New Liquid Argon Light Maps and Simulation

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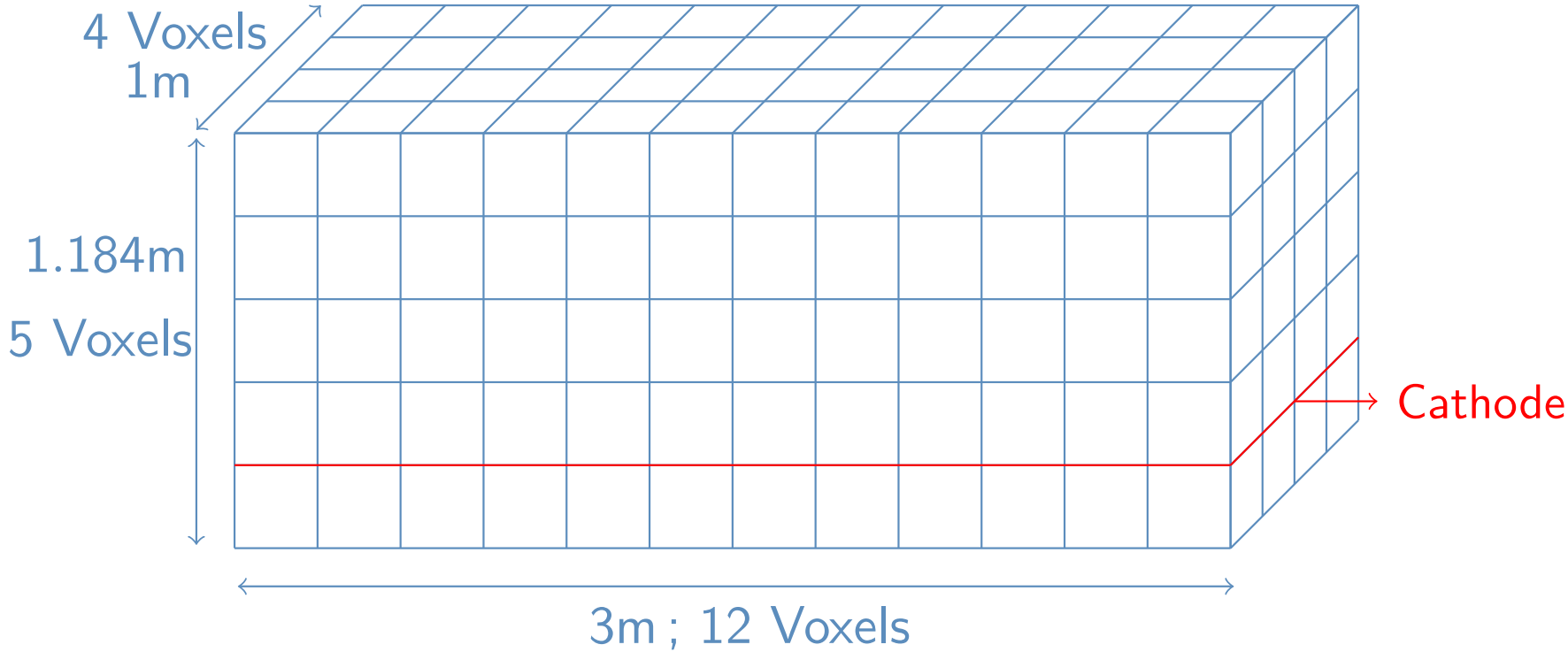
Reminder : Light Maps
Old Map

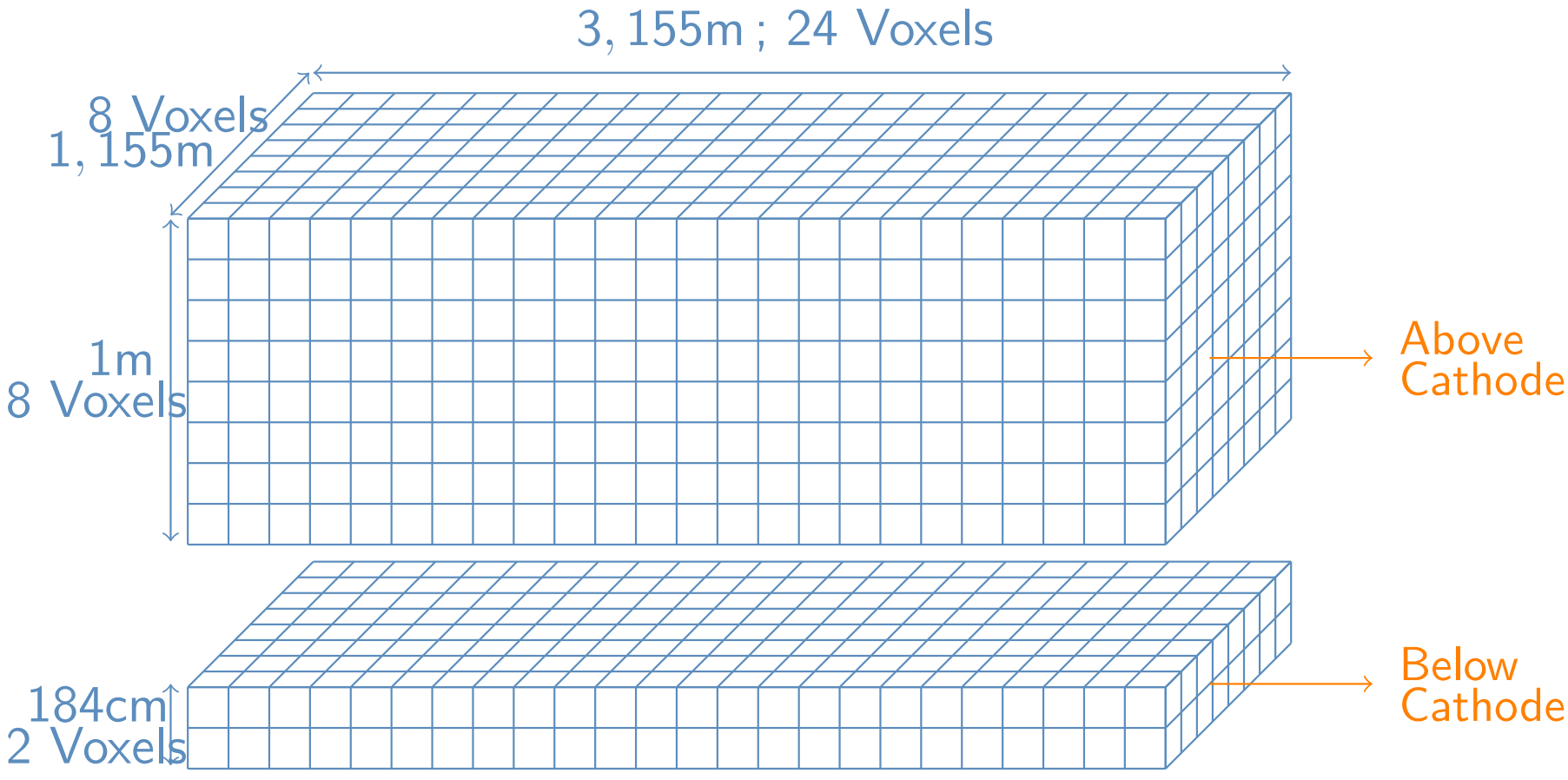


Number of voxel : 240 ; Distance between PMTs : 46.123cm

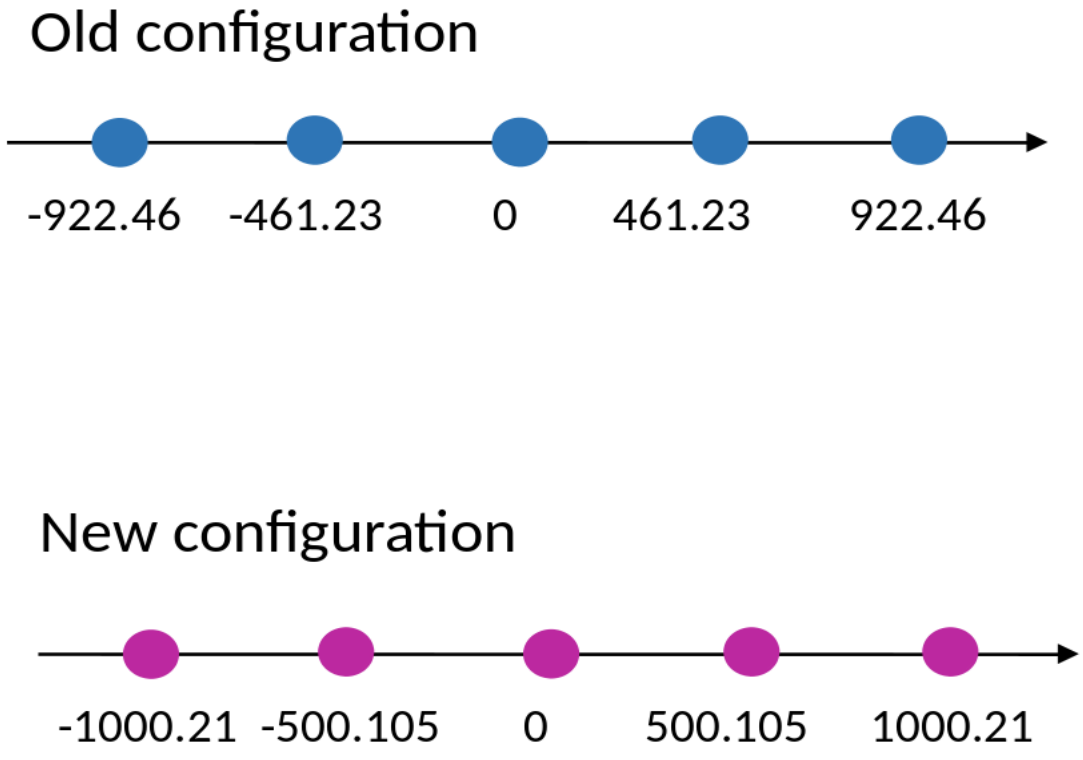
Reminder : Light Maps

New Map

Split Liq Ar volume in 2, increase voxelisation and change in geometry



PMT configuration
in mm



PMT acceptance simulation

PMT acceptance spans up to an angle of 48°

Effects of the photon impact position on the photocathode f(θ)

