Ferrous Materials:

[Cantilever] Jib Crane

Eric King

Last Updated:

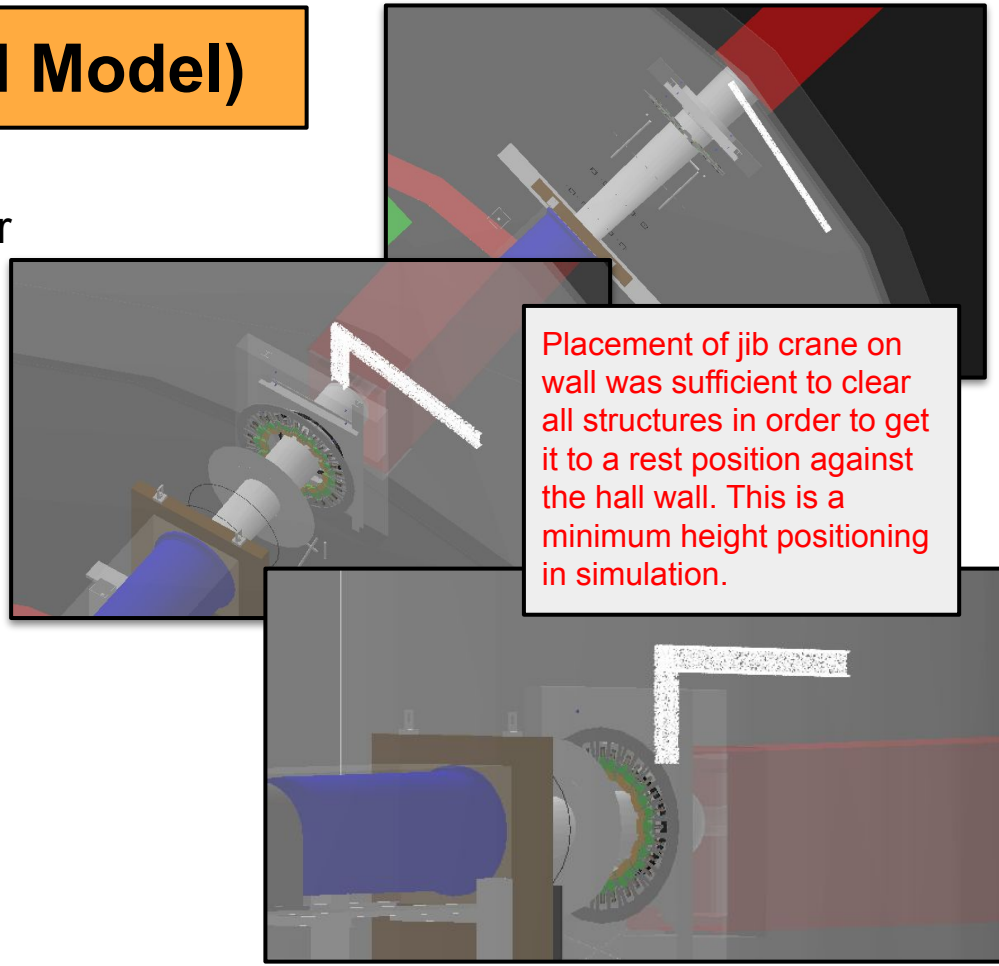
08.23.2023

9209 – Jib Crane (Updt'd Model)

Jib Crane model changed to cantilever type, 20 ft model with 2-ton capacity

Generic Image from Gorbel

Did not model the connective brackets

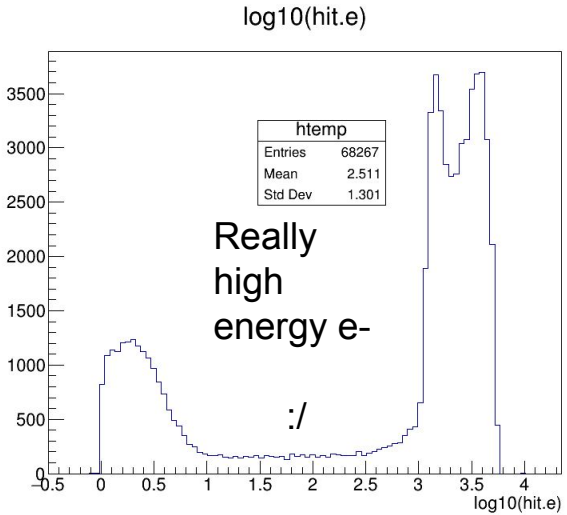


Placement of jib crane on wall was sufficient to clear all structures in order to get it to a rest position against the hall wall. This is a minimum height positioning in simulation.

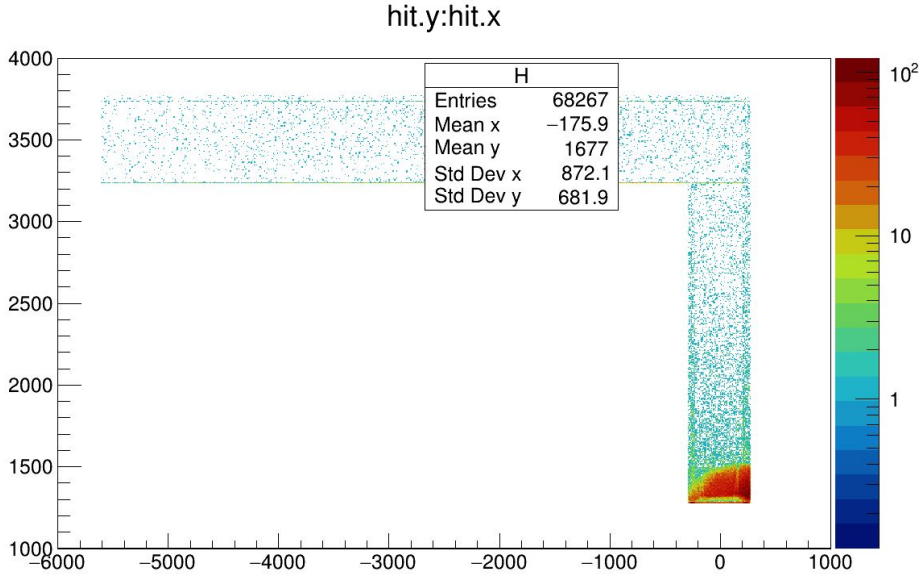
Symmetric Magnetic Field Maps

9209 – Jib Crane :: Symmetric Field Maps

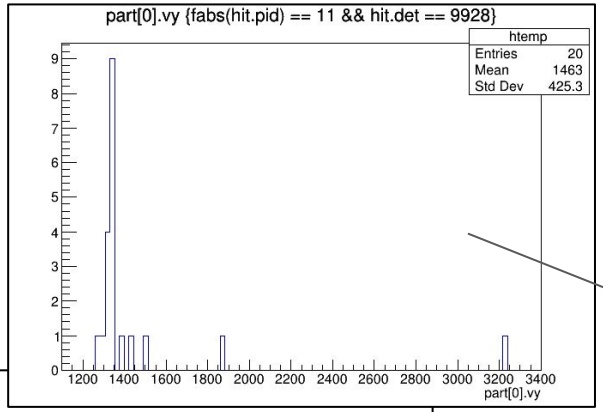
- Primary hits concentrated in single spot.
  - This could be avoided by moving ¼-½ meter upwards
  - **This will probably be key to making sure the jib crane can stay on the wall.**



