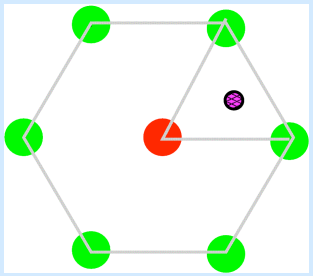
About a new T5 in order to recover more high energy events

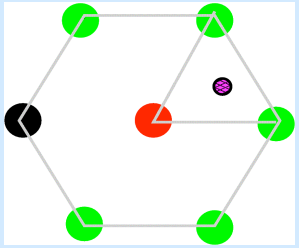
O. Deligny, P. L. Ghia, I. Lhenry, H. Lyberis

Definitions and method



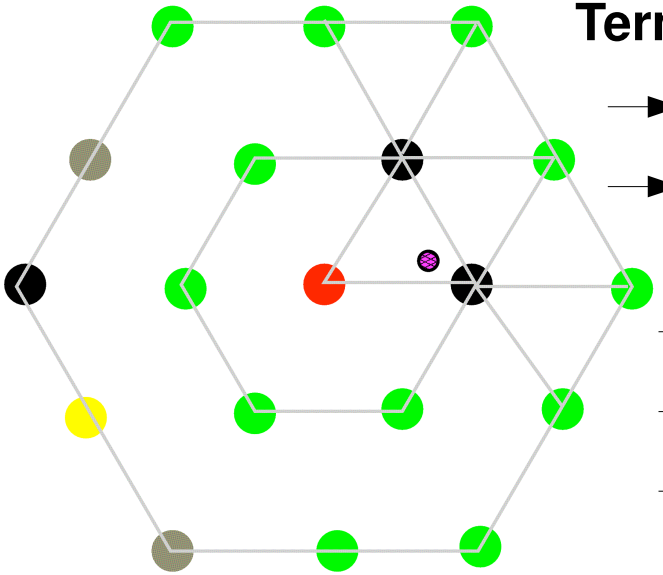
6T5: 6 active tanks around the hottest one
good energy resolution at above 3 EeV

→ **used for the spectrum**



5T5-Pos : good reconstruction at higher energies

→ **used for the anisotropy studies at high energies**



Terminology: 4T5-55

→ **recovering more events of high energy**

→ **good discrimination power of the borders in the array**

<u>Questions</u>:

→ **up to what energy, with what energy discrepancy?**

→ **angular resolution discrepancy?**

→ **can it be improved?**

Definitions and method

What for? : the anisotropy studies need more statistics

Requirements for a new selection

- like all the already existing one, it have to be « as much as possible », fiducial cut (i.e. based on the geometry of the array)

Method : creating a new dataset of T5 by modifying the 6T5

we remove some tanks in the array → simulate a hole or a black tank

→ we plot the distribution of the relative energy difference

and the angular distance between the original event & the new one

$$\frac{\Delta E}{E} = \frac{E_{\text{original}} - E_{\text{modified}}}{E_{\text{original}}}$$

Reconstruction : CDAS v4r6

6T5 : Official selection

Energy: energy estimator $37

Data set : 6T5 events with $\theta < 60°$ & $E > 40$ EeV , no cut (e.g. $22)

Definitions and method

What we require for a new T5 :

- **energy resolution degradation < 10%**
  - **~ order of magnitude of shower-to-shower fluctuations**
- **angular resolution degradation < 1°**
  - **~ resolution above 40 EeV**
- **no queues in the distributions**

To avoid tails in the distributions ➡ quality cuts

The actual one $22:

the 1st estimation of the core with the triangle of 3 highest signal tanks (a kind of center of mass) should not be « to far » from the reconstructed one

