

# Status about light studies at LAPP

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*WA105 SB Meeting*

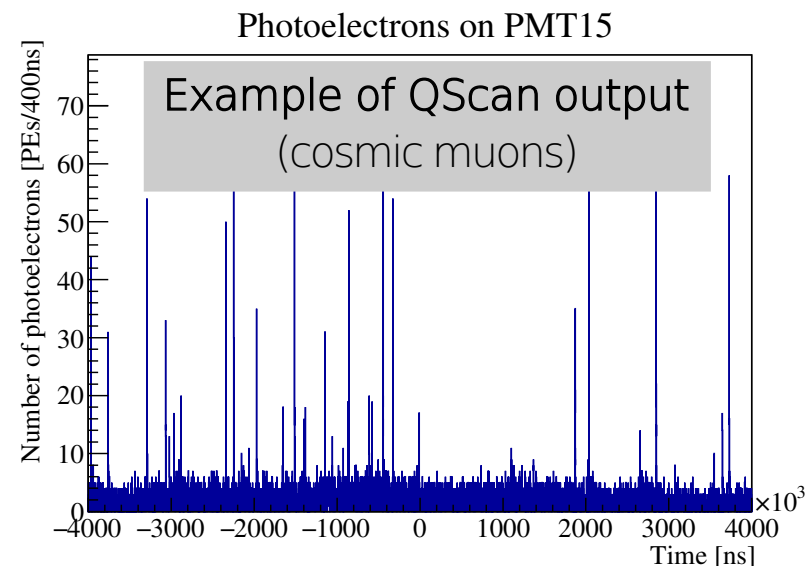
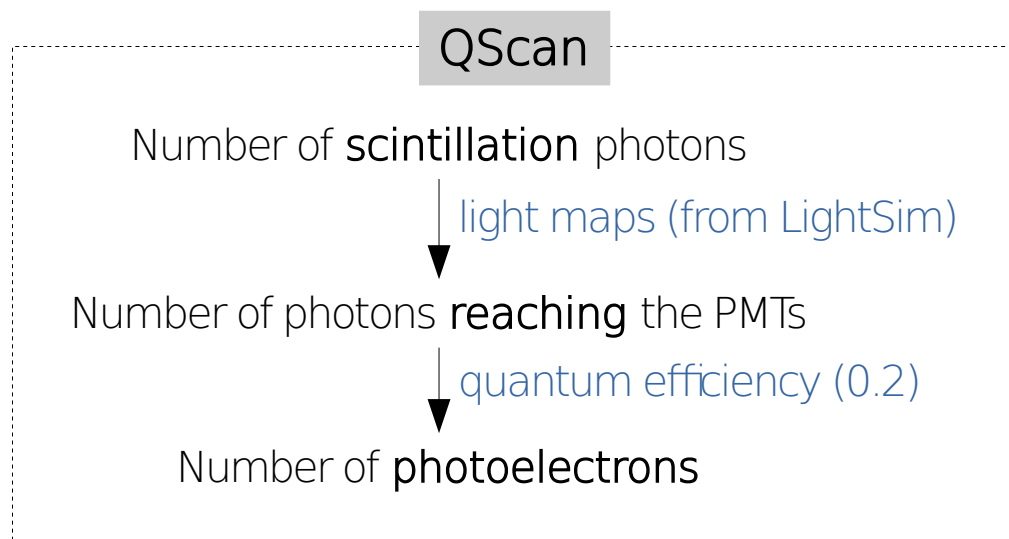
26 July 2017



# Simulation of **PMT** response

# Introduction

**Output of QScan:** number of photoelectrons ( $N_{pe}$ ) in a time window, PMT by PMT



These distributions are used as an **input** for ROSim code

**Slavic's code** available in svn: <https://svn.in2p3.fr/wa105/LightSimulation/ROSim/>

→ Simulation of the **PMT response** to the photoelectrons (PE)

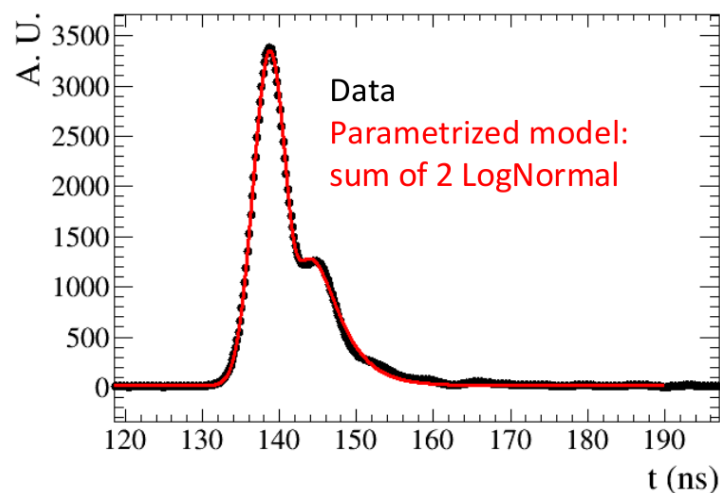
For the time being:

