PMT Simulation

sim/data analysis introduction

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Summary

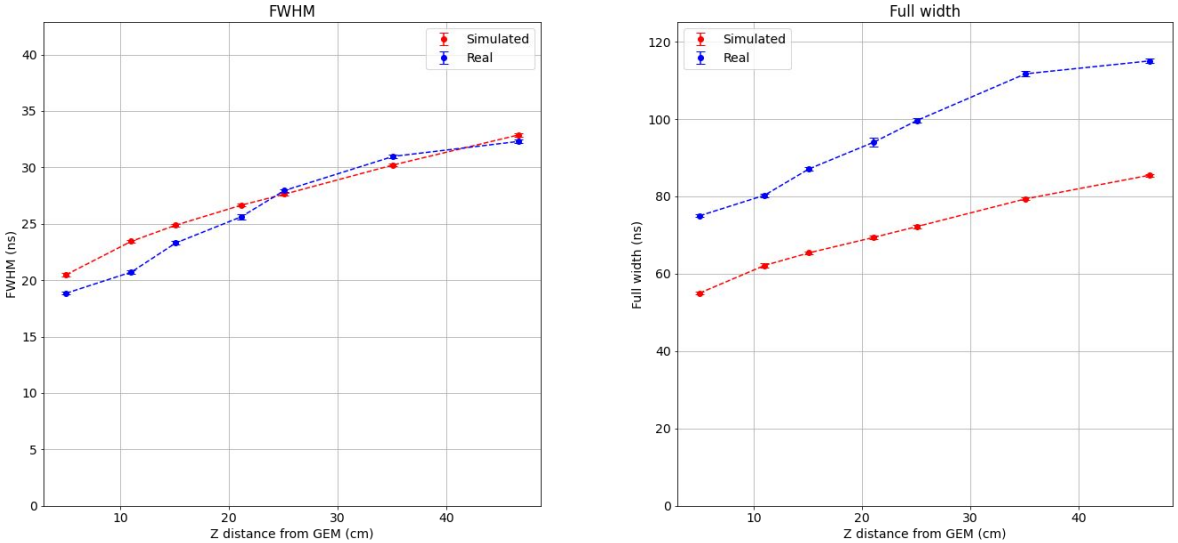
In this presentation:

1. Introduction
2. Strategy for the analysis
3. Preliminary results from simulation analysis

Introduction

Remembering the recent results…

Signal width in function of the Z distance from GEM



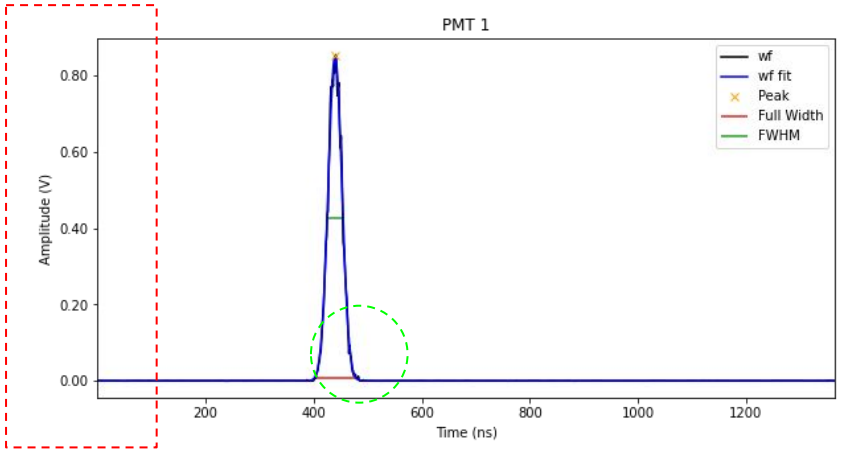
Result from the first sim/data comparison (Z diffusion analysis)

