Synchrotron Radiation EIC Files



Rey Cruz-Torres EIC RNC Meeting 11/08/2021

Synchrotron radiation background at EIC

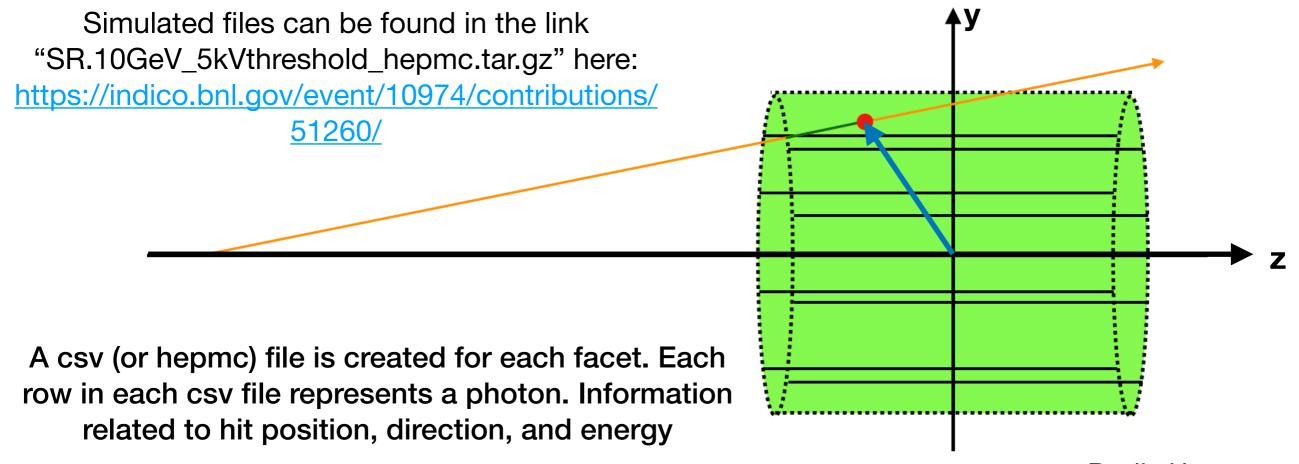
Synrad+ simulation of photons due to the final electron Forward magnets.

Synrad+: MC simulation for synchrotron radiation

10-min intro to Synrad+ here: https://molflow.web.cern.ch/sites/molflow.web.cern.ch/files/

synrad%20quick%20start.pdf

- "virtual cylinder" comprised of rectangular facets is placed just inside the IR beampipe
- Electrons are propagated through B field
- resulting photons which pass through this facet are tracked.



Example (facet #25099)

Hit coordinates [cm]

Photon direction (unit vector)

Photon energy [ev]