- Same **characteristics** for all PMTs (Gain...)
- **ADC** resolution and **pedestal** not taken into account

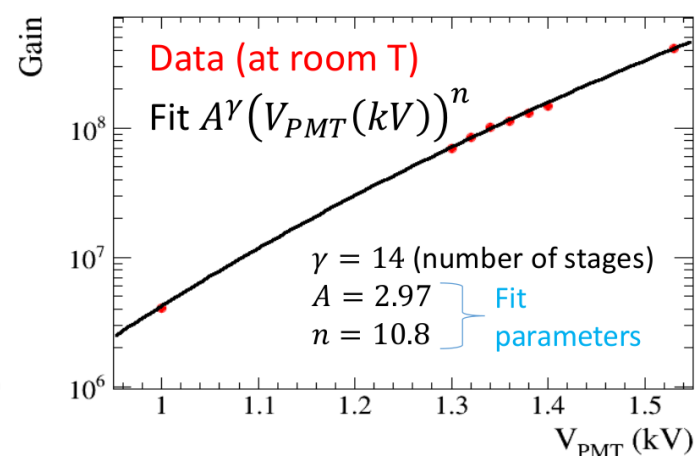
# Measurements used to simulate PMT response

In **ROSim** code: use of RD5912-mod2 measurements in warm in Lyon

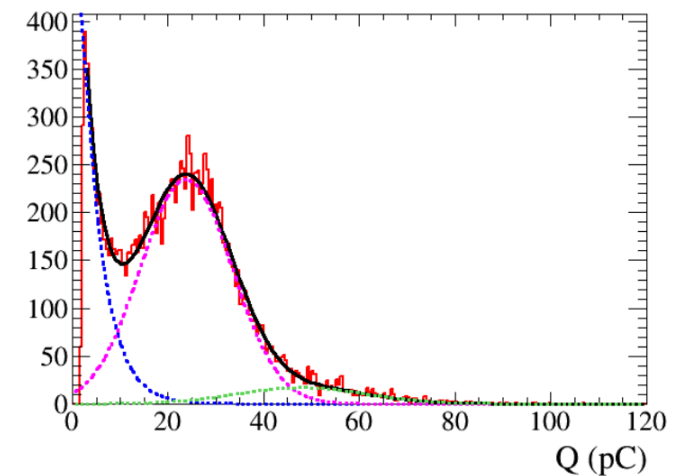
(see Slavic slides, WA105 SB 26.08.2015)



PMT response to single photoelectrons (SPE)



PMT gain



Charge yield measurements (at 1.4kV)

For the **simulations** presented **today**:

- PMT characterization **in warm**
- $G = 1.6 \times 10^8$  (at 1.4kV)

# Parametrization of PMT response

1. **Q norm** corresponding to  $N_{pe}$  photoelectrons:

From a **Gaussian distribution** with

$$\mu = N_{pe} \cdot \text{Gain} \cdot q_e$$

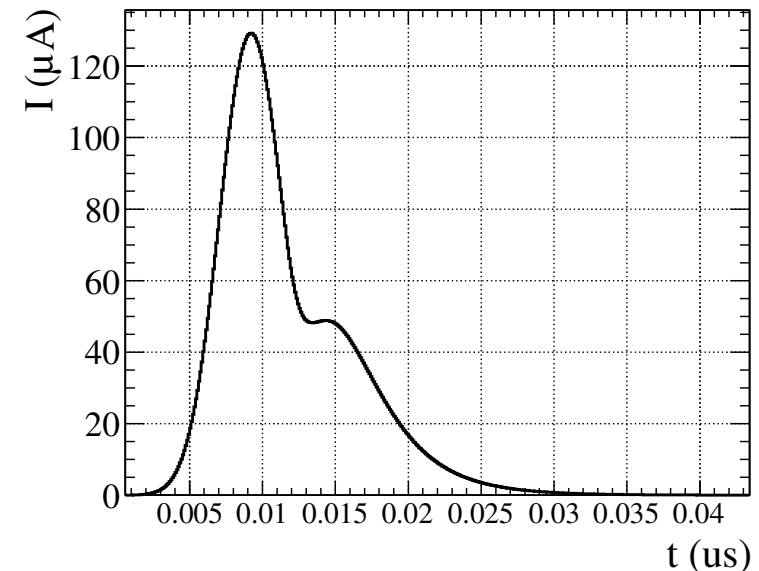
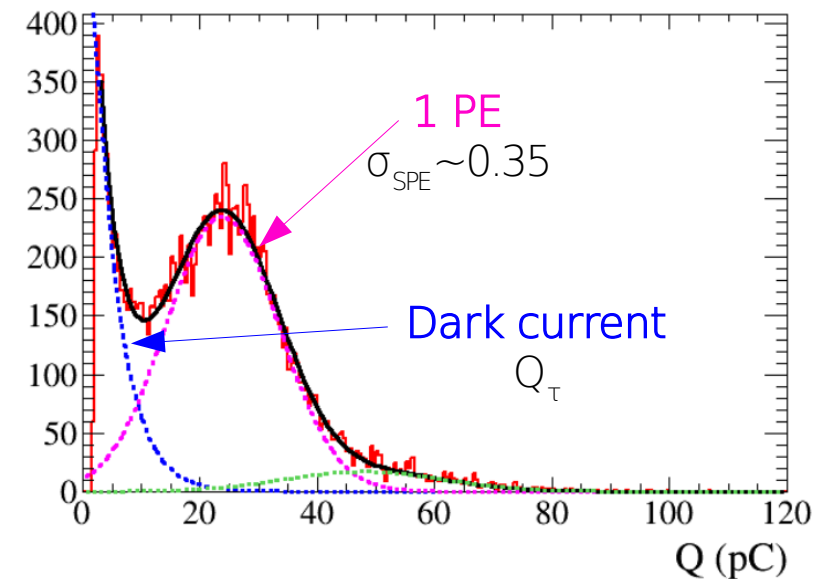
$$\sigma = \sqrt{N_{pe}} \cdot \sigma_{SPE} \cdot \text{Gain} \cdot q_e$$

2. Possibility to add **dark current**:

From an **exponential distribution** and a **dark rate** (number of dark counts /  $\mu\text{s}$ )

3. **Convolution** with **SPE waveform**

- **Note** : before convolution, the waveform is **rebinned** to match the final binning by **averaging (not summing) group** of original **bins** within the **new bin**
- From these measurements, **SPE response**  $\sim 30\text{ns}$



