Status report

Geant4 simulation segmented calorimeter

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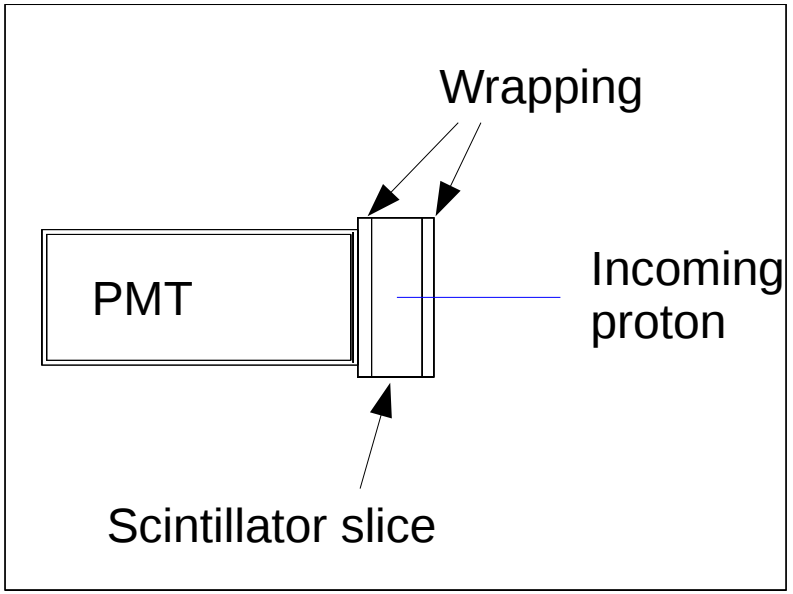
Geant4 simulation segmented calorimeter

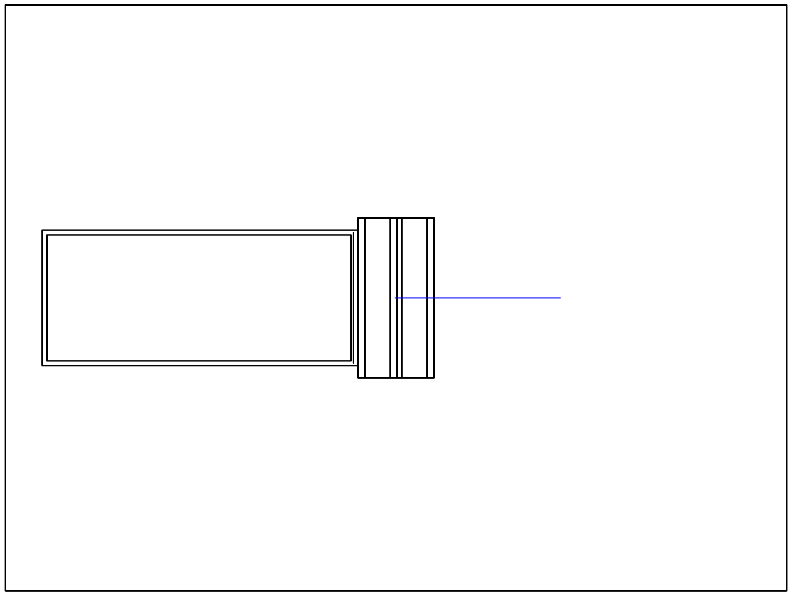
- Starting point: Anastasia's simulation code (2014)
  What's already in:
  - Single block of scintillator
  - PMT with photocathode
  - Production of photons (+Birks' law)
- What's been added (yet):
  - Construction: Segmentation of scintillator with parameters:
    - Number of slices
    - Wrapping thickness (per slice)
  - Outputs (per slice):
    - Deposited energy
    - Produced optical photons & their energy