Pos_Y_[cm] 0.892506 0.827151	Pos_Z_[cm] 402.124		Pos_v	Dir_X	Dir_Y	D: 7	B: 11					D D45
	402.124				ם ווים	Dir_Z	Dir_theta_[rad]	Dir_phi_[rad]	LowFluxRatio	Energy_[eV]	Flux_[photon/s]	Power_[W]
0.827151		0.936165	0.765545	0.00347649	0.000413811	0.999994	1.57426	-0.000500074	1	5091.4	2.37436E+07	1.93685E-08
	401.578	0.935437	0.633965	0.00355164	0.000318425	0.999994	1.57431	-0.000611662	1	8568.64	2.62137E+07	3.59876E-08
0.566204	402.542	0.936723	0.108601	0.0011339	0.000116512	0.999999	1.57192	-0.000180932	1	8458.49	3.8606E+06	5.23193E-09
0.874632	274.962	0.766616	0.729559	0.00461989	0.000411934	0.999989	1.57537	-0.000797826	1	5399	5.01373E+07	4.33699E-08
0.696684	319.571	0.826095	0.371297	0.00390543	0.000331787	0.999992	1.57465	-0.000690322	1	13582.4	2.7392E+07	5.96092E-08
0.683506	414.33	0.95244	0.344765	0.00429288	0.000328031	0.999991	1.57503	-0.000794232	1	7534.46	5.42091E+07	6.54392E-08
0.550056	390.662	0.920883	0.0760899	0.00422765	0.000247995	0.999991	1.57494	-0.000854659	1	11253.1	4.65217E+07	8.3877E-08
0.759367	304.608	0.806144	0.497496	0.0041344	0.000306715	0.999991	1.57487	-0.000773805	1	11430.6	3.61566E+07	6.62169E-08
0.878422	348.153	0.864204	0.73719	0.00375227	0.000420485	0.999993	1.57453	-0.000565007	1	10813.5	2.8232E+07	4.89125E-08
0.888235	368.794	0.891726	0.756945	0.00408431	0.000412529	0.999992	1.57485	-0.00065863	1	5833.63	4.03138E+07	3.76796E-08
0.677081	407.329	0.943105	0.331829	0.00364828	0.00025407	0.999993	1.57439	-0.000698836	1	5572.35	2.81858E+07	2.51641E-08
0.822257	248.537	0.731383	0.624112	0.00480152	0.000421061	0.999988	1.57554	-0.000836022	1	9989.97	5.29457E+07	8.4744E-08
0.567099	225.404	0.700539	0.110402	0.0046274	0.000286726	0.999989	1.57534	-0.000920713	1	5774.42	3.96288E+07	3.66634E-08
0.773186	379.201	0.905602	0.525318	0.00358844	0.000390656	0.999993	1.57436	-0.000551415	1	5130.67	2.31987E+07	1.907E-08
0.521776	298.453	0.797937	0.0191541	0.00115815	0.000102522	0.999999	1.57194	-0.000200723	1	5053.06	3.8606E+06	3.12553E-09
0.771548	54.2046	0.472273	0.52202	0.00630197	0.000460707	0.99998	1.577	-0.00118608	1	10571.9	7.55019E+07	1.27887E-07
0.701741	284.138	0.778851	0.381477	0.00441071	0.000216819	0.99999	1.57511	-0.000932154	1	5985.8	4.37028E+07	4.19127E-08
0.667366	393.504	0.924673	0.31227	0.00359361	0.000286502	0.999994	1.57434	-0.000653359	1	12342.7	2.381E+07	4.70851E-08
0.762463	425.065	0.966753	0.503729	0.00350593	0.000368484	0.999994	1.57428	-0.000551476	1	9645.65	2.24862E+07	3.47505E-08
0.670984	368.133	0.890844	0.319554	0.00407954	0.000314499	0.999992	1.57482	-0.000752087	1	7173.99	3.82712E+07	4.39892E-08
0.538725	205.698	0.674264	0.0532768	0.00477701	0.000288972	0.999989	1.57549	-0.000957265	1	10310.5	4.20888E+07	6.9528E-08
	0.566204 0.874632 0.696684 0.683506 0.550056 0.759367 0.878422 0.888235 0.677081 0.822257 0.567099 0.773186 0.521776 0.771548 0.701741 0.667366 0.762463 0.670984	0.566204402.5420.874632274.9620.696684319.5710.683506414.330.550056390.6620.759367304.6080.878422348.1530.888235368.7940.677081407.3290.822257248.5370.567099225.4040.773186379.2010.521776298.4530.77154854.20460.701741284.1380.667366393.5040.762463425.0650.670984368.133	0.566204 402.542 0.936723 0.874632 274.962 0.766616 0.696684 319.571 0.826095 0.683506 414.33 0.95244 0.550056 390.662 0.920883 0.759367 304.608 0.806144 0.878422 348.153 0.864204 0.888235 368.794 0.891726 0.677081 407.329 0.943105 0.822257 248.537 0.731383 0.567099 225.404 0.700539 0.773186 379.201 0.905602 0.521776 298.453 0.797937 0.771548 54.2046 0.472273 0.701741 284.138 0.778851 0.667366 393.504 0.924673 0.762463 425.065 0.966753 0.670984 368.133 0.890844	0.566204 402.542 0.936723 0.108601 0.874632 274.962 0.766616 0.729559 0.696684 319.571 0.826095 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Position in the facet coordinate system (u,v define facet plane)



