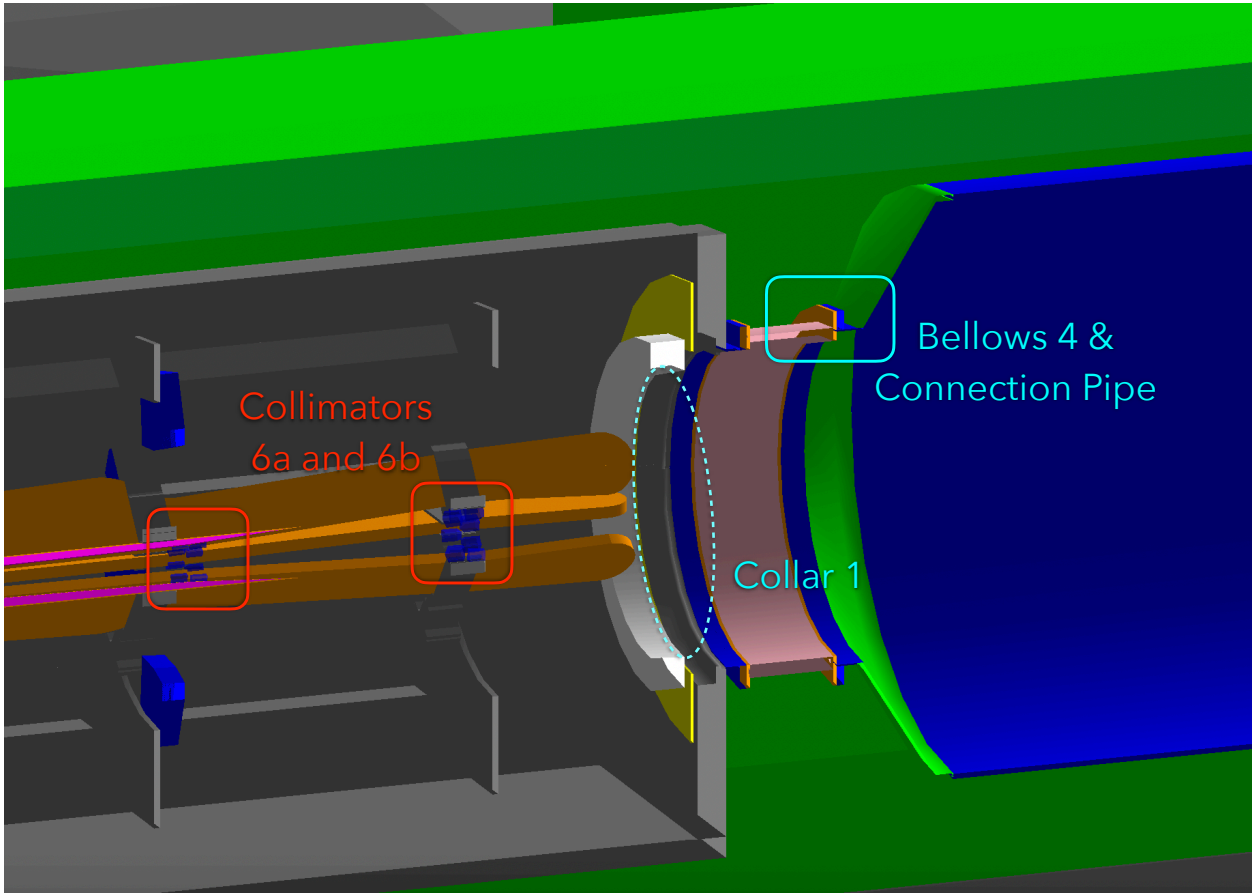
Beamline backgrounds

Ryan, Prakash, Andrew, Sayak, Sakib, Kent…

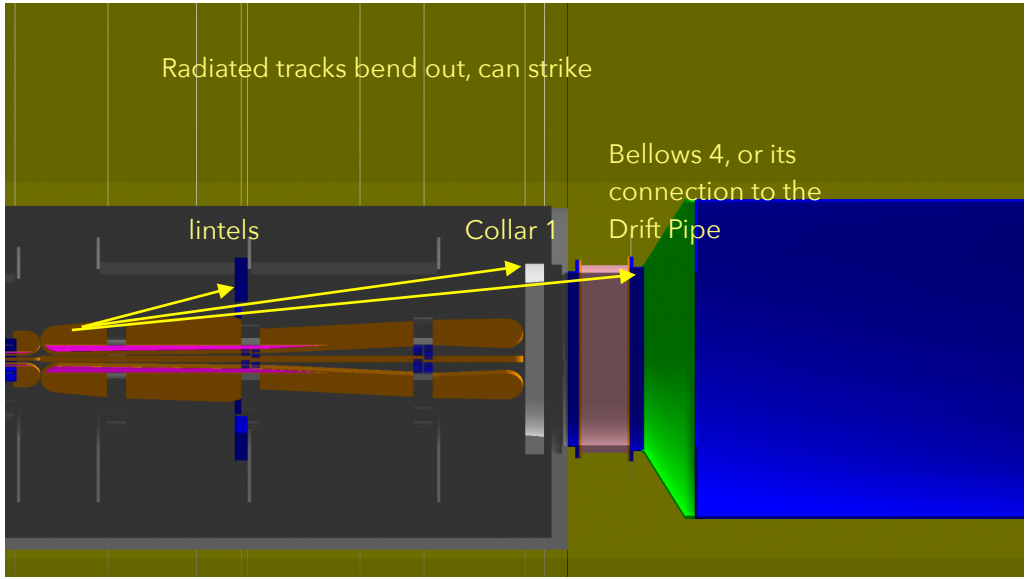
Backgrounds



Unexpected rescattering backgrounds were observed from two regions:

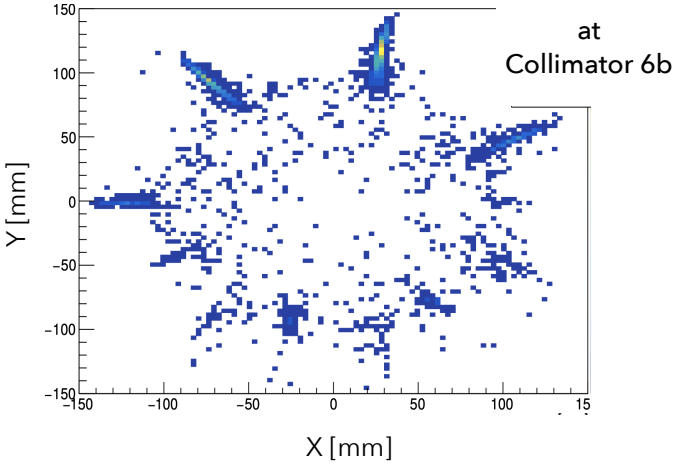
- Bellows 4 and its connection to the drift pipe, and Collar 1
- from Collimators 6a and 6b

Charged Beamline Backgrounds



