Understanding measurements with single glasses II

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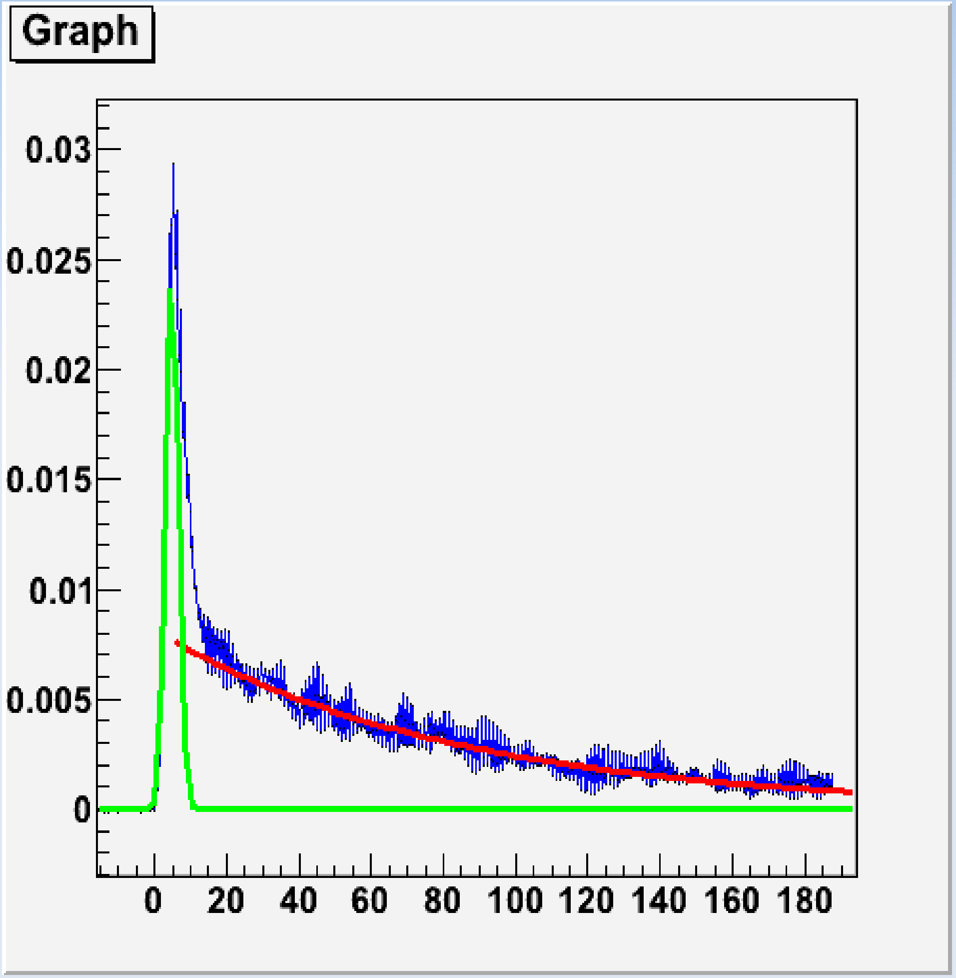
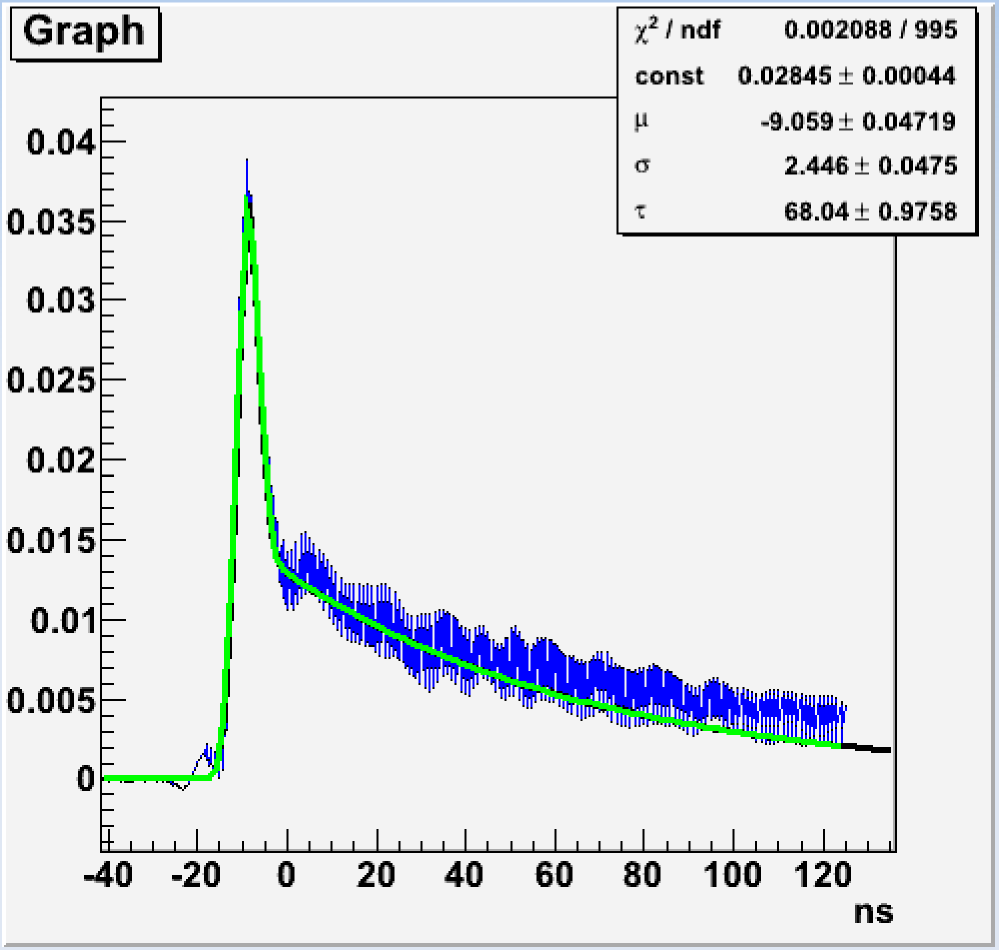
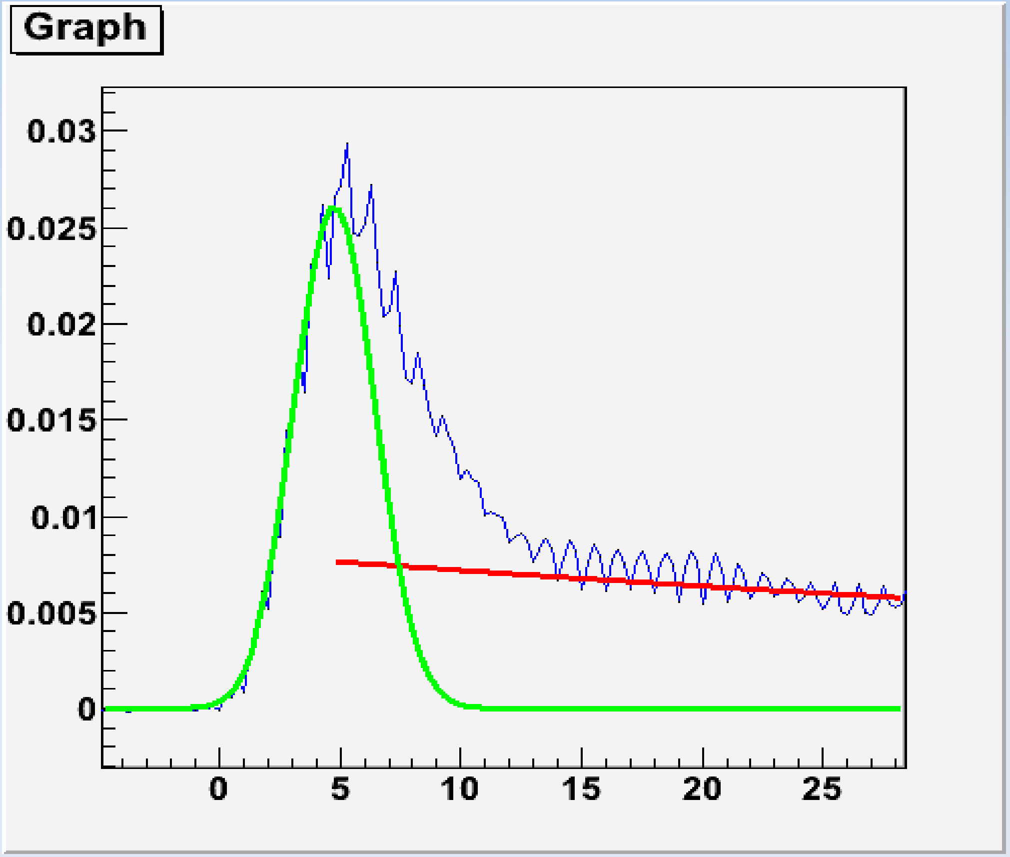
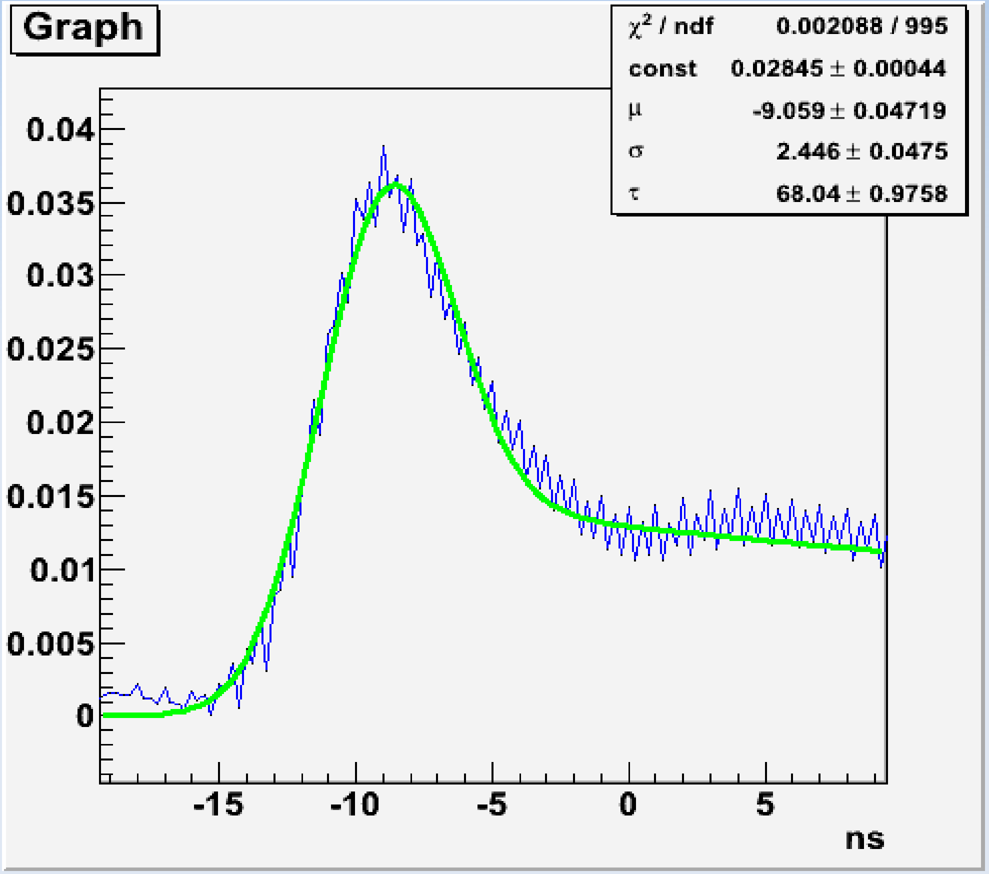
- The analysis of the scintillating glasses has the goal to separate cherenkov and scintillation effects on the basis of their different time distributions.
- These results can then be compared with a simulation.
- For now we are still dealing with cosmic muons

