

Ferrous Materials:

Brass Tie Rods

US Torus Region

Eric King

Updated:

May 31st, 2023

Modeling

Tie Rods are modeled as G4 tubes extending from end to end.

Material is Brass

My original spreadsheet shown

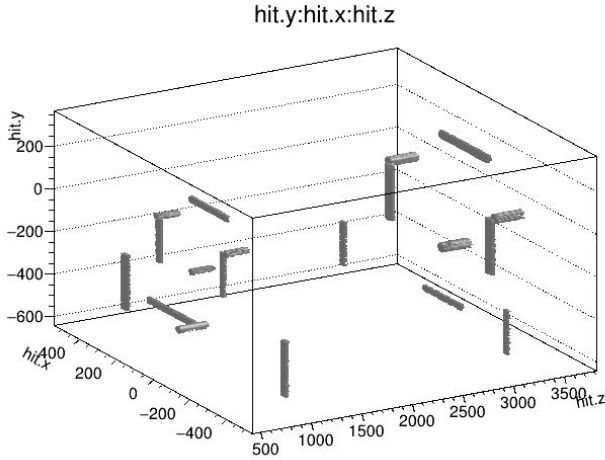
“Regions” in my table were just based on original filenames from Cip gave me.

In-plane and out-of-plane just let me know orientation.

I'll attach these at the end just for reference.

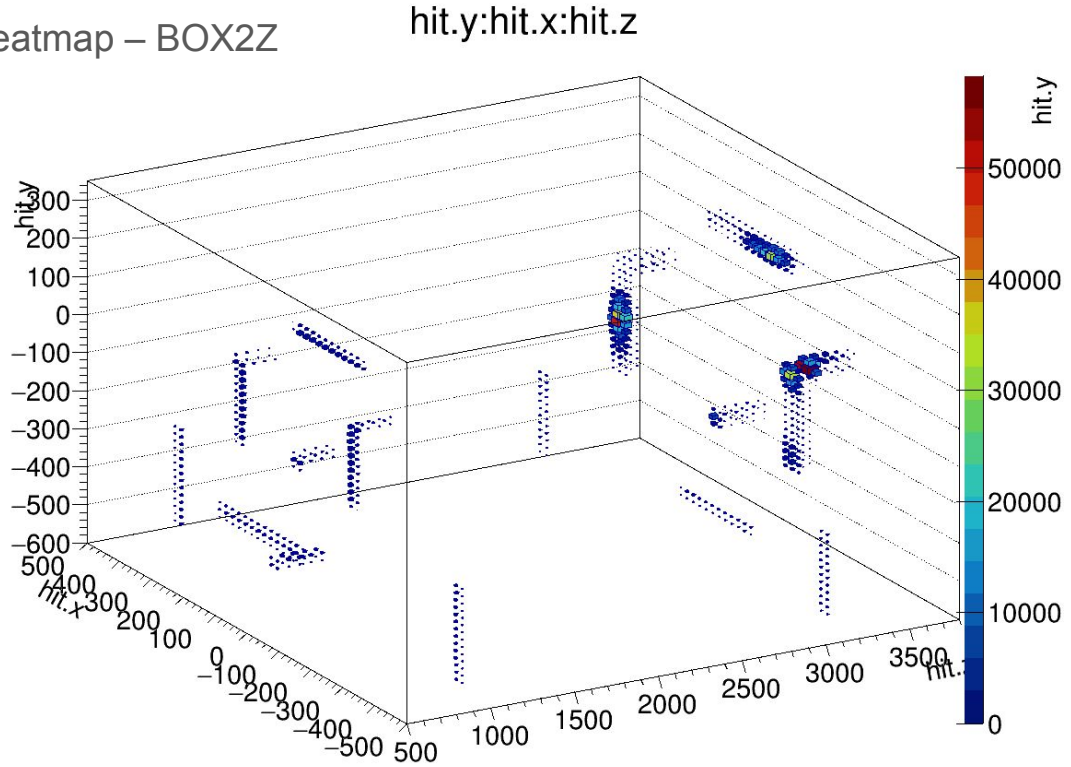
"REGION"	Dimensions (mm)		Position (mm)			Rotation (deg)		Position (inches)			Dimensions (in)		radius
	R	LZ	X	Y	Z	X	Y	X	Y	Z	R	LZ	r
P1	26	255	434	-434	944	90	0	17	-17	37	1	10	613
	26	255	-434	-434	944	90	0	-17	-17	37	1	10	613
	26	255	179	-459	944	0	90	7	-18	37	1	10	492
	26	255	0	-434	816	0	0	0	-17	32	1	10	434
P2_2	22	204	-102	173	803	0	90	-4	6.8	31.5	0.87	8	201
In plane	22	204	-173	-102	803	90	0	-6.8	-4	31.5	0.87	8	201
	22	204	173	-102	803	90	0	6.8	-4	31.5	0.87	8	201
P2_1	22	204	0	-173	905	0	0	0	-6.8	35.5	0.87	8	173
out plane	22	204	-189	0	905	0	0	-7.4	0	35.5	0.87	8	189
	22	204	189	0	905	0	0	7.4	0	35.5	0.87	8	189
P4	22	204	-444	-444	3111	90	0	-17.4	-17.4	122	0.87	8	627
	22	204	444	-444	3111	90	0	17.4	-17.4	122	0.87	8	627
	22	204	-102	-444	3111	0	90	-4	-17.4	122	0.87	8	455
P5	34	255	271	-135	3264	90	0	10.625	-5.3125	128	1.35	10	303
in plane	34	255	-271	-135	3264	90	0	-10.625	-5.3125	128	1.35	10	303
	34	255	-135	271	3264	0	90	-5.3125	10.625	128	1.35	10	303
P5	34	255	288	0	3417	0	0	11.3	0	134	1.35	10	288
out plane	34	255	-288	0	3417	0	0	-11.3	0	134	1.35	10	288
	34	255	0	-271	3417	0	0	0	-10.625	134	1.35	10	271

Geometry – Visualized via primary hit distribution.



Quick and dirty rendering from skimmed hits.

