Electromagnetic showers energy estimation

LAPP – Annecy
Florian Brunet
Supervisor : Amina Zghiche

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Outline

- New tool to estimate the energy
- Testbeam data analysis
- Energy estimation with the old tool on new MC production
- Efficiency calculation

New MC production

Electron Energy estimation : New training of the neural network in the shower reconstruction tool

- MC sample statistics : 50k electrons – [0,30]GeV
  [-500,+500]mrad incoming angle

- A test production is done → 10k electrons
- After Electron ID efficiency → 6.6k electrons

New tool to estimate shower energy

- The goal is to build a tool :
  - more stable wrt energy in a range of [2,30] GeV
  - more flexible : only one ANN or one per BT efficiency
  - Can be extended to 2 bricks : adjacent (same wall) or downtream

A new tool for energy estimation

- Training Sample : 1387 « Contained » electrons
- Test sample : 1387 Fully « Contained » electrons
- Methods used : Linear Discriminant, ANN MLP
- Input variables :
  - BT multiplicity
  - Plate extension
  - Longitudinal profile : 22 plates described by 10 variables (BT content in the plates 1-4, plate 5&6, plates 7&8 up to 21&22) → first results implied necessity of using a parametrized profile
  - angular information (shower axis angle OR angular difference between segments and shower axis)

New Shower Tool : Status of « Frank tool » strategy

- Select FC showers + Adding variables (angular) + weighting events (Energy) improve the rec energy
- But it is still unstable

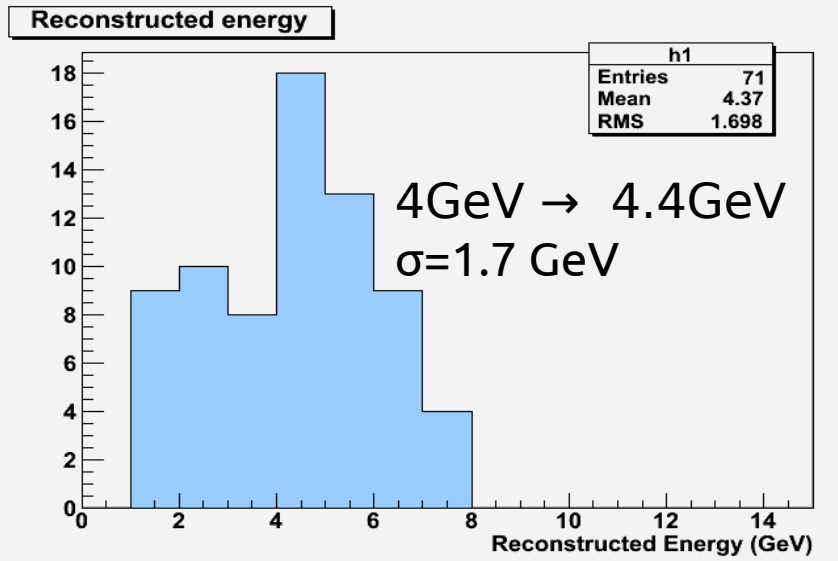
- New idea : use a fitted longitudinal profile

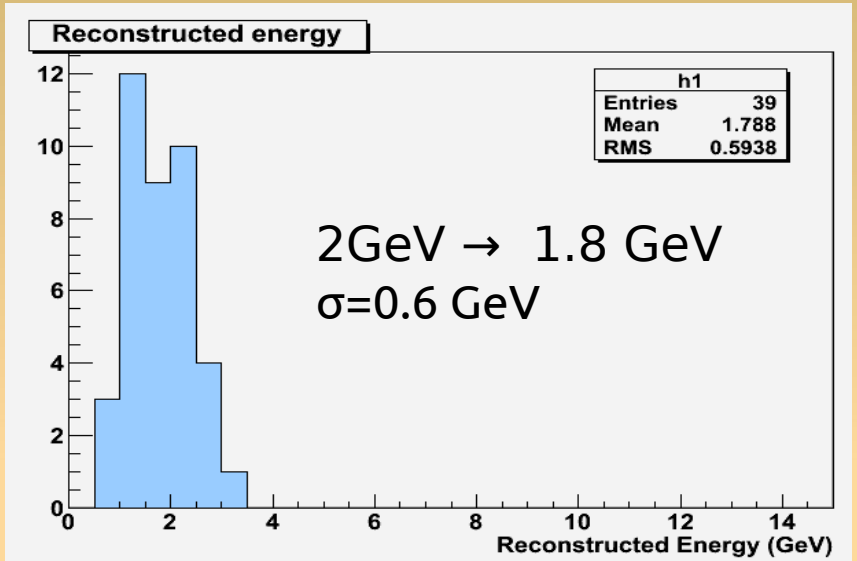
  → being optimized the two selected functions (Cruijff + Bifurcated gaussian) to fit single shower

  → estimated efficiency of fitting on the MC sample

Calibration Data Energy estimation

Ariga





- On going : produce a small sample of electron in the same reconstruction conditions as TB data & estimate the energy

  → done for 2 GeV : estimated at 0.9 GeV

Reminder : physics performance of current tool to estimate shower energy

- Past results about energy shown in Strasbourg meeting :
  - Overestimation of electron mean energy in a nue sample + monochromatic electron (MC true 4GeV 40% overestimated : 5.1 GeV)
  - Strong dependance upon the energy value
- New electron MC sample
  - Reconstructed shower energy estimation is being investigated : underestimated by 45% !
  - New tool to estimate the energy is under construction

Discrepancy Old tool between 4 GeV electron (nov 2011) & new MC production (jan 2012)

- Aki should use the same routine to reconstruct showers of the TB data as the one implement in OpEmuRec
- Flo is implementing the routine used in Bern data analysis in OpEmuRec
- Flo is checking if the number of plate used to estimate the energy is the same in both the old and the new MC samples.

