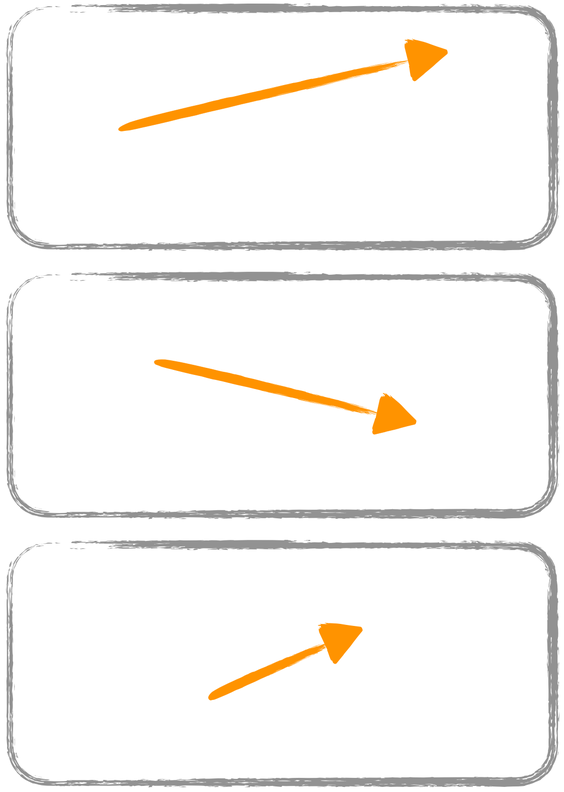
Synchrotron Radiation Studies - Update

Rey Cruz-Torres
EPIC Tracking Meeting
12/08/2022

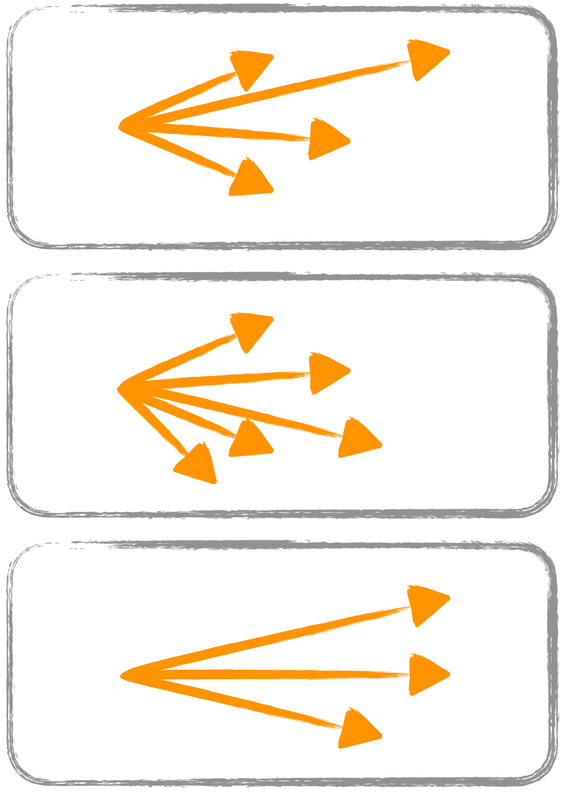
Recap

Have



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

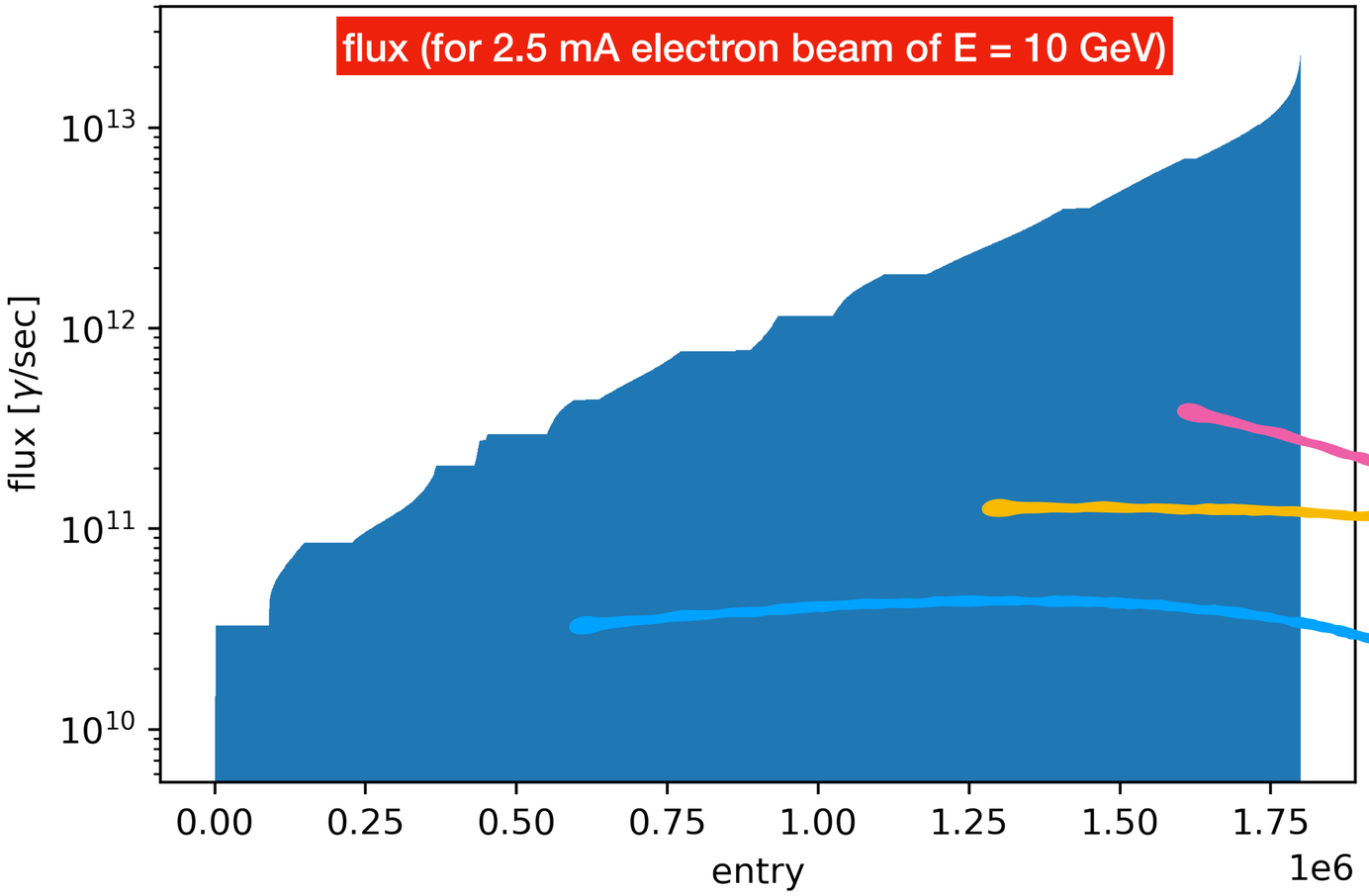
Want



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

Composing an event

Sample consists of 1.8M photons, each with a flux (γ/sec) weight



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

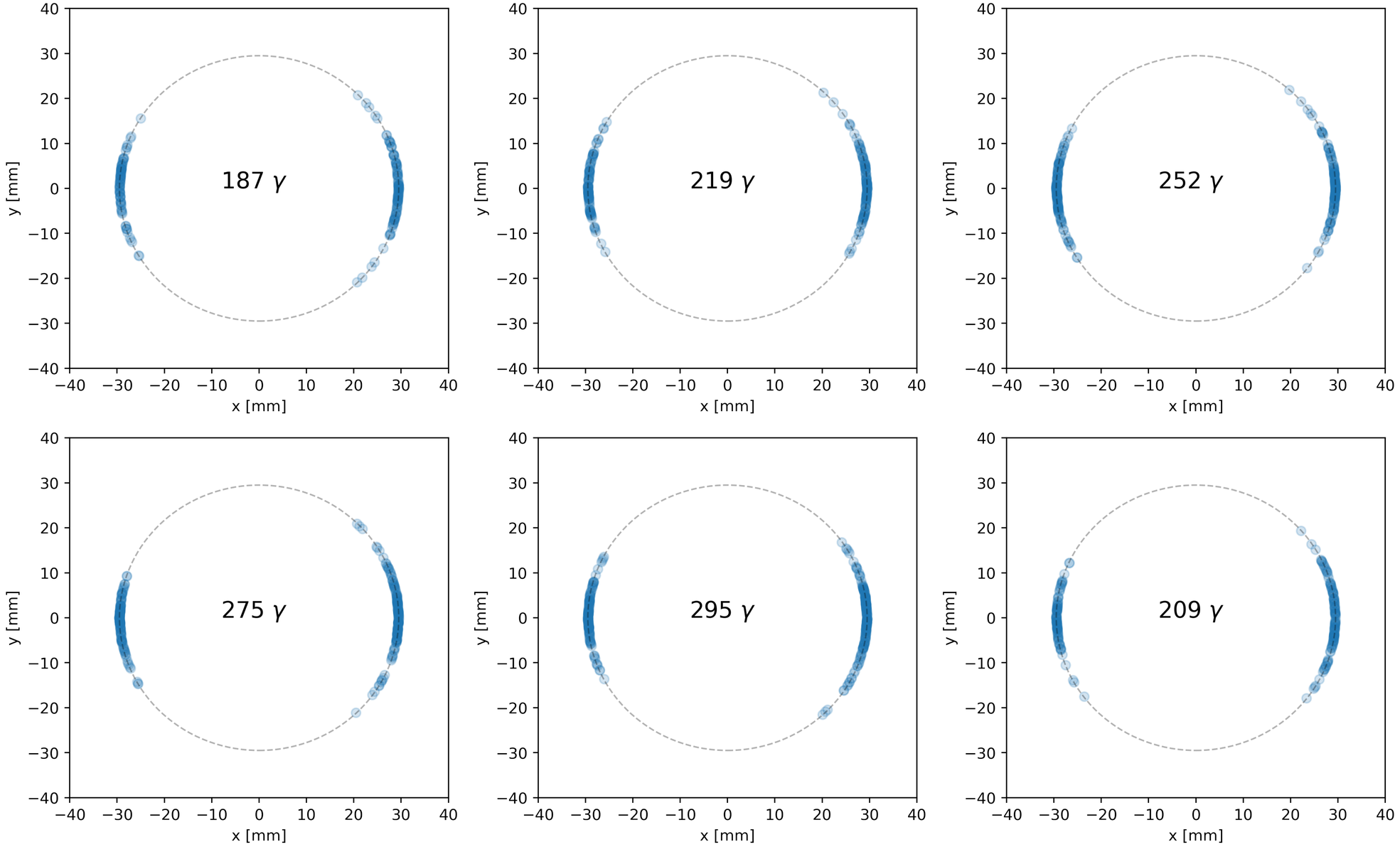
Define an integration window (IW)

```
integral = 0
while integral < IW:
    Randomly sample photon, add it to event
    integral += 1/flux
return event
```

