

Towards continuous integration of optical code

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Daren Sawkey

Varian Medical Systems

Motivation

User touch points

- Examples and macros
 - Physics list
 - UI commands
 - User defined properties (e.g. RINDEX)
 - Data files (boundary scattering)
-
- Goal: 75% CI coverage

Long term plan

- Get functionality to work
- Full continuous integration coverage
- Benchmarking
- Code clean-up (including examples)
- Speed (??)

Examples

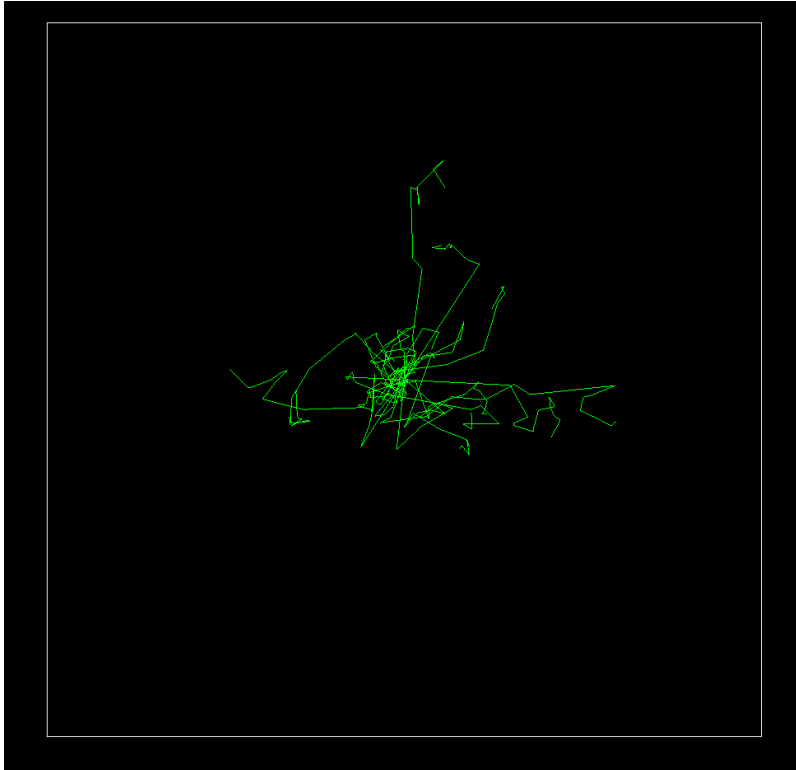
- All the macros run
- Example OpNovice2 (new in 10.5)
- Test using macro: great for Discourse
- In particular modular physics list

```
G4VModularPhysicsList* physicsList = new FTFP_BERT;  
G4OpticalPhysics* opticalPhysics = new G4OpticalPhysics();  
physicsList->RegisterPhysics(opticalPhysics);
```