Efficiency calculation NC

MC : numunc	OpCarac (CONT+BSNC)	BF	CS	Scanback	Vertex (+Umut single stop)
Cumulative	0.869	0.488	0.415	0.373	0.262 (0.238)
Relative	0.869	0.561	0.852	0.898	0.703 (0.974)
MC : numunc 2B	OpCarac	BF	CS	Scanback	Vertex
Cumulative	0.866	0.646	0.550	0.494	0.347
Relative	0.866	0.743	0.852	0.898	0.703
Data 08/09	Predicted by ED			Located	DS performed
0mu 2008	406		275 (0.677)	169 (0.416)	165 (**0.406**)
0mu 2009	1097		729 (0.664)	360 (0.328)	348 (**0.317**)
MC recalc	OpCarac	BF	CS	Scanback	Vertex
NumuNC C	1.	0.561	0.478	0.429	0.302
NumuNC R	1.	0.561	0.852	0.898	0.703
MC 2B approx	OpCarac	BF	CS	Scanback	Vertex
NumuNC C	1.	0.743	0.633	0.568	**0.399** (0.554)
NumuNC R	1.	0.743	0.852	0.898	0.703 (0.974)

Efficiency calculation CC

MC : numucc	OpCarac (CONT+BSNC)	Brick Finding	CS	Scanback	Vertex (+Umut single stop)
Cumulative	0.975	0.745	0.708	0.688	0.468 (0.530)
Relative	0.975	0.764	0.950	0.971	0.679 (0.986)
MC : numucc 2B	OpCarac	Brick Finding	CS	Scanback	Vertex
Cumulative	0.975	0.885	0.841	0.816	0.554 (0.805)
Relative	0.975	0.908	0.950	0.971	0.679 (0.986)
Data 08/09	Predicted by ED		CS	Located	DS performed
1mu 2008	1292		1053(0.815)	834(0.646)	812 (**0.628**)
1mu 2009	2460		2080(0.846)	1490(0.606)	1454 (**0.591**)
MC recalc	OpCarac	BF	CS	Scanback	Vertex
NumuCC C	1.	0.764	0.726	0.705	0.479
NumuCC R	1.	0.764	0.950	0.971	0.679
MC 2B approx	OpCarac	BF	CS	Scanback	Vertex
NumuCC C	1.	0.908	0.863	0.838	**0.569** (0.826)
NumuCC R	1.	0.908	0.950	0.971	0.679 (0.986)

Outlook

1/ Electron Energy estimation

a/ solve the discrepancy between old and new energy estimation of 2 differents MC sample

b/ build a new tool to estimate the energy of showers

→ check/tune my functions for single showers

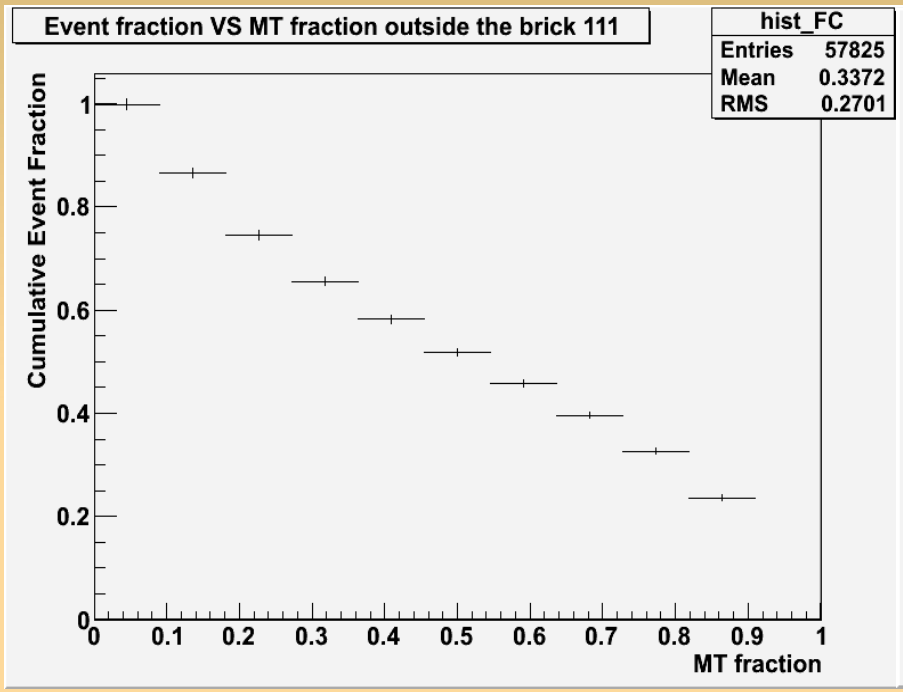
c/ Calibration of shower tool with electron data