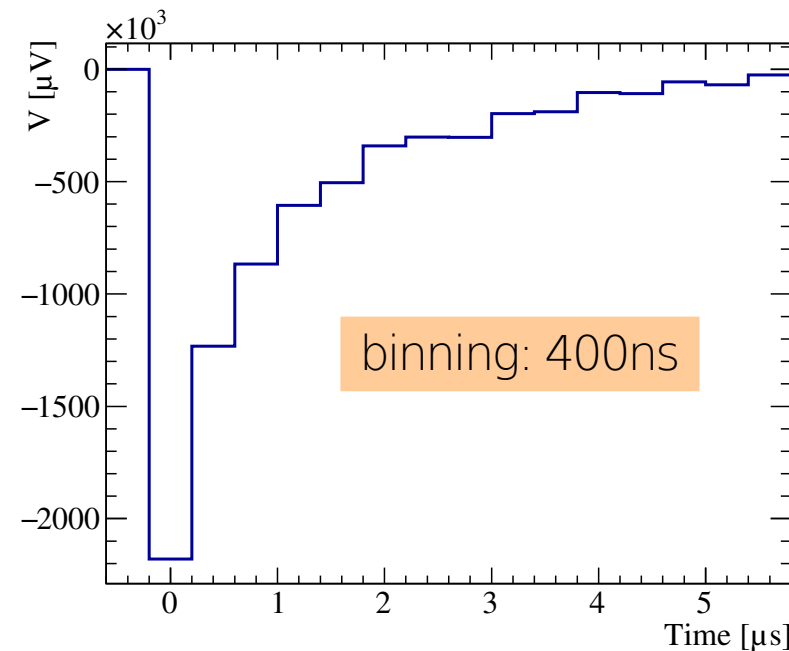
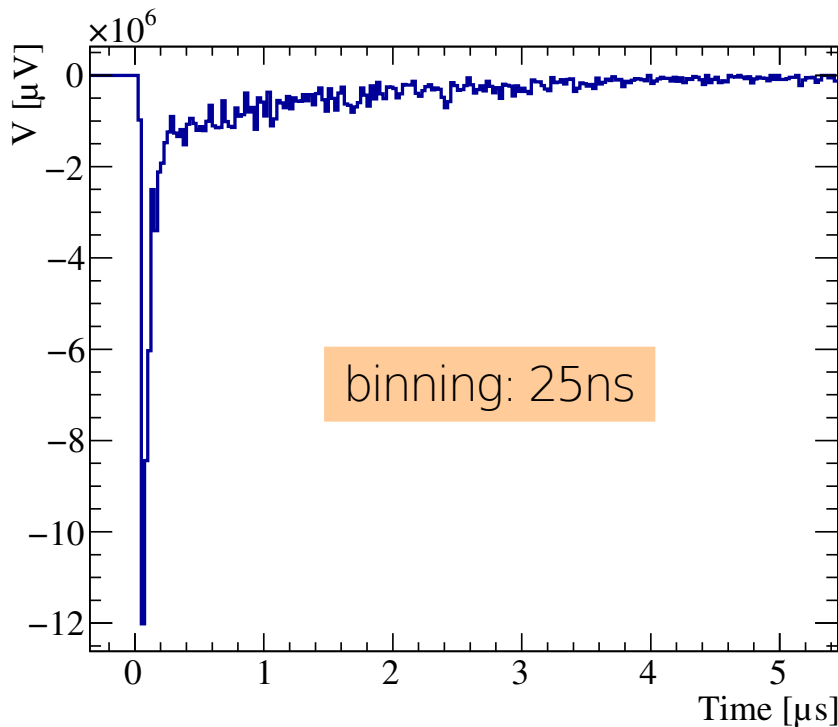
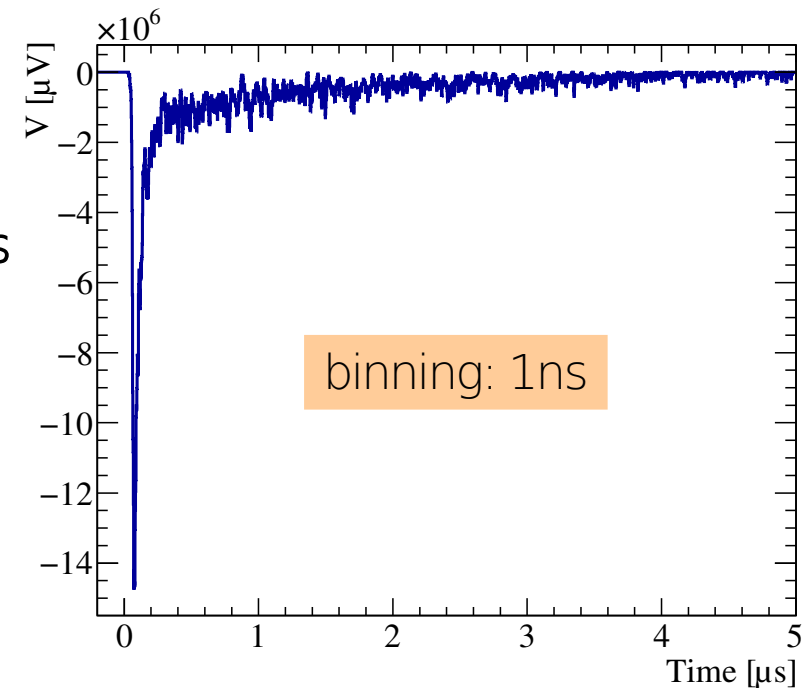
**Reminder:** for the time being, no pedestal, no ADC resolution

# S1 signal due to a single muon

Sum of the 36 PMT response:

The simulation is performed **independently** for each PMT, before **summing** the 36 PMT responses

