Introducing example OpNovice2

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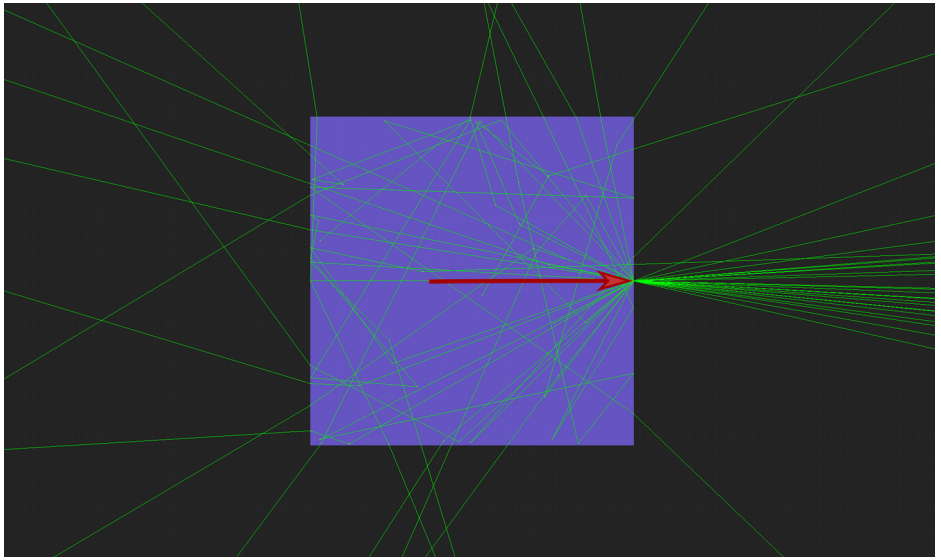
Motivation

- Make it easy to verify that optical physics works
- Set material properties with messenger (macro files)
- Follows EM TestEm examples
- Developed internally to answer HyperNews questions
  - Why not share

Designed to be easy to use



- Material property messenger
- Simple geometry (box in world box)
- Physics constructor including G4OpticalPhysics
- Histogram and table output

Material properties in code

Previously, could only specify material properties in code

- doesn't scale
- hard to share

```
// DetectorConstruction.cc

G4double lxe_Energy[]    = { 7.0*eV , 7.07*eV, 7.14*eV };
const G4int lxenum = sizeof(lxe_Energy)/sizeof(G4double);

G4double lxe_SCINT[] = { 0.1, 1.0, 0.1 };
assert(sizeof(lxe_SCINT) == sizeof(lxe_Energy));
G4double lxe_RIND[]  = { 1.59 , 1.57, 1.54 };
assert(sizeof(lxe_RIND) == sizeof(lxe_Energy));
G4double lxe_ABSL[]  = { 35.*cm, 35.*cm, 35.*cm};
assert(sizeof(lxe_ABSL) == sizeof(lxe_Energy));
fLXe_mt = new G4MaterialPropertiesTable();
fLXe_mt->AddProperty("FASTCOMPONENT", lxe_Energy, lxe_SCINT, lxenum);
fLXe_mt->AddProperty("SLOWCOMPONENT", lxe_Energy, lxe_SCINT, lxenum);
fLXe_mt->AddProperty("RINDEX",        lxe_Energy, lxe_RIND,  lxenum);
fLXe_mt->AddProperty("ABSLENGTH",     lxe_Energy, lxe_ABSL,  lxenum);
```

Material properties messenger

```
## macro file

## specify properties of the box

/opnovice2/boxProperty RINDEX .000002 1.3 .000008 1.4
/opnovice2/boxProperty FASTCOMPONENT .000002 1.0 .000008 1.0
/opnovice2/boxConstProperty FASTTIMECONSTANT 0.000000001
/opnovice2/boxConstProperty SCINTILLATIONYIELD 5000.0

## specify properties of the surface

/opnovice2/surfaceModel unified
/opnovice2/surfaceType dielectric_dielectric
/opnovice2/surfaceFinish ground
/opnovice2/surfaceProperty REFLECTIVITY 0.000002 .2 0.000008 .2

## specify properties of the world

/opnovice2/worldProperty RINDEX 0.000002 1.01 0.000008 1.01
```