Primary hits on the jib crane… there are alot. (Next Slide)

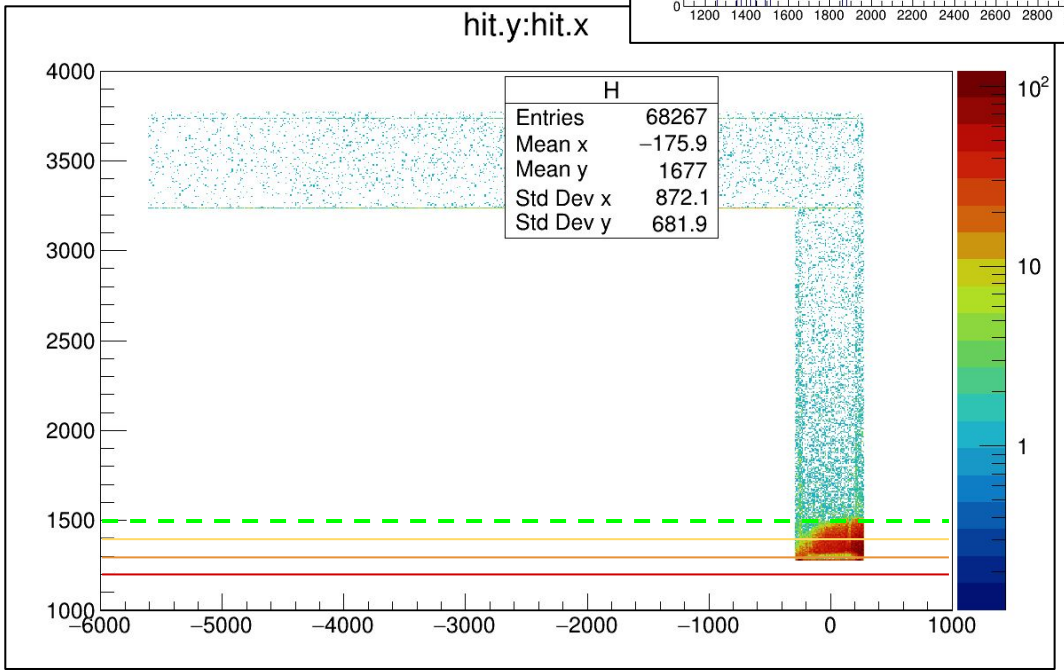


9209 – Jib Crane Symmetric Field Maps



Moving the crane above the y=1500mm point reduces backgrounds by order of magnitude.

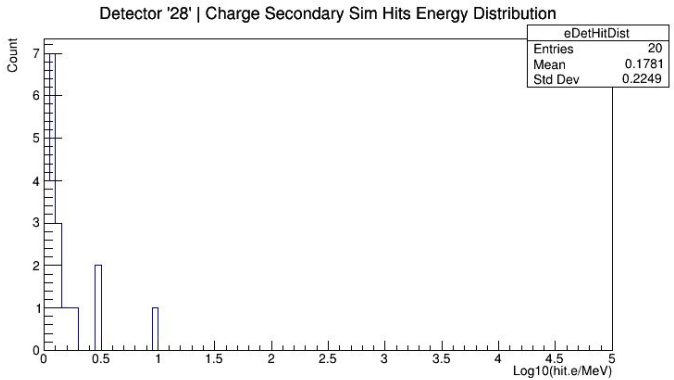
Max y	Hits on 28
1200	20
1300	19
1400	4
1500	2

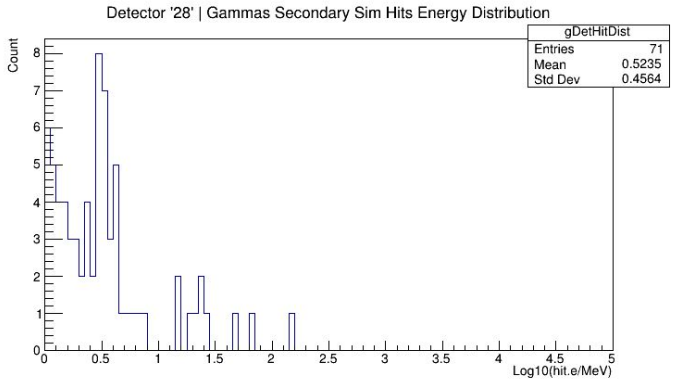


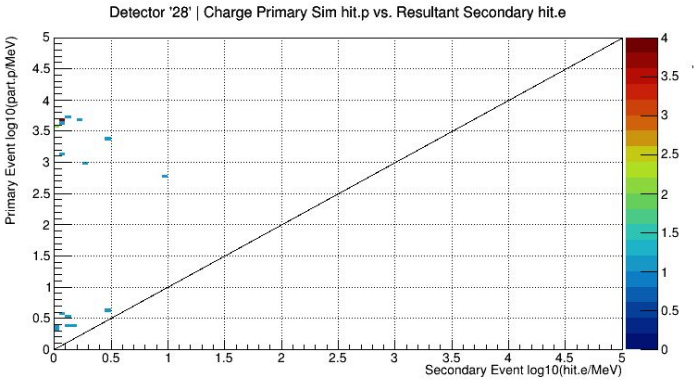
Perfectly aligned fields the bottom of the crane direct above the beamline should be no less than 1.5m above.