Ryan Richards

Tracks passing collimator location, go on to hit ring 5



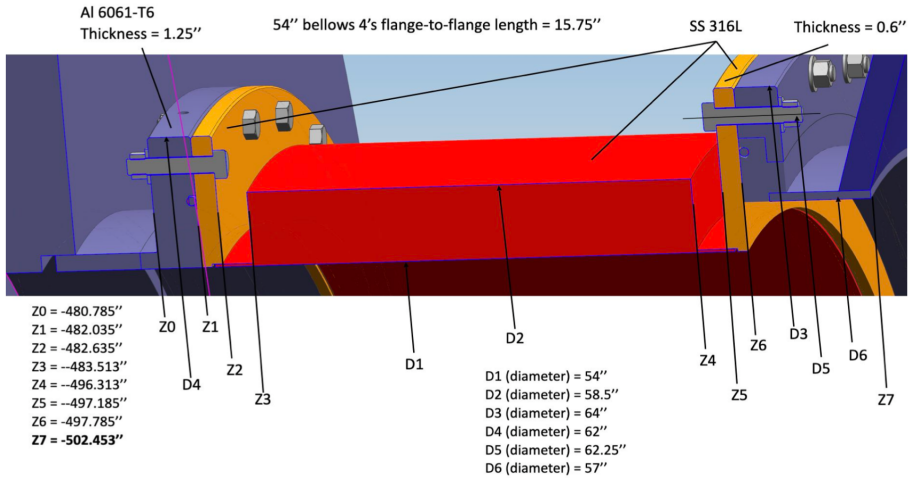
Prakash Gautam

Initial check

Beam generator, develop sim

100M beam generator events, develop branch.

- Fields: Upstream torus V2U.1a.50cm.parallel.txt,
  Downstream torus V2DSg.9.75cm.parallel.txt
- Collar 1 IR = 623mm. (used "widened" connection pipe with asymmetric flange).

