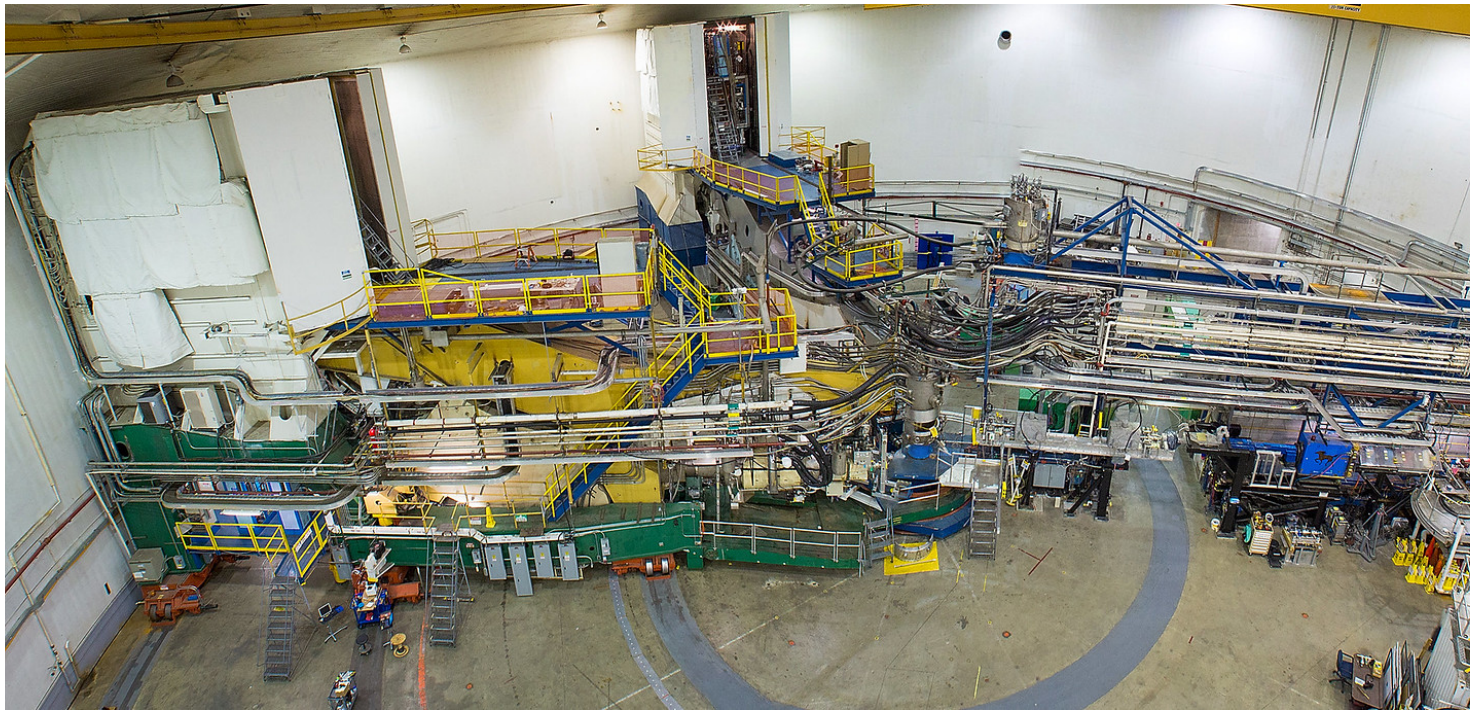
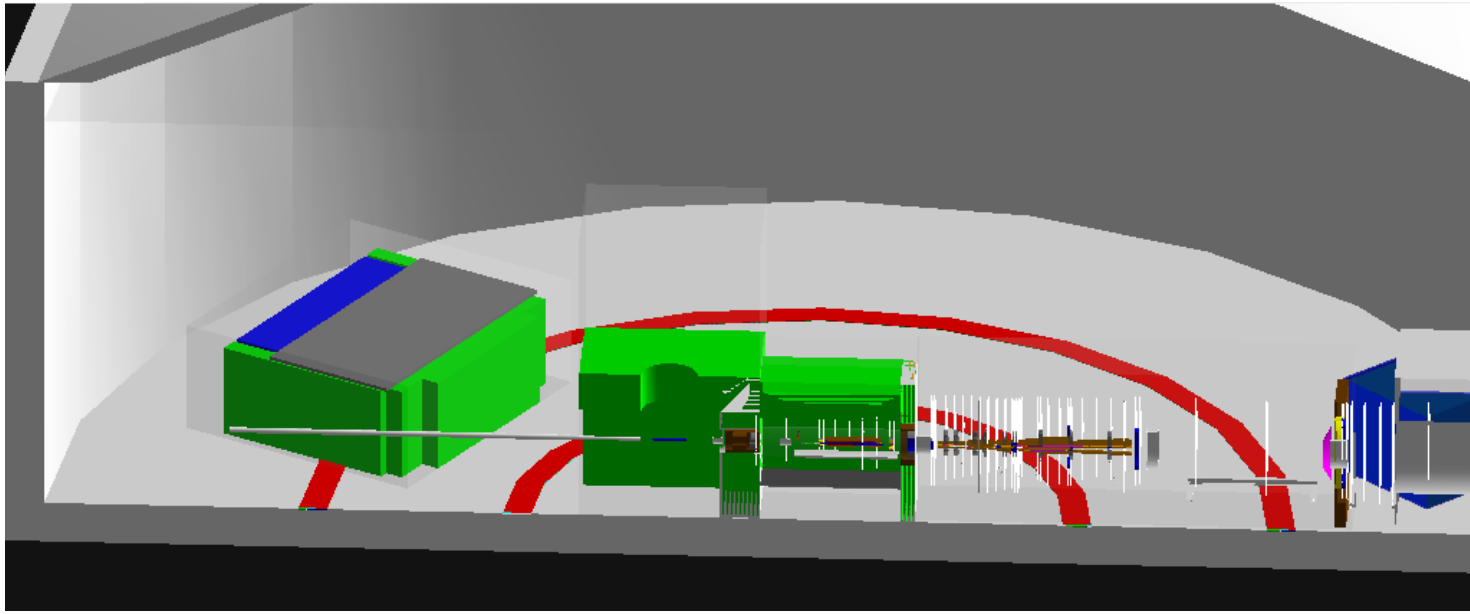