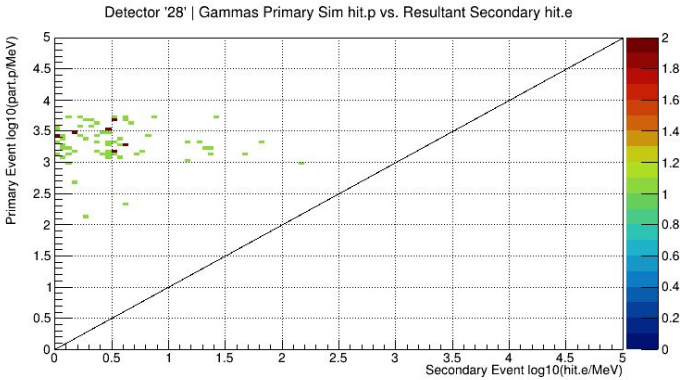
**Will run sims with asymmetric fields

9209 – Jib Crane :: Symmetric Field Maps









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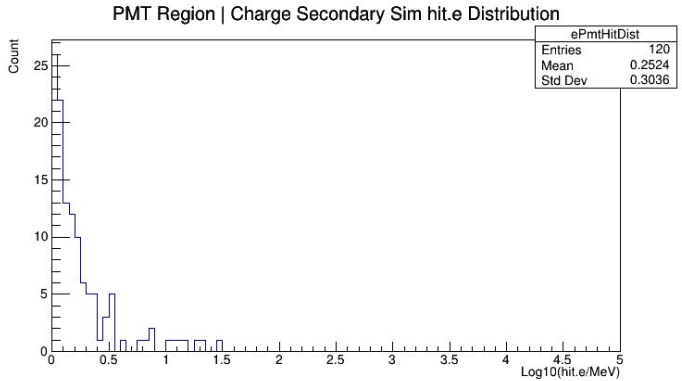
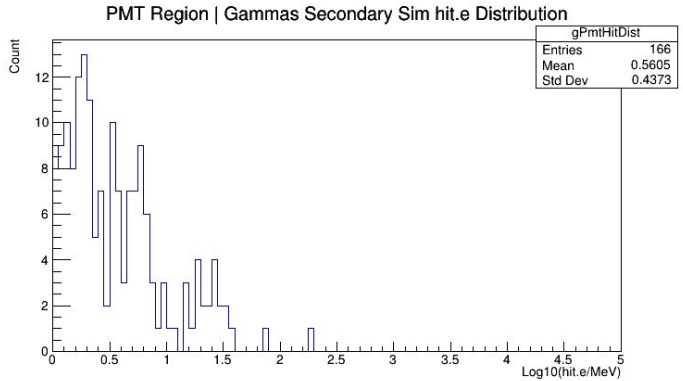
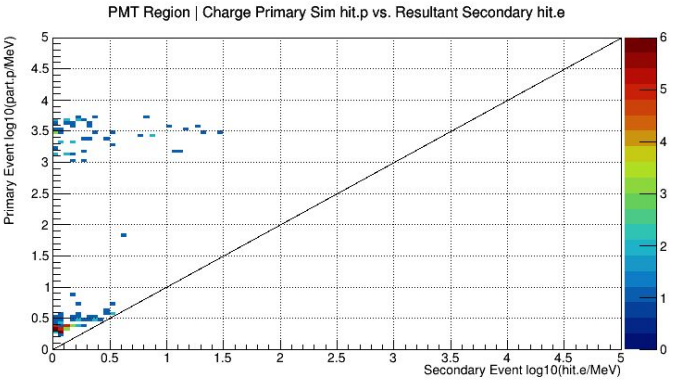
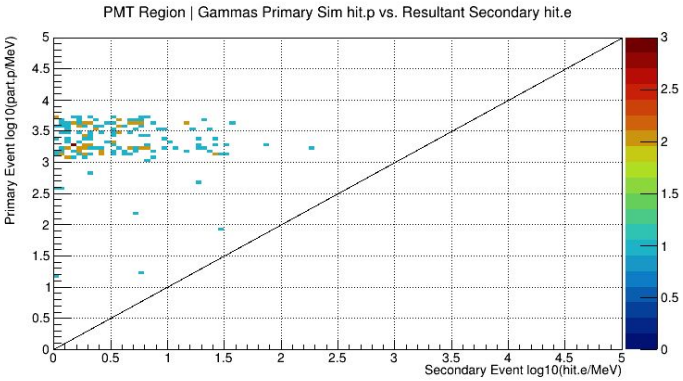




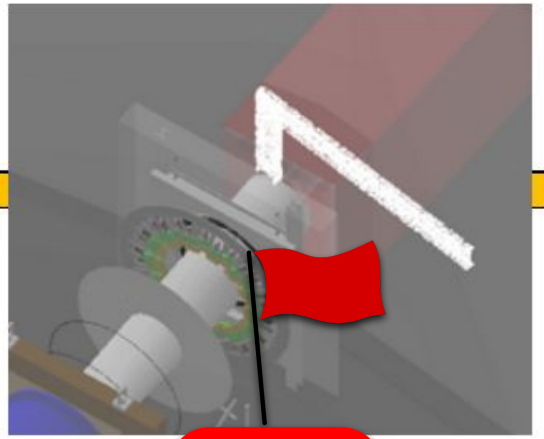




9209 – Jib Crane Symmetric Field Maps

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

Sens Volume:	Cantilever Jib Crane
Sim Date:	8/8/2023
Detector #:	9209



Cantilever Jib Crane -- Unweighted By BField

Total Prim's:	10,000,000,000

Total Sec's:	500,000	(per sens det)

Primary Counts		
Primaries	0	0&1
9209		68267

Primary Fractional		
Primaries	0	0&1
9209		6.83E-06

(9928 MainDet) Secondary Counts - 0&1		
Secondaries	Electrons	Gammas
9209	20	71

(9928 MainDet) Secondary Fractional - 0&1		
Secondaries	Electrons	Gammas
9209	4.00E-05	1.42E-04

(9928 MainDet) Total Fractional - 0&1		
Secondaries	Electrons	Gammas
9209	2.73E-10	9.69E-10

(9911 PMT Region) Secondary Counts - 0&1		
Secondaries	Electrons	Gammas
9209	120	166

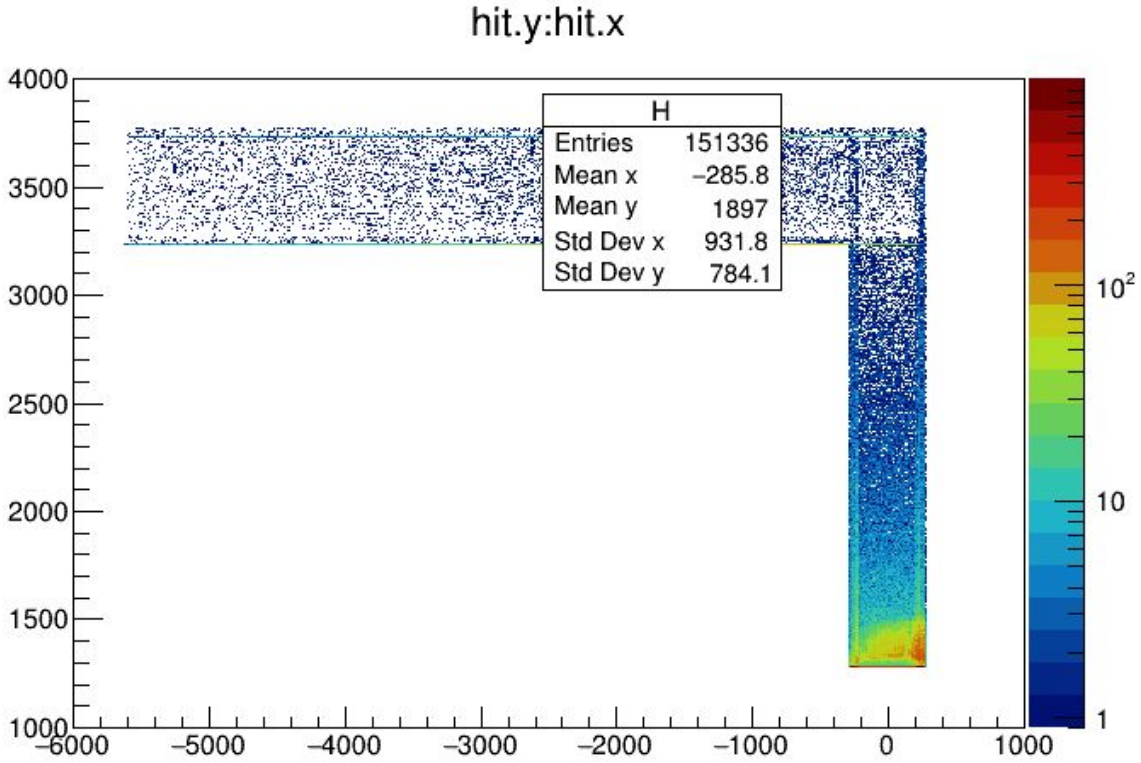
(9911 PMT Region) Secondary Fractional - 0&1		
Secondaries	Electrons	Gammas
9209	2.40E-04	3.32E-04

(9911 PMT Region) Total Fractional - 0&1		
Secondaries	Electrons	Gammas
9209	1.64E-09	2.27E-09

Results, given geometry situation, are in excess of what we would find to be acceptable.