Operational Properties of Photomultiplier Tubes in the MiniBooNE Experiment

Published in: 2002 IEEE Nuclear Science Symposium Conference Record

and the photon incidence angle g(ϕ)

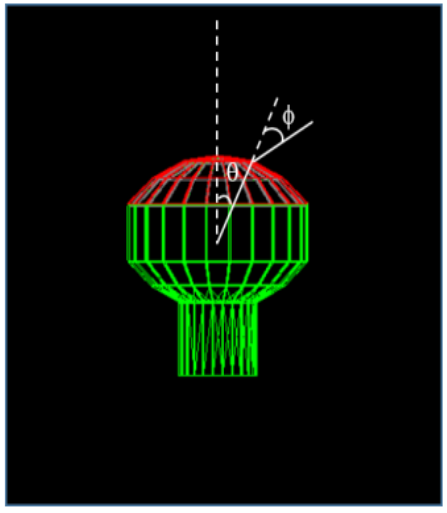
Photomultiplier Tubes – Basic and Applivations (Third edition)

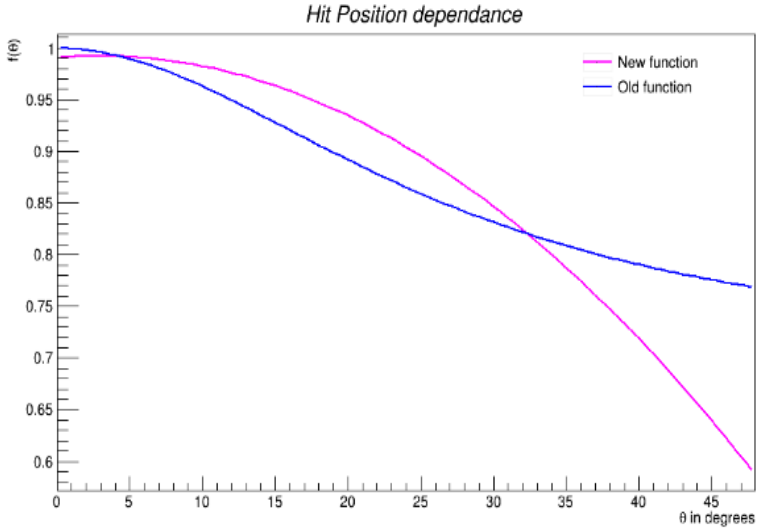
Hamamatsu

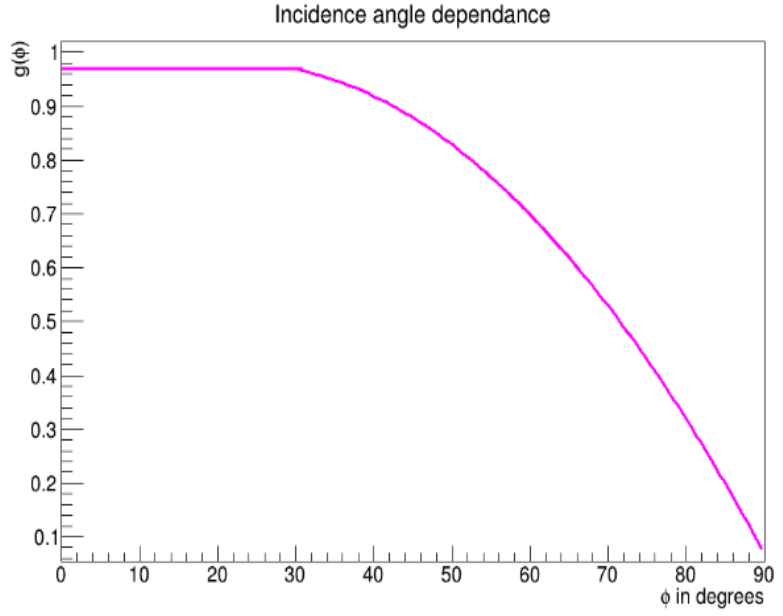
PMT quantum efficiency QE=0.20 (set in Qscan)