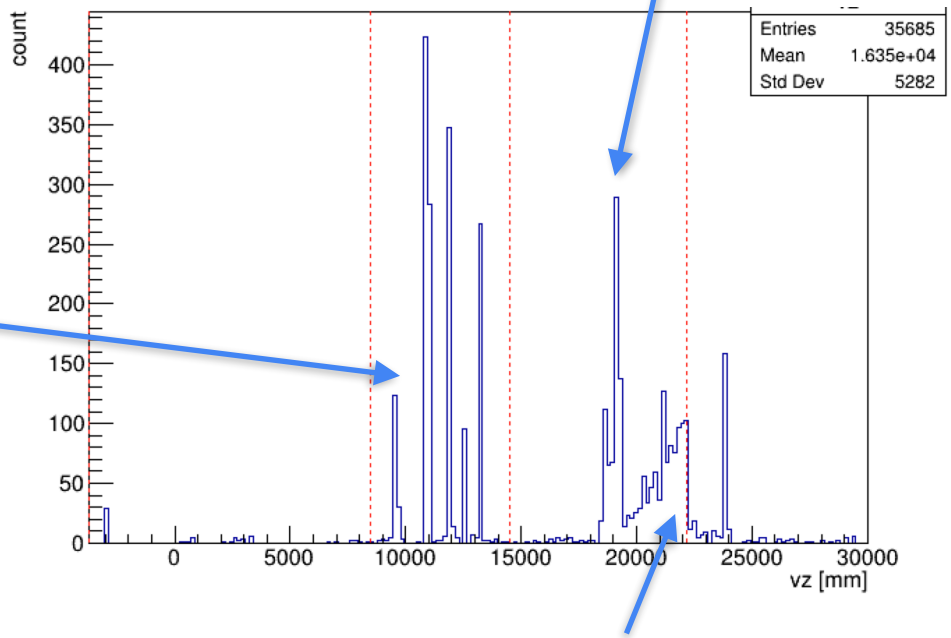


Bellows flanges are asymmetric. Larger flange (larger gasket, larger IR) for the downstream side.

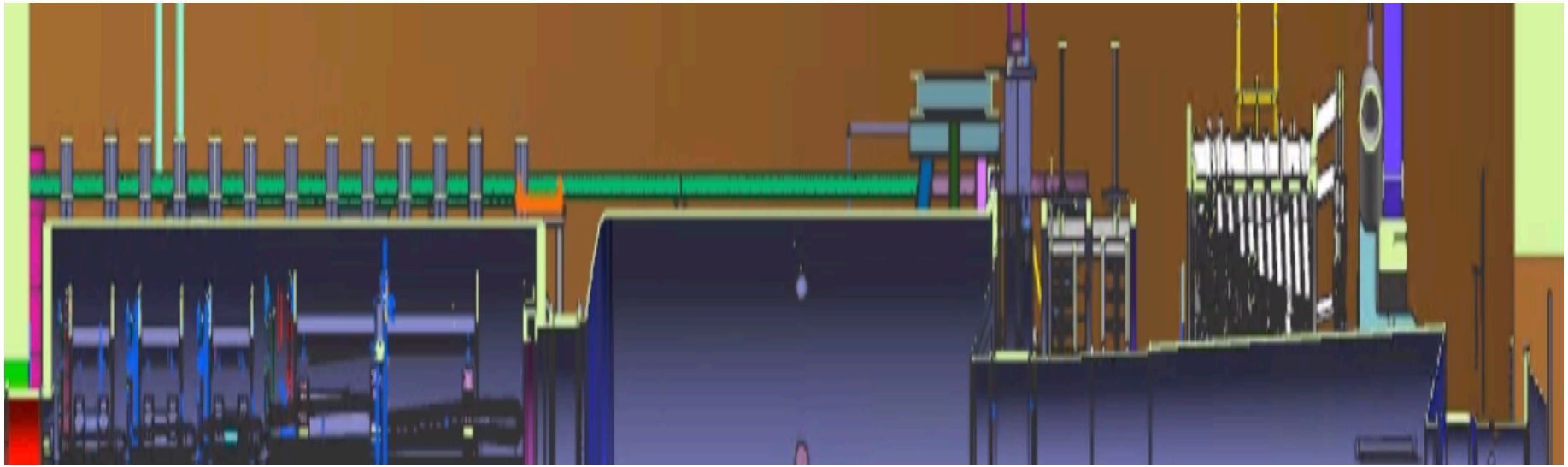
Vertex distribution of R5 e+/- rates

Range	Number / 100M eot	R5 fraction
Target [< -3.7m]	31939	89.5%
Early spectrometer [-3.7m,8.5m]	62	0.2%
Mid-spectrometer [8.5m,14.5m]	1636	4.6%
Spectrometer end [14.5m,22.2m]	1716	4.8%
Post-detector [22.2m,35m]	315	0.9%
Dump [>35m]	17	0.0%