Asymmetric Magnetic Field Maps

9209 – Jib Crane :: **Asymmetric** Field Maps



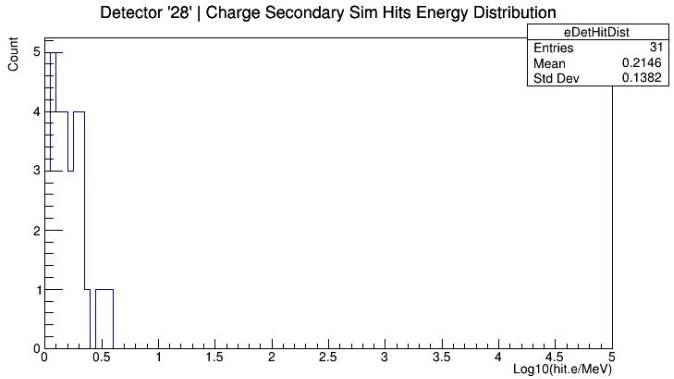
Primary hits…

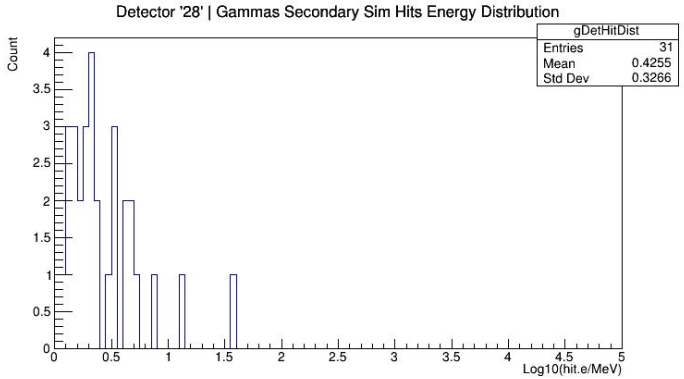
Can’t remember the bin sizes of the plots of the symmetric field version that I made a week or so ago.

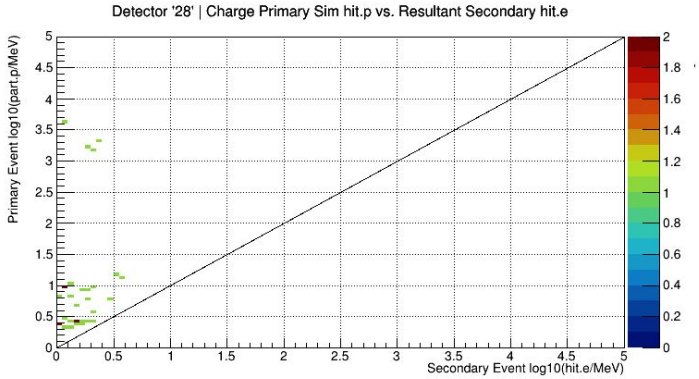
There are more hits overall and the number of hits drops off less-slowly in the vertical when compared to the symmetric field maps.

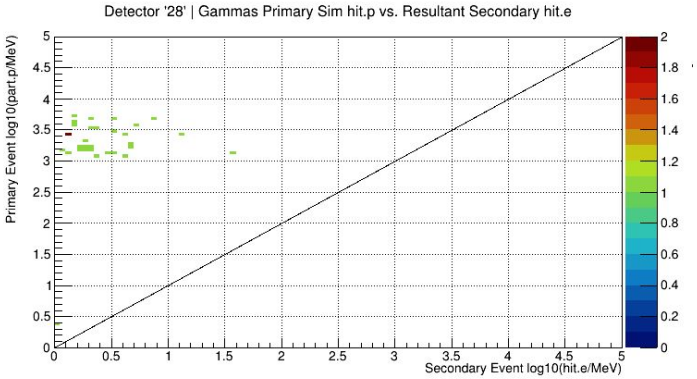
(See the flux plane slides)

9209 – Jib Crane :: Asymmetric Field Maps









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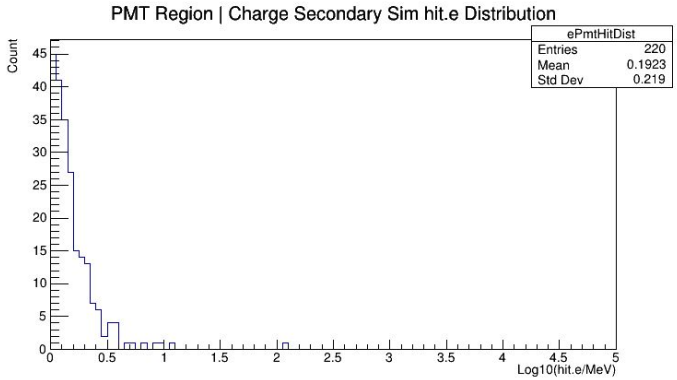