Calorimeter thickness = 60mm, E_proton = 60MeV

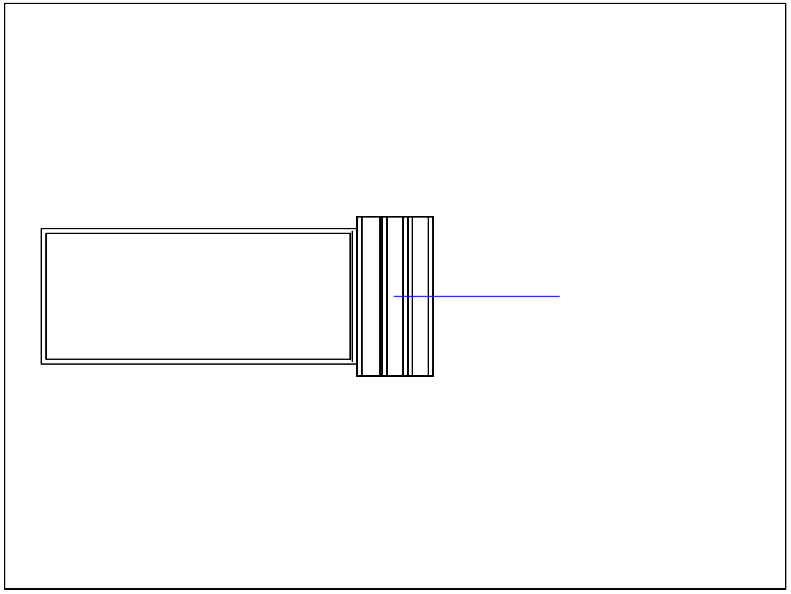
N_slices = 1, wrapping = 10mm



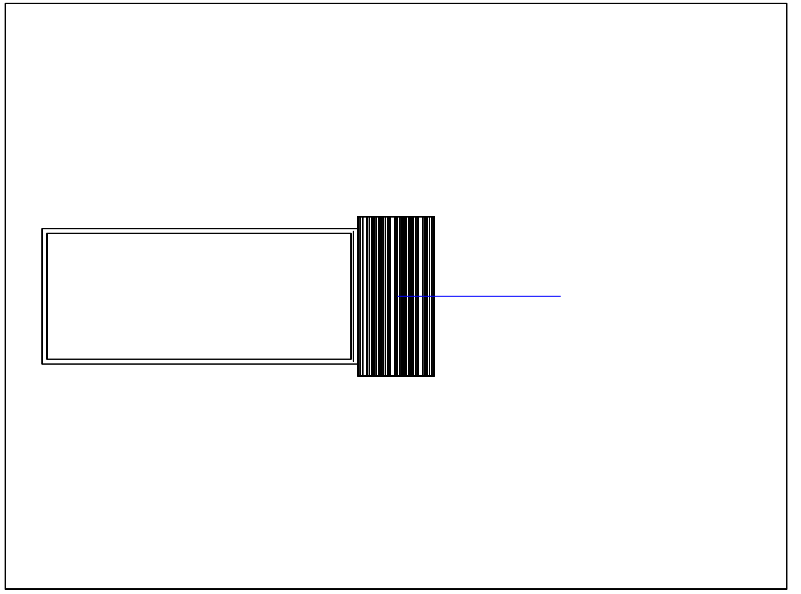
N_slices = 2, wrapping = 5mm



N_slices = 3, wrapping = 3mm

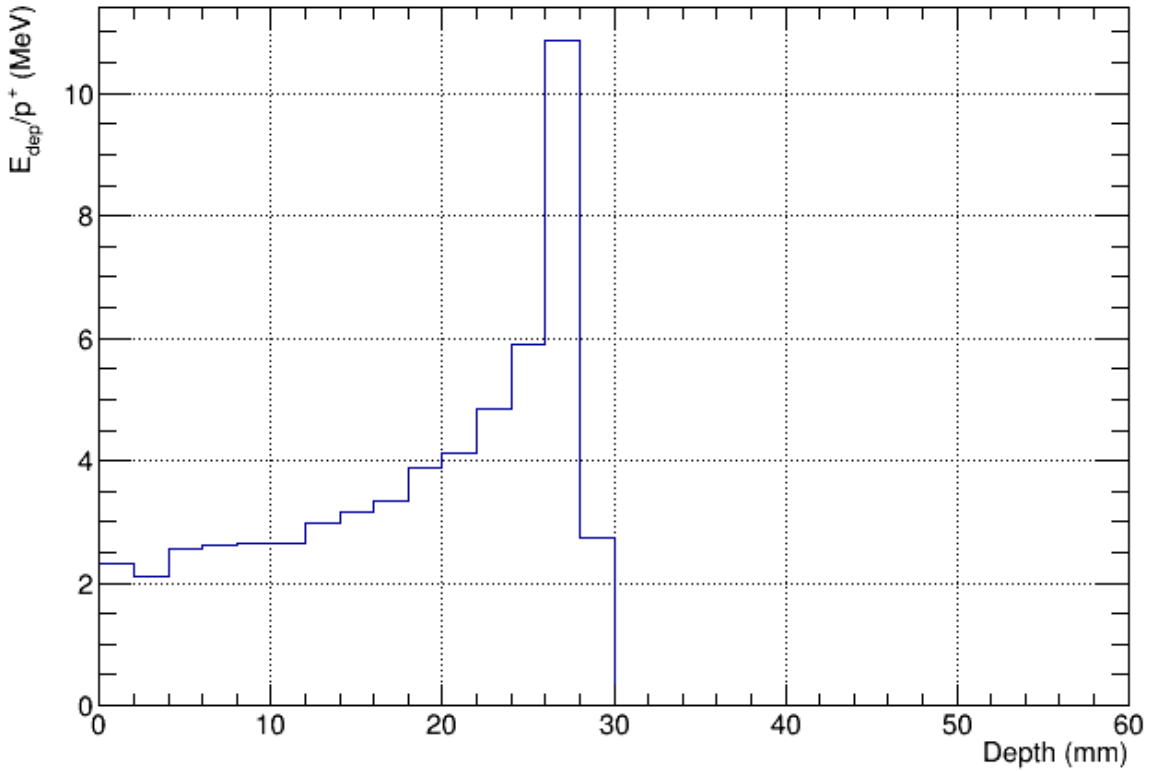


N_slices = 30, wrapping = 0.01mm



Control plot: Energy deposition in scintillator

