

Synchrotron Radiation EIC Files



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Synchrotron radiation background at ELC

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

Synrad+: MC simulation for synchrotron radiation

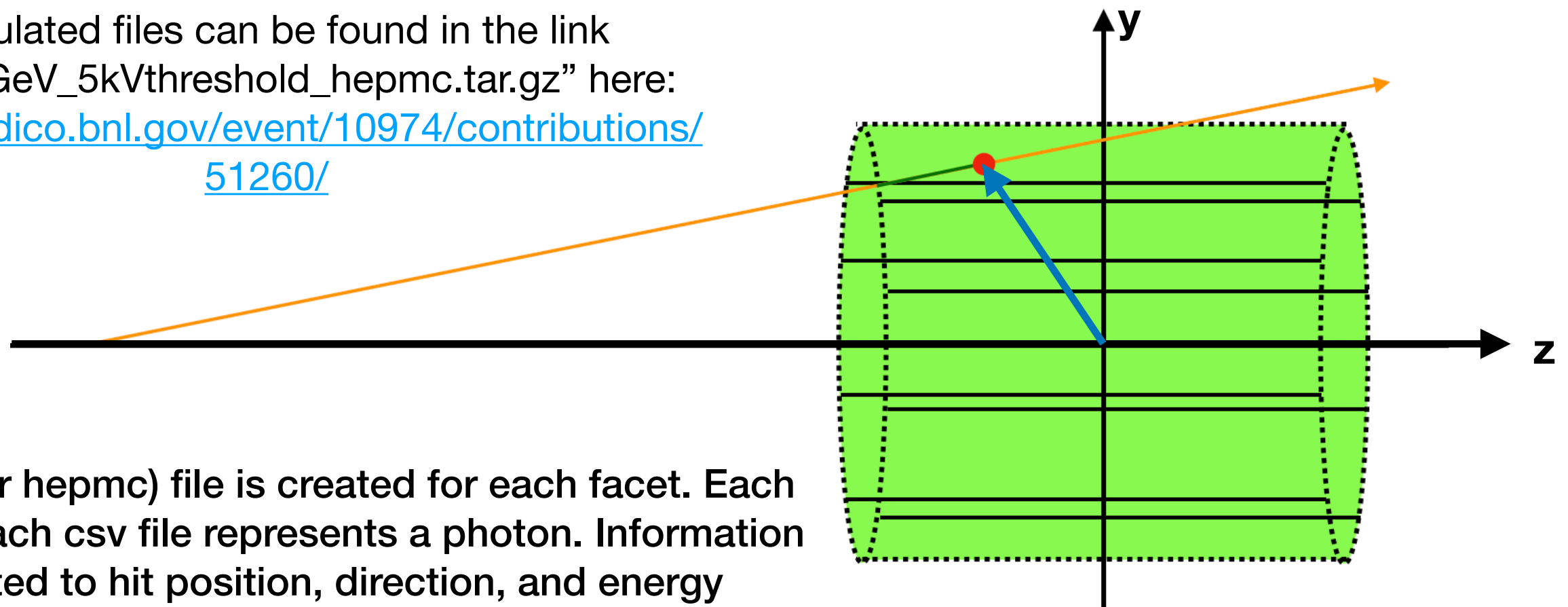
10-min intro to Synrad+ here: <https://molflow.web.cern.ch/sites/molflow.web.cern.ch/files/synrad%20quick%20start.pdf>

- “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.

Simulated files can be found in the link

“SR.10GeV_5kVthreshold_hepmc.tar.gz” here:

<https://indico.bnl.gov/event/10974/contributions/51260/>



A csv (or hepmc) file is created for each facet. Each row in each csv file represents a photon. Information related to hit position, direction, and energy

Example (facet #25099)

Hit coordinates [cm]

Photon direction
(unit vector)

Photon energy
[ev]