the final quantum efficiency is parametrised by two functions

$QE \times f(\theta) \times g(\phi)$

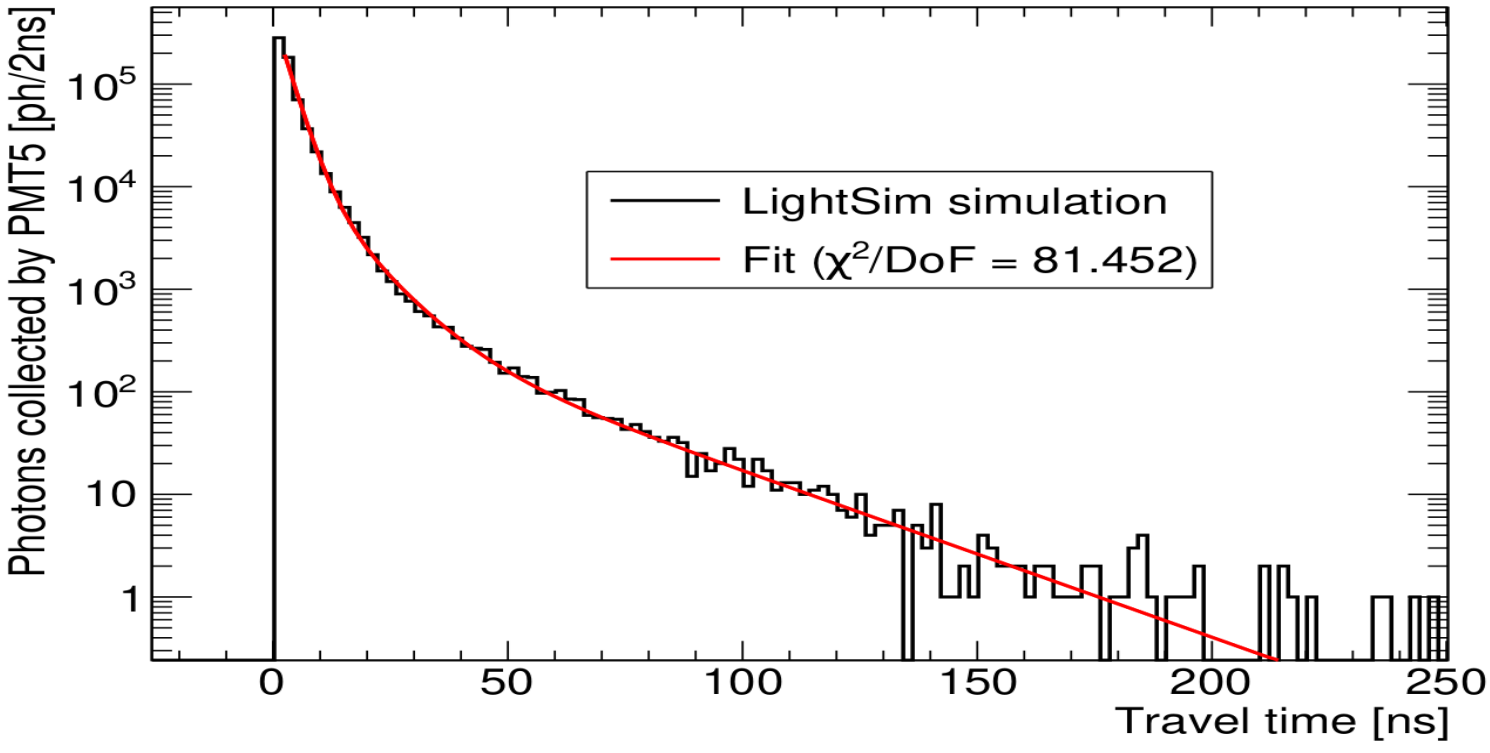






Old fit of time distribution

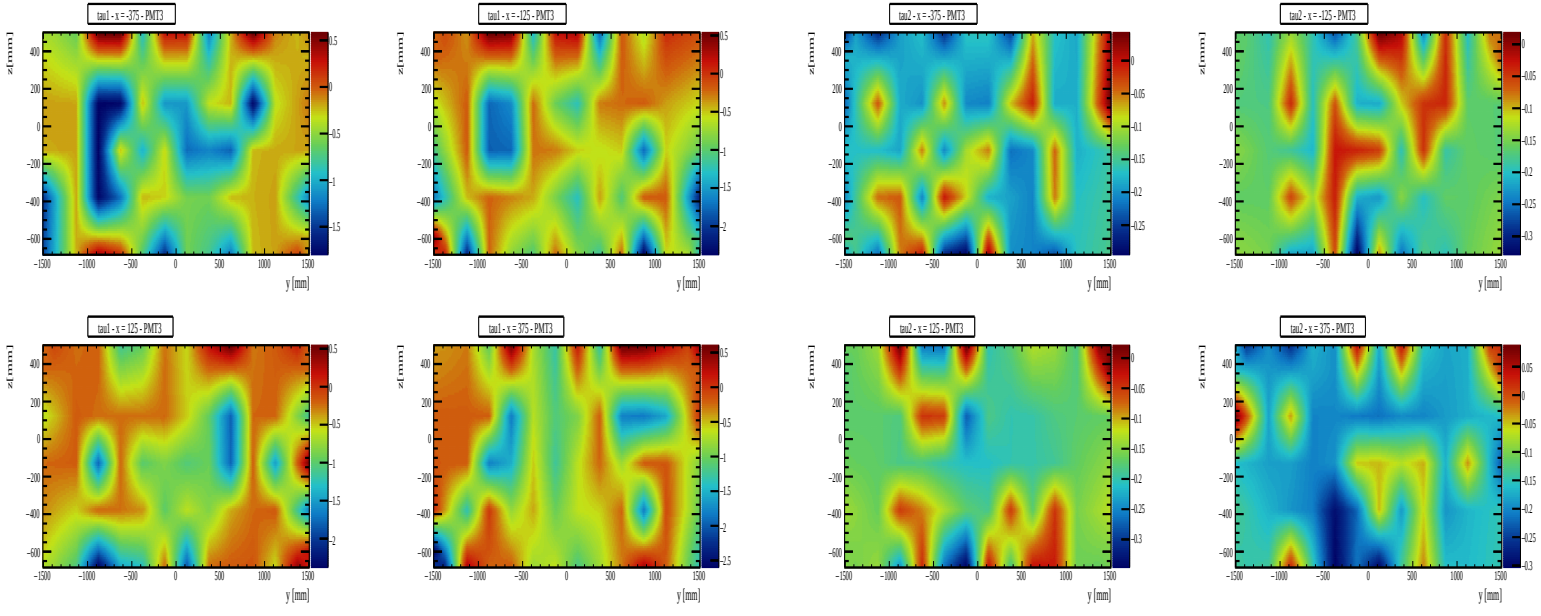
$$f(t) = e^{A+\tau_1 t} + e^{B+\tau_2 t} + e^{C+\tau_3 t}$$