Warning: these quality cuts should not discard to much events

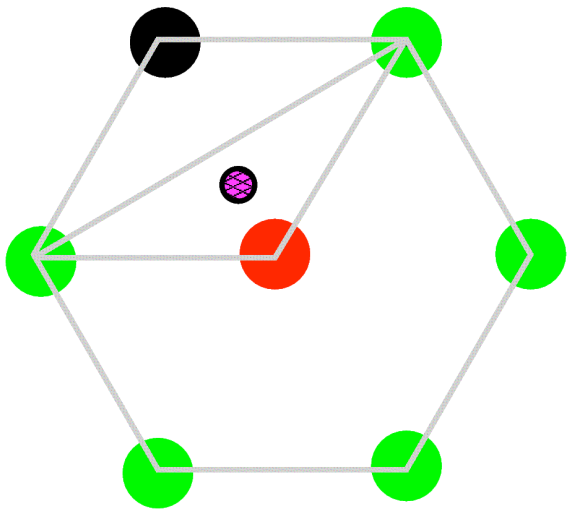
5T5 : looking for a more relaxed T5

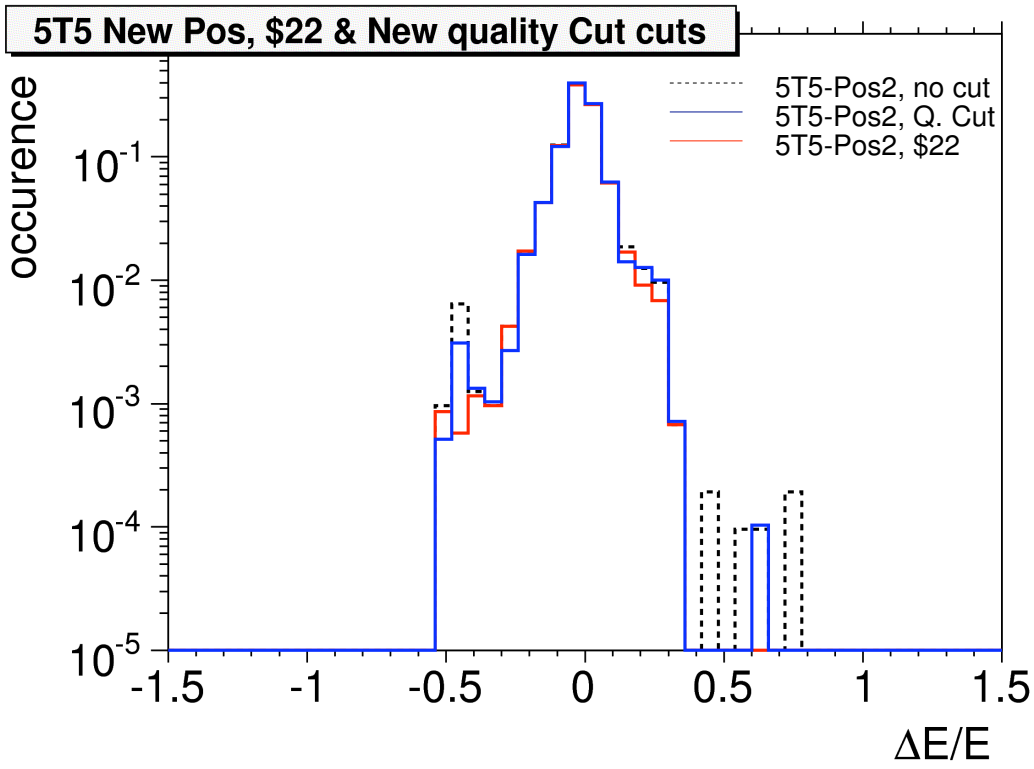
- Same new set of events
- New Pos: recon. core in the isosceles triangle