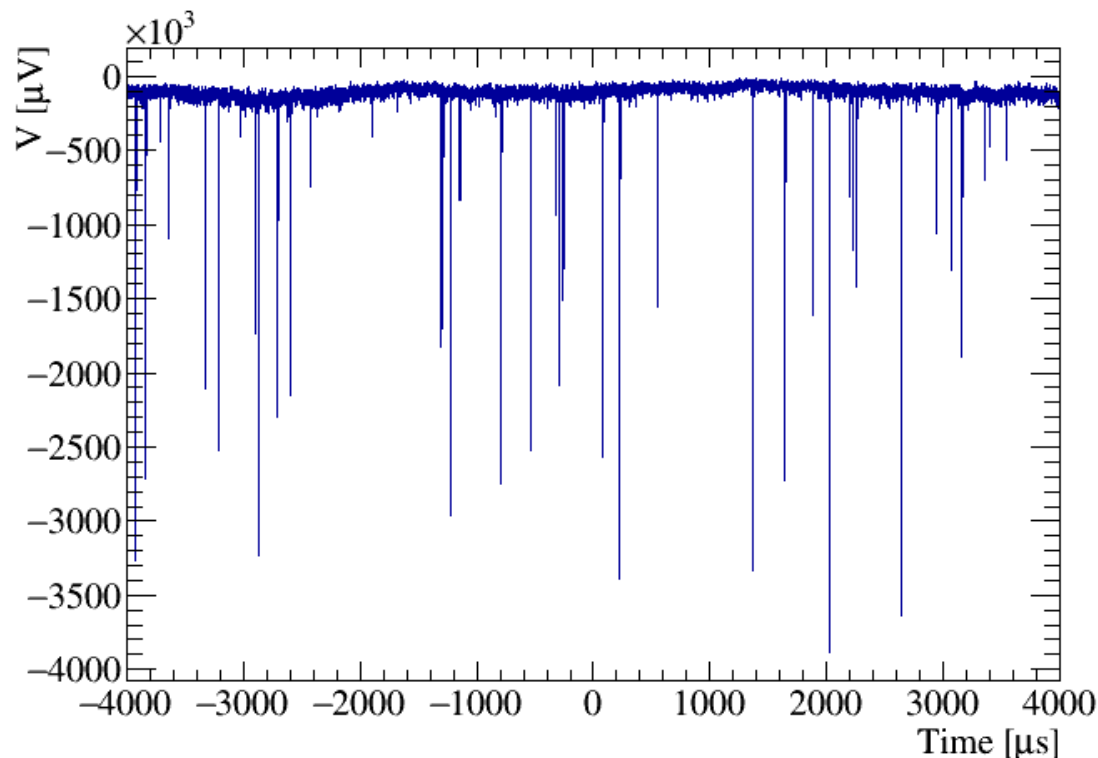
For these examples: Dark rate = 0



# Conclusion

Preliminary studies on the **PMT response** simulation, based on Slavic's code ROSim and QScan output.

Results obtained using measurements at **room temperature** in Lyon



Signal induced by  
**cosmic muons**  
(sum of 36 PMT responses)

## Next steps:

- **Update** with PMT characterization in cold
- Adding **pedestal**, **ADC** resolution...

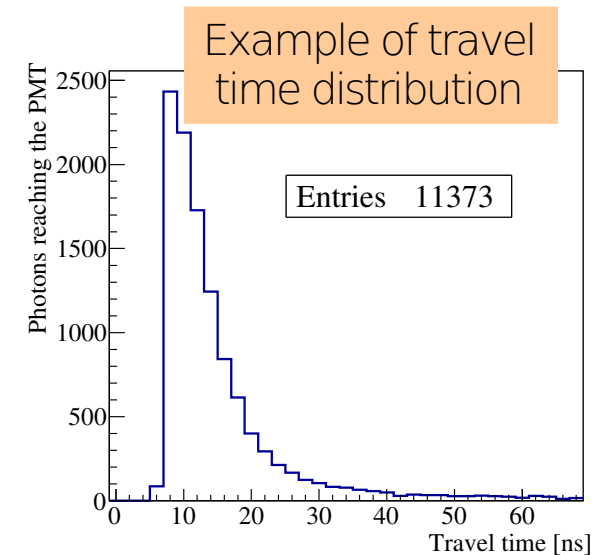
Work with CIEMAT group

Status of the **3x1x1** light maps



# Status of the 3x1x1 map production

- **Production** has been launch for the **LAr map**:
  - $10^8$  photons **generated** in each **voxels** ( $\sim 5h$  per voxel)
  - Same voxel **definition** as for 6x6x6: **25cmx25cmx25cm**  $\rightarrow 12x4x4 = 192$  **voxels**
  - **Travel time** distributions are **obtained** for **all LAr voxels** and **PMTs**
    - Distribution **shapes** are different than shapes obtained for 6x6x6
    - $\rightarrow$  Close to **exponential** distributions
    - $\rightarrow$  We are **adapting** the **parametrization** for these distributions
- **Next steps**:
  - For the **LAr light map**
    - **Construct** the 3x1x1 map using the parametrization
    - Look at the **interpolation** to determine if the **voxelisation** is **suitable**
  - Production of **GAr light map**



**Aim:** make the maps **available** for the collaboration at the **beginning of August**