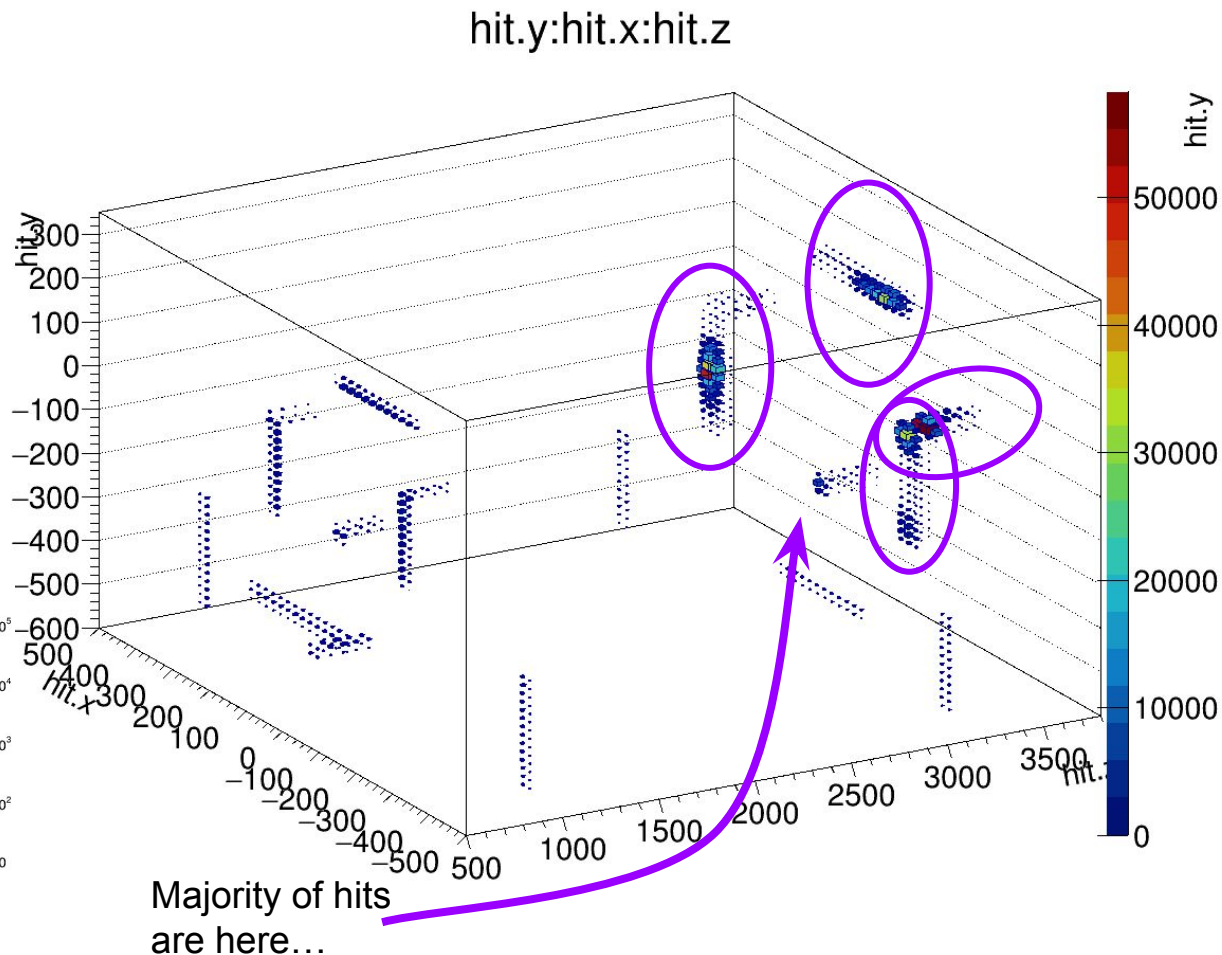
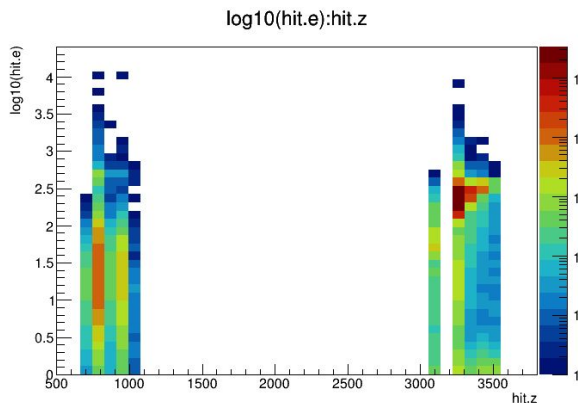
Heatmap – BOX2Z



Primary Hits

Concentrated on Tie Rods that hold up Collimator 2 (I think that's what we're calling it).

Hits are confined largely to four of the rods.



Notes on Field Weighting

Field extends from
900mm to 3100mm in z,
and 0 to 1/2 meter in r

```
ifarm1802.jlab.org> head map_directory/V2U.1a.50cm.parallel.txt
251 0.000 0.500
23 0.9 3.1
0.0
0.0
0 -180 0.9 0 0 1.0872293e-17
0.002 -180 0.9 8.7429521e-18 1.165423e-09 -1.523274e
0.004 -180 0.9 7.3277972e-18 2.3309704e-09 7.7719326e
0.006 -180 0.9 1.8190744e-19 3.4937824e-09 3.6280711e
ifarm1802.jlab.org>
```

obaXterm by subscribing to the professional edition here: <https://mobaxterm.mobatek.net>

"REGION"	Dimensions (mm)			Position (mm)			Rotation (deg)		Position (inches)			Dimensions (in)		radius
	R	LZ		X	Y	Z	X	Y	X	Y	Z	R	LZ	r
P1	26	255		434	434	944	90	0	17	17	37	1	10	613
	26	255		434	434	944	90	0	17	17	37	1	10	613
	26	255		179	-459	944	0	90	7	-18	37	1	10	492
	26	255		0	434	816	0	0	0	17	37	1	10	494
P2_2	22	204		102	173	803	0	90	4	6.8	31.5	0.87	8	201
In plane	22	204		173	102	803	90	0	6.8	4	31.5	0.87	8	201
	22	204		102	173	803	90	0	6.8	4	31.5	0.87	8	201
P2_1	22	204		0	-173	905	0	0	0	-6.8	35.5	0.87	8	173
out plane	22	204		189	0	905	0	0	7.4	0	35.5	0.87	8	189
	22	204		189	0	905	0	0	7.4	0	35.5	0.87	8	189
P4	22	204		444	444	3111	90	0	17.4	-17.4	122	0.87	8	627
	22	204		444	444	3111	90	0	17.4	-17.4	122	0.87	8	627
	22	204		102	444	3111	0	90	4	-17.4	122	0.87	8	455
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out plane	34	255		288	0	3417	0	0	11.3	0	134	1.35	10	288
	34	255		0	271	3417	0	0	0	10.625	134	1.35	10	271

⇒ I crossed out everything beyond the z-bounds of the map in **blue** (I did one on the edge of z in **cyan** as these are likely very very small)

⇒ I crossed out anything greater than the maps rmax in **magenta**.

