

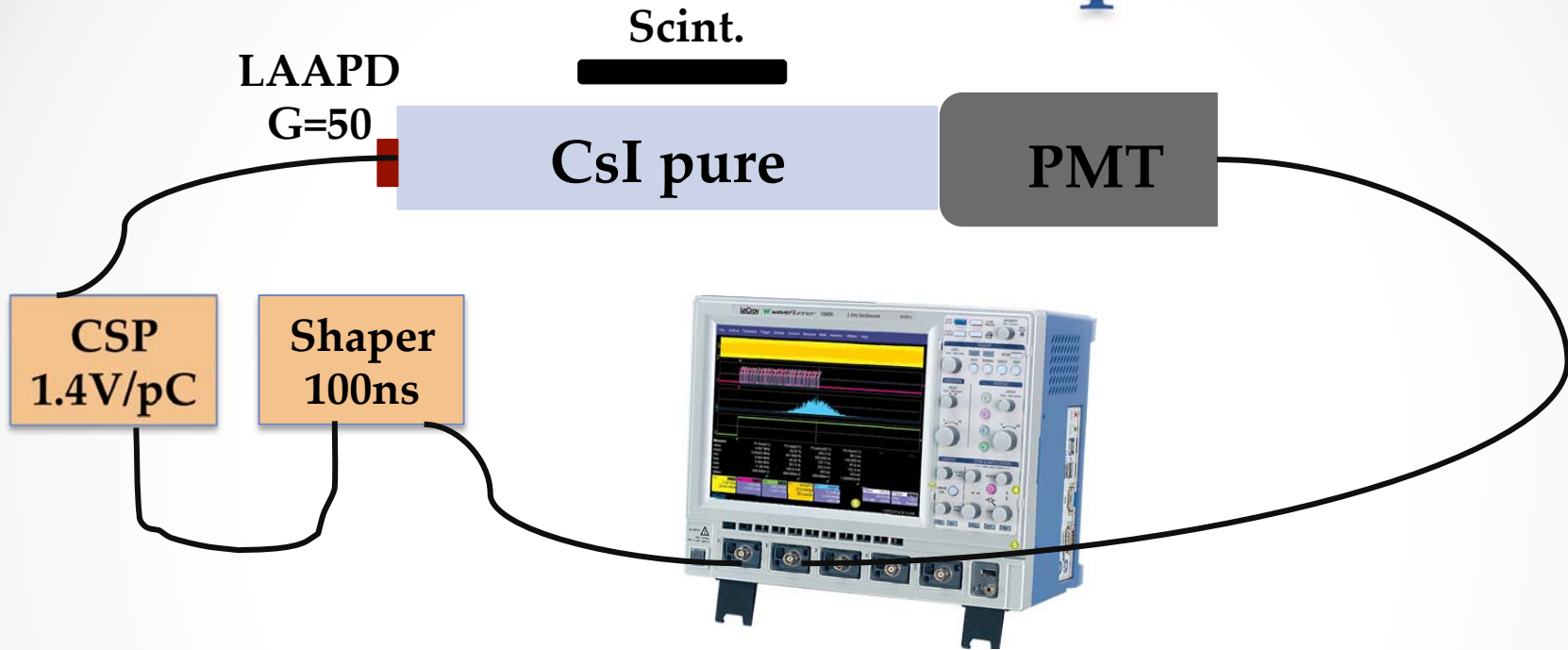
CsI (pure) Lab measurements

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Outline

- Power Supply changed
 - With the old one is not easy understand the real bias on LAAPD
- New measurements performed with 2 configuration:
 - 2 LAAPD
 - G=50 at 365 V
 - Test also at 380V and 390V
 - 1 LAAPD
 - G=50 at 442 V

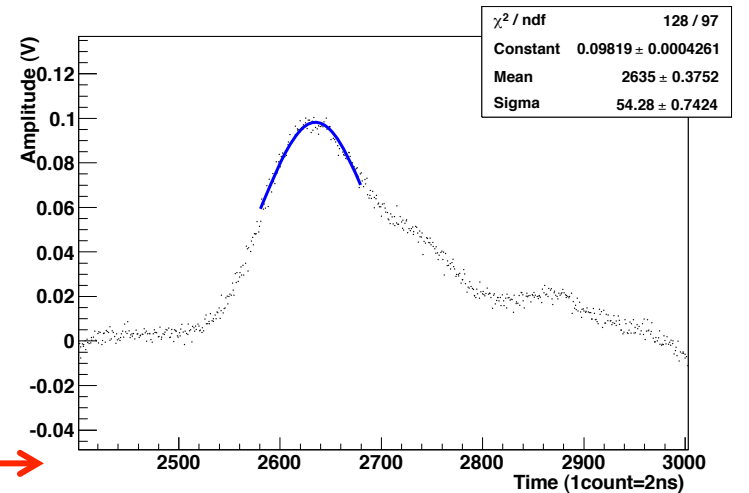
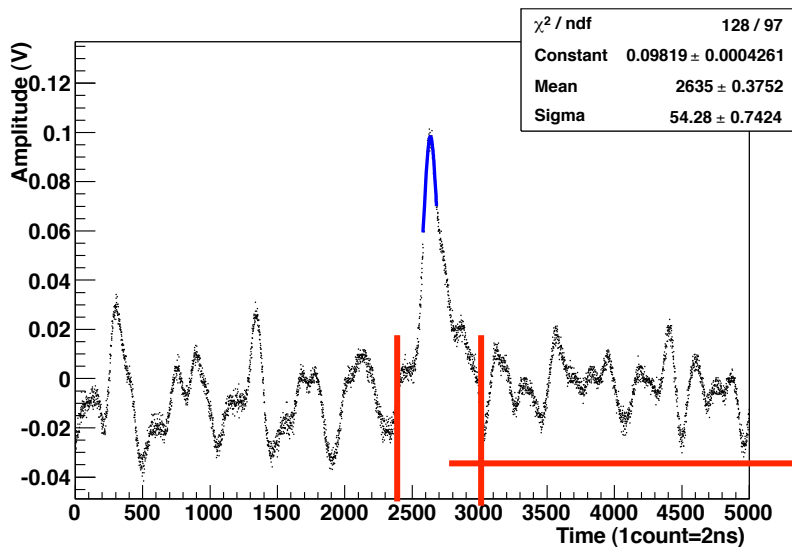
First SetUp



