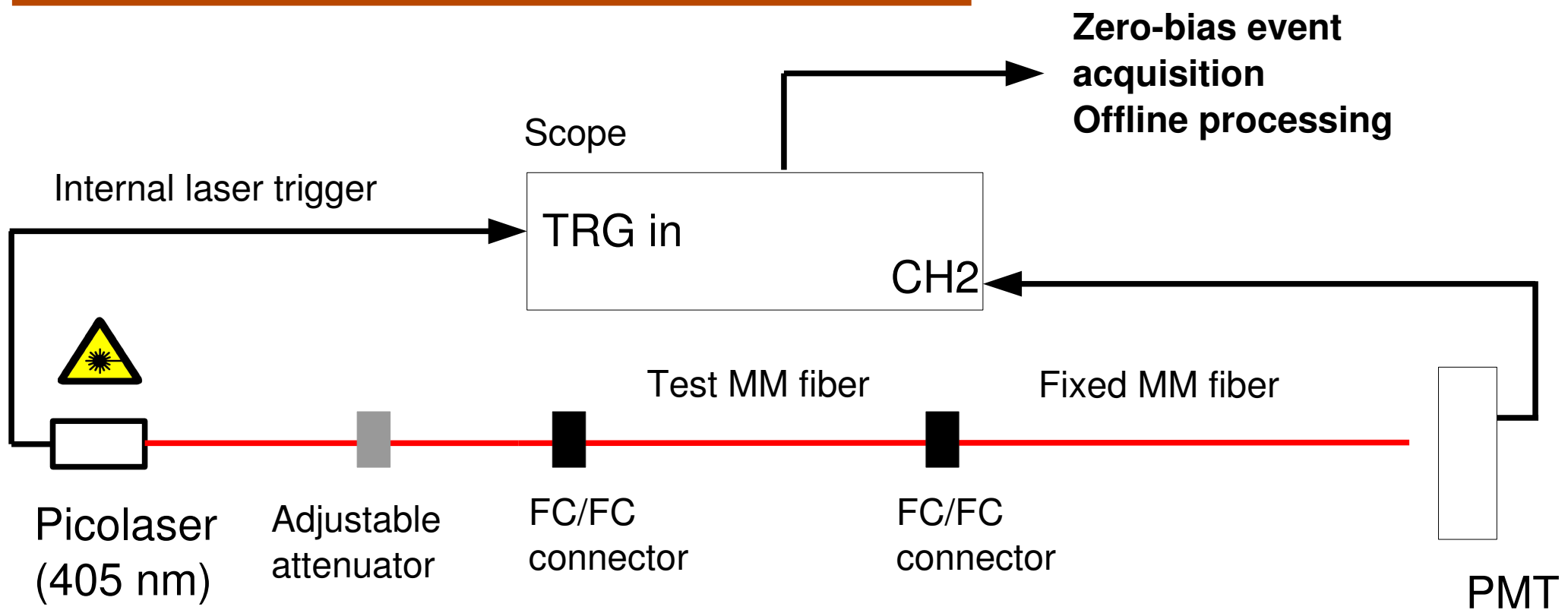


# Radiation damage on MM Fibers

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# Setup

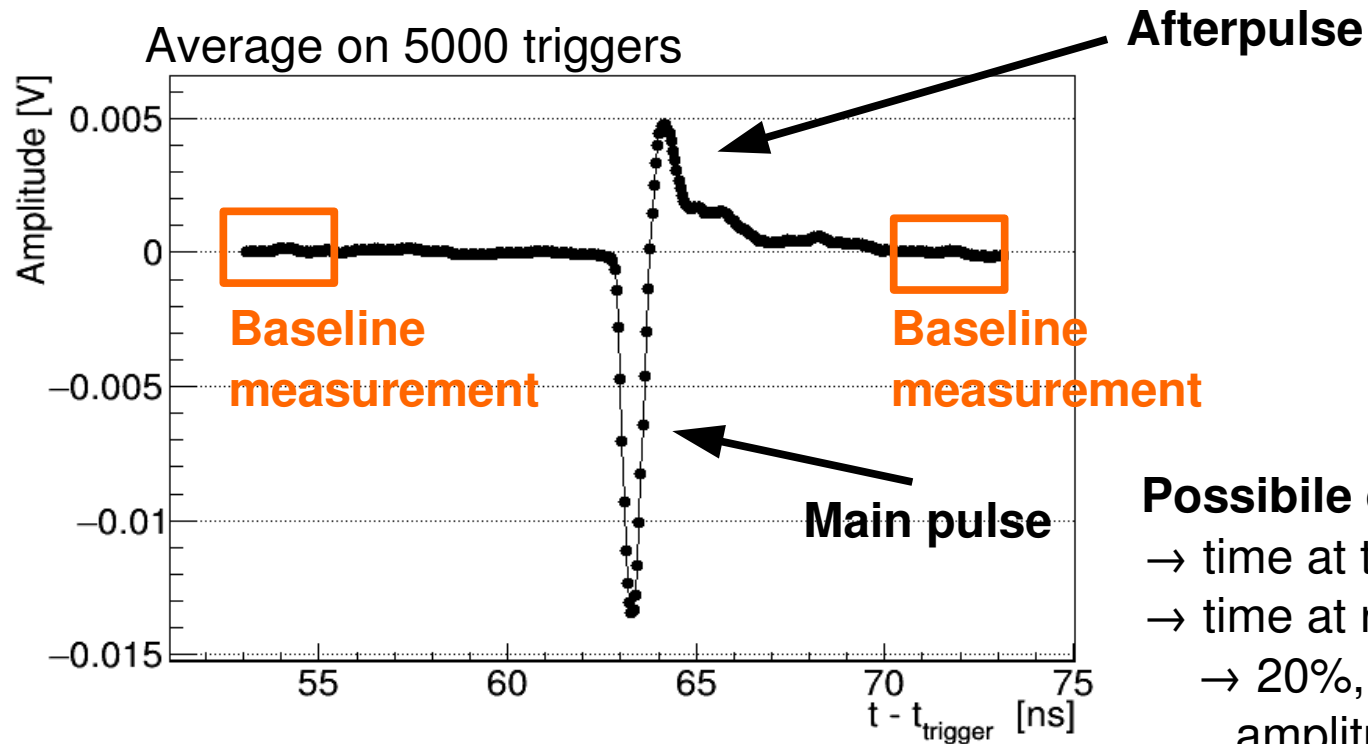


## Normalization sample:

Test Fiber is removed from the setup

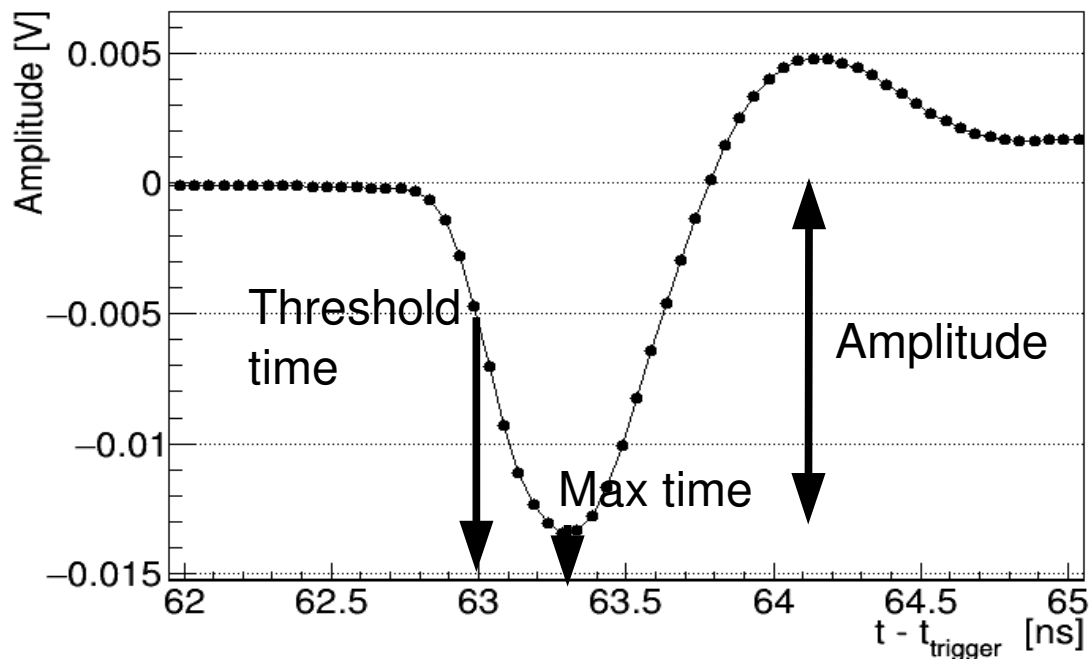