Source : Anne Chappuis's thesis

Interpolation problems

2D distribution of τ_1 (left) and τ_2 (right) for PMT3

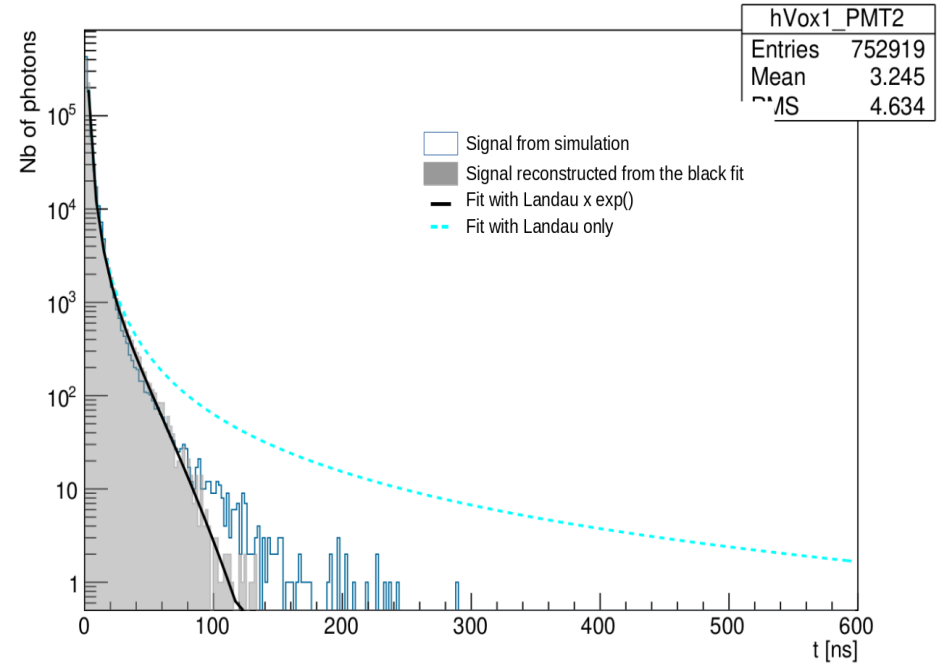


New Fit of time distribution

$$f(t) = A \cdot \text{Landau}(t, \mu, \sigma) \cdot e^{-\frac{t-t_0}{\tau}}$$

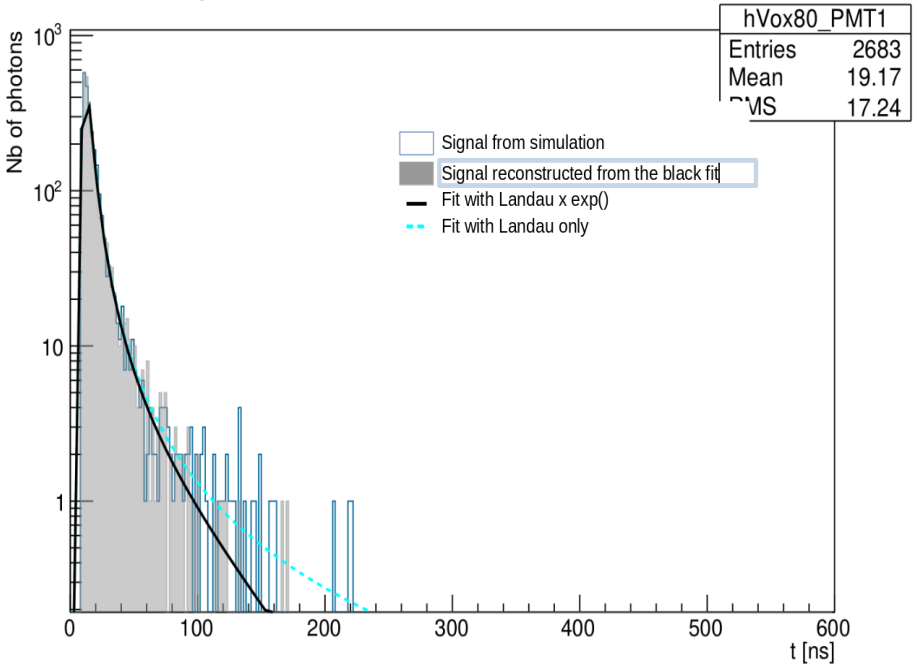
Fit with Voxel close to PMT

xel 1 at x = 70, y = 65, z = -394



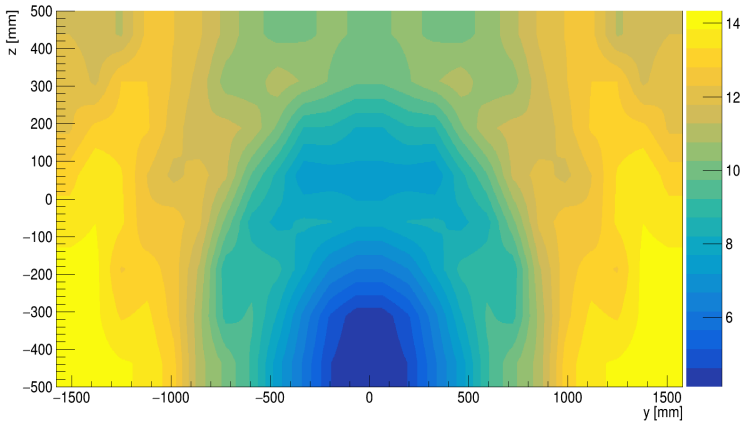
Fit with voxel far from PMT

xel 80 at x = 70, y = 1236, z = 481

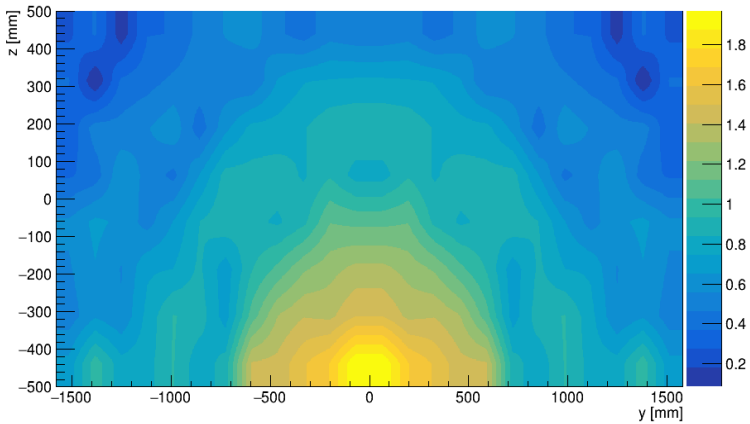


Parameters 2D view

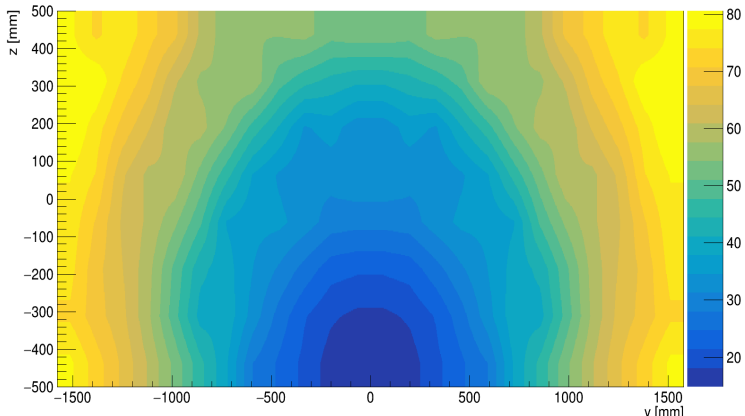
