Energy resolution

- Principle of Neural Network
- Variable used in Kais work
- How to improve energy resolution with the NN
- New variables
- The shower display
- The showers beginning
- Conclusion & further work

Principles of Neural Network

- The neural network is a “intelligent” program capable of “learning” parameters which corresponds to physicals variables like energy
- After “training” the NN with some knowns parameters and corresponding energy, it can deduces the energy from new parameters

Variables used in Kais work

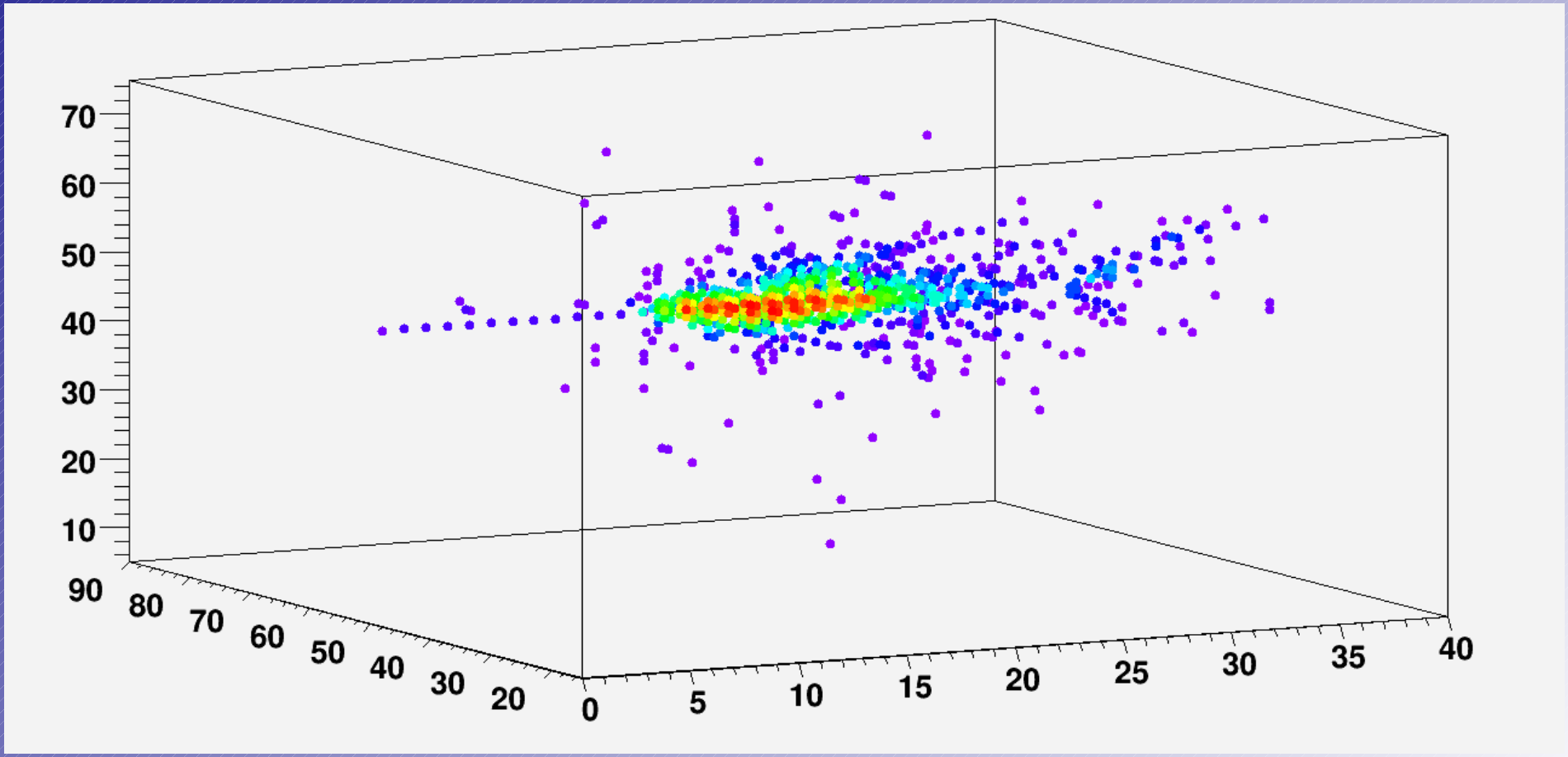
- Kais used three variables in the NN input
- These variables correspond to the number of hits who trigs the three thresholds of the detector
- Kais obtained the energy with a good resolution but we hope to improve this resolution

