

# Optical Photon Update

## Previous changes:

- Activated optical physics (all standard G4 optical processes are available).
  - Scintillation, Cherenkov, Absorption/Reflection, WLS, Rayleigh, Mie.
  - Processes not called unless the optical material properties are given to G4Material.
- Optical material properties for LAB/PC, veto PMT glass, vessel-scintillator surface and vessel-CIS surface.
  - These are set by UI commands, so optical physics can be turned on/off.
  - WLS, Rayleigh scattering, and Mie scattering properties aren't implemented, so they don't occur.

The screenshot shows a software interface with a command tree on the left and a table on the right. The command tree is expanded to show the 'vetoScint' command under the path 'Command / SABRE / detector / vetoScint'. The table below the tree has columns for 'Parameter', 'Guidance', 'Type', and 'Ommitabl'.

	Parameter	Guidance	Type	Ommitabl
1	choice		s	False

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## Previous changes:

- Scored hits in the veto PMTs.
  - Changed the geometry, since hits were only scored when a photon reached the interior surface of the PMT.
    - Old geom: uniform average density. Material = pyrex.
    - New geom: 2 mm thick glass + vacuum. Material = borosilicate, since R5912 uses this.
- Saved veto PMT hits in the output.
  - Any suggestions for extensions/more hit info are welcome!

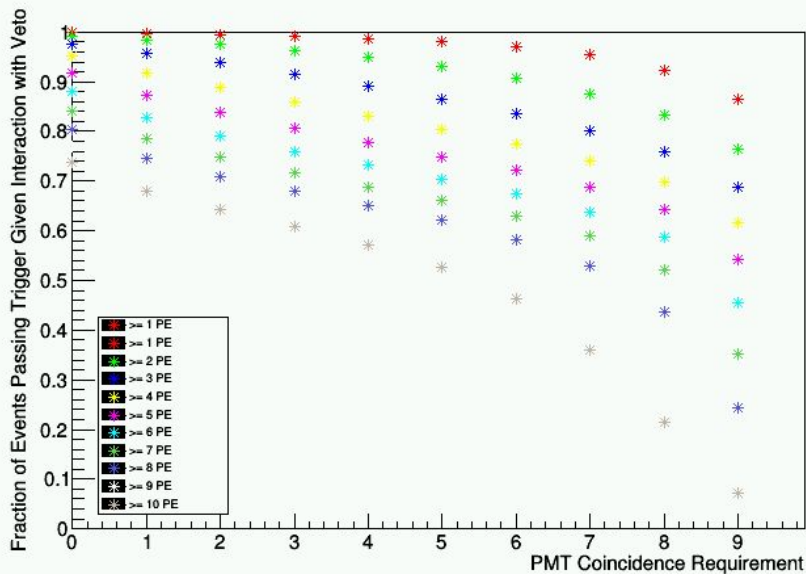
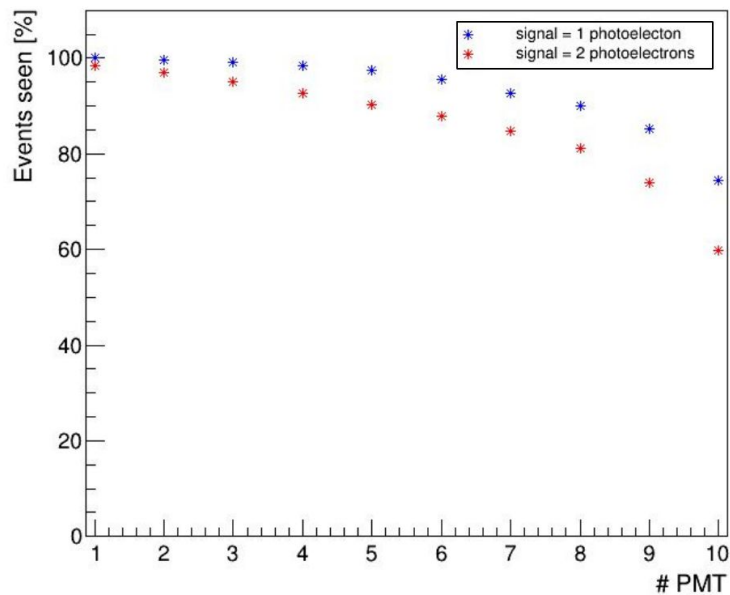
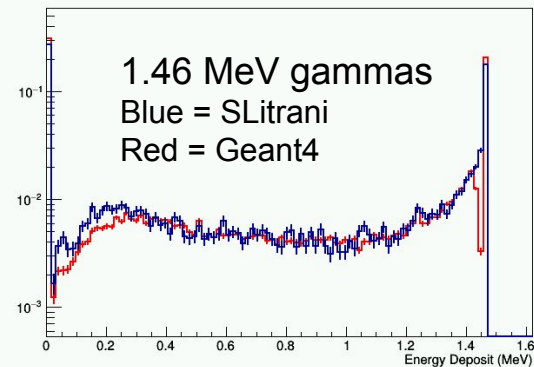