- Previous analysis used a gaussian shape for the cherenkov peak and an exponential shape for the scintillation part.
- Now a convolution between a gaussian shape and an exponential shape is used for the scintillation part
- A gaussian shape is still used for the Cherenkov peak
- These two contribution are summed.


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
χ² / ndf 0.002088 / 995
const 0.02845 ± 0.00044
μ -9.059 ± 0.04719
σ 2.446 ± 0.0475
τ 68.04 ± 0.9758
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
-40 -20 0 20 40 60 80 100 120
ns


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


Graph
χ² / ndf 0.002088 / 995
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μ -9.059 ± 0.04719
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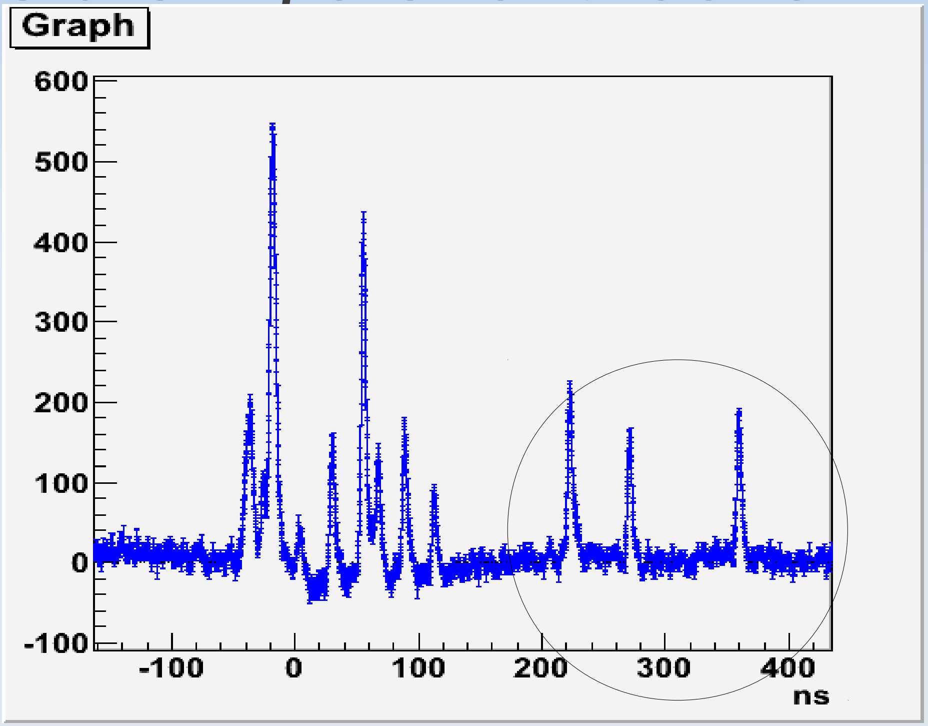
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
-15
-10
-5
0
5
ns