collar 2, detector window still to be studied

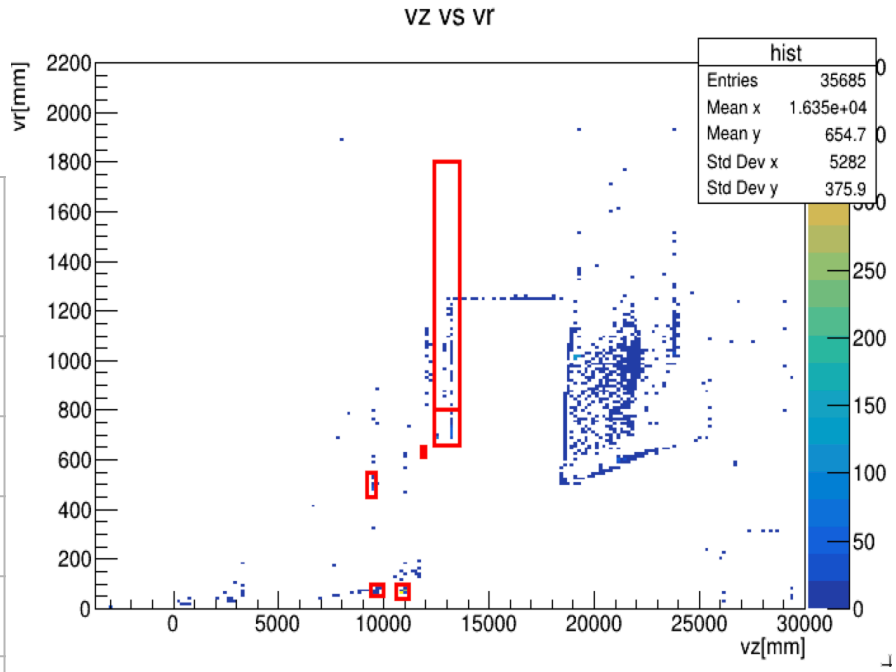


mostly irreducible and harmless rescattering at detector



Mid-spectrometer R5 e+/- sources

Component	Vz range	Vr range	Counts / 100M eot	Fraction of target rate
Lintel IR	[9200,9600]	[450,550]	82	0.25%
Collimator 6a	[9400,10000]	[50,100]	54	0.16%
Collimator 6b	[10600,11200]	[40,100]	694	2.2%
Collar 1	[11800,12000]	[610,650]	348	1.1%
Connection pipe	[12400,13600]	[610,800]	329	1.0%
Vacuum box	[12400,13600]	[800,1800]	47	0.15%



Mid-spectrometer charged backgrounds

~5% of the charged background comes out of the mid-spectrometer region

Reduce scattering from:

1. Collar 1 and vacuum pipe connection (Ryan Richards)
2. Collimators 6a and 6b (Prakash Gautam)

Fix these sources, but keep to the original purpose:

1. Do not damage the Moller acceptance or deconvolution
2. Do not allow backgrounds from the target region

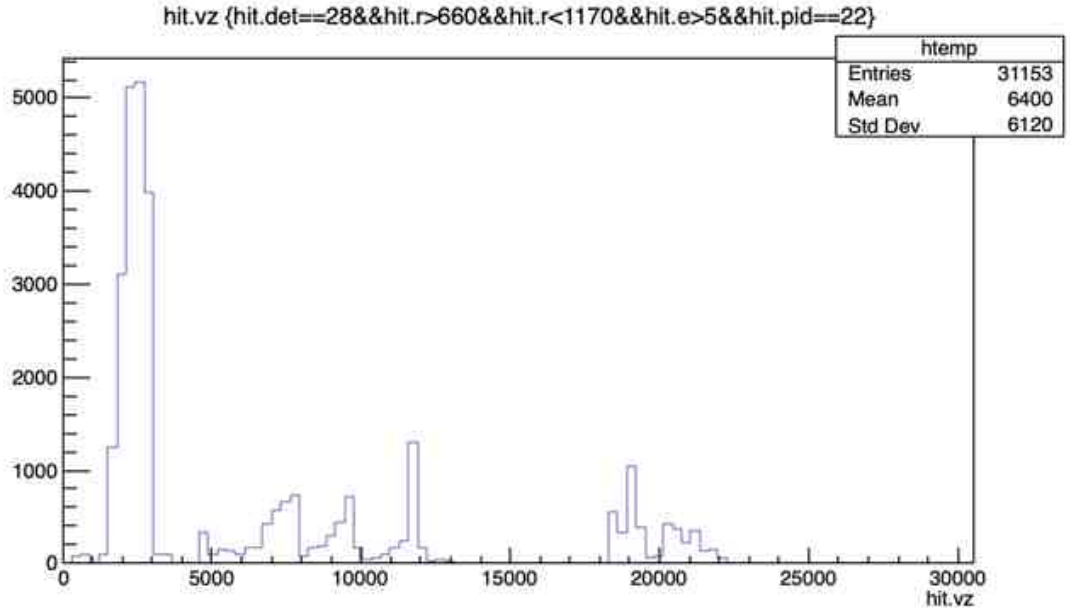
While fixing these sources, don't let backgrounds propagate to other regions (i.e. vacuum box or detector pipie)