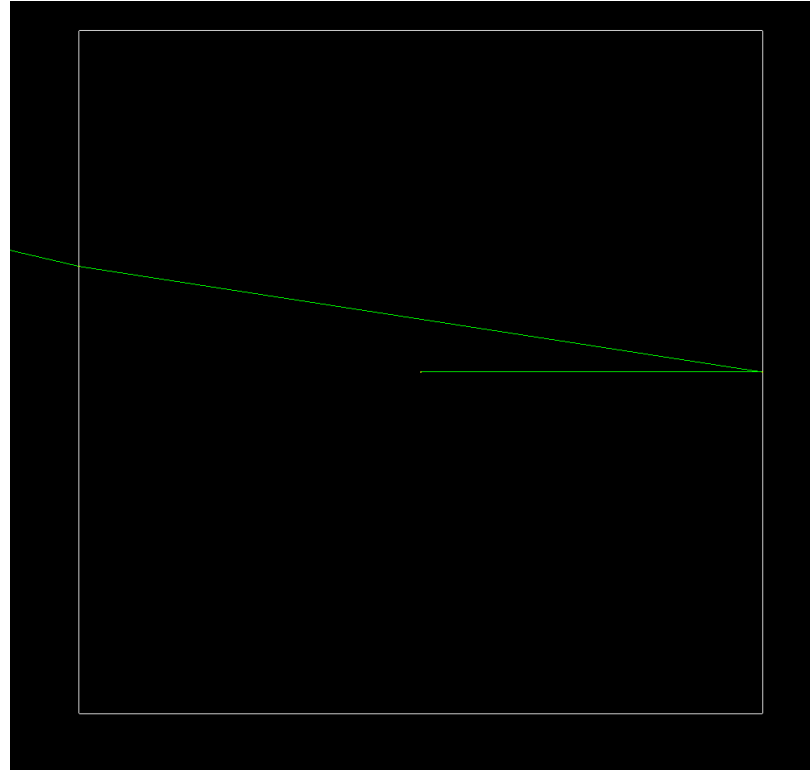
- Basis for the tests

Step 1. A test/example OpNovice2

Since 10.5



Start with charged particle, observe generated optical photons



Shoot optical photons at surface

Modular physics list

- Now works in parallel world
- Addresses bug 2113
- Ref-09 or a recent physics list tag

UI commands

1. Deprecated first set of redundant commands (“default”)
2. Some still to be deprecated
3. Most verified as working
4. Some to check
5. Add to CI

In G4OpticalProcessMessenger

/process/optical/*

/setTrackSecondariesFirst

/scintillation/setTrackSecondariesFirst

/cerenkov/setTrackSecondariesFirst

/cerenkov/setMaxPhotons

/cerenkov/setMaxBetaChange

/cerenkov/setStackPhotons

/scintillation/setYieldFactor

/scintillation/setExcitationRatio

/scintillation/setByParticleType

/scintillation/setTrackInfo

/scintillation/setFiniteRiseTime

/scintillation/setStackPhotons

/wls/setTimeProfile

/boundary/setInvokeSD

/verbose PROCESS VALUE

/cerenkov/verbose

/wls/verbose

/scintillation/verbose

/boundary/verbose

/absorption/verbose

/rayleigh/verbose

/mie/verbose

/process/activation

Material Properties

(energy dependent)

RINDEX

REFLECTIVITY

REALRINDEX

IMAGINARYRINDEX

EFFICIENCY

TRANSMITTANCE

SPECULARLOBECONSTANT

SPECULARSPIKECONSTANT

BACKSCATTERCONSTANT

GROUPVEL

MIEHG

RAYLEIGH

WLSCOMPONENT

WLSABSLLENGTH

ABSLLENGTH

FASTCOMPONENT

SLOWCOMPONENT

PROTONSCINTILLATIONYIELD

DEUTERONSCINTILLATIONYIELD

TRITONSCINTILLATIONYIELD

ALPHASCINTILLATIONYIELD

IONSCINTILLATIONYIELD

ELECTRONSCINTILLATIONYIELD

User-defined

(constant)

