

Ferrous Materials:

HRS Steel Track Rings

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Updated:

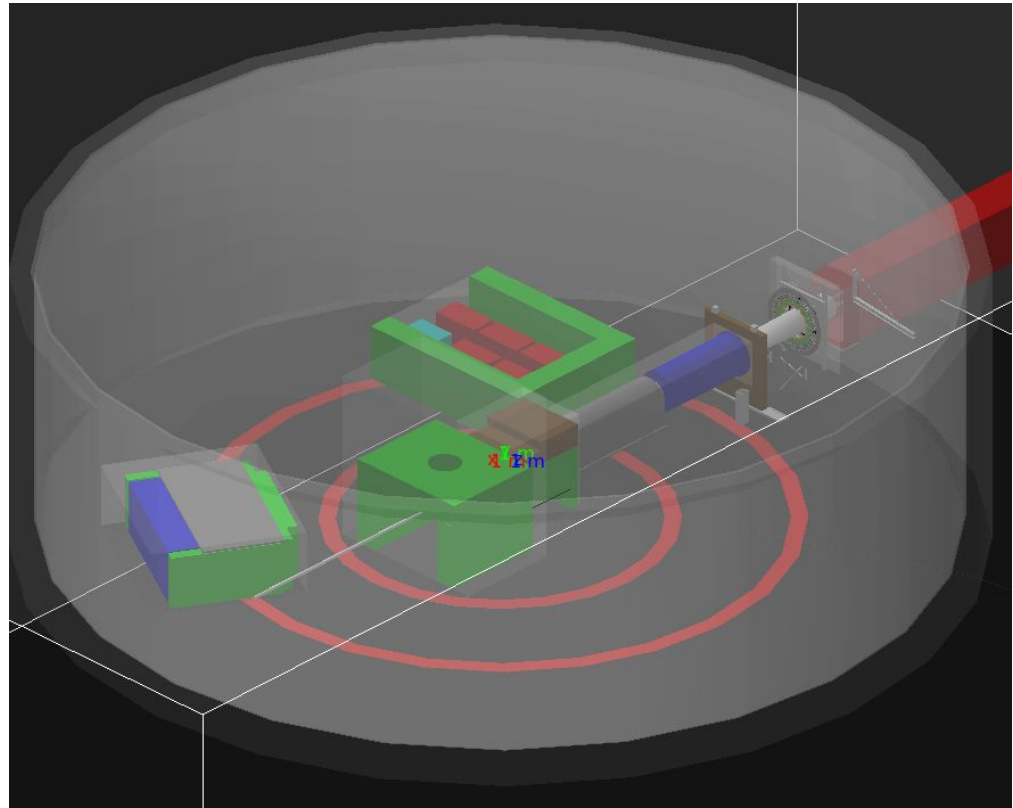
June 12th, 2023

9000 – HRS Steel Tracks

Geometry incorporated per specs from Kent's spring semester student who worked on the project.

r_{\min} (mm)	r_{\max} (mm)	Z_{full} (mm)
9360	10360	30
16550	17550	30

Since these remain an area of concern I may look at them more in detail than usual.