- DAQ with Oscilloscope
- Trigger: Scint + PMT coincidence
- 2 LAAPD : $G=50 @ 365V$; $V_{BD} = 410V$

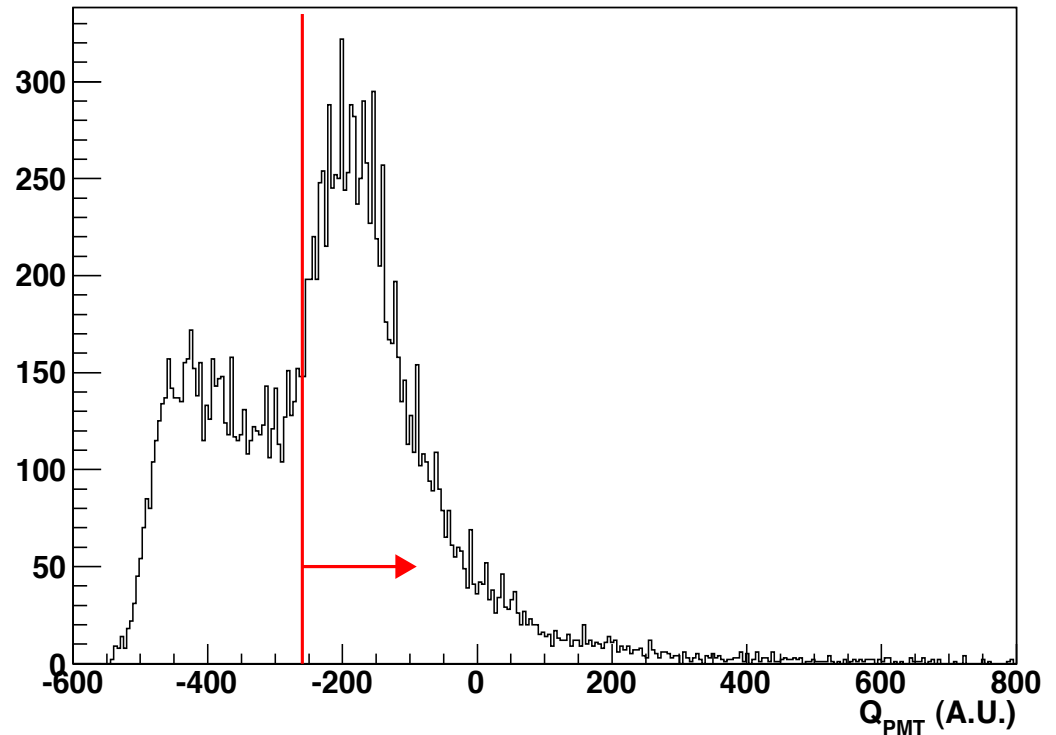
Data acquisition

- WaveForm from both LAAPD and PMT
 - 10 μ s window at 500 MS/s (5k counts)
- Peak extraction for LAAPD with a gaussian fit on a 200ns window around the expected position



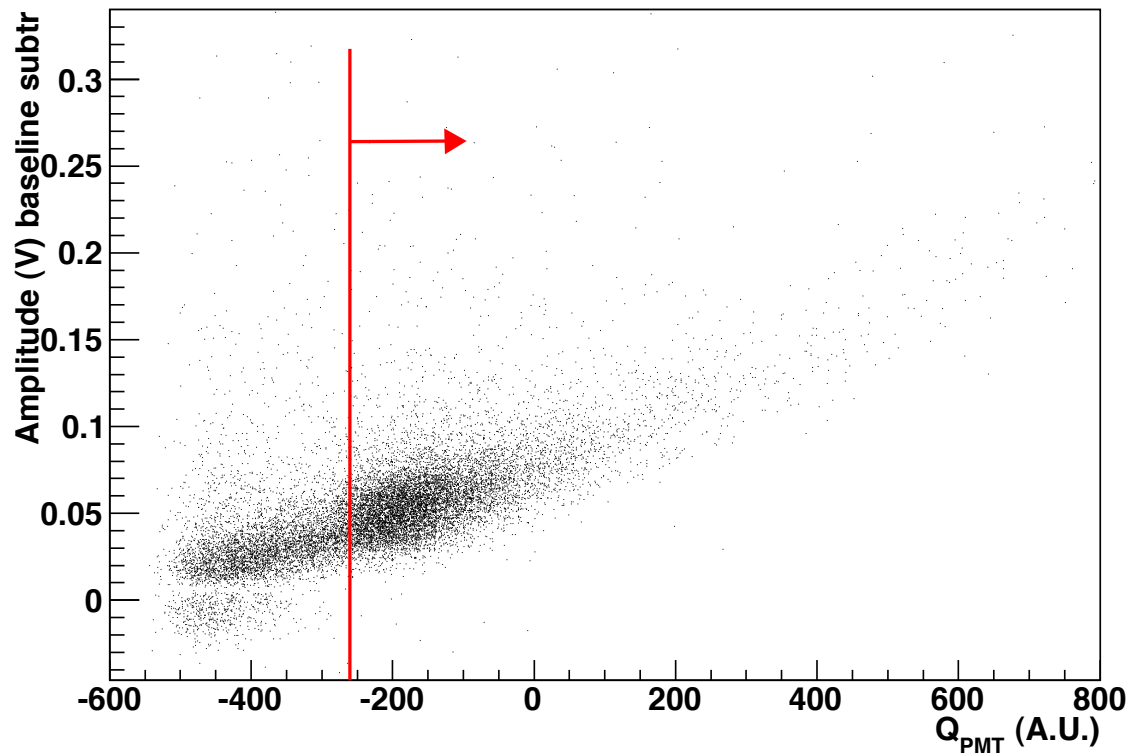
PMT Selection

- Integrated PMT Signal on a 500ns windows
- Select only events where cosmics go along all the crystal