Sigma



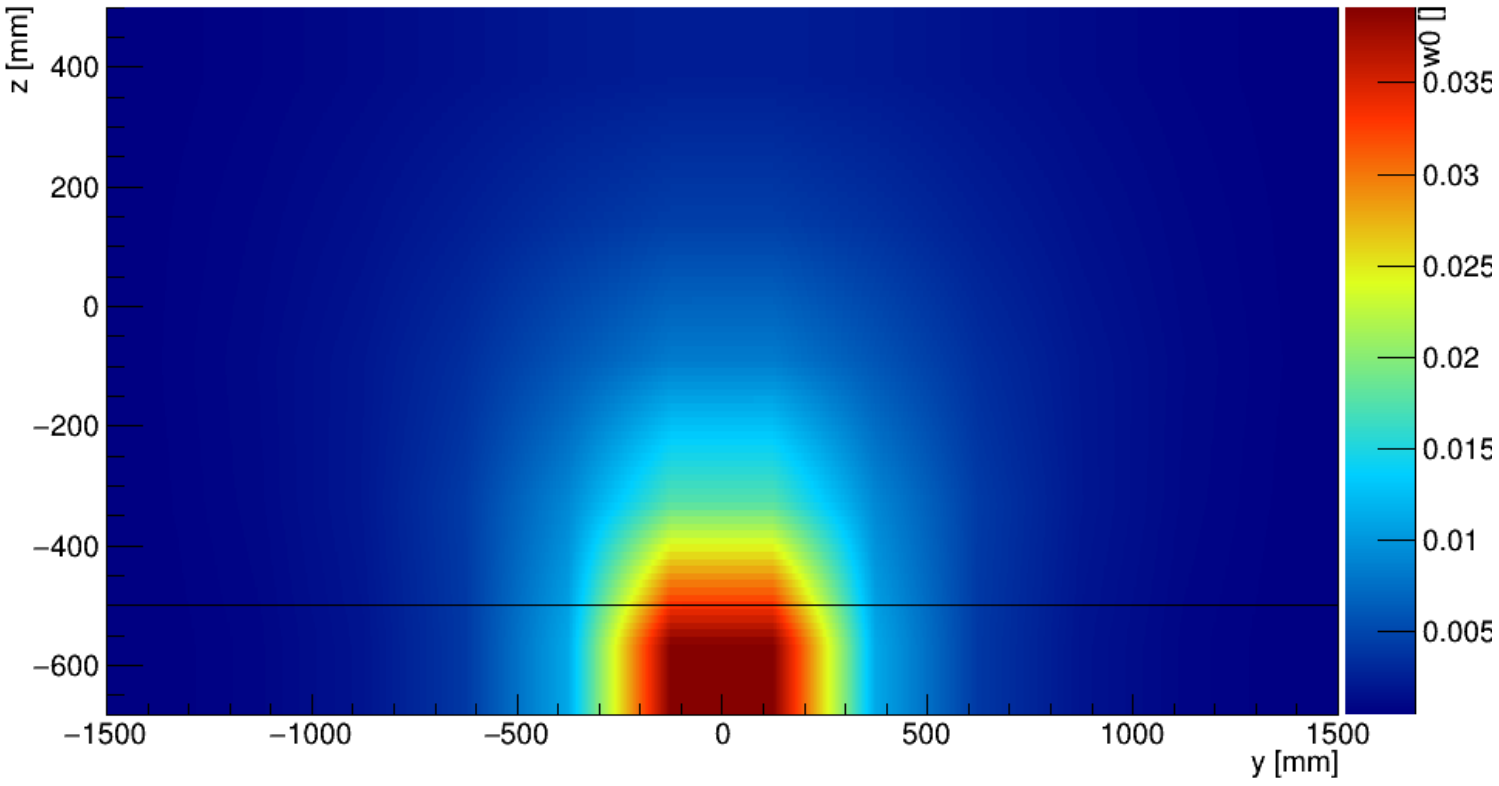
Tau



MPV

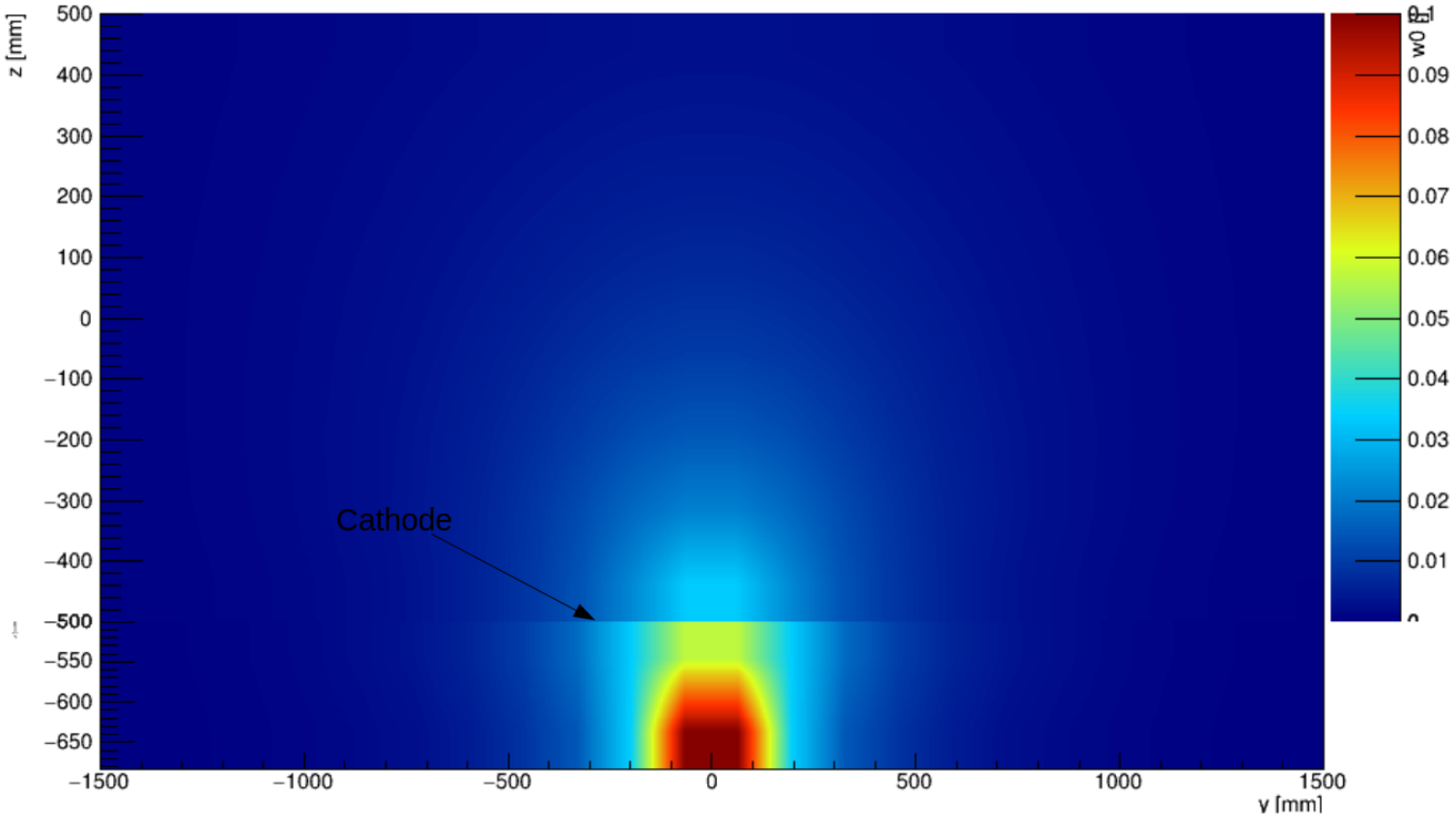


2D view of visibility PMT 2 yz
Old Map



Use of a unique map → Problem with interpolation above and below cathode

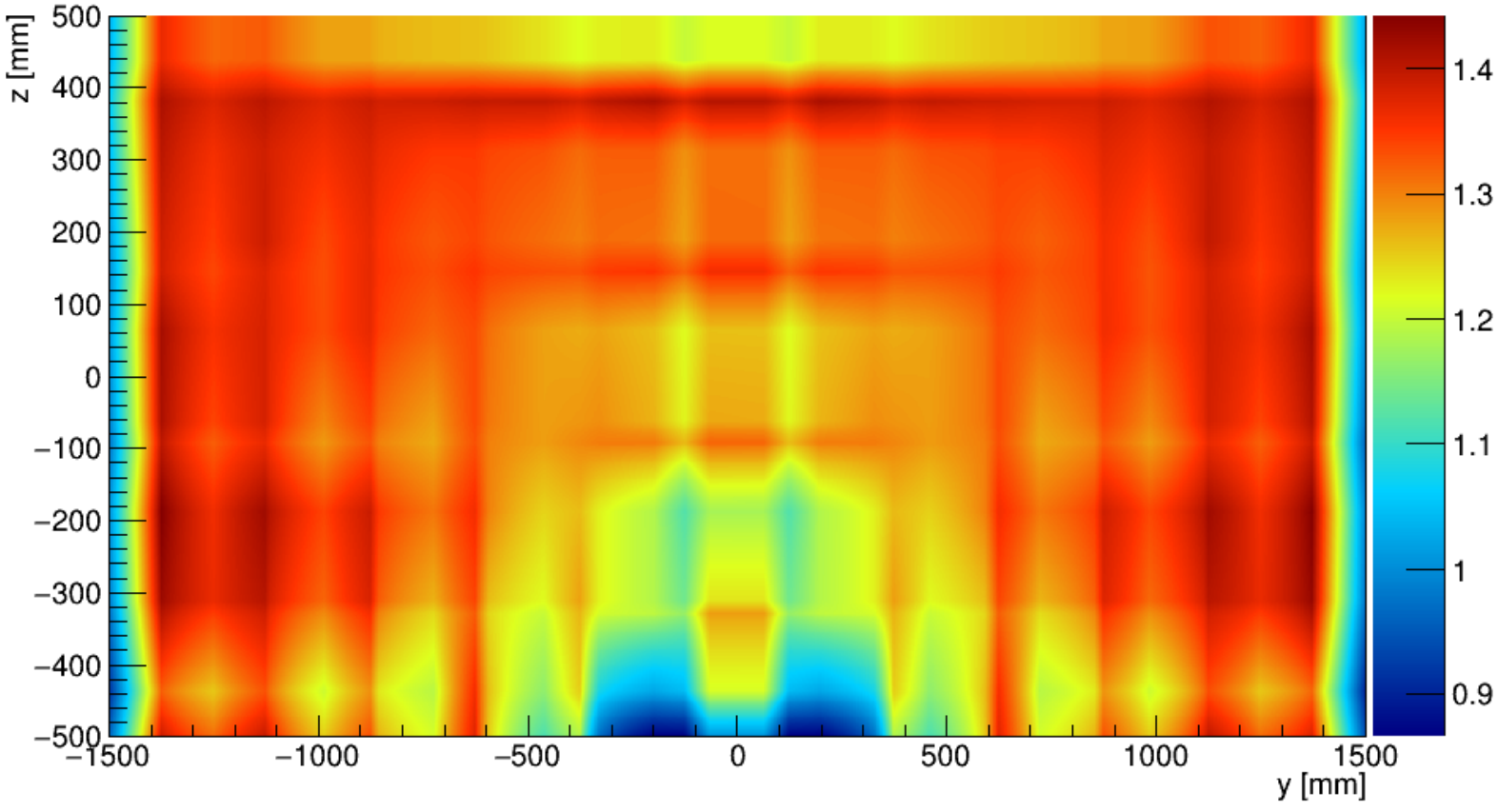
2D view of visibility PMT 2 yz
New Maps



Clear effect of the cathode on visibility

2D view of ratio PMT 2 yz

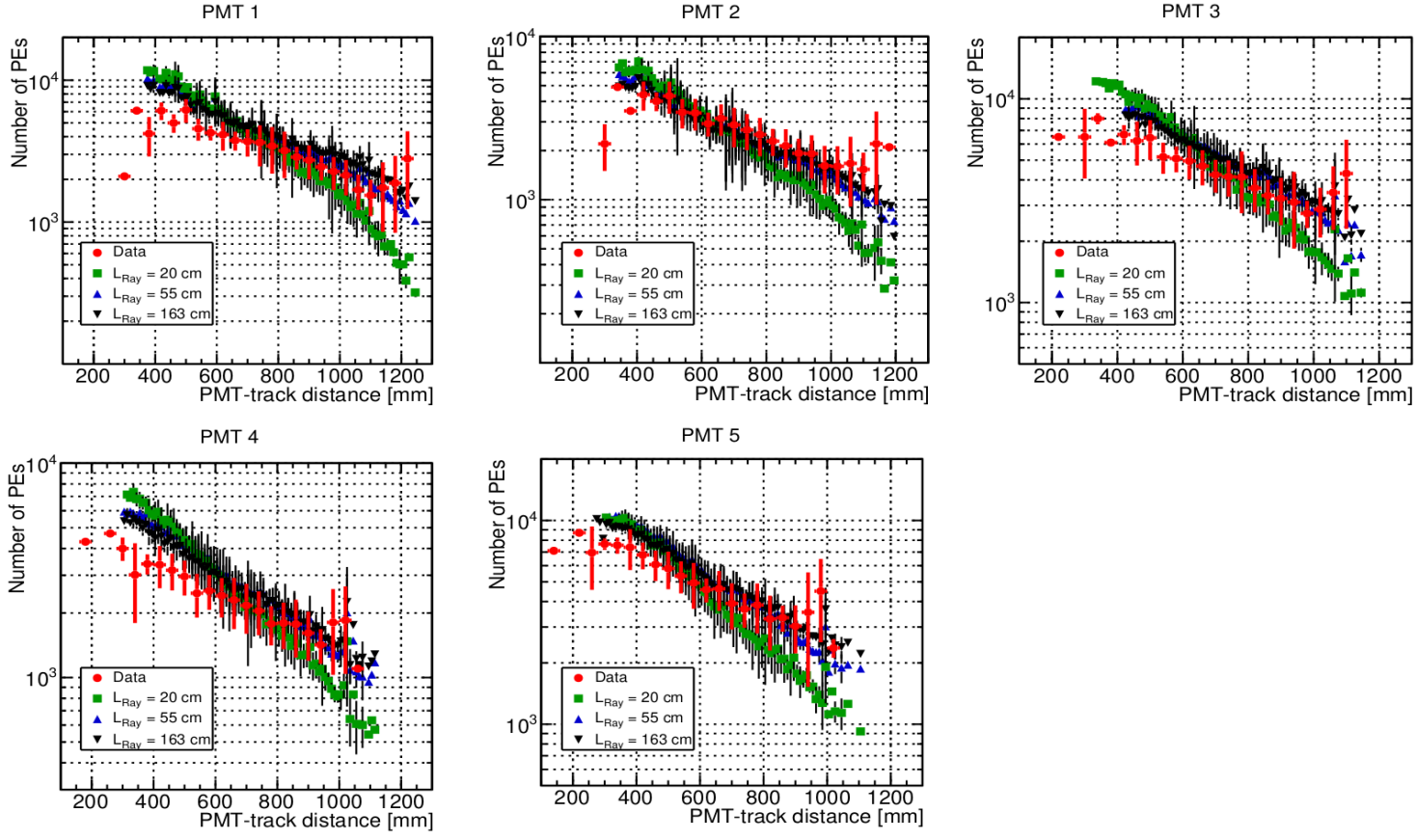
Ratio New/Old



Higher visibility for new maps far from the PMT but lower close to the PMT.
Probably due to the acceptation angle.