A screenshot of a list of hit types, with "photonEn\_hits" highlighted in a grey bar. The list includes various hit types such as pdgIDScint\_hits, trackIDScint\_hits, edepScint\_hits, id\_det, parentIDPMT\_hits, trackIDPMT\_hits, pdgIDPMT\_hits, PMTnum\_hits, photonEn\_hits, timePMT\_hits, photonTimePMT\_hits, xPMT\_hits, yPMT\_hits, zPMT\_hits, and photonCreatorProc\_hits.

pdgIDScint_hits
trackIDScint_hits
edepScint_hits
id_det
parentIDPMT_hits
trackIDPMT_hits
pdgIDPMT_hits
PMTnum_hits
photonEn_hits
timePMT_hits
photonTimePMT_hits
xPMT_hits
yPMT_hits
zPMT_hits
photonCreatorProc_hits

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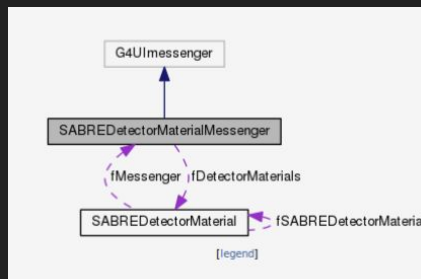
- Preliminary comparison with SLitrani.
  - The energy deposit in the scintillator doesn't agree!
  - Can make plots similar to Serena's.



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## New changes:

- Restructured the code to conform with ModularGeometry implementation.
- Transparent to a 'user' (same UI commands, same output).
- Created a new G4UImessenger class to handle material changes.
- Numerous changes to other parts of the code.
  - Most of this is cleanly implemented, with the exception of optical surfaces.



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Optical surfaces:

- Defining the `G4LogicalBorderSurface` requires the `G4PhysicalVolume*`
- This is complicated, because:
  - For the CIS, this depends on whether the CIS is wet or dry.
  - Access to the relevant pointer is not straightforward, and currently I'm searching the `G4PhysicalVolumeStore` (not robust to name changes).
- Can be solved by making more class members, but that duplicates code (once each for the South, PoP, and North geometries).
- A more elegant solution would be to make the `SABRESouth`, `SABREPoP`, and `SABRENorth` inherit from a common base class (`SABREModule?`).

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## TODO:

- Comparison with SLitrani.
- Implement NaI optical properties - currently being worked on by Yiyi Zhang, (master's student) for semester project.
- Investigate extending the Geant4 model, particularly for quenching.
- *Provide simulation support for CIS/veto design.*

## Others:

- Code documentation - are people using doxygen, sphinx, or similar?
- Given compiler issues - use a container? Does anyone have experience?