Pos_X [cm]	Pos_Y [cm]	Pos_Z [cm]	Pos_u	Pos_v	Dir_X	Dir_Y	Dir_Z	Dir_theta [rad]	Dir_phi [rad]	LowFluxRatio	Energy [eV]	Flux [photon/s]	Power [W]
2.8033	0.892506	402.124	0.936165	0.765545	0.00347649	0.000413811	0.999994	1.57426	-0.000500074	1	5091.4	2.37436E+07	1.93685E-08
2.82081	0.827151	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
2.89073	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
2.80809	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
2.85577	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
2.8593	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
2.89506	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
2.83897	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
2.80707	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
2.80444	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
2.86102	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
2.82212	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
2.89049	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
2.83527	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
2.90263	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
2.83571	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
2.85441	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
2.86362	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
2.83814	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
2.86265	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
2.89809	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

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:

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

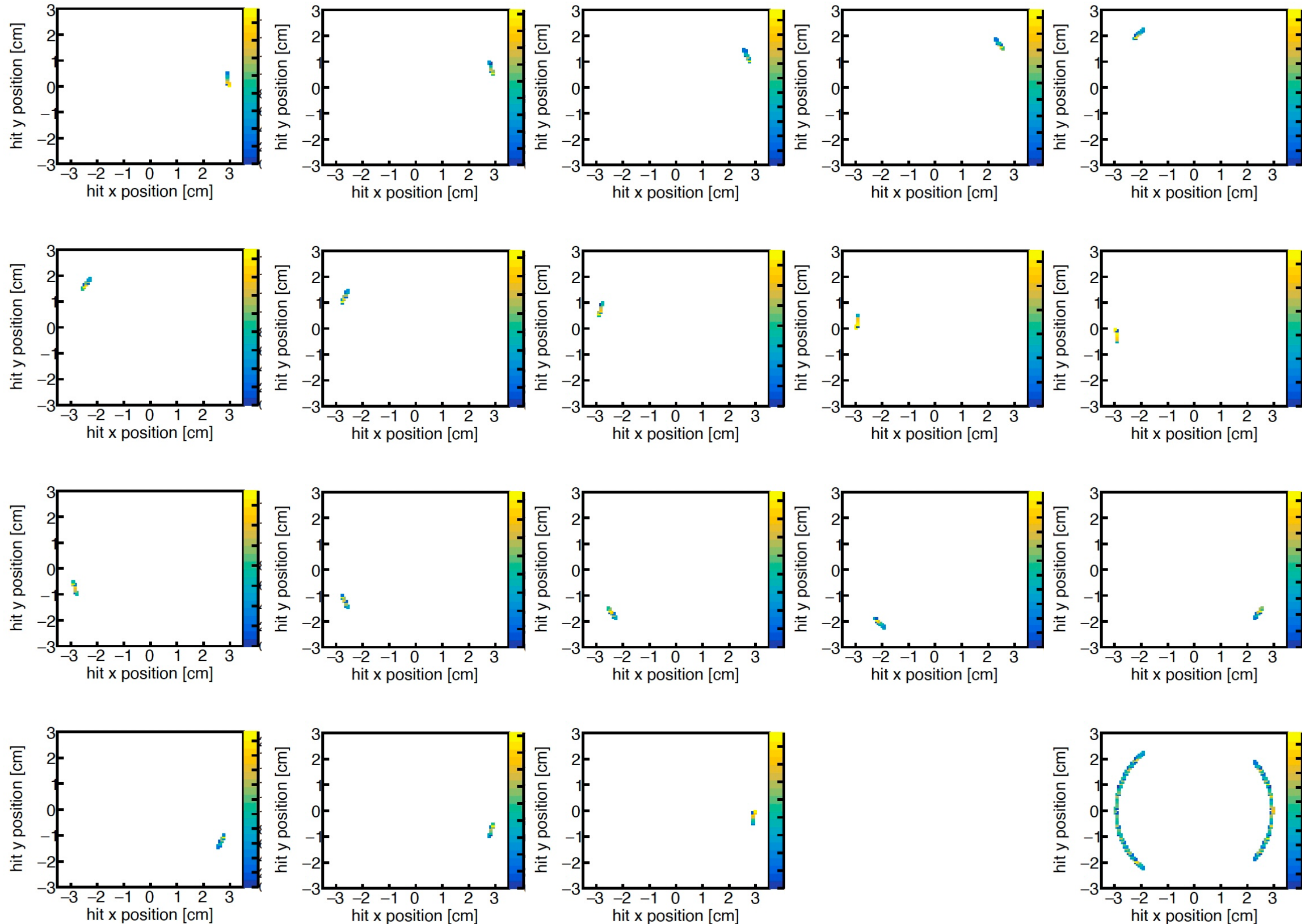
where w_i is a weight included in each facet file, $\sum_i w_i$ is the sum of the weights in a