Related to normalization (not really photons/s)

Normalization

- Each facet contains 100k photons
- In order to get a meaningful photon flux (for a 2.5 mA electron beam of E = 10 GeV)
 we weigh each photon by:

$$f_i = F\left[\frac{w_i}{\sum_i w_i}\right]$$

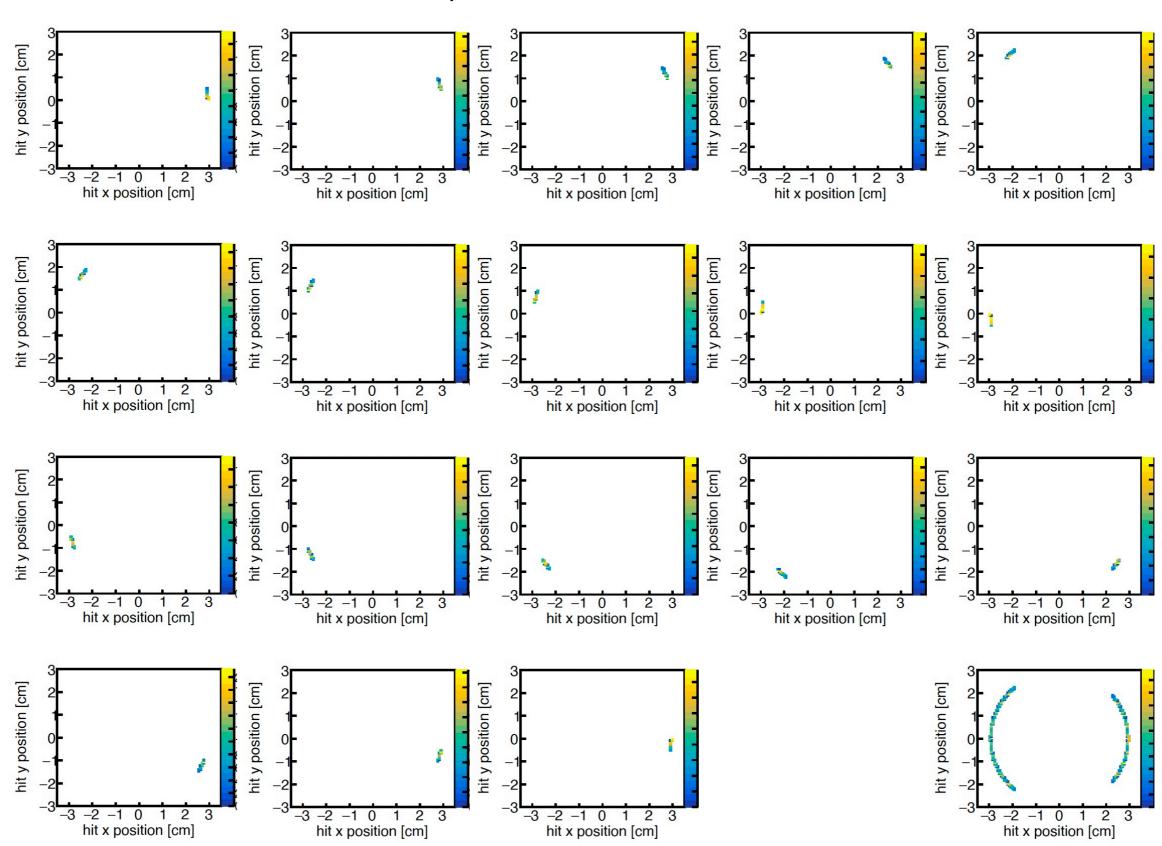
where w_i is a weight included in each facet file, $\sum_i w_i$ is the sum of the weights in a

given facet file, and ${\cal F}$ is a flux factor provided in the simulations. The resulting weight f_i should correspond to photons/s

