LArSoft light signal simulation

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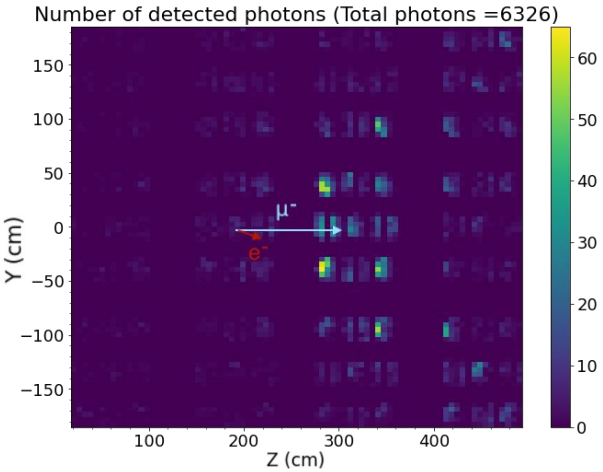
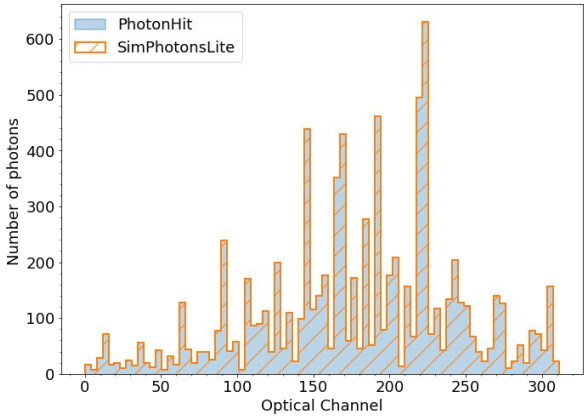
Reminder:



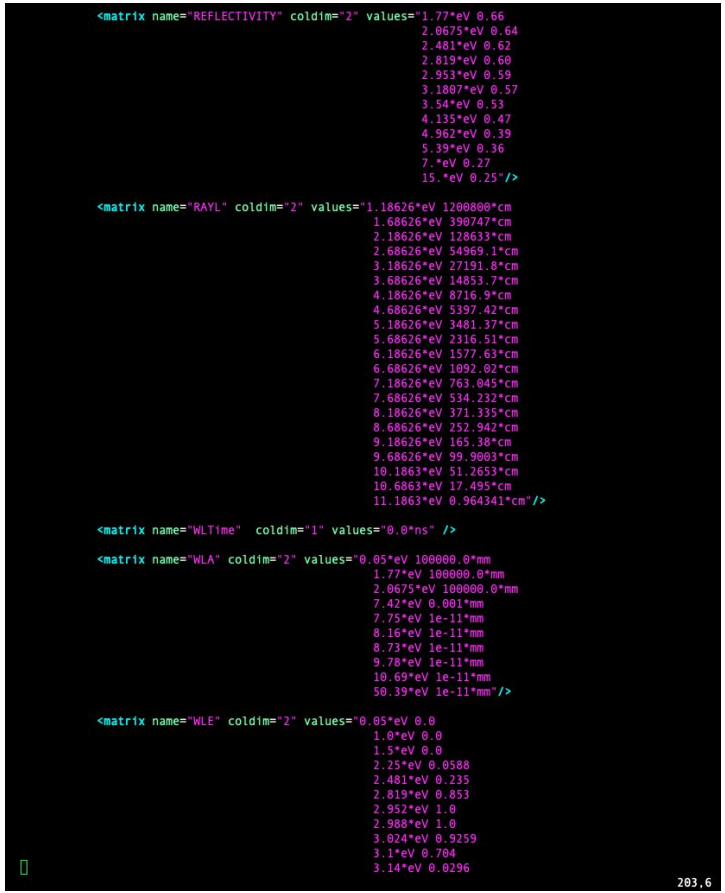


- We successfully ran the first full simulations after solving the issue with the new LArG4.
- Created a new module (HitLiteConverter) to translate from PhotonHits to SimPhotonsLite which is the object used for reconstruction.
- There were a few things to be solved: complete the HitLiteConverter module and include reflected VIS photons in the FullSim.