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

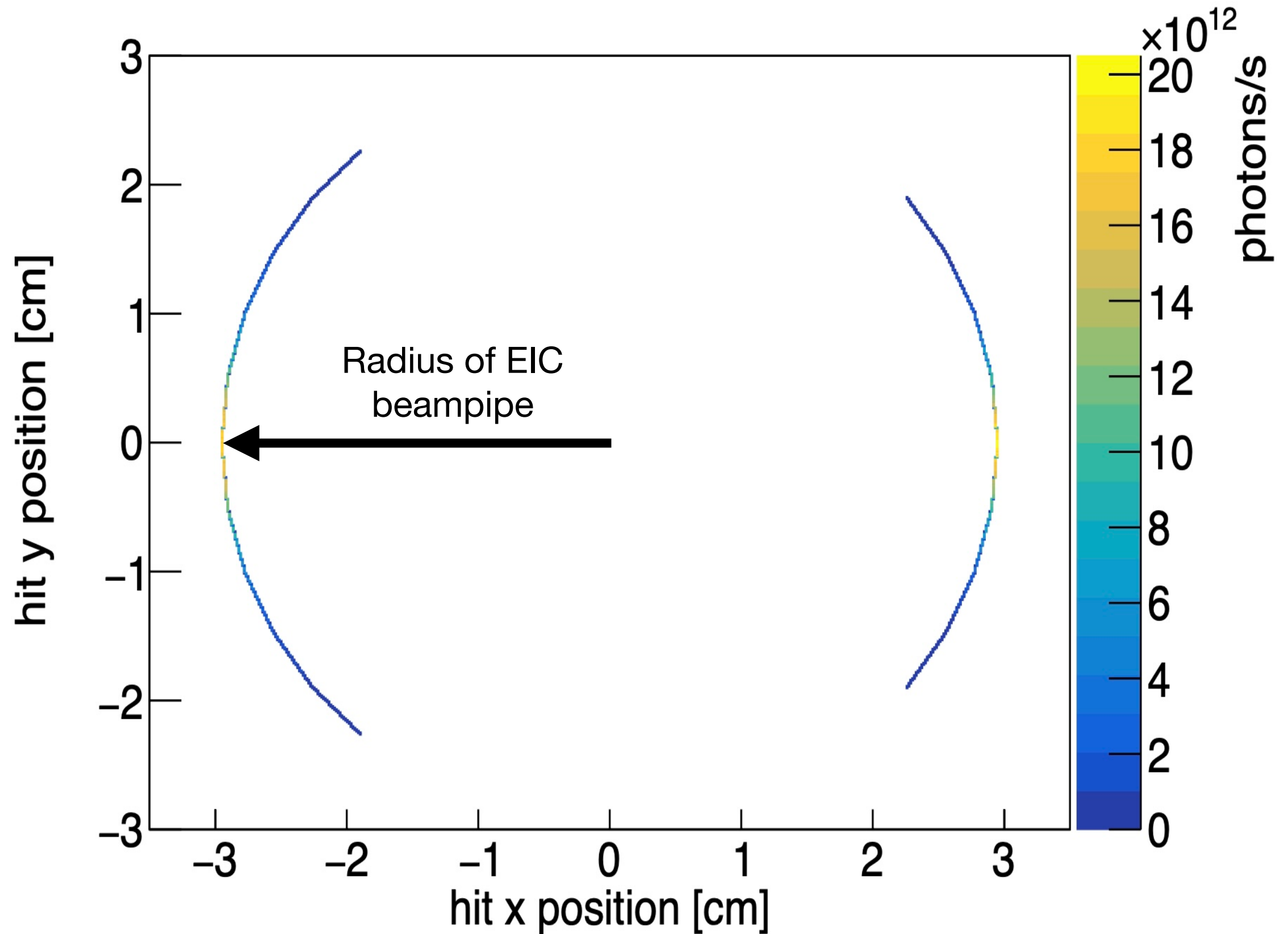
Facet geometry (x-y) plane