Introduction

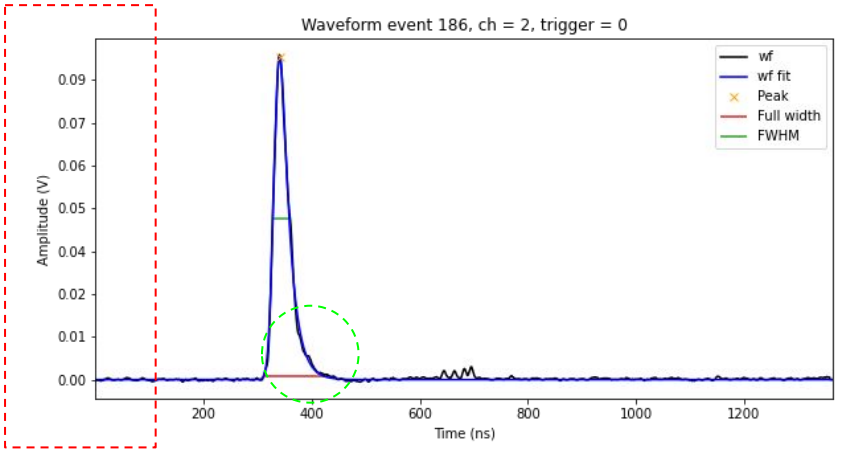
Remembering the recent results…

Problem in simulated waveform height peak and shape

Simulation



Real data

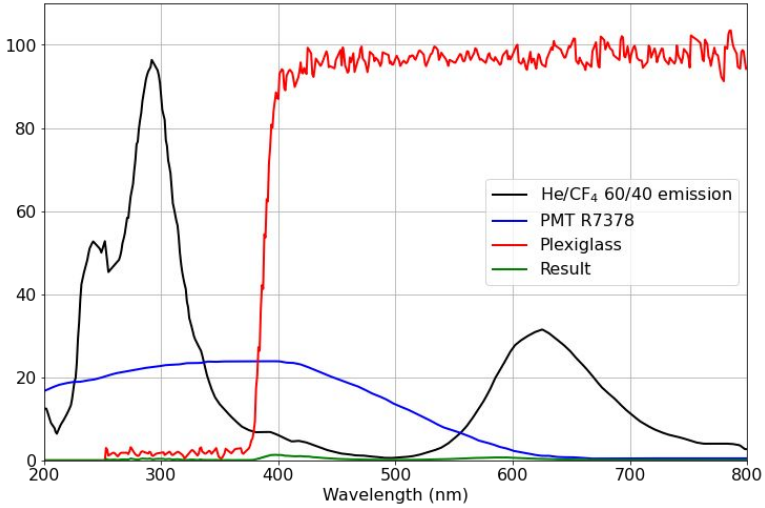


Example for run 12174 (Step 5 = 46.6 cm)

Introduction

Remembering the recent results…

PMT QE and glass transmission spectrum



$$\frac{Area_{green\_curve}}{Area_{black\_curve}} = 1.36\%$$

1.36% of produced photons by the GEMs will have the possibility of hitting the PMTs and generating a signal

Multiply the number of produced photons by this value before simulating the PMT

Introduction

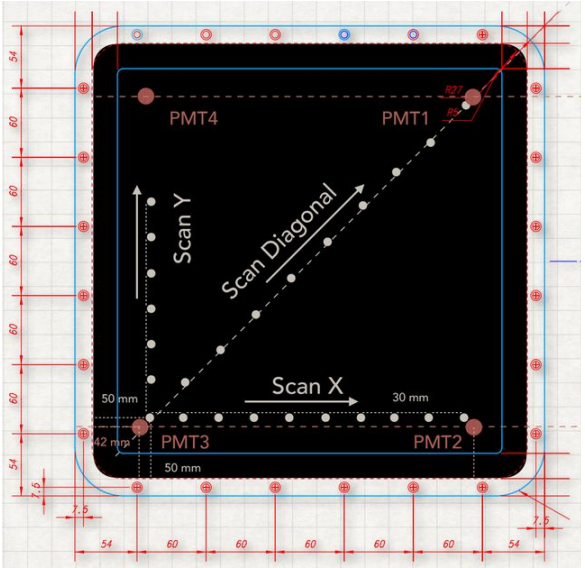
To do tasks:

- Simulation parameters tuning
  - Fix simulated waveform shape
  - Fix simulated waveform height peak
  - Improve photon by photon propagation time
  - Code optimization in general
  - Add missing parameters
- Analysis
  - Simulation/data comparison
  - Simulation for different tracks with different energies

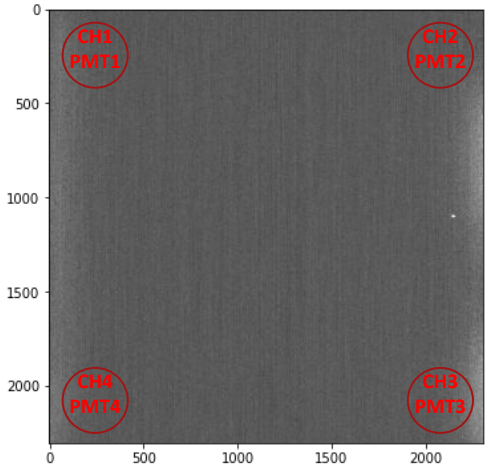
Introduction

Positions of the PMTs

Simulation code



Reconstruction code



Strategy

Points to consider in this analysis:

- Consider the X-Y-Z position of the tracks
- Associate channels with PMTs
- Simulate 6 keV spots

Parameters to be verified:

- Peak
- Integral
- RMS

Strategy

For this analysis:

- Based on runs of Fe55 source
- Selected just events with one cluster
- Use PMT + camera reco for data analysis → Waveform, Image

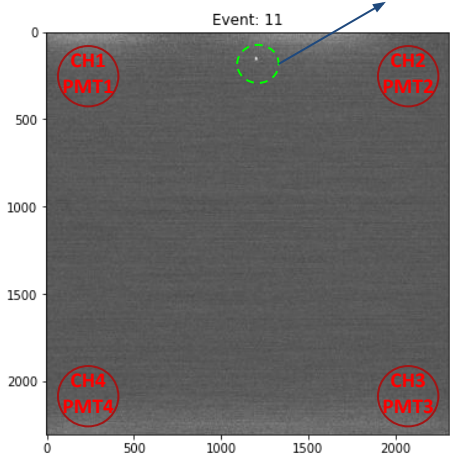
- 12170: Step 1 = 5.0 cm
- 12245: Step 1 + 6 divisions = 11.0 cm
- 12171: Step 2 = 15.1 cm
- 12246: Step 2 + 6 divisions = 21.1 cm
- 12172: Step 3 = 25.1 cm
- 12173: Step 4 = 35.1 cm
- 12174: Step 5 = 46.6 cm