Latest improvements:

- HitLiteConverter improvements:
  - Extend the new module to include also SimPhotons, which is the other object that LArSoft uses for reconstruction.
  - For the first checks we were using only direct VUV light, but there is also reflected VIS light emitted by TPB at the CPA foils.
  - New label included when creating SimPhotons/SimPhotonsLite to differentiate between direct VUV and reflected VIS light.
  - Now the module output works within LArSoft workflow.

Latest improvements:

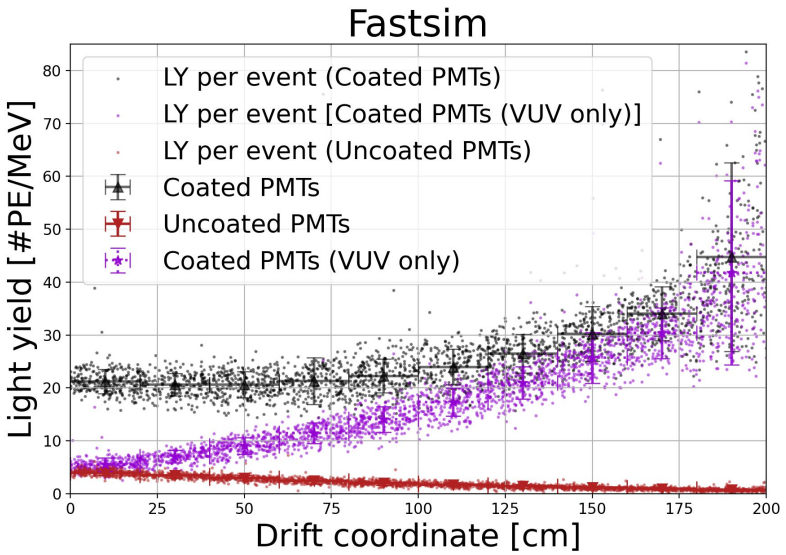


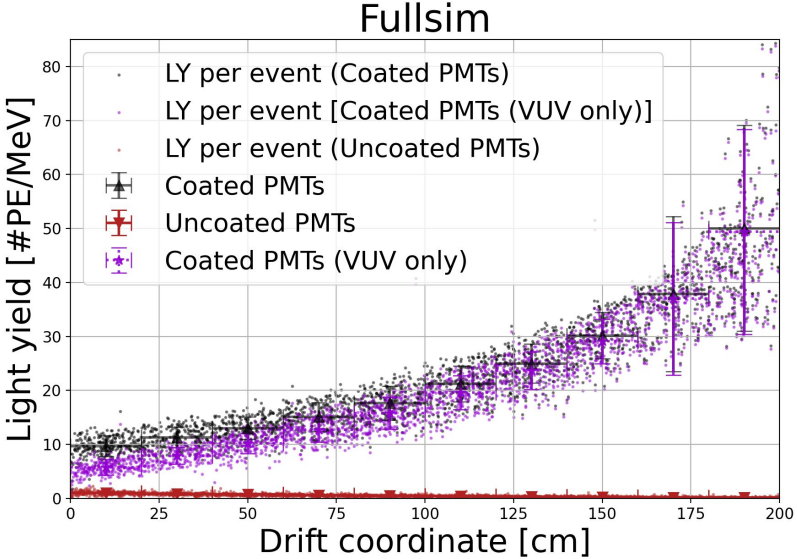
- Geometry changes:
  - Each optical process in G4 has its associated properties to be defined in the geometry file. (Refractive index, Rayleigh scattering, reflection, WLS…)
  - The standard SBND geometry file is not prepared for full simulations (optical properties are missing).
  - Need to add manually all of them.

Current tasks with FullSim:

- Check that the FullSim reproduces the results of the FastSim.
- Compare the light yield for a sample of 2500 low energy (0.01 GeV) electrons with FullSim and FastSim.