SURFACEROUGHNESS

ISOTHERMAL_COMPRESSIBILITY

WLSMEANNUMBERPHOTONS

WLSTIMECONSTANT

MIEHG_FORWARD

MIEHG_BACKWARD

MIEHG_FORWARD_RATIO

SCINTILLATIONYIELD

RESOLUTIONSCALE

FASTTIMECONSTANT

FASTSCINTILLATIONRISETIME

SLOWTIMECONSTANT

SLOWSCINTILLATIONRISETIME

YIELDRATIO

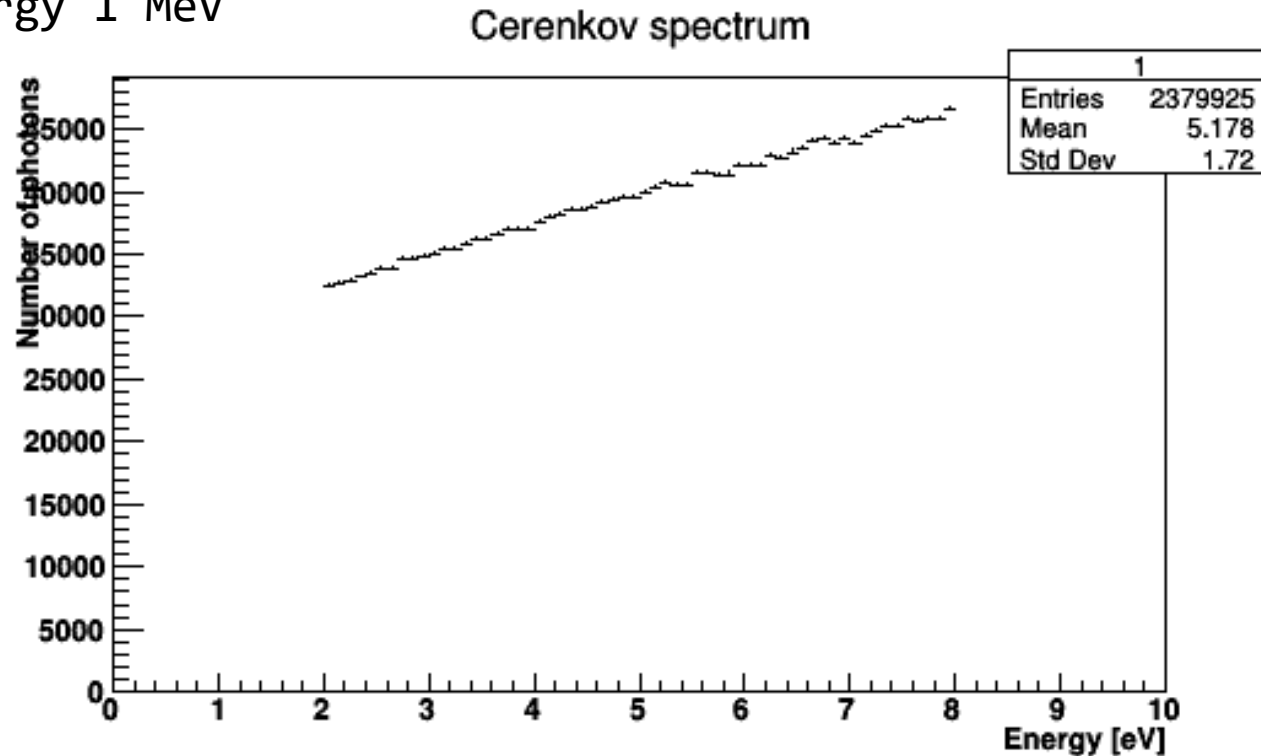
User-defined

Legend: not yet investigated

Cerenkov

cerenkov.mac

```
/opnovice2/boxProperty RINDEX 0.000002 1.3 0.000008 1.4  
/gun/particle e-  
/gun/energy 1 MeV
```



Average energy of Cerenkov photons created per event: 1.2×10^3 eV.
Average number of Cerenkov photons created per event: 237
Average energy: 5.2 eV.