→ Checking the accuracy of the 5T5-Pos2

Pos2

Configuration

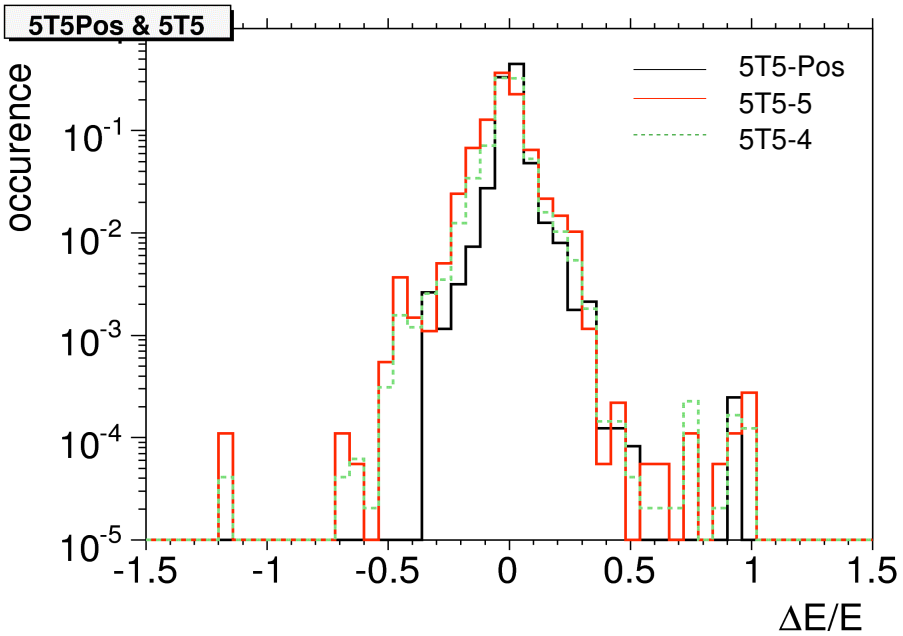




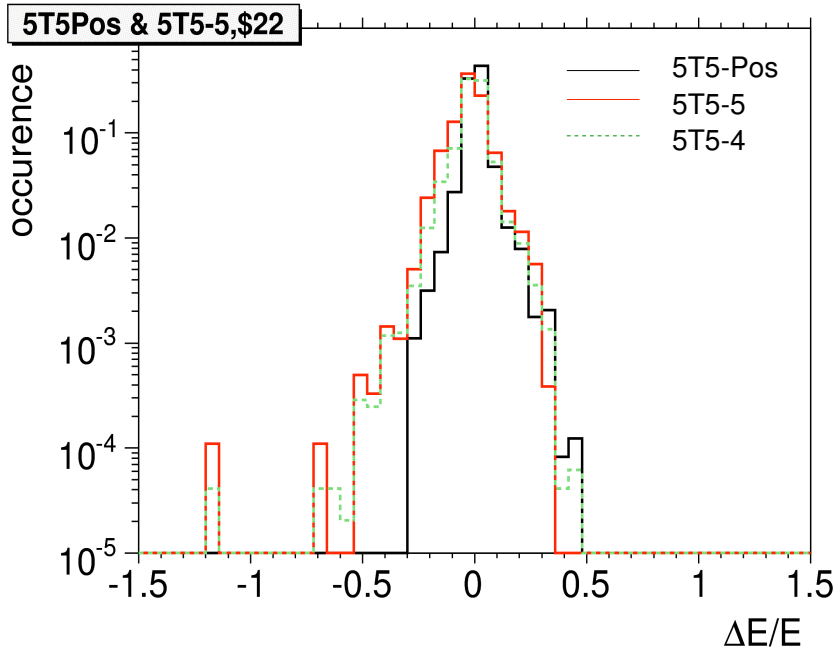
5T5 : looking for a more relaxed T5

- Checking the accuracy of the 5T5-Pos, 5/4 reconstruction
- New set of events by removing 1 tank in the 1st crown (incl. the hottest one) and 2 tanks in the 2nd crown