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

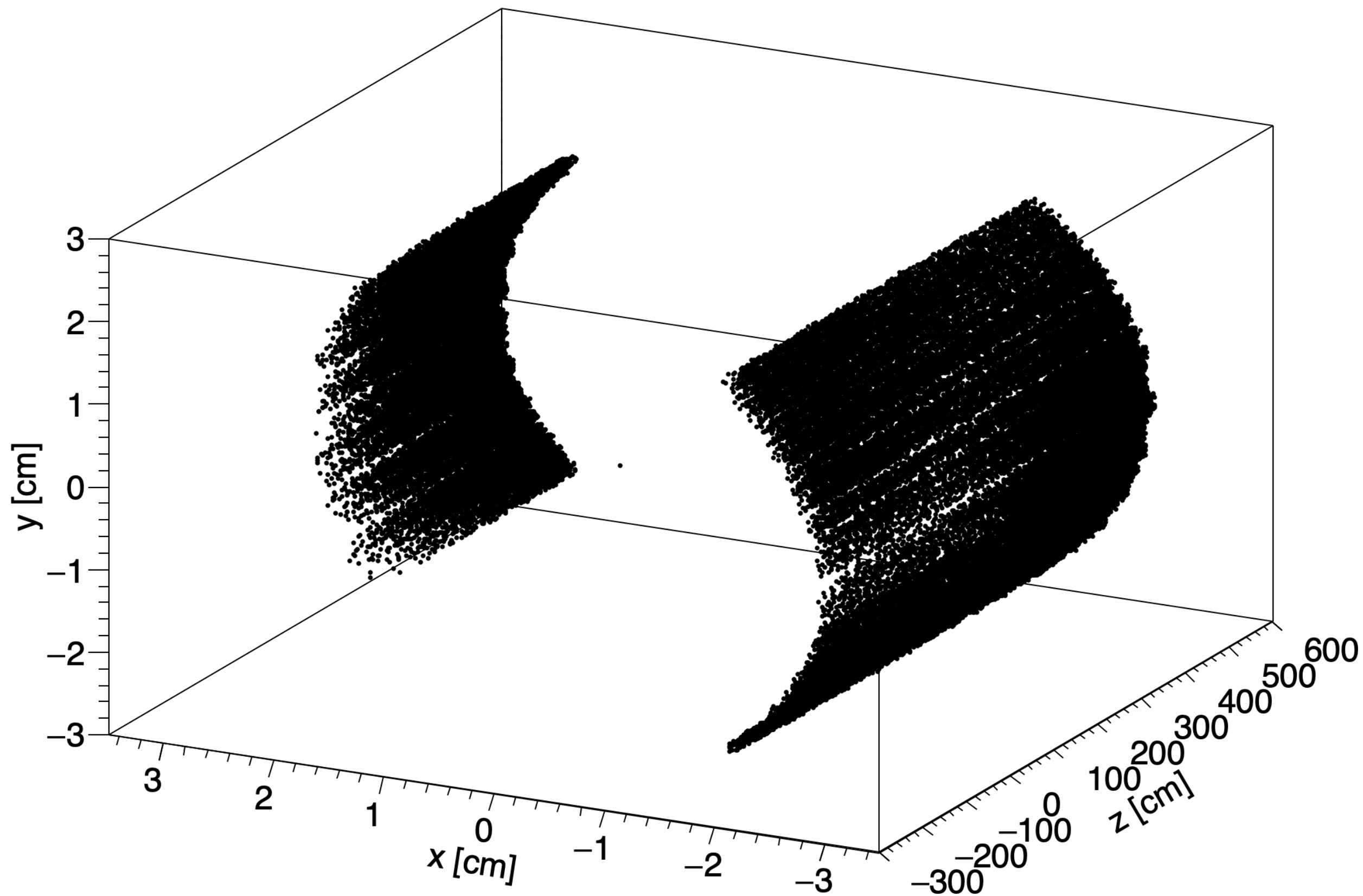
The last plot is the sum of all others