⇒ Remaining is a single element in **orange**.

Weighting doesn't do much of anything here. In the secondary sim no charges came from **here** although two photons did.

9095 – US Torus Tie Rods

Material	X_r	Spin Polarization (P_f)	Frac e- on Target	Frac of events Per Moller
Mild Steel	2000	1E-02	1E-11	1E-07
Stainless Steel (Worst)	1	1E-05	1E-08	1E-04
Stainless Steel (Ideal)	0.01	1E-07	1E-06	1E-02
Aluminum	0.0001	1E-09	1E-04	1E+00
Inconel 625	0.001	1E-08	1E-05	1E-01
Brass/Bronze (Worst)	0.001	1E-08	1E-05	1E-01

Collar 2 Barite Wall I-beam Supports

Simulation Date: 5/30/2023

Detector # 9095

10 Billion Primaries – 1 Million Hits

US Torus Tie Rods -- Unweighted By BField

Total Prim 10,000,000,000

Total Secondaries 5,000,000 (per sens det)

Primary Counts		
Primaries	0	0&1
9095		1019643

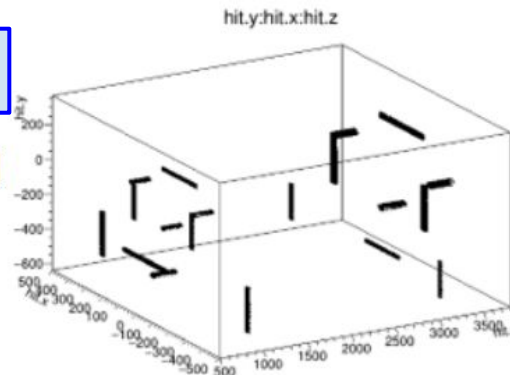
Primary Fractional		
Primaries	0	0&1
9095		1.02E-04

(9928 MainDet) Secondary Counts - 0&1		
Secondaries	Electrons	Gammas
9095	13	502

(9928 MainDet) Secondary Fractional - 0&1		
Secondaries	Electrons	Gammas
9095	2.60E-06	1.00E-04

(9911 PMT Region) Secondary Counts - 0&1		
Secondaries	Electrons	Gammas
9095	28	107

(9911 PMT Region) Secondary Fractional - 0&1		
Secondaries	Electrons	Gammas
9095	5.60E-06	2.14E-05



(9928 MainDet) Total Fractional - 0&1		
Secondaries	Electrons	Gammas
9095	2.65E-10	1.02E-08

(9911 PMT Region) Total Fractional - 0&1		
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9095	5.71E-10	2.18E-09

Probably should have run more secondaries...

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Collar 2 Barite Wall I-beam Supports

Simulation Date: 5/30/2023

Detector # 9095

Secondary were 5 million events

US Torus Tie Rods -- Unweighted By BField

Total Prim 10,000,000,000

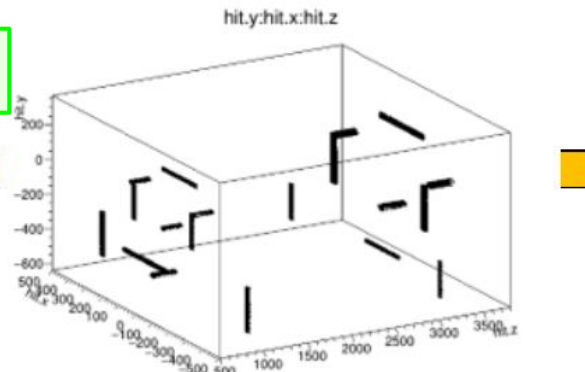
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Collar 2 Barite Wall I-beam Supports

