Understanding measurements with single glasses

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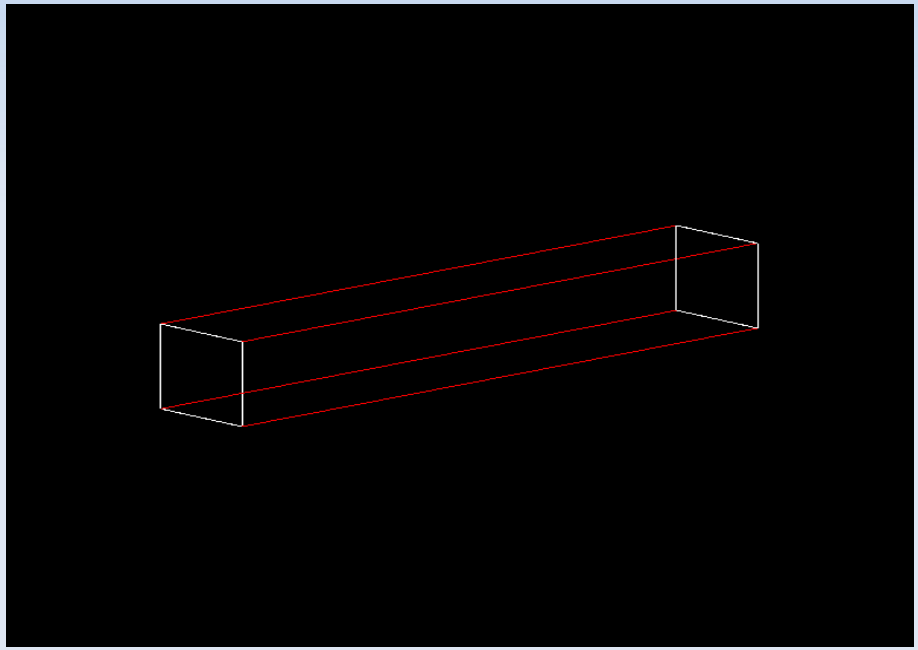
- A simulation is needed in order to interpret the data taken with cosmic muons and test beam protons, pions and electrons and thereby obtain properties of the scintillating glasses and evaluate the methods of photodetection used.
- This simulation will need to incorporate photon production and tracking inside the glass
- We started off with the DRCAL simulator kindly supplied by Hans Wenzel and we are modifying it for use with our glasses

Glass Main Properties

Our glasses are composite materials:

BaO	43.4%
SiO_2	42.5%
Li_2O	4.0%
MgO	3.3%
K_2O	3.3%
Al_2O_3	2.0%
Ce_2O_3	1.5%



- They have dimensions 15x15x89 (7.5x7.5x89) cm^3

DRCAL changes

- The original DRCal simulation used BGO crystal
- We have to modify the simulation in order to work with our glasses
- Changed the material using the G4Element and G4Material objects
- Changed the geometry
- The refraction index is taken 1.61 for all energies.
- Trasmittance data are taken from previous measurements