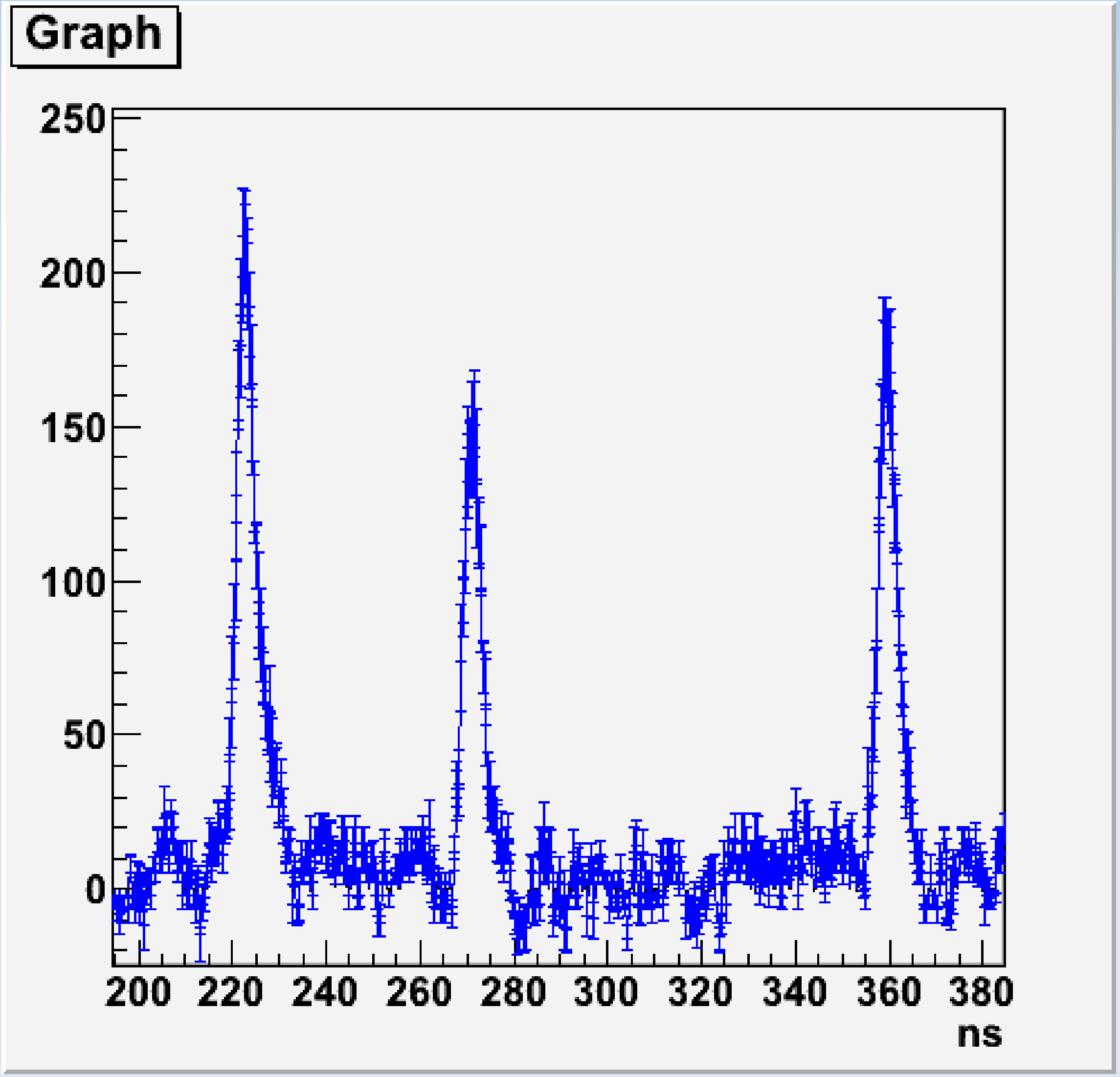
- Our main goal is for the moment understanding how the photodetector response influences the overall pulse shape
- We are investigating the photodetector response using two methods:
- Firstly looking at single events coming from interaction between cosmic rays and glasses.
- Secondly simulating Cherenkov events using a picosecond infrared laser source.

Single event analysis

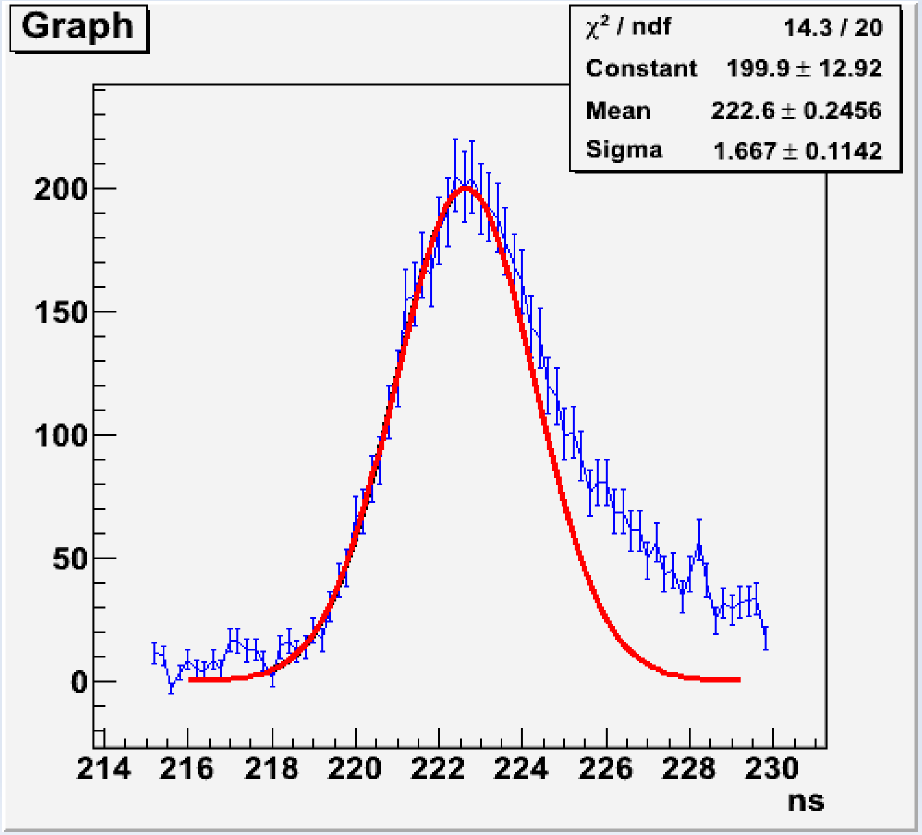
- This is as a single event looks like:

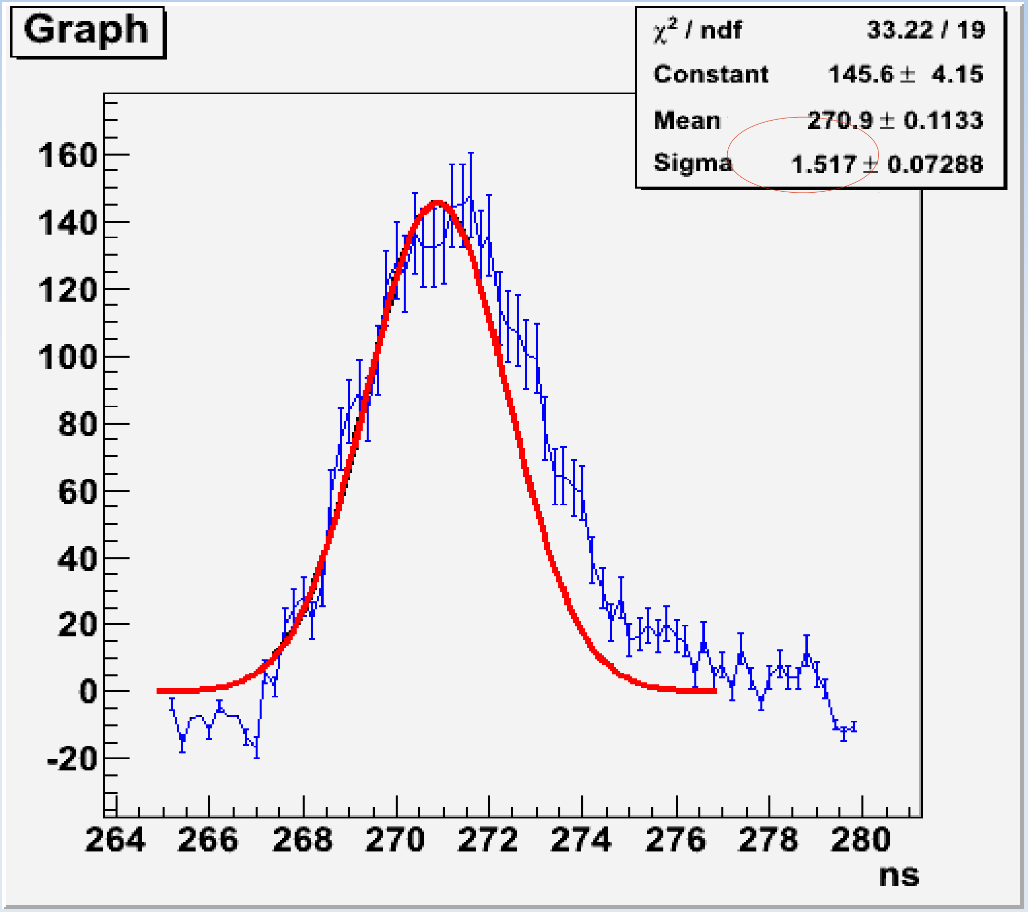


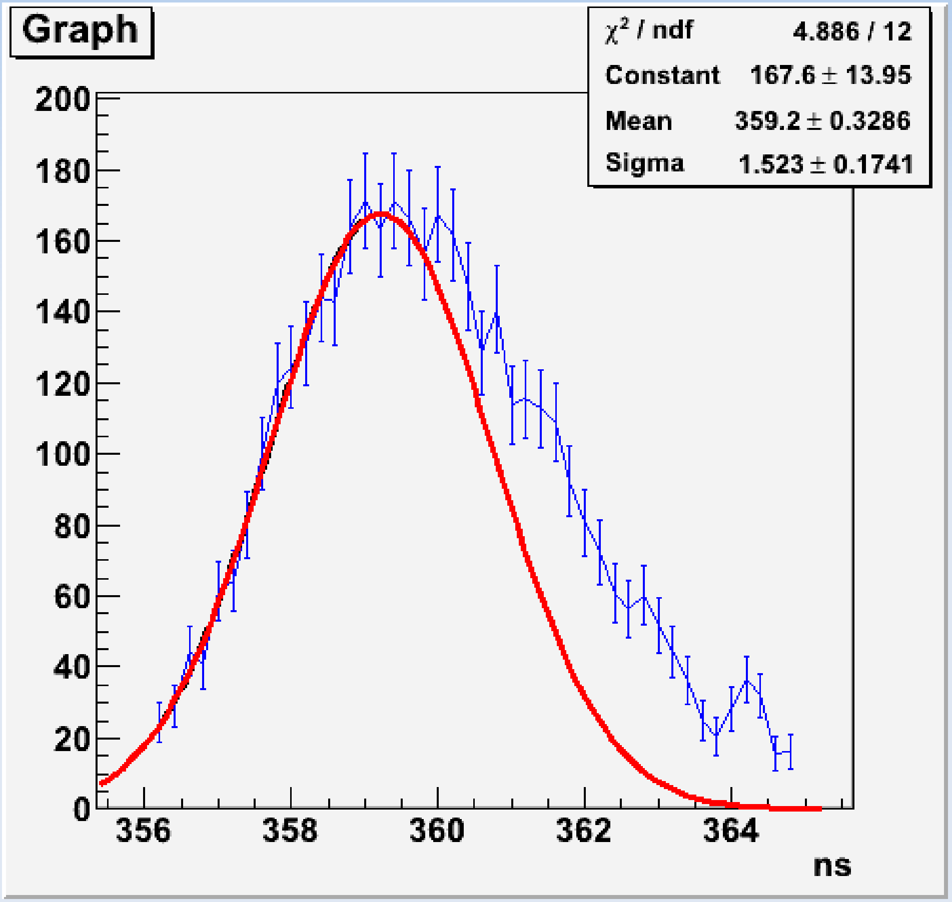
- The number of photoelectrons is limited so that single photoelectrons ca be isolated. The photoelectrons in the circled area are well isolated


Graph
250
200
150
100
50
0
200
220
240
260
280
300
320
340
360
380
ns

- Analyzing single peaks and obtained following fits shows the asymmetry.
- The fits are made only in the leading edge range