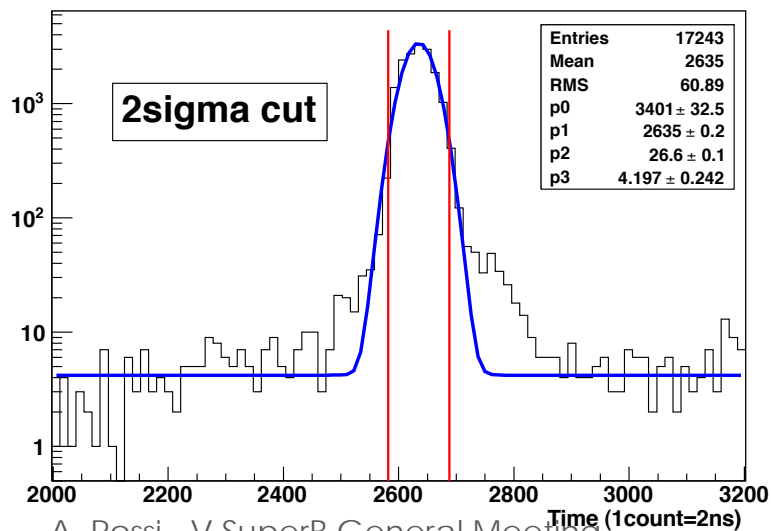
PMT vs LAAPD

- Clear correlation between PMT and LAAPD signals

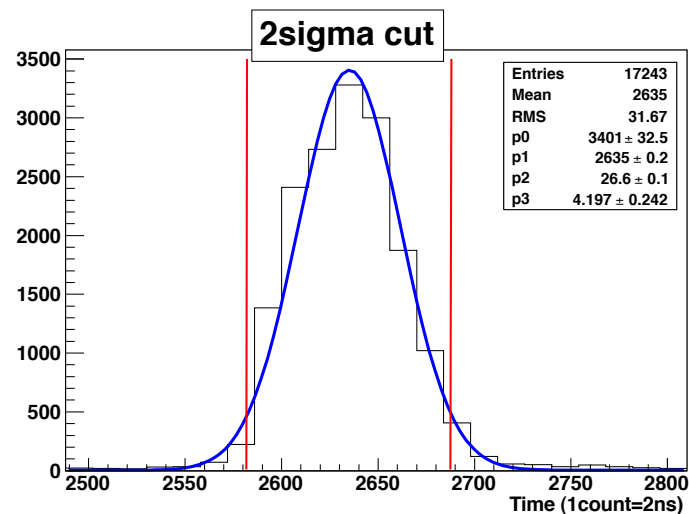


Time resolution and selection

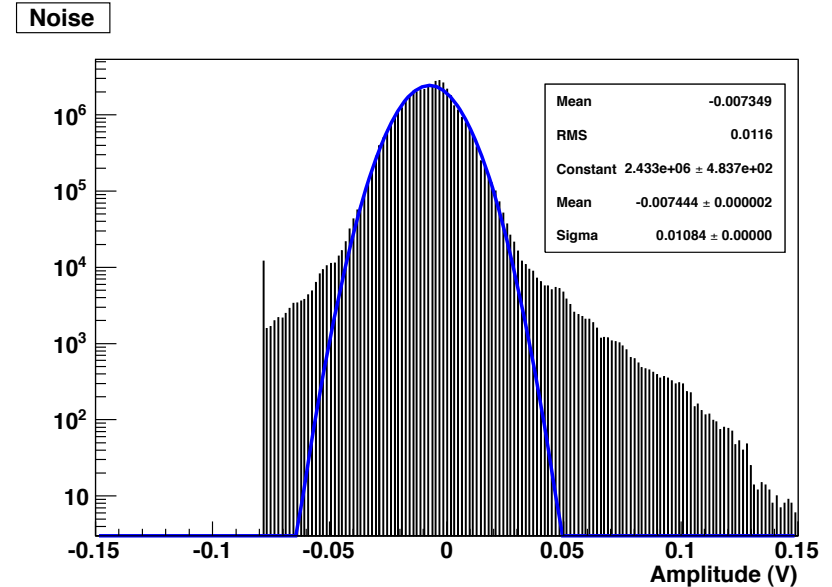
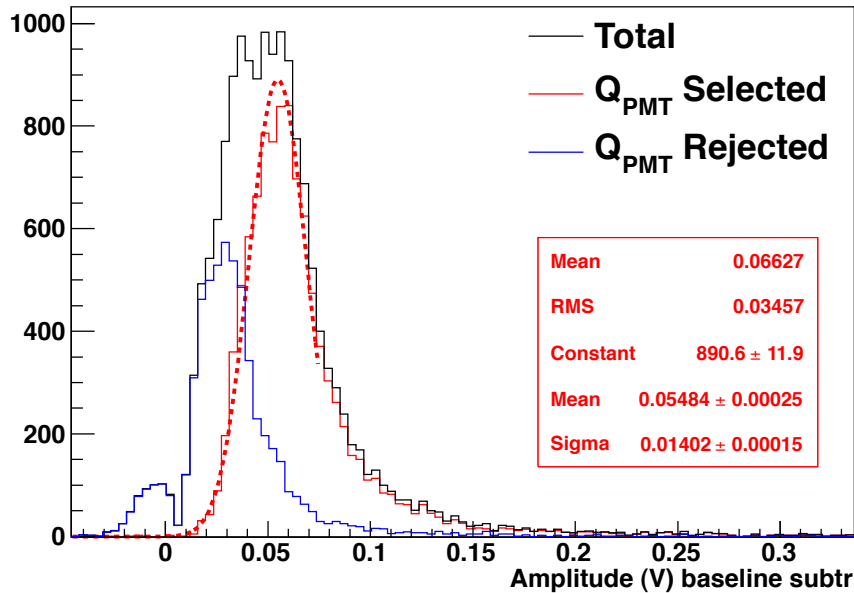
- Peak position with respect trigger is used to compute the time resolution
- A selection on the peak position is also applied (2σ cut around mean position)



