

Ferrous Materials:

Pion Donut Tie-rods

**Updated conclusion explanation:
Kent Paschke
July 27, 2023**

Eric King

Updated:

July 19th, 2023

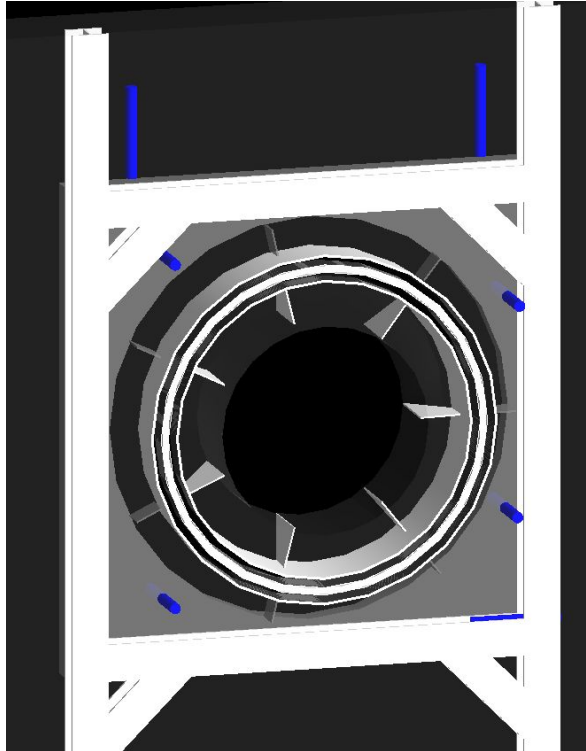
Pion Donut Tie-rods

Total volume of steel = to amounts cited by Ryan in email.

Modeled as tubes of steel from end to end making no assumptions about the material.

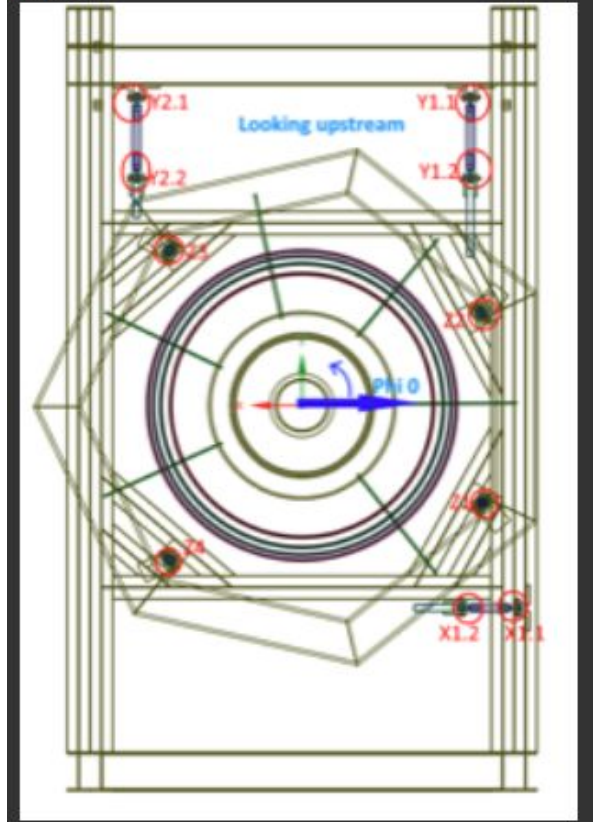
Model Looks reasonable.

