AHCAL hadron analysis

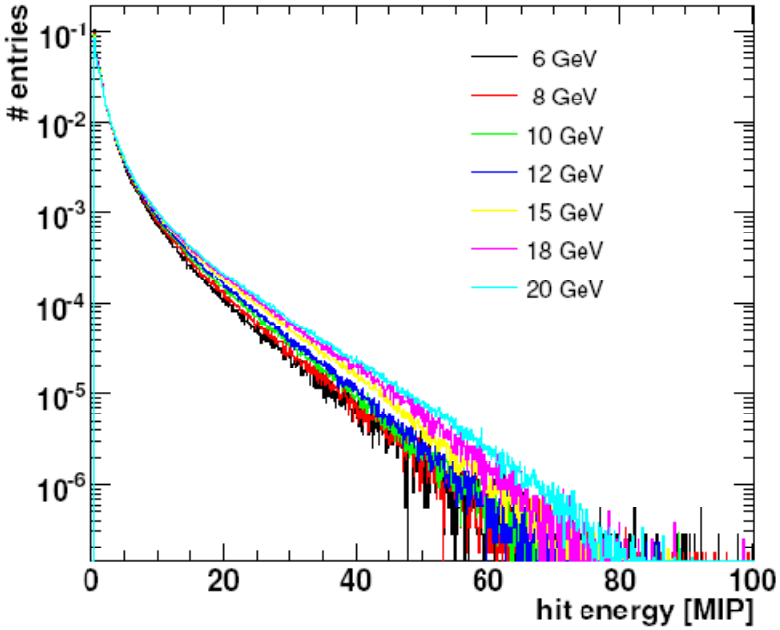
Analysis report from the independent analyses of
M. Groll and V. Morgunov

and N. D'Ascenzo

The data

see CALICE analysis meeting 30.05, M. Groll
http://nicadd.niu.edu/cdsagenda//fullAgenda.php?ida=a0725

- pion with negative polarity from 6 GeV to 20 GeV
- stable detector: runs have been collected in ∼48 h
- low hit energy: 20 GeV run 97 % of the hits are below 15 mips
- ≈3 % of the total energy is deposited by hits of energy above 15 mips

