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

FISHERS, NEW YORK, USA

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 $\frac{1}{4}-\frac{1}{2}$ 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



part[0].vy {fabs(hit.pid) == 11 && hit.det == 9928}

htemp Entries

3200 3400 part[0].vv

Mean Std Dev 20

1463 425.3 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



9209 – Jib Crane :: Symmetric Field Maps



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 Cra	ane						/
Sim Date:	8/8/2023						~	1
Detector #:	9209							1 1
			Cantilever Jib (Crane Unweigh	ted By BField	-		
				0		144 M		
Total Prim's:	10,000,000,000		Total Sec's:	500,000	(per sens det)			
	Primary Counts		Р	rimary Fractiona			Set T	
Primaries	0	0&1	Primaries	0	0&1		The P	
9209		68267	9209		6.83E-06		-XI	
(9928 Mair	Det) Secondary C	Counts - 0&1	(9928 MainDe	t) Secondary Fra	ctional - 0&1	(9928 Ma	nDet) Total Fracti	nal - 0&1
Secondaries	Electrons	Gammas	Secondaries	Electrons	Gammas	Secondaries	Electrons	Gammas
9209	20	71	9209	4.00E-05	1.42E-04	9209	2.73E-10	9.69E-10
(9911 PMT R	egion) Secondary	Counts - 0&1	(9911 PMT Regi	on) Secondary F	ractional - 0&1	(9911 PMT	Region) Total Frac	ional - 0&1
Secondaries	Electrons	Gammas	Secondaries	Electrons	Gammas	Secondaries	Electrons	Gammas
9209	120	166	9209	2.40E-04	3.32E-04	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

hit.y:hit.x



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



9209 – Jib Crane :: Asymmetric Field Maps



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

						ne (Asym Fields)	Cantilever Jib Cra	Sens Volume:
	-						8/8/2023	Sim Date: 8
							9209	Detector #:
		-	nweighted By BField	Asym Fields) Ur	antilever Jib Crane (A	C		
			(per sens det)	500,000	Total Sec's:		10,000,000,000	Total Prim's:
			L.	rimary Fractional	P		Primary Counts	
			0&1	0	Primaries	0&1	0	Primaries
	A1		1.51E-05		9209	151336		9209
ctional - 0&1	Det) Total Fraction	(9928 Ma	ctional - 0&1	t) Secondary Fra	(9928 MainDe	ounts - 0&1	Det) Secondary Co	(9928 Main[
Gamma	Electrons	Secondaries	Gammas	Electrons	Secondaries	Gammas	Electrons	Secondaries
9.38E-1	9.38E-10	9209	6.20E-05	6.20E-05	9209	31	31	9209
ac onal - 0&1	legion) Total Frac	(9911 PMT	ractional - 0&1	on) Secondary Fr	(9911 PMT Regi	Counts - 0&1	gion) Secondary	(9911 PMT Re
Gamma	Electrons	Secondaries	Gammas	Electrons	Secondaries	Gammas	Electrons	Secondaries
2 365 0	6.66E-09	9209	1 56E-04	4 40F-04	9209	78	220	9209

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.

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

500

1000

1500

hit.x [mm]

Flux Plane at Jib Crane (near wall) 300 Count [N/cm^2] н Entries 585438 280 Č. -53.87Mean x Mean y 1405 260 Std Dev x 660 Std Dev v 399.1 200 in 2400 2200 150 2000 1800 100 1600 1400 50 1200 1000

0

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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.

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hit.y [mm]

-1000

-500

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

Flux Plane at Jib Crane (near wall)



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(h	nits)
	y(base)	Symm	Asymm
	1200	44196	96157
	1250	43483	90555
	1300	<mark>42315</mark>	<mark>84153</mark>
	1350	30516	64483
	1400	17550	51045
	1450	8714	39101
v	1500	4789	32127
1000	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.





Comparison of Symmetric vs. Asymmetric Secondary Sims

Sens Volume:	Cantilever Jib Cran	e	•		en e			
Sim Date:	8/8/2023	8/8/2023		netric				
Detector #:	9209		e y minotino i norao					
			Cantilever Jib	Crane Unweigh	ted By BField	-		
Total Prim's:	10,000,000,000		Total Sec's:	500,000	(per sens det)			
	Primary Counts		P	rimary Fractiona		0	No Internet	
Primaries	0	0&1	Primaries	0	0&1			
9209		68267	9209	j	6.83E-06		×1	
(9928 Mair	Det) Secondary Co	unts - 0&1	(9928 MainDe	et) Secondary Fra	ctional - 0&1	(9928 M	Det) Total Fract	nal - 0&1
Secondaries	Electrons	Gammas	Secondaries	Electrons	Gammas	Secondaries	Electrons	Gamm
9209	20	71	9209	4.00E-05	1.42E-04	9209	2.73E-10	9.69E-
(9911 PMT R	egion) Secondary C	ounts - 0&1	(9911 PMT Reg	ion) Secondary F	ractional - 0&1	(9911 PM	legion) Total Fra	onal - 0&
Secondaries	Electrons	Gammas	Secondaries	Electrons	Gammas	Secondaries	Electrons	Gamm
9209	120	166	9209	2.40E-04	3.32E-04	9209	1.64E-09	2.27E-

