Implementation of the 3x1x1 geometry in LightSim

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Introduction

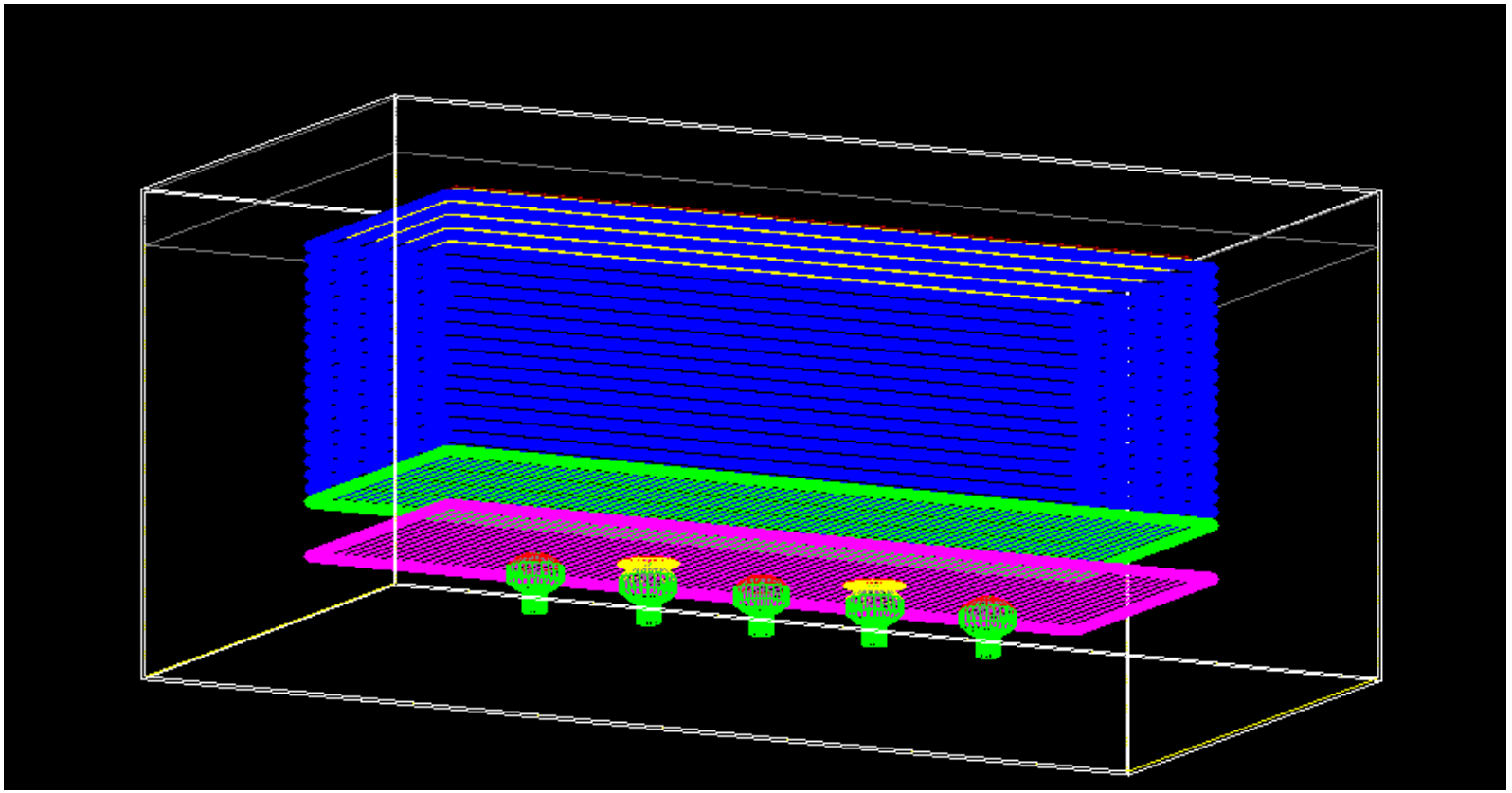
Implementation of the 3x1x1 geometry in LightSim:

Aim: provide 3x1x1 light maps for the collaboration
→ Comparison with light data obtained with 3x1x1 detector

Outline

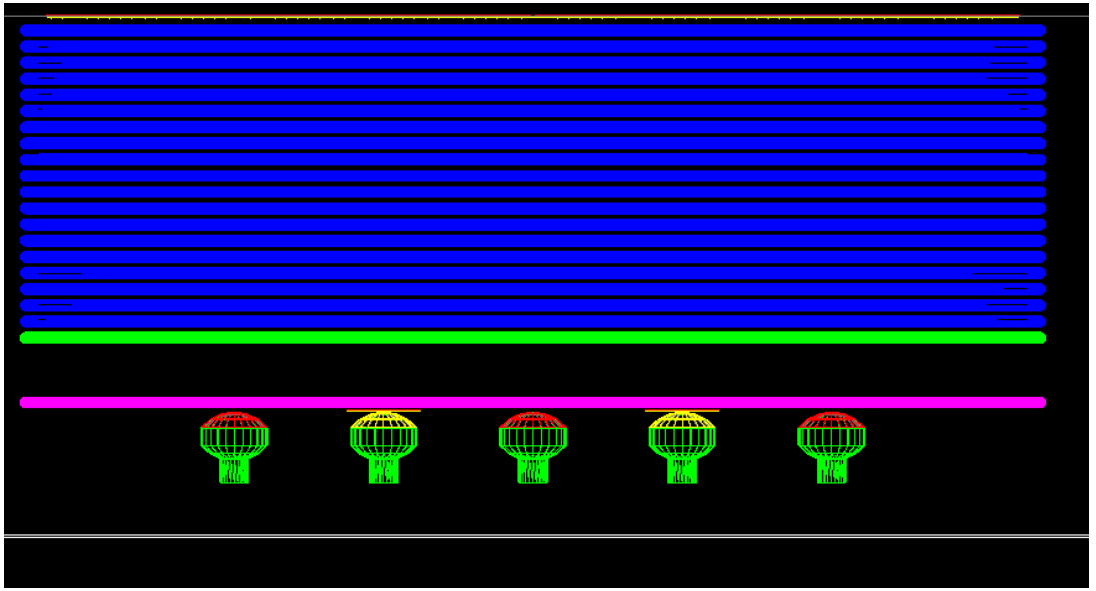
- 3x1x1 geometry
- Preliminary results on photon travel time distributions
- Next steps

3x1x1 implemented geometry



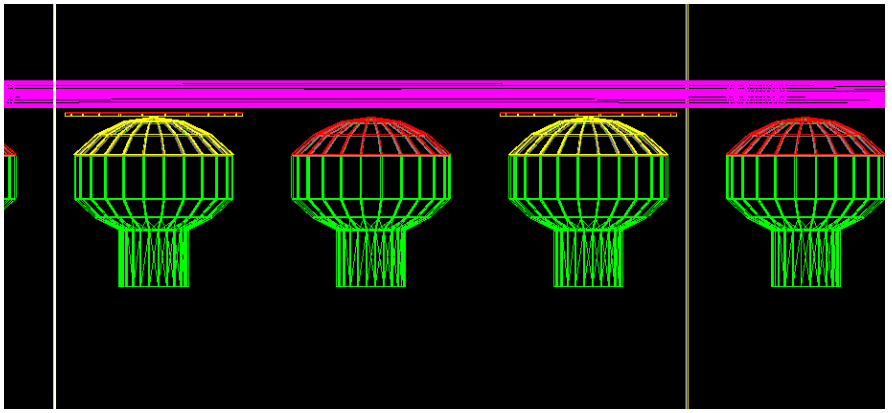
- ✔ **Tank:** (2x4x1.8)m^3
- ✔ **LAr** and **GAr** volumes
- ✔ **LEM** plates (copper)
- ✔ **Extraction** grid
- ✔ **Field** cage: 19 **stainless-steel** rings