Sample as many photons as fit in the defined time integration window

Time integration window

Sample events

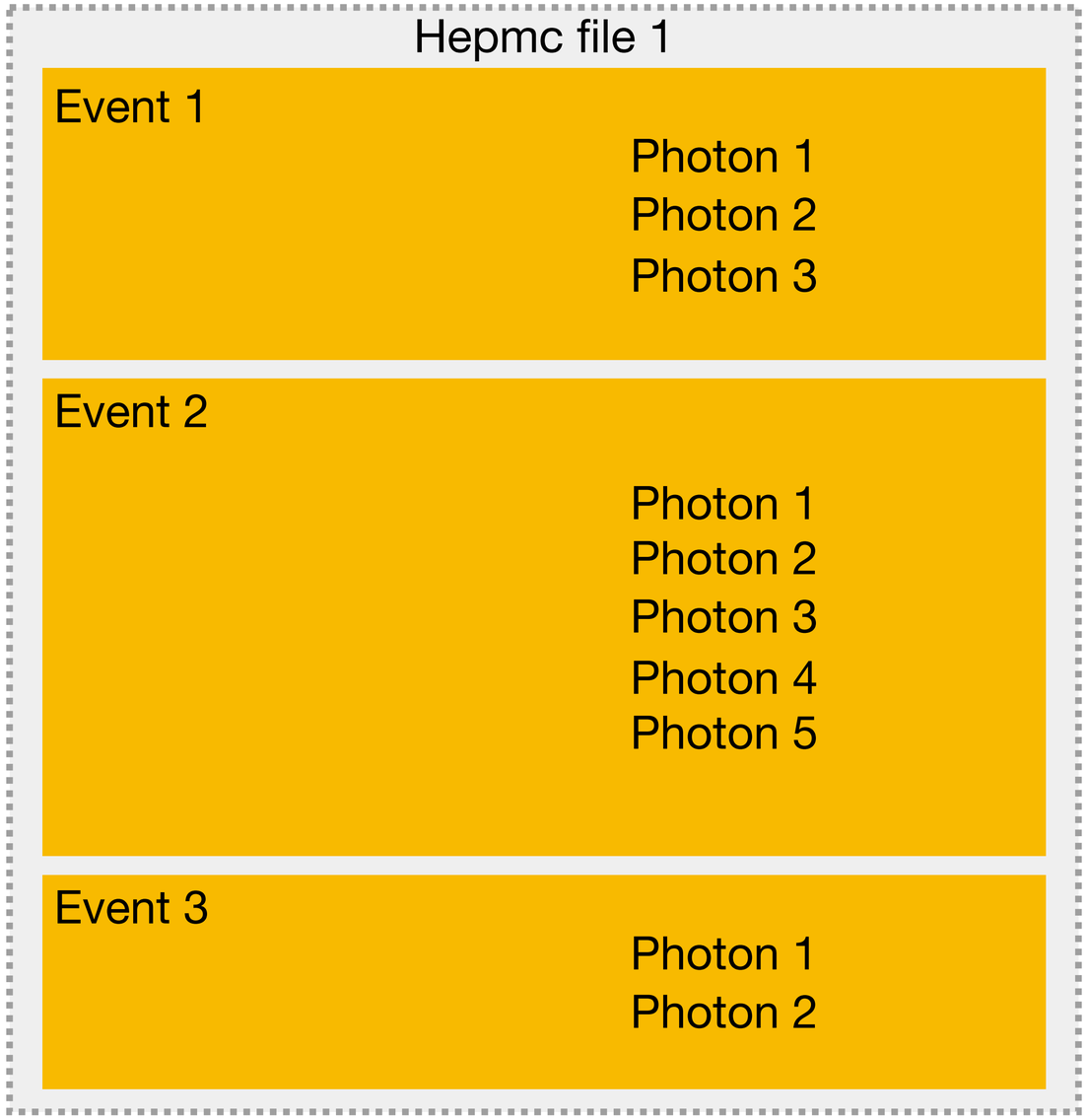


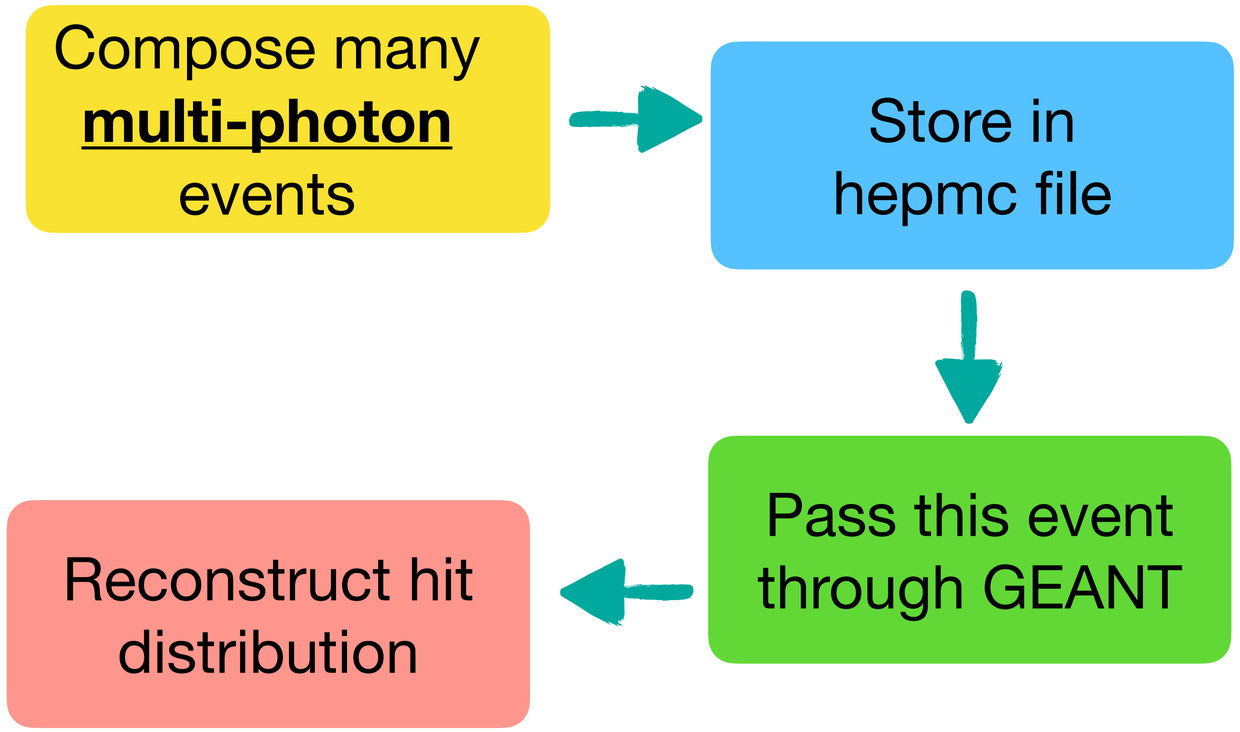
before interaction with gold coating

Integration window = 100 ns

flux (for 2.5 mA electron beam of E = 10 GeV)

Geant propagation





Issues:

- DD4HEP hit distributions revealed that photon momentum vectors were detached from their respective