Cantilever Jib Cra	ine (Asym Fields)						100
8/8/2023		Asvm	metric	Fields		-	
9209		7.0,7.11					6 1
	(Cantilever Jib Crane (Asym Fields) U	nweighted By BField			
10,000,000,000		Total Sec's:	500,000	(per sens det)			
Primary Counts		P	rimary Fractiona	L		e o	
0	0&1	Primaries	0	0&1		Mark In	
	151336	9209		1.51E-05			
Det) Secondary C	ounts - 0&1	(9928 MainDe	et) Secondary Fra	ctional - 0&1	(9928 M	Det) Total Fract	al - 0&1
Electrons	Gammas	Secondaries	Electrons	Gammas	Secondaries	Electrons	Gammas
31	31	9209	6.20E-05	6.20E-05	9209	9.38E-10	9.38E-10
egion) Secondary	Counts - 0&1	(9911 PMT Reg	ion) Secondary F	actional - 0&1	(9911 PM	egion) Total Frac	onal - 0&1
Electrons	Gammas	Secondaries	Electrons	Gammas	Secondaries	Electrons	Gammas
220	78	9209	4.40F-04	1.56E-04	9209	6.66F-09	2.36E-09
	Cantilever Jib Cra 8/8/2023 9209 10,000,000,000 Primary Counts 0 Det) Secondary C Electrons 31 egion) Secondary Electrons	Cantilever Jib Crane (Asym Fields) 8/8/2023 9209 10,000,000,000 Primary Counts 0 0&1 151336 Det) Secondary Counts - 0&1 Electrons Gammas 31 31 egion) Secondary Counts - 0&1 Electrons Gammas 20 78	Cantilever Jib Crane (Asym Fields) 8/8/2023 9209 Cantilever Jib Crane (10,000,000,000 Total Sec's: Primary Counts 0 0&1 151336 9209 Det) Secondary Counts - 0&1 Electrons Gammas 31 31 9209 egion) Secondary Counts - 0&1 (9911 PMT Reg Electrons Gammas Secondaries 31 31 9209	Cantilever Jib Crane (Asym Fields) 8/8/2023 9209 Cantilever Jib Crane (Asym Fields) Cantilever Jib Crane (Asym Fields) – U 10,000,000,000 Primary Counts 0 0&1 151336 9209 Det) Secondary Counts - 0&1 Electrons Gammas 31 31 9209 6.20E-05 gion) Secondary Counts - 0&1 (9912 MainDet) Secondary Fra Secondaries Electrons 31 31 9209 6.20E-05 9209 4.40F-04	Cantilever Jib Crane (Asym Fields) Asymmetric Fields 8/8/2023 Cantilever Jib Crane (Asym Fields) – Unweighted By Brield 10,000,000,000 Total Sec's: 500,000 (per sens det) Primary Counts Primaries 0 0&1 0 0&1 Primaries 0 0&1 Det) Secondary Counts - 0&1 (9928 MainDet) Secondary Fractional - 0&1 Cantilever Jib Crane (Asym Fields) – Unweighted By Brield 10,000,000,000 Total Sec's: 500,000 (per sens det) Primary Counts Primaries 0 0&1 151336 9209 1.51E-05 Secondaries Electrons Gammas 31 31 9209 6.20E-05 6.20E-05 Secondaries Electrons Gammas 200 78 9209 4.40F-04 1.56F-04	Cantilever Jib Crane (Asym Fields) 8/8/2023 Asymmetric Fields 9209 Cantilever Jib Crane (Asym Fields) – Unweighted By BField 10,000,000,000 Total Sec's: 500,000 (per sens det) Primary Counts Primary Fractional 0 0&1 151336 9209 9209 1.51E-05 Det) Secondary Counts - 0&1 (9928 MainDet) Secondary Fractional - 0&1 Electrons Gammas 31 31 9209 6.20E-05 egion) Secondary Counts - 0&1 (9911 PMT Region) Secondary Fractional - 0&1 Electrons Gammas Secondaries Electrons 220 78 9209	Cantilever Jib Crane (Asym Fields) Asymmetric Fields 8/8/2023 9209 9209 Cantilever Jib Crane (Asym Fields) Unweighted By BField 10,000,000,000 Total Sec's: 500,000 (per sens det) Primary Counts Primary Fractional 0 0&1 151336 9209 0 0&1 151336 9209 151336 9209 151336 9209 151336 9209 0 0&21 151336 9209 9209 1.51E-05 Det) Secondary Counts - 0&1 (9928 MainDet) Secondary Fractional - 0&1 Electrons Gammas 31 31 9209 6.20E-05 9209 9.38E-10 9209 9.38E-10 9209 9.38E-10 9209 9.38E-10 9209 9.404-06-04 1.56E-04 9209 9209 9.66E-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.