At 365 V : time res. 53.2ns



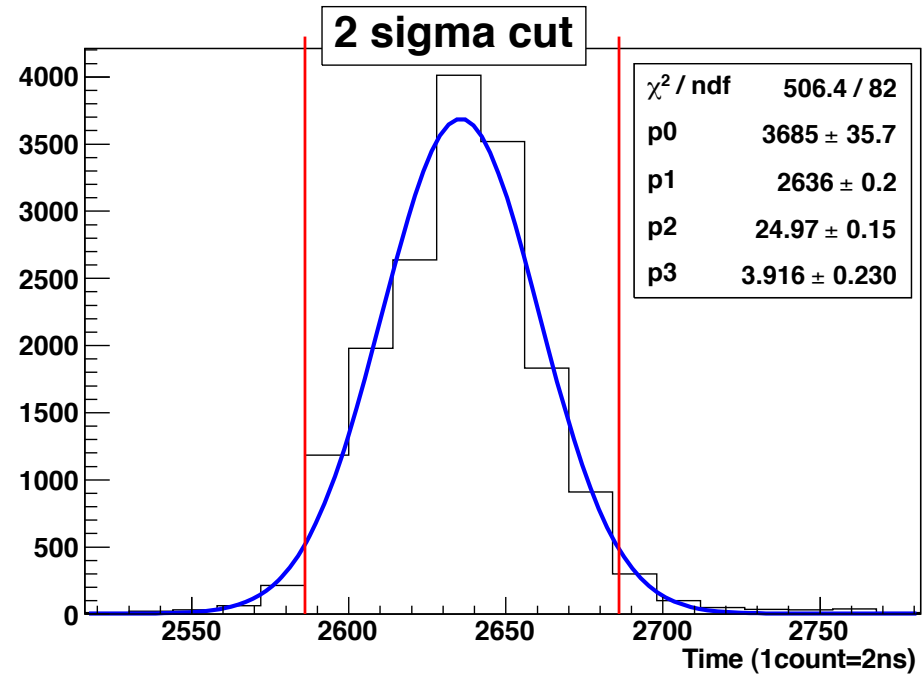
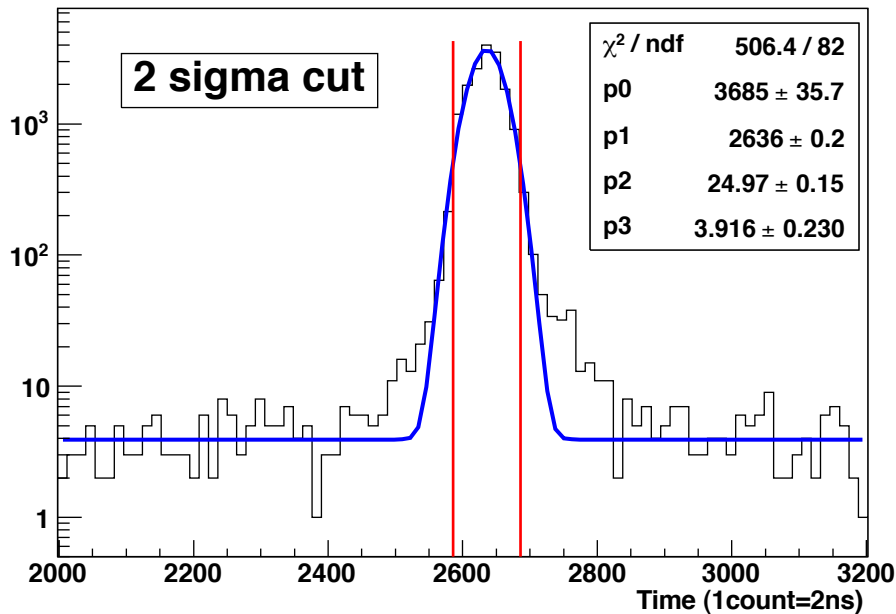
Results at 365 V (G=50)



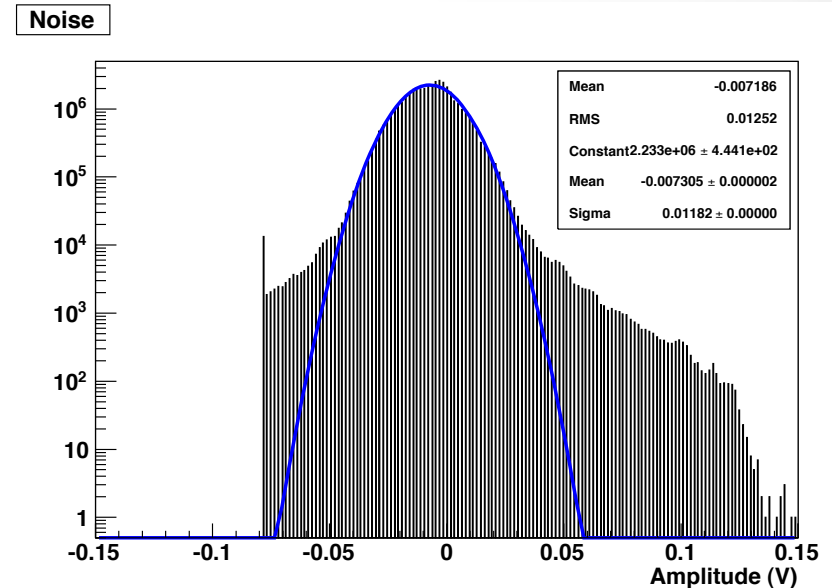
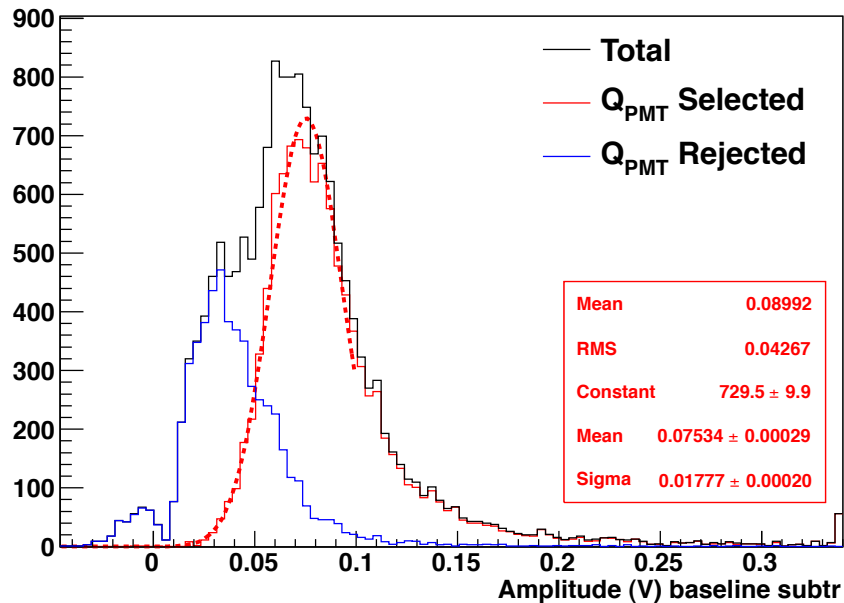
- Most probable signal on LAAPD ~55mV
- Noise level 11mV but with non-gaussian tails