vertices and launched from v = (0,0,0), which produces wrong topology

Workaround

Instead of:

Hepmc file 1

Event 1
Photon 1
Photon 2
Photon 3

Event 2
Photon 1
Photon 2
Photon 3
Photon 4
Photon 5

Event 3
Photon 1
Photon 2

We use:

Hepmc file 1

Event 1	Photon 1
Event 2	Photon 2
Event 3	Photon 3

Hepmc file 2

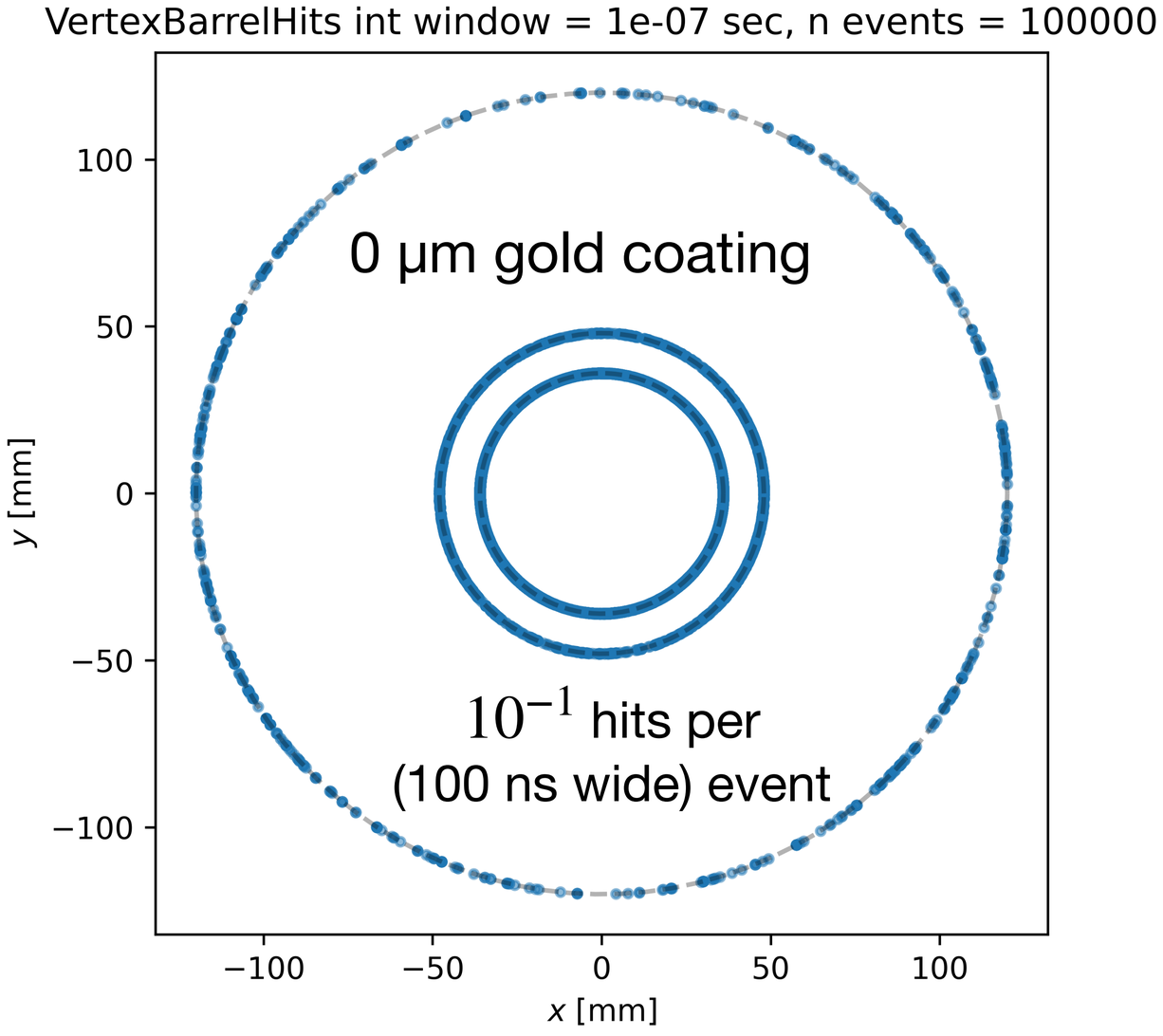
Event 1	Photon 1
Event 2	Photon 2
Event 3	Photon 3
Event 4	Photon 4
Event 5	Photon 5