How to improve energy resolution

- We can use the features of our detector (like the high granularity) to compute new variables which can help the NN with the energy reconstruction
- These new variables can be found by a good understanding of the showers development
- For this purpose we can display the hadronic showers and look if the variables fits with data

Event display

- An example of the display I am using to check my variables (with density in color gradient)



New Variables

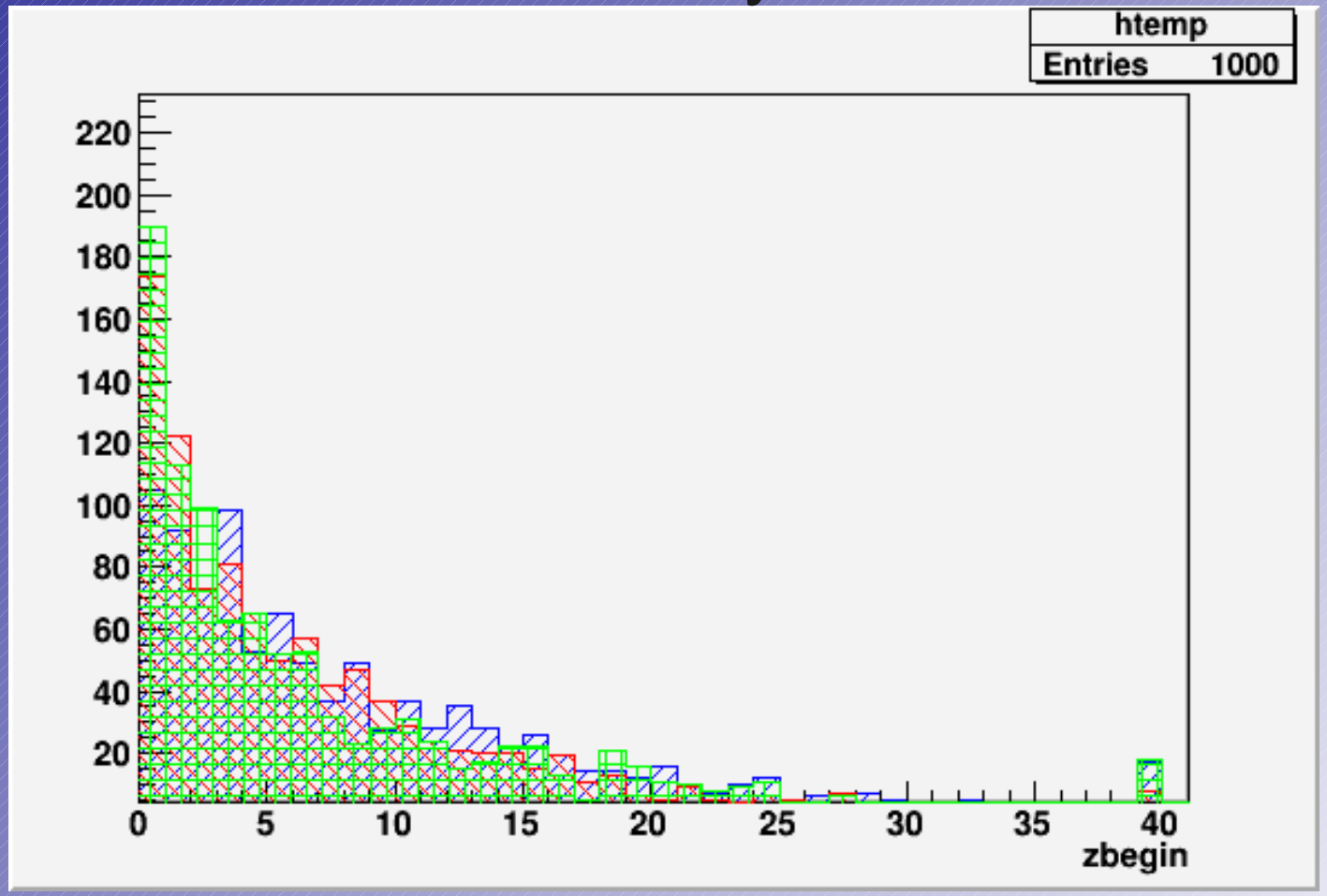
- We think that interesting variables can be :
  - The shower beginning
  - The position the shower maximum occurs
  - The radius of 95 % of lateral shower containment
  - The length for full longitudinal containm
  - The density
  - ....