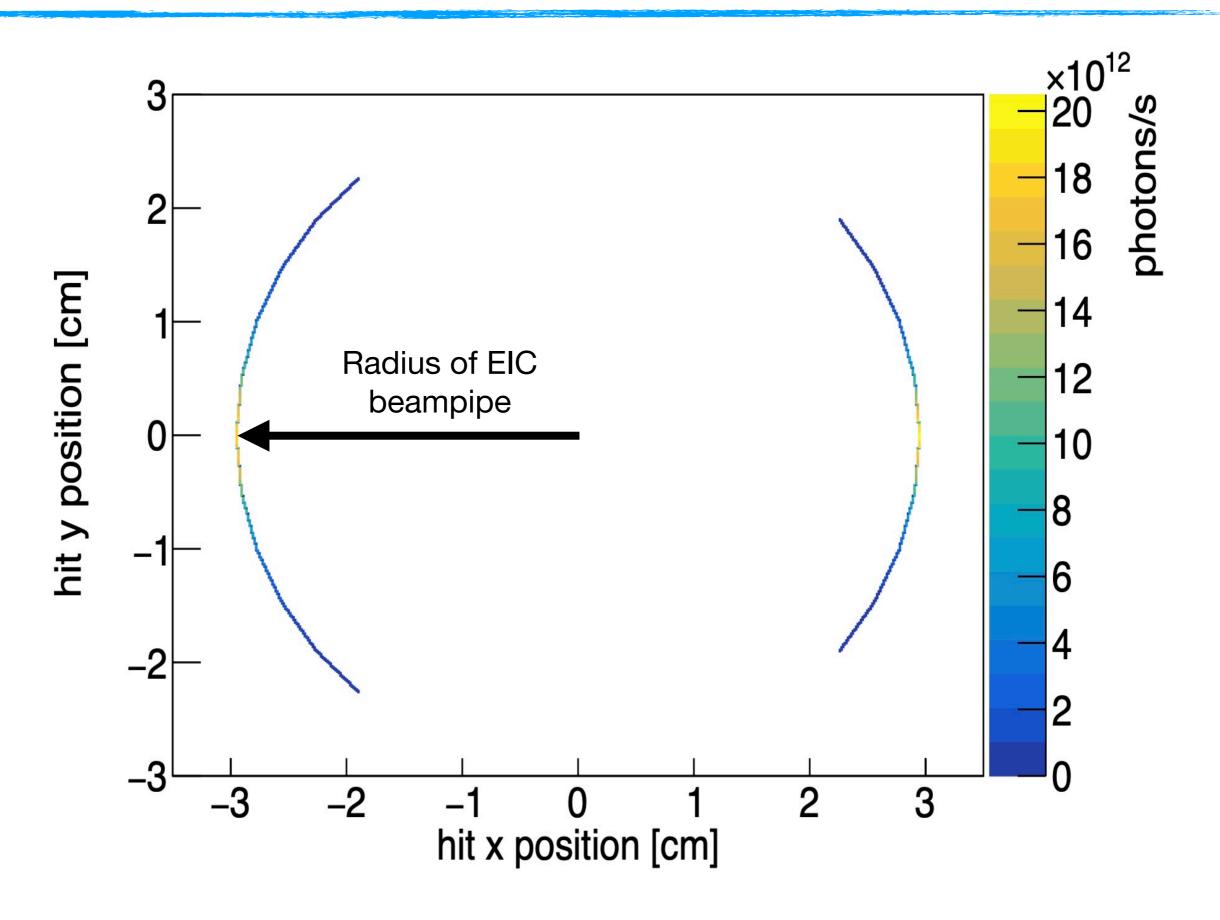
Facet geometry (x-y) plane

Each plot (except for the last one) corresponds to a csv file (i.e. a facet).