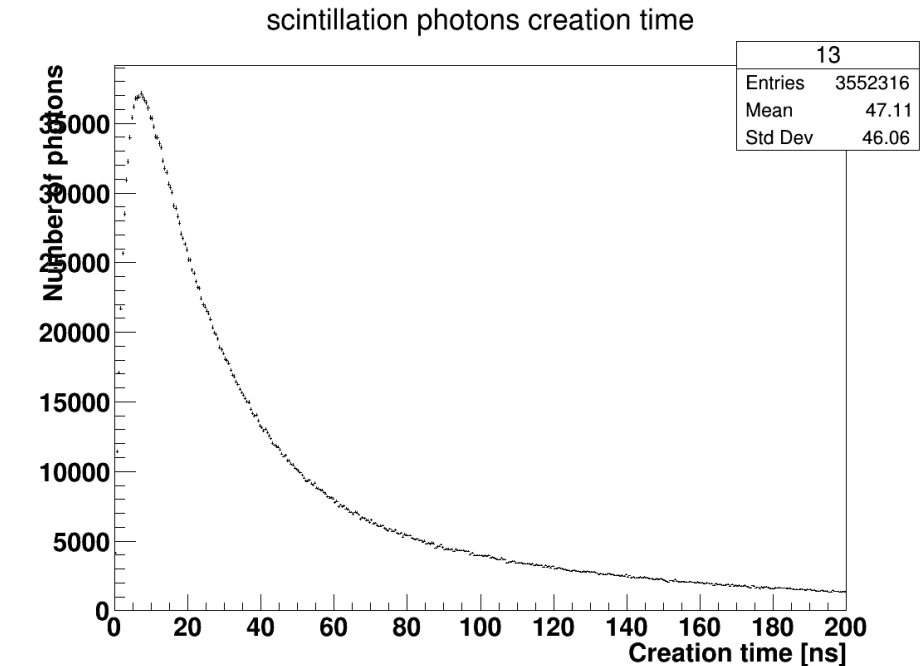
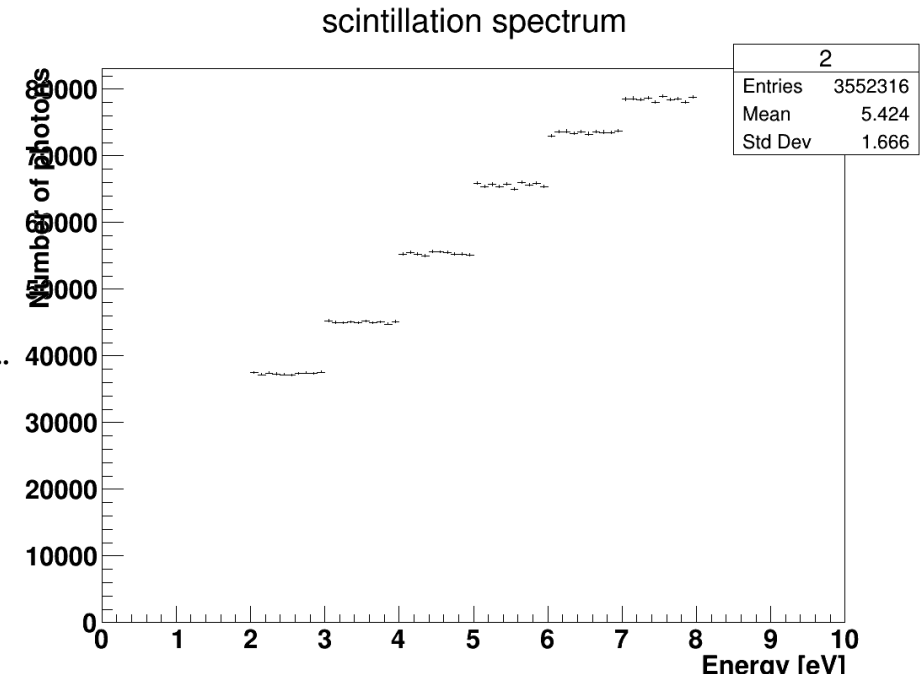
Scintillation

scintillation.mac

```
/opnovice2/boxProperty FASTCOMPONENT 0.000002 1.0 0.000008 1.3
/opnovice2/boxProperty SLOWCOMPONENT 0.000002 0.1 0.000003 0.2 ..
/opnovice2/boxConstProperty FASTTIMECONSTANT 20 ## ns
/opnovice2/boxConstProperty SLOWTIMECONSTANT 100
/opnovice2/boxConstProperty SCINTILLATIONYIELD 5000.0
/opnovice2/boxConstProperty YIELDRATIO 0.5
/opnovice2/boxConstProperty RESOLUTIONSCALE 1
/opnovice2/boxConstProperty FASTSCINTILLATIONRISETIME 3
/opnovice2/boxConstProperty SLOWSCINTILLATIONRISETIME 10
```

```
/process/optical/scintillation/setYieldFactor 10
/process/optical/scintillation/setExcitationRatio .5
/process/optical/scintillation/setByParticleType false
/process/optical/scintillation/setTrackInfo false
/process/optical/scintillation/setFiniteRiseTime true
/process/optical/scintillation/setStackPhotons true
```

```
/process/optical/scintillation/setTrackSecondariesFirst true
```