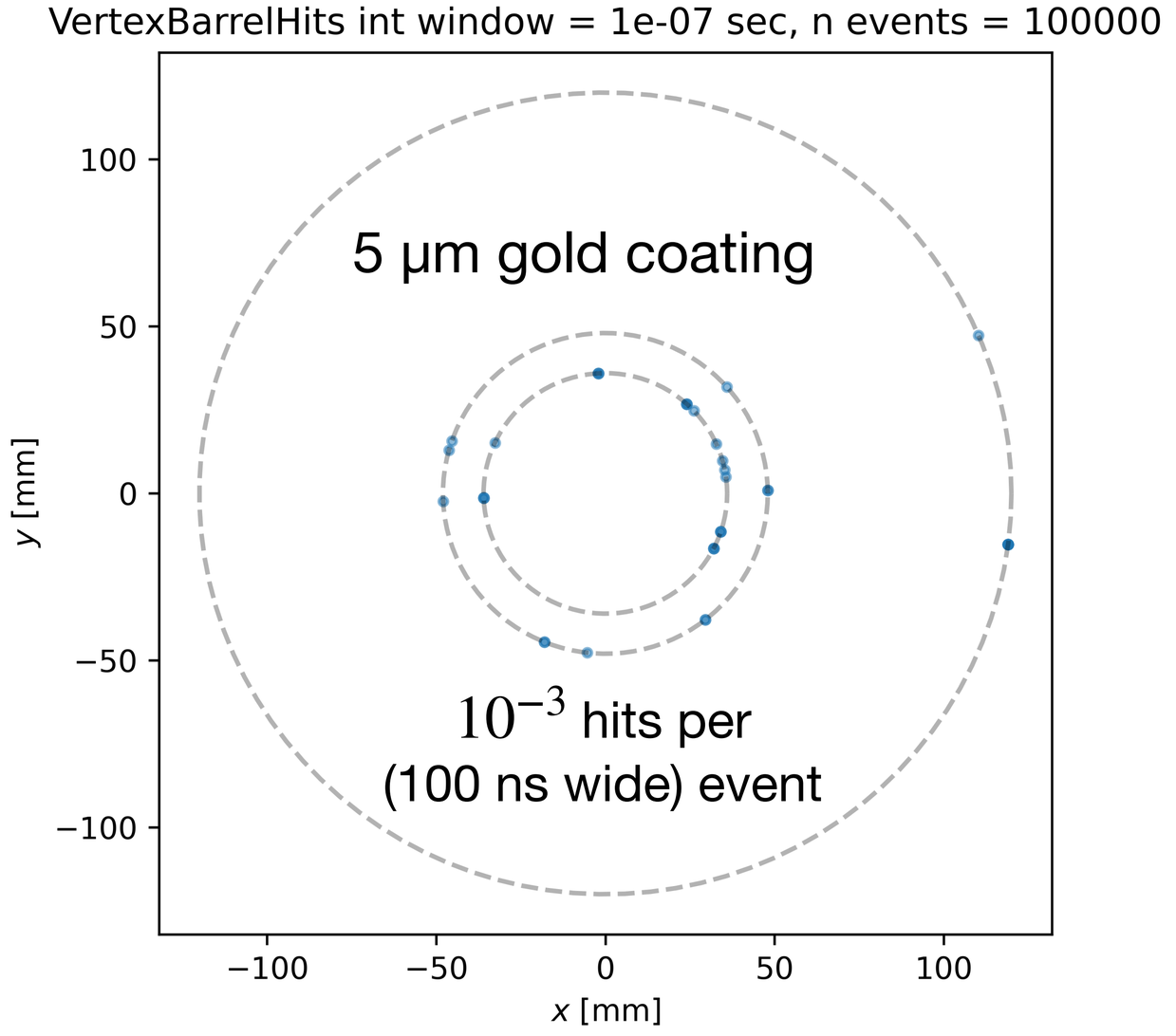
Hepmc file 3

Event 1	Photon 1
Event 2	Photon 2

* Implemented by UC Berkeley undergrad B. Sterwerf

Results


VertexBarrelHits int window = 1e-07 sec, n events = 100000
0 μm gold coating
10^{-1} hits per
(100 ns wide) event
y [mm]
x [mm]
100
50
0
−50
−100
−100
−50
0
50
100