Assigned ferrous detector number 9221



Very Respectfully,

Ryan



9221 – Pion Donut Tierods

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:	Pion Donut Tierods
Sim Date:	2/8/2023
Detector #:	9221

Background rates per e.o.t. are
 $\sim 10^{-10} \ll 10^{-8}$

Pion Donut Tierods -- Unweighted By BField

Total Prim's: 12,500,000,000

Total Sec's: 5,000,000 (per sens det)

Primary Counts		
Primaries	0	0&1
9221		4119

Primary Fractional		
Primaries	0	0&1
9221		3.30E-07

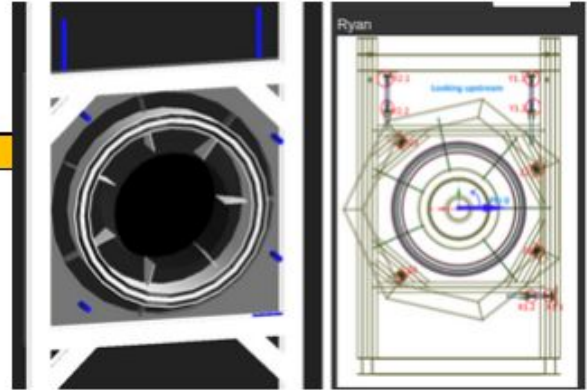
(9928 MainDet) Secondary Counts - 0&1		
Secondaries	Electrons	Gammas
9221	2348	5237

(9928 MainDet) Secondary Fractional - 0&1		
Secondaries	Electrons	Gammas
9221	4.70E-04	1.05E-03

(9928 MainDet) Total Fractional - 0&1		
Secondaries	Electrons	Gammas
9221	1.55E-10	3.45E-10

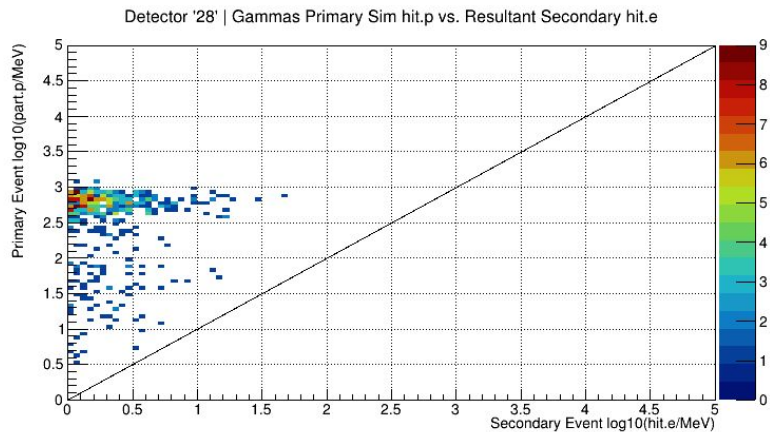
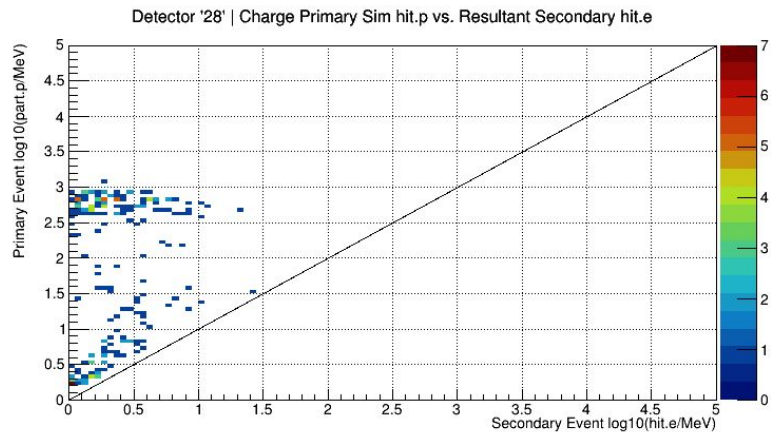
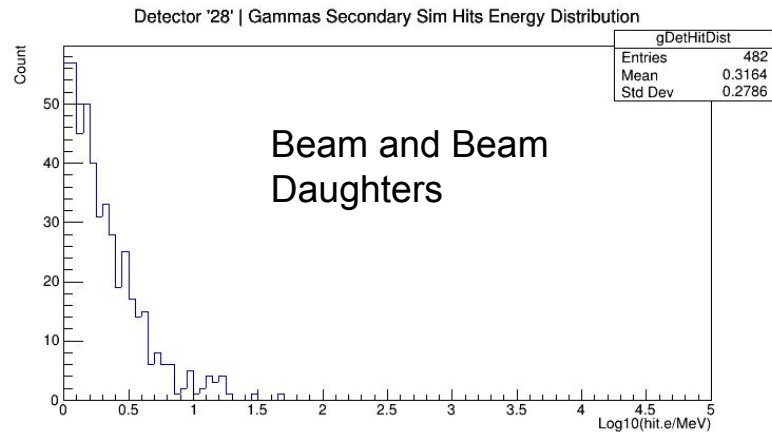
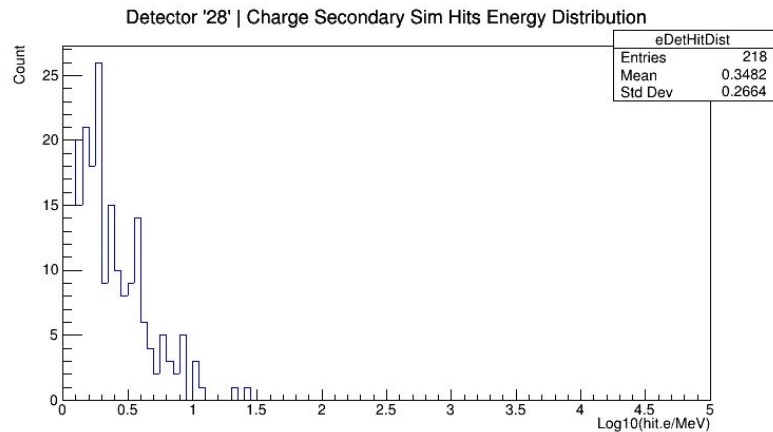
(9911 PMT Region) Secondary Counts - 0&1		
Secondaries	Electrons	Gammas
9221		