The data

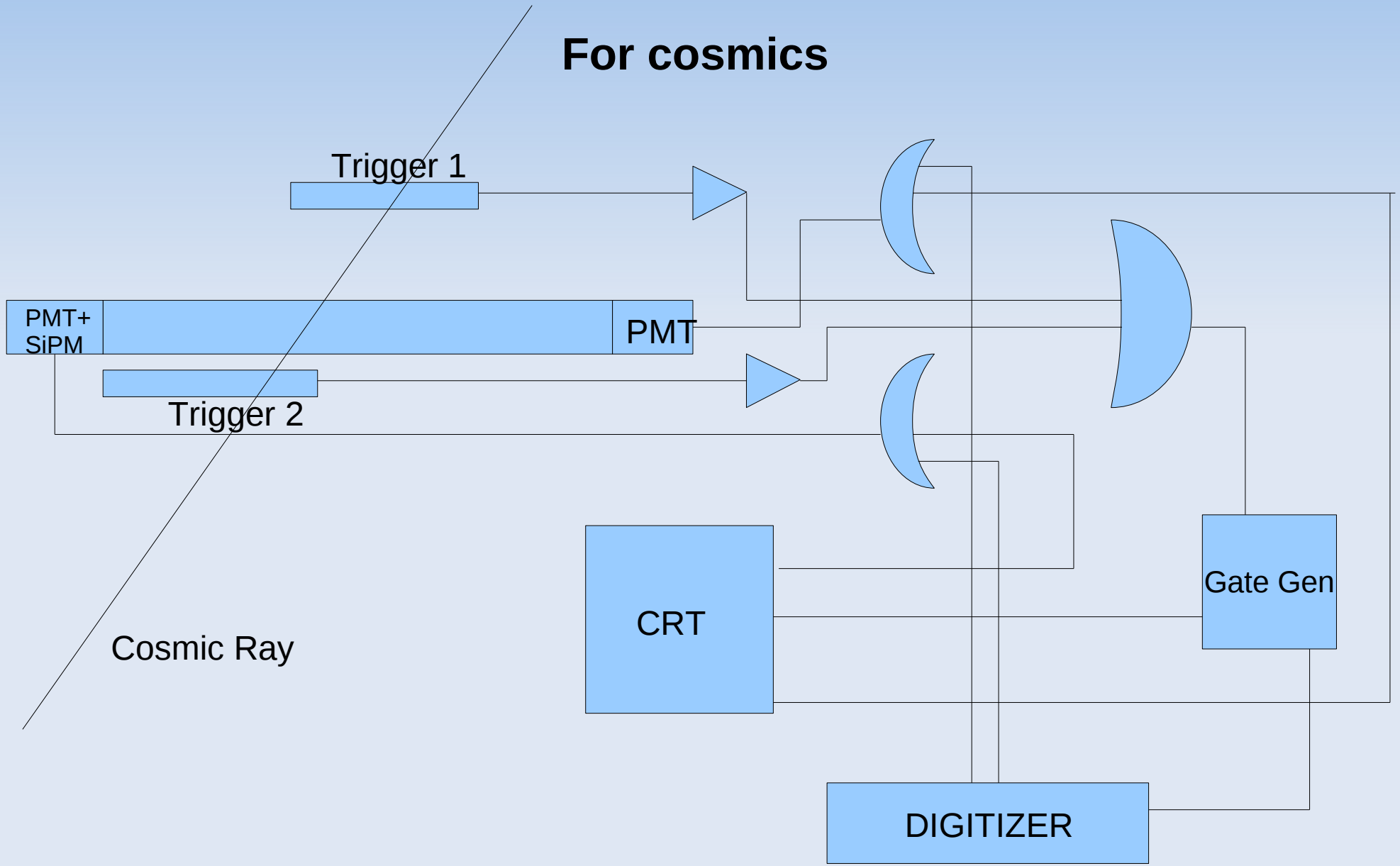
Two sources of data:

- Data are taken using cosmic rays (muons)
- Data taken at test beam (protons, pions, electrons and muons) at known energies and well-defined directions

Data Acquisition: oscilloscopes, and pulse shape digitizers (TB4 and CAEN)