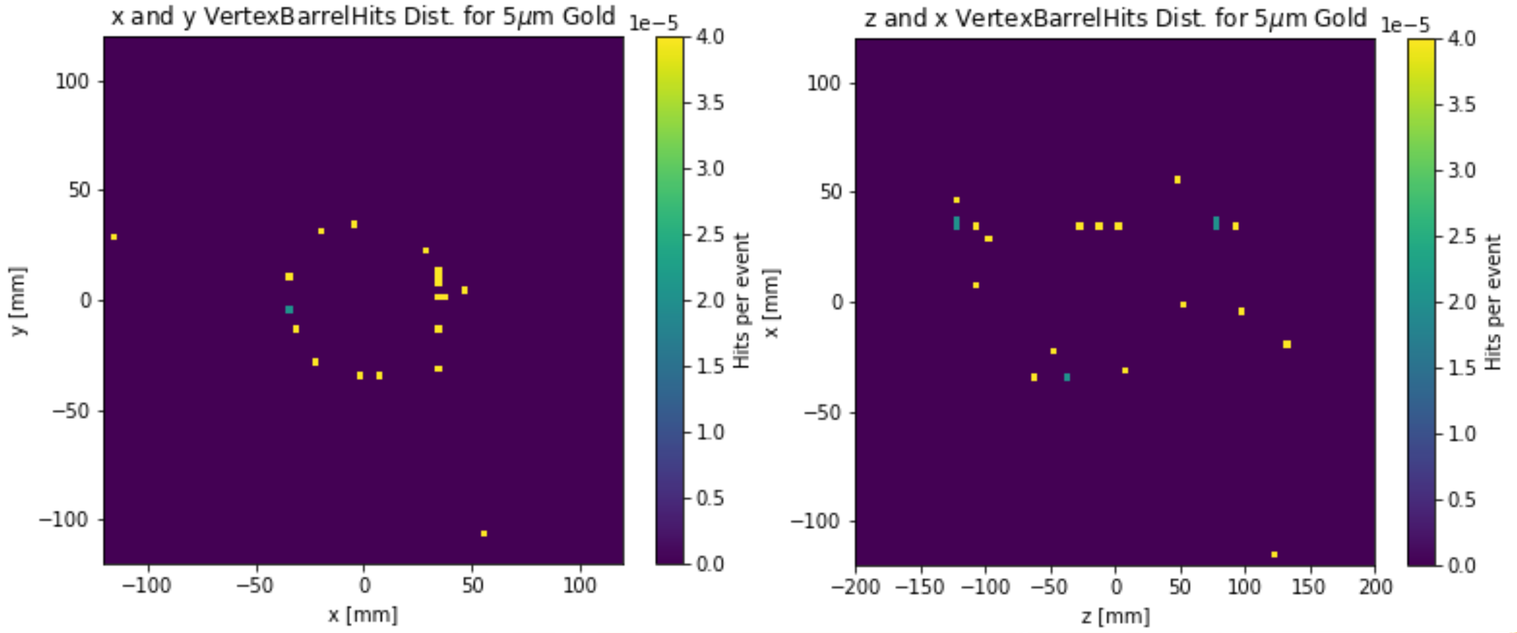

VertexBarrelHits int window = 1e-07 sec, n events = 100000
5 μm gold coating
10^{-3} hits per
(100 ns wide) event
y [mm]
x [mm]
100
50
0
−50
−100
−100
−50
0
50
100

Results with this new method

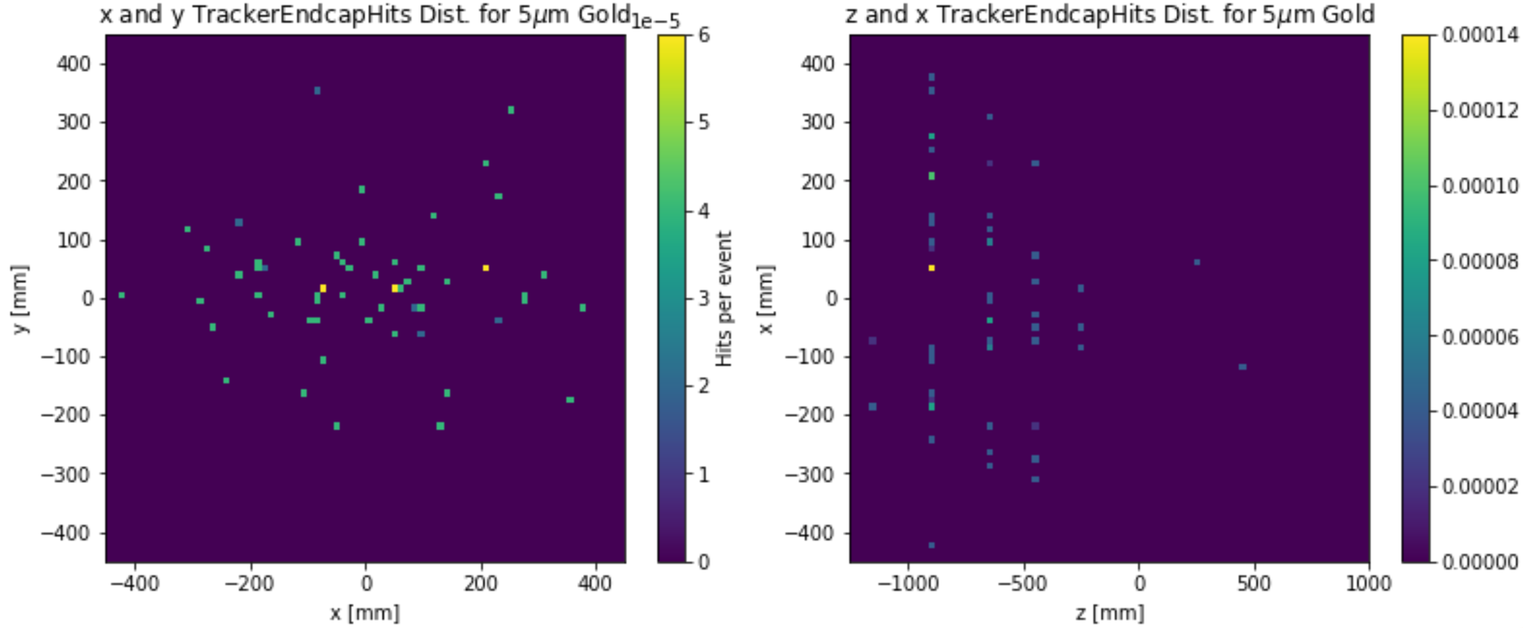
flux (for 2.5 mA electron beam of E = 10 GeV)