(9911 PMT Region) Secondary Fractional - 0&1		
Secondaries	Electrons	Gammas
9221	0.00E+00	0.00E+00



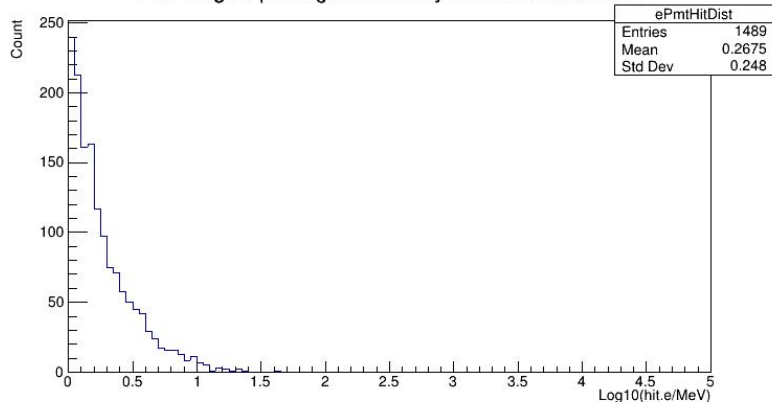
(9911 PMT Region) Total Fractional - 0&1		
Secondaries	Electrons	Gammas
9221	0.00E+00	0.00E+00