No cut



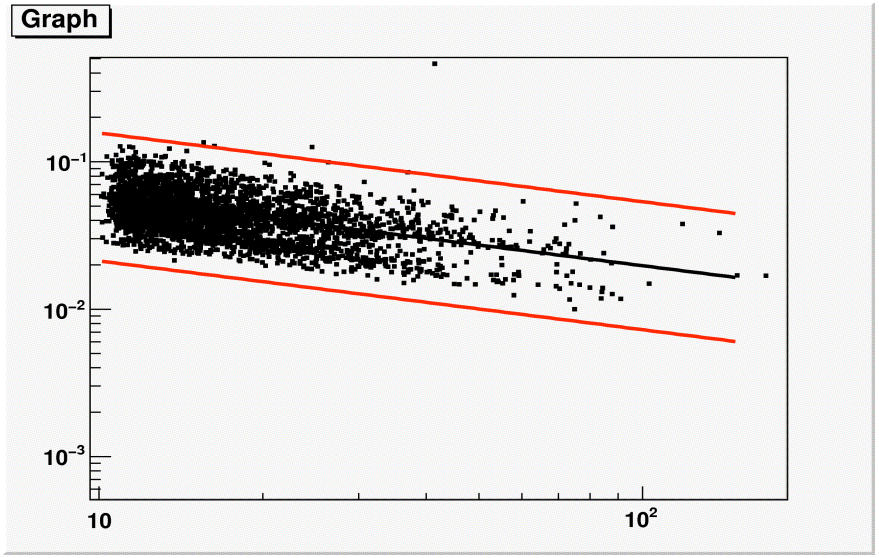
$22 (1.7%)



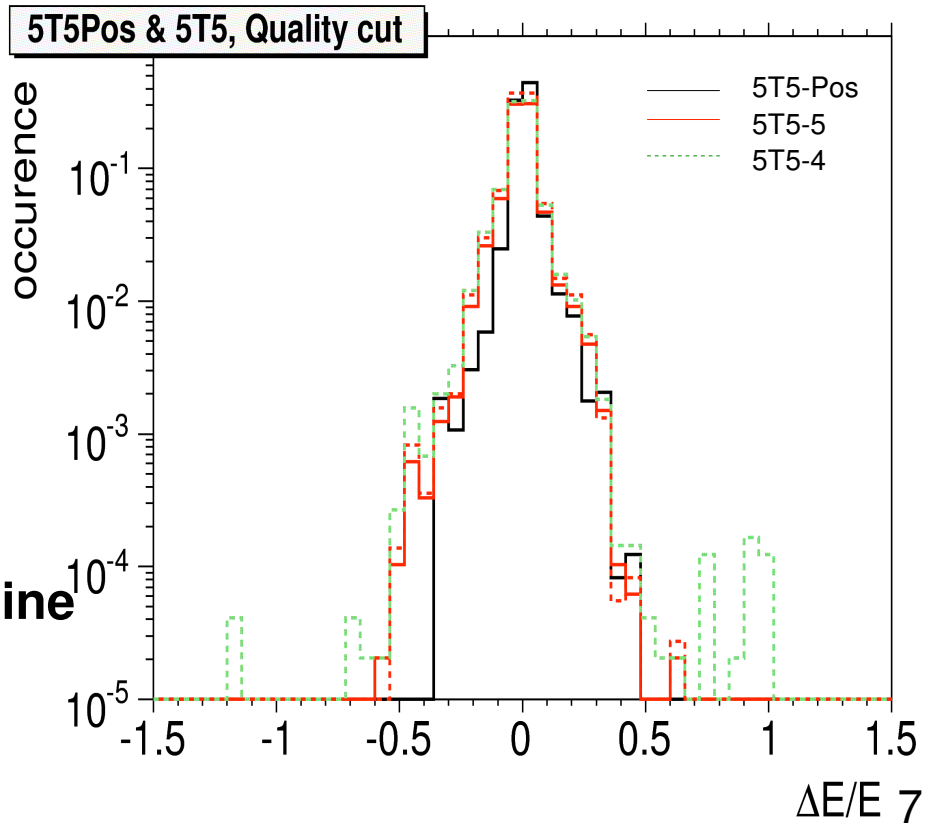
- Added to these fiducial cuts, we obviously need quality cuts
- the one in use for the previous selection is not enough