- E_proton = 60 MeV
- Calorimeter thickness = 60 mm
- N_layer = 30
- Wrapping thickness = 10 mu
- => scintillator slice thickness = ~2 mm

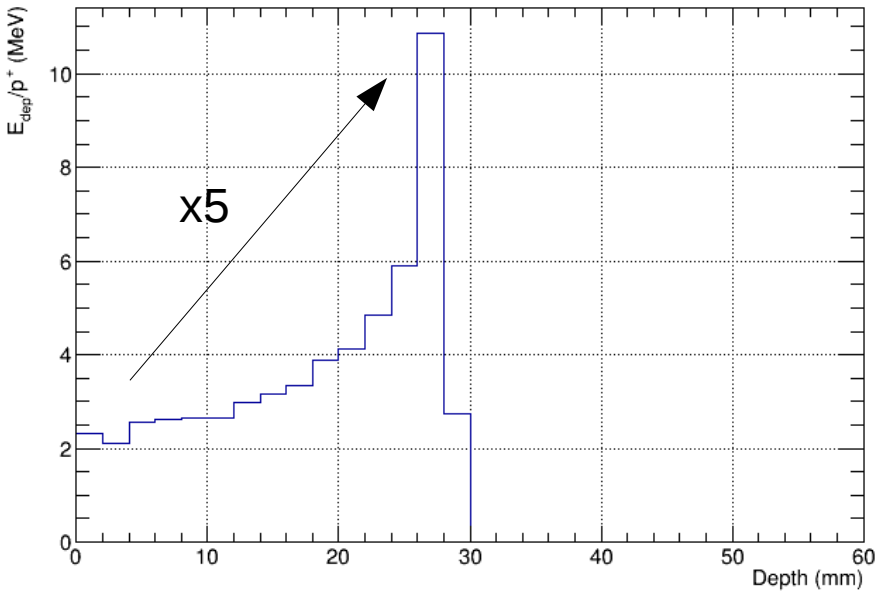


Bug: E_dep_scint = 59.0314 MeV
E_dep_wrap = 1.1525 MeV → sum unequal 60.000 MeV
→ Double counting of E_dep for steps which start in one volume (scint or wrap) and end in other?