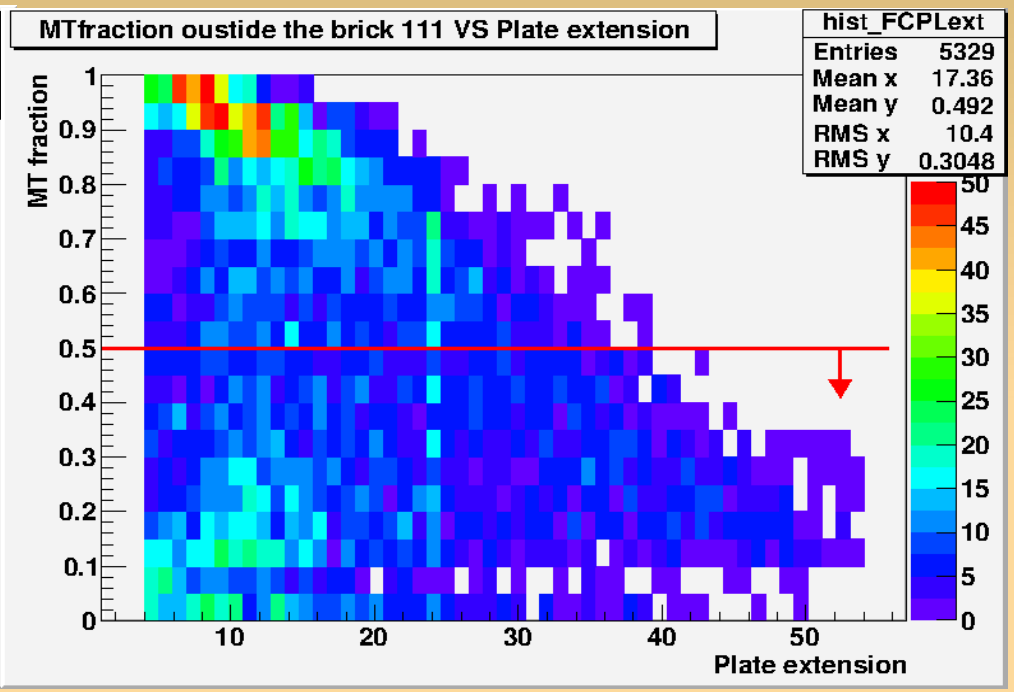
→ MC sample in the same conditions to be analyzed

d/ production of new MC sample for building a new energy tool → 40k remaing events

Backup slides

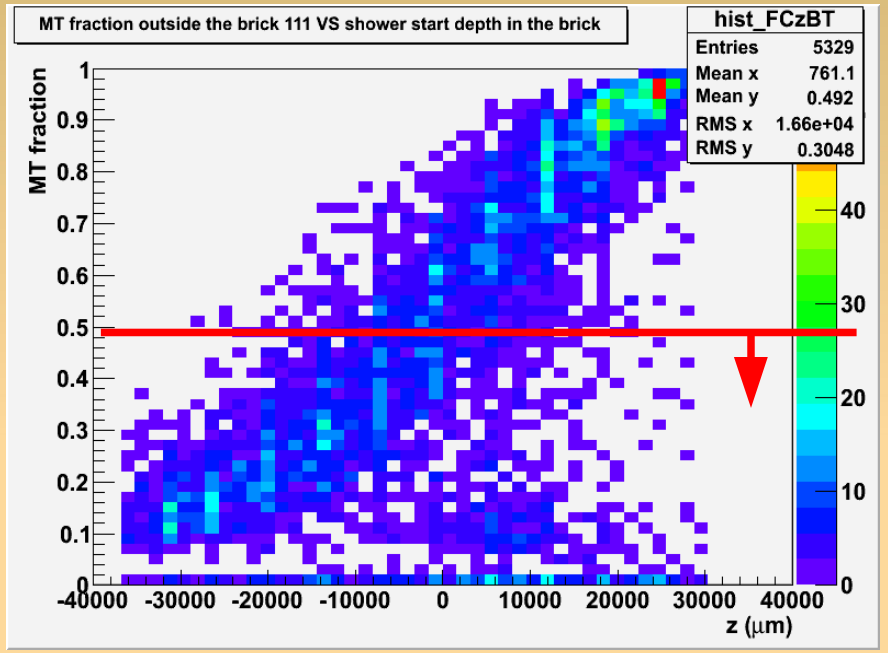
New Shower Tool : FC selection

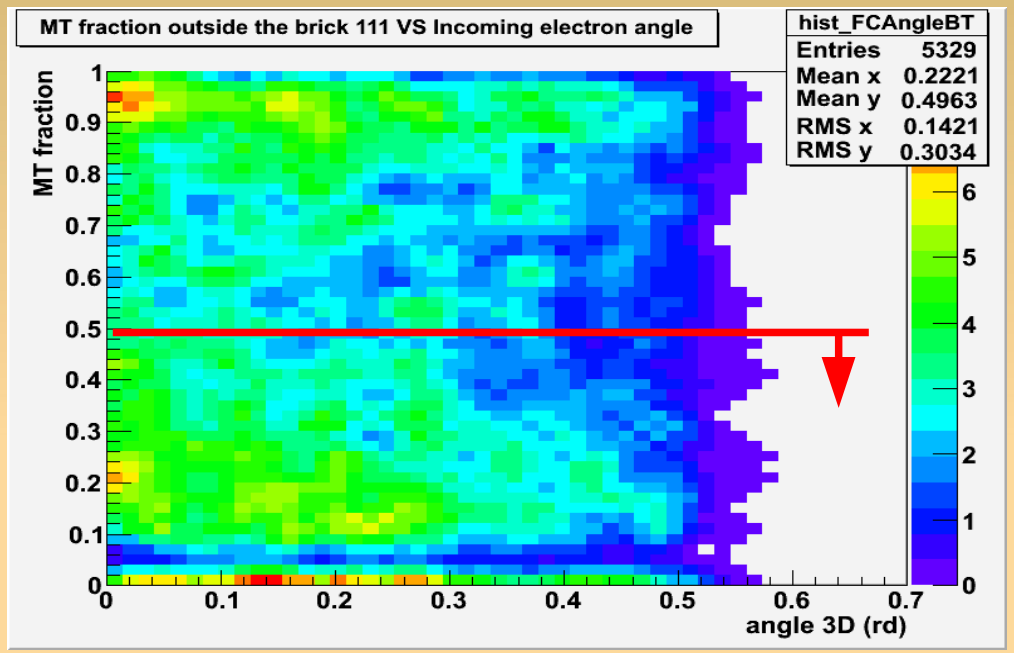




- Selecting Fully Contained showers (at least 50% MT inside the located brick)
- The 0.5 cut on MT fraction seems reasonable by removing the cluster high MT fraction + low plate extension
- A cut on Plate extension requiring shower with at least 5X0 would be a good idea BUT the statistics of remaining shower decreases