Fibres are measured before and after the irradiation

# PMT response



**Possible definition of pulse time:**

- time at the pulse maximum
- time at relative threshold
- 20%, 50%, 80%.... of maximum amplitude



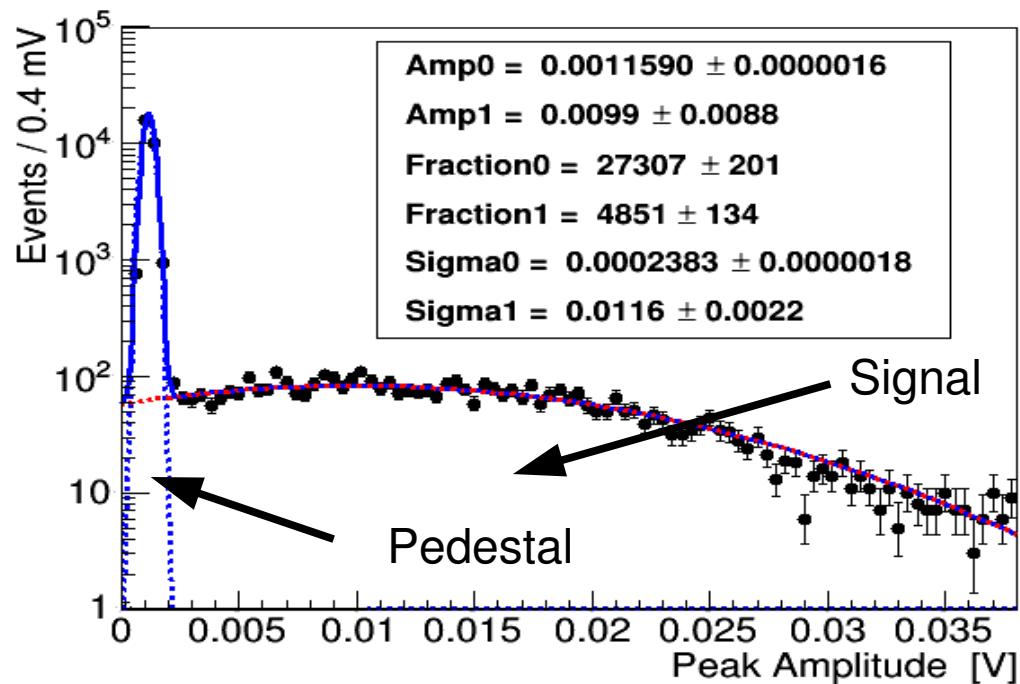
**Determination of parameters at maximum (amplitude and time)**