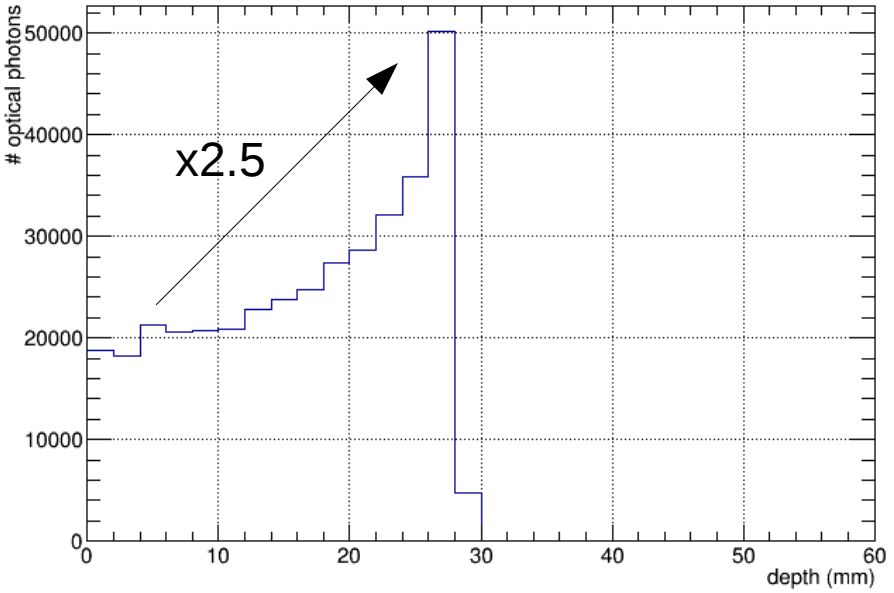
Photon production: yield

Compare energy deposition of 60MeV proton with number of produced optical photons

Deposited energy



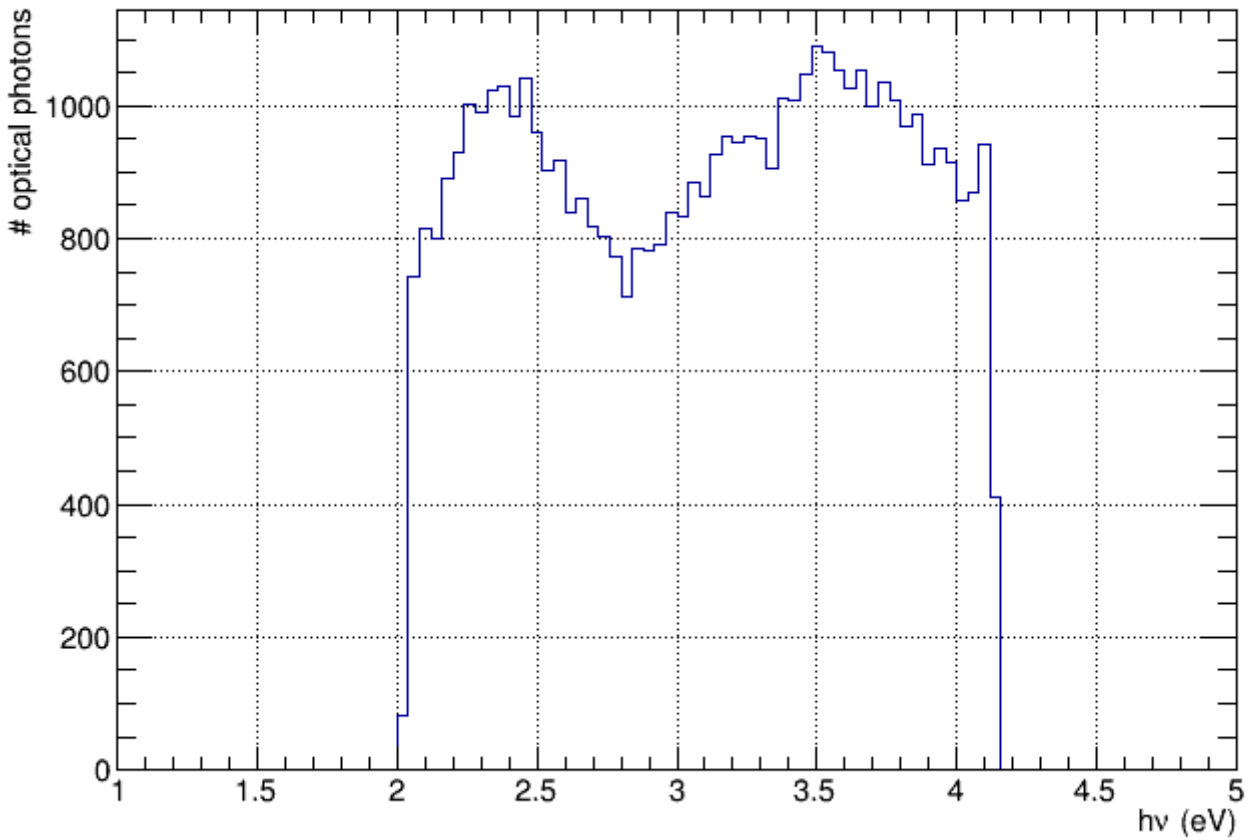
Number of optical photons



- Peak-to-plateau ratio shows expected unlinearity between energy loss and photon production
- Still, maximum photon yield coincides with Bragg peak position (2mm layer thickness)