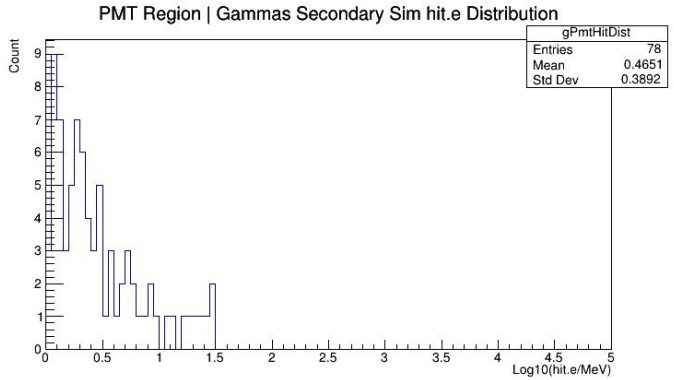

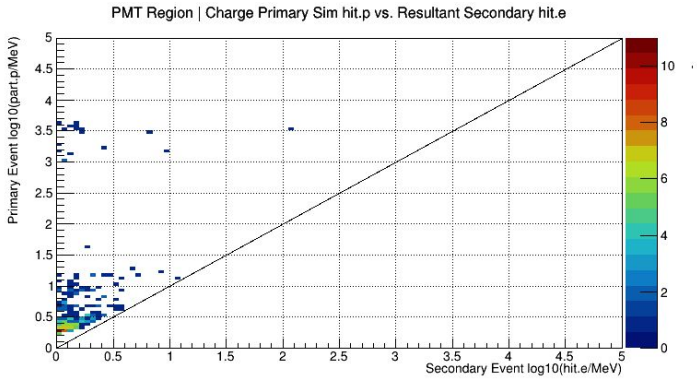

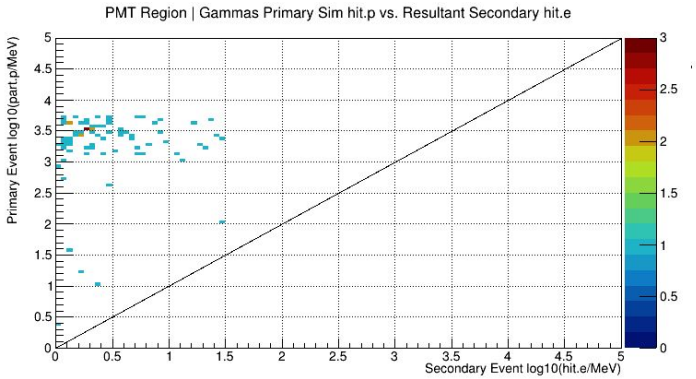

9209 – Jib Crane Symmetric Field Maps

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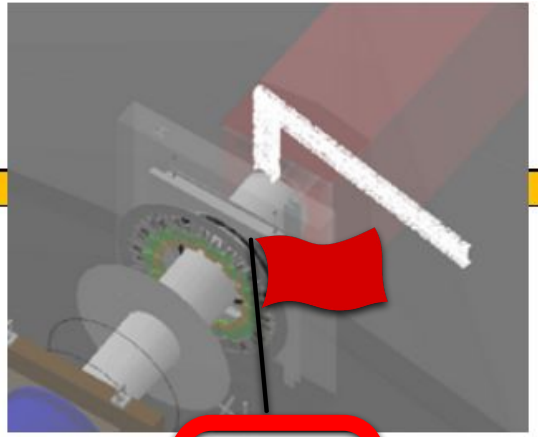
Aluminum	0.0001	1E-09	1E-04	1E+00
Inconel 625	0.001	*1E-08*	1E-05	1E-01
Brass/Bronze (Worst)	0.001	*1E-08*	1E-05	1E-01

Sens Volume:	Cantilever Jib Crane (Asym Fields)
Sim Date:	8/8/2023
Detector #:	9209



Cantilever Jib Crane (Asym Fields) -- Unweighted By BField

Total Prim's:	10,000,000,000

Total Sec's:	500,000	(per sens det)

Primary Counts		
Primaries	0	0&1
9209		151336

Primary Fractional		
Primaries	0	0&1
9209		1.51E-05

(9928 MainDet) Secondary Counts - 0&1		
Secondaries	Electrons	Gammas
9209	31	31

(9928 MainDet) Secondary Fractional - 0&1		
Secondaries	Electrons	Gammas
9209	6.20E-05	6.20E-05

(9928 MainDet) Total Fractional - 0&1		
Secondaries	Electrons	Gammas
9209	9.38E-10	9.38E-10

(9911 PMT Region) Secondary Counts - 0&1		
Secondaries	Electrons	Gammas
9209	220	78

(9911 PMT Region) Secondary Fractional - 0&1		
Secondaries	Electrons	Gammas
9209	4.40E-04	1.56E-04

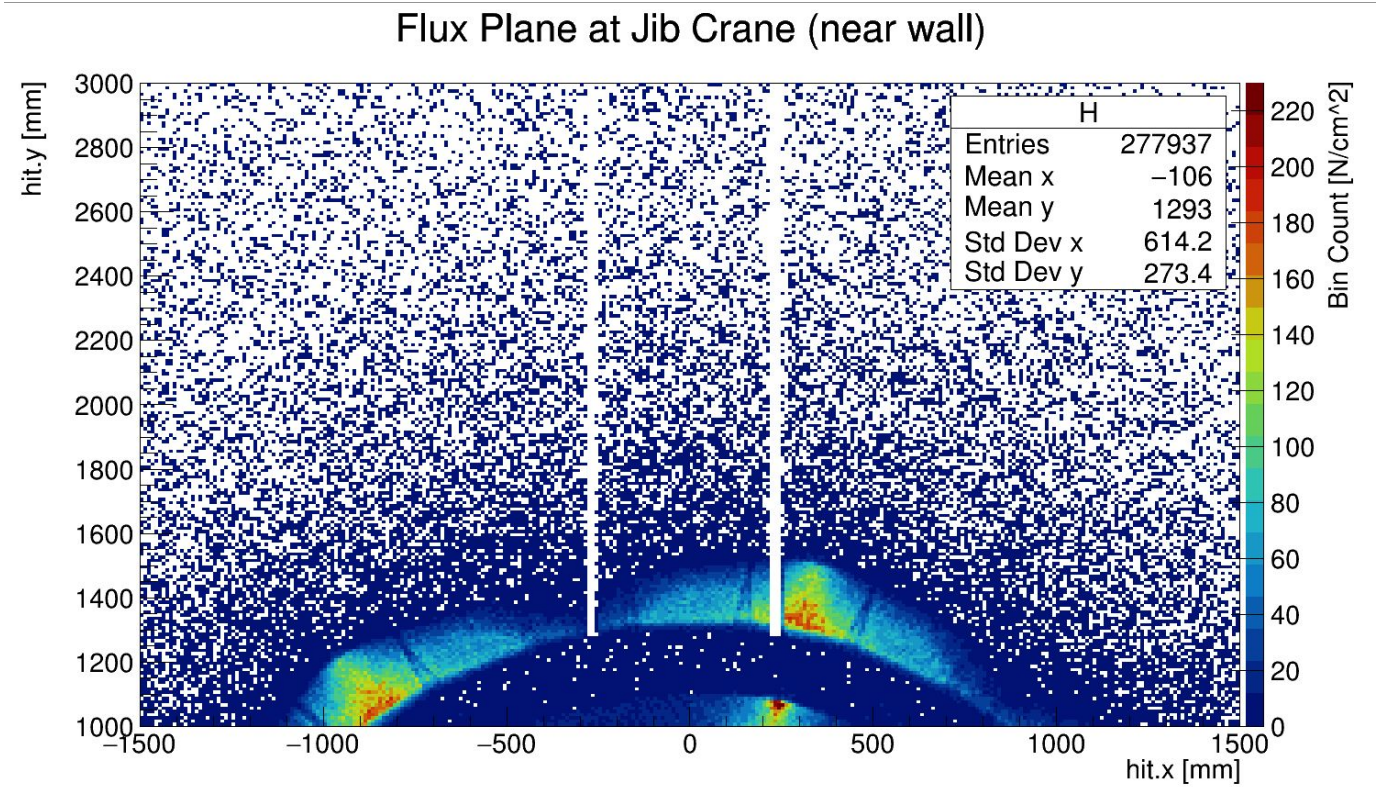
(9911 PMT Region) Total Fractional - 0&1		
Secondaries	Electrons	Gammas
9209	6.66E-09	2.36E-09

Results, given geometry situation, are in excess of what we would find to be acceptable.