- parabolic fit around maximum ( $\pm 3$  points)

**Determination of threshold crossing time**

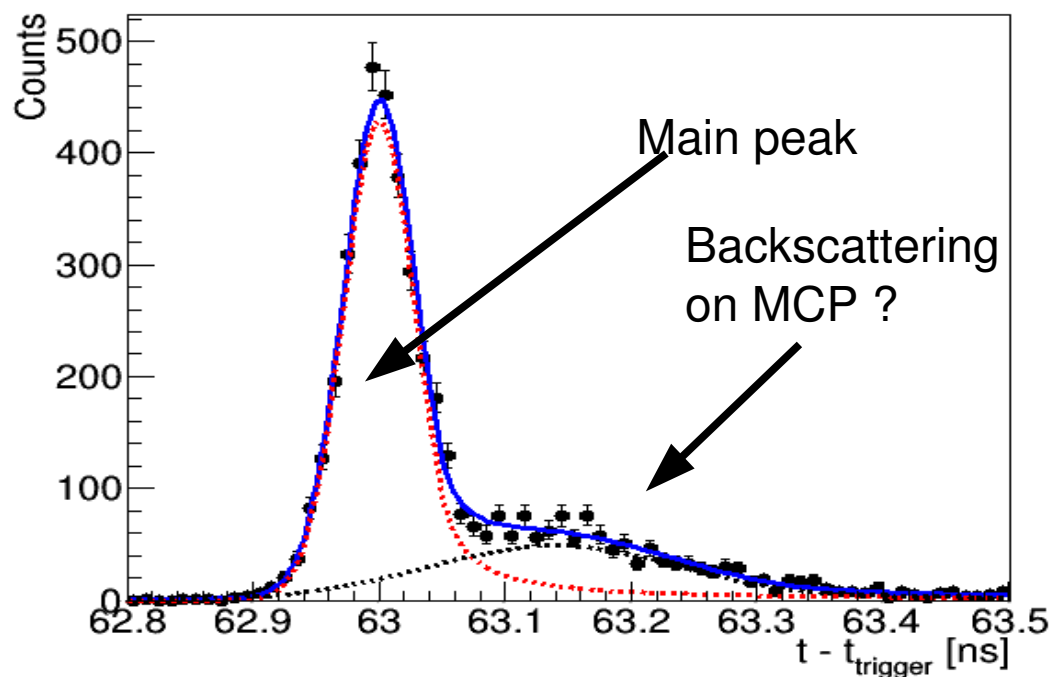
- linear fit around the crossing point
- gaussian fit of the rising edge

# PMT response (old data)



**Single photon regime**  
KT477, Channel 3, Max HV

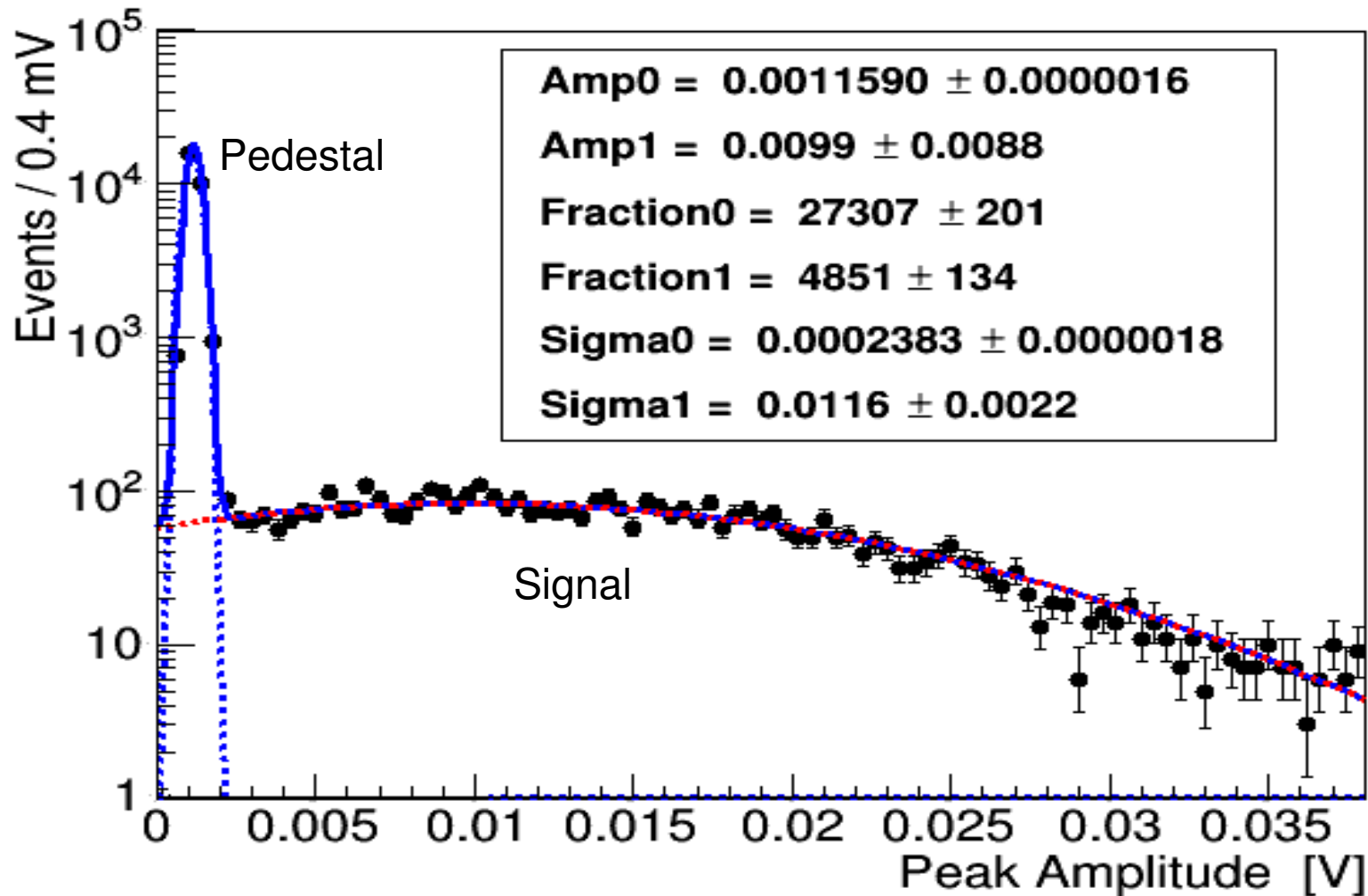
Avg pedestal amplitude: 1.1 mV  
Pedestal gaussian fluctuation: 0.2 mV  
Signal events:  $4851 \pm 134$   
Pedestal events:  $27307 \pm 201$   
Avg signal amplitude:  $(10 \pm 9)$  mV