Photon production: energy

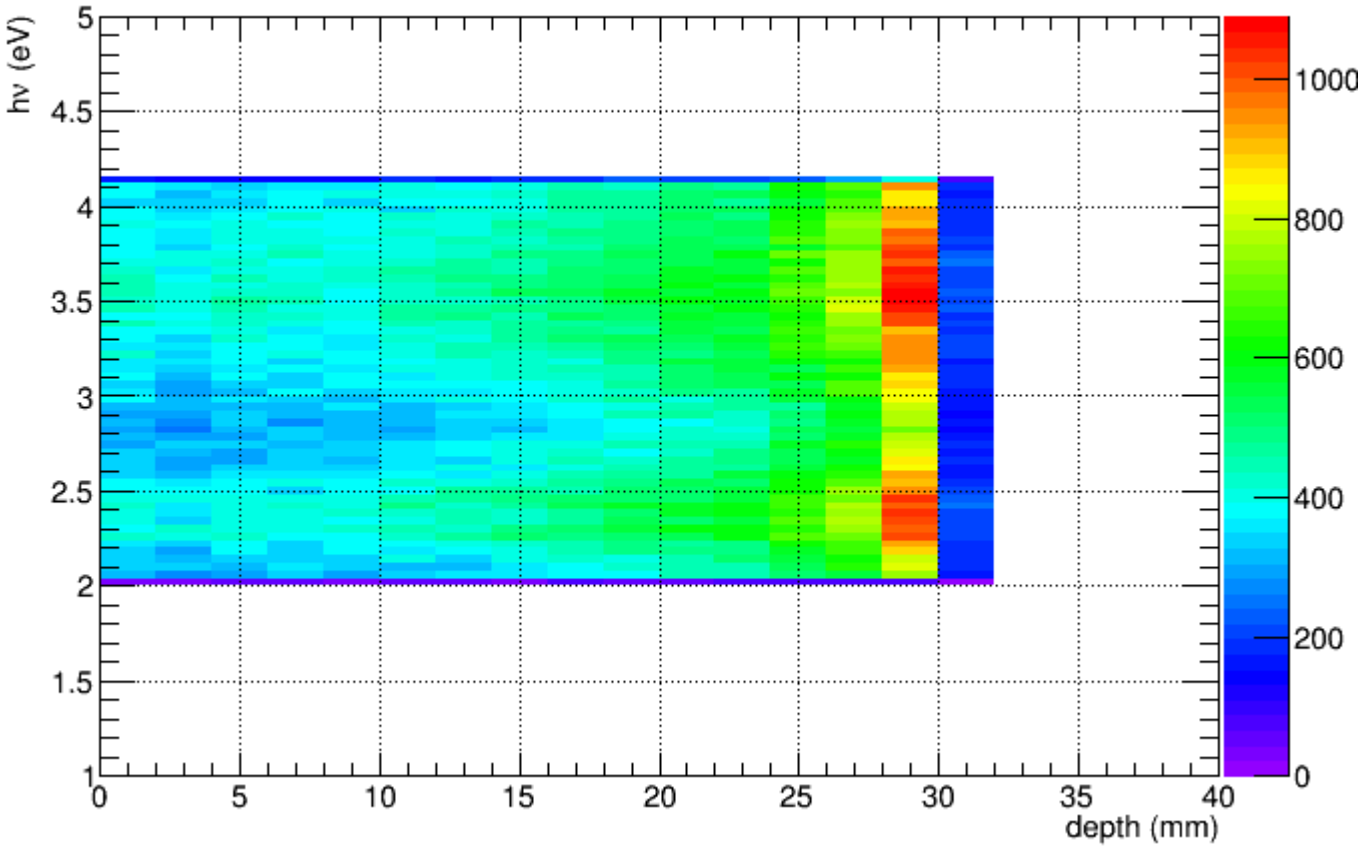
Energy of optical photons in scintillation layer with maximum photon production



- Double structure? (→ slow/fast component?)
- Sharp cuts outside of optical region?

Photon production: yield/energy

Energy and depth dependence of produced optical photons



- calorimeter thickness: 40mm
- N_layer = 20 → layer thickness = 2mm
- Wrapping thickness = 10mu

To do

- Fix E_dep bug
- Remove PMT (design photodiode instead)
- Understand optical photon energy spectrum
- Runtime for 1 proton: about 30 seconds (30 scint layers) → Optimize?
- Current simulation on SL5, Geant4.10.0 → Upgrade to SL6, Geant4.10.2