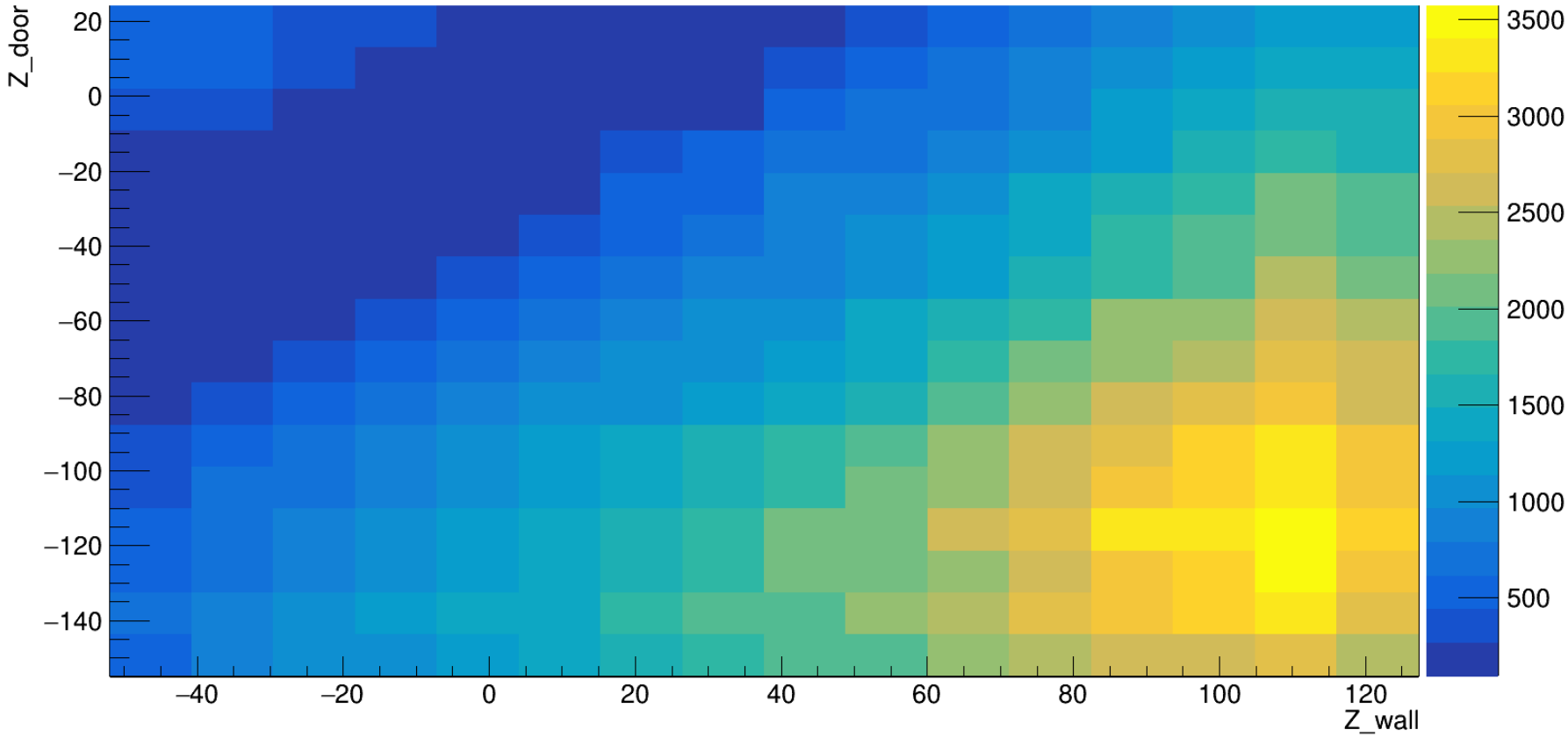
Goal

Update Anne's study on Rayleigh length effect with the new simulation

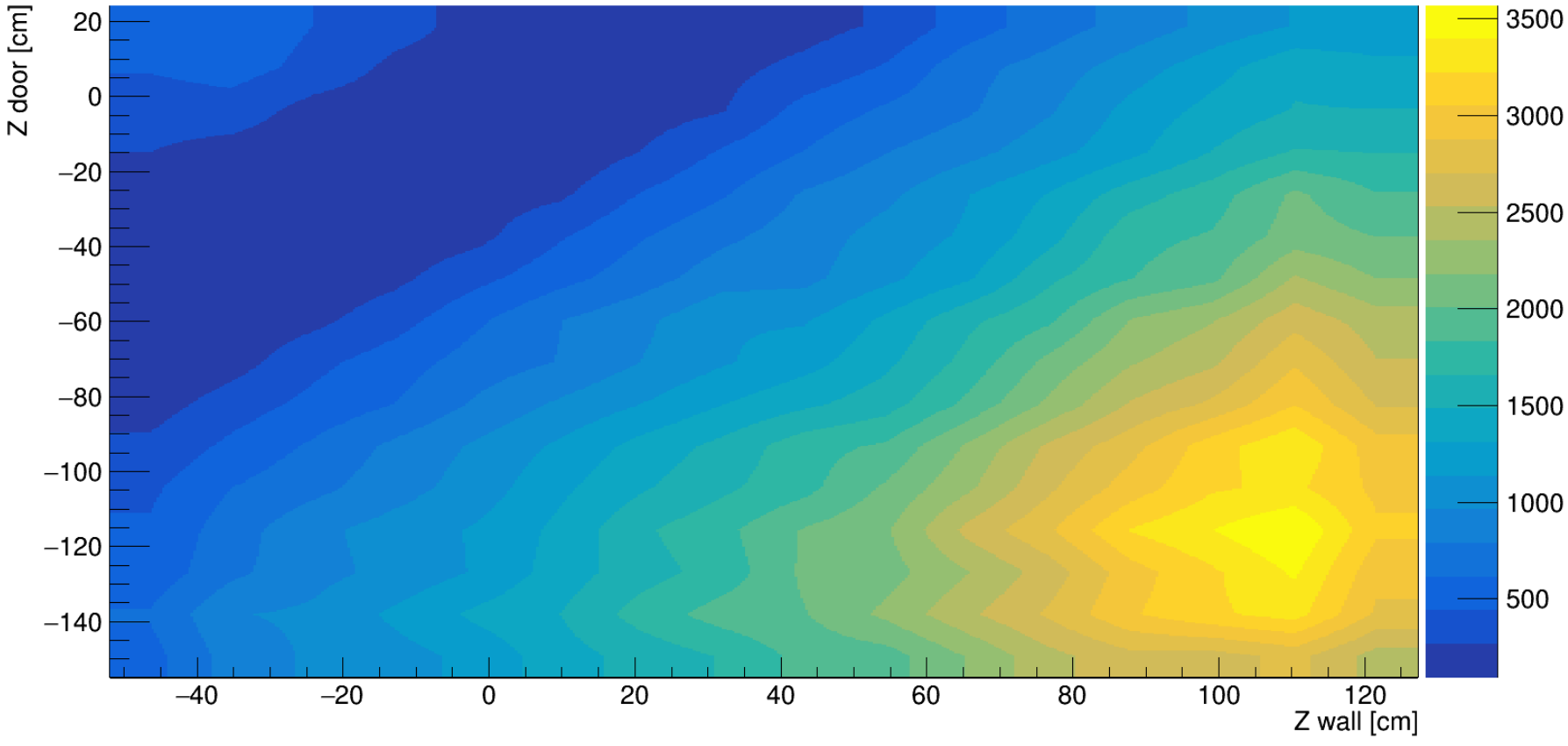


Source : Anne Chappuis's thesis

Simulated μ generated with CRT planes
Data



Simulated μ generated with CRT planes
Interpolation

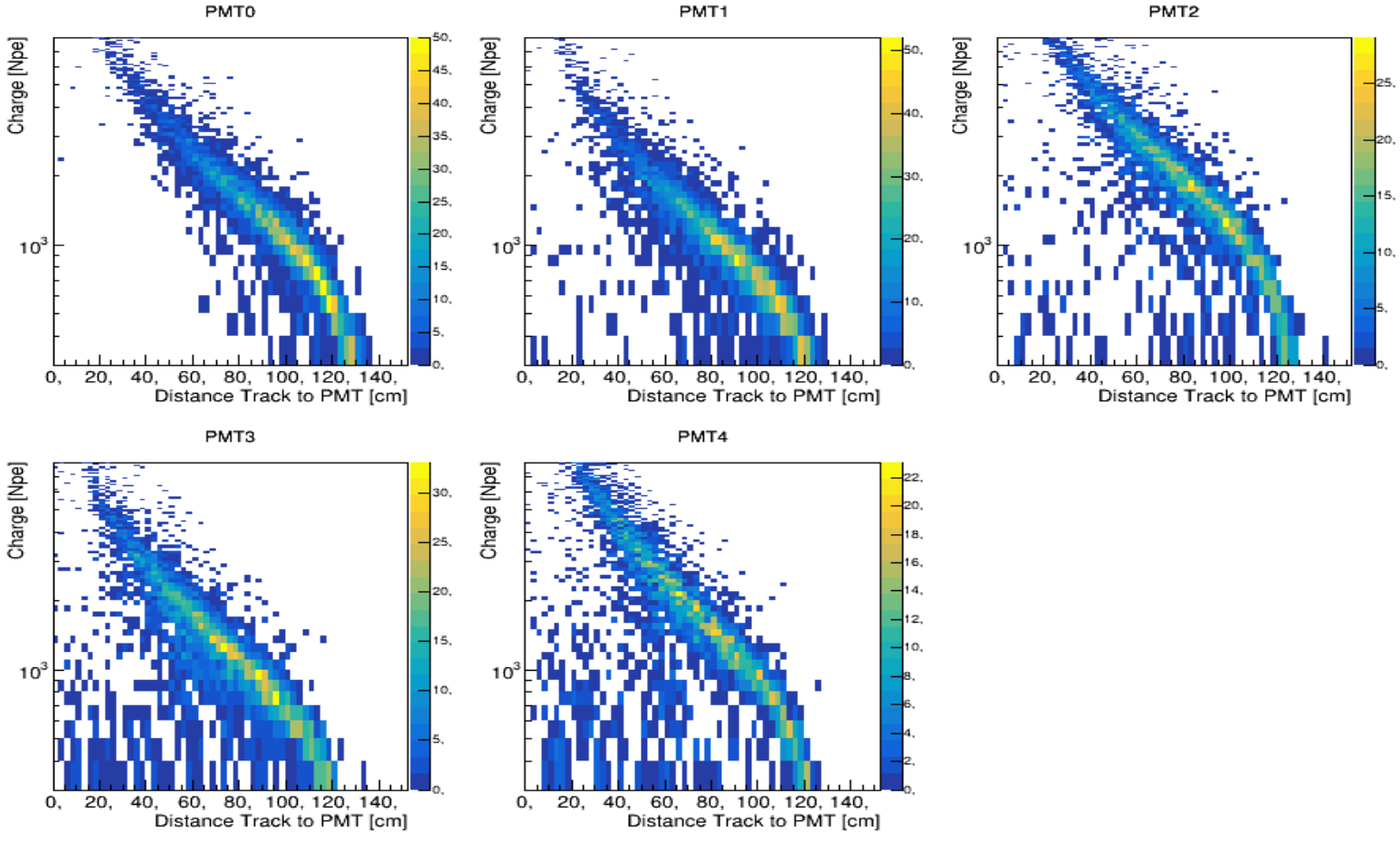


Correlation used to generate muons.

Simulation Parameters