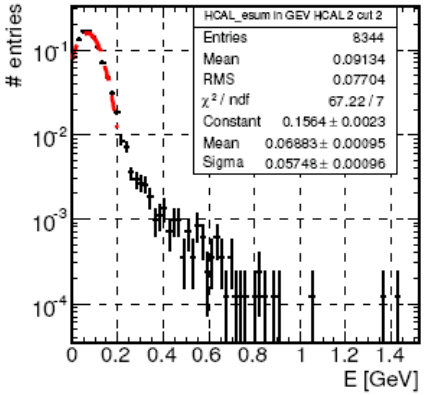


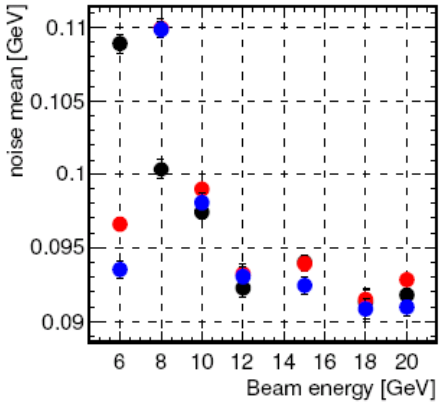
Stability checks

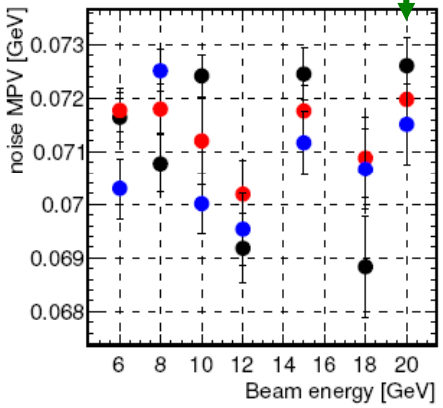
M. Groll

compare results of 3 runs at same energy

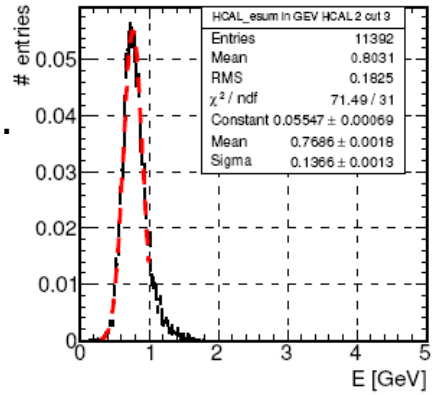
Noise stability +/- 2.5%

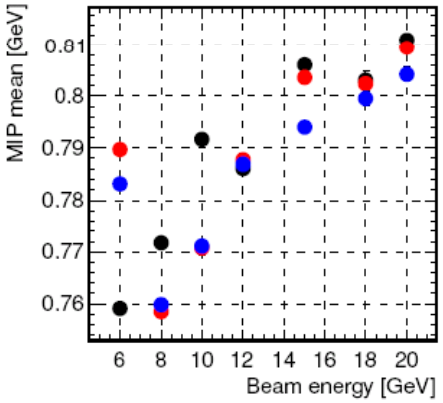


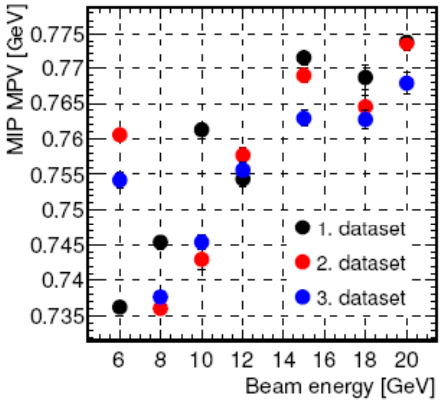




MIP calib. stability +/-2.5%

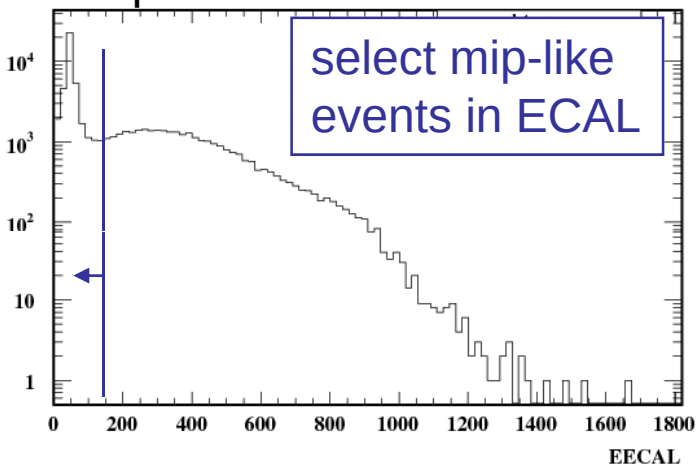




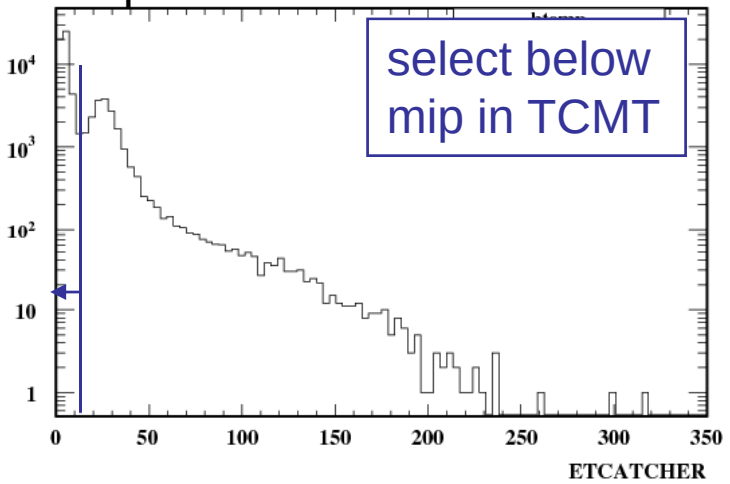


The event section

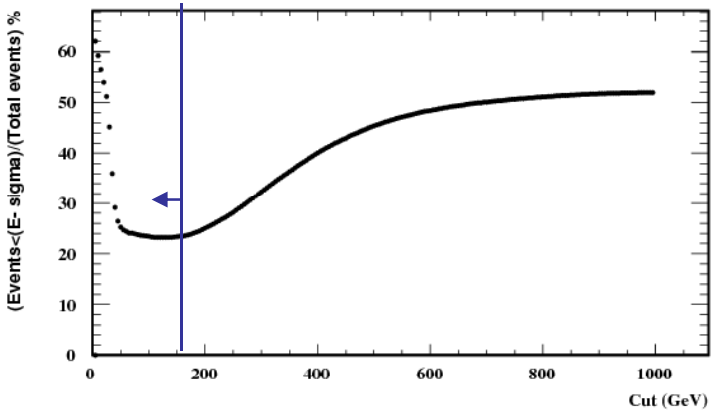
E spectrum in ECAL

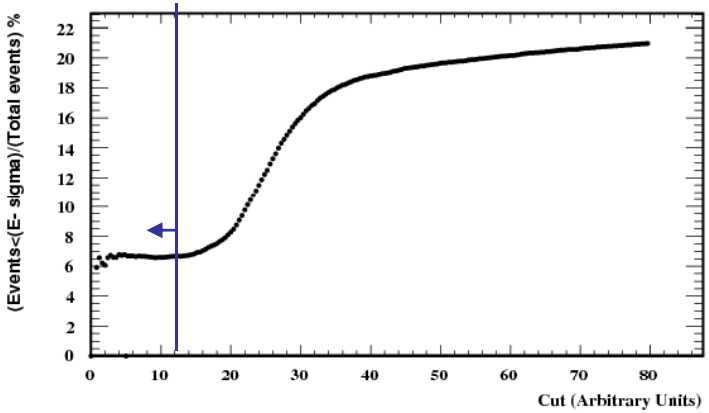


E spectrum in TCMT



Effect of cuts on HCAL contamination

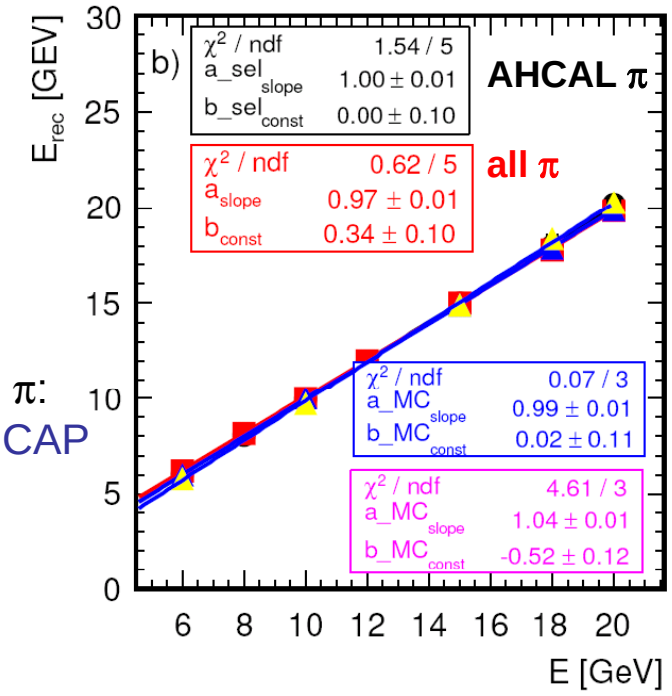


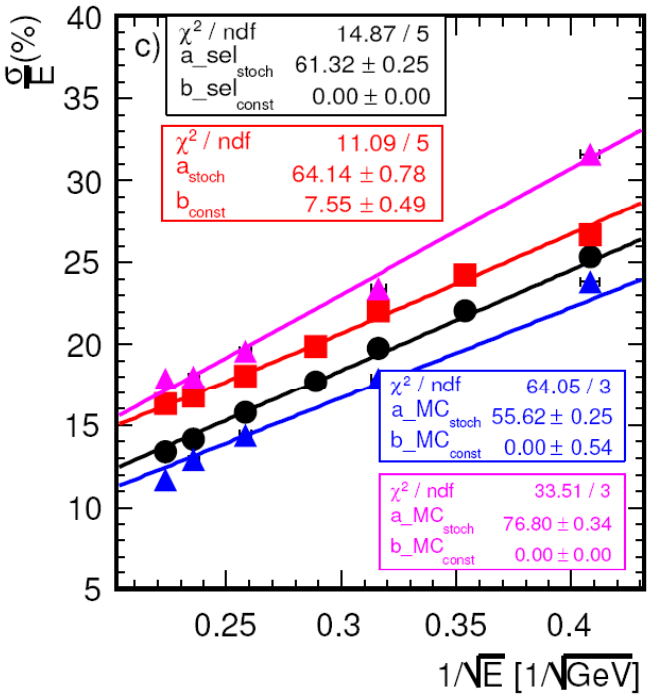