Fe55 runs

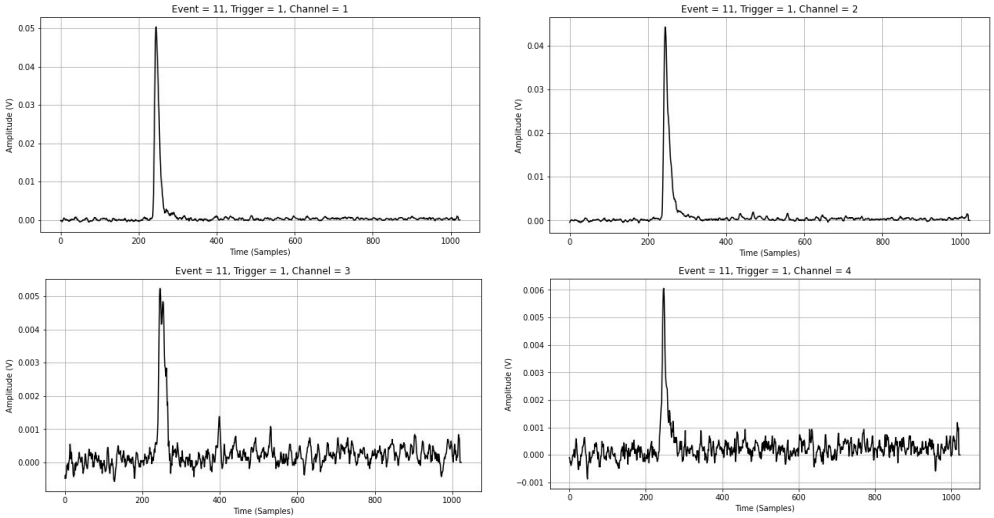
Strategy

Example of sim/data comparison for one event:

Get x-y position



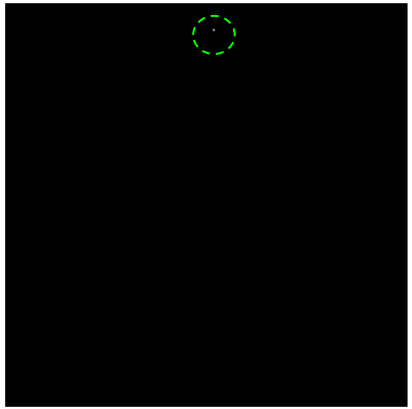
Get data from waveforms analysis



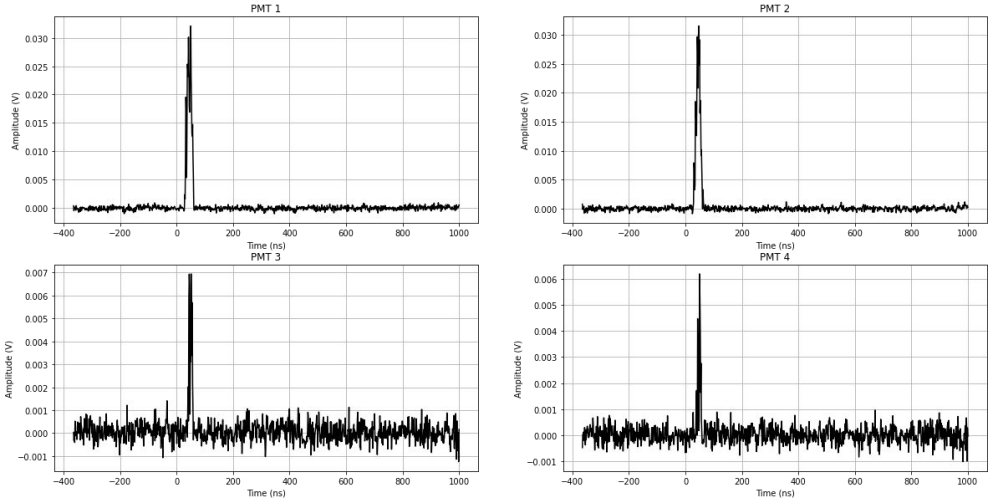
Strategy

Example of sim/data comparison for one event:

Simulate the 6 keV spot at the same position



Get data from waveforms analysis



Strategy

Example of sim/data comparison for one event:

- Do the sim/data comparison for the event
- Repeat the process for all one cluster events

One cluster events:

Run 12170: Step 1: [11, 23, 27, 49, 50, 63, 94, 103, 148, 188, 200, 204, 228, 283, 345, 356, 375, 386, 397]

Run 12245: Step 1 + 6 divisions: [53, 68, 99, 122, 125, 183, 188, 212, 254, 288, 298, 307, 333, 400]

Run 12171: Step 2: [15, 34, 47, 63, 104, 119, 154, 194, 197, 204, 235, 251, 265, 276, 277, 287, 298, 334]

Run 12246: Step 2 + 6 divisions: [33, 215, 274, 318, 326, 362, 397]

Run 12172: Step 3: [87, 89, 103, 125, 135, 168, 193, 211, 241, 244, 251, 257, 288, 323, 342, 357, 366]

Run 12173: Step 4: [13, 25, 68, 93, 154, 156, 168, 177, 178, 186, 194, 203, 224, 247, 252, 262, 266, 268, 303, 394]

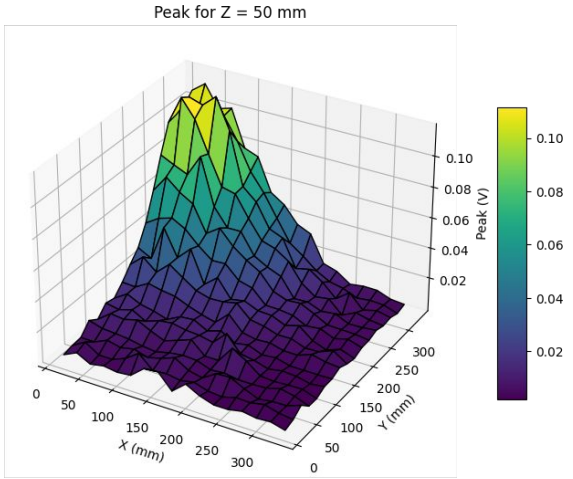
Run 12174: Step 5: [42, 51, 53, 63, 103, 112, 141, 237, 265, 272, 306, 328, 332, 334, 335, 339, 357, 366, 383, 388]