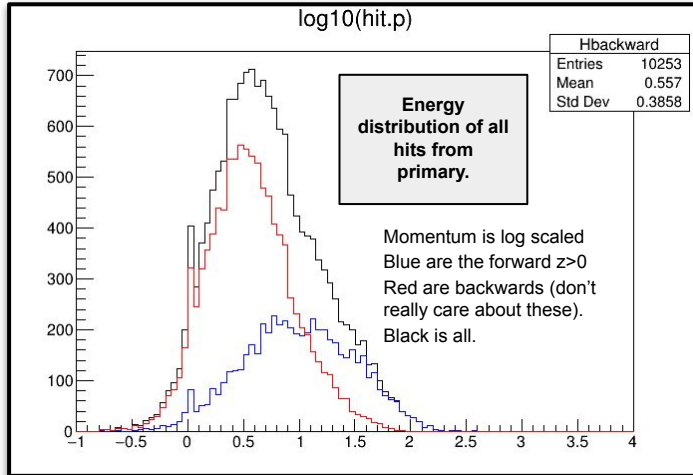
9000 – HRS Steel Tracks

Primary Hits

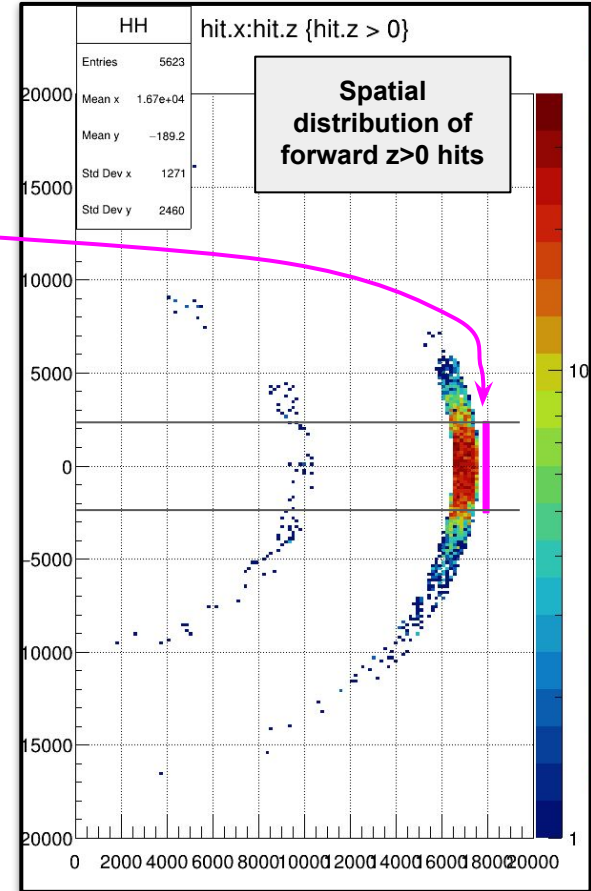
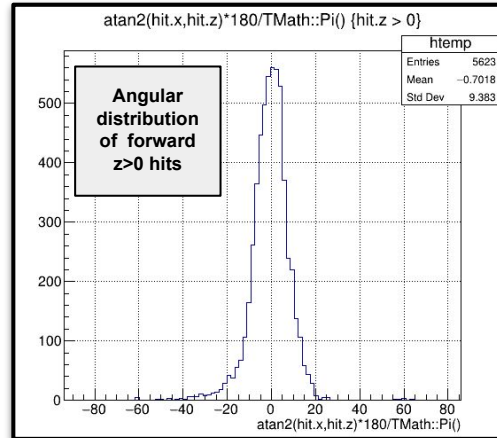
This is more or less just for my curiosity.

Magenta is rough location of the barite wall which should extend from $x=[-2300,2300]$

In practice much of this stuff should be blocked.



Momentum of events of interest peaks around 10MeV tapering off to a tail around 100MeV



9000 – HRS Steel Tracks

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

I don't see these as necessarily problematic.

I'm unsure why they were previously...
Wall size issue maybe? idk.

Sens Volume:	HRS Steel Tracks
Sim Date:	5/30/2023
Detector #:	9000

HRS Steel Tracks -- Unweighted By BField

Total Prim's:	10,000,000,000
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Total Sec's:	500,000	(per sens det)
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Primary Counts		
Primaries	0	0&1
9000	15876	

Primary Fractional		
Primaries	0	0&1
9000	1.59E-06	

(9928 MainDet) Secondary Counts - 0&1		
Secondaries	Electrons	Gammas
9000	1	10

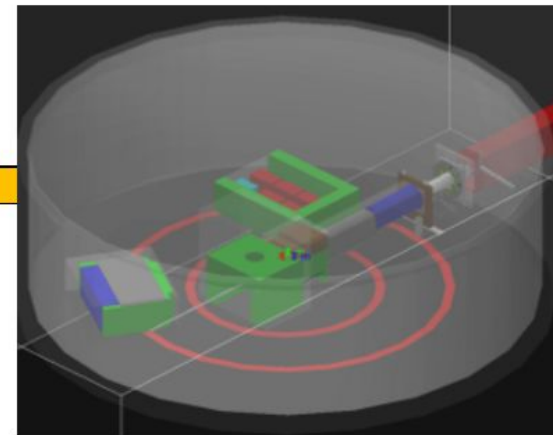
(9928 MainDet) Secondary Fractional - 0&1		
Secondaries	Electrons	Gammas
9000	2.00E-06	2.00E-05

(9928 MainDet) Total Fractional - 0&1		
Secondaries	Electrons	Gammas
9000	3.18E-12	3.18E-11

(9911 PMT Region) Secondary Counts - 0&1		
Secondaries	Electrons	Gammas
9000	13	33

(9911 PMT Region) Secondary Fractional - 0&1		
Secondaries	Electrons	Gammas
9000	2.60E-05	6.60E-05

(9911 PMT Region) Total Fractional - 0&1		
Secondaries	Electrons	Gammas
9000	4.13E-11	1.05E-10



9000 – HRS Steel Tracks

Hits pass from wall sides through wall center.