5T5: New quality cut

- A large quantity of information is contained in the uncertainty σ(E) given by the fit of the LDF
- Fit of the 6T5 events above 10 EeV of σ(E)/E: in log/log it is a straight line



New quality cut (2.3-7.1%)

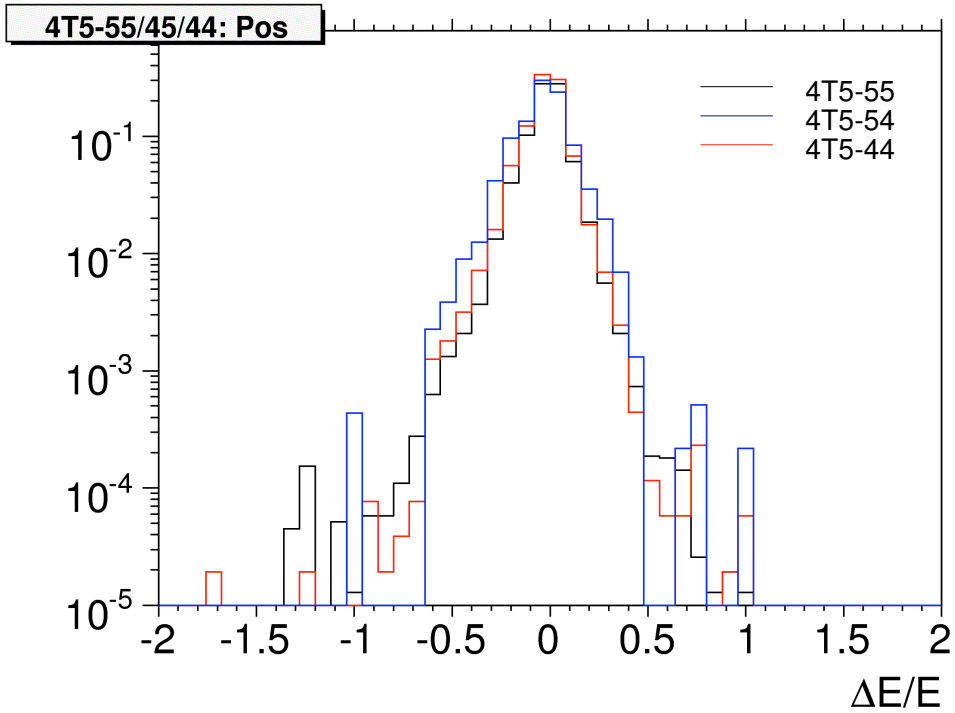


Translation up and down of this straight line as the definition of the new quality cut