**Single photon time resolution: 28.5 ps**

**Main peak position:  $(99.472 \pm 0.001)$  ns**  
- correlated to the fibre length  
- stat. Error only

# Measurement of the light yield



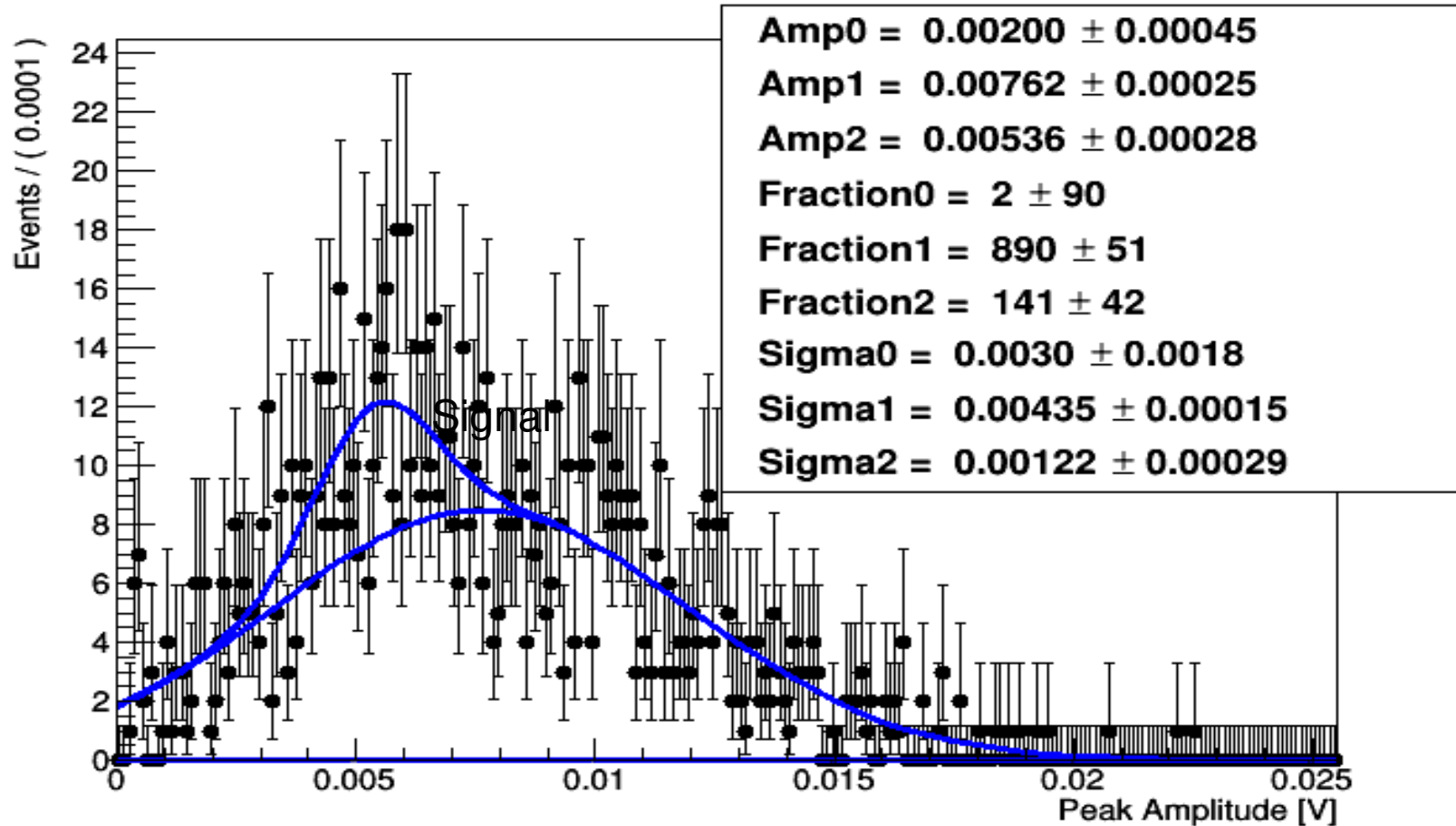
## Method 1: Photon counting

- photon detection is assumed to be a poissonian event
- the yield of pedestal events gives the probability of not detecting a photon
- $\langle \text{ph} \rangle = -\log(n_{\text{ped}}/n_{\text{trigger}})$