3x1x1 implemented geometry



✔ Cathode
✔ Ground grid

4mm-diameter stainless-steel wires

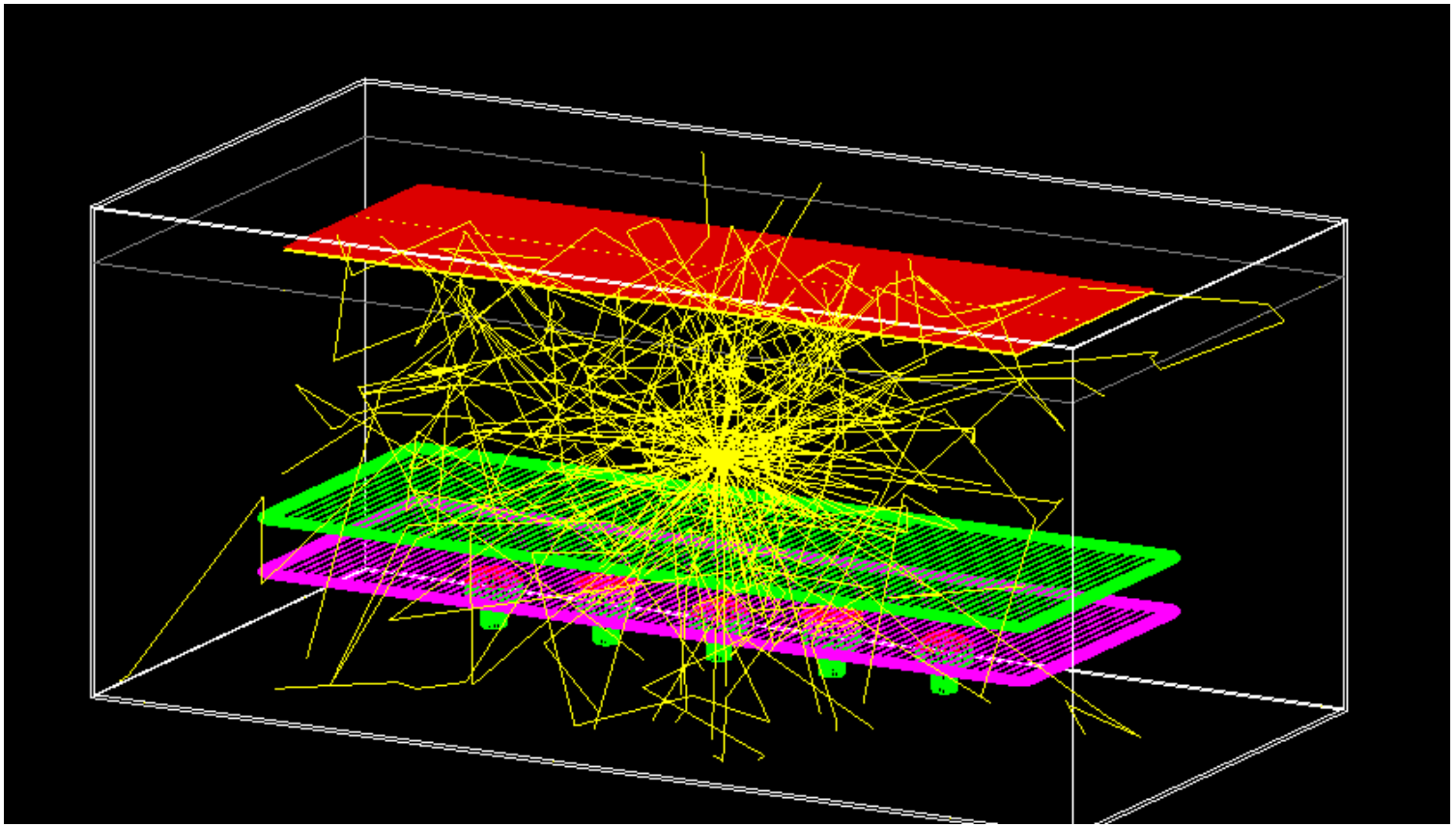


✔ 3 TPB-coated **PMTs**
✔ 2 PMT with TPB-coated **plate**

For the time being: no **internal reflection** in the plates

→ Studies (simulation and data) of the coating impact on light collection are foreseen