Time at 380 V

- Time resolution : 50ns



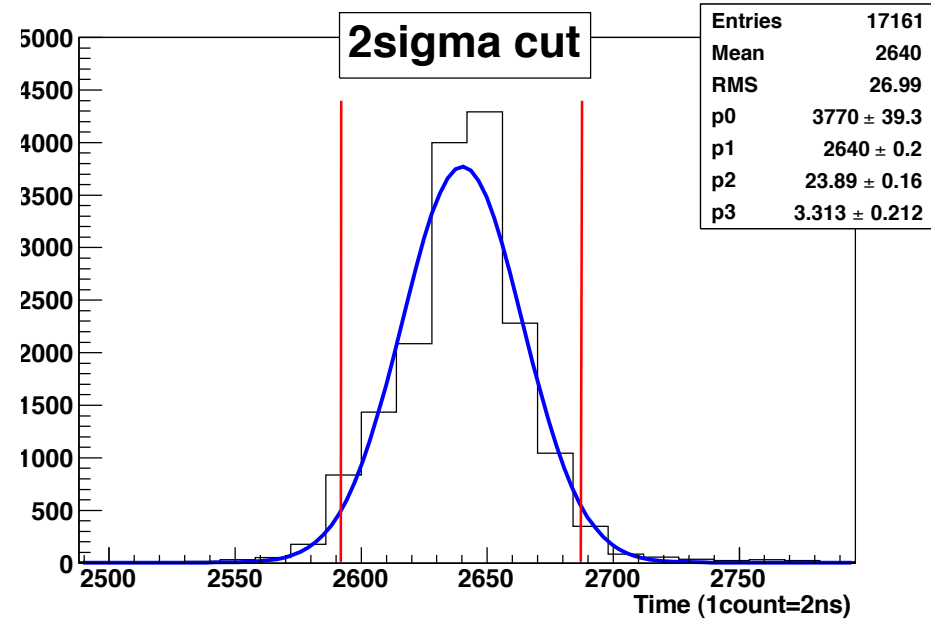
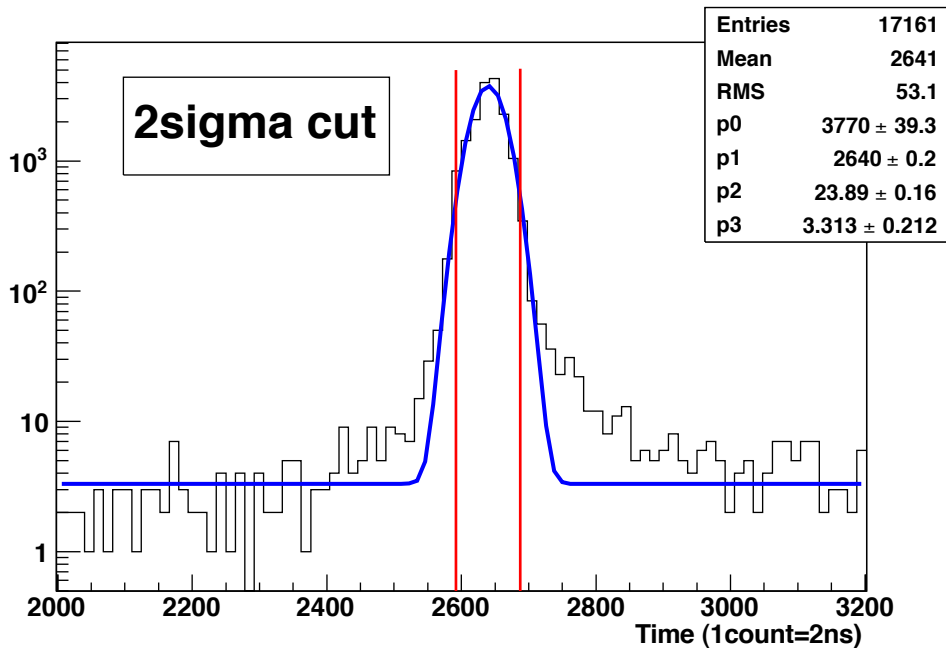
Results at 380 V



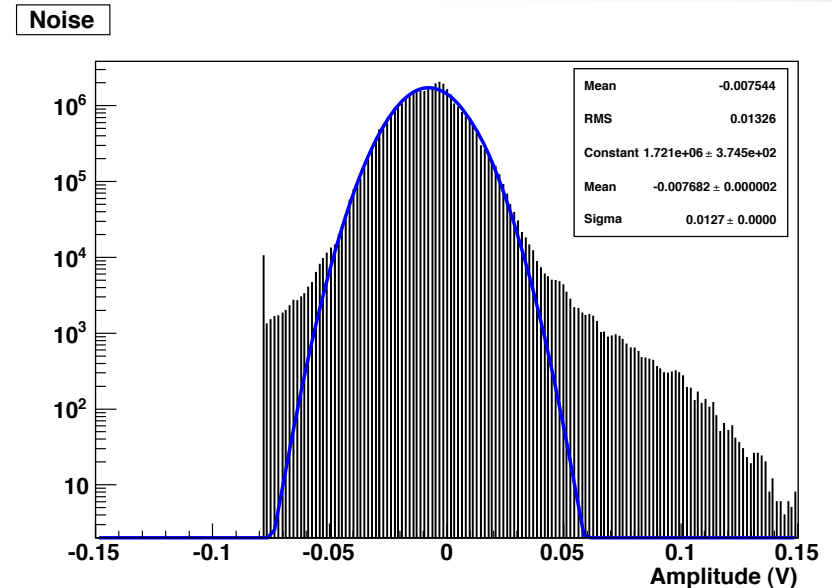
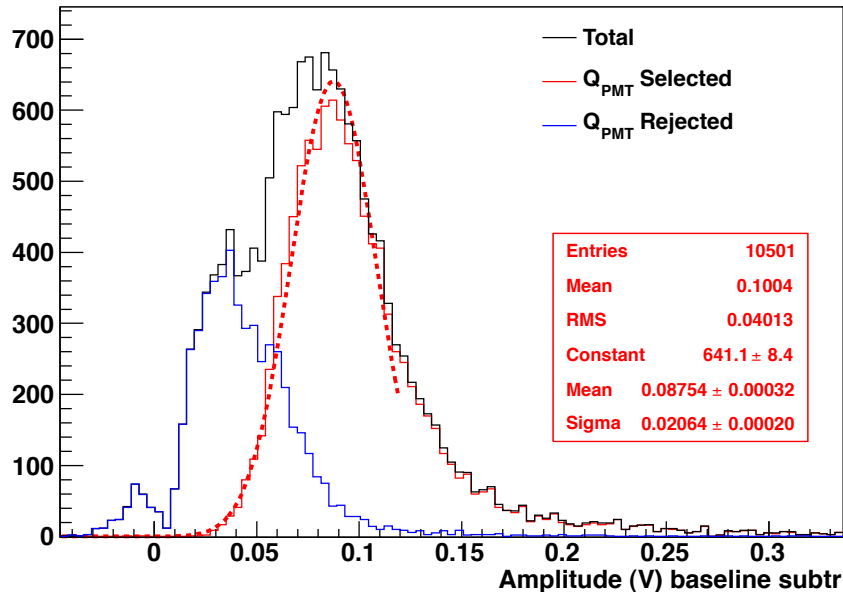
- Most probable signal on LAAPD $\sim 75\text{mV}$
- Noise level 12mV