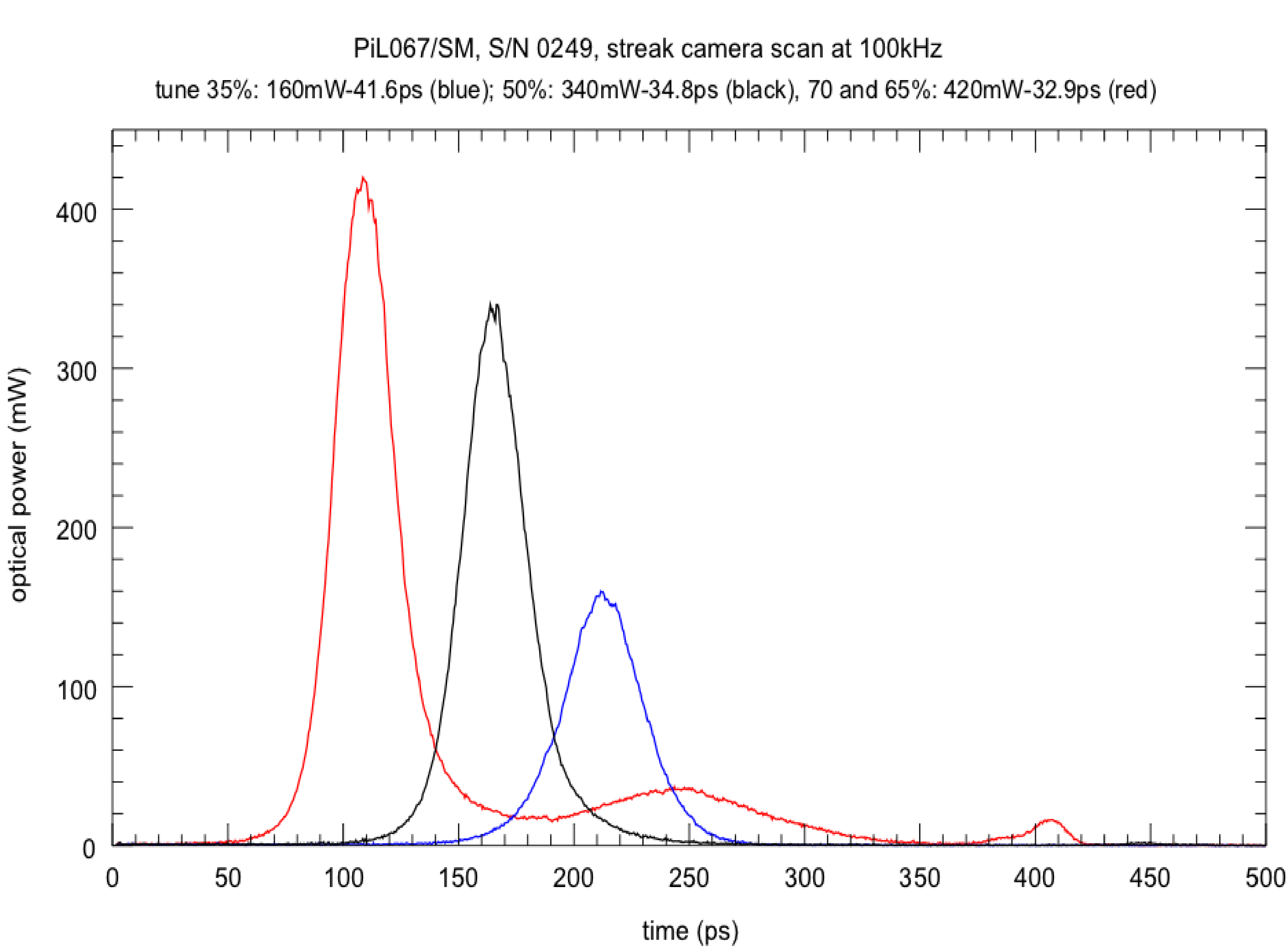



Graph
χ^2 / ndf 33.22 / 19
Constant 145.6 ± 4.15
Mean 270.9 ± 0.1133
Sigma 1.517 ± 0.07288
160
140
120
100
80
60
40
20
0
-20
264
266
268
270
272
274
276
278