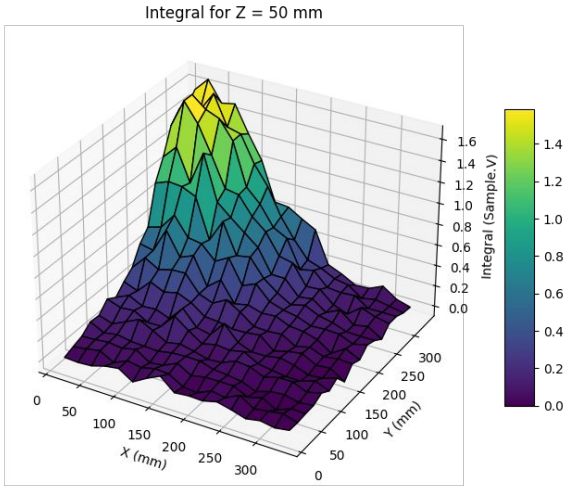
Preliminary results from simulation analysis

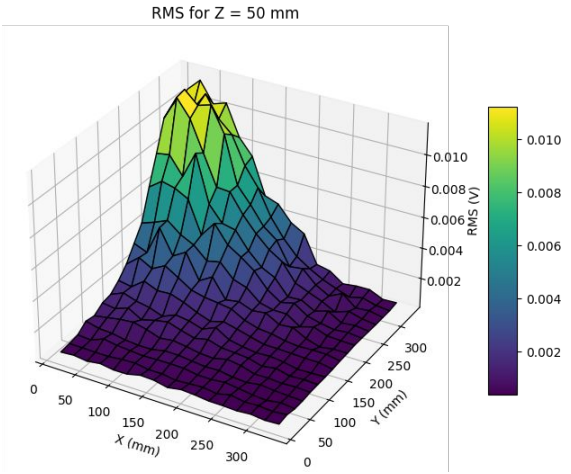
Results for PMT 1

Z = 50 mm

Performing a x-y position scan





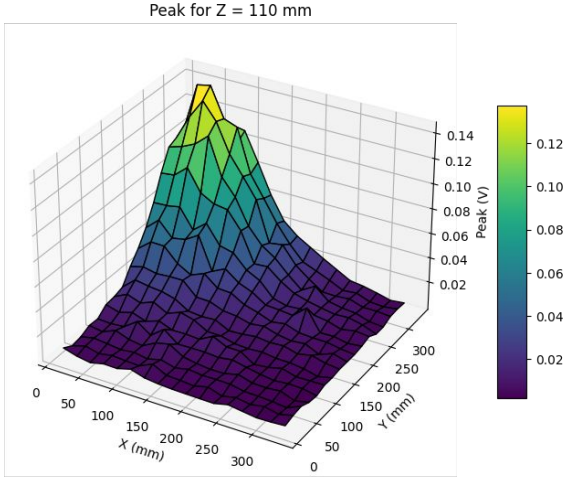


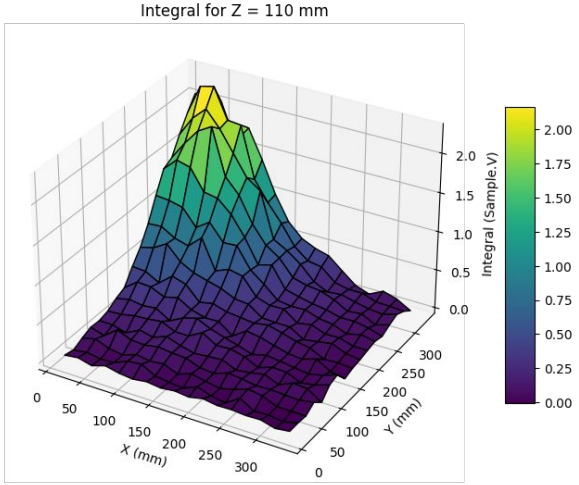
Preliminary results from simulation analysis