Scintillation by particle type

scint_by_particle.mac

```
/opnovice2/boxProperty SCINTILLATIONYIELD      5000.  
/opnovice2/boxProperty PROTONSCINTILLATIONYIELD  0 50 10  5000  
/opnovice2/boxProperty DEUTERONSCINTILLATIONYIELD 0 50 10  5000  
/opnovice2/boxProperty TRITONSCINTILLATIONYIELD  0 50 10  5000  
/opnovice2/boxProperty ALPHASCINTILLATIONYIELD   0 50 10  50000  
/opnovice2/boxProperty IONSCINTILLATIONYIELD    0 50 10  5000  
/opnovice2/boxProperty ELECTRONSCINTILLATIONYIELD 0 5000 10  500000
```

```
/gun/particle e-
```

```
...
```

```
/gun/particle proton
```

Primary particle was: e- with energy 1 MeV.

Average number of scintillation photons created per event: 34150

Primary particle was: proton with energy 1 MeV.

Average number of scintillation photons created per event: 495

Primary particle was: alpha with energy 1 MeV.

Average number of scintillation photons created per event: 5012

Surfaces

surface.mac

```
/opnovice2/boxProperty RINDEX 0.000002 1.3 0.000008 1.4
```

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

```
/opnovice2/surfaceModel unified
```

```
/opnovice2/surfaceType dielectric_dielectric
```

```
/opnovice2/surfaceFinish ground
```

```
/opnovice2/surfaceSigmaAlpha 1.1
```

```
/opnovice2/surfaceProperty SPECULARLOBECONSTANT 0.000002 .1 0.000008 .1
```

```
/opnovice2/surfaceProperty SPECULARSPIKECONSTANT 0.000002 .01 0.000008 .01
```

```
/opnovice2/surfaceProperty BACKSCATTERCONSTANT 0.000002 .05 0.000008 .05
```

```
/opnovice2/surfaceProperty REFLECTIVITY 0.000002 .99 0.000008 .99
```