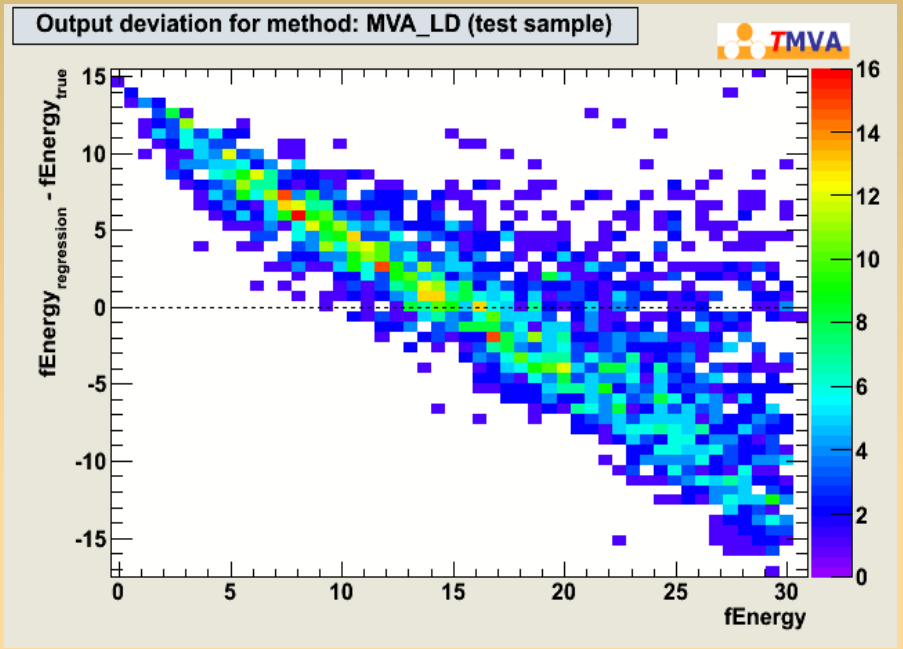
New Shower Tool : FC selection

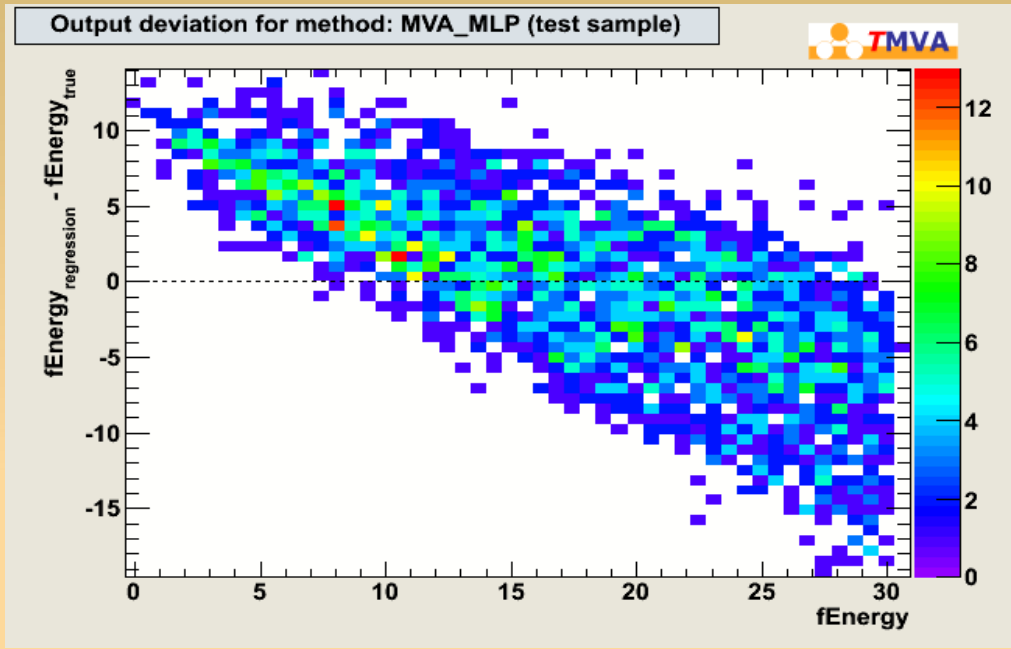




- Selecting Fully Contained showers (at least 50% MT inside the located brick)
- The 0.5 cut on MT fraction seems reasonable by removing the cluster high MT fraction + vertex depth dowstream in the brick