Facet geometry (x-y) plane

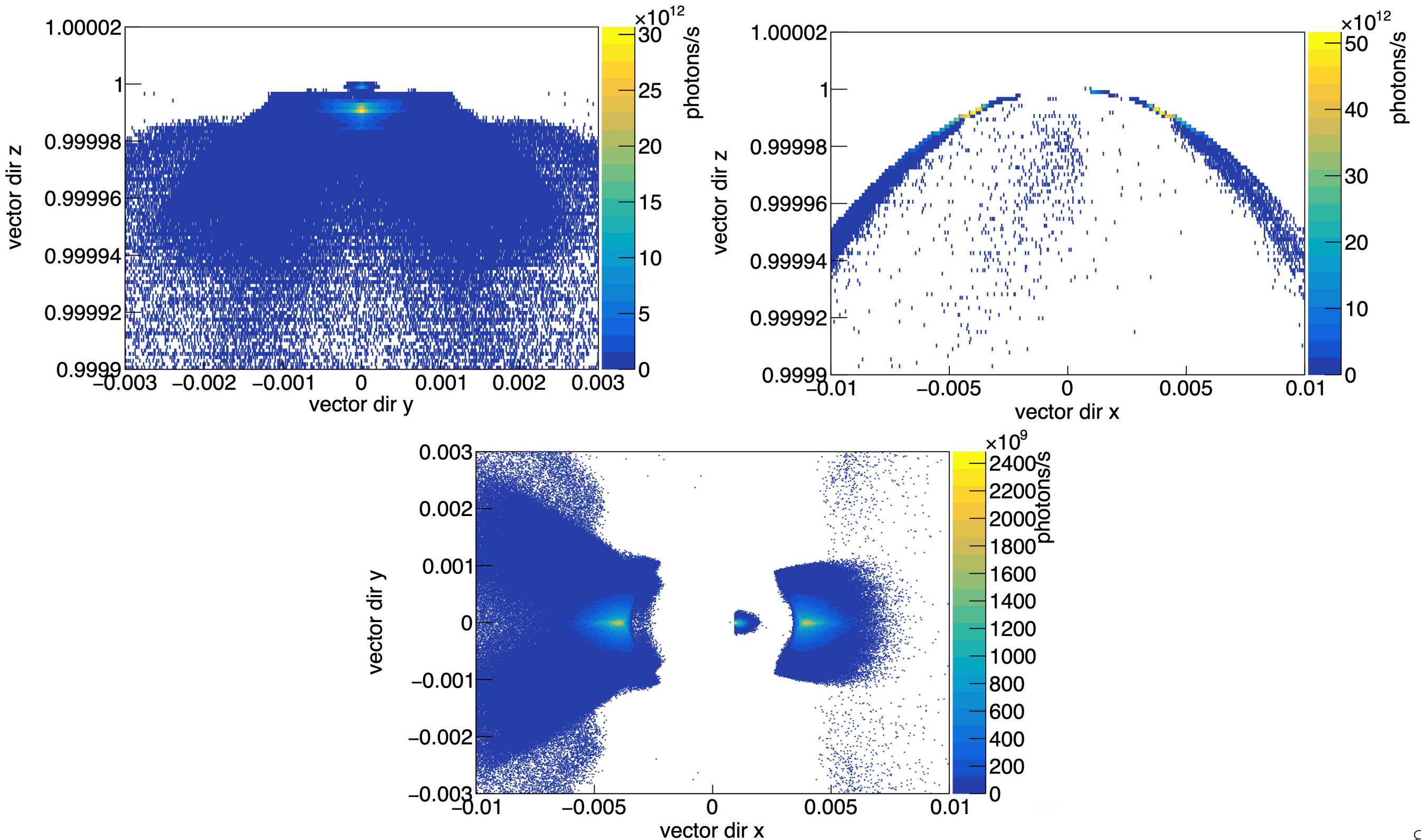


Registered hits

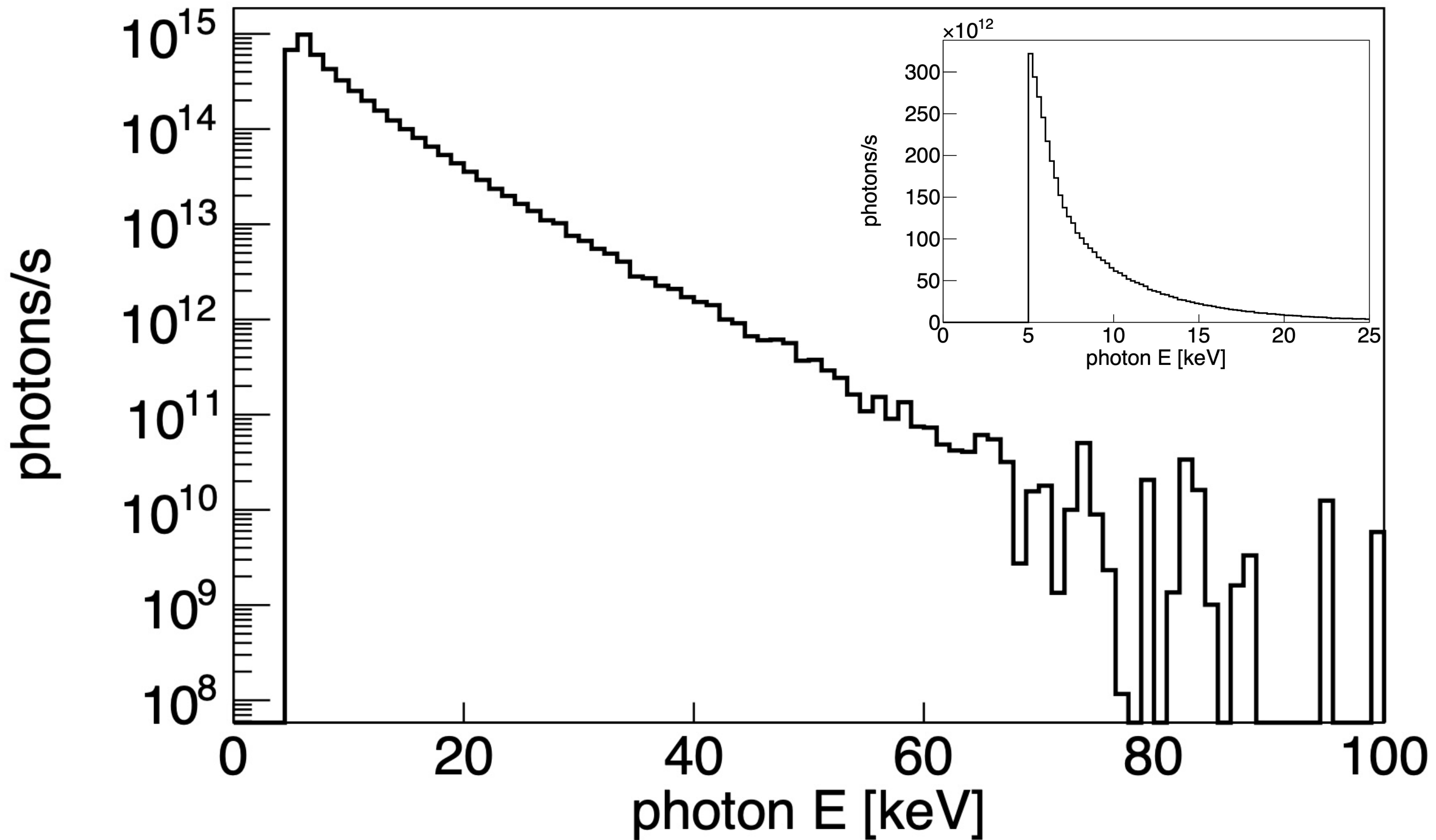