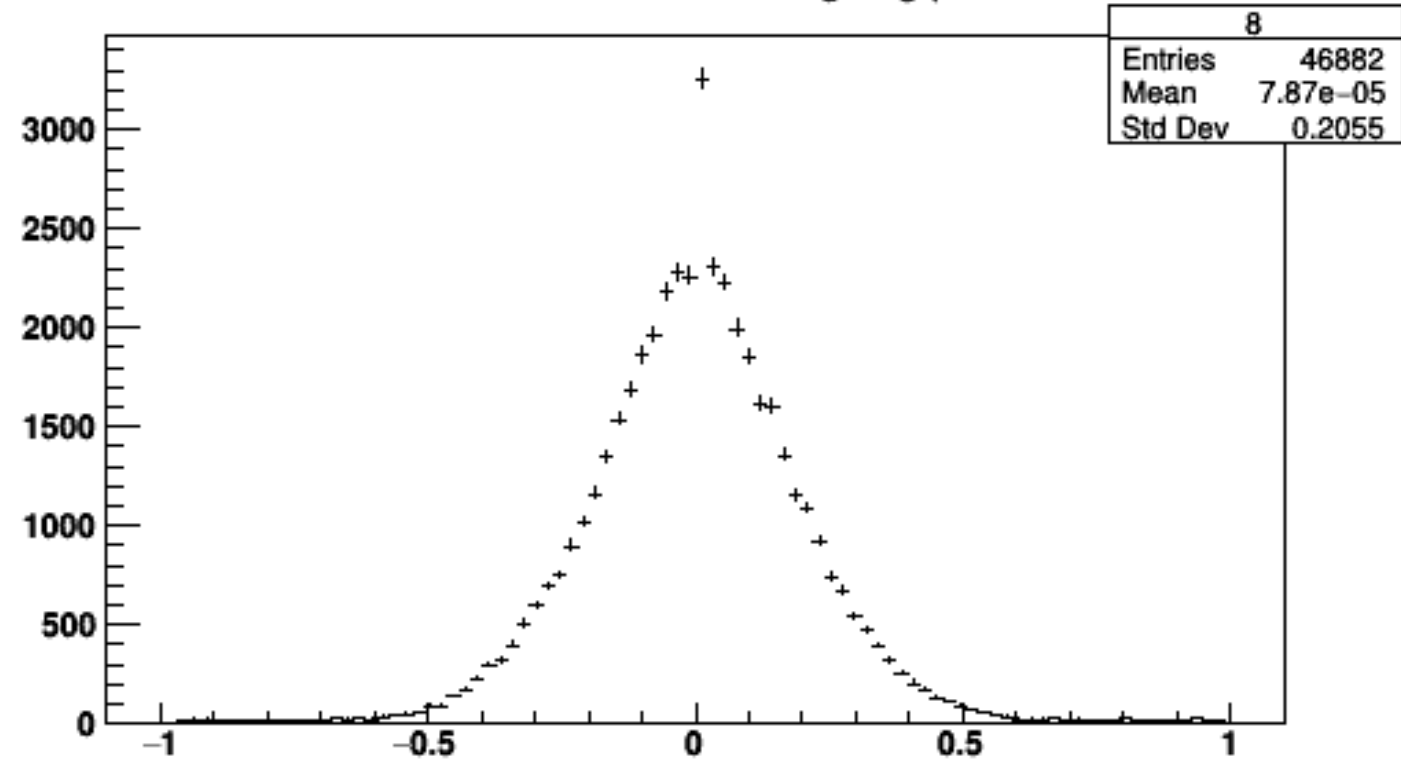
Surfaces

Run Summary

Surface events by process:

Fresnel refraction:	45975
Lambertian reflection:	49339
Lobe reflection:	240
Spike reflection:	501
Backscattering:	2883
Absorption:	988
Sum:	99926