Photodetectors: PMTs and SiPMs

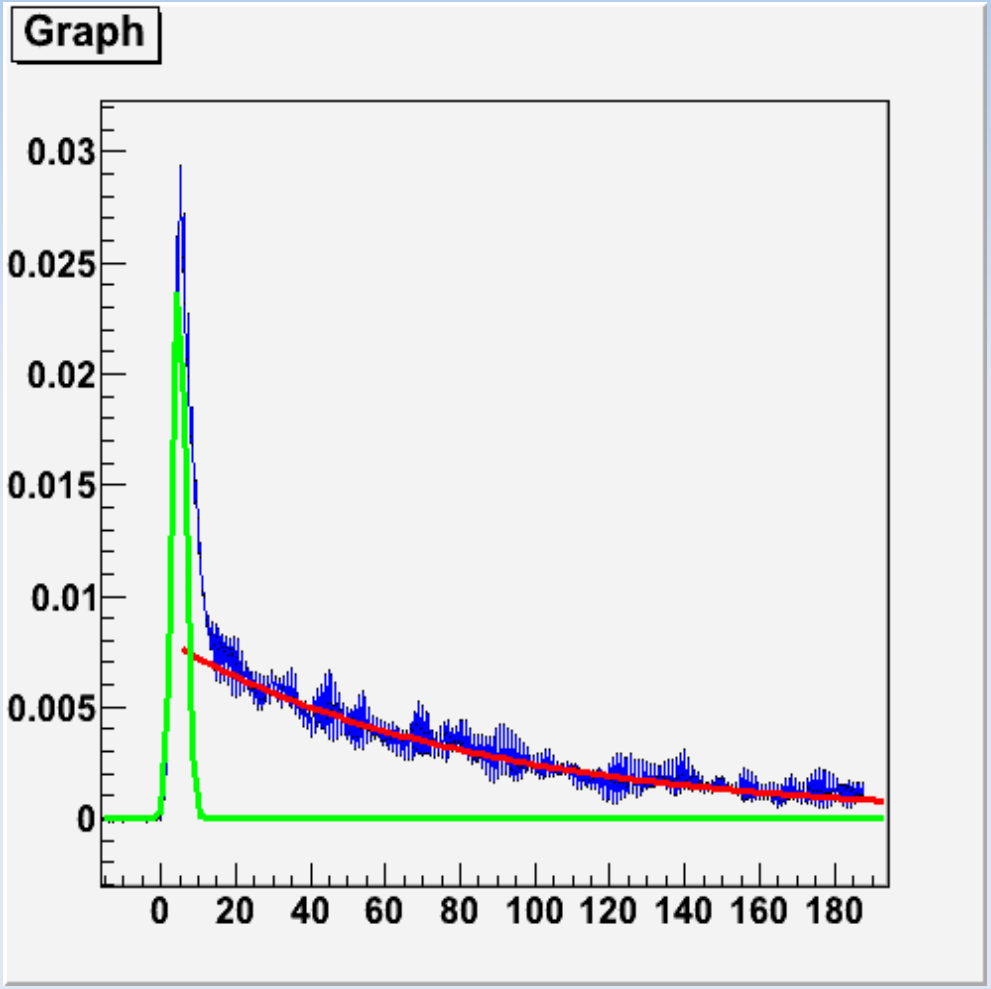
Experimental setup

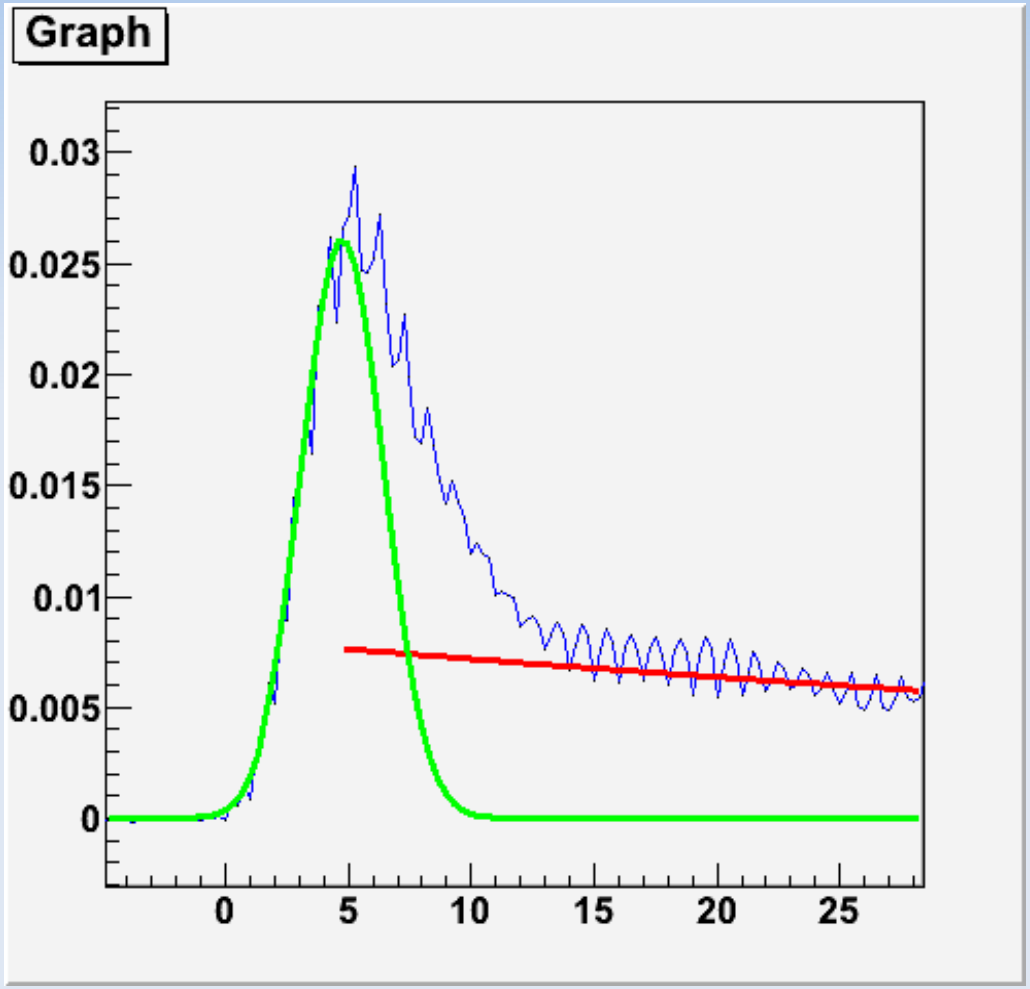


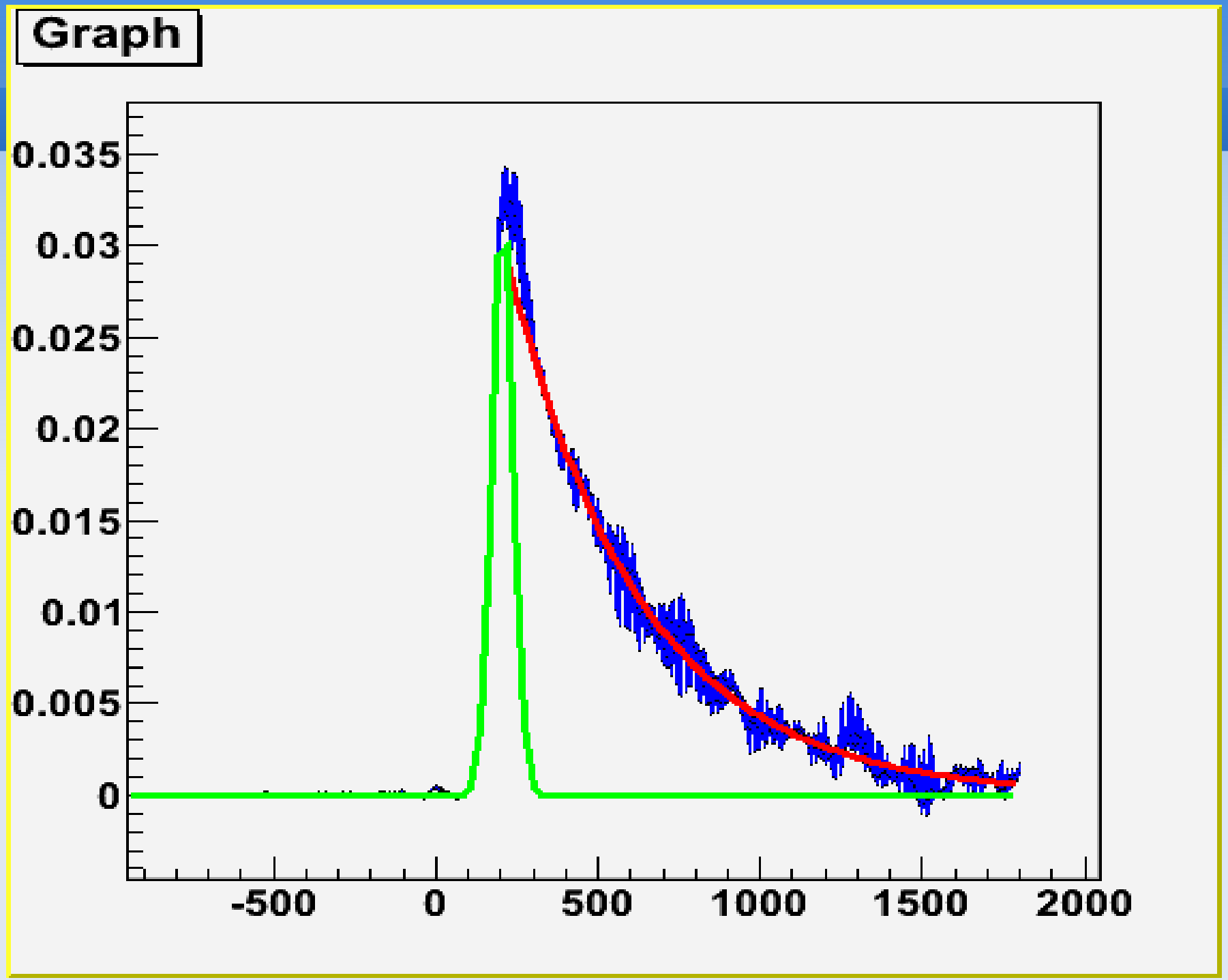
Data analysis

- The analysis should aim at separating the Cherenkov and scintillation components in the signal on the basis of their different time distributions. These results can then be compared with the simulation.
- The analysis is relatively simple for muons
- A Root macro is being designed to fit the signal so as to integrate the scintillation and Cherenkov contributions and find the scintillation decay time

- To begin with, the signal is fitted in two parts
- The cherenkov peak with a gaussian curve and the scintillation part with an exponential curve
- The separate fits are then summed to obtain the whole signal
- For a set of cosmic ray data we obtain the following


Graph
0.03
0.025
0.02
0.015
0.01
0.005
0
0 20 40 60 80 100 120 140 160 180


Graph
0.03
0.025
0.02
0.015
0.01
0.005
0
0 5 10 15 20 25


Graph
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
-500
0
500
1000
1500
2000

Further improvements to analysis

- Improve the fit method by using a convolution of the gaussian and exponential functions to fit the data. The parameters obtained from this preliminary method can be used as starting values for the fit.
- When the simulation is complete, the results of the data analysis will be compared with the simulation in order to extract glass properties such as the ammount of light generated and the relative proportions of scintillation and Cherenkov