Ferrous Pivot Rings

Christopher Martin - UVa

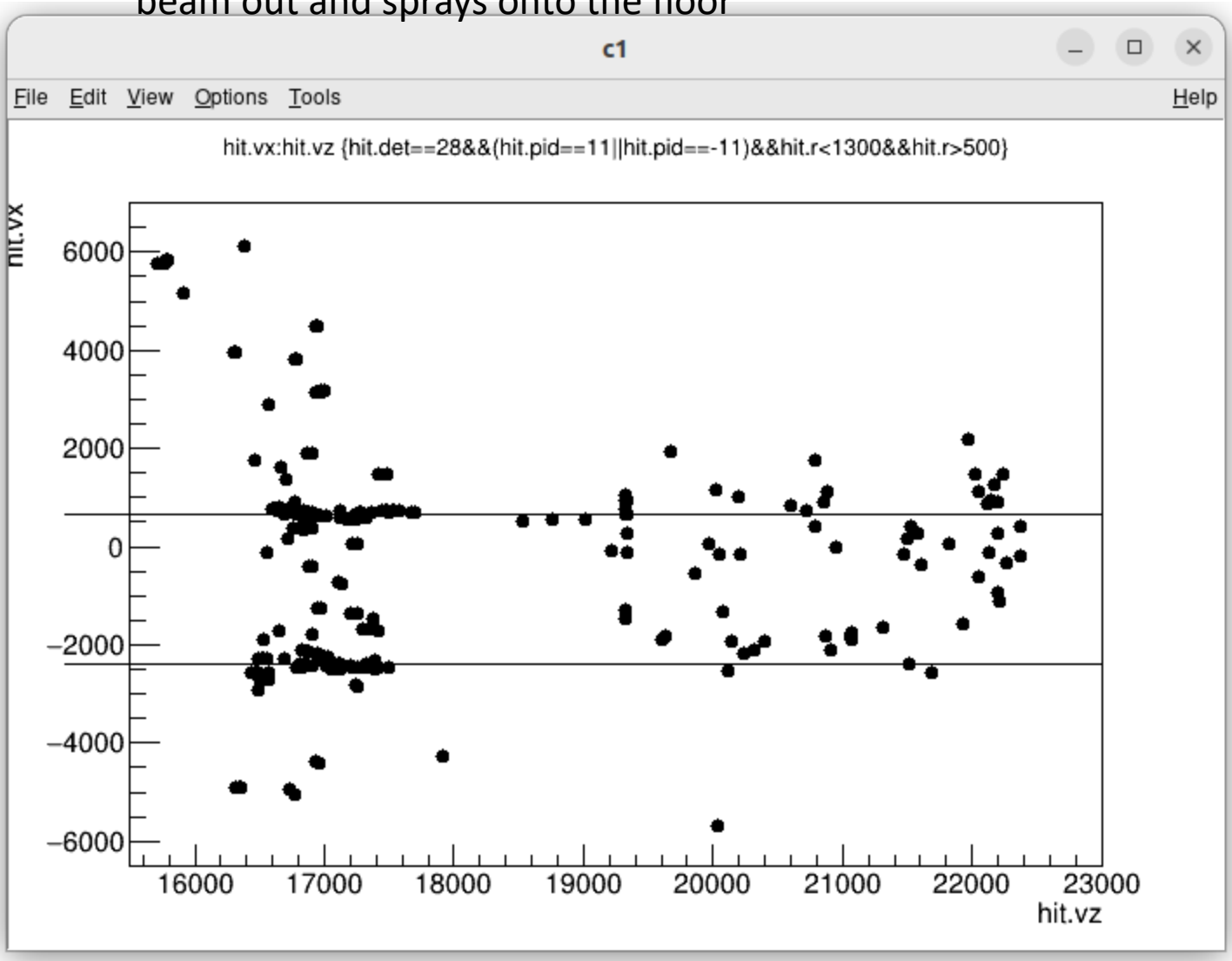