Response and Resolution

M. Groll

MC G3 for all π:
GCALOR+MICAP
GHEISHA



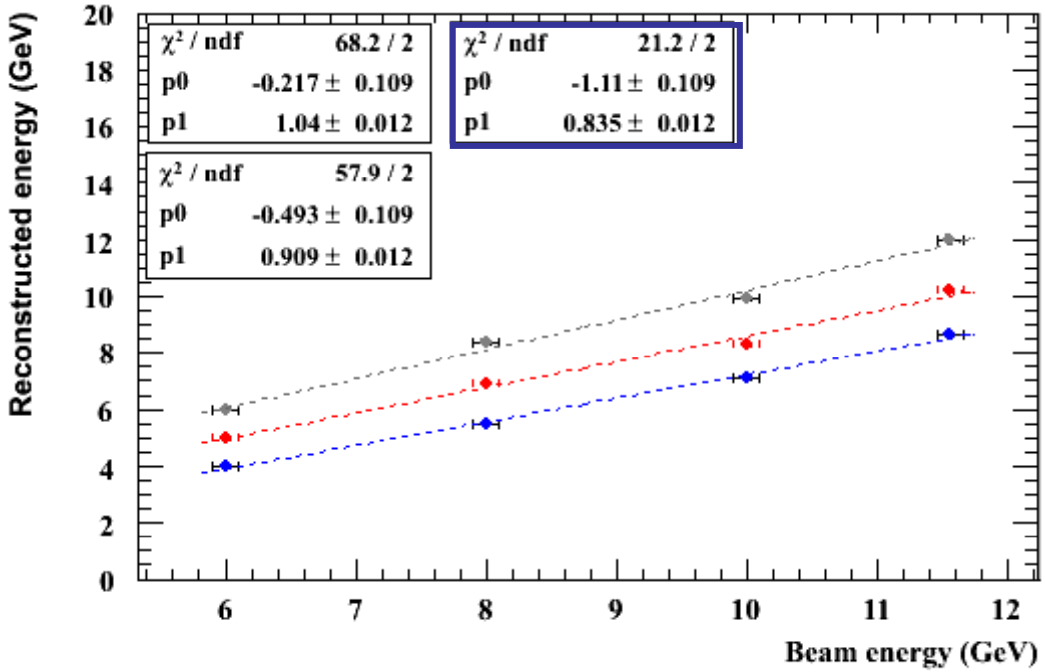


Data and MC rescaled at the 10 GeV point, scaling factors:

all π	1.4	GCALOR+MICAP	1.0
(AHCAL π	1.35)	GHEISHA	1.4

Energy response

N. D'Ascenzo



MC true
MC + cut + dead ch.
Data π contained

MC = G4
QGSP+Bertini+HP

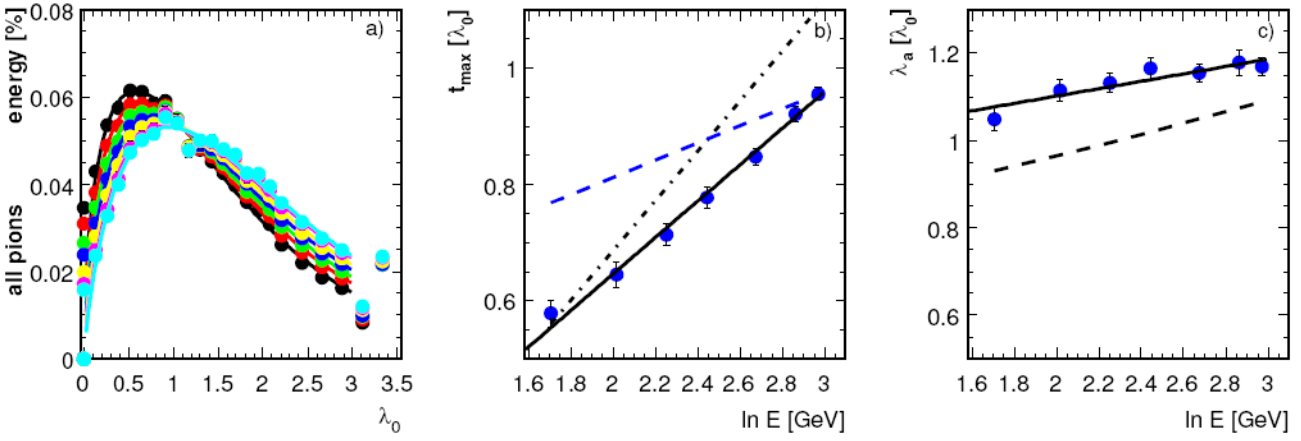
The slope (0.83+-0.01 + syst.) is comparable with
Marius analysis: 29.5/39.5=0.74 (1/1.35 in previous slide)
~10% difference between analysis: no E_{ECAL} compensation, modules 1&2 not used
The linearity at the e.m. scale is good

Longitudinal profiles

M. Groll

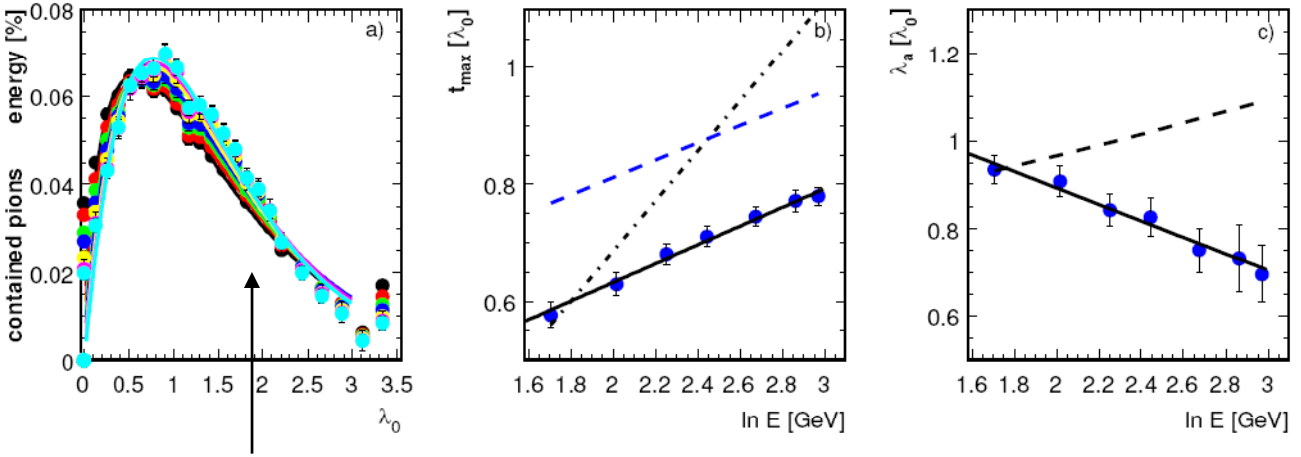
shower max and shower attenuation scale as logE