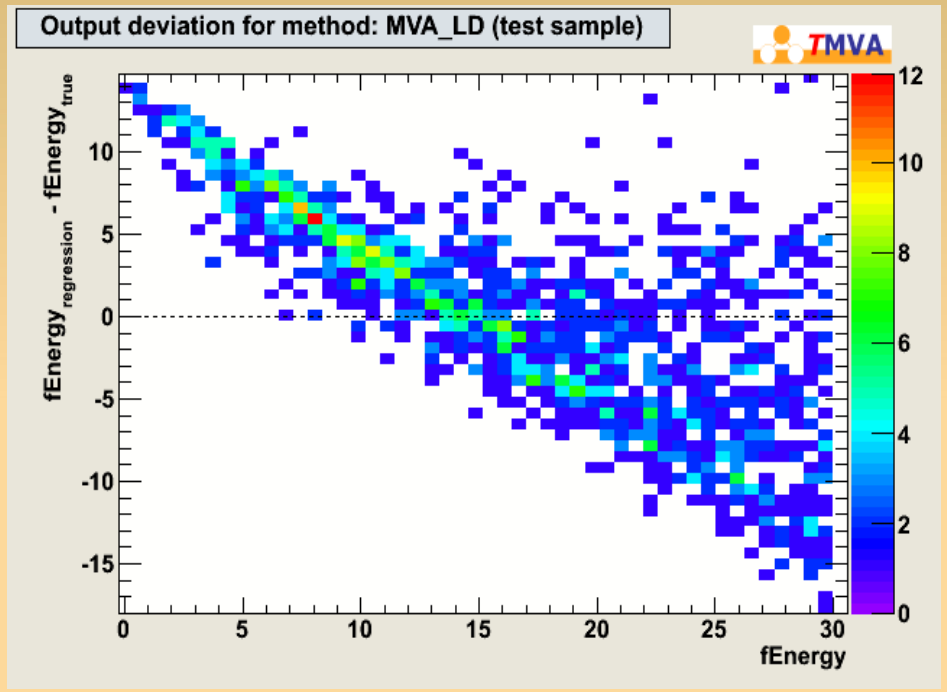
New Shower Tool : former result

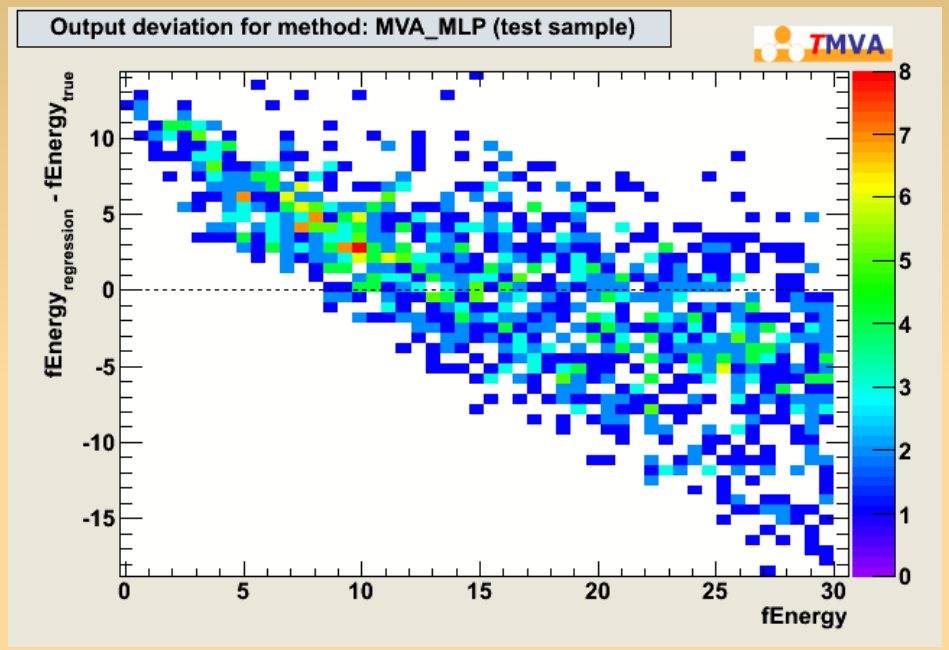




- 50% resolution wrt MC energy at 15 GeV
- Regression ineffective (small weights) → « always the mean value »