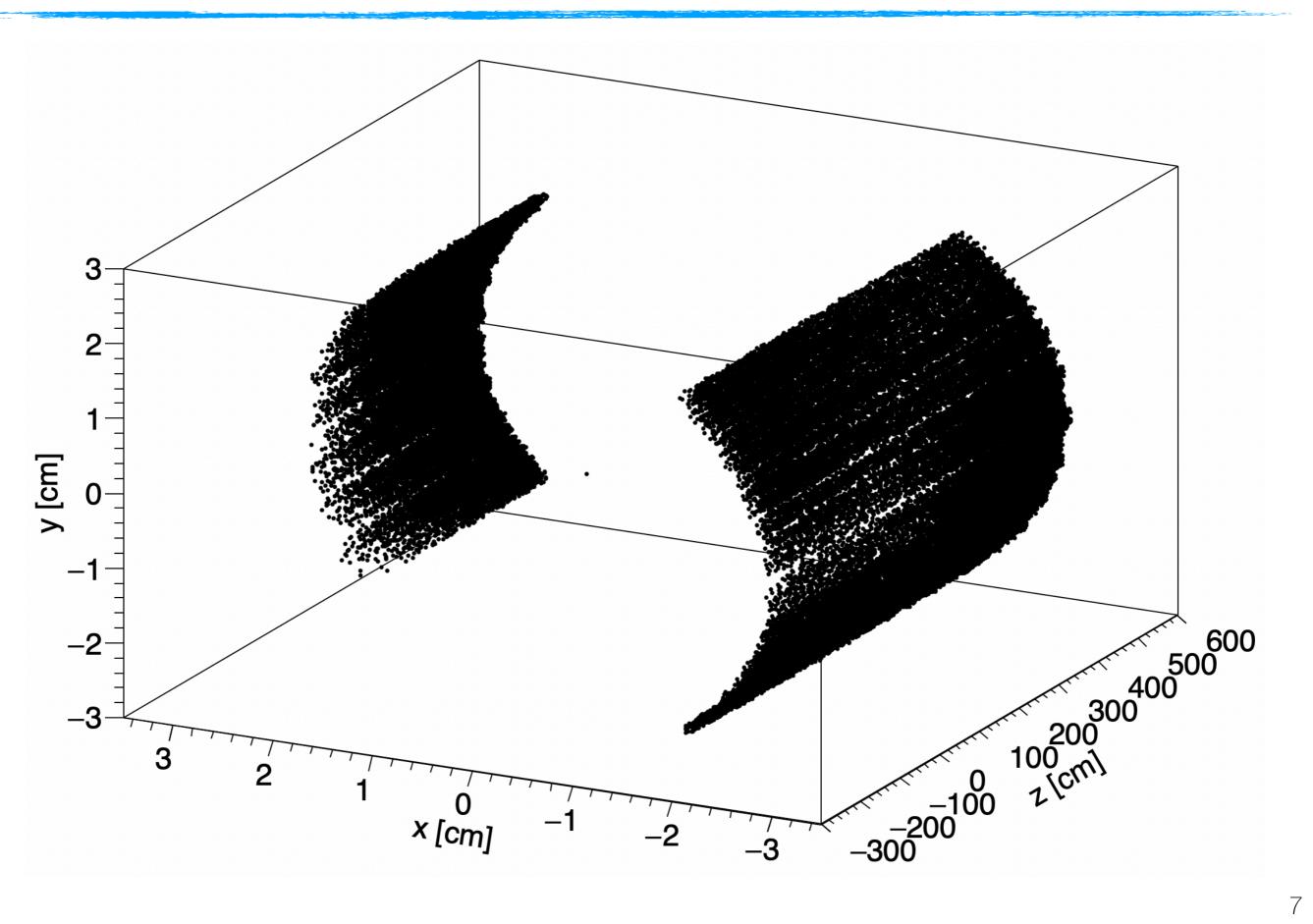
The last plot is the sum of all others



Facet geometry (x-y) plane