Time at 390 V

- Time resolution : 48ns



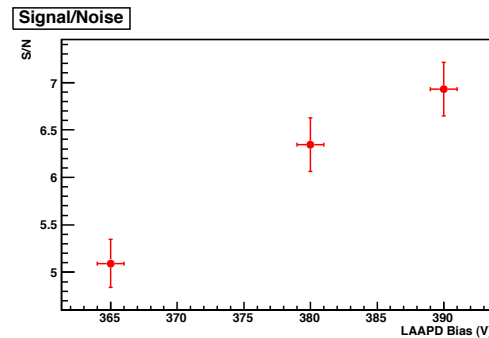
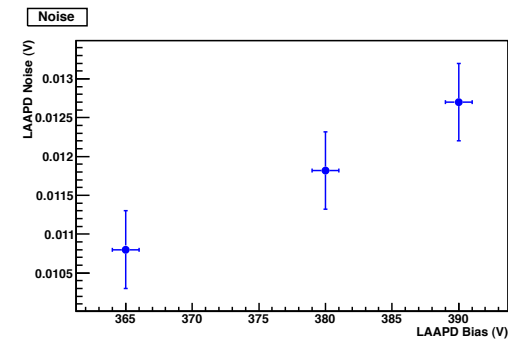
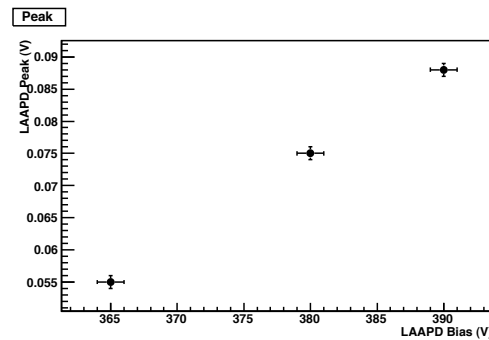
Results at 390 V



- Most probable signal on LAAPD $\sim 88\text{mV}$
- Noise level 13mV but with non-gaussian tails

2 LAAPD results (1)

- Gain at 380 and 390 V evaluated starting from 365V results
 - G=50 bias from Hamamatsu
- Cosmics deposited energy ~ 40MeV
- Noise ~6MeV