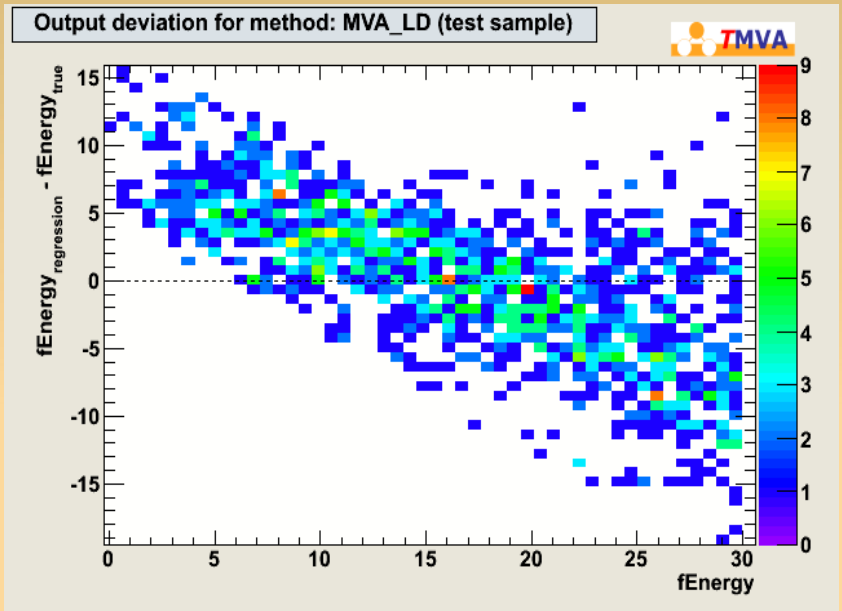
New Shower Tool : + FC showers

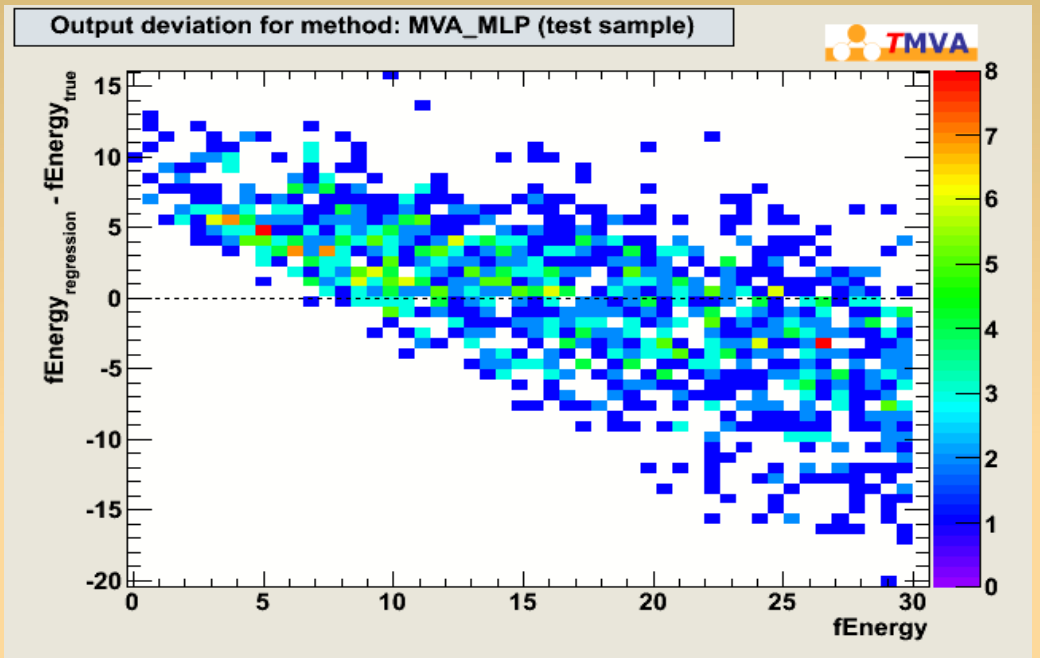




- Regression ineffective (small weights) → « always the mean value »
- No improvements

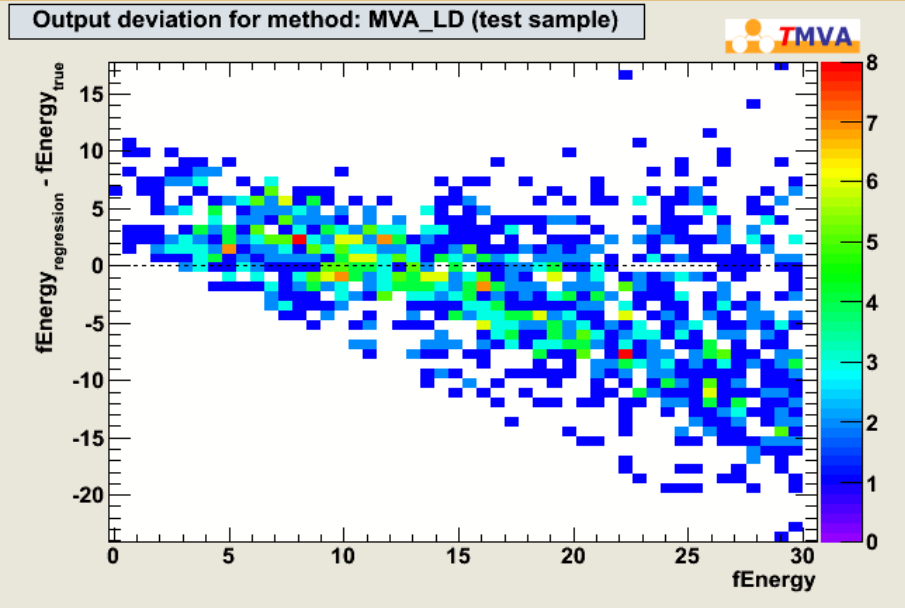
New Shower Tool : FC showers + 1 angular information

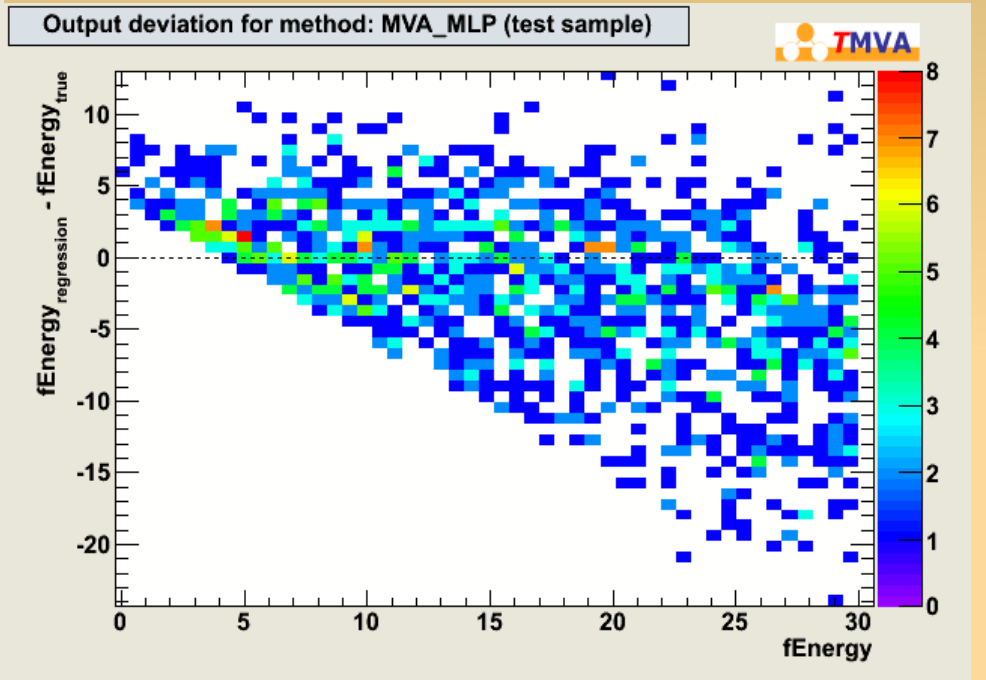




- Selecting Fully Contained showers (at least 50% MT inside the located brick)
- Adding the incoming electron track angle as an input variable
- Next step : Komatsu-san idea → adding the angular difference between basetracks and shower axis (mean and RMS)

