Synchrotron Radiation Studies - Update



Rey Cruz-Torres RNC EIC Meeting 10/25/2022







A series of single-photon events from a Synrad+ simulation.

Recap





A series of events with many photons corresponding to a time integration window.



with a flux (γ /sec) weight



x-axis: every photon in the sample (1 per bin)







For each photon in the event we have: p_x , p_y , p_z , x, y, z

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Multiplicity





Sample events



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What we want(ed) to do



Advantages:

- Simplicity (event generator is a very light python code)
- Requires minimal processing of input photon files
- Portability: can test hepmc files in multiple platforms (DD4HEP, Fun4All, ...)
- Can pass same sample over multiple detector configurations (e.g. changing gold coating)

Issues:

respective vertices and launched from v = (0,0,0), which produces wrong topology

- DD4HEP hit distributions reveal that photon momentum vectors are detached from their

Alternate method

- Pass each photon one by one through Geant and save hits 1)
- Compose many-photon event (as before) 2)
- 3) Instead of saving to hepmc, locate Geant hits associated with the photons in this event

hits or no hits (i.e. passing photons once can lead to wrong conclusions). in more than one event)

The single-photon events don't have the vertex-detachment problem (one global vertex for an event with only one photon seems to work)

Caveat: passing the same photon through Geant multiple times can result in different - Additionally, we count on these stochastic events to work around the fact that we compose these events by sampling from a finite photon pool (same photon may end up







Solution

Pass each photon through Geant model of detector in DD4HEP with multiple seeds, keeping track of the seed

> Hepmc file with singlephoton events

At the moment I have done it for seeds in [1,50]

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Geant hits photon by photon MC seed = 1

Geant hits photon by photon MC seed = 2

Geant hits photon by photon MC seed = 3

Geant hits photon by photon MC seed = N





Do the sampling to compose a multi-photon event (as before)

Once the event is composed (instead of saving the photons to a hepmc file) loop over photons

For each photon in the event

Randomly select one of the available Geant-hit files

Find the photon and get its hits

Solution

Geant hits photon by photon MC seed = 1

Geant hits photon by photon MC seed = 2

Geant hits photon by photon MC seed = 3

Geant hits photon by photon MC seed = N









Disadvantages with respect to original method

- More convoluted code than event generator that writes to hepmc
- Requires significant processing of input photon files
- Not portable: need to produce hits with DD4HEP first before running code
- Need to propagate single photons multiple times for each configuration (e.g. gold coating)
- Lots of heavy files to generate and keep track of
- Any small changes down the line (e.g. renaming a branch in DD4HEP) will render the codes unusable







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Results

Summary of hit frequency



Comparison to previous results

Old (biased) method in which we passed all photons through Geant only once and scaled the resulting contribution by the provided weight.



* Keep in mind the detector versions between these plots is different

New method previously described







- The synchrotron-radiation event generator was composed a while back (independently by RCT and Benjamen Sterwerf).
- There was (is) a bottleneck with Hepmc/DD4HEP detaching photon momentum vectors from vertices (still working on this, with Kolja Kauder).
- We implemented an alternate method to work around this issue and developed the software to achieve the same task.
- New results predict smaller synchrotron radiation rates and imply (as expected) that the preliminary results (pre-proposals) were biased by a few photons with very high weights.

Summary









Backup slides

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VertexBarrelHits int window = 1e-07 sec, n events = 100000



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z [mm]