Simulation Date: 5/30/2023

Detector # 9095

3-4 Orders of Magnitude below limits

US Torus Tie Rods -- Unweighted By BField

Total Primis 10,000,000,000

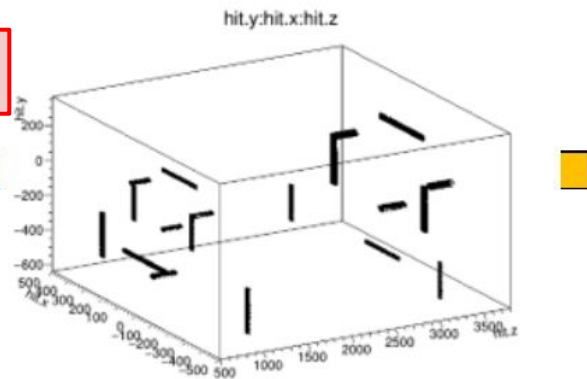
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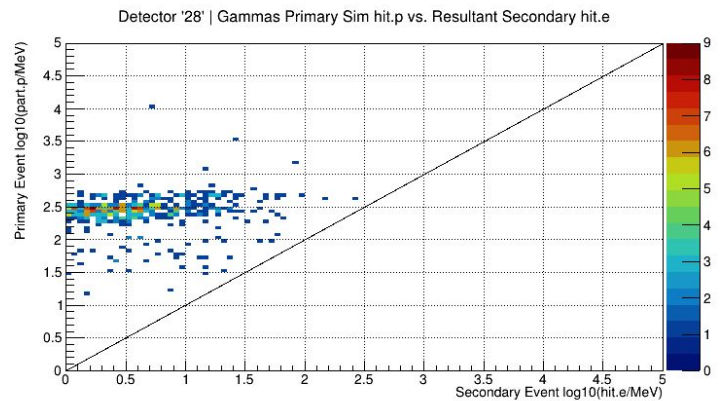
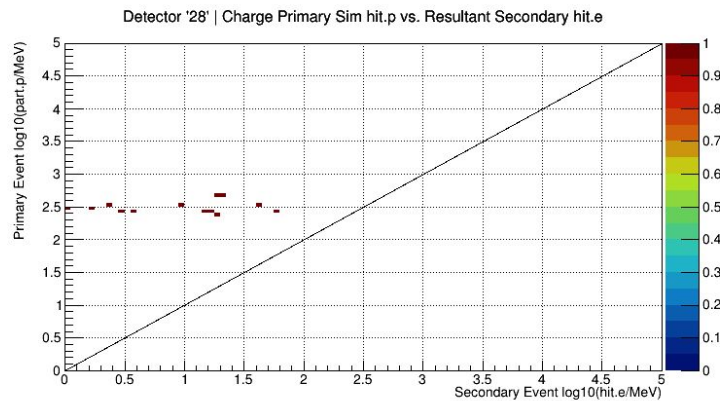
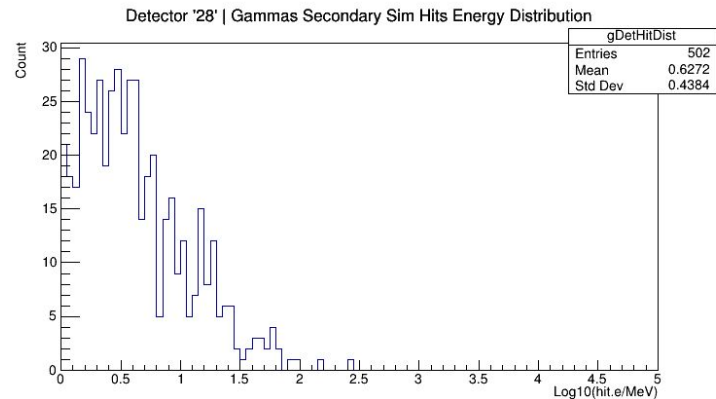
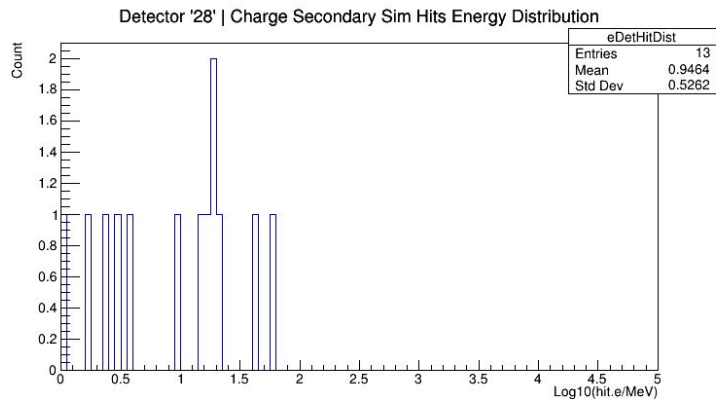
(9928 MainDet) Total Fractional - 0&1		
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(9911 PMT Region) Secondary Counts - 0&1		
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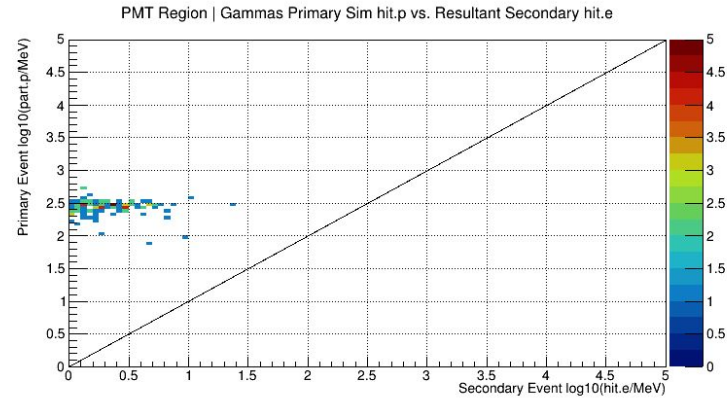
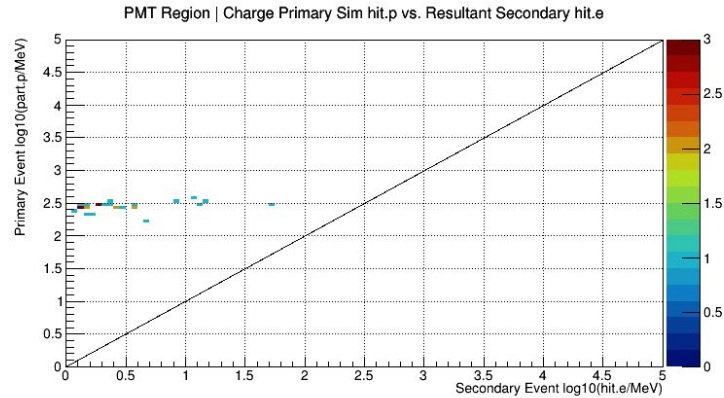
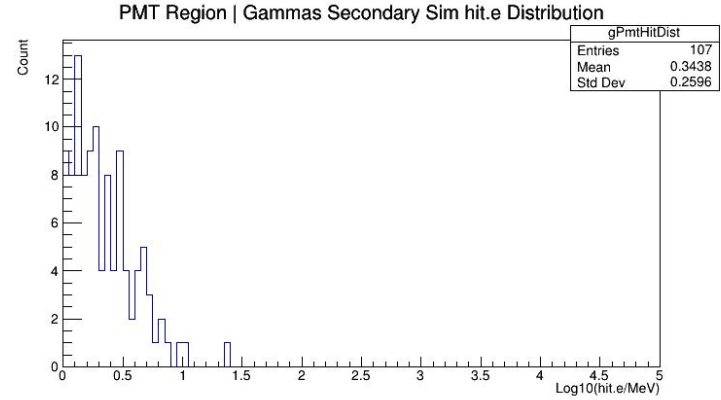
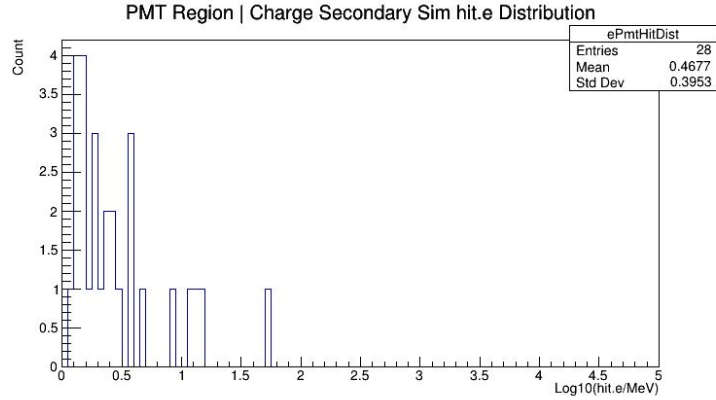
(9911 PMT Region) Secondary Fractional - 0&1		
Secondaries	Electrons	Gammas
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(9911 PMT Region) Total Fractional - 0&1		
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9095	5.71E-10	2.18E-09