If we wanted we could eliminate this with some shielding.

- One Pb brick 2" thick is about 9 rad lengths.
 - 1" sheets for ground cover in areas of concern???
 - Aluminum rad length is ~9cm – just not practical to get meaningful shielding.
- Another thought is shielding walls of Pb bricks to block both barite-wall rail ferrous backgrounds and this.
- I think thin Pb sheets are better although idk if that will necessarily fly with the lab safety.

Atomic and nuclear properties of aluminum (Al)

Quantity	Value	Units	Value	Units
Atomic number	13			
Atomic mass	26.9815385(7)	g mol ⁻¹		
Density	2.699	g cm ⁻³		
Mean excitation energy	166.0	eV		
Minimum ionization	1.615	MeV g ⁻¹ cm ²	4.358	MeV cm ⁻¹
Nuclear interaction length	107.2	g cm ⁻²	39.70	cm
Nuclear collision length	69.7	g cm ⁻²	25.81	cm
Pion interaction length	136.6	g cm ⁻²	50.62	cm
Pion collision length	95.6	g cm ⁻²	35.41	cm
Radiation length	24.01	g cm ⁻²	8.897	cm
Critical energy	42.70	MeV (for e ⁻)	41.48	MeV (for e ⁺)
Muon critical energy	612.	GeV		
Molière radius	11.93	g cm ⁻²	4.419	cm
Plasma energy $\hbar\omega_p$	32.86	eV		
Melting point	933.5	K	660.3	C
Boiling point @ 1 atm	2792.	K	2519.	C

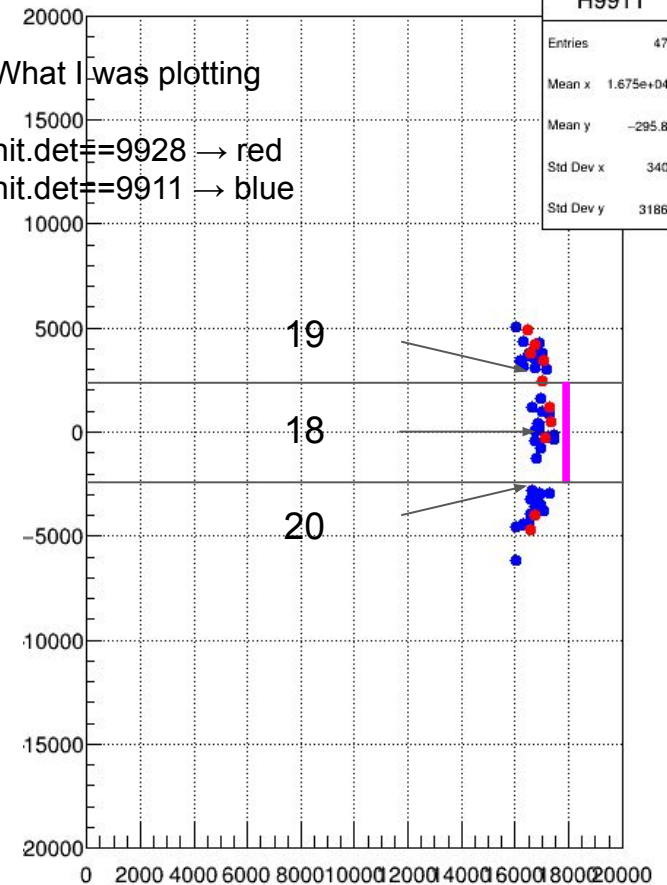
Atomic and nuclear properties of lead (Pb)