The shower beginning

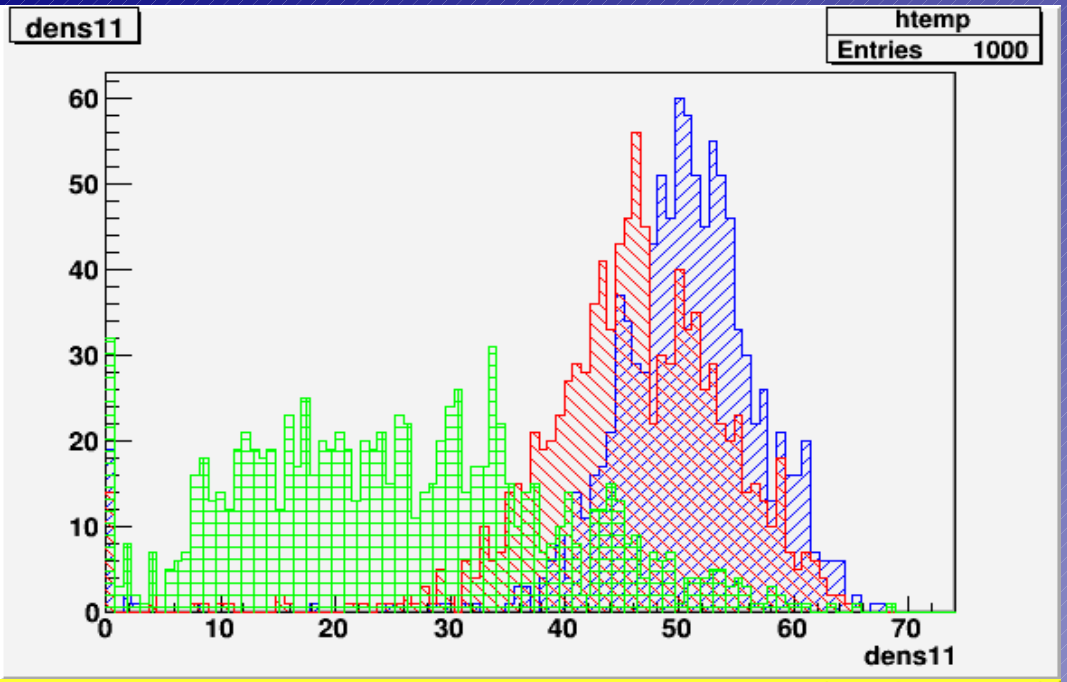
- The data I 'm using for computing the variables are those provided by Rhan from Gean4t simulation of Pions for different energies
- I have computed several variables for 10 , 50 and 100 GeV Pions and for 1000 events
- I have plotted histograms of those variables for these 3 energies to determine if we can use them to evaluate the energy