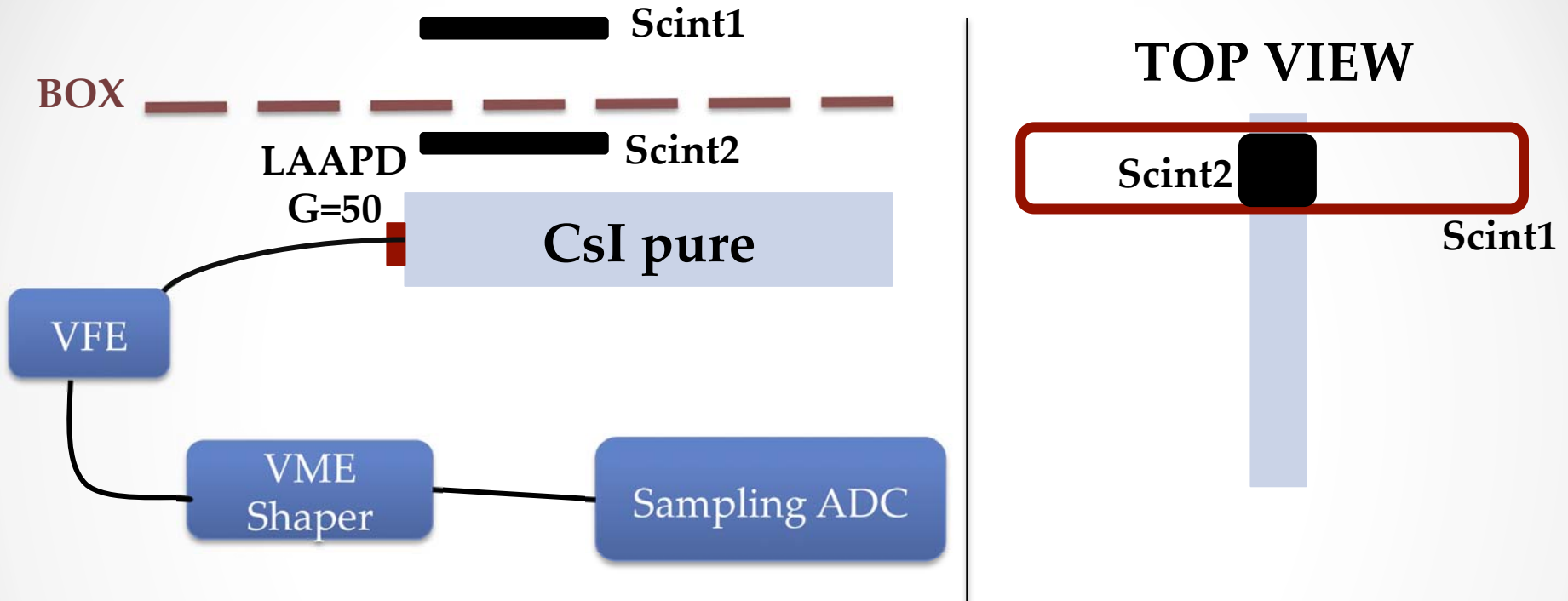


G=50 at 365V

G=68 at 380V

G=80 at 390V

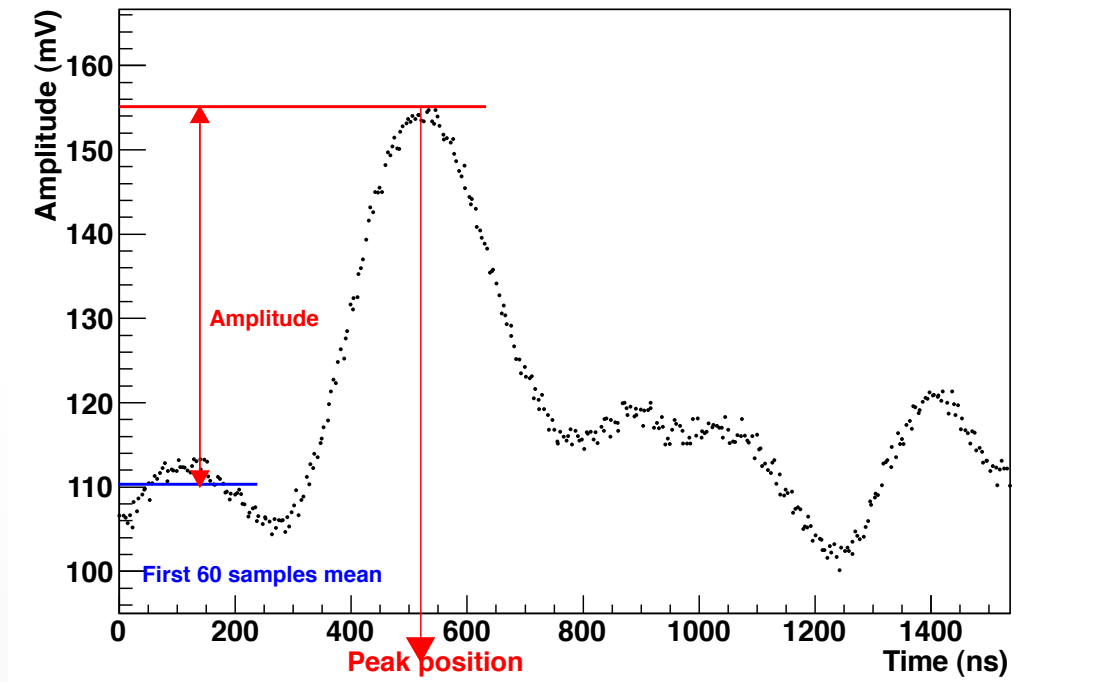
Second SetUp



- DAQ with TB system (BOX + VFE + SHAPER + V1720)
- Trigger: Scint1 – Scint2 coincidence
 - Scints outside the BOX, distance from crystal ~10cm
 - Same cosmuics (which trigger) don't go inside crystal completely

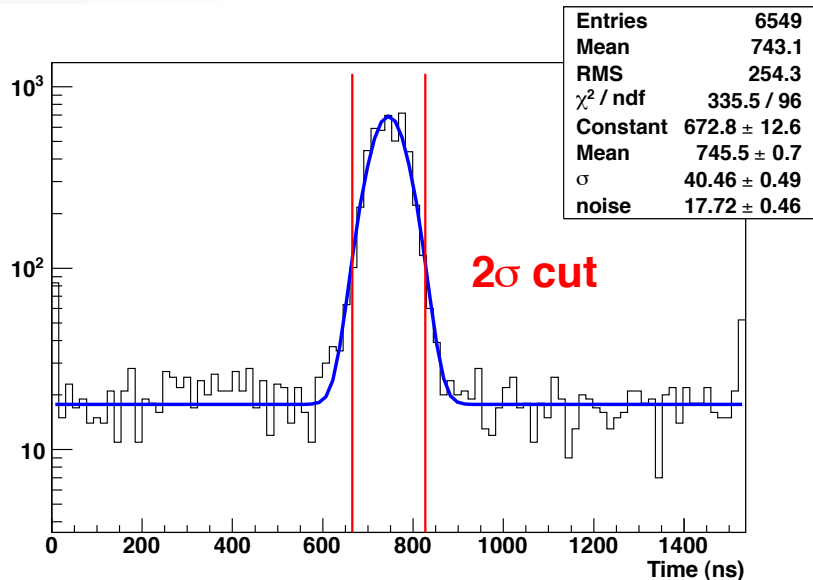
Data acquisition

- Waveform sampled @ 250MS/s
- 384 samples (~1500ns)
- First 60 samples used to evaluate baseline
- Amplitude equal to the difference between the baseline and the maximum value in all range