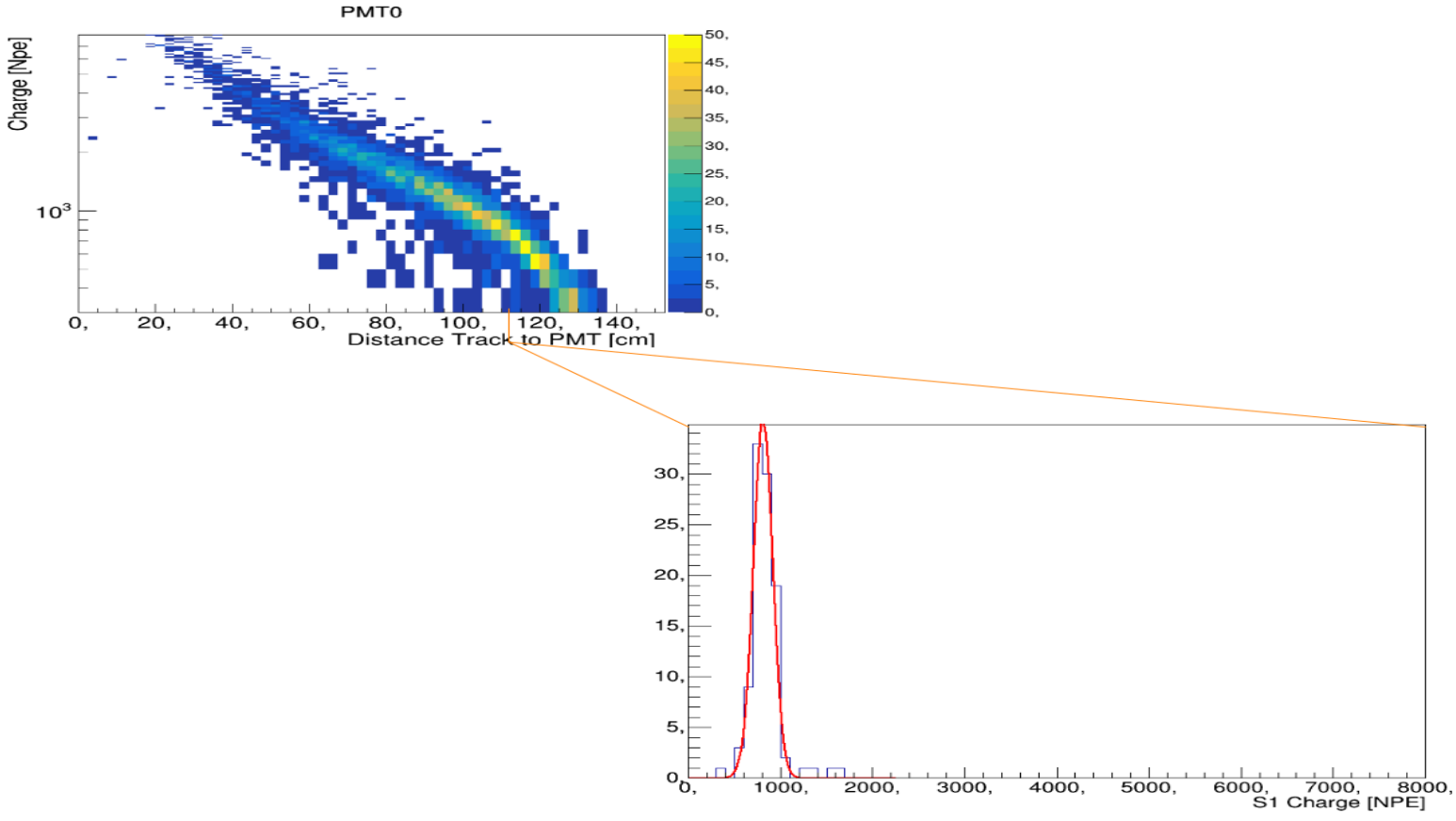
- 5000 muons
- Rayleigh length : 55cm
- No Electric Drift Field
- Charge obtained by integrating over $1\mu s$
- Event taken only if closest point Track-PMT is above the cathode

2D Charge vs Distance Track-PMT



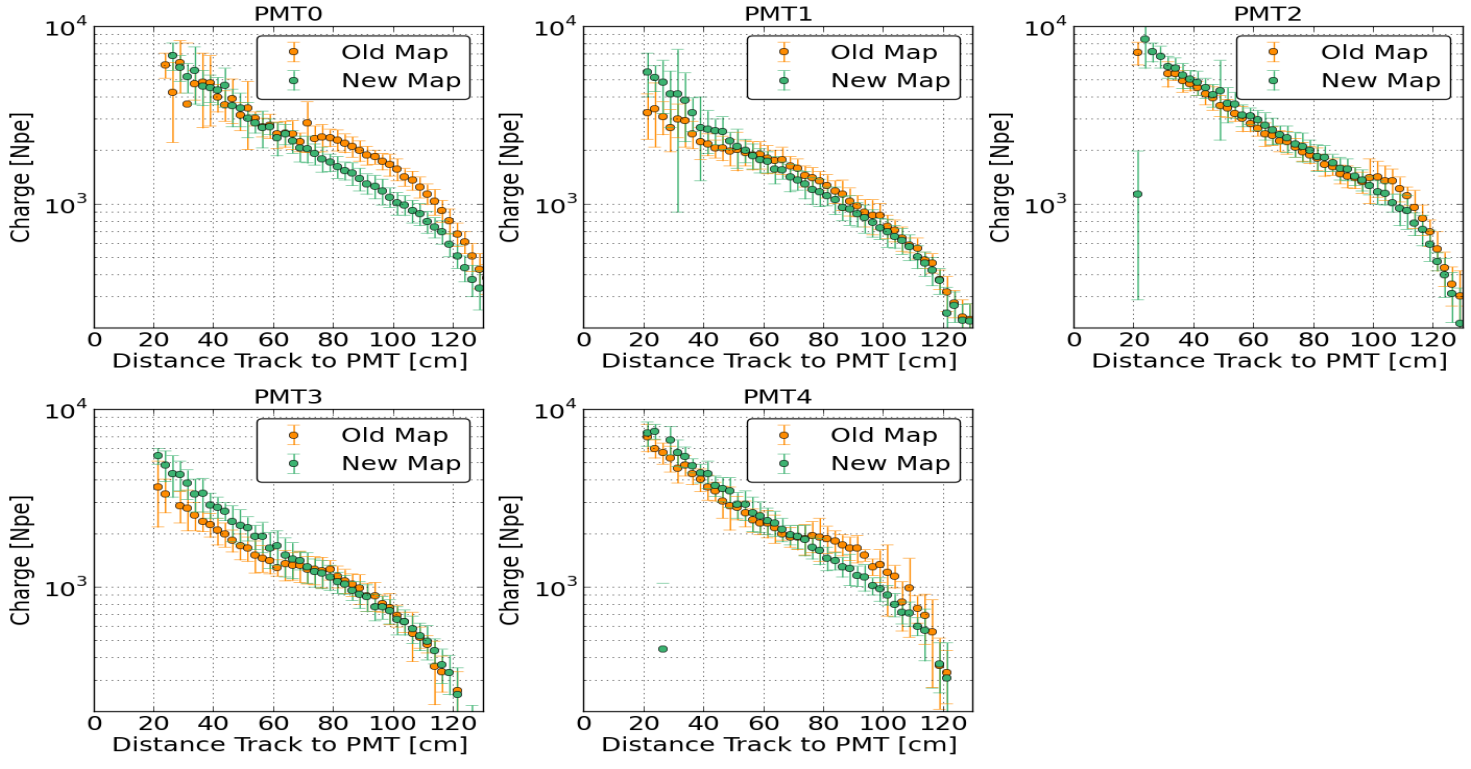
At each bin on X axis → Gaussian Fit

2D Charge vs Distance Track-PMT



We take the mean and sigma of the fit.