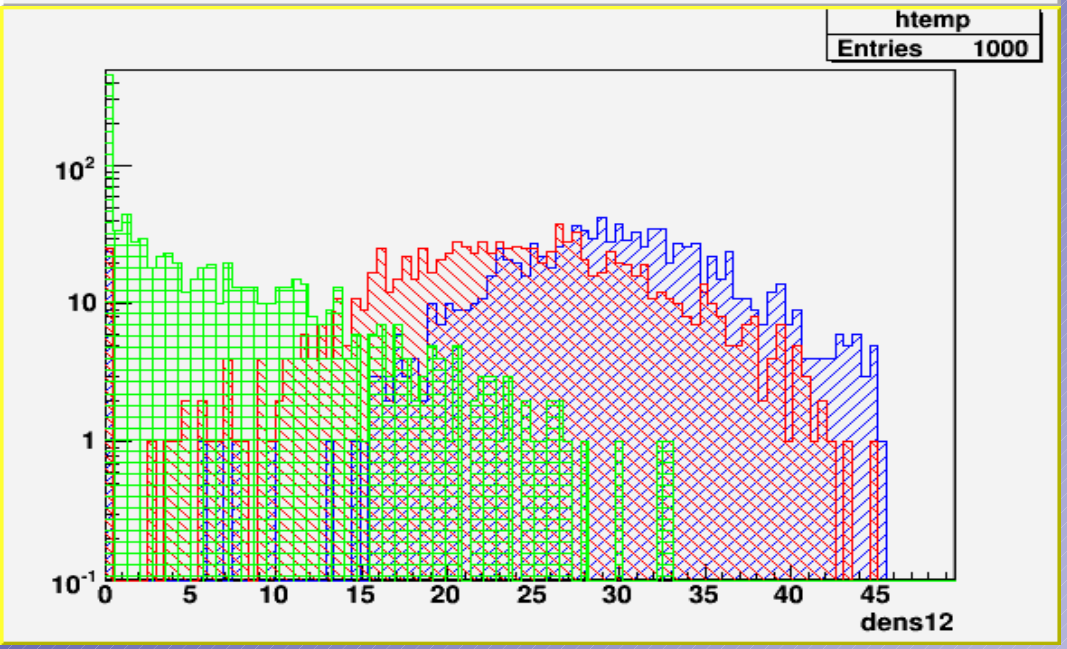
The shower beginning

- Histogram of the layer corresponding to the shower beginning (there are 40 layers in the simulation)
- We can see that it is not very discriminant