Quantity	Value	Units	Value	Units
Atomic number	82			
Atomic mass	207.2(1)	g mol ⁻¹		
Density	11.35	g cm ⁻³		
Mean excitation energy	823.0	eV		
Minimum ionization	1.122	MeV g ⁻¹ cm ²	12.74	MeV cm ⁻¹
Nuclear interaction length	199.6	g cm ⁻²	17.59	cm
Nuclear collision length	114.1	g cm ⁻²	10.05	cm
Pion interaction length	225.9	g cm ⁻²	19.90	cm
Pion collision length	137.3	g cm ⁻²	12.10	cm
Radiation length	6.37	g cm ⁻²	0.5612	cm
Critical energy	7.43	MeV (for e ⁻)	7.16	MeV (for e ⁺)
Muon critical energy	141.	GeV		
Molière radius	18.18	g cm ⁻²	1.602	cm
Plasma energy $\hbar\omega_p$	61.07	eV		
Melting point	600.6	K	327.5	C
Boiling point @ 1 atm	2022.	K	1749.	C

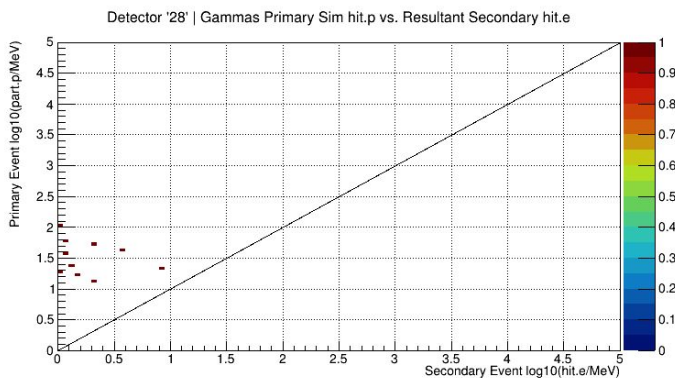
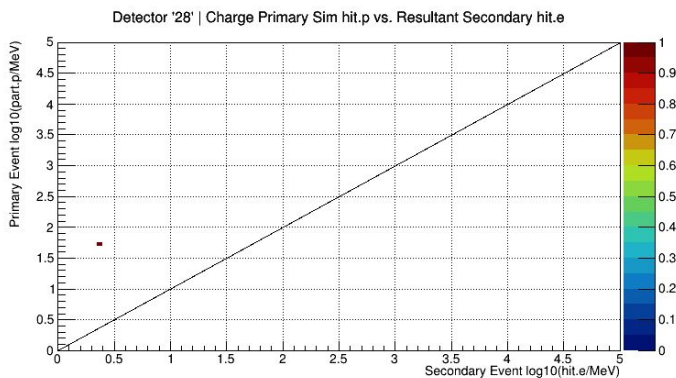
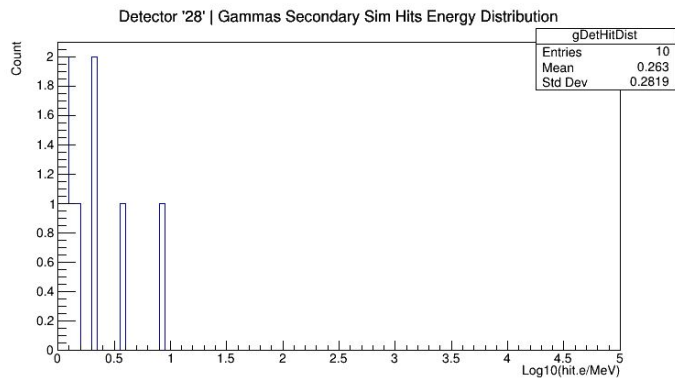
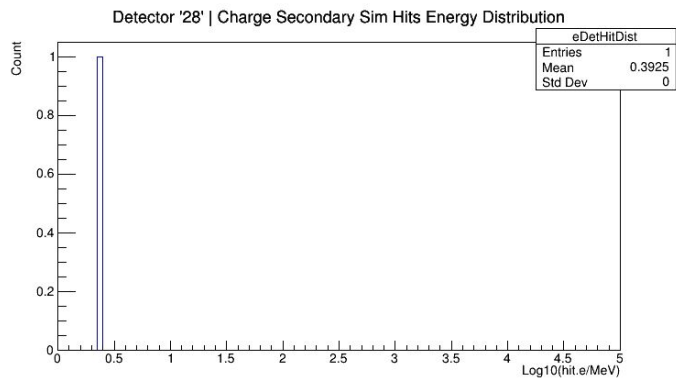
What I was plotting

hit.det==9928 → red

hit.det==9911 → blue



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