including pions with leakage to TCMT



unit of interaction length

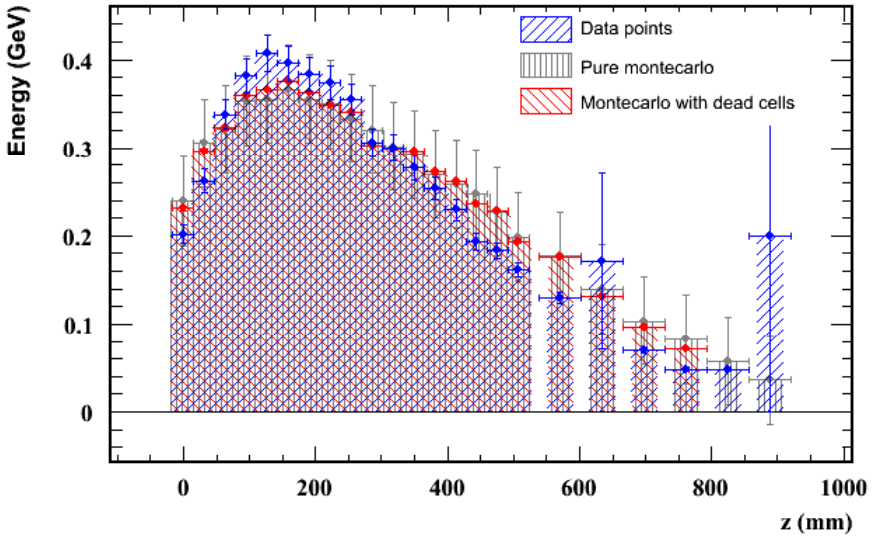
pions fully contained in AHCAL

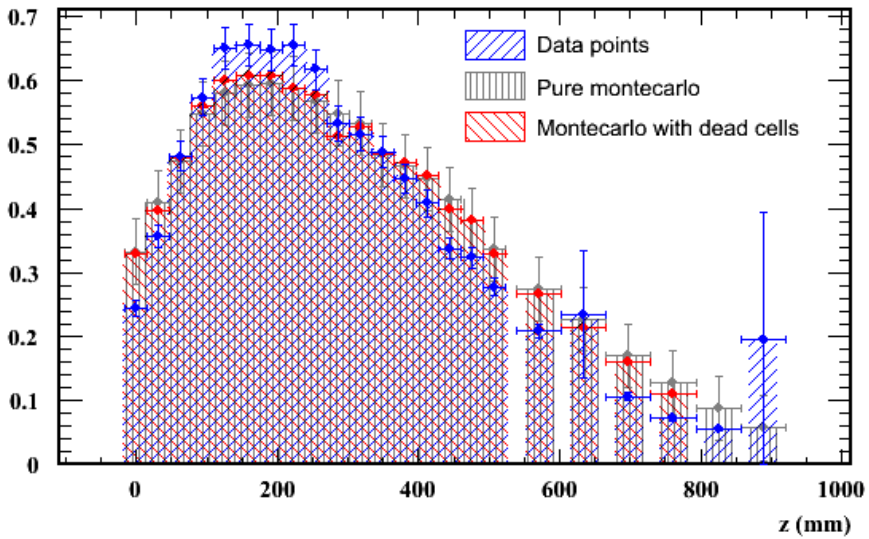


Compression of shower due to containment requirement

Longitudinal profiles

N. D'Ascenzo

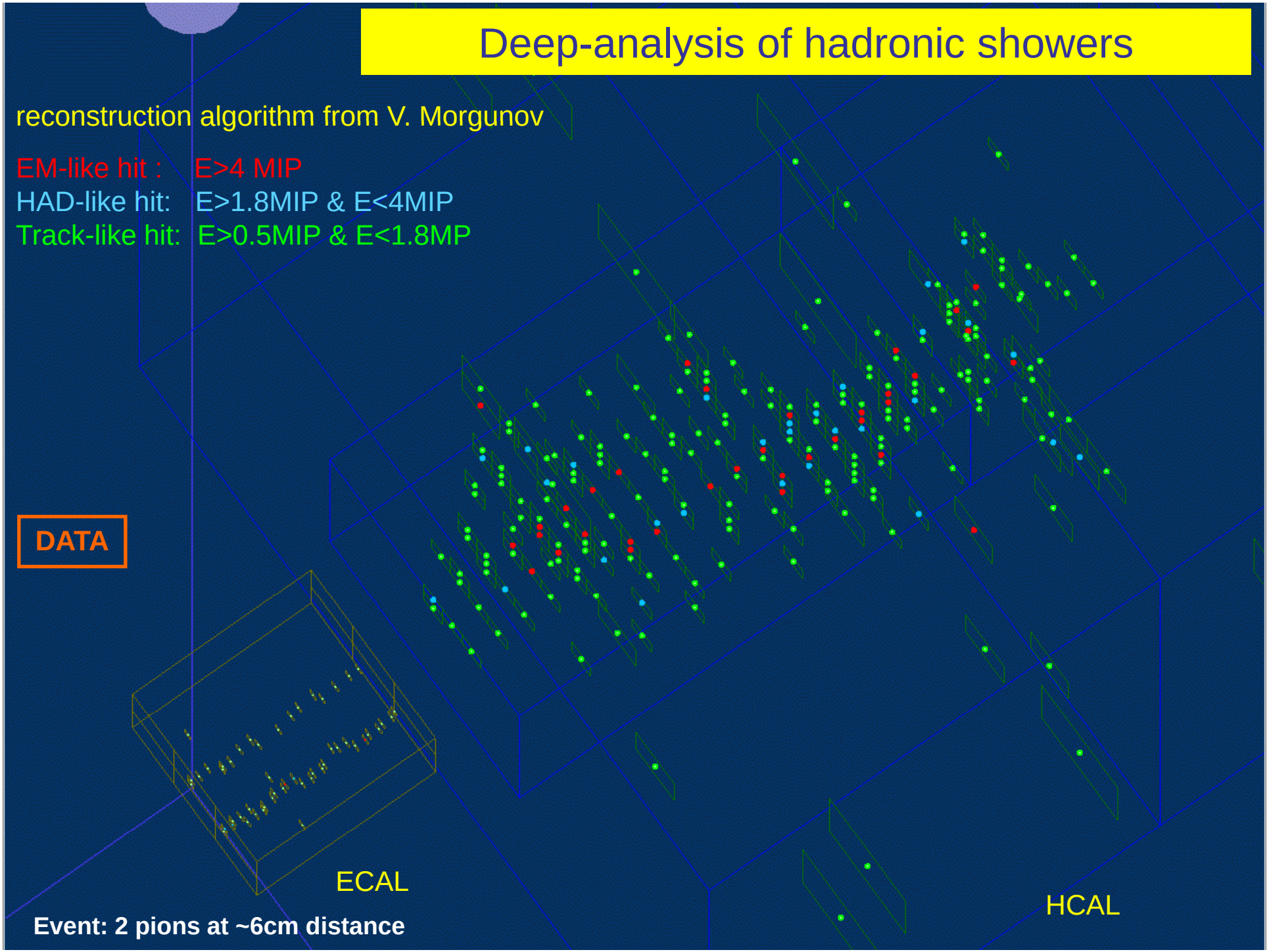




6 and 10 GeV pion contained in AHCAL
MC: G4 OGSP + Bertini + HP (nucleon transport)

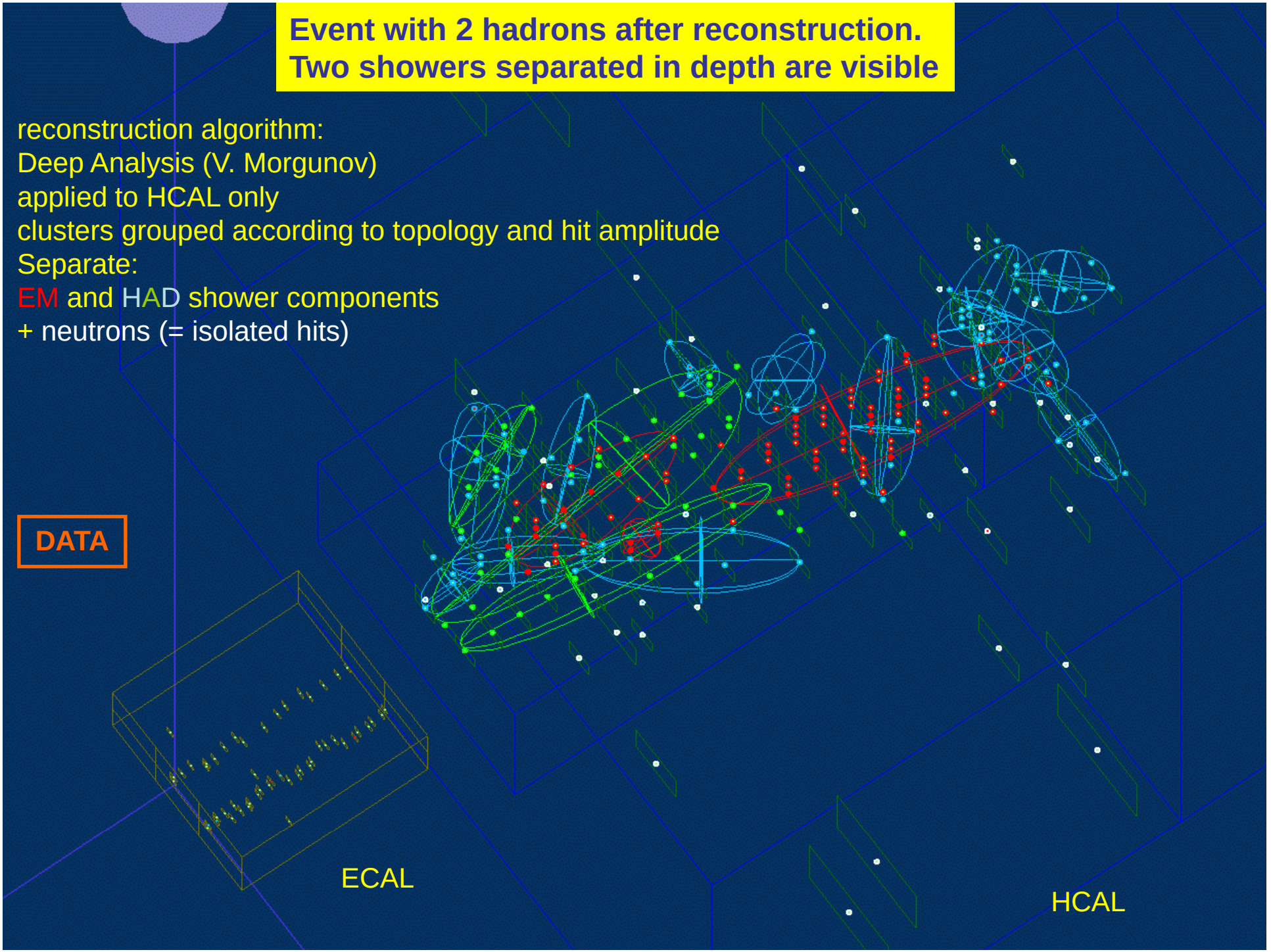
The MC longitudinal profile is broader than data

Deep-analysis of hadronic showers



Event with 2 hadrons after reconstruction.
Two showers separated in depth are visible

reconstruction algorithm:
Deep Analysis (V. Morgunov)
applied to HCAL only
clusters grouped according to topology and hit amplitude
Separate:
EM and HAD shower components
+ neutrons (= isolated hits)



Shower decomposition (DATA)