The densities



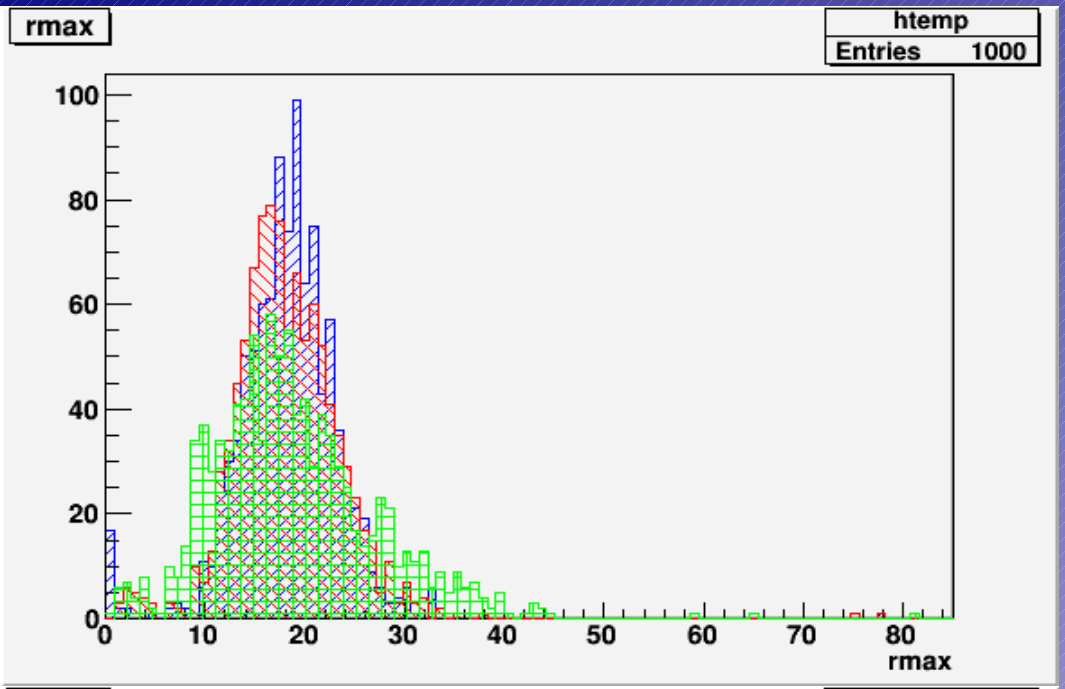


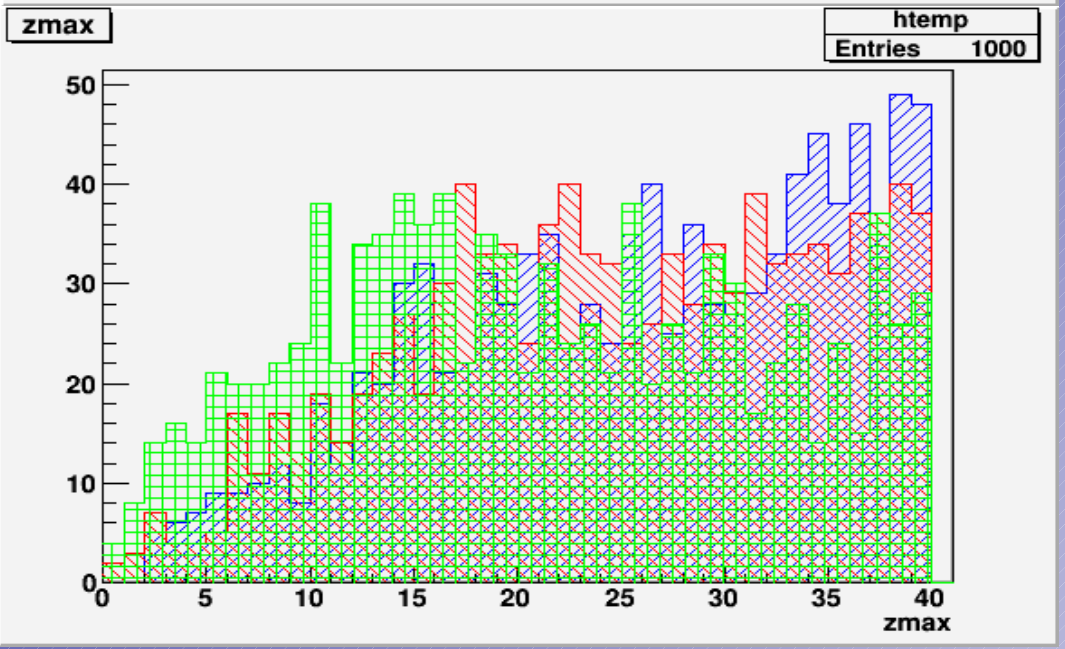
.In colors :

- 10 GeV → green
- 50 GeV → red
- 100 GeV → blue

- 3 kinds of pads are define
- The first one is for a density larger than 4 hits
- The second one is for a density larger than 10 hits
- We can see that the separation between energies is more clear that for the beginning