Results: Boundary scattering

```
    Run Summary
--------------------------------
Primary particle was: opticalphoton with energy 3 eV .
OpAbsorption per event:      0

Surface events (on +X surface) this run:
# of primary particles:        100000
OpAbsorption before surface:       74
Total # of surface events:      99926
Unaccounted for:                    0

Surface events by process:
  Fresnel refraction:           45960
  Lambertian reflection:        49350
  Lobe reflection:                246
  Spike reflection:               496
  Backscattering:                2886
  Absorption:                     988
 Sum:                           99926
 Unaccounted for:                   0
--------------------------------
```

Results: photon production

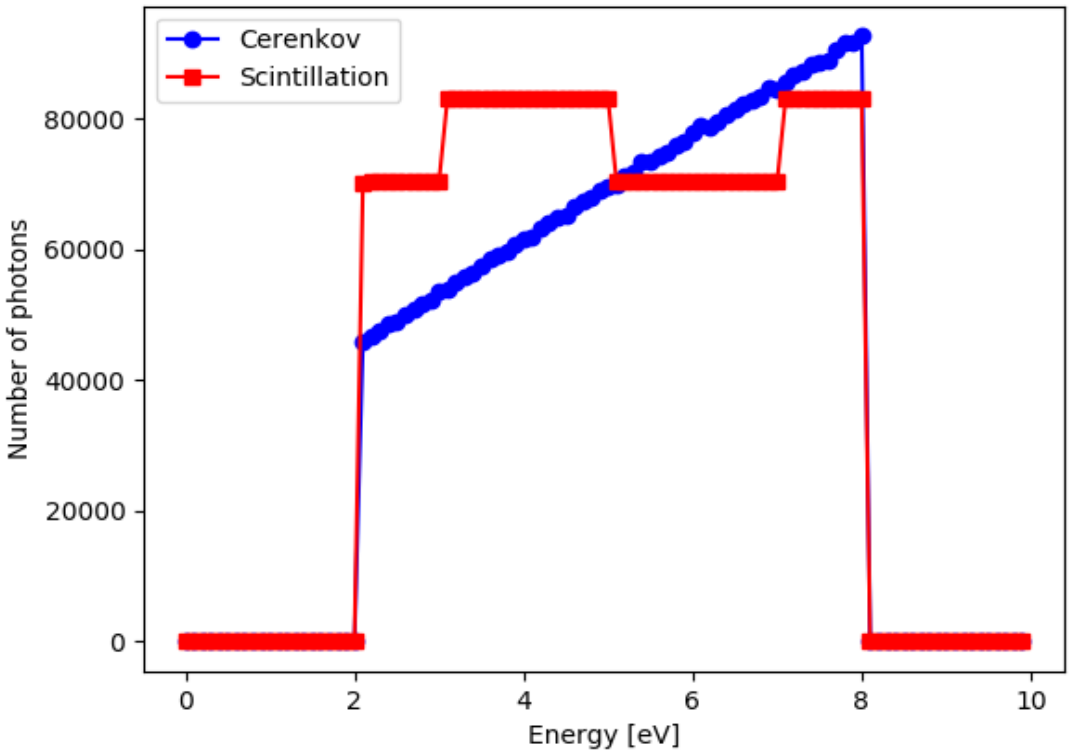
```
    Run Summary
------------------------------
Primary particle was: e- with energy 5e+02 keV.
Average energy of Cerenkov photons created per event: 2.2e+02 eV.
Average number of Cerenkov photons created per event: 41
 Average energy: 5.3 eV.
Average energy of scintillation photons created per event: 1.1e+04 eV.
Average number of scintillation photons created per event: 2293
 Average energy: 5 eV.
Average number of OpRayleigh scatters per event: 3654

OpAbsorption per event:      1847

Surface events (on +X surface) this run:
# of primary particles:          1000
OpAbsorption before surface:  1807023
Total # of surface events:     527803

Surface events by process:
  Fresnel refraction:           54655
  Lambertian reflection:        50770
  Absorption:                  422378
 Sum:                          527803
 Unaccounted for:                   0
--------------------------------
```

Example histogram: photon spectra



Examples of use

- Boundary scattering doesn't work!
  - Bugzilla # 2043
  - Janacek/Moses real surface data not included in RealSurfaceData
- Particle specific scintillation doesn't work!
  - Hypernews/optical/687
  - It works but gap in documentation: what parameters need to be set?
- Etc.

Next steps

- More histograms (e.g. time for scintillation)
- Validation and consistency checks of optical physics
- Validation test to ensure basic optical physics functionality (test suite)
- Material properties messenger in Geant4 source (maybe)