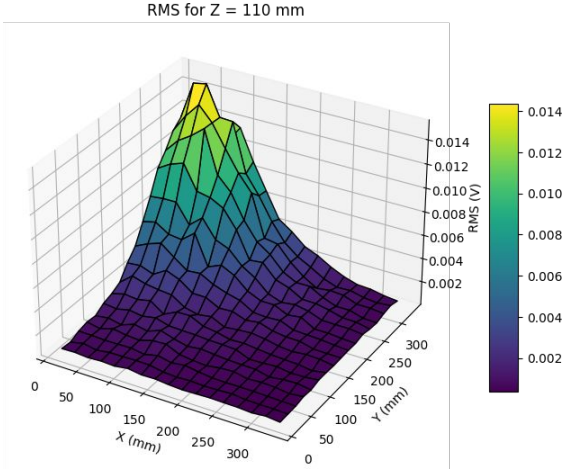
Results for PMT 1

Z = 110 mm

Performing a x-y position scan





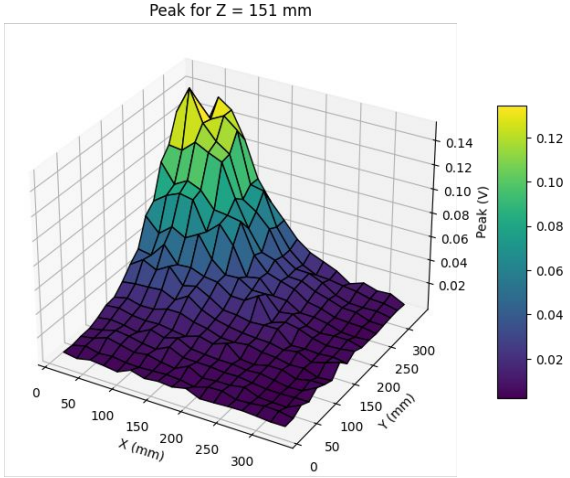


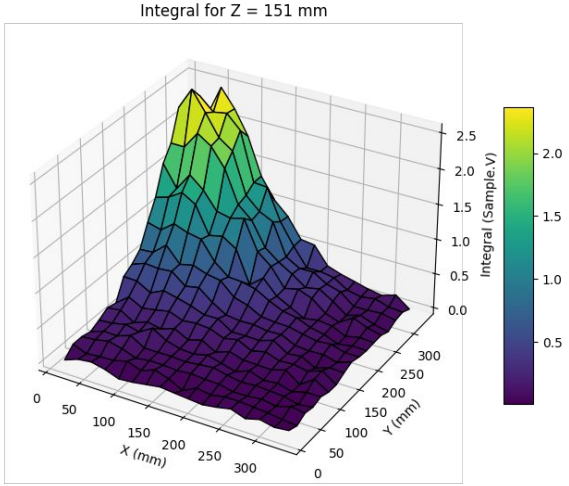
Preliminary results from simulation analysis

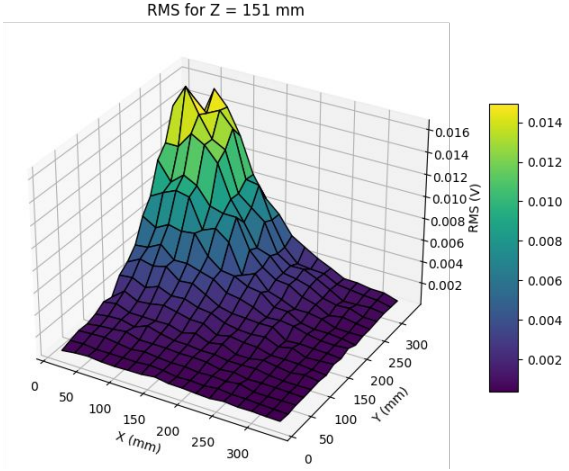
Results for PMT 1

Z = 151 mm

Performing a x-y position scan





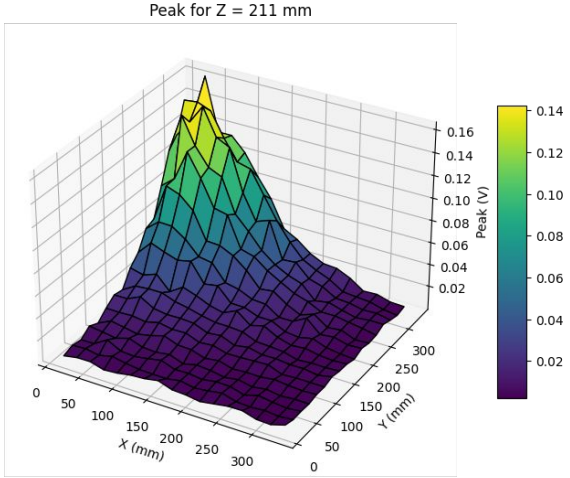


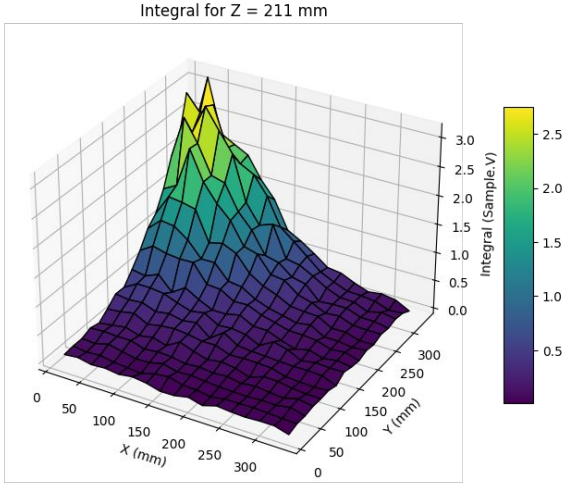
Preliminary results from simulation analysis