Travel time distributions



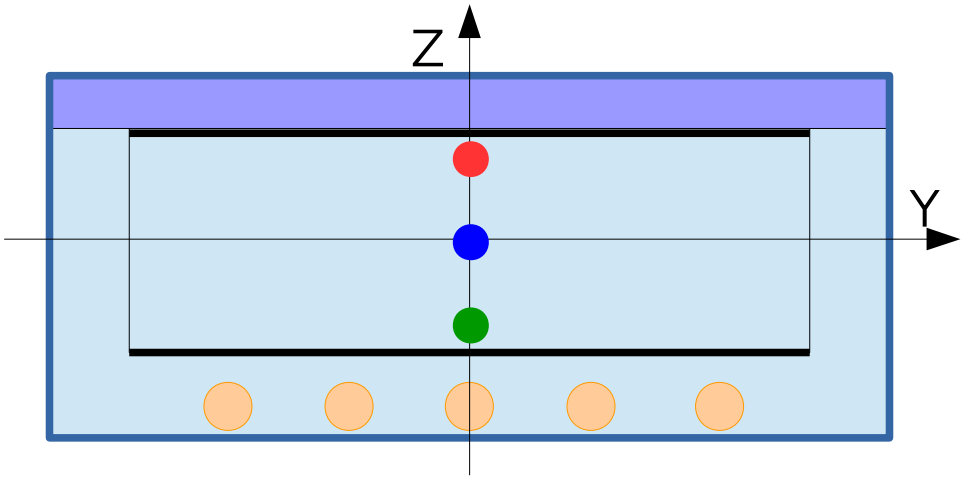
Same propagation parameters in LAr as for the 6x6x6 simulation

→ LAr absorption process is not taken into account

Rayleigh scattering length	55cm 350cm	(128nm) (435nm)
Absorption on stainless-steel and copper	100% 50%	(128nm) (435nm)
LAr refractive index	1.38 1.25	($\lambda < 130$nm) ($\lambda > 130$nm)