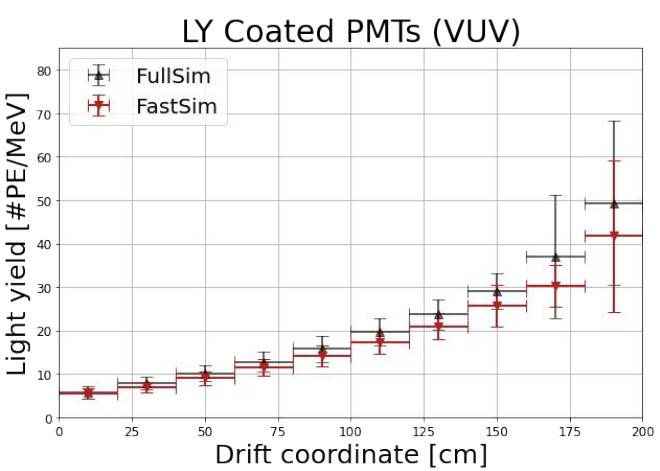
Current tasks with FullSim:

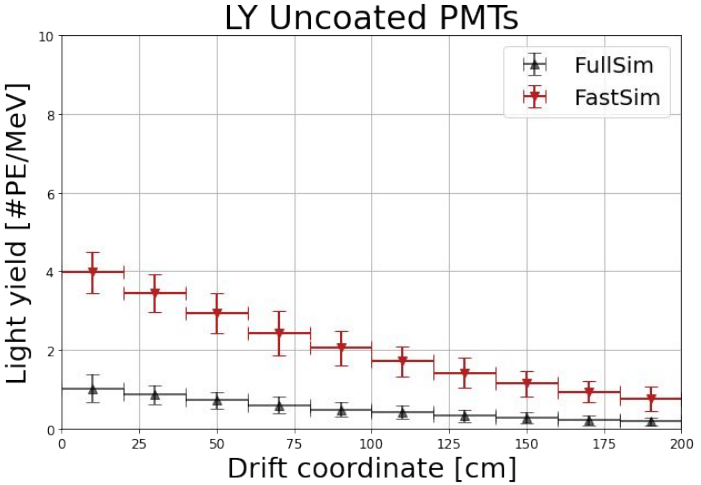


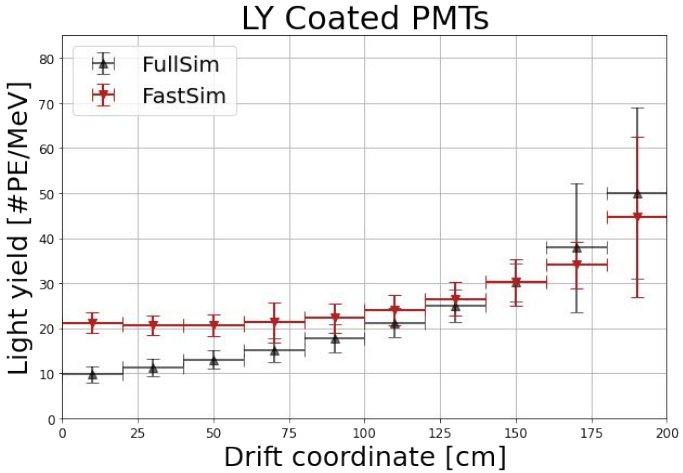


- Light yield from direct VUV light is compatible for both simulations.
- The difference for reflected VIS light might be due to some misconfiguration of the optical properties in the geometry file. Currently being examined.
- Once the discrepancy is solved we might easily use the FullSim for instance to compare the light yield with and without Cherenkov light.