Photon backgrounds

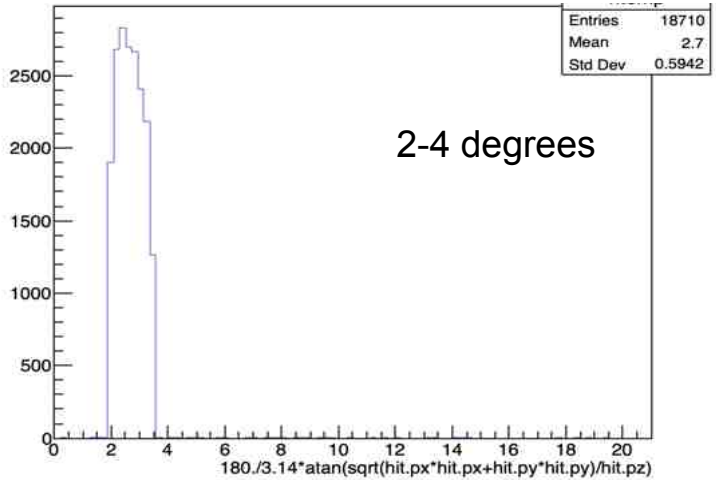
Significant source of photons from middle of UST

100M eot, blocked acceptance at Collimator 2.
Photons >5MeV z=[2000,3000]~50% of expected Moller signal

Photons aren't such a bad background, conversion into light ~300x less than electrons



Photon background path to detectors

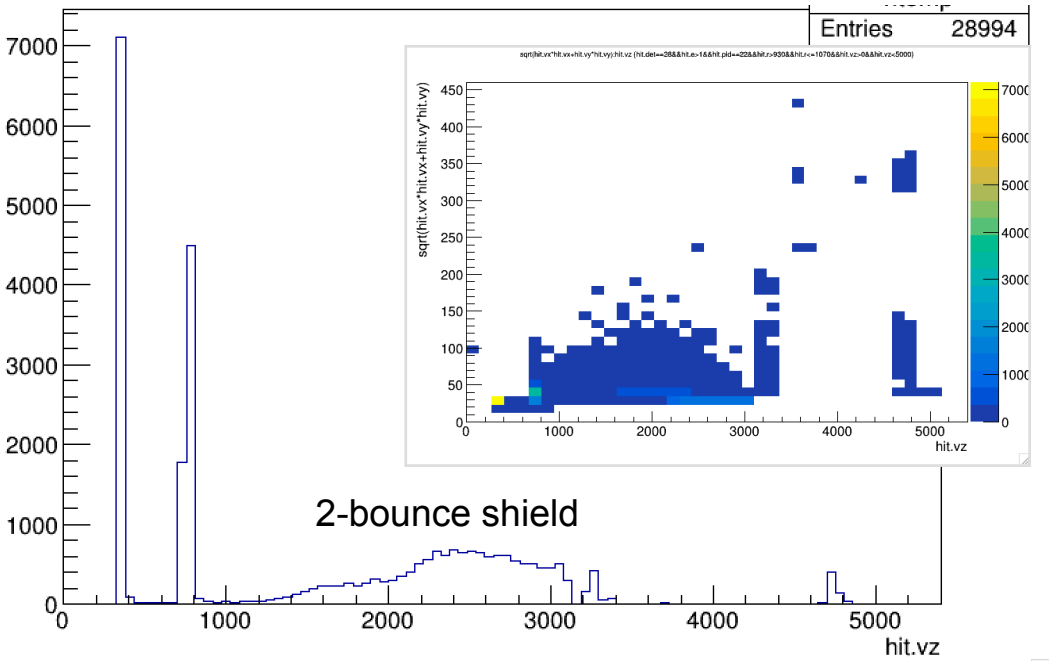


- Electromagnetic power strikes 2-bounce shield,
- photons cross beamline,
- pass through collimator 4 beam bore,
- into acceptance of photon blocker (sets minimum angle).
- Max angle is the cutoff at the detector