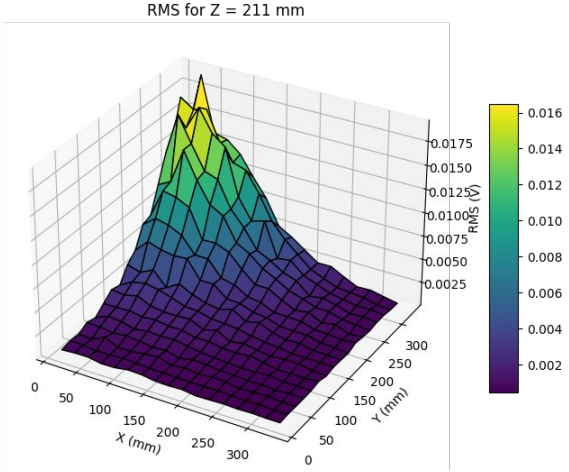
Results for PMT 1

Z = 211 mm

Performing a x-y position scan





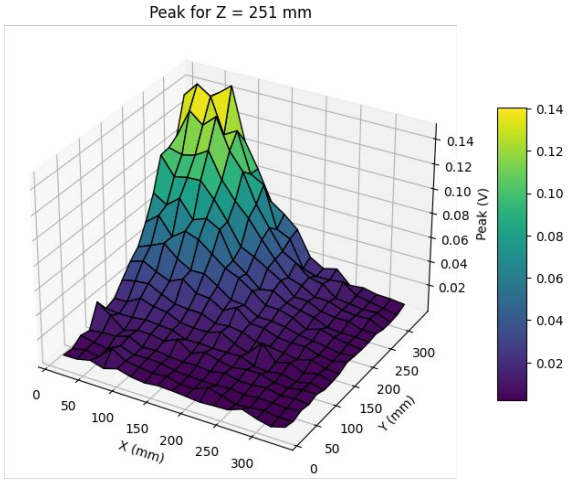


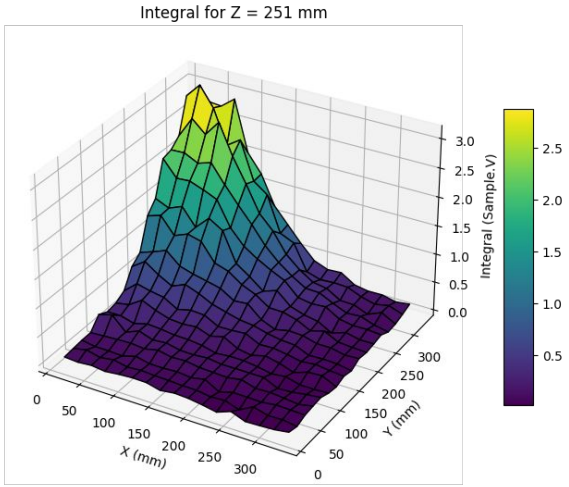
Preliminary results from simulation analysis

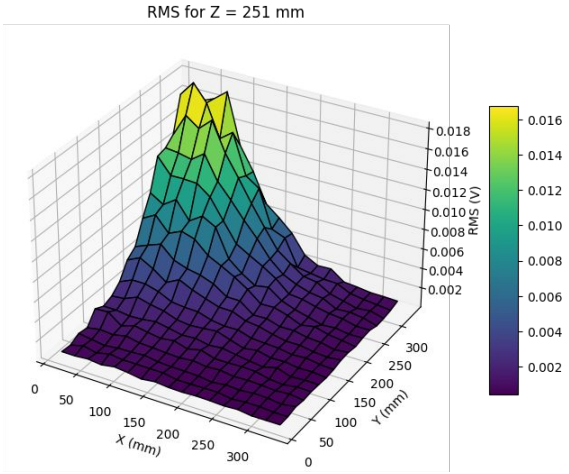
Results for PMT 1

Z = 251 mm

Performing a x-y position scan





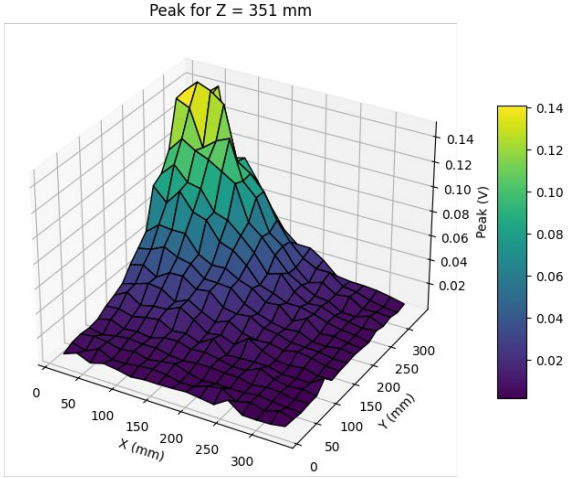


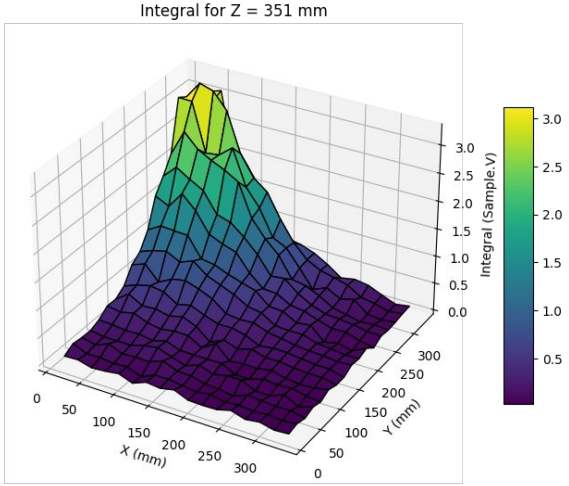
Preliminary results from simulation analysis