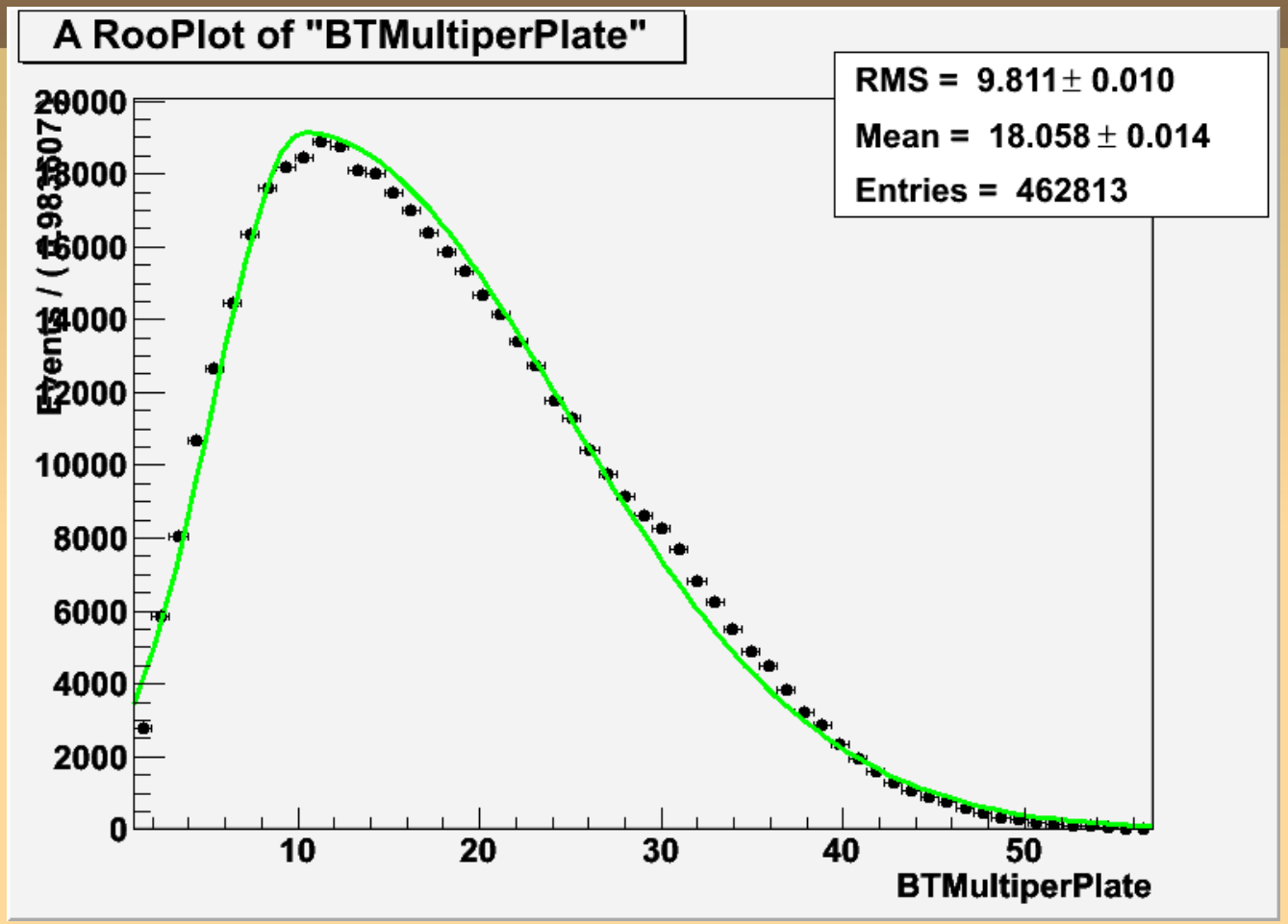
New Shower Tool : FC showers + weighted with the MC true energy





- Selecting Fully Contained showers (at least 50% MT inside the located brick)
- Event Weight = 1/E(MC)