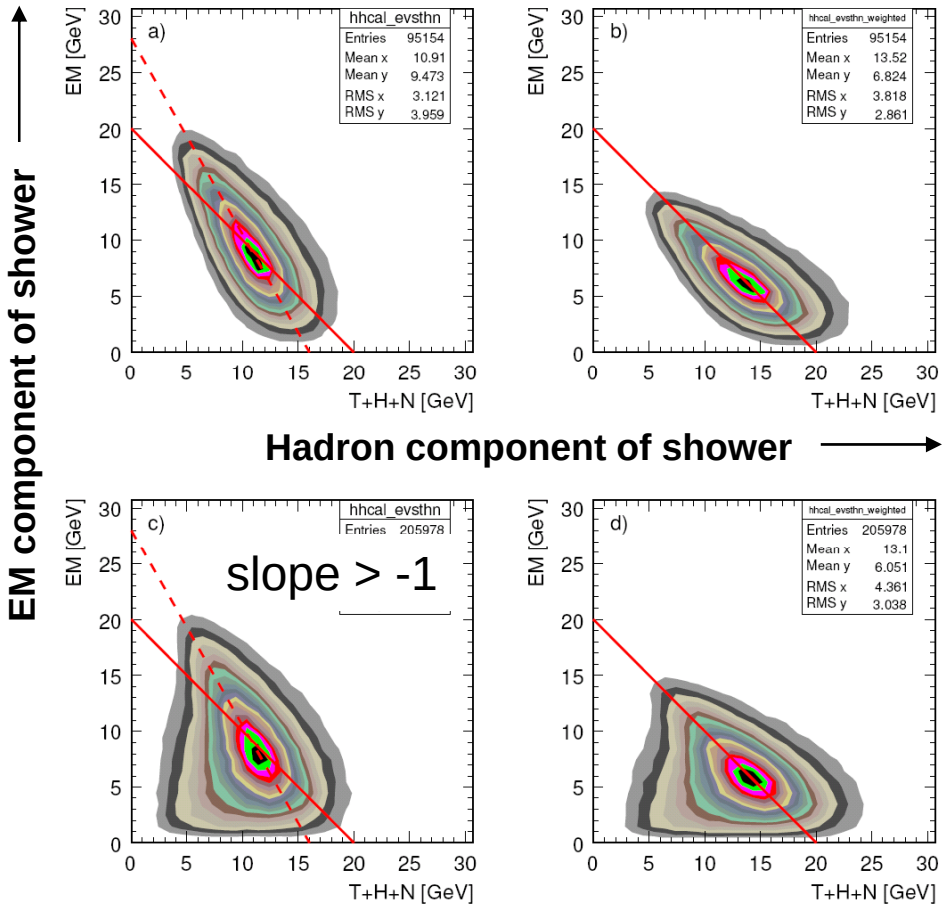
pions fully contained in AHCAL

including pions with leakage to TCMT

Before

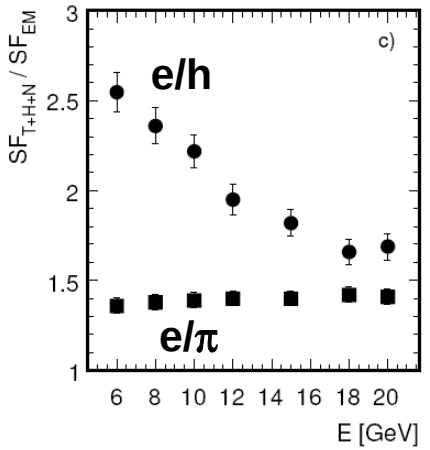
After

rotation
= software compensation

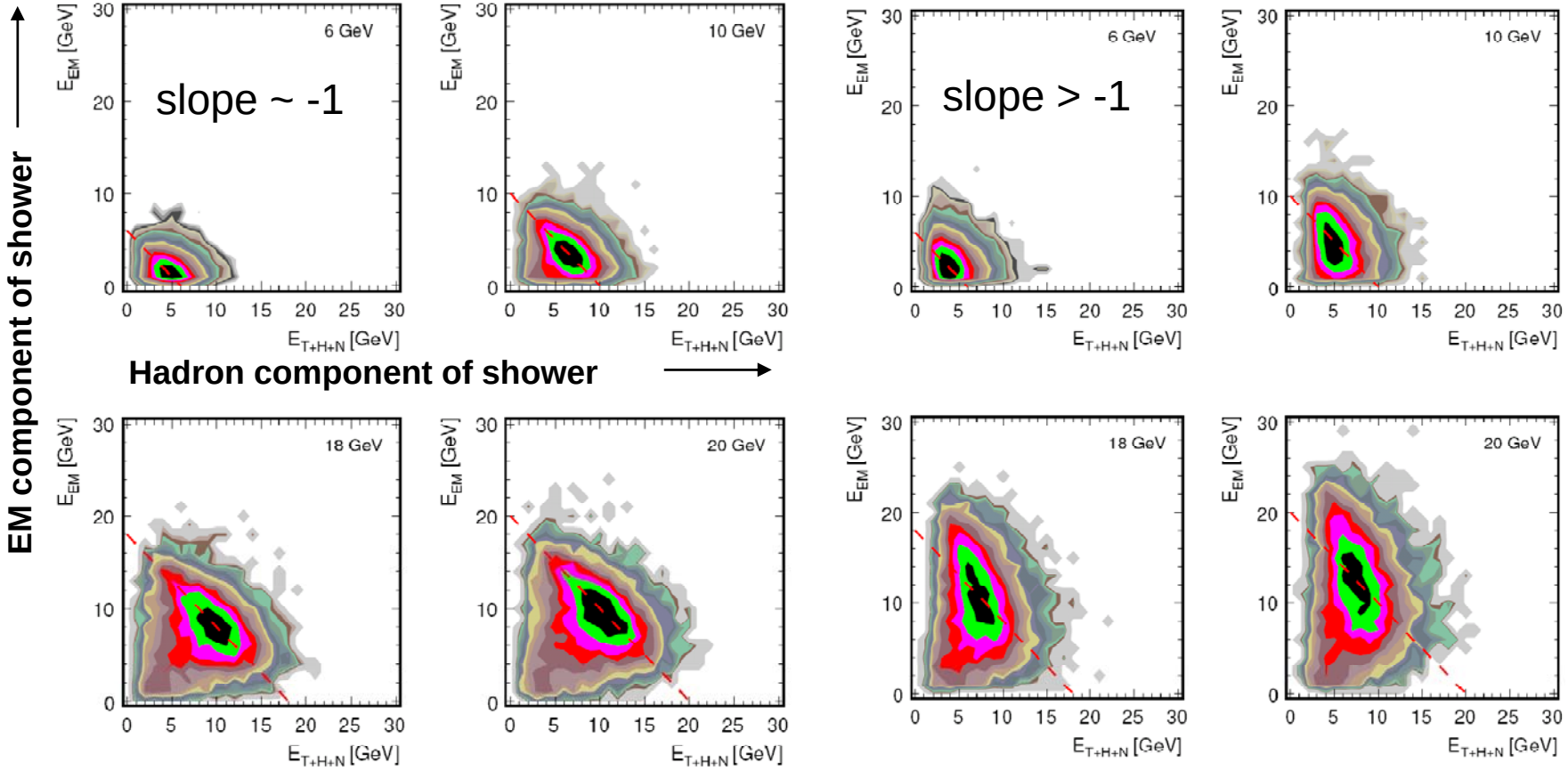


➔using deep-analysis deconvolution of hadronic showers (V. Morgunov)