# Measurement of the light yield (II)

The data before the irradiation were taken with **high light yield**

→ **no pedestal for  $\langle n_{ph} \rangle$  estimation!**



## Method 2: Average pulse height

→ The signal rising time is constant and do not depend on the signal amplitude

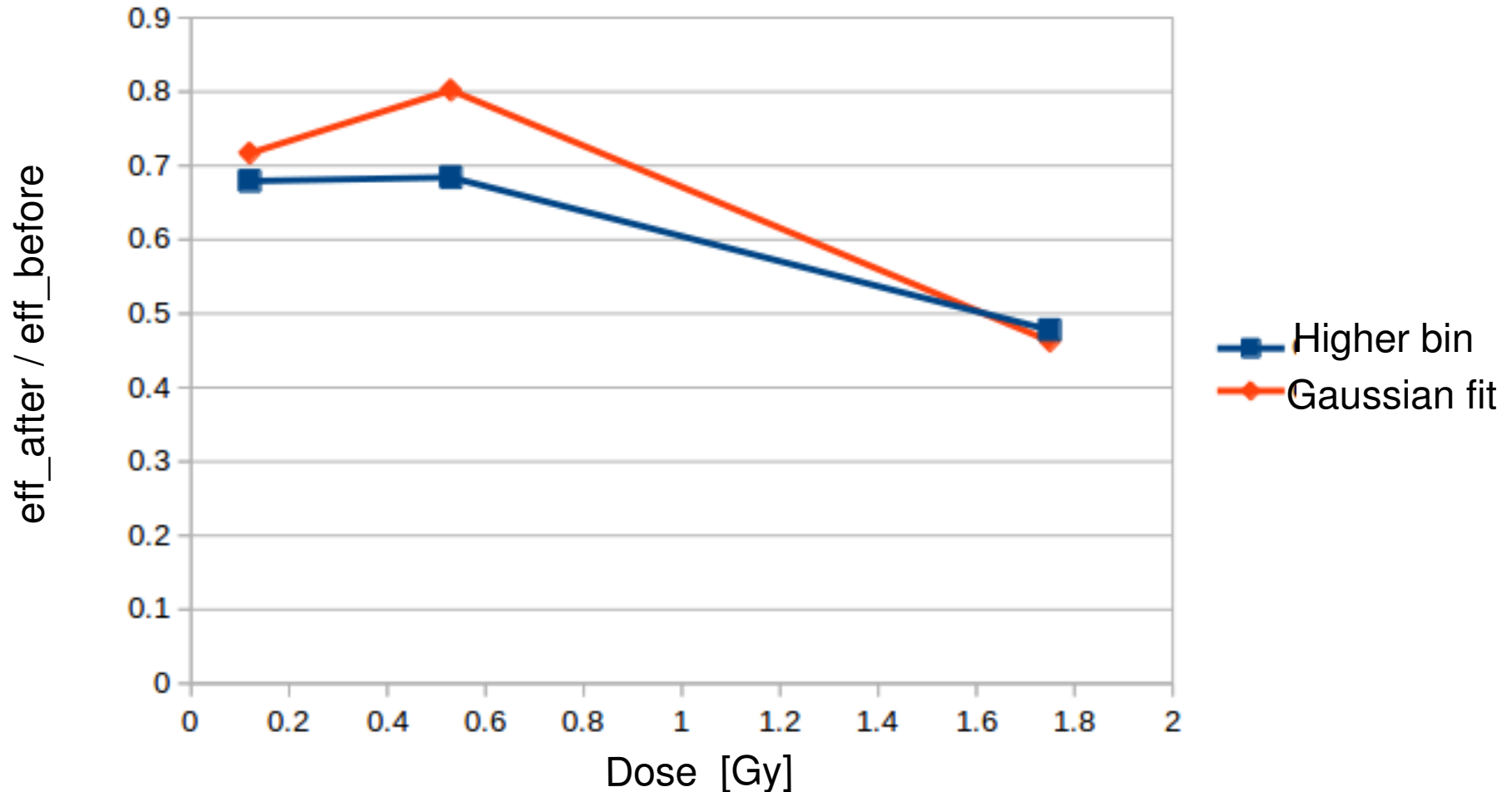
→ The average pulse amplitude, **including pedestal events**, is an estimator of the total light yield