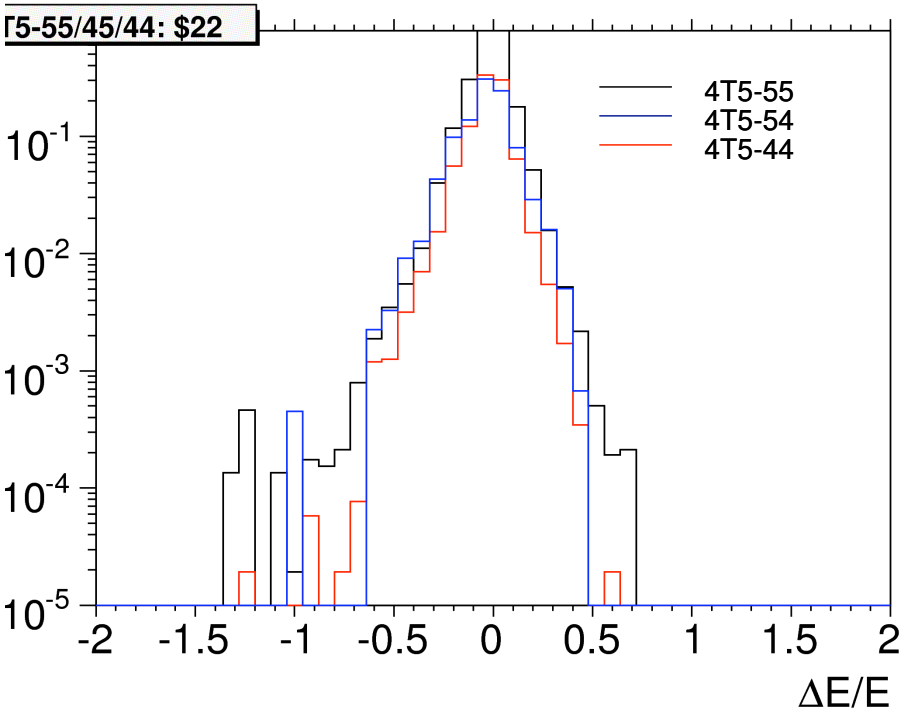
4T5: the POC proposition

- Checking the accuracy of the 5T5-Pos, 5/4 reconstruction
- New set of events by removing 2 tanks in the 1st crown (incl. the hottest one) and 2 tanks in the 2nd crown

No cut



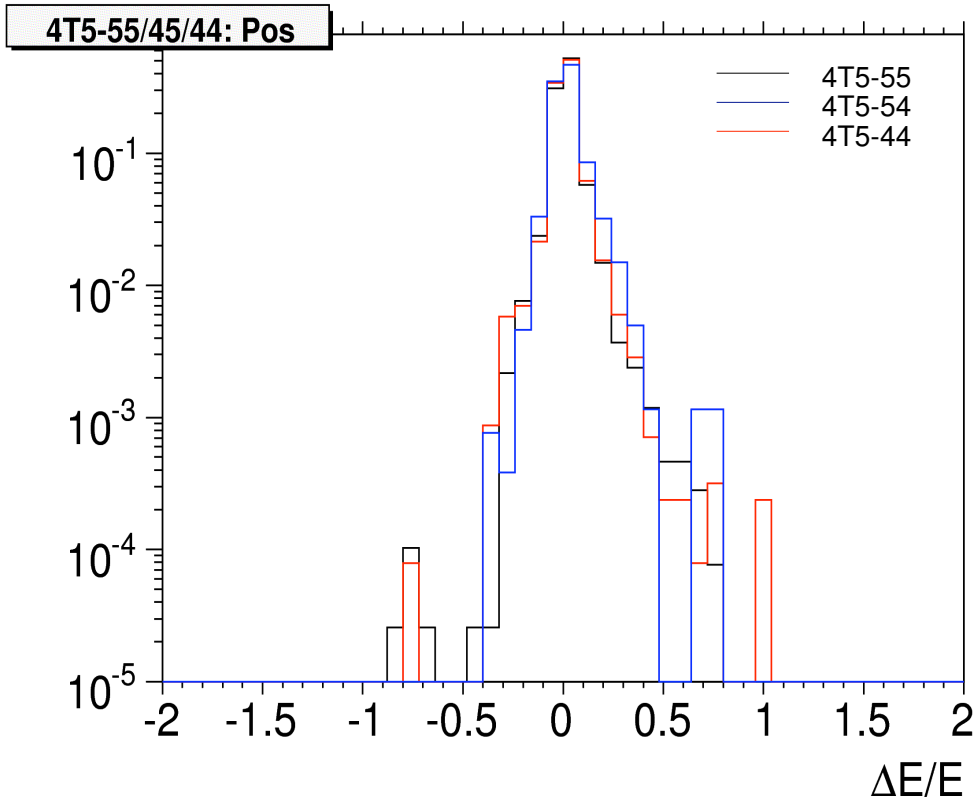
$22 (1.2-2.5%)