extract e/h ratio from data

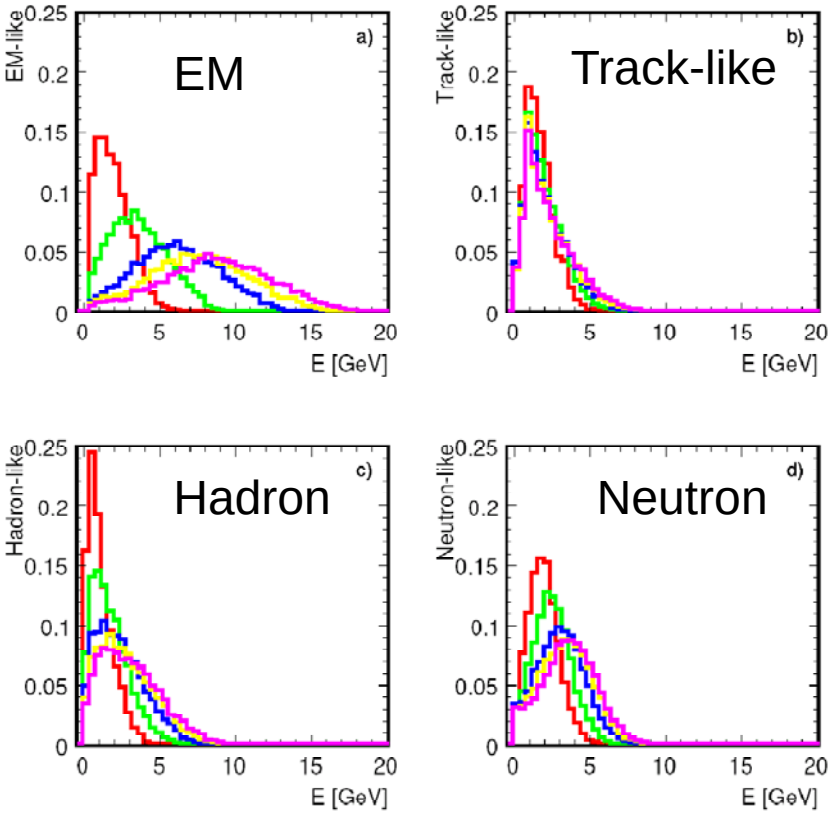


Shower decomposition (MC)

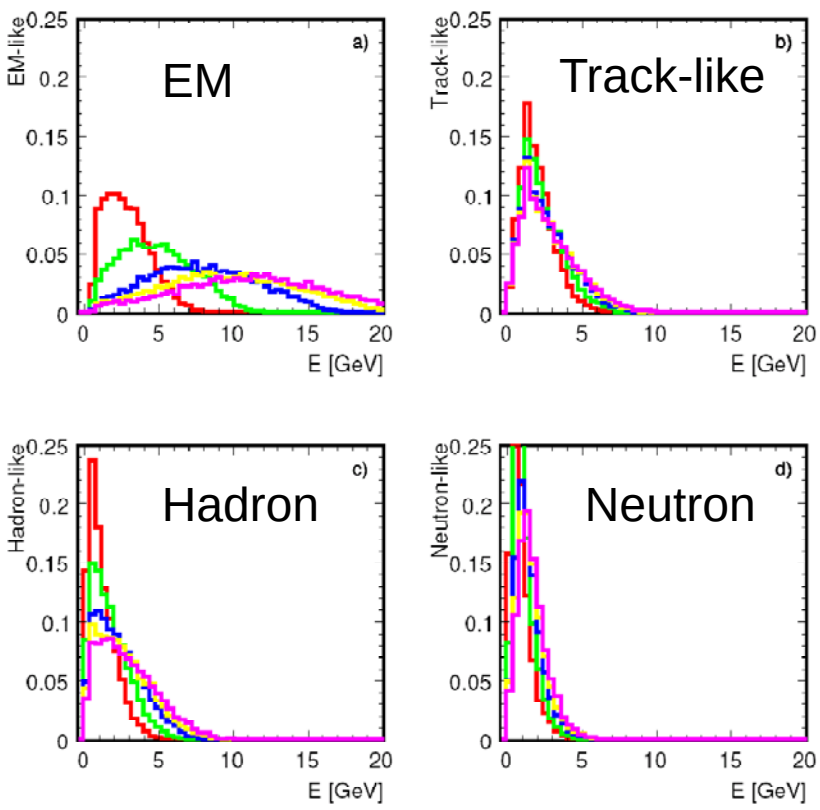


Shower decomposition (MC)