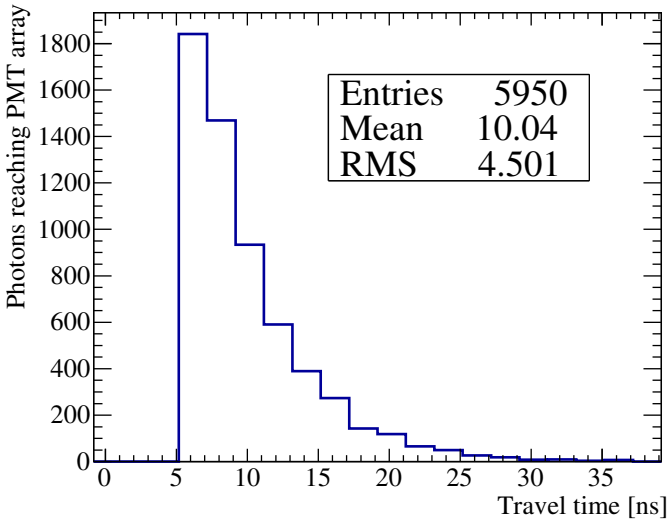
Travel time distributions

- 10^7 photons
- Sum of the 5 PMTs
- Quantum efficiency not taken into account

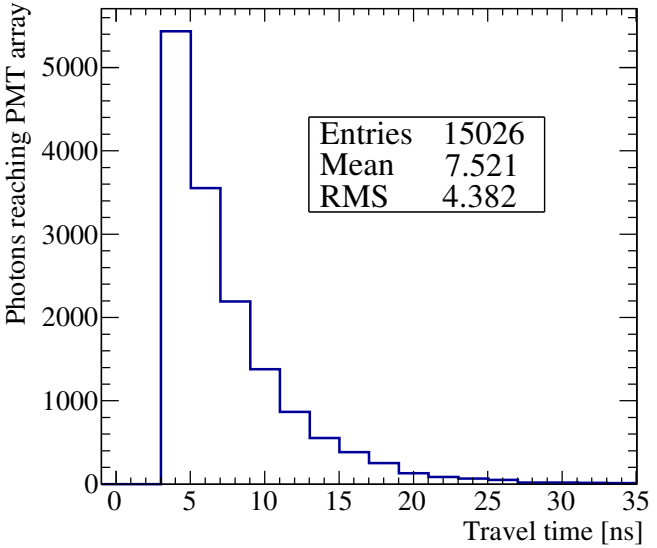


Travel time distribution for photons produced at (X,Y)=(0,0) and different Z-coordinates