Detector Hits



PMT Region Hits

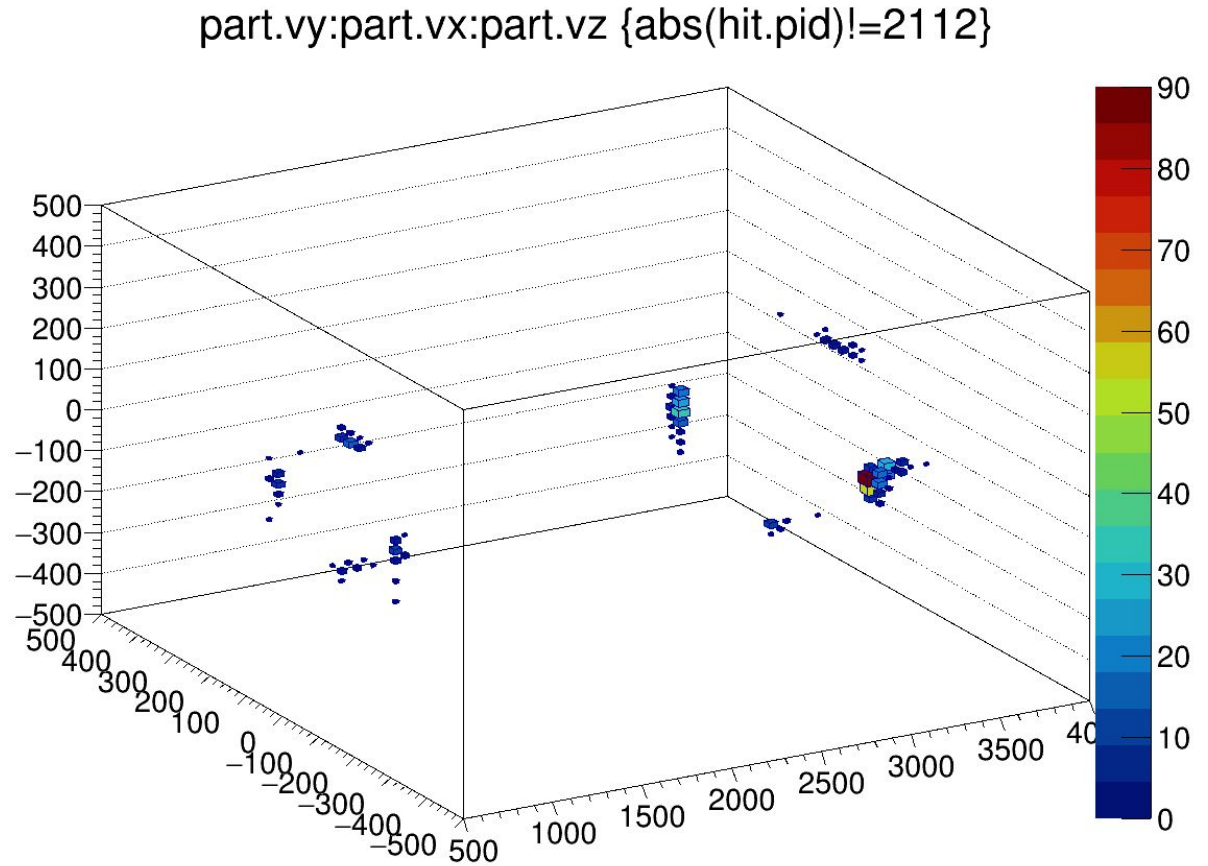


Particle event vertices from secondary events

These are the generated particles and not the hit vertices.

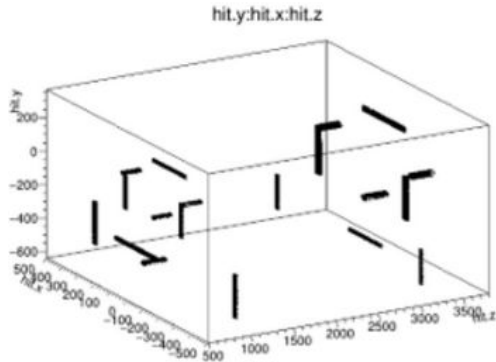
Seems that the hot spot from the primary is the region where most secondary hits come from... this is unsurprising.

Why is that spot bad???



MAIN POINT: US Torus Tie Rods

Material	X _r	Spin Polarization (P _f)	Frac e- on Target	Frac of events Per Moller
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Aluminum	0.0001	1E-09	1E-04	1E+00
Inconel 625	0.001	1E-08	1E-05	1E-01
Brass/Bronze (Worst)	0.001	1E-08	1E-05	1E-01



Assumption:

- Outside the field map used for simulation we still encounter possible fields of say 50-100 gauss

The computed ferrous backgrounds of 10^{-10} per e.o.t. would be weighted and give a 10^{-8} 'ish per e.o.t