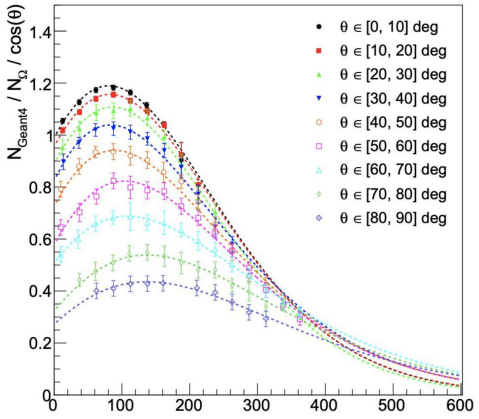
Current tasks with FullSim:

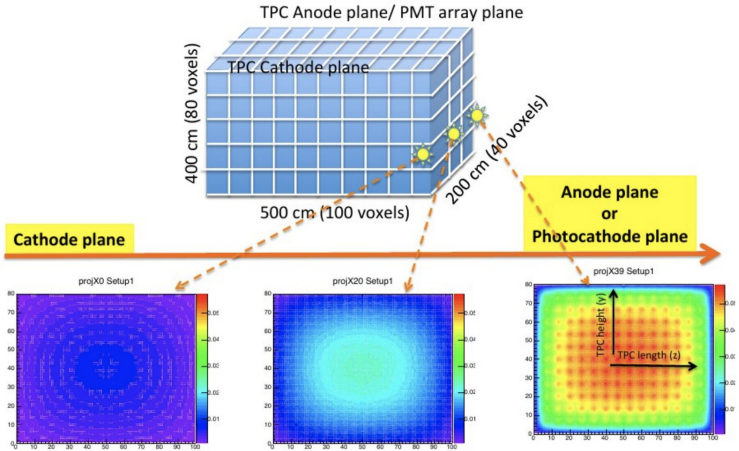






Current tasks with FullSim:

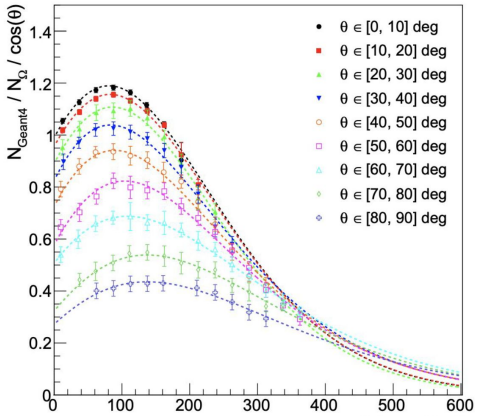


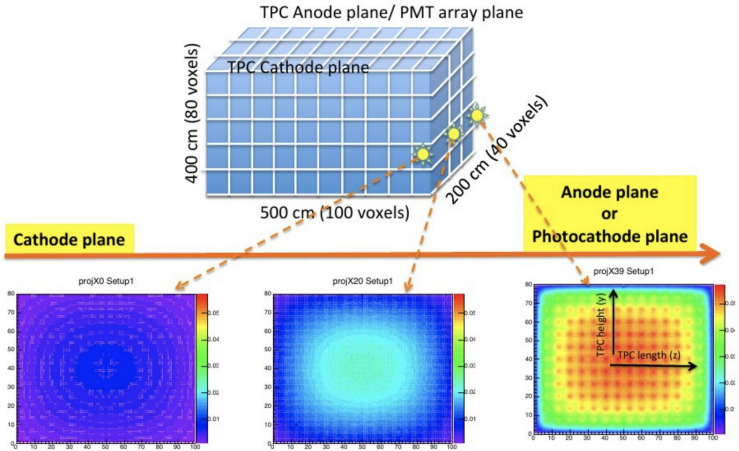


- Recall that one of the main reasons we need the FullSim is to calibrate the fast optical simulations.

- We need to make sure that we are able to use the FullSim with the new LArG4 to this end.

Current tasks with FullSim:





- Calibration is done with a module (LightSource) that produces optical photons.
- Module for the production of the optical libraries (SimPhotonCounter) needs some modifications for the new LArG4.

Summary:

- We are finally able to carry out a full simulation within the LArSoft framework:
  - Optical properties needs to be examined to fix the issue with reflected photons.

- We need to accommodate the modules that are used for the production of the optical libraries to have a fully-functional FullSim.