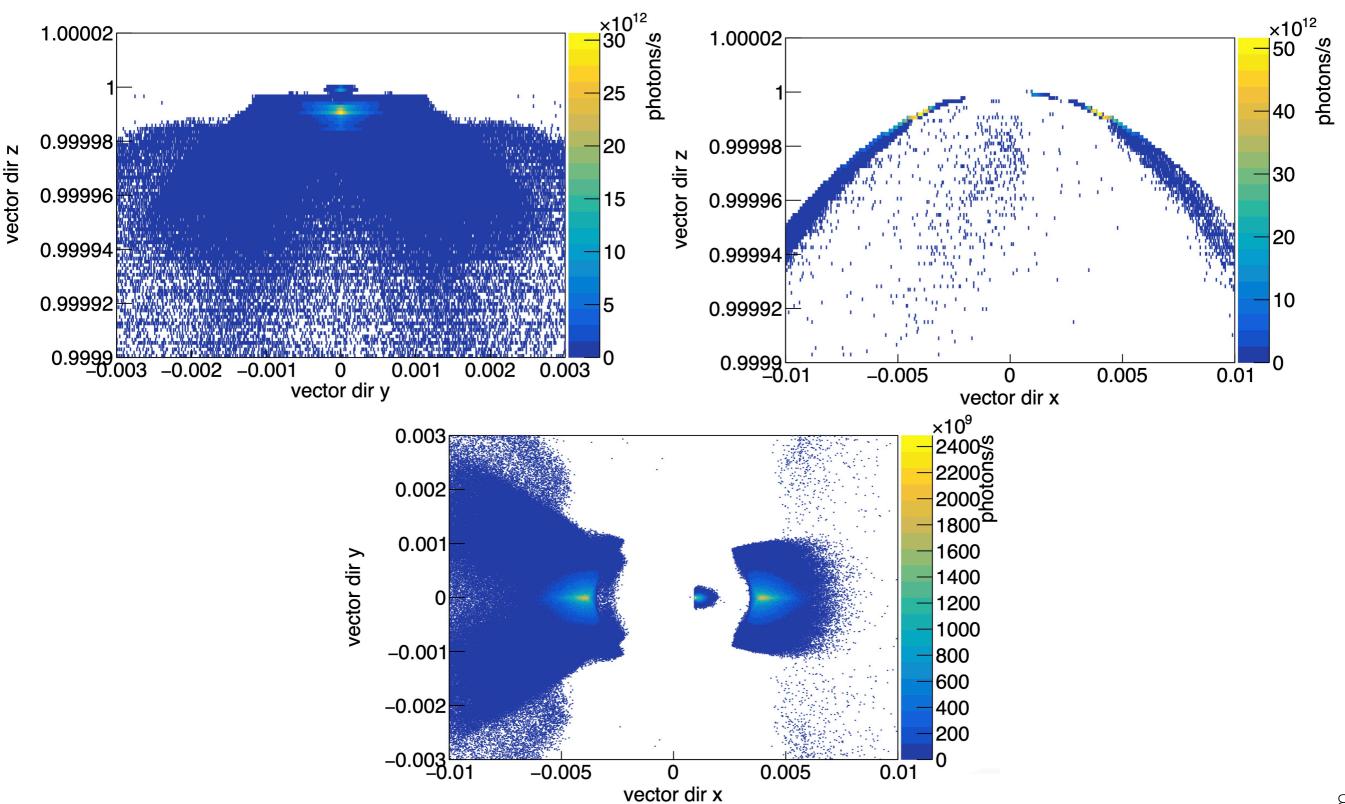


Registered hits

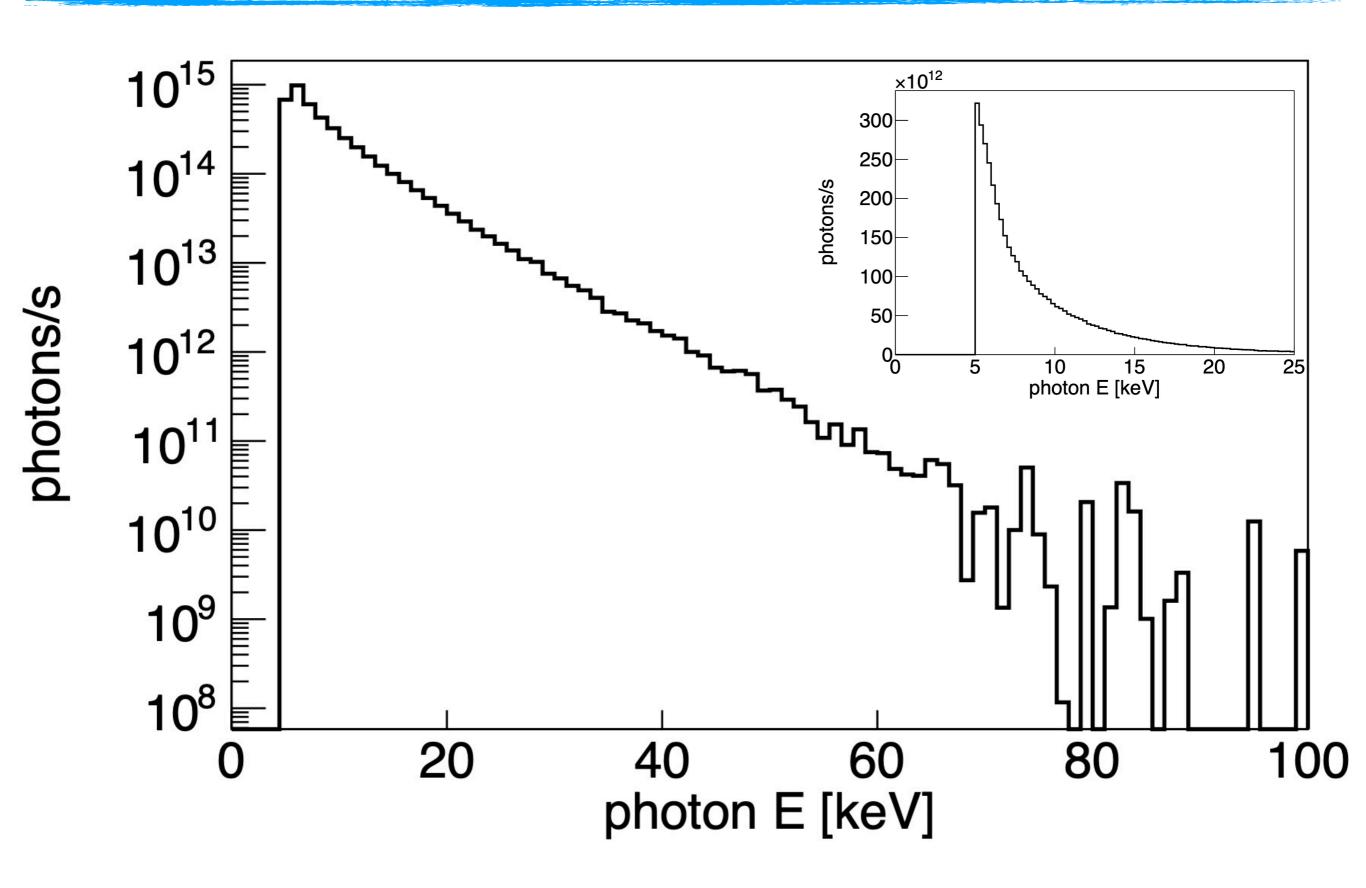


Photon direction