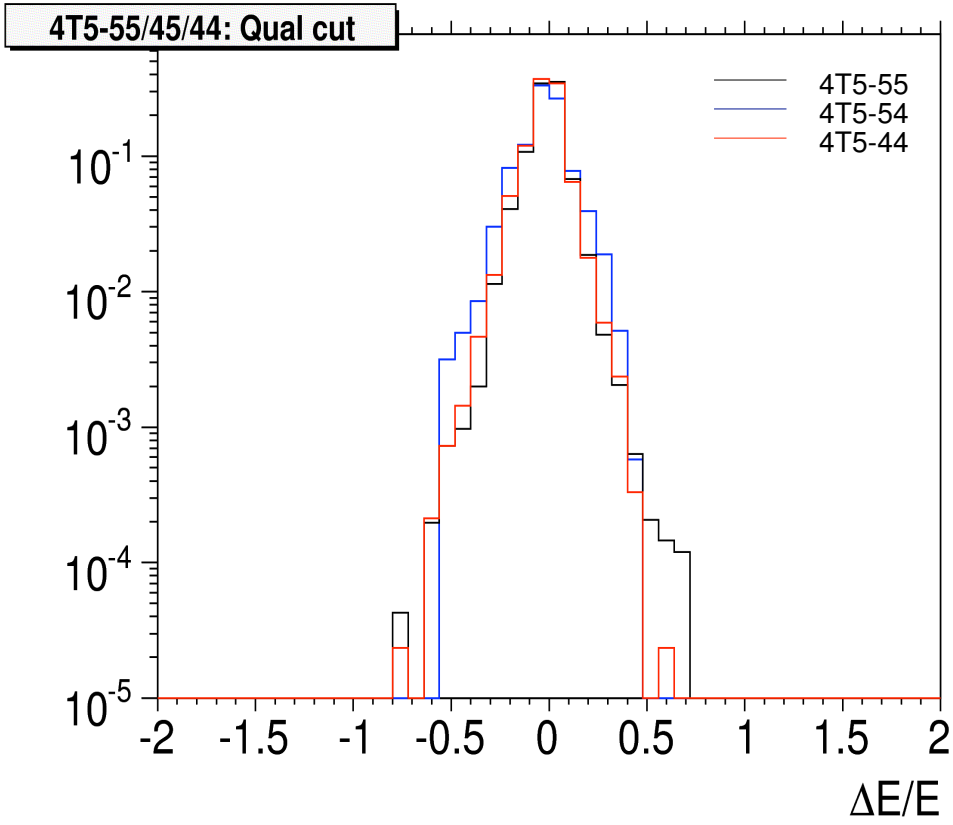
- Added to these fiducial cuts, we obviously need quality cuts
- the one in use for the previous selection is also not enough

4T5: New quality cut

Pos (75%)



new quality cut (2.-2.4%)



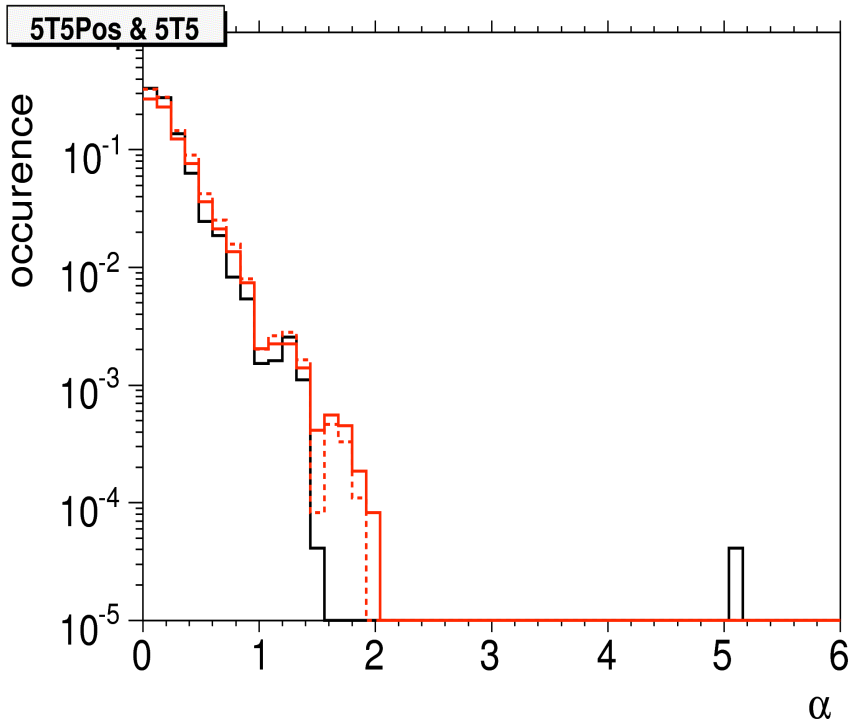
→ **<u>Results</u>: Mean, RMS & # of events above a given deviation**

