

Cleanup of OpFastScintillation

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The Problem

- In DUNE we wanted to be able use photon libraries which contained reflected light.
- But, the use of reflected light was only implemented when storing OnePhoton objects, not SimPhotonsLite objects.
 - OnePhoton – one object for each detected photon
 - SimPhotonsLite – a sparse histogram of photon arrival times on each channel
- DUNE uses SimPhotonsLite to avoid memory problems, SNBD moving the same way.
- Wait...why was this a problem in the first place?

Previous Structure of OpFastScintillation

```
if (SimPhotonsLite output)
```

```
for (each channel)
  for (each photon)
    - Calculate Scintillation time
    - (Calculate transport time with Dual Phase parameterization)
    - Store photon in SimPhotonsLite
    - Store OpDetBTR
```

```
else // One Photon output
```

```
for (each channel)
  for (each photon)
    - Calculate Scintillation time
    - (Calculate transport time with SBND parameterization)
    - Store photon in OnePhoton
```

```
if (Using reflected light)
```

```
for (each channel)
  for (each photon)
    - Calculate Scintillation time
    - (Calculate transport time with SBND parameterization)
    - Store photon in OnePhoton
```

New Structure of OpFastScintillation

```
for (not reflected, reflected)
  if (reflected and not using reflections) continue
  for (each channel)
    for (each photon)
      - Calculate Scintillation time
      - (Calculate transport time with Dual Phase parameterization)
      - (Calculate transport time with SBND parameterization)
      - Store OpDetBTR
      if (SimPhotonsLite output)
        - Store photon in SimPhotonsLite
      else // OnePhotonOutput
        - Store photon in OnePhoton
```

- Should allow SNBD to transition to SimPhotonsLite easily
- Allows us to easily use different timing parameterizations.
- Everyone gets photon backtracking
- Caveat: this is all with *old* LArG4, and will need to get ported to *new* LArG4
 - This is a post-TDR project.

How Reflected Light is Stored

- Previously: reflected light and direct light stored together in the same collection as `OnePhoton` objects
 - Wavelength stored in `OnePhoton` distinguished between them.
- Now: two separate labels (“”, “reflected”) of `SimPhotonsLite/OnePhoton/OpDetBTR` so that downstream code can work equivalently for all 3.
 - Needed because `SimPhotonsLite` has no way to store “wavelength” or other properties which vary photon-to-photon
- Important caveat: this only applies to **Fast** Scintillation.
- **Full** optical simulation does not store separate direct/reflected collections.
 - Primarily used for making photon libraries, and it’s already working, so it was not urgent to make changes here.