# Measurement of the attenuation

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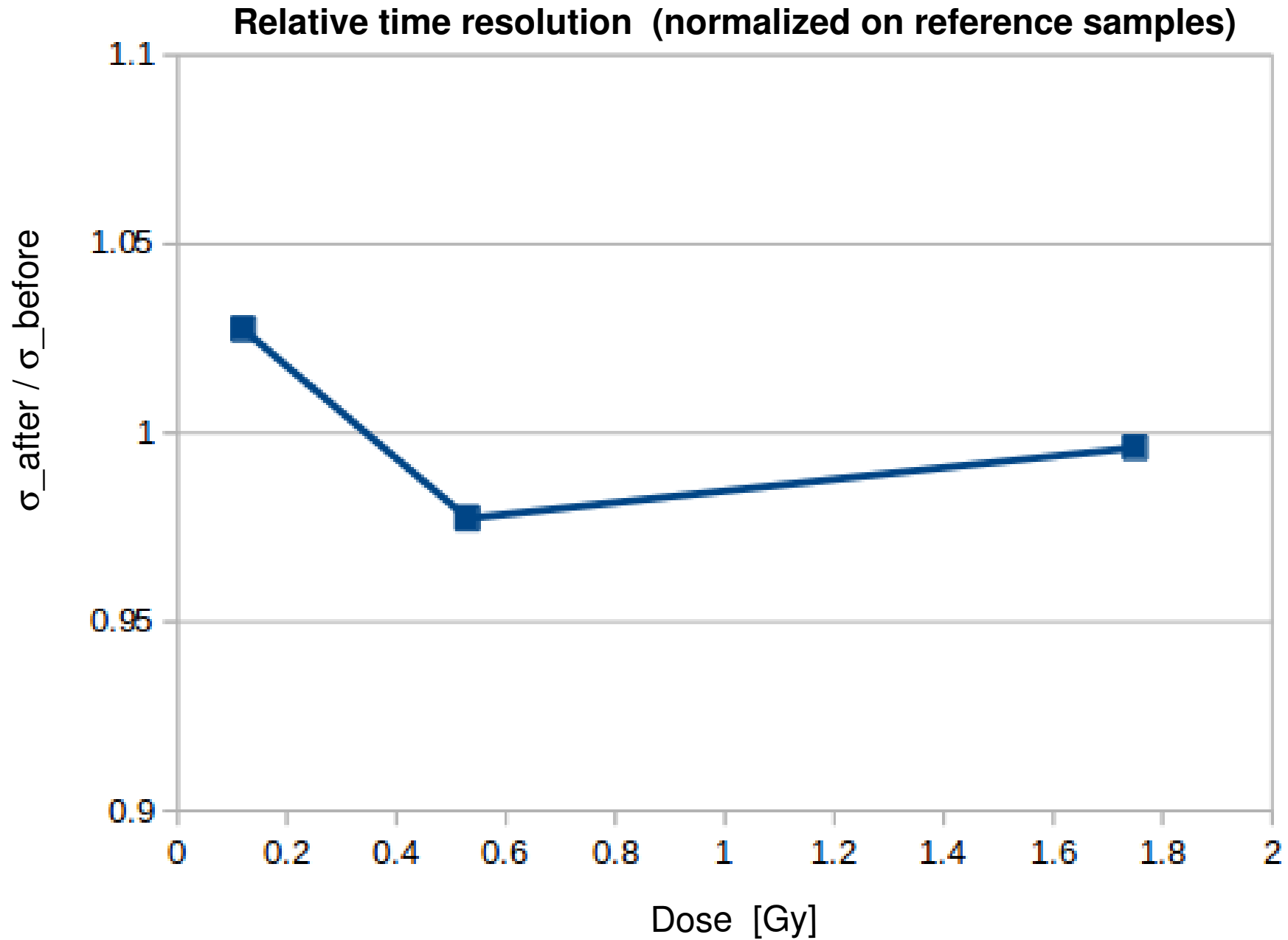
**Transmission efficiency = Light yield with fiber / Light yield without fiber**

- compensate for laser effects
- compensate for PMT gain variation
- compensate for temperature and other environmental effects
- **one connection is removed: not a reliable measurement of absolute transmission!**