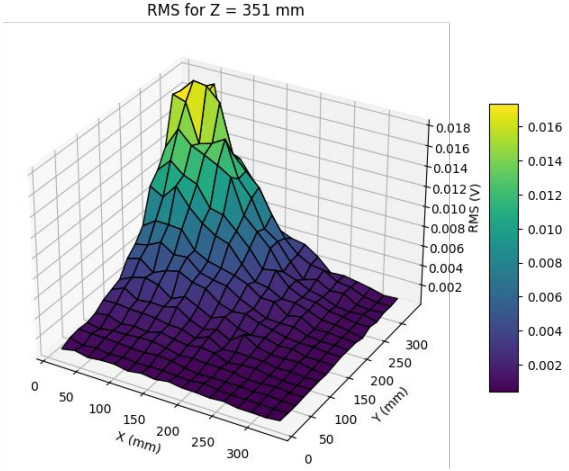
Results for PMT 1

Z = 351 mm

Performing a x-y position scan





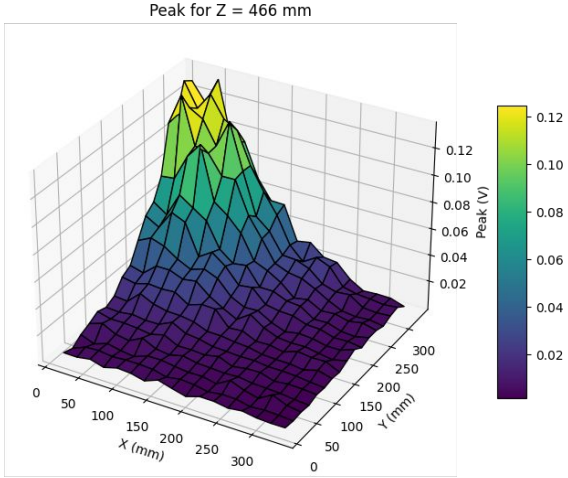


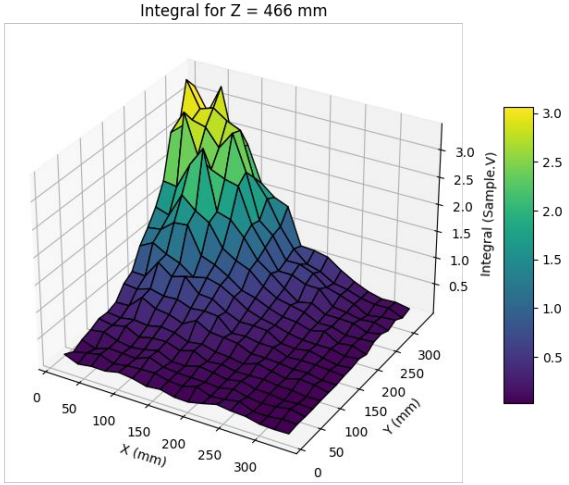
Preliminary results from simulation analysis

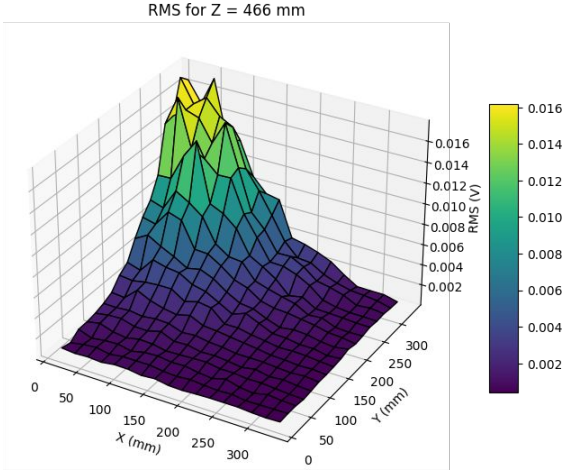
Results for PMT 1

Z = 466 mm

Performing a x-y position scan

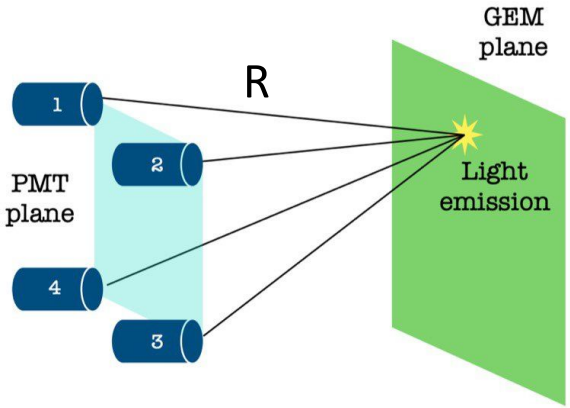






Preliminary results from simulation analysis

Results in function of the R distance (spot at GEM plane to PMT)



$$Z_{PMT} = 134\ mm$$

$$PMT_1: X_1 = 42\ mm,\ Y_1 = 312\ mm$$

$$PMT_2: X_2 = 312\ mm,\ Y_2 = 312\ mm$$

$$PMT_3: X_3 = 312\ mm,\ Y_3 = 42\ mm$$

$$PMT_4: X_4 = 42\ mm,\ Y_4 = 42\ mm$$

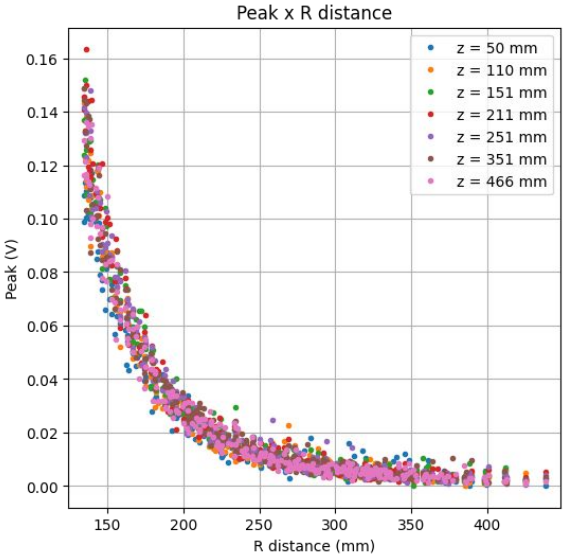
$$R = \sqrt{(X_{PMT} - x_0)^2 + (Y_{PMT} - y_0)^2 + (Z_{PMT} - z_0)^2}$$