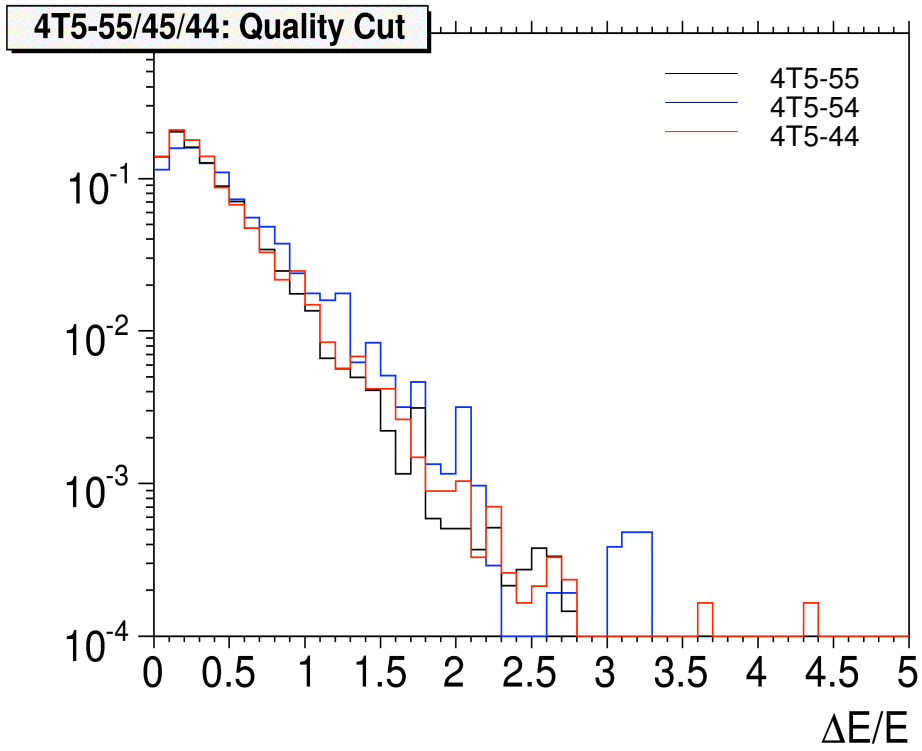
4T5-55 #ent: 111689 --> -1.2 +- 9.0 % **30%: 4T5-55: 0.9 % 4T5-45: 1% 4T5-44: 3%**

4T5-54 #ent: 42449 --> -1.7 +- 9.2 % **50%: 4T5-55: 0.13% 4T5-45:0.07% 4T5-44:0.2%**

4T5-44 #ent: 10308 --> -2.4 +- 12.3 %

Angular discrepency of 5T5 & 4T5





0.2°

0.3°

→ **By checking in the recovered events in the new herald we noticed that a cut on the angular reconstruction is also needed**

Still needs to be done

This is a preliminary result:

- Check the angular discrepancy
- Run it with the latest version of the CDAS reconstruction
- Try some crossed definitions e.g. : 5T5-5Pos2
- Optimize the quality cuts
- Implement it in the Observer reconstruction and cross-check the results
- Look up to what energy we still remain within the critireas we fixed