Photon direction

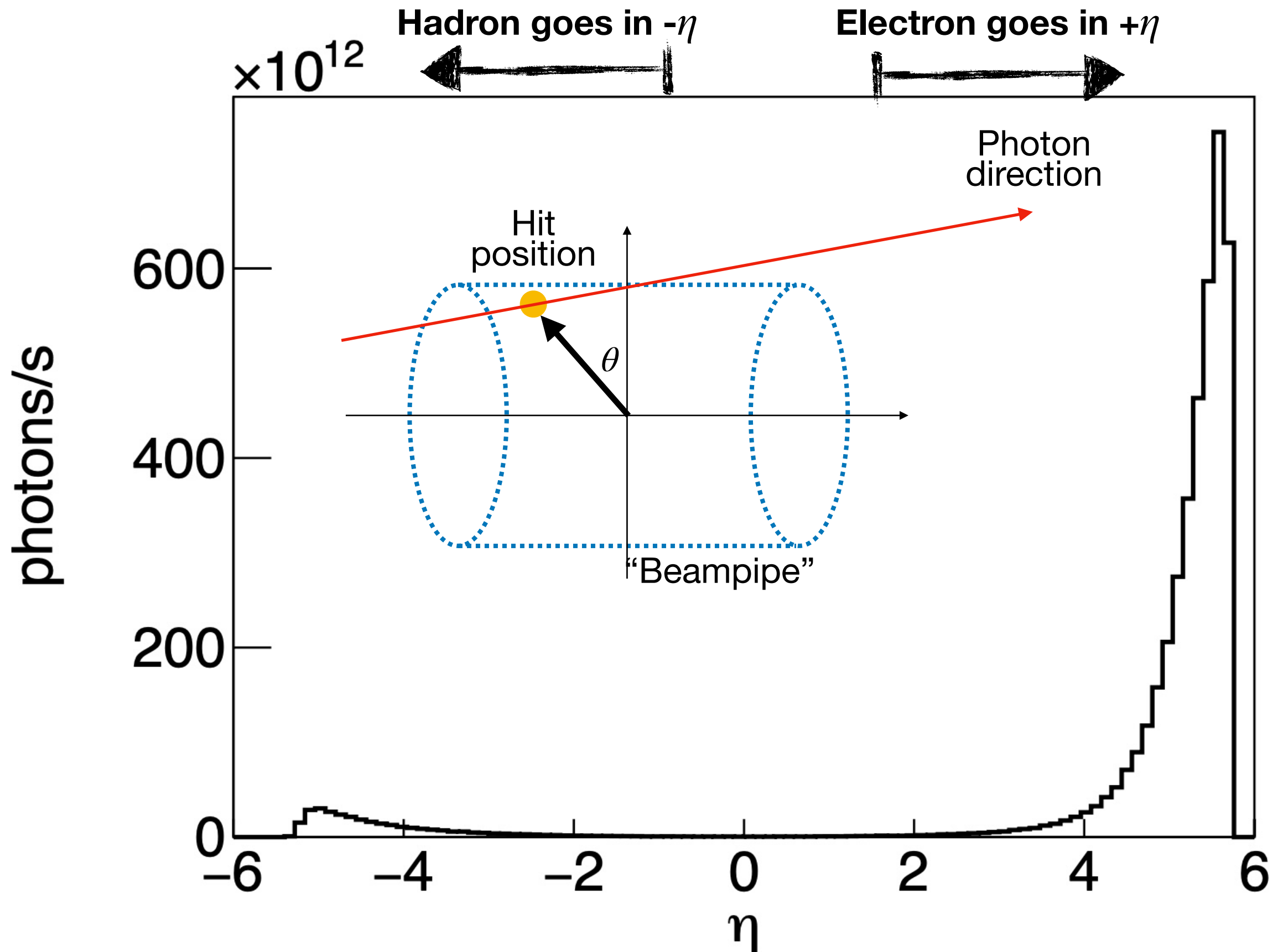
Photon direction in $+\hat{z}$ $\rightarrow$ in EIC lab coordinate system electron moves towards $-\hat{z}$



Energy distribution



Hit eta distribution



Hit eta vs. phi distribution