Mean Charge vs Distance Track-PMT
Old and New Maps



"little bump" disapeared with new maps

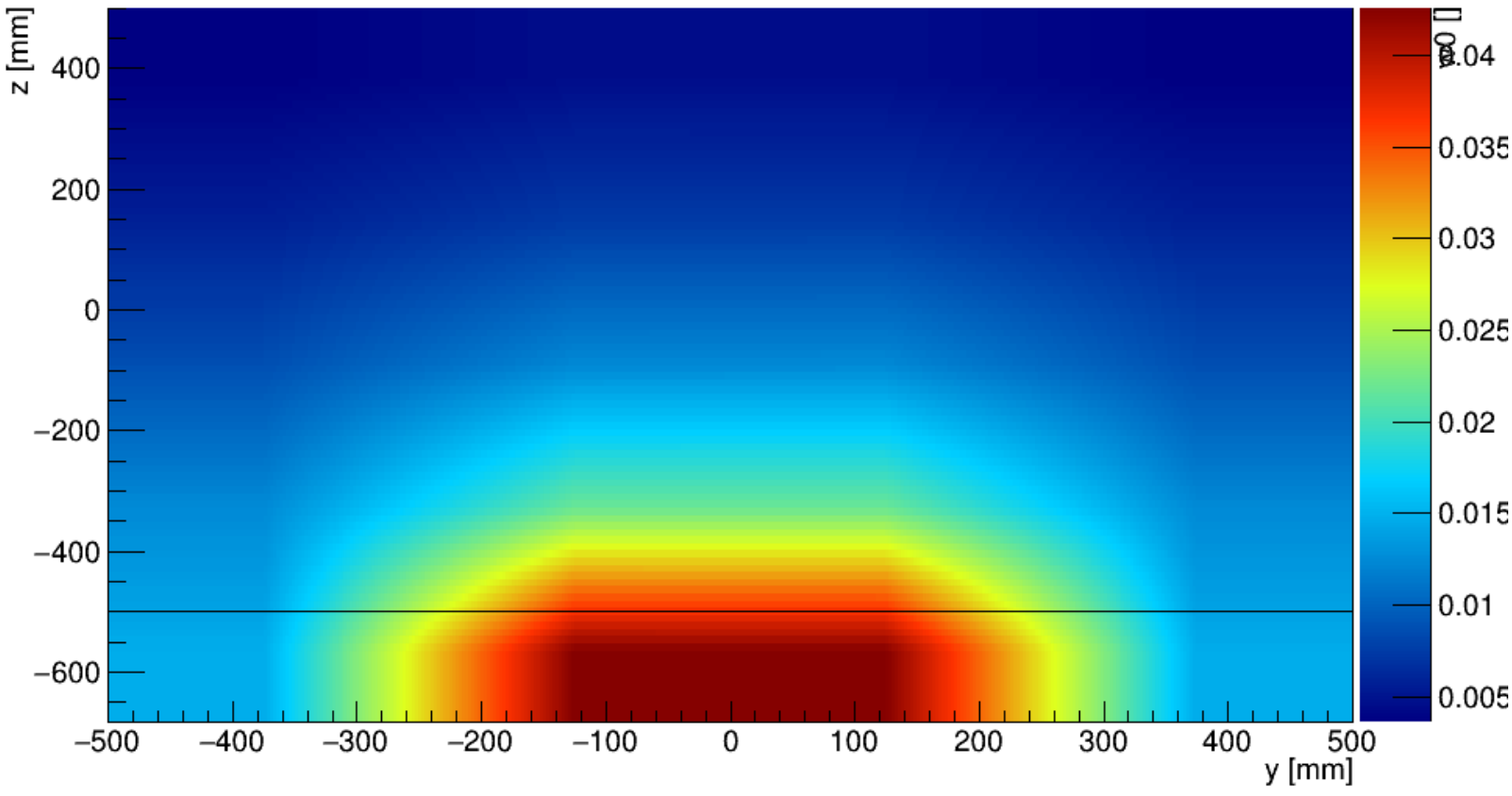
$\rightarrow$ probably was due to interpolation between above and below cathode

Conclusion

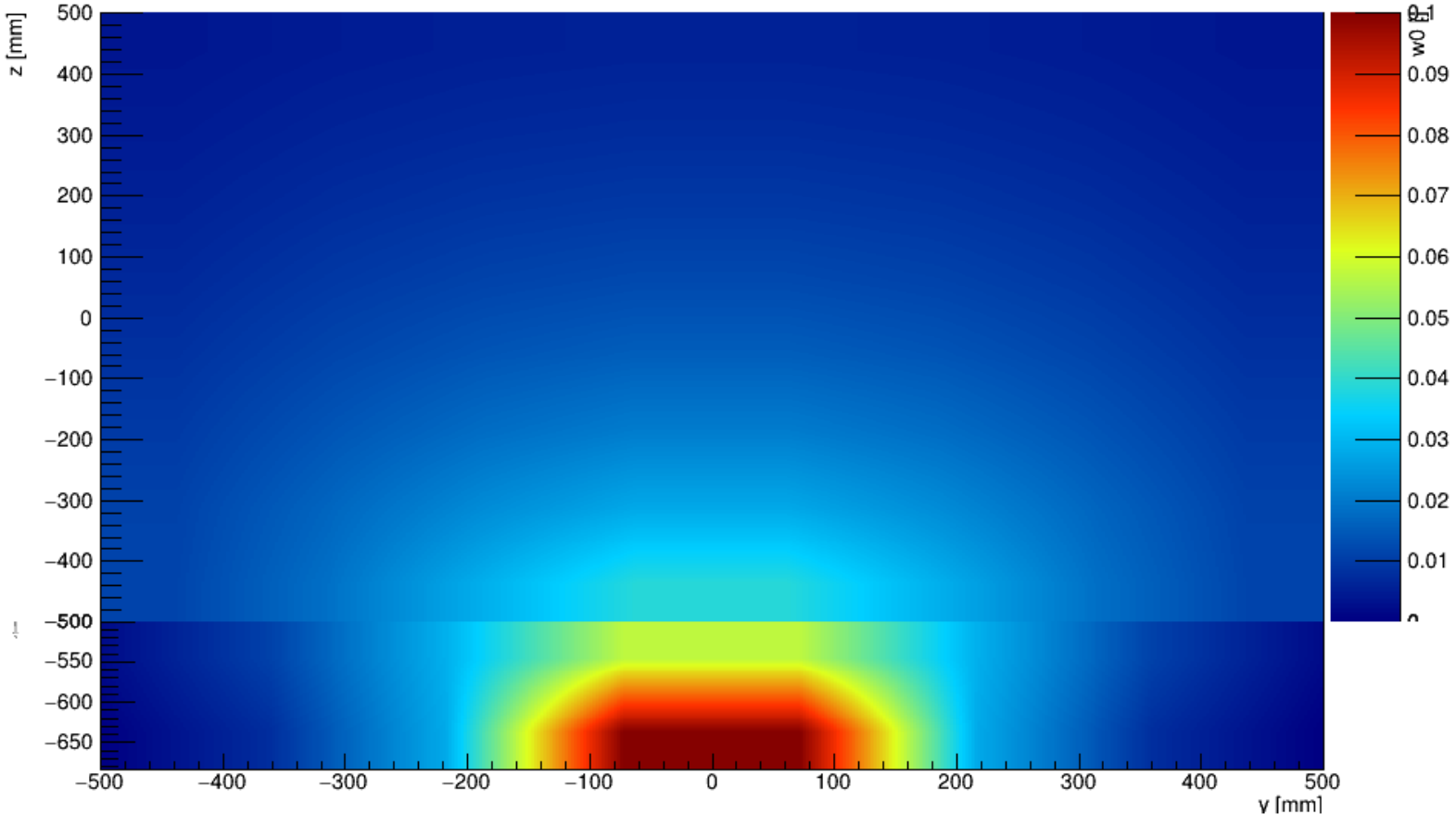
- Do the same with Rayleigh length at 20cm, 163cm and 90cm
- Compare to data

Back-up

2D view of visibility PMT 2 xz
Old Map



2D view of visibility PMT 2 xz
New map



2D view of ratio PMT 2 xz

Ratio New/Old