# ***Time resolution after irradiation***

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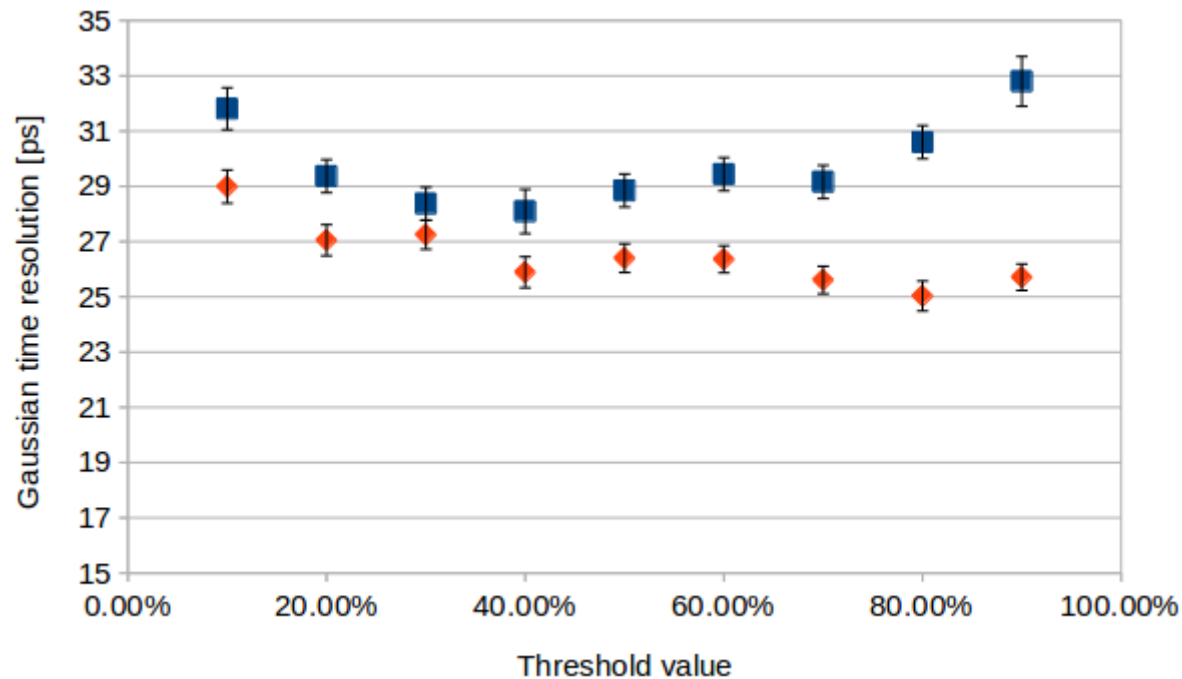
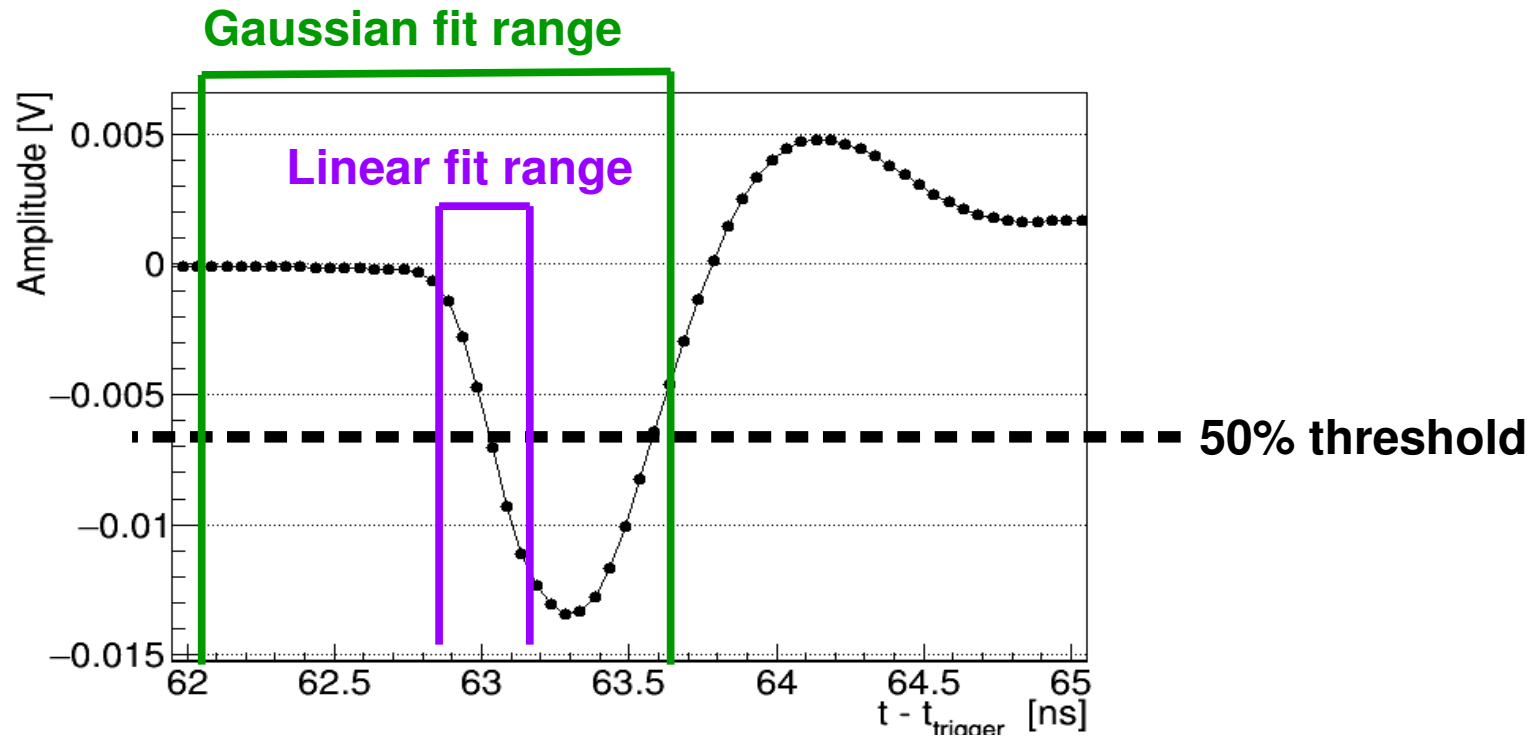




# ***Backup***

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# Maximum time VS threshold time



The gaussian fit is more stable  
Against the choice of the  
threshold value

■ Linear fit  
◆ Gaussian fit

# ***Channel-by-channel performances***

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**Goal:** characterization of the channel-by-channel performances of MCP-PMTs in Italy

**Technique:** PMT pixels are scanned using a motorized slide

Channel 9 and 13 are missing due to problems on the readout board connectors

**Single photon time resolution: 25 – 35 ps**

Channel -by-channel differences are due to differences in the cabling length for each channel

PMT-PMT offset is due to different laser position

# ***Sensitivity on fibre length***

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**Goal:** precise measurement of the delay on each fibre of the calibration system

**Technique:** distance between fibre and PMT is changed through micrometric 3D slide system

**PRELIMINARY**

**Expected sensitivity on to the fibre length difference: 0.6 ps**

# ***Fibre bending test***

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**Goal:** Check the impact of different bending radii on the light propagation in the single mode fibres

**Technique:** 13m fibre is bent at different radii

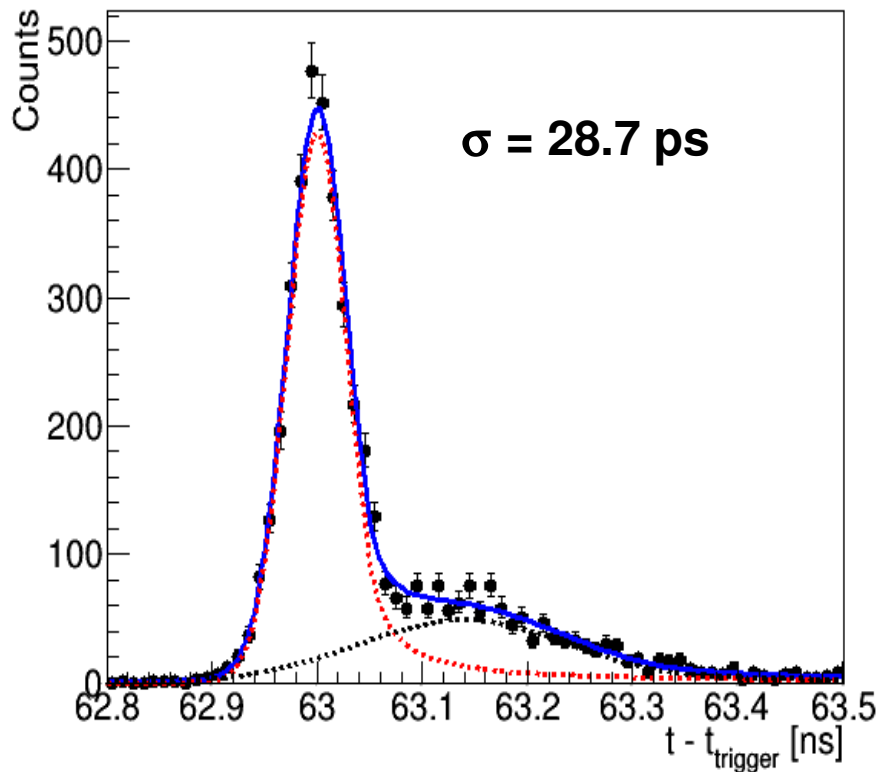
Caveat: no test has been done on the impact of the tension applied to the fibre.