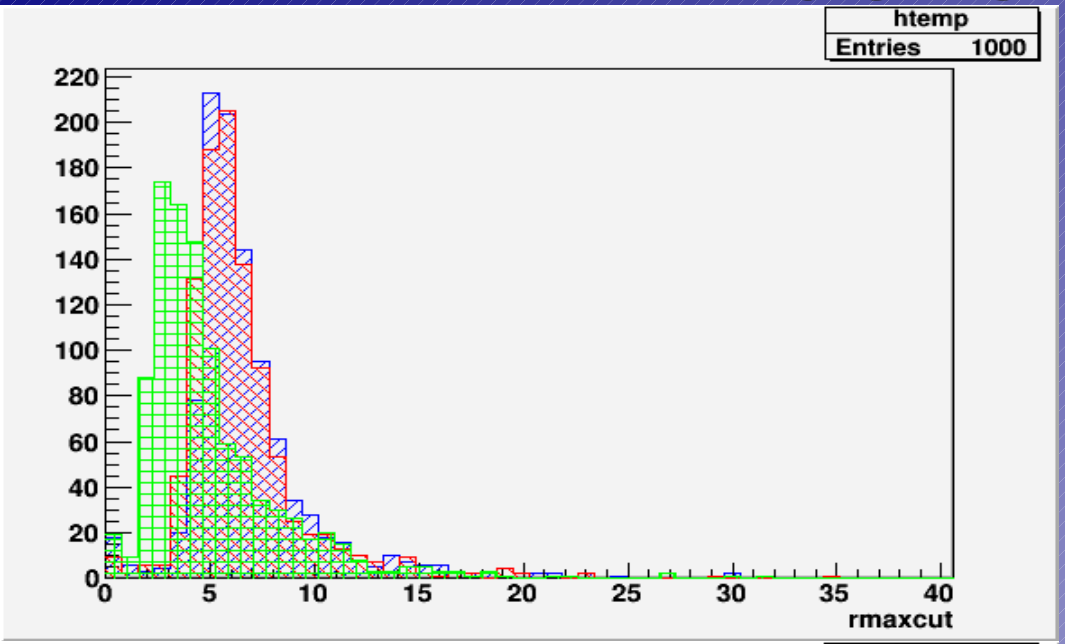
The maximum lateral radius

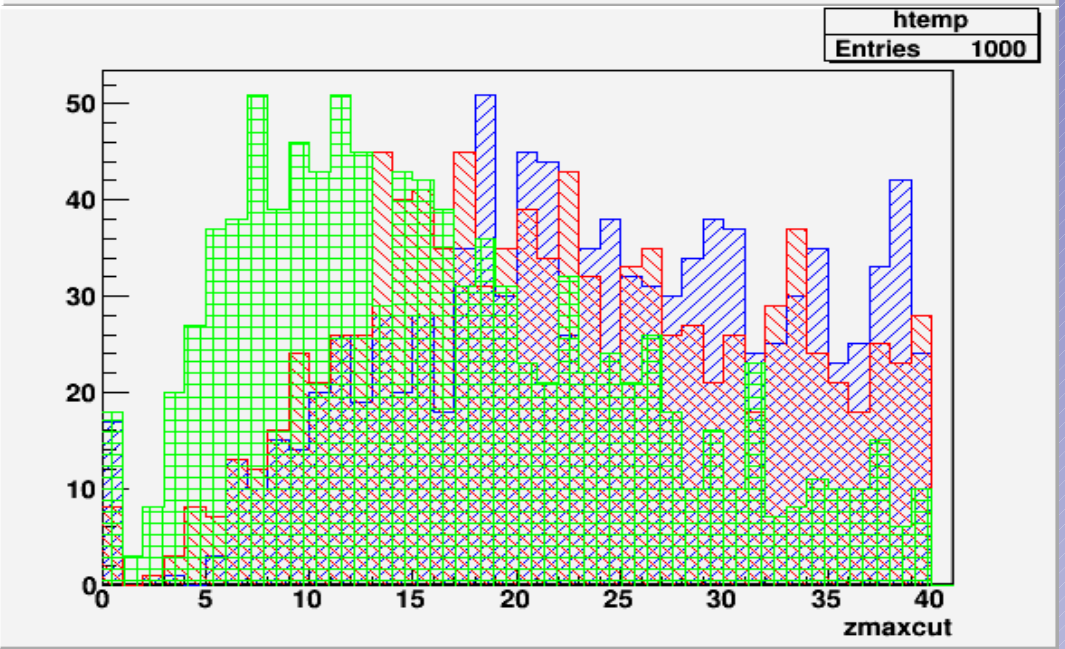




- Histograms of the maximum radius including 95 % of the hits (up) and the corresponding layer (down)
- These two variables are not very determinant because we take too much hits around the axis of the shower
- That why we try to apply a cut on the density