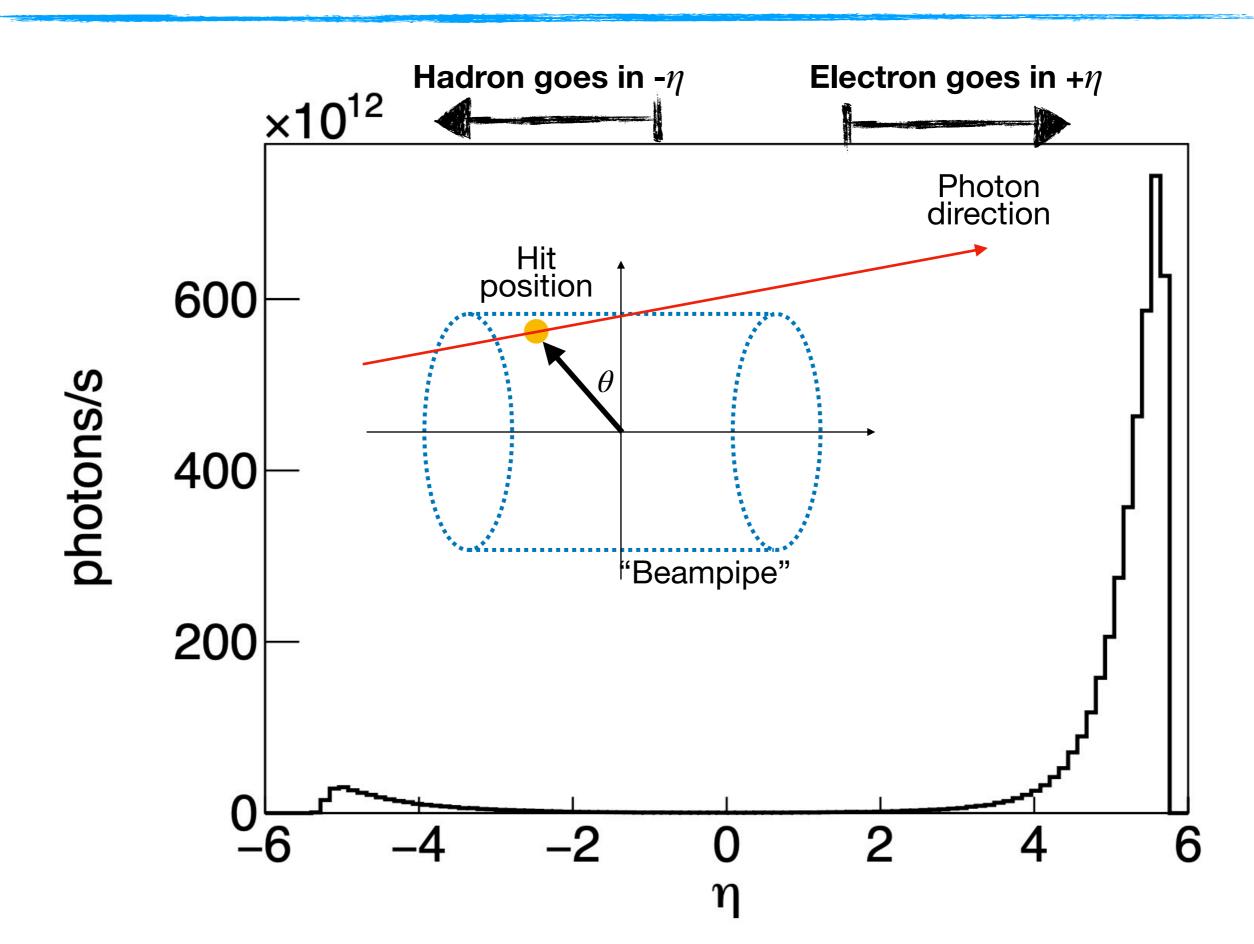
Photon direction in $+\hat{z} \rightarrow$ in EIC lab coordinate system electron moves towards $-\hat{z}$



Energy distribution



Hit eta distribution



Hit eta vs. phi distribution