9221 – Pion Donut Tierods

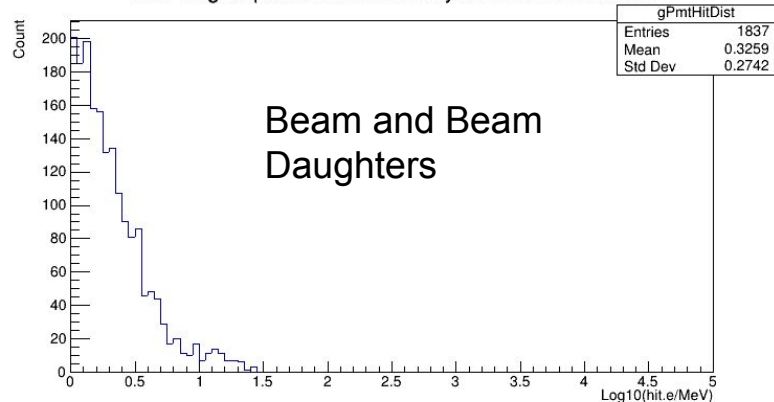


9221 – Pion Donut Tierods

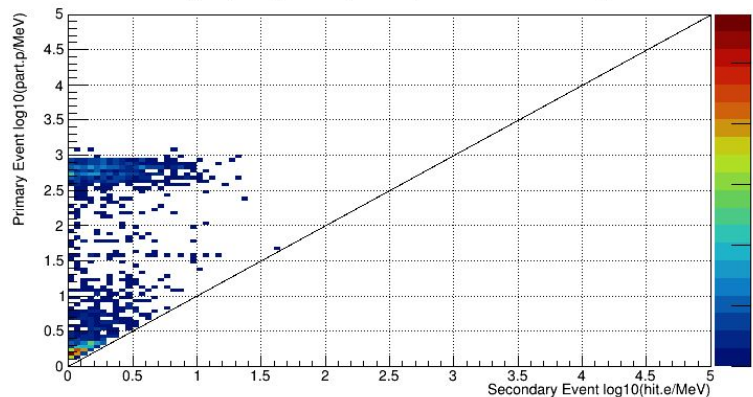
PMT Region | Charge Secondary Sim hit.e Distribution



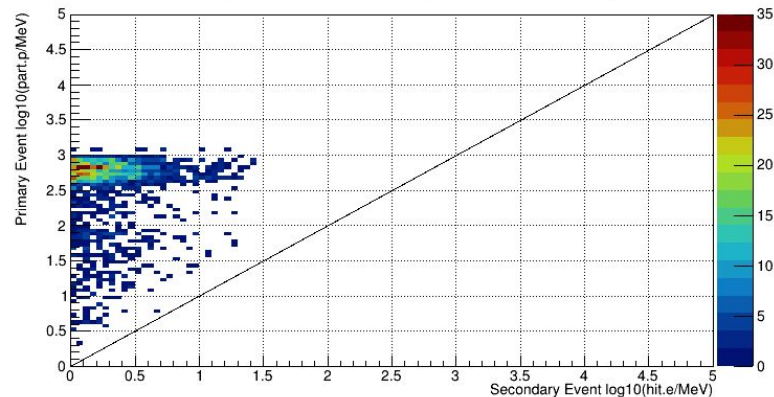
PMT Region | Gammas Secondary Sim hit.e Distribution