The tolerable magnetic susceptibility for the background rate is $X_r \sim 1$

For worst-case brass/bronze $X_r \sim 0.001$

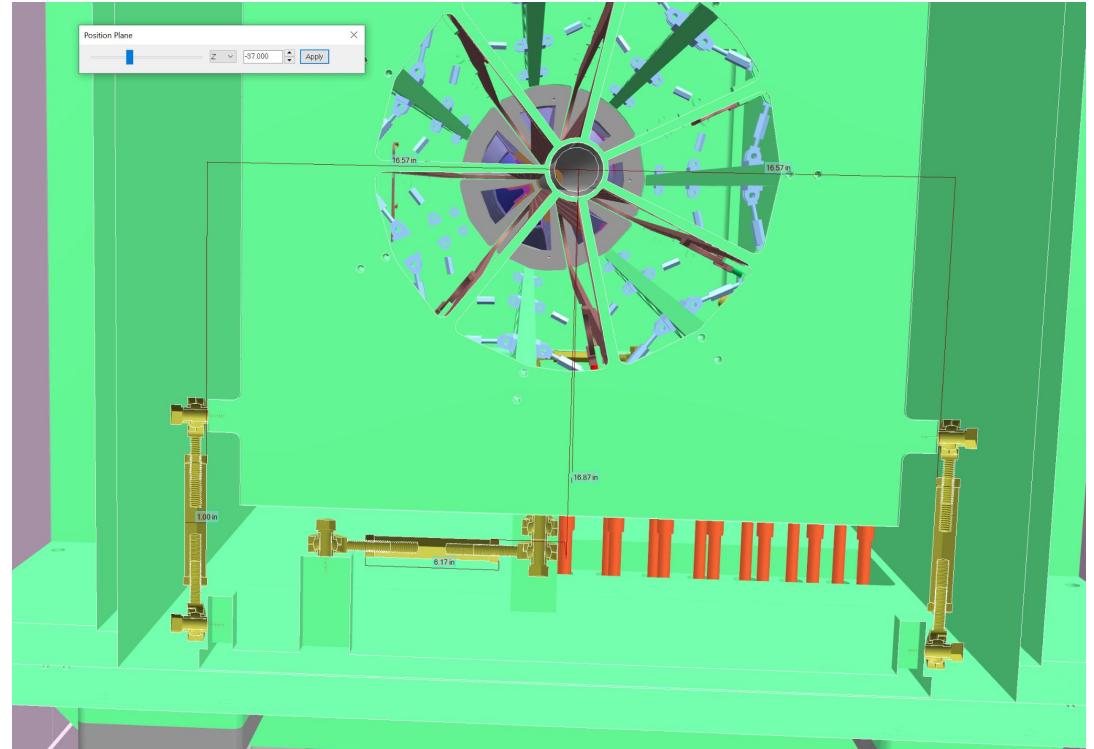
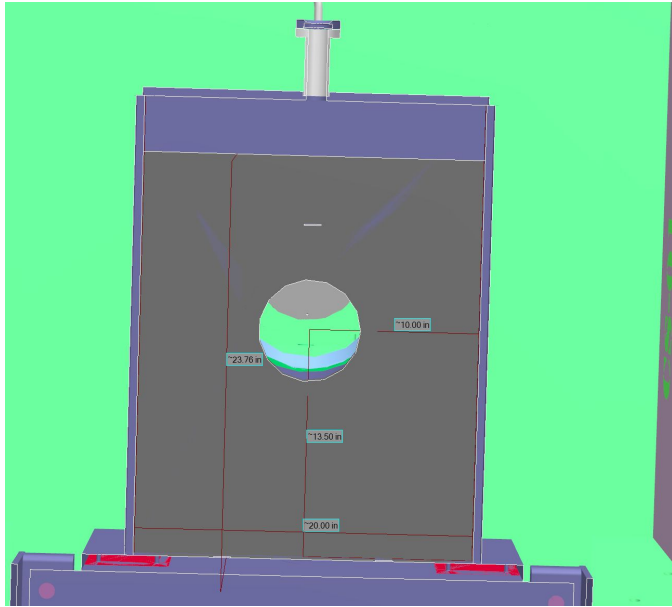
We're safe under very-conservative estimates by around three orders of magnitude considering the worst possible case of 100G fields beyond the map and worst magnetic quality brass.

(9928 MainDet) Total Fractional - 0&1		
Secondaries	Electrons	Gammas
9095	2.65E-10	1.02E-08

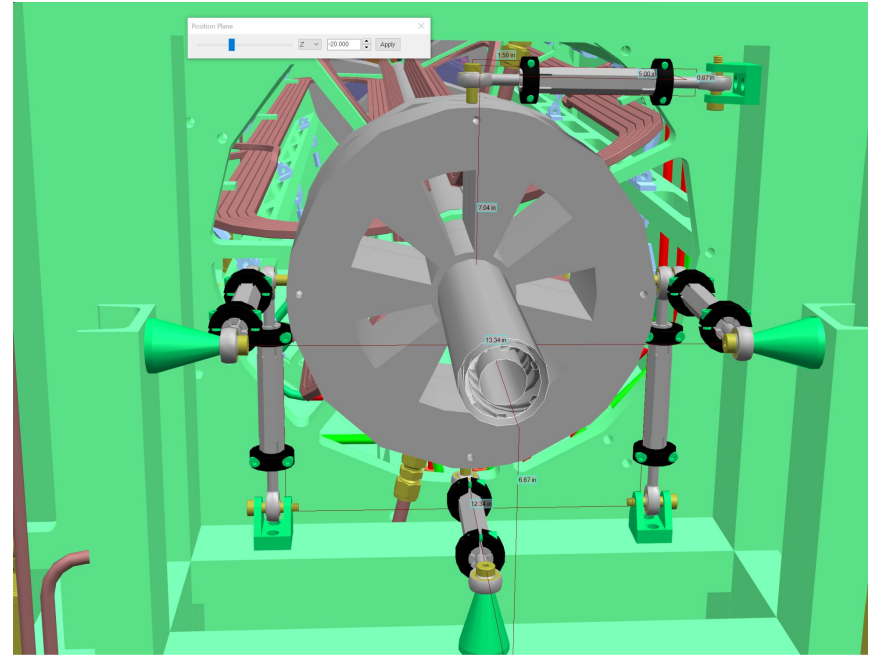
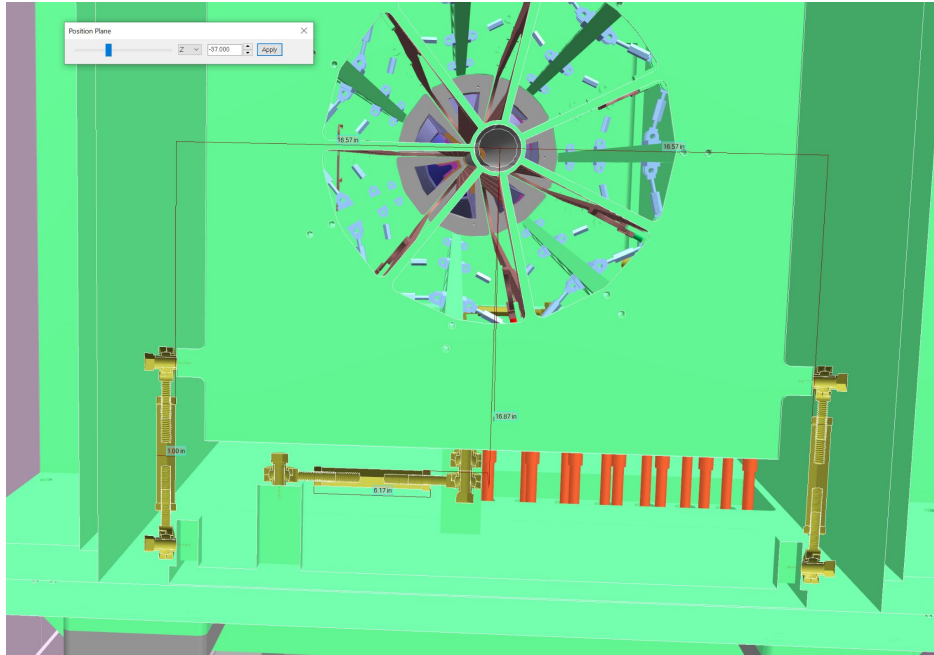
(9911 PMT Region) Total Fractional - 0&1		
Secondaries	Electrons	Gammas
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Original images from
Ciprian