* plots by UC Berkeley undergrad B. Sterwerf

Vtx layers



Disks



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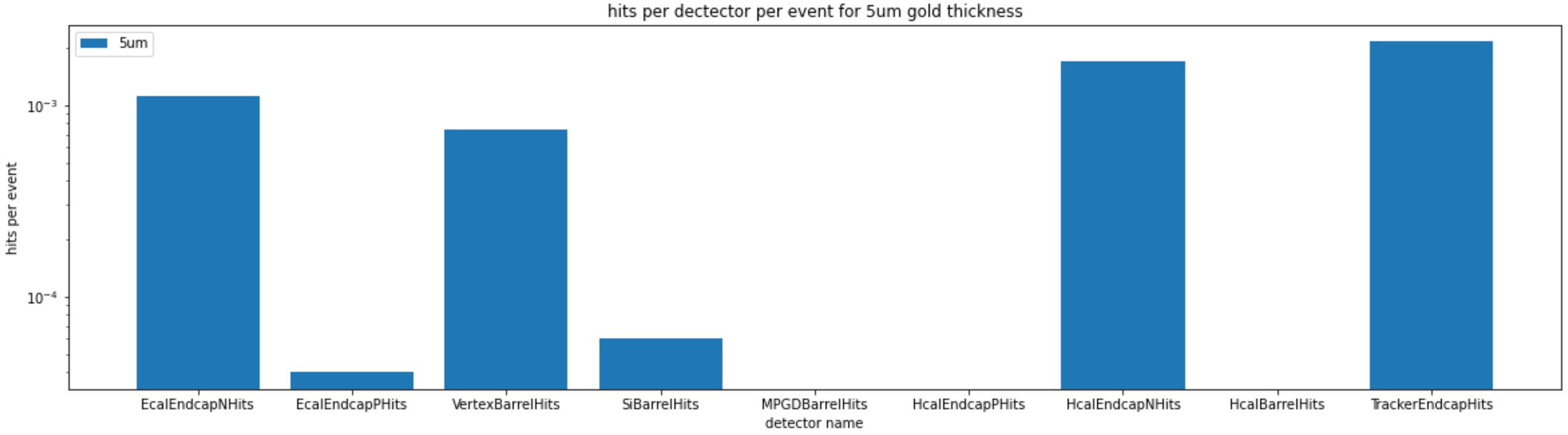
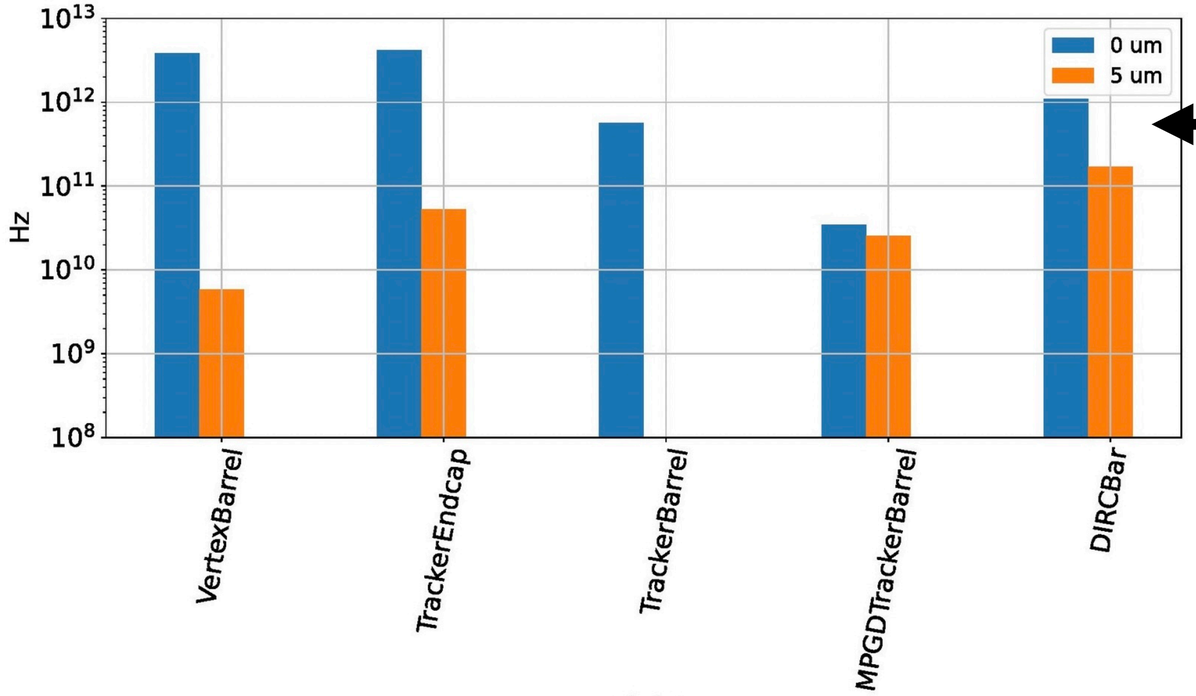


* plots by UC Berkeley undergrad B. Sterwerf

Comparison to previous results

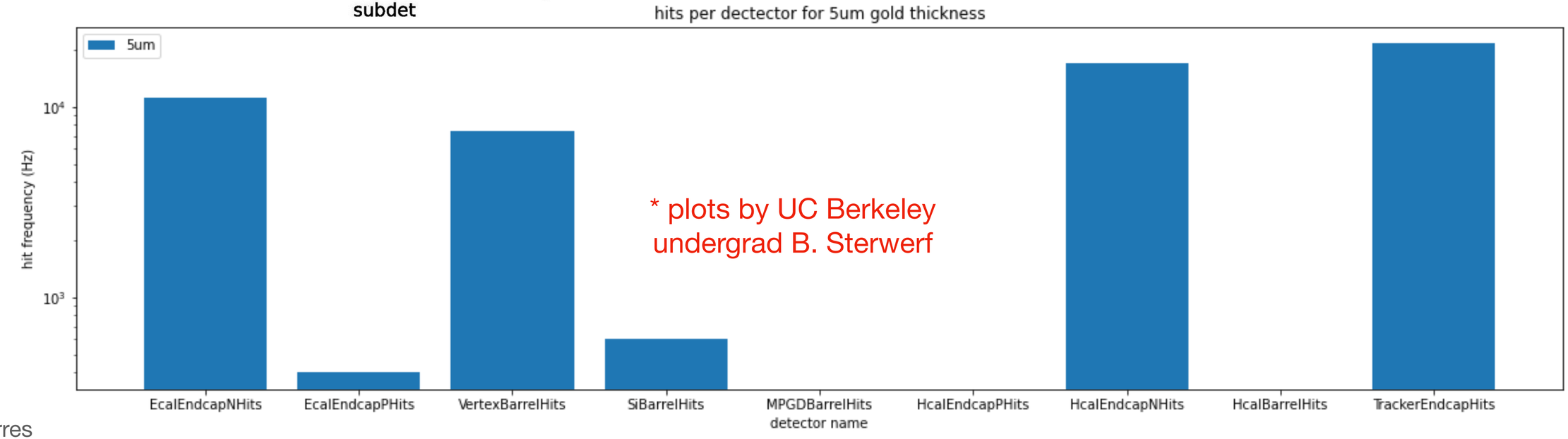
flux (for 2.5 mA electron beam of E = 10 GeV)



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

Compare orange on top to blue on bottom plot



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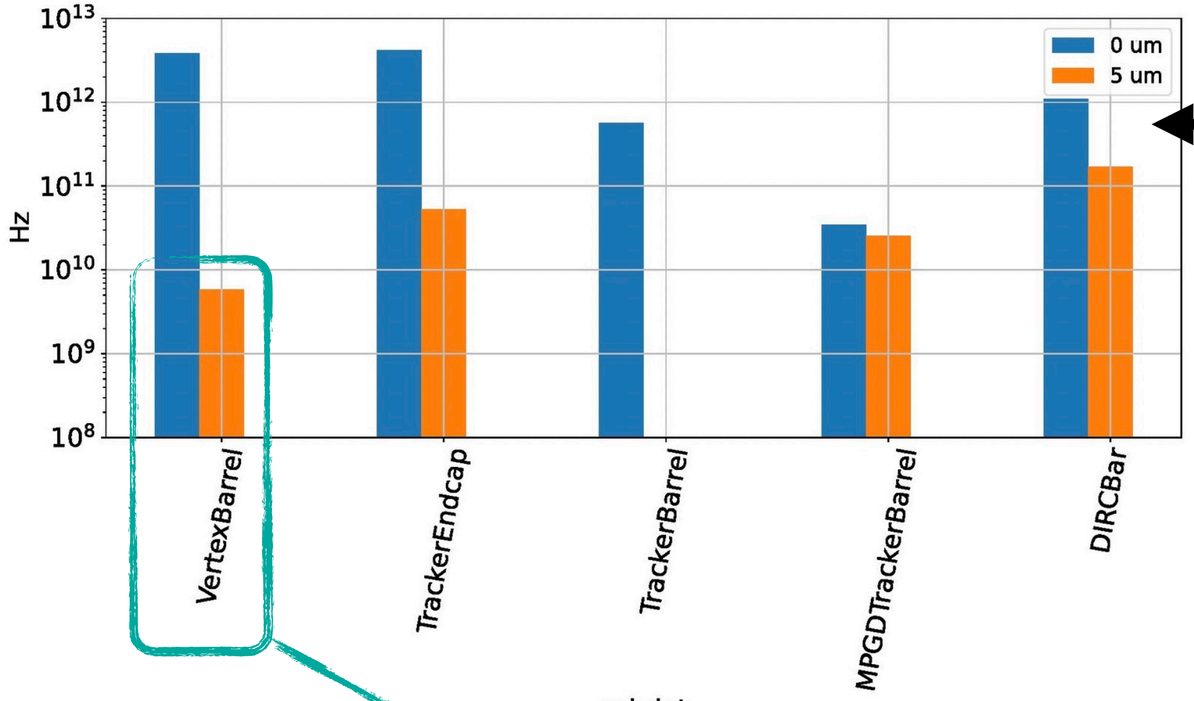