After the photon blocker, these are in the acceptance.
Only way to reduce them is narrowing collimator 4 beam bore

⟶ evaluated by Prakash

Additional photon backgrounds through acceptance channel



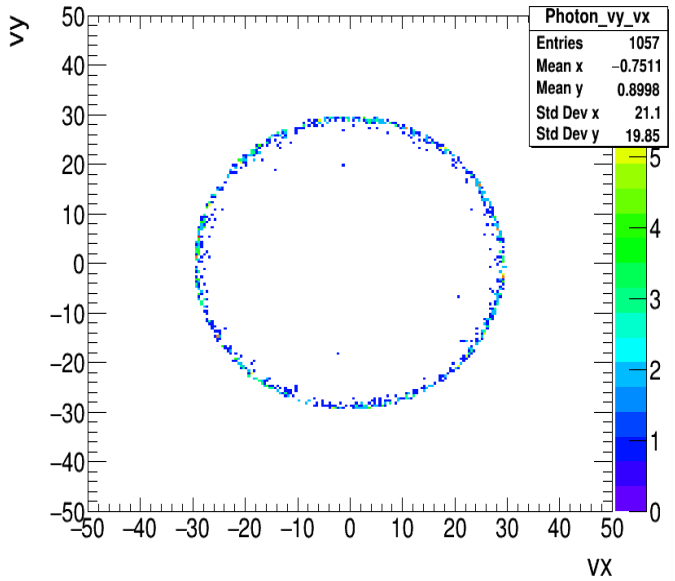
Simulation: beam, 100M events.