GCALOR+MICAP



GHEISHA

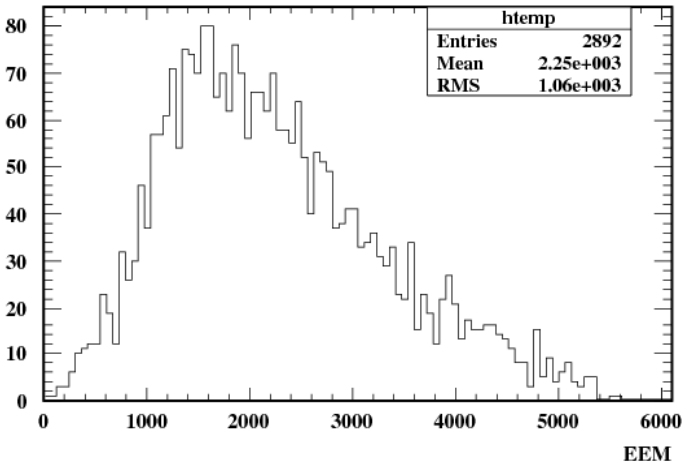


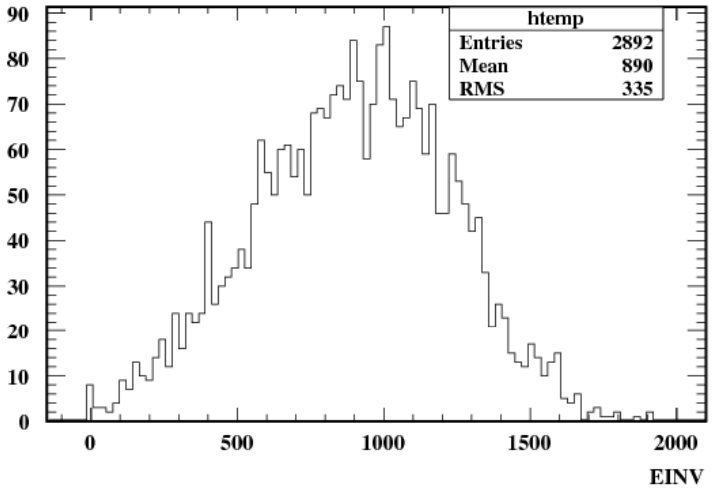
GHEISHA: larger fluctuations in the EM component, smaller neutron component

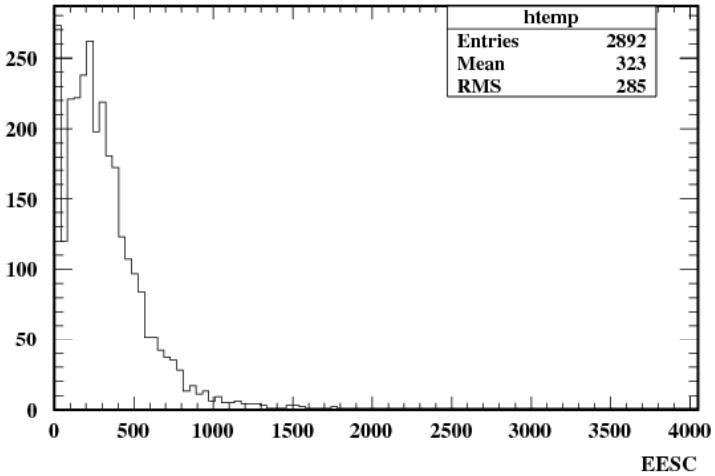
MC true shower composition

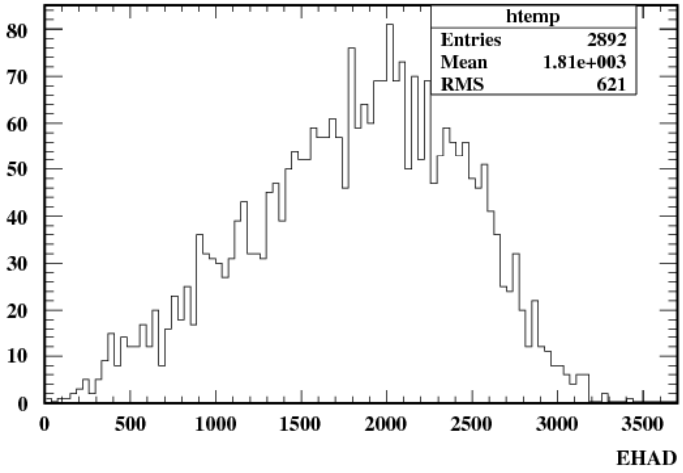
N. D'Ascenzo

MC: G4 QGSP + Bertini + HP (nucleon transport)
MOKKA charnel modified to extract step info



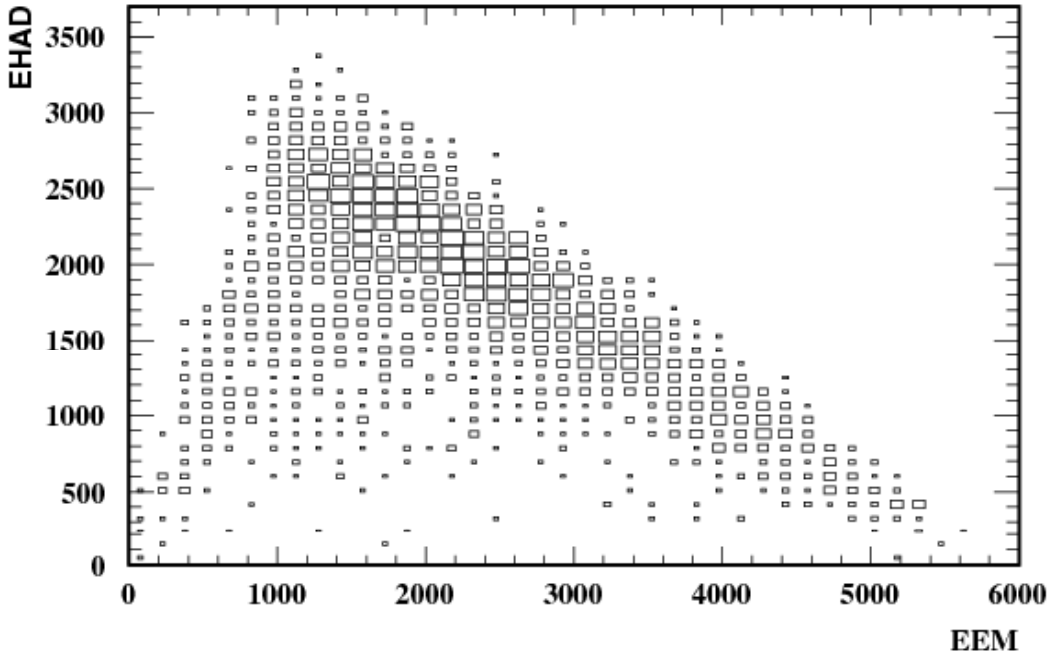






MC true

N. D'Ascenzo



Possibility to access the true MC energy decomposition and compare to result of Deep-Analysis reconstruction
(not yet available for G3 models)

Conclusion & outlook

- 2 independent analysis have started on pion data
- SiPM saturation plays a minor role, linearity better than 3% (6-20GeV)

- Comparison to MC just started for “classical” shower properties
- Need to have all models available

- Shower decomposition possible with deep-analysis tool
- Software compensation to come

- True shower composition accessible from MOKKA (modified)
- Allows deeper understanding of physics and clustering algorithm

- Still a lot of work to be done, but the preliminaries are promising !