Time resolution and selection

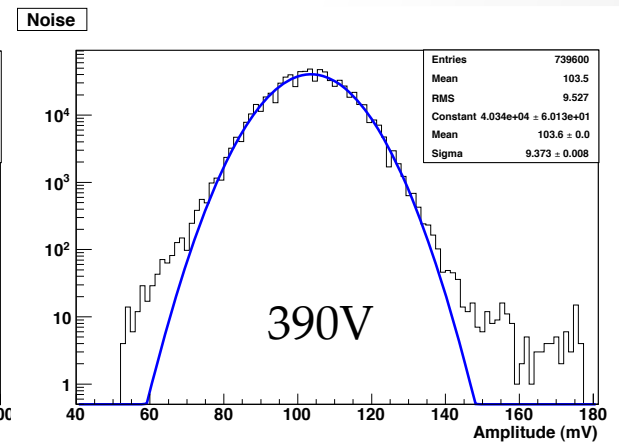
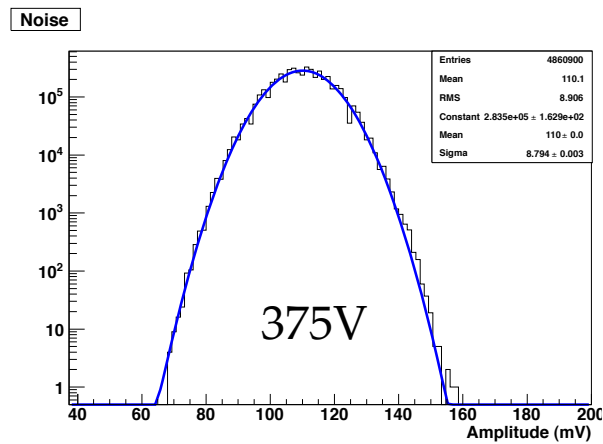
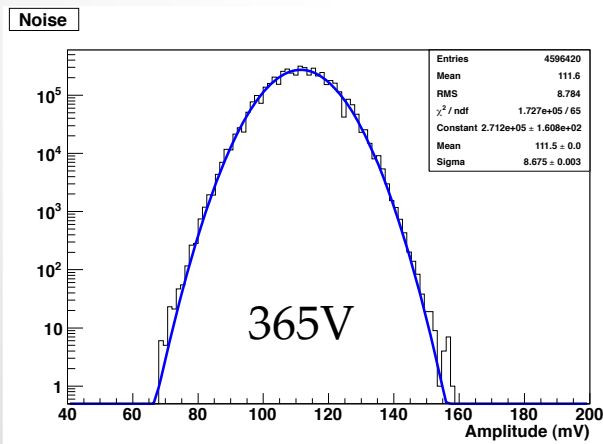
- Peak position is used to compute the time resolution
- A selection on the peak position is also applied (2σ cut around mean position)



Time res. 40.5ns
(constant wrt bias)

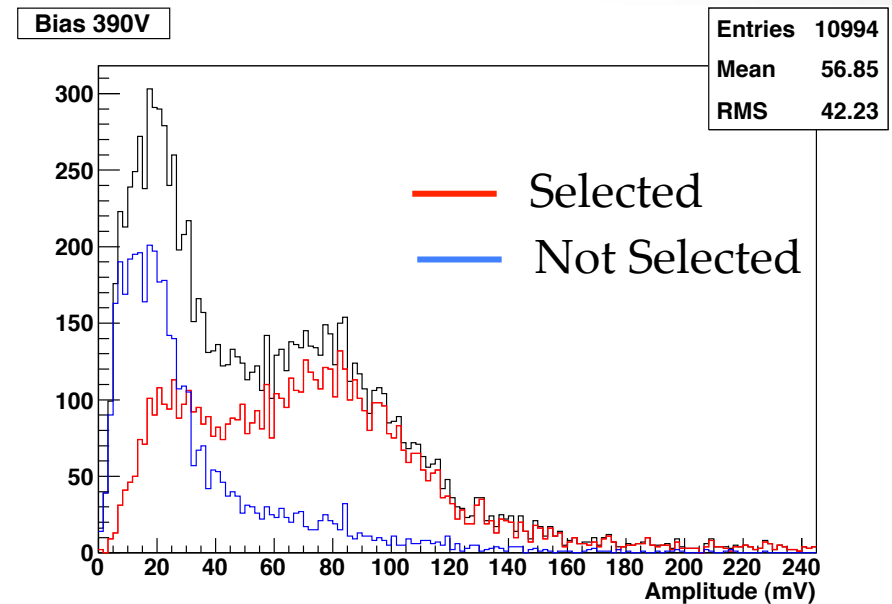
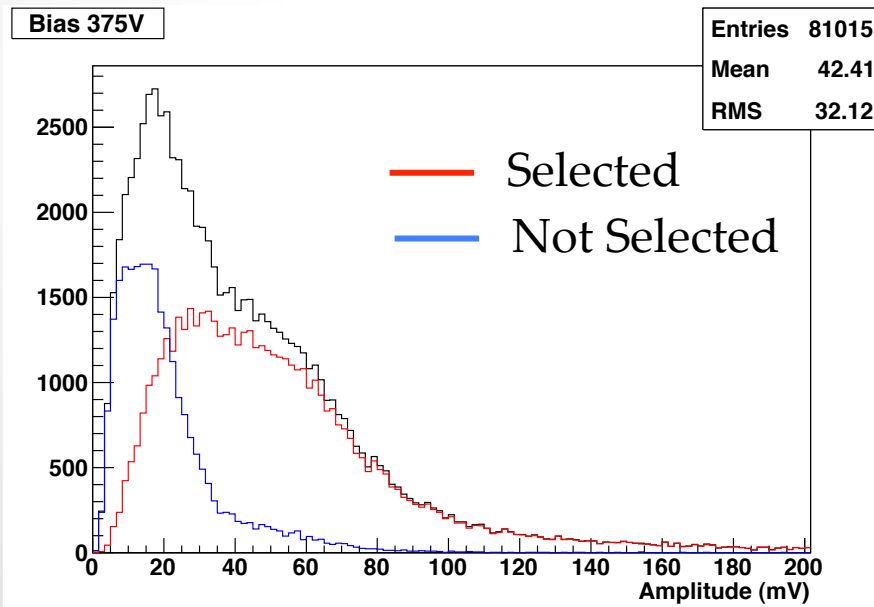
Noise level

- Noise estimated through random trigger runs
- About the same level at different bias
 - RMS : 8.7mV (365V) 8.8mV (375V) 9.3mV (390V)
- Noise is 30% lower wrt external box for CSP and Shaper



Signal Amplitude

- NOT ALL NOISE IS REMOVED WITH THE TIME INFORMATION
 - In this case is not possible to have a dual readout (PMT+LAAPD)
- This fact is more evident at higher bias
- Anyway at 390V cosmics deposition peaks roughly at 85mV
 - Same level of the previous test



Conclusion

- Test in Lab. with CsI(pure) and LAAPD
 - Best S/N ratio at 390 V : $85\text{mV}/9.3\text{mV} = 9$
 - 1GeV muons trough ~5cm of CsI have a most probable deposition of about 40MeV (we don't need high level precision now)
 - Noise conversion in MeV : $40\text{MeV}/9 = 4.5\text{MeV}$
 - Too high noise, full sim "request" $\leq 1\text{MeV}$
- Energy calibration could be optimized
 - Radioactive sources (Cs137, Co60) could be a solution but the low light level of CsI(pure) can be a problem
 - Another solution is a calibration with MC but a more accurate trigger is needed for this solution
 - Select only vertical cosmics with very small scintillator trigger