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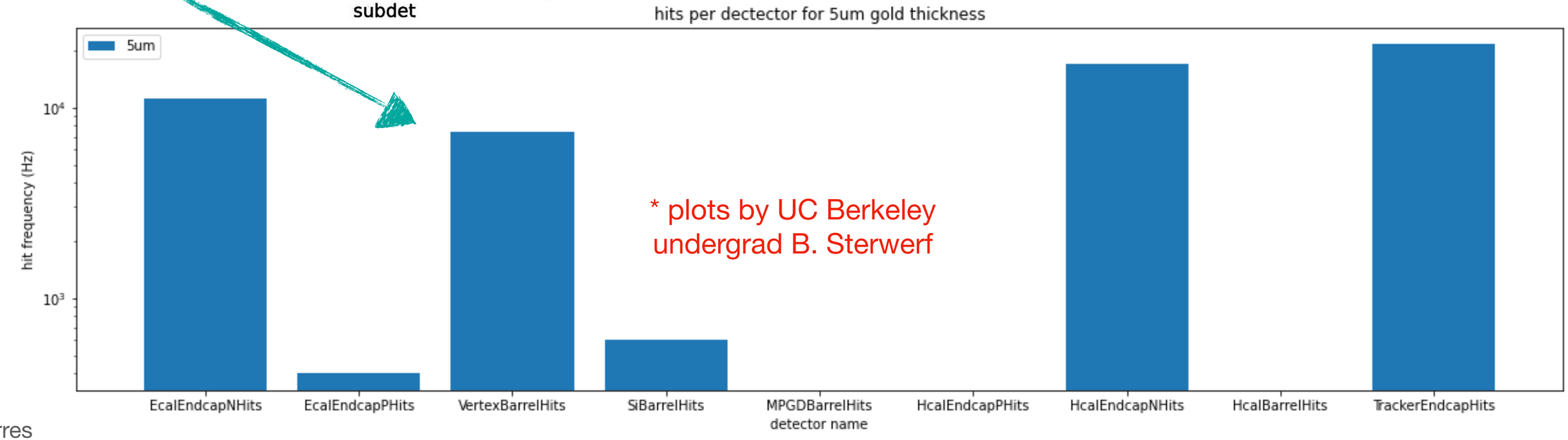

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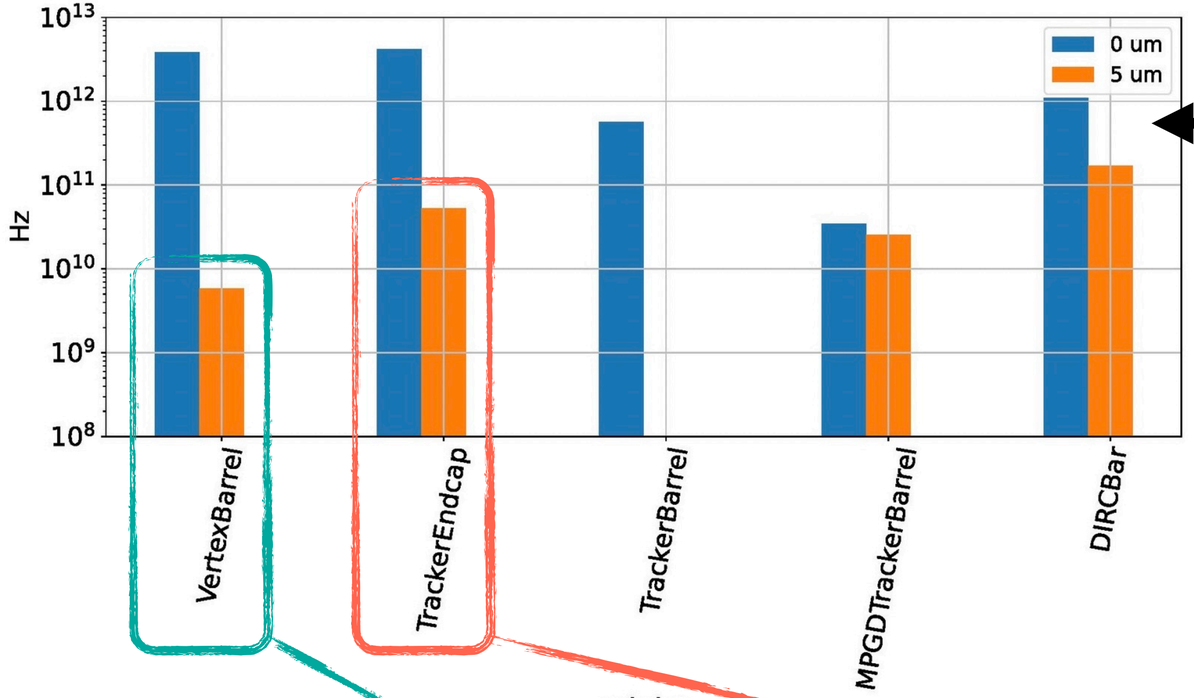