Flux Plane At Jib Crane Location

We wanted a look at the distribution of backgrounds in the Jib Crane region so I inserted a flux plane in the general vicinity at the appropriate z-location.

Flux Plane Distributions [9876] :: Symmetric Field Mappings

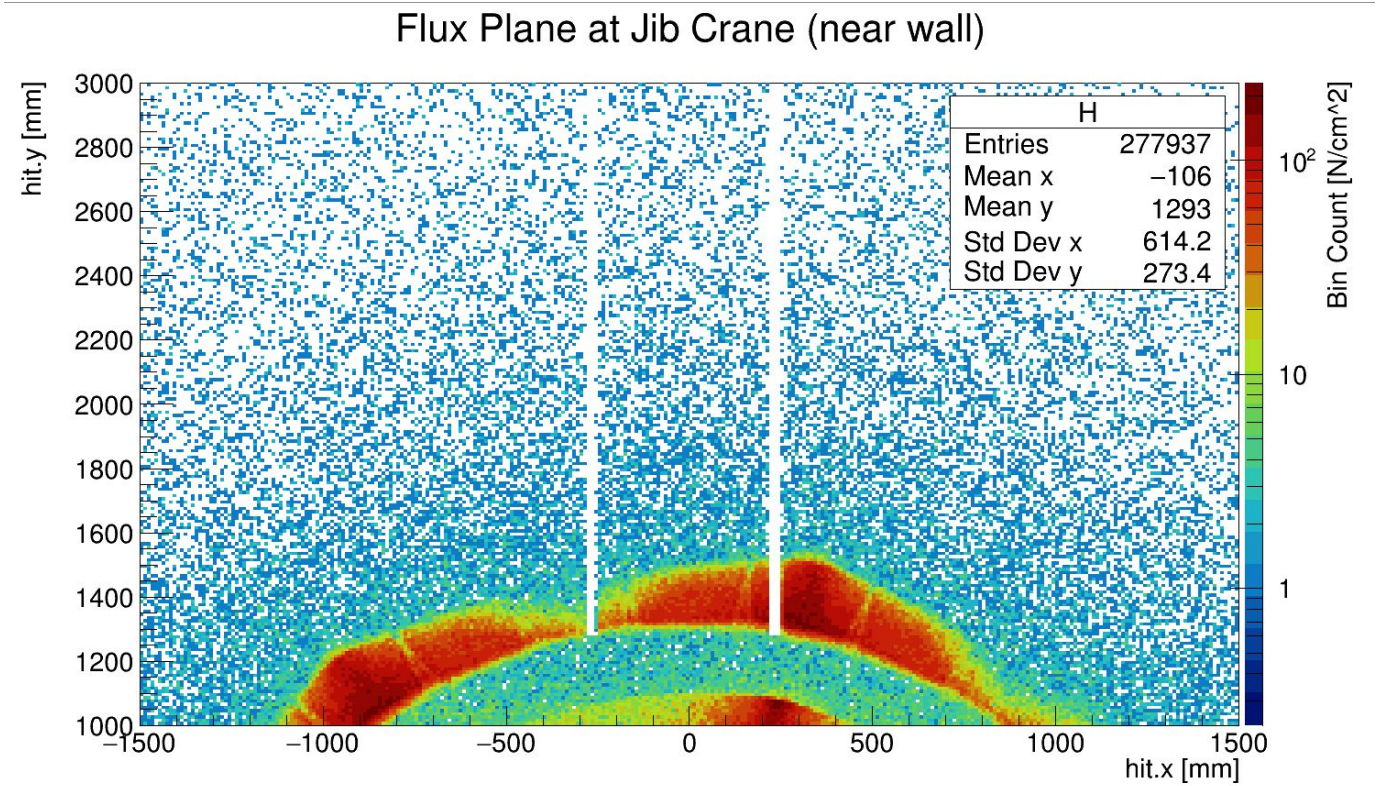


I threw the flux plane in but accidentally left the geometry for the jib on.

The flux plane intersects with the jib crane and the two vertical lines with no hits are where e- would have hit jib crane ibeam first.

I wasn't going to spend the time to alter the skimming script or re-run simulations as it's not going to change the meaning of the results.

Flux Plane Distributions [9876] :: Symmetric Field Mappings



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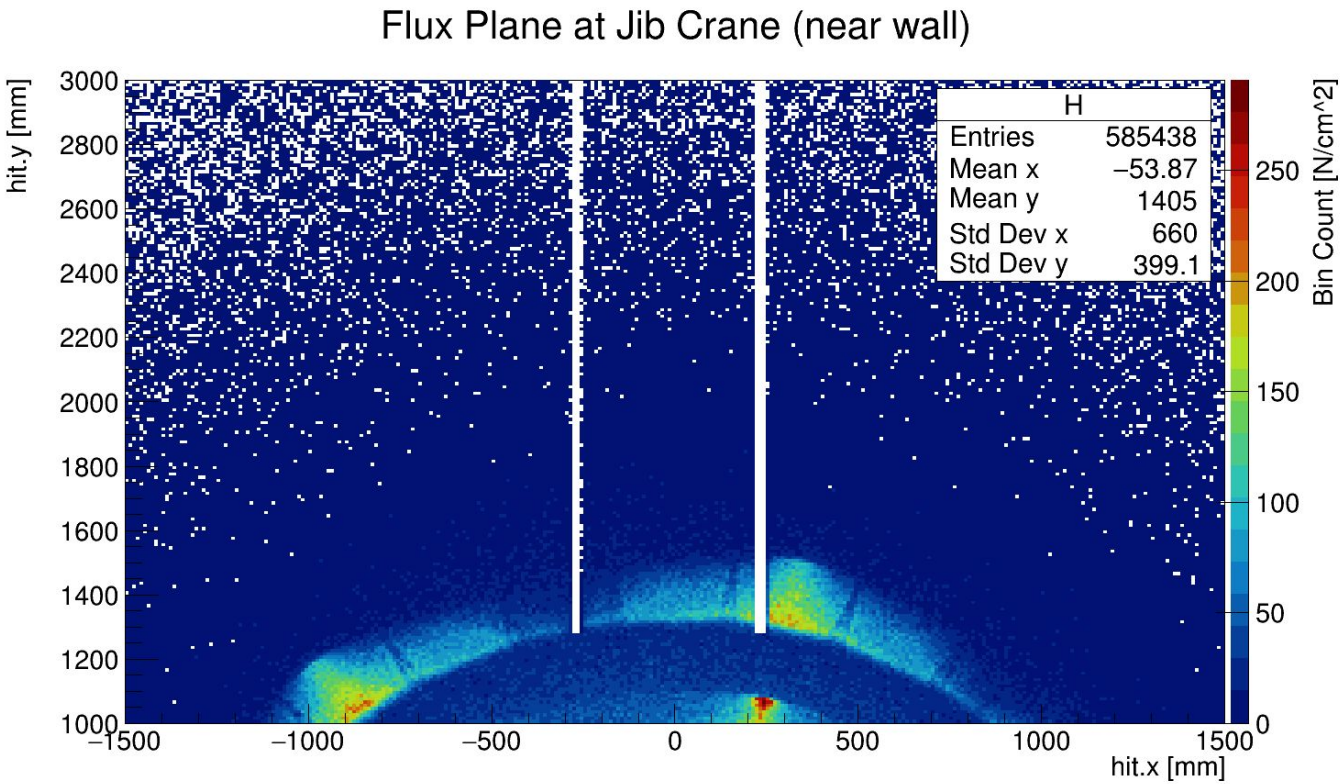
Flux Plane Distributions [9876] :: **Asymmetric** Field Mappings