No kryptonite block at collimator 2

Additional peaks from front/end of collimator 1/2

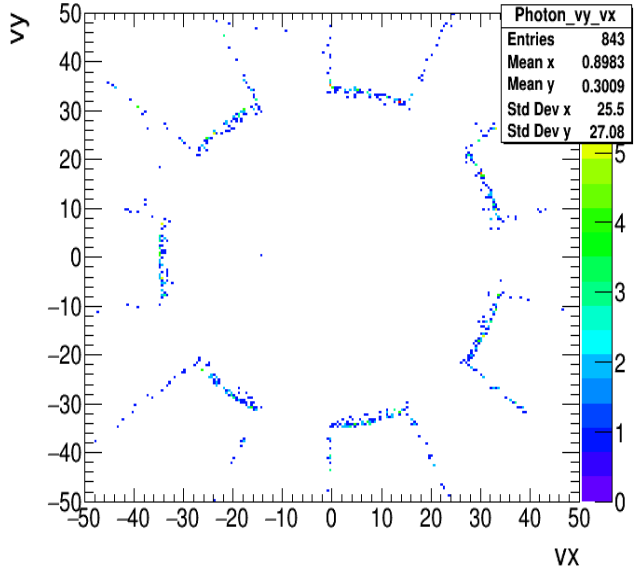
Ryan

Collimator 1 and 2 photon sources



Vz ~ 340

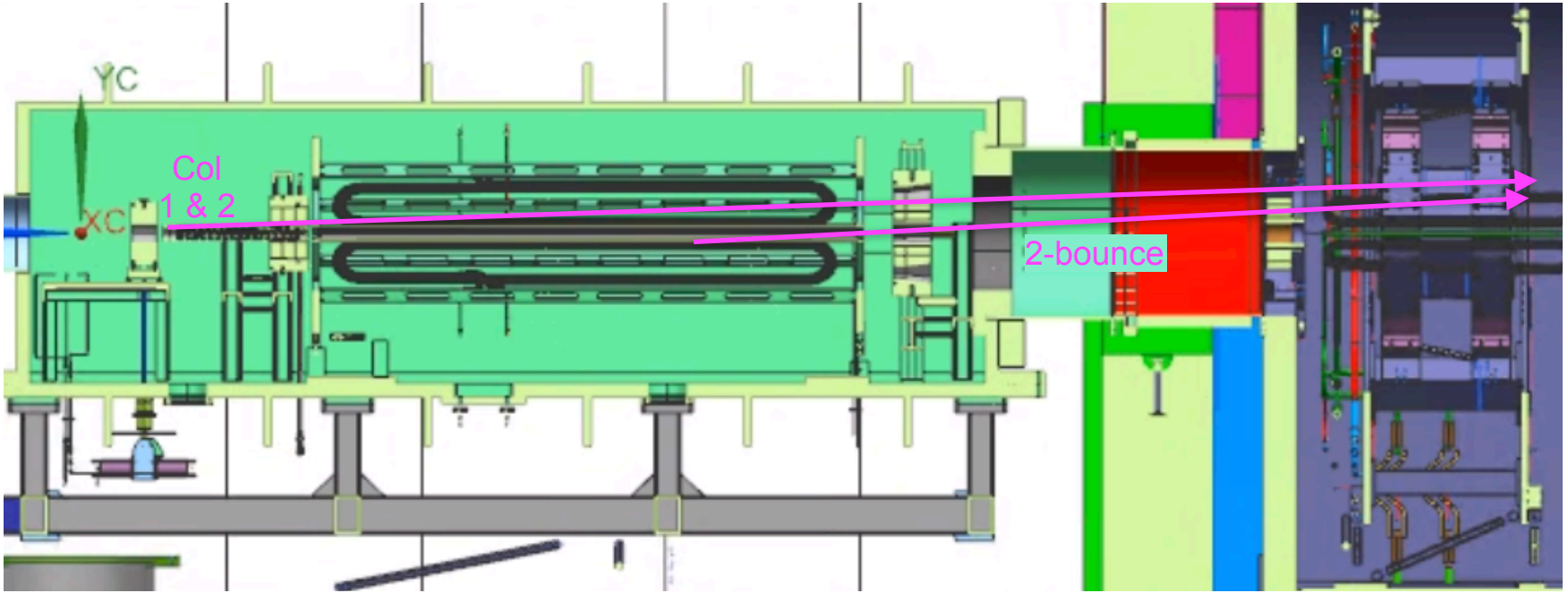
From Collimator 1 nose through acceptance (probably overestimated in remoll geometry)



Vz ~ 780

From Collimator 2 slit, through acceptance

Andrew Hurley


YC
XC
Col
1 & 2
2-bounce

What we've resolved:

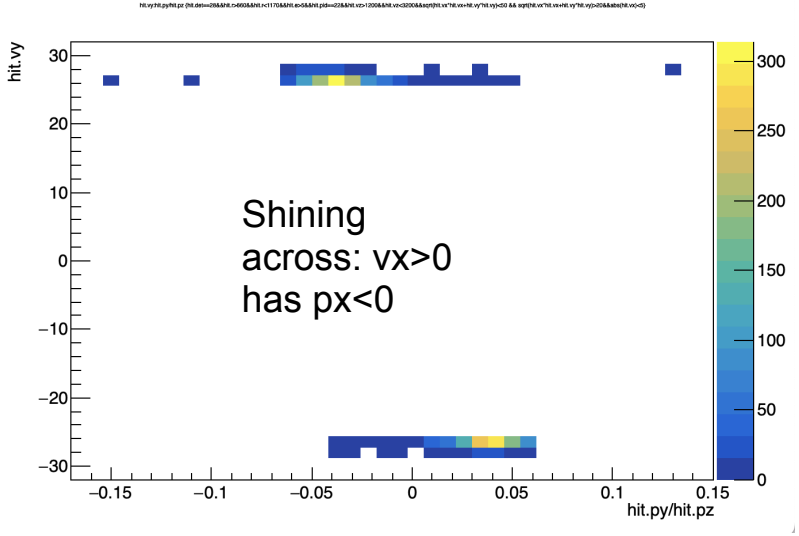
- Collar 1 / bellows 4 connection pipe: optimized
- Collimators 6a/6b to minimize beamline background (still needs final checks)
- 2-bounce source minimized as is possible

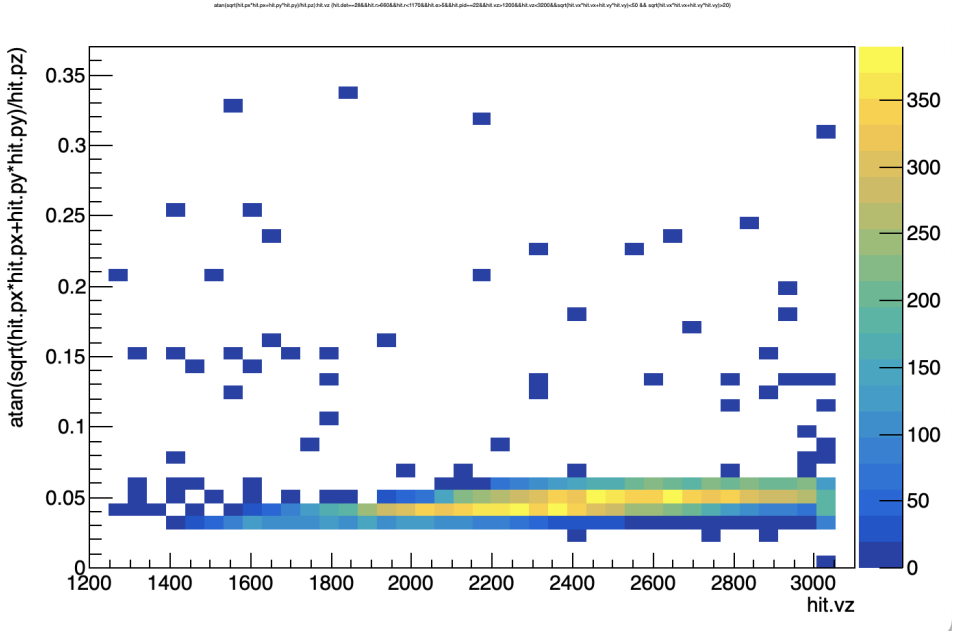
What is left for design tweaks:

- collar 2, detector window region

Backup

2-bounce photons Crossing the beamline

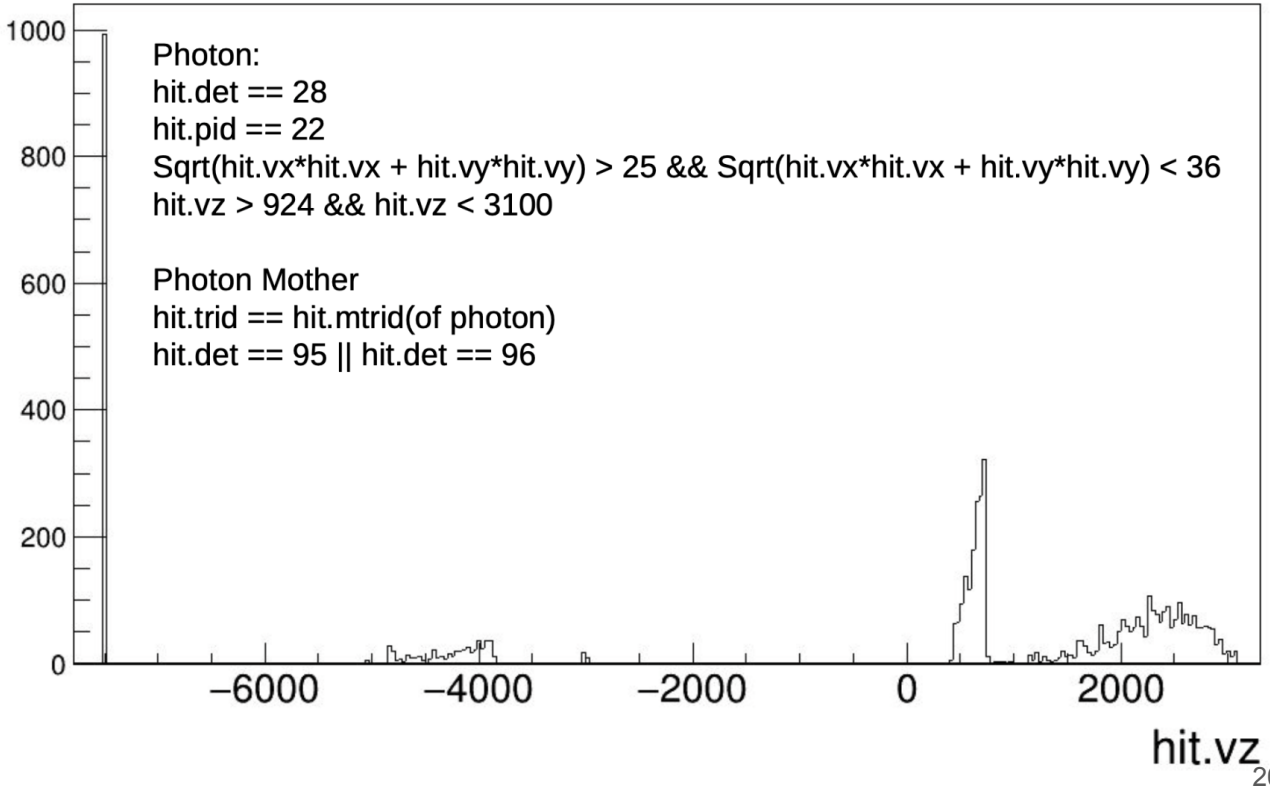




What created the 2-bounce shield photons

Similarly, this is the vz for the tracks that mothered the photons that hit the MD.

Some are from the target, some from collimator 1, some rattled off of the 2-bounce shield itself



Checking: Do we need the 2-bounce shield?