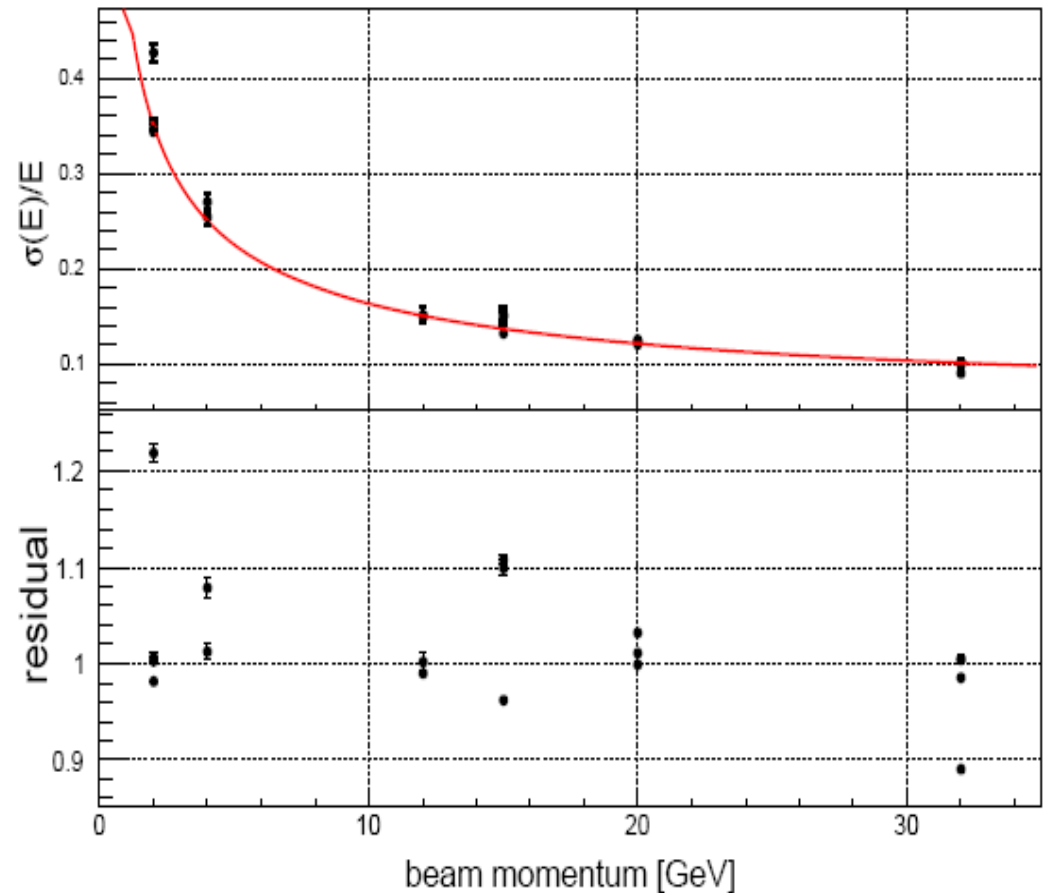➜ Current calibration accuracy ~5%

Combined response of ScECAL+AHCAL

VERY Preliminary

Linearity and resolution for electrons in ScECAL cross-checked against [CAN016] results:

a = (14 ± 0.1)% √GeV [(14.80 ± 0.04)%]
b = (2.20±0.04)%   [(1.59 ± 0.03)%]
c = (0±0.3) GeV

- $\sigma(E)/E = (a/\sqrt{E} \oplus b \oplus c/E)$
- $a = (49 \pm 5)\% \cdot \sqrt{GeV}$ $b = (0 \pm 8)\%$ $c = (0 \pm 0.3) \cdot GeV$

Boris Bulanek (Charles Uni., Prague)

Conclusion

- Ivan and Nils (after his defense) will focus on the AHCAL pion papers
- Expected drafts to the reviewing committee by February

- Leakage paper in the pipeline (CAN29)