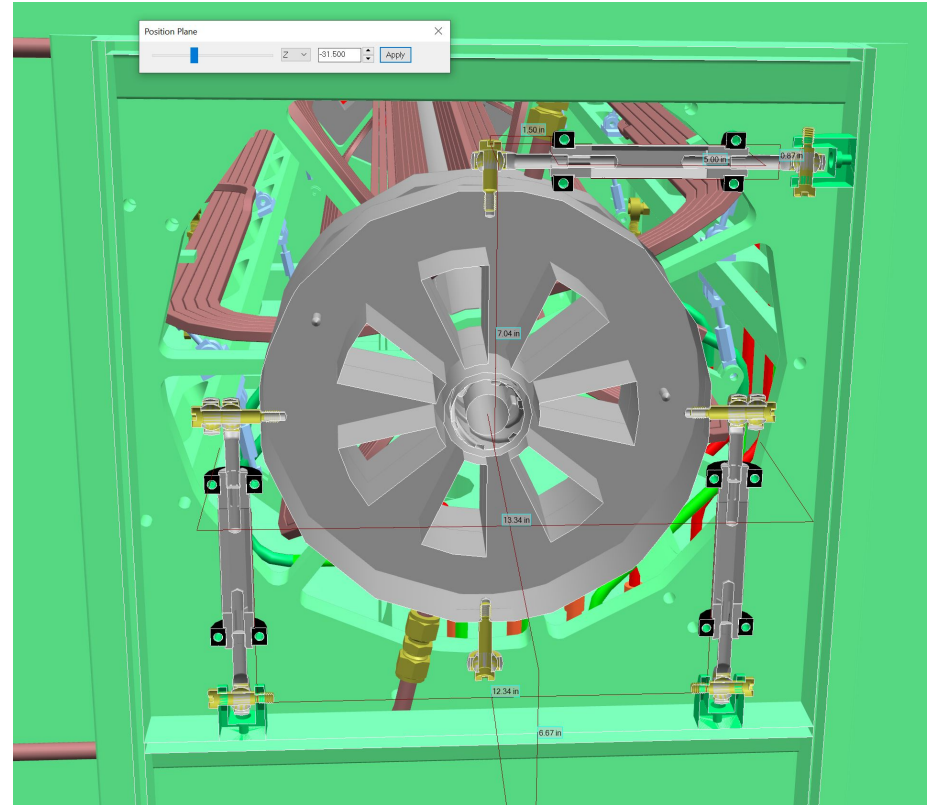
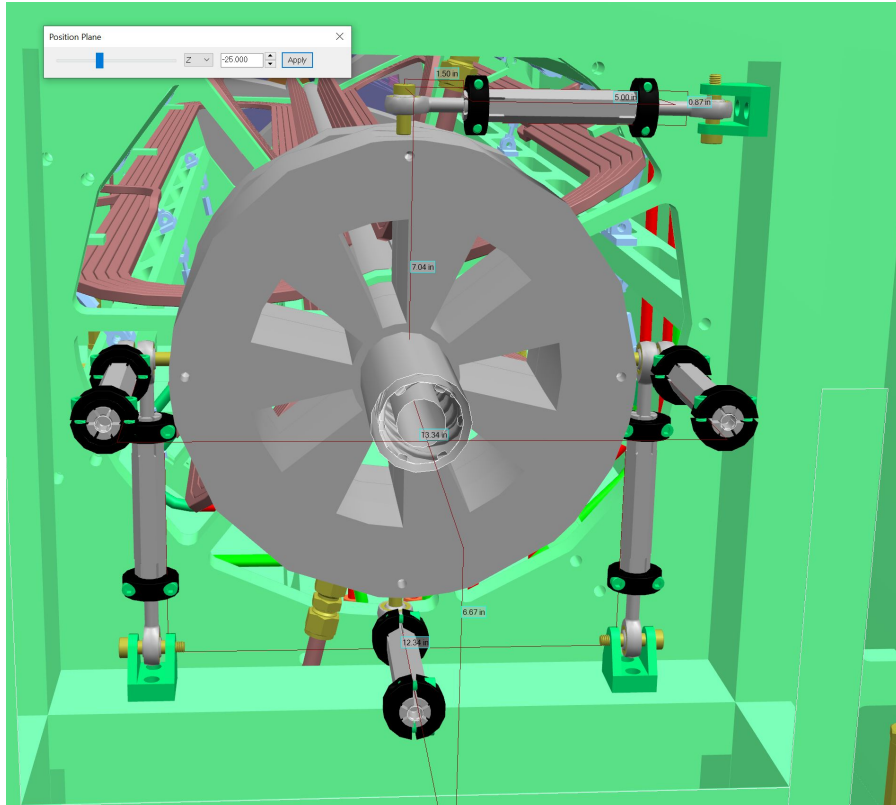
Original images with measurements