280
ns

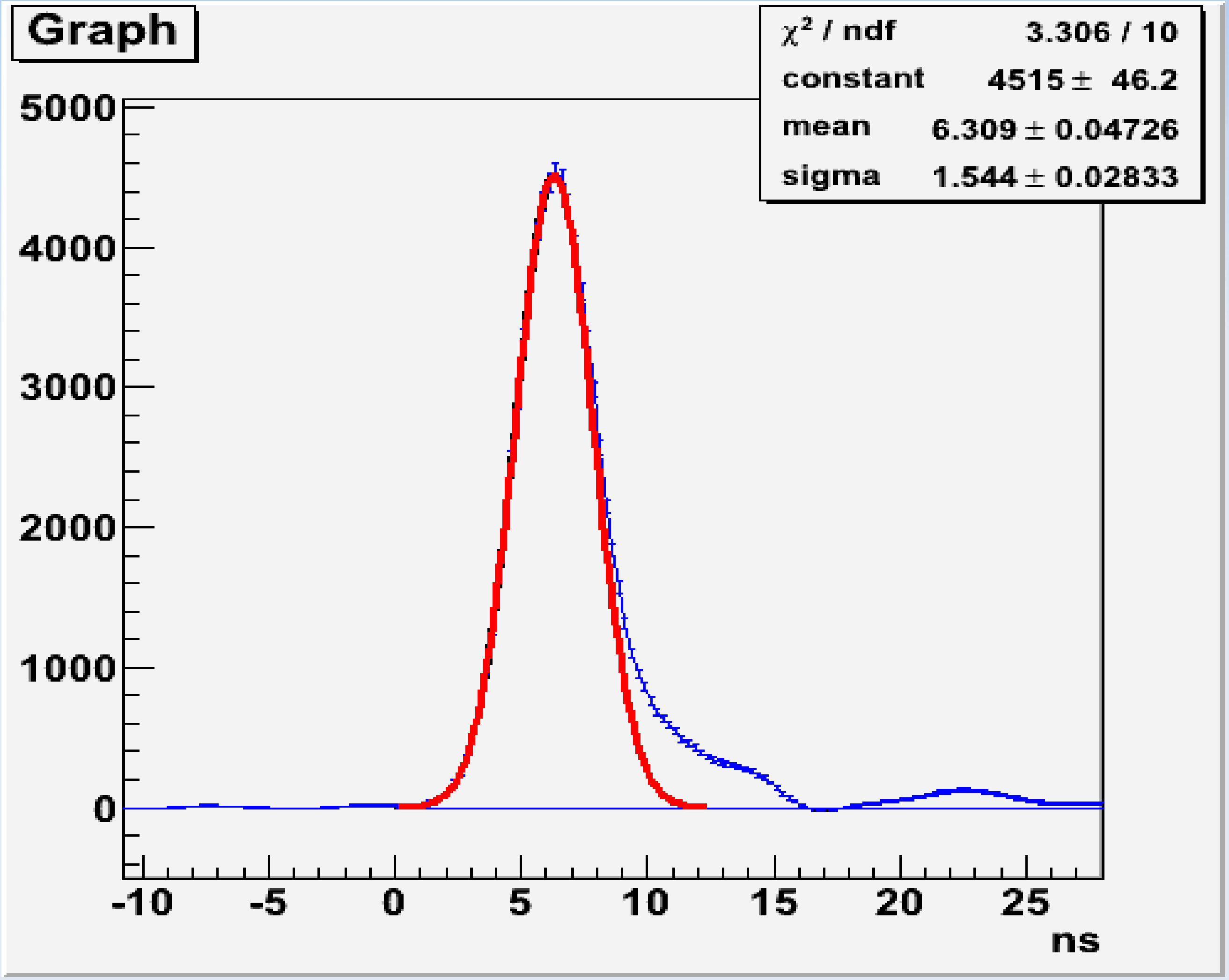

Graph
χ^2 / ndf 4.886 / 12
Constant 167.6 ± 13.95
Mean 359.2 ± 0.3286
Sigma 1.523 ± 0.1741
200
180
160
140
120
100
80
60
40
20
0
356
358
360
362
364
ns