Y momentum dir of forward-going photons



Surface types

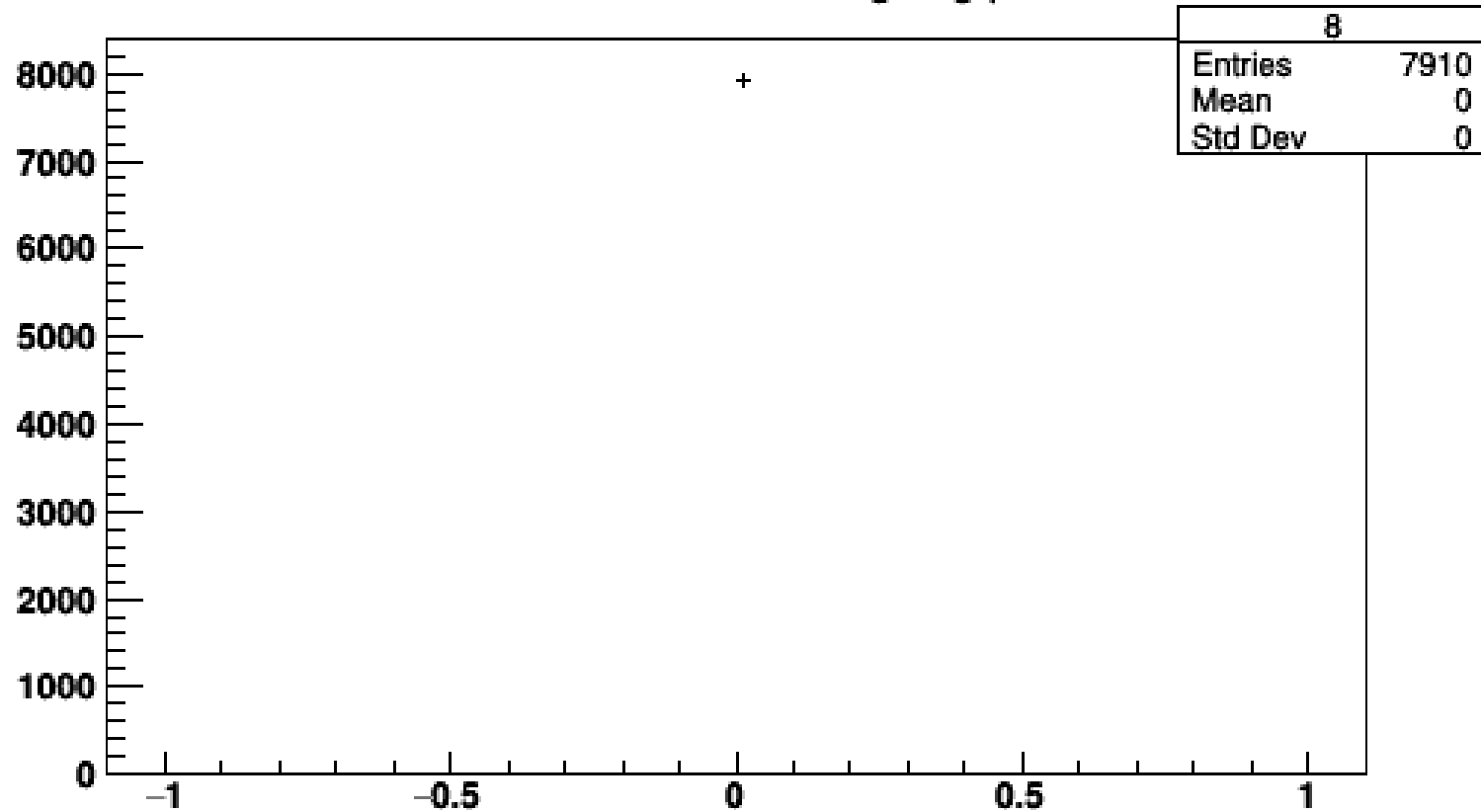
```
G4SurfaceType:  
  dielectric_metal,           // dielectric-metal interface  
  dielectric_dielectric,     // dielectric-dielectric interface  
  dielectric_LUT,           // dielectric-Look-Up-Table interface  
  dielectric_LUTDAVIS,      // dielectric-Look-Up-Table DAVIS interface  
  dielectric_dichroic,      // dichroic filter interface  
  firsov,                   // for Firsov Process  
  x_ray                     // for x-ray mirror process
```