# Laser stability

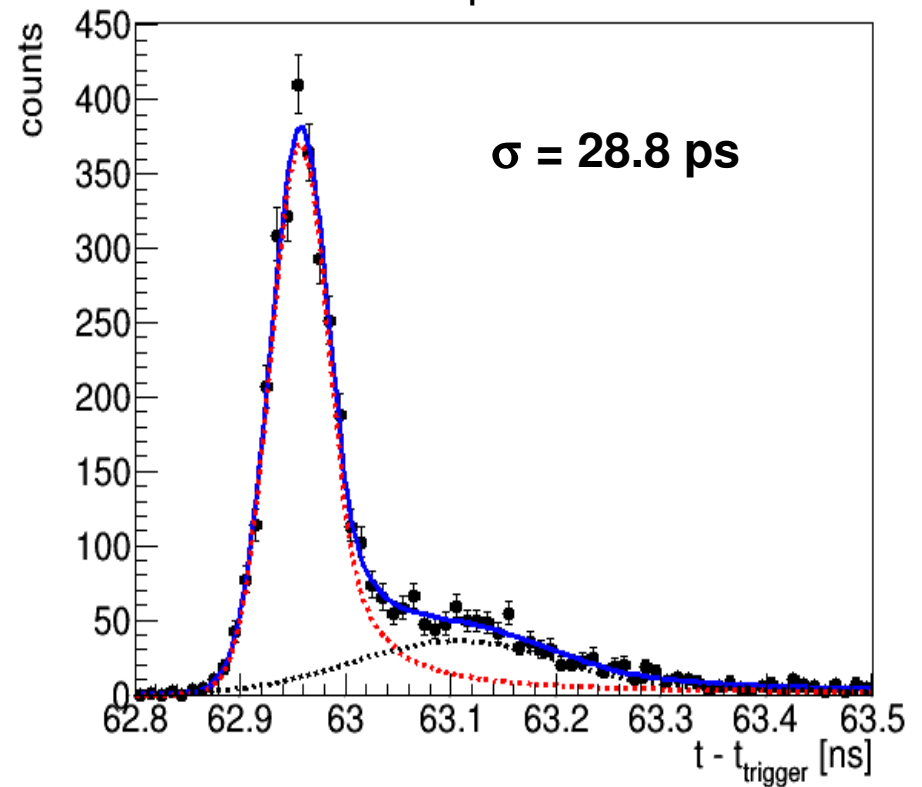
**Goal:** Check the stability of the laser performances during long operations

**Technique:** compare the time resolution before and after 12 hours of continuum operation at the nominal settings

Before 12hrs operation



After 12hrs operation

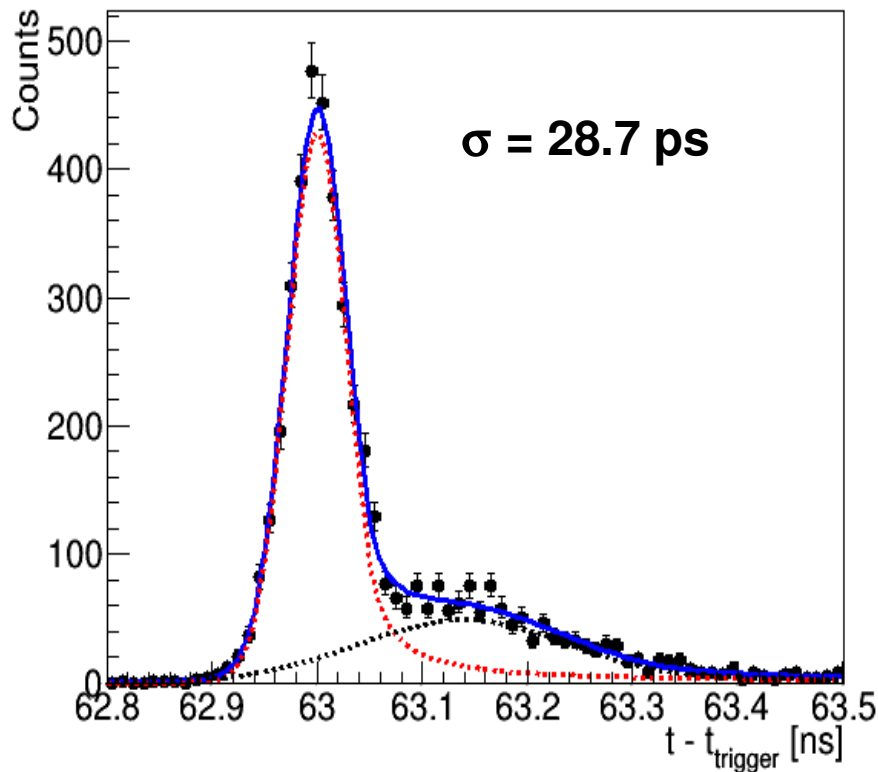


# Laser stability

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