Using a Picosecond IR laser

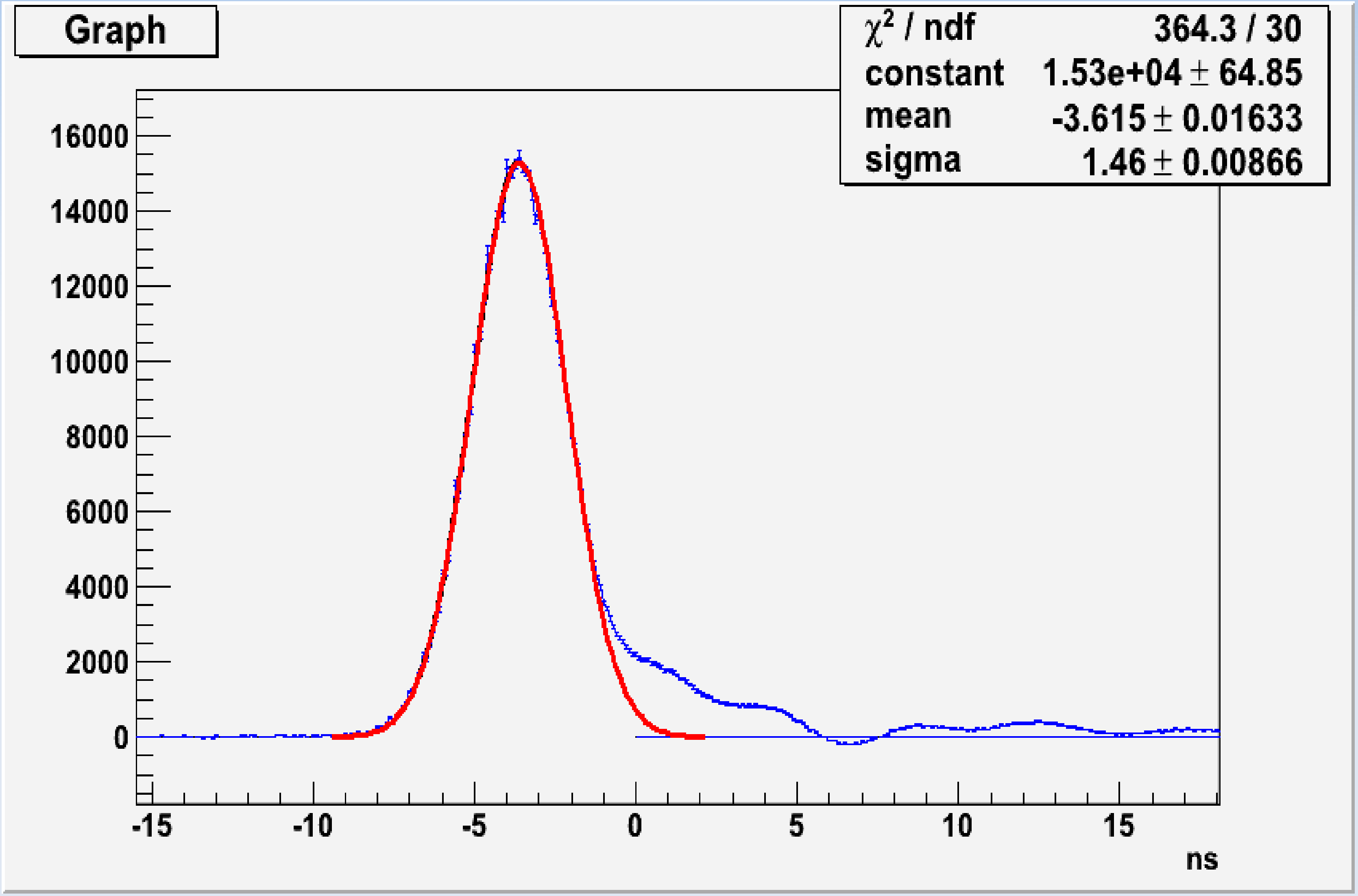
- The laser used is a Picosecond IR Laser
- Laser pulse width is about 35 picoseconds in so that it simulates Cherenkov pulses
- The potons are injected in the glass and also are projected directly to the phototube


PiL067/SM, S/N 0249, streak camera scan at 100kHz
tune 35%: 160mW-41.6ps (blue); 50%: 340mW-34.8ps (black), 70 and 65%: 420mW-32.9ps (red)
optical power (mW)
0
100
200
300
400
time (ps)
0
50
100
150
200
250
300
350
400
450
500

Directly to PMT



Through glass



Conclusions

- We have fitted the average pulse shapes from cosmic muons with a convolution of a gaussian with the sum of a deta function (for cerenkov) and an exponential (for scintillation).
- Cerenkov/scintillation contributions are about 0.4 as expected. The scintillator time constant is about 70 ns (as expected)
- We have then investigated the assumption of a Gaussian for the photodetector response using two methods
- In both methods we can see a RMS for the gaussian of the order of 1.5 ns.

Conclusions ctd.

- This is smaller than the width of the convolution gaussian obtained from the fit to the average pulse shapes of mip events (2.4 ns)
- This difference, as well as the deviations from the gaussian are more likely due to differences in photon path lengths rather than phototube contributions
- We plan to obtain an independent measurement of scintillation decay time by illuminating the glass with a U/V laser.