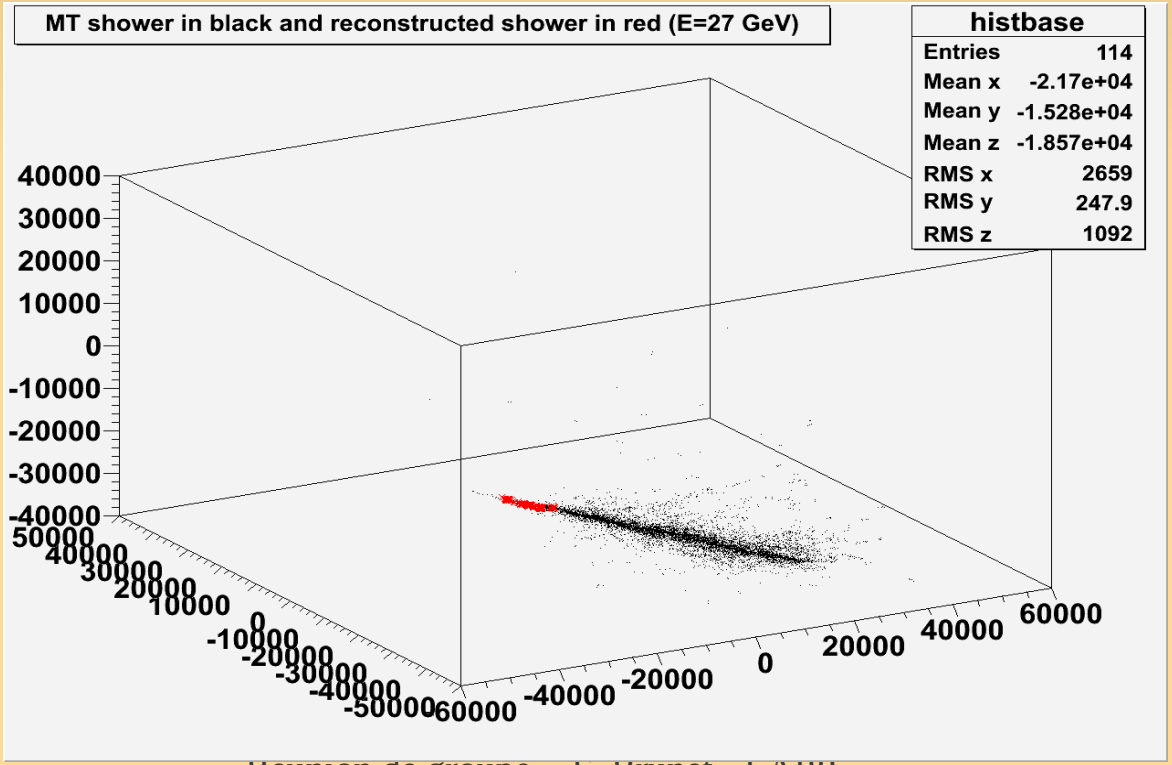
New Shower Tool : mean long. profile



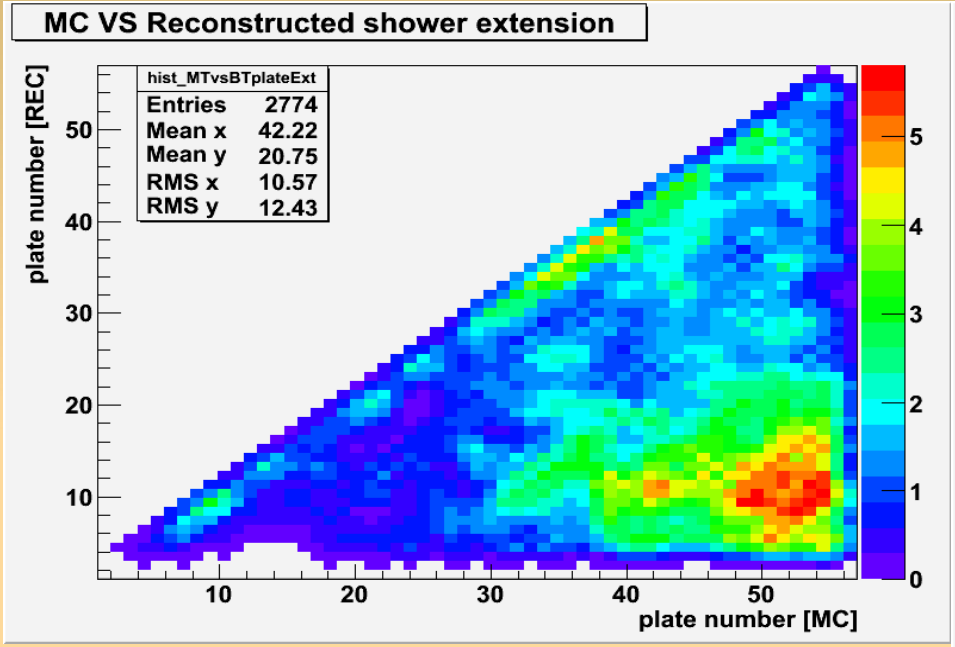
- Fit the longitudinal profile with an asymetric gaussian + asymetric tails (5 parameters function)
- See how it fits a single shower profile and then if multiple shower fits are converging

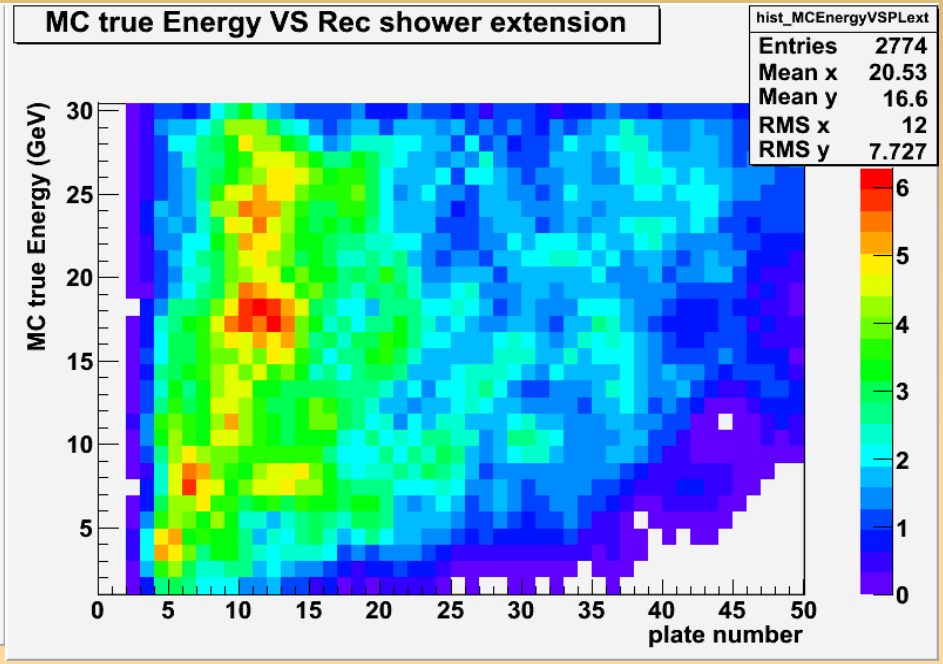
New Shower Tool : single shower long. profile

- Fitting process on single shower profile fails → because of a bug



New Shower Tool : single shower long. profile





- High energy showers with a 10 plates mean extension = 35%
- Bug tracking : when linking access zones and view information → most of these object are empty
- NEW : Michele is checking my output : he saw 38 views → no empty views but missing views