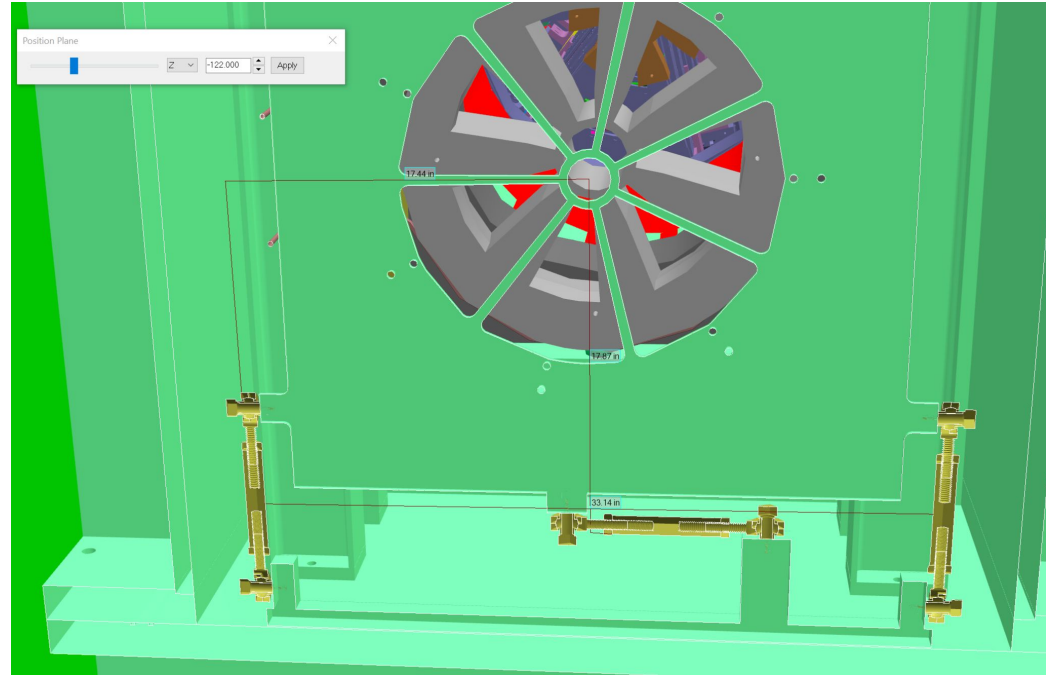
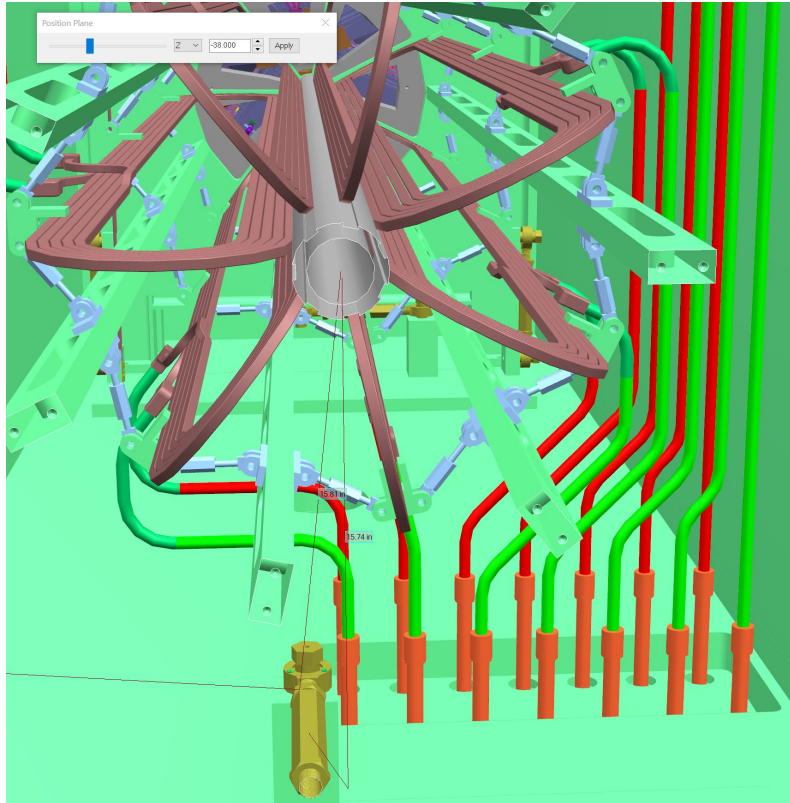
Original images with measurements



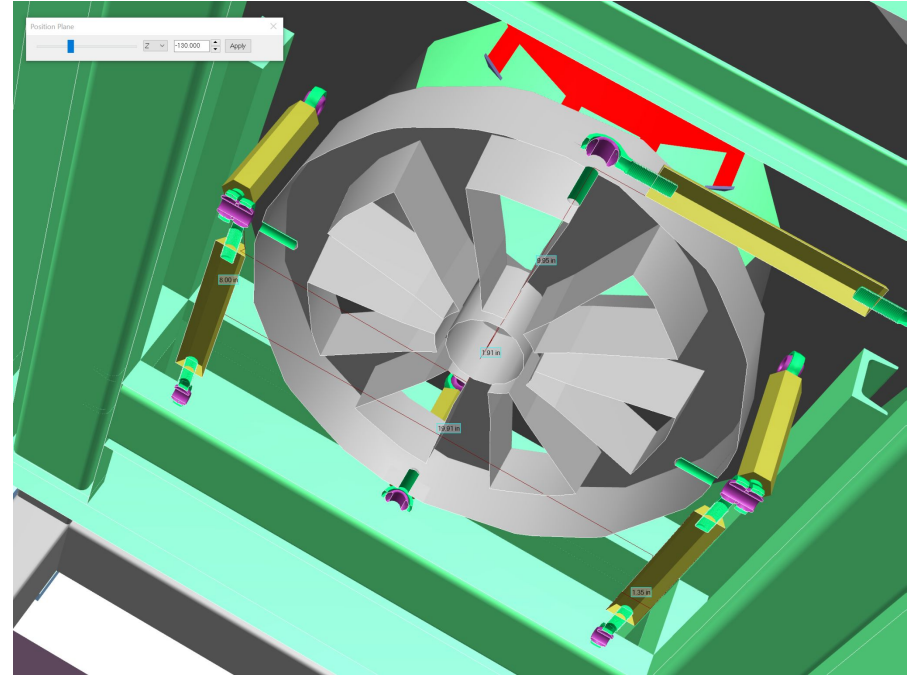
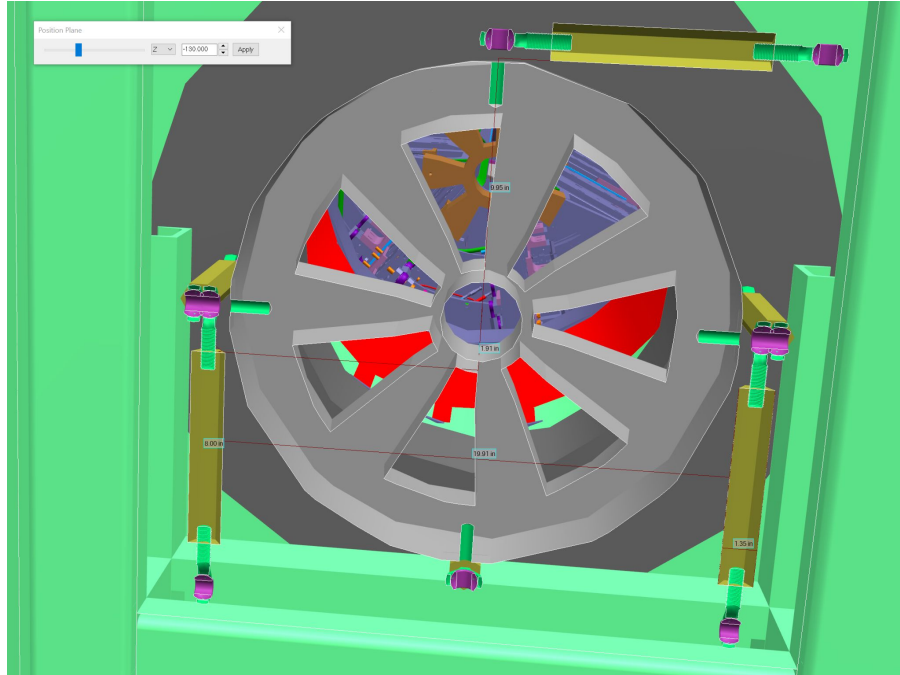
Original images with measurements



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