PMT Region | Charge Primary Sim hit.p vs. Resultant Secondary hit.e

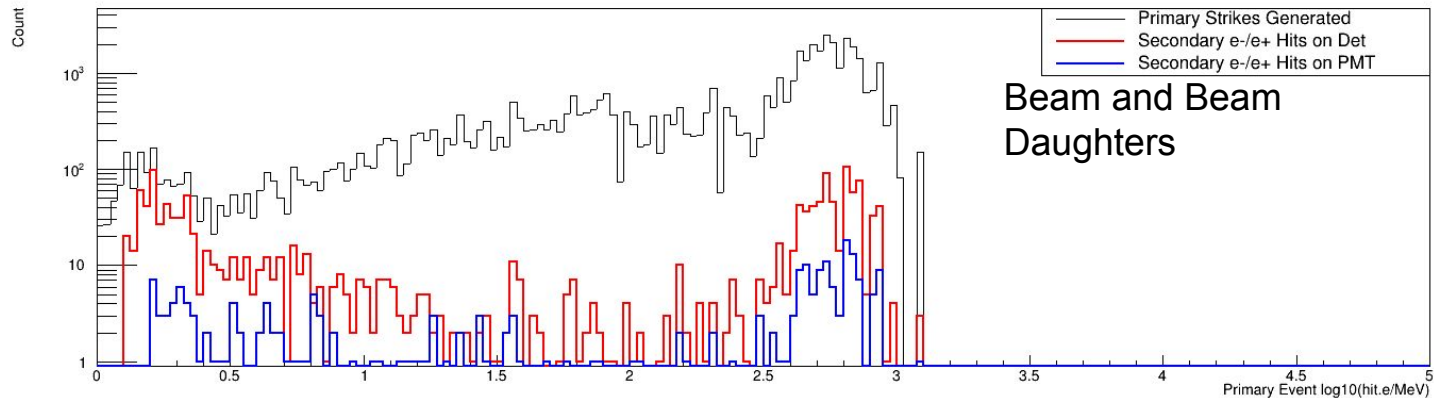


PMT Region | Gammas Primary Sim hit.p vs. Resultant Secondary hit.e

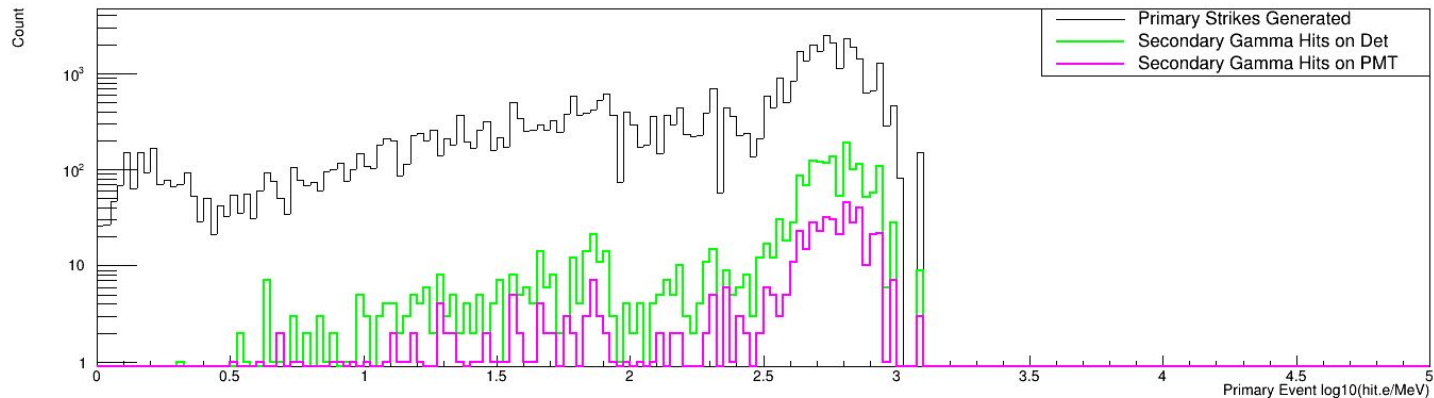


9221 – Pion Donut Tierods

Detector 9221 | Charges hit.e From Primary hit.mtrid <= 1



Detector 9221 | Charges hit.e From Primary hit.mtrid <= 1



9221 – Pion Donut Tierods

Takeaway

Material	X _r	Spin Polarization (P _f)	Frac e- on Target	Frac of events Per Moller
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- ~~No specific concerns about the pion donut tie rods.~~
These components should not be made from ferrous steel.
If ferrous steel is required, further study is required to demonstrate risk is manageable
- Objects → tubes in simulation model the mass of the tie rods and tie rod ends per Ryan Biraben at specified locations^{Text}

➤ **10⁻¹⁰ (ferrous background rates) << 10⁻⁸ rates for even the worst-quality (in terms of χ_R) stainless steel.**

Component specifics given to me.

Rod Ends (McMaster Carr 60656K62) are each 119 cm³ of zinc-plated carbon steel. Bolts (McMaster Carr 91247A924) are each 76 cm³ of zinc-plated grade 5 steel.

Specified locations for tie rods, just for the record.

Link	φ (°)	R (in)	R (mm)
X1.1	318.2	89.2	2267
X1.2	309.6	77.2	1961
Y1.1	62.3	107.2	2722
Y1.2	54.5	85.8	2180
Y2.1	116.9	106.4	2704
Y2.2	124.6	84.9	2157
Z1.1 & .2	331.6	63.4	1612
Z2.1 & .2	27.3	62.2	1580
Z3.1 & .2	130.6	63.0	1600
Z4.1 & .2	229.3	62.8	1596