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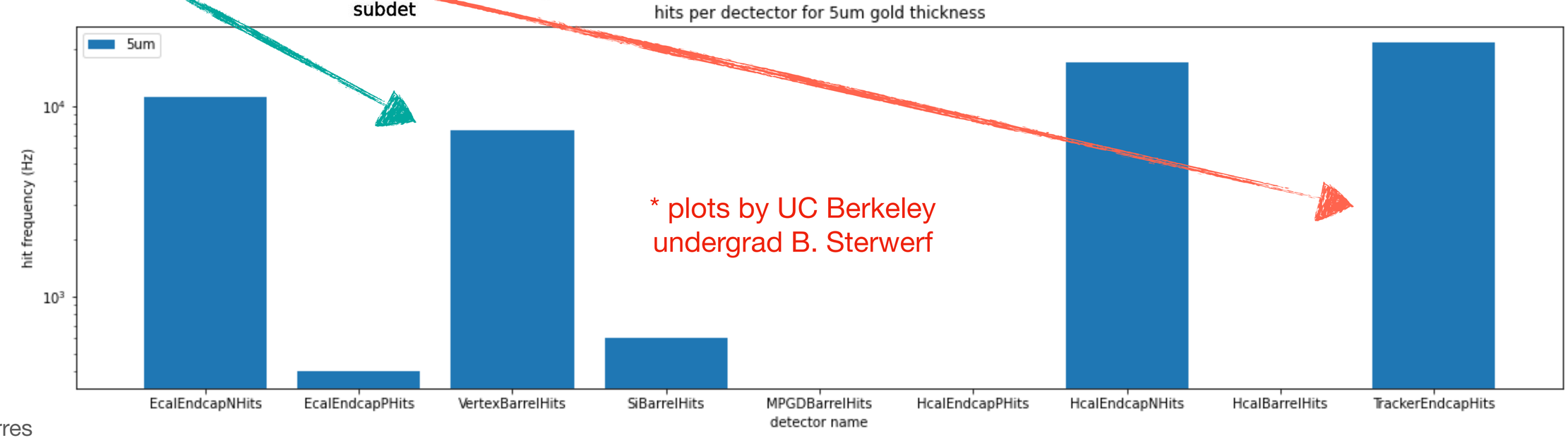

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Summary

- The **SR event generator** was composed a while back (independently by RCT and B. Sterwerf).

- There was a bottleneck with **DD4HEP detaching photon momentum vectors from vertices** (fix found and implemented by K. Kauder).

- We implemented an **alternate method** to work around this issue and developed the software to accomplish the same task.

- New results (with three different methods) predict much **smaller synchrotron radiation rates** and imply (as expected) that the preliminary results (pre-proposals) were biased by a few photons with very high weights.

Versioning of stored EPIC events

https://dtn01.sdcc.bnl.gov:9001/buckets/eictest/browse/RVBJQy9SRUNPLzIyLjExLjIvZXBpY19icnljZWNhbnlvbi9ESVMvTkMvMTh4Mjc1L21pbIEyPTEv

minQ2=1

eictest / EPIC / RECO / 22.11.2 / epic_brycecanyon / DIS / NC / 18x275 / minQ2=1

Search Objects

Select	Name	Last Modified	Size	Options
☐	pythia8NCDIS_18x275_minQ2=1_beamEffects_xAngle=...	Tue Nov 22 2022 23:32:34 GMT-0800	56 MB	
☐	pythia8NCDIS_18x275_minQ2=1_beamEffects_xAngle=...	Tue Nov 22 2022 23:33:26 GMT-0800	55 MB	
☐	pythia8NCDIS_18x275_minQ2=1_beamEffects_xAngle=...	Tue Nov 22 2022 23:21:42 GMT-0800	54 MB	
☐	pythia8NCDIS_18x275_minQ2=1_beamEffects_xAngle=...	Wed Nov 23 2022 00:03:06 GMT-0800	55 MB	
☐	pythia8NCDIS_18x275_minQ2=1_beamEffects_xAngle=...	Wed Nov 23 2022 00:22:17 GMT-0800	55 MB	
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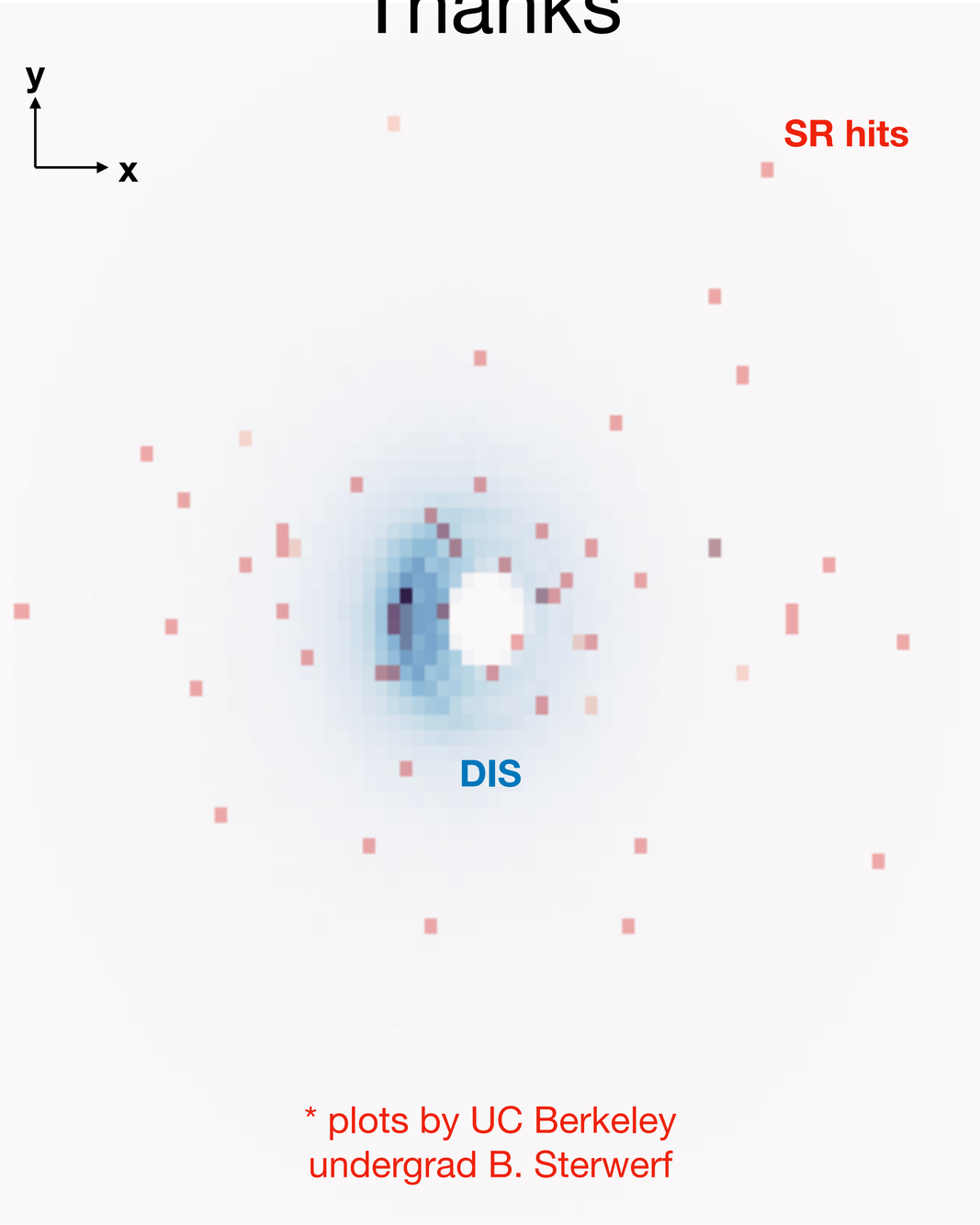
Thanks



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