The maximum lateral radius with density cut

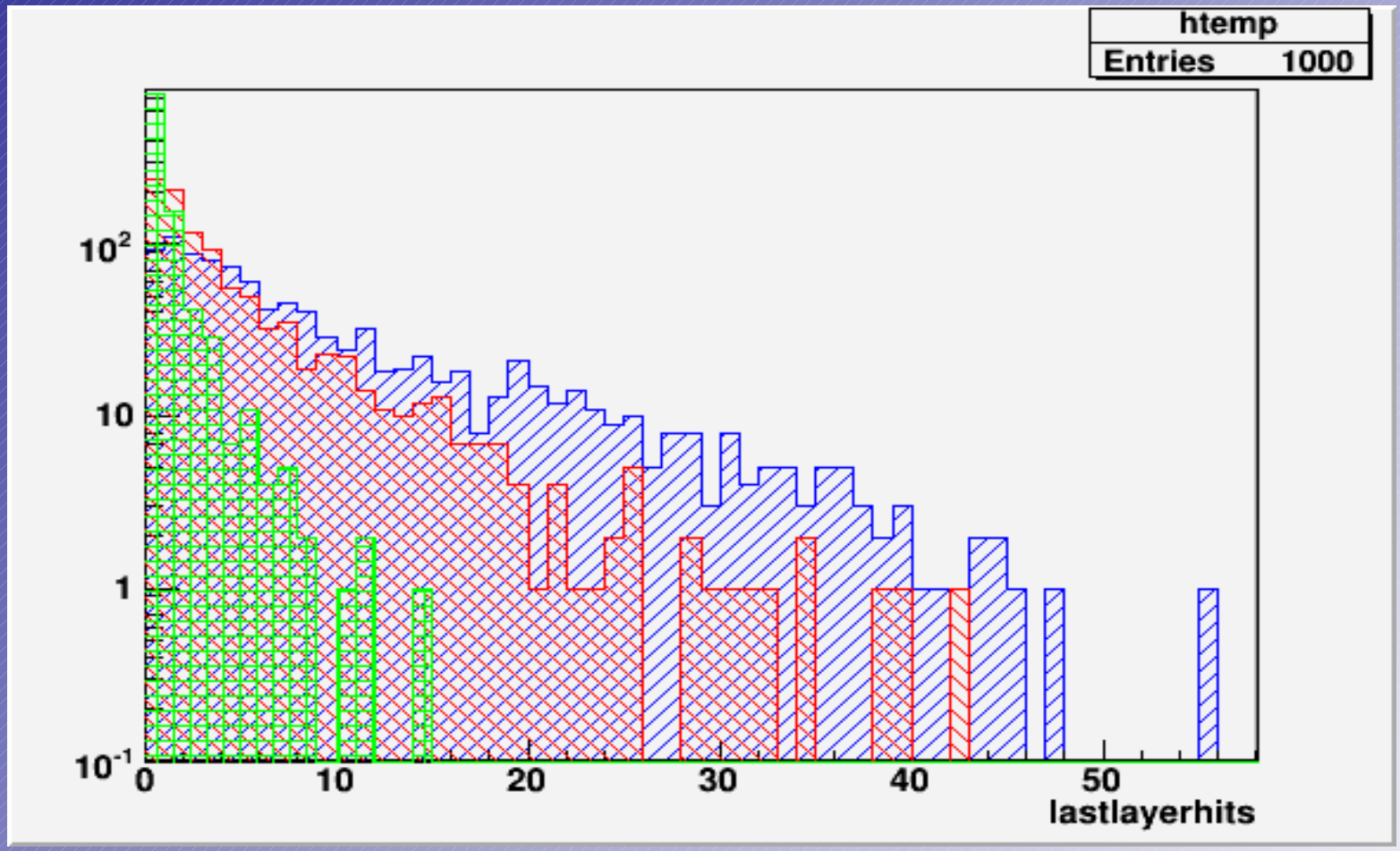




- Same histograms as previous slide but taking only the pads which have a density larger than 3 hits in 1 pad region
- We can see that the 10 GeV are quiet separated of the other energies but that the difference between 50 and 100 GeV are not obvious

Hits in the last layer

- Histogram of the number of hits in the last layer
- This variable is not bad but we are going to add additional information about the last layer : the shower spread around the axis



further work

- Put the helpful variables in the NN
- Find new variables
- ....