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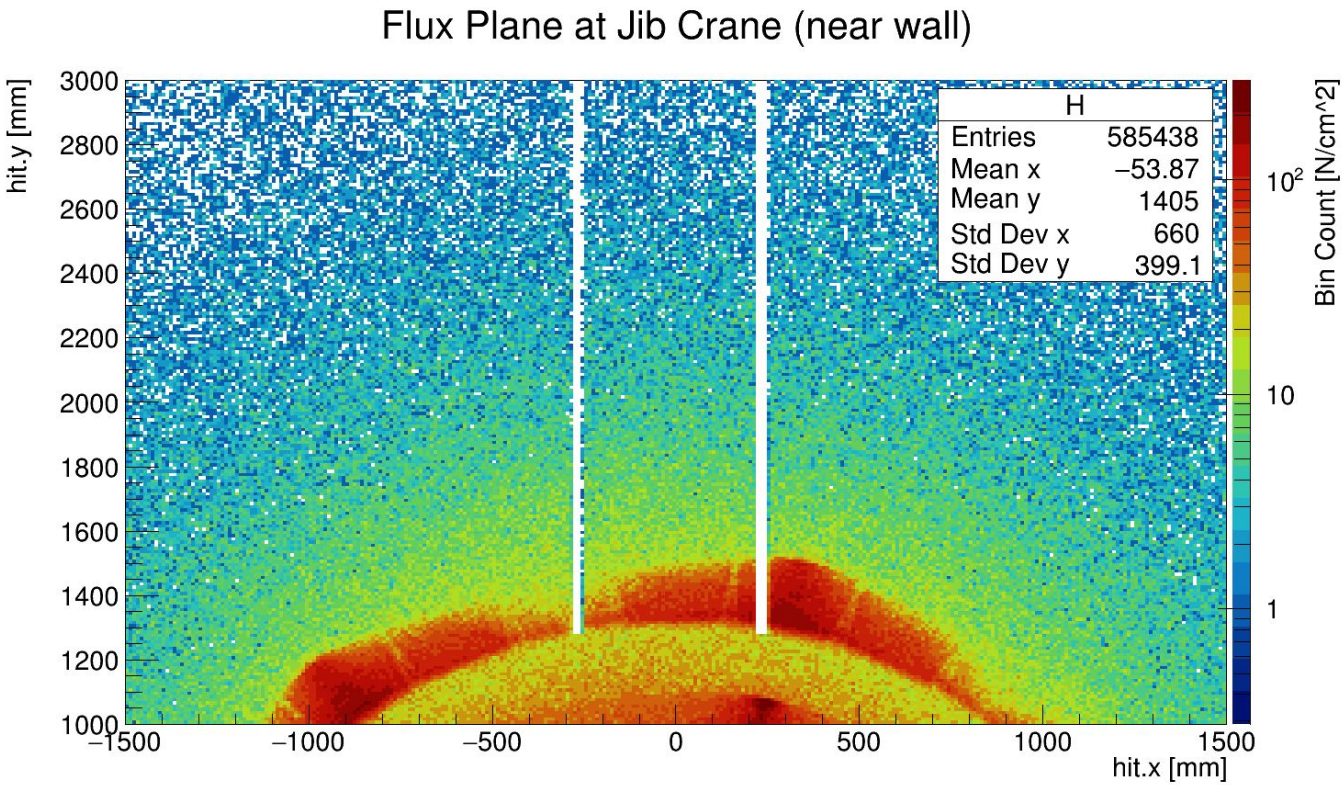
Flux Plane Distributions [9876] :: **Asymmetric** Field Mappings



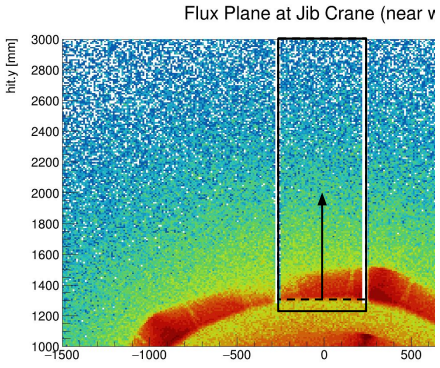
I threw the flux plane in but accidentally left the geometry for the jib on.

The flux plane intersects with the jib crane and the two vertical lines with no hits are where e- would have hit jib crane ibeam first.

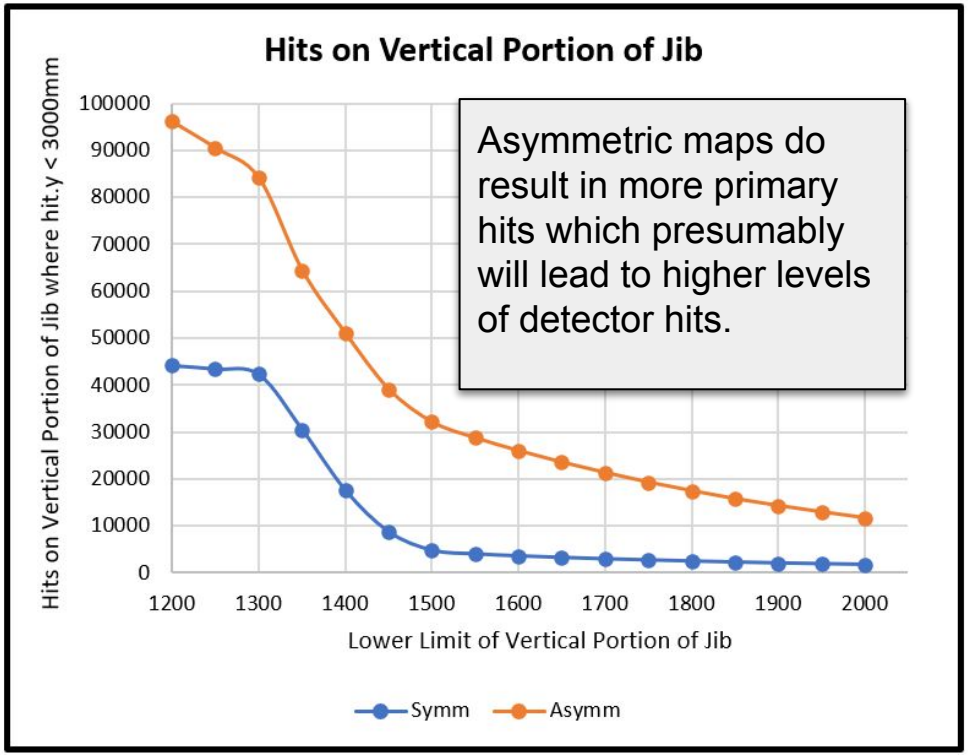
I wasn't going to spend the time to alter the skimming script or re-run simulations as it's not going to change the meaning of the results.