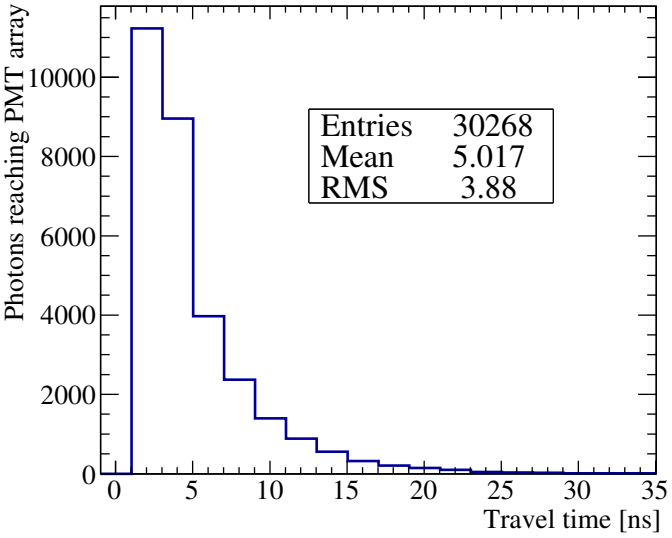
Z = 450mm



Z = 0mm

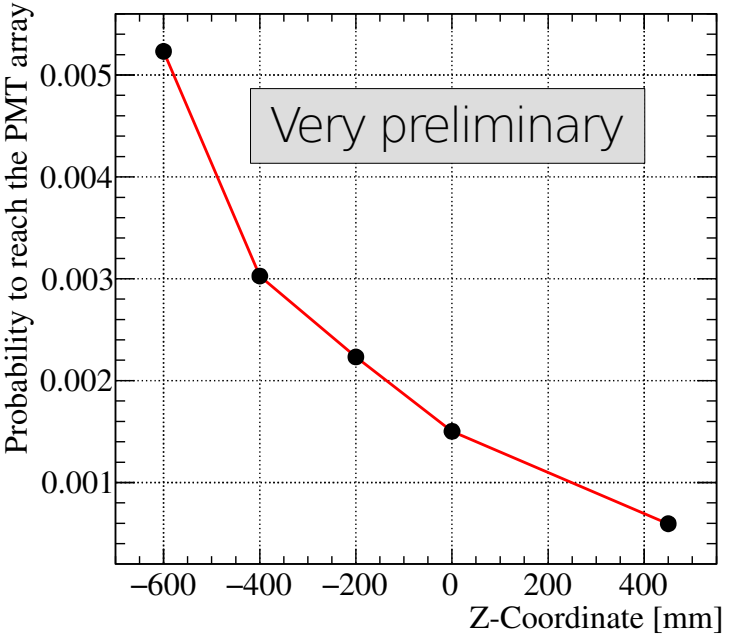


Z = -400mm



Travel time distributions

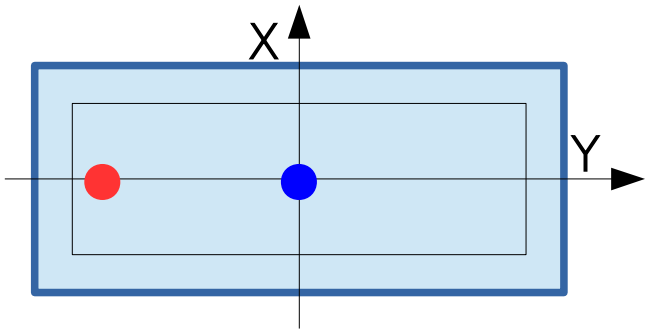
Probability to **reach the PMT array** for photons produced at (X,Y)=(0,0) and **different Z-coordinates**



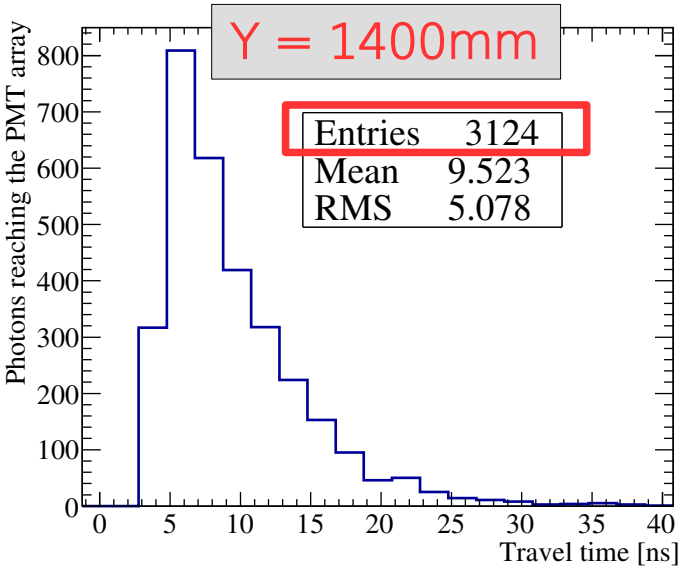
Note:

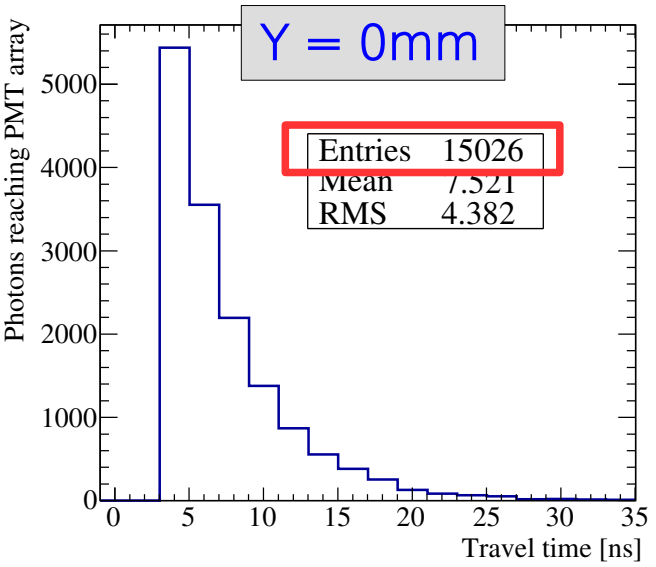
- (0,0,0) = fiducial volume center
- Z=-600mm photons generated **between cathode** and ground **grid**

Travel time distribution for photons produced at (X,Z)=(0,0) and different Y-coordinates



→ Non-negligible border effects





Next steps

Toward light maps:

- ✔ 3x1x1 geometry has been implemented

  → Additional **checks** on the implementation

- **Adaptation** of the 6x6x6 voxel definition to the **smaller** volume
- Simulation of **all** the voxels
- **Adaptation** of the **travel distribution** parametrization

  Smaller volume → **narrow** distributions

  → Exponential parametrization ?

- **Extraction** of time distribution **parameters** to build the maps