- Two additional analysis on Fe-AHCAL data ongoing

- **Still quite some analysis topics open for newcomers:**
  - leakage shower correction ➔ implementation in PandoraPFA
  - hadronic shower development with combined calorimeters
  - proton / pion analysis
  - comparison analog / digital HCAL performance

backup

Linearity and resolution of electrons
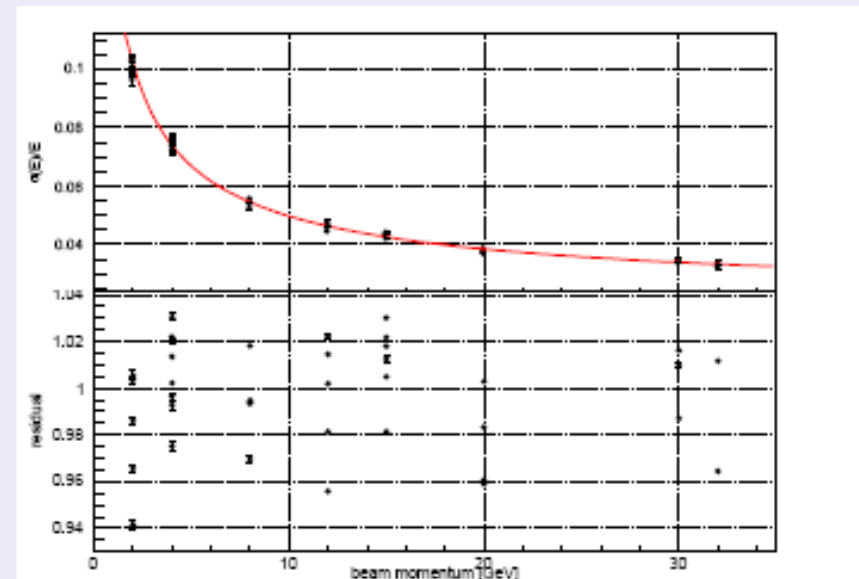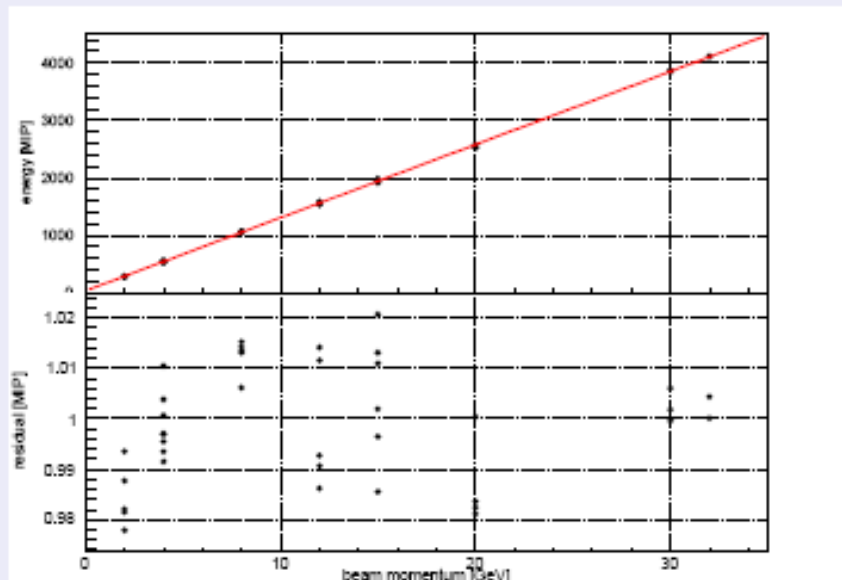
- $a + bx$
- $a = (127.50 \pm 0.02)$ MIP
- $b = (33.0 \pm 0.2)$ MIP/GeV
- dev. from linearity $\approx$ 1-2 (CAN-016: 6 % using a=0 MIP)%

- $\sigma(E)/E = (a/\sqrt{E} \oplus b \oplus c/E)$
- $a = (14 \pm 0.1)\% \cdot \sqrt{GeV}$ $b = (2.20 \pm 0.04)\%$ $c = (0 \pm 0.3) \cdot GeV$

- gauss fit in range $(-2\sigma + mean, 2\sigma + mean)$ from previous gauss fit using mean and rms of distribution
- CAN-016: FNAL2008, $\sigma(E)/E = (a/\sqrt{E} \oplus b)$
  - Central: $Const : (1.59 \pm 0.03)\%$ $Stoch : (14.80 \pm 0.04)\% \cdot \sqrt{GeV}$