Quick and Dirty Comparison of Symm and Asym Maps

Total number of primary hits on Crane Flux Plane Region bounded by hit.x(-250,250) with varied lower limit for hit.y



	N(hits)	
y(base)	Symm	Asymm
1200	44196	96157
1250	43483	90555
1300	42315	84153
1350	30516	64483
1400	17550	51045
1450	8714	39101
1500	4789	32127
1550	4019	28740
1600	3587	25995
1650	3259	23532
1700	2961	21329
1750	2728	19274
1800	2495	17455
1850	2273	15750
1900	2081	14286
1950	1924	12944
2000	1776	11689



Takeaway Information

Takeaway

- Vertical positioning of the jib crane is important for minimizing background levels for ferrous materials concerns.
  - Moving the crane vertically with the base at 1.5m above beamline center reduces the number of hits by 60-90% depending magnetic steering.
  - Horizontal movement in the placement could also be considered.
    - See box in lower left image outlined in chartreuse just for example.

- Non-symmetric field maps do lead to primary hit levels up to an order of magnitude more than symmetric fields.

➢ **CARE NEEDS TO BE TAKEN ON THIS.**

	N(hits)	
y(base)	Symm	Asymm
1200	44196	96157
1250	43483	90555
1300	42315	84153
1350	30516	64483
1400	17550	51045
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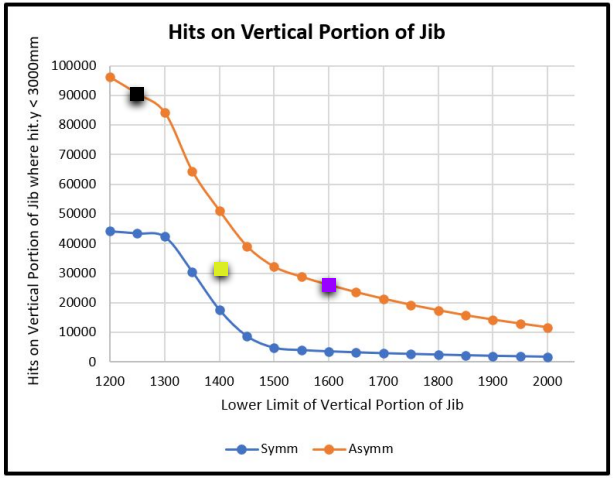
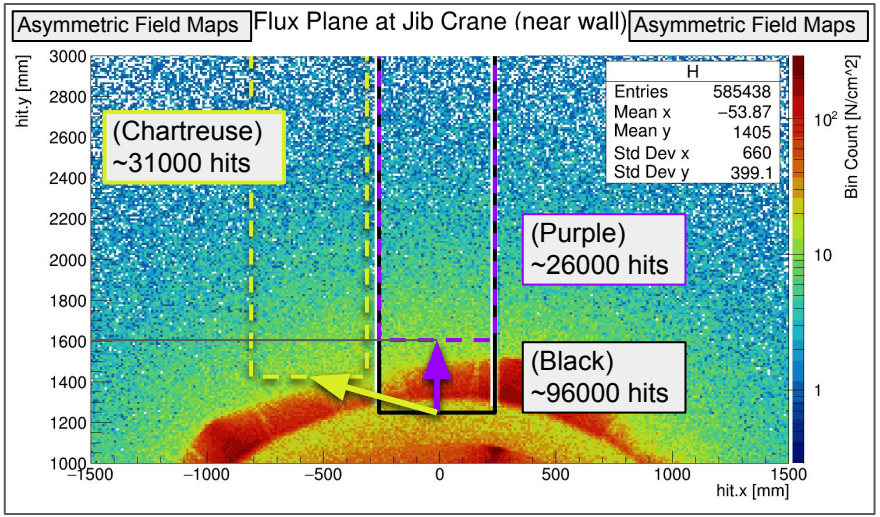
1900	2081	14286
1950	1924	12944
2000	1776	11689



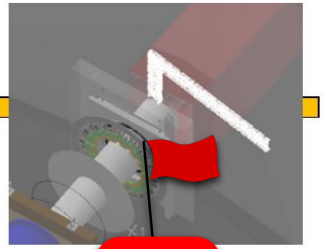


Comparison of Symmetric vs. Asymmetric Secondary Sims

Sens Volume:	Cantilever Jib Crane
Sim Date:	8/8/2023
Detector #:	9209

Symmetric Fields

Cantilever Jib Crane -- Unweighted By BField



Total Prim's: 10,000,000,000

Total Sec's: 500,000 (per sens det)

Primary Counts		
Primaries	0	0&1
9209		68267

Primary Fractional		
Primaries	0	0&1
9209		6.83E-06

(9928 MainDet) Secondary Counts - 0&1		
Secondaries	Electrons	Gammas
9209	20	71

(9928 MainDet) Secondary Fractional - 0&1		
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9209	2.73E-10	9.69E-10

(9911 PMT Region) Secondary Counts - 0&1		
Secondaries	Electrons	Gammas
9209	120	166

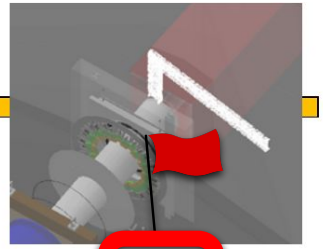
(9911 PMT Region) Secondary Fractional - 0&1		
Secondaries	Electrons	Gammas
9209	2.40E-04	3.32E-04

(9911 PMT Region) Total Fractional - 0&1		
Secondaries	Electrons	Gammas
9209	1.64E-09	2.27E-09

Sens Volume:	Cantilever Jib Crane (Asym Fields)
Sim Date:	8/8/2023
Detector #:	9209

Asymmetric Fields

Cantilever Jib Crane (Asym Fields) -- Unweighted By BField



Total Prim's: 10,000,000,000

Total Sec's: 500,000 (per sens det)

Primary Counts		
Primaries	0	0&1
9209		151336

Primary Fractional		
Primaries	0	0&1
9209		1.51E-05

(9928 MainDet) Secondary Counts - 0&1		
Secondaries	Electrons	Gammas
9209	31	31

(9928 MainDet) Secondary Fractional - 0&1		
Secondaries	Electrons	Gammas
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(9928 MainDet) Total Fractional - 0&1		
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(9911 PMT Region) Total Fractional - 0&1		
Secondaries	Electrons	Gammas
9209	6.66E-09	2.36E-09

Asymmetric fields (worst case scenario) increase problem by around a factor of 5.

- With asymmetric fields we miss our ferrous backgrounds goal of 10^{-11} by two orders of magnitude.
- Selection of position on the wall will be important.
  - Again, the jib crane was placed so that it could clear all other equipment when going to its rest position.