No coverage

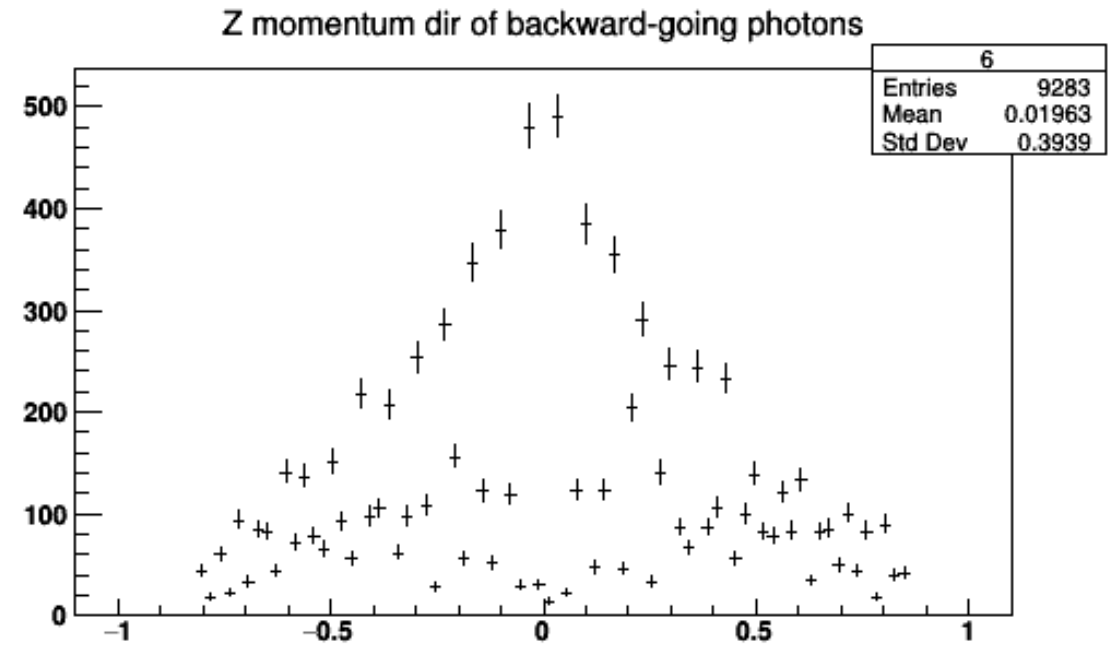
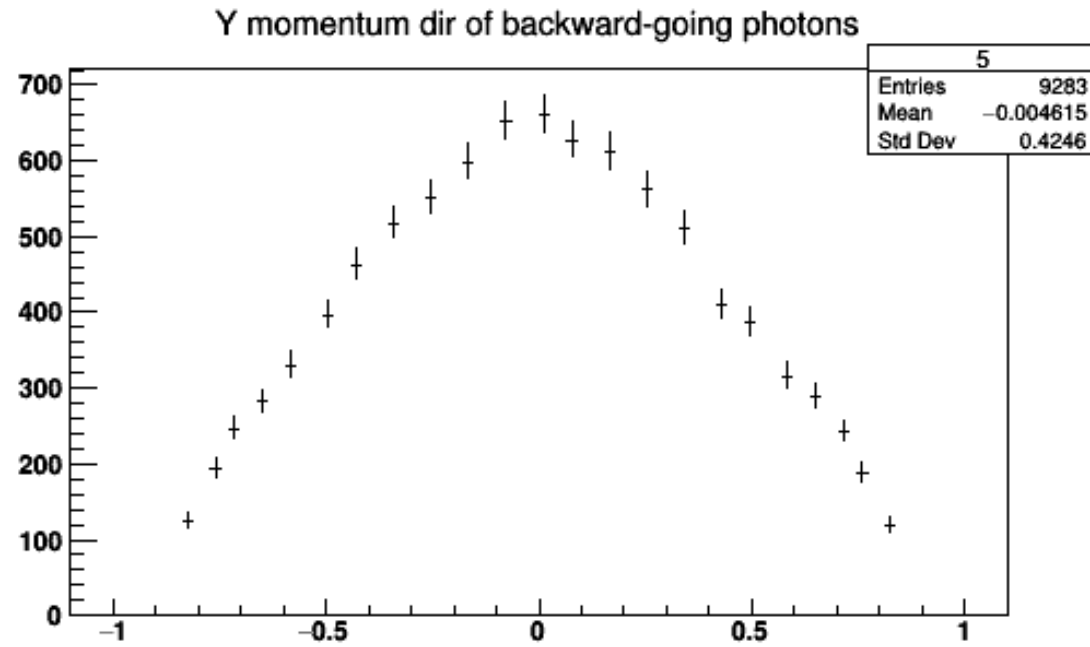
LUT_Davis

Normal incidence

Y momentum dir of forward-going photons



LUT LBNL



Summary

- Almost everything verified to compile and run
- Good “effectiveness” coverage
- Part of Cdash soon
- Validation not yet started