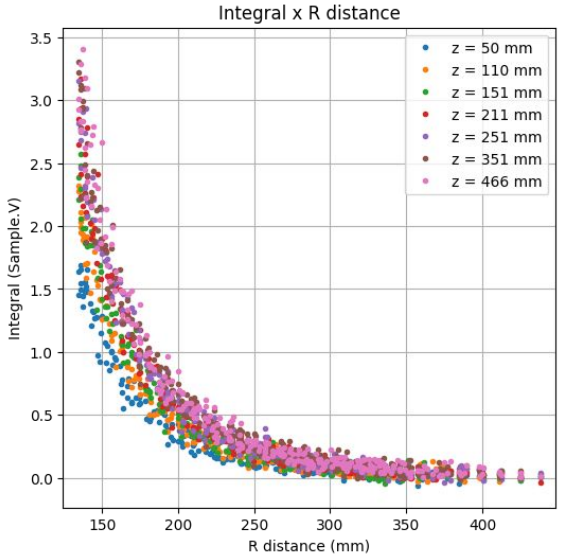
$$x_0, y_0 = spot\ position$$

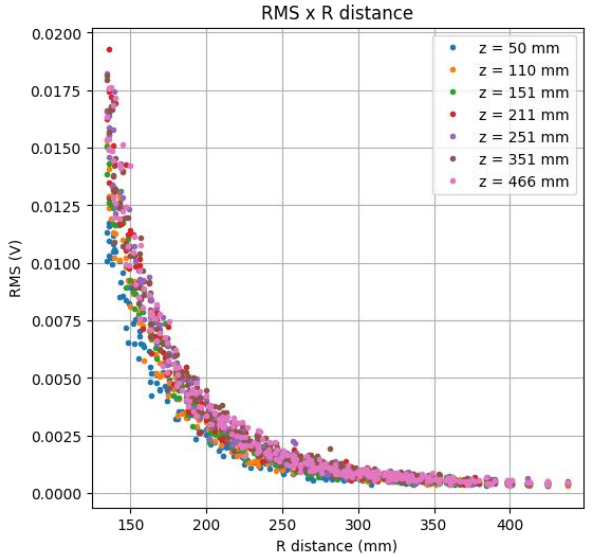
$$z_0 = 0\ (GEM\ plane)$$

Preliminary results from simulation analysis

Results in function of the R distance (spot at GEM plane to PMT) - PMT 1



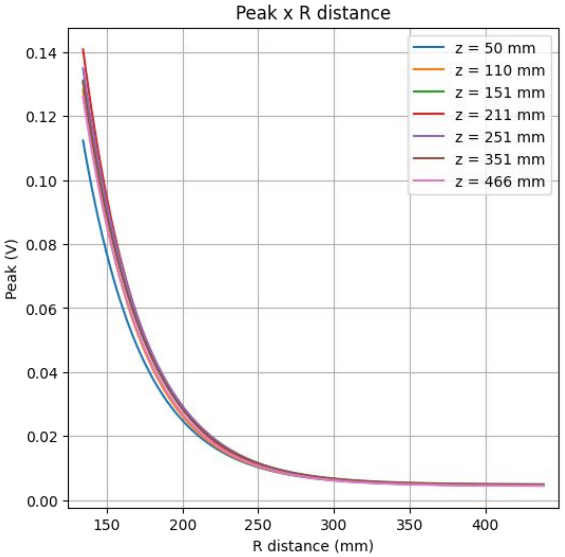


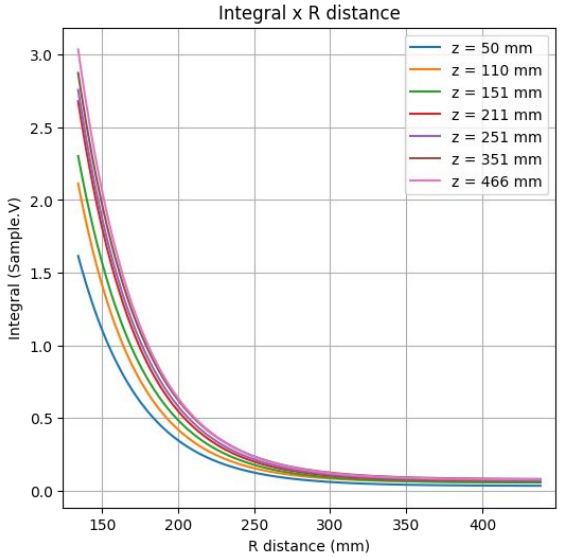


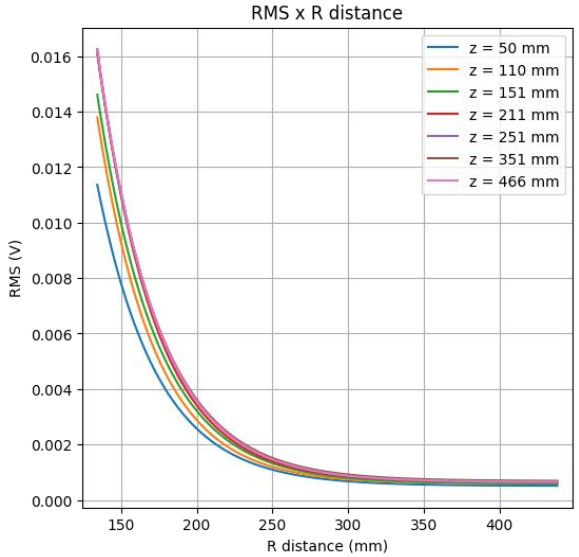
Preliminary results from simulation analysis

Results in function of the R distance (spot at GEM plane to PMT) - PMT 1

Fitting the data…







Conclusions

- The height peaks of the simulated waveforms are now very similar to the real data

Next steps

- Finish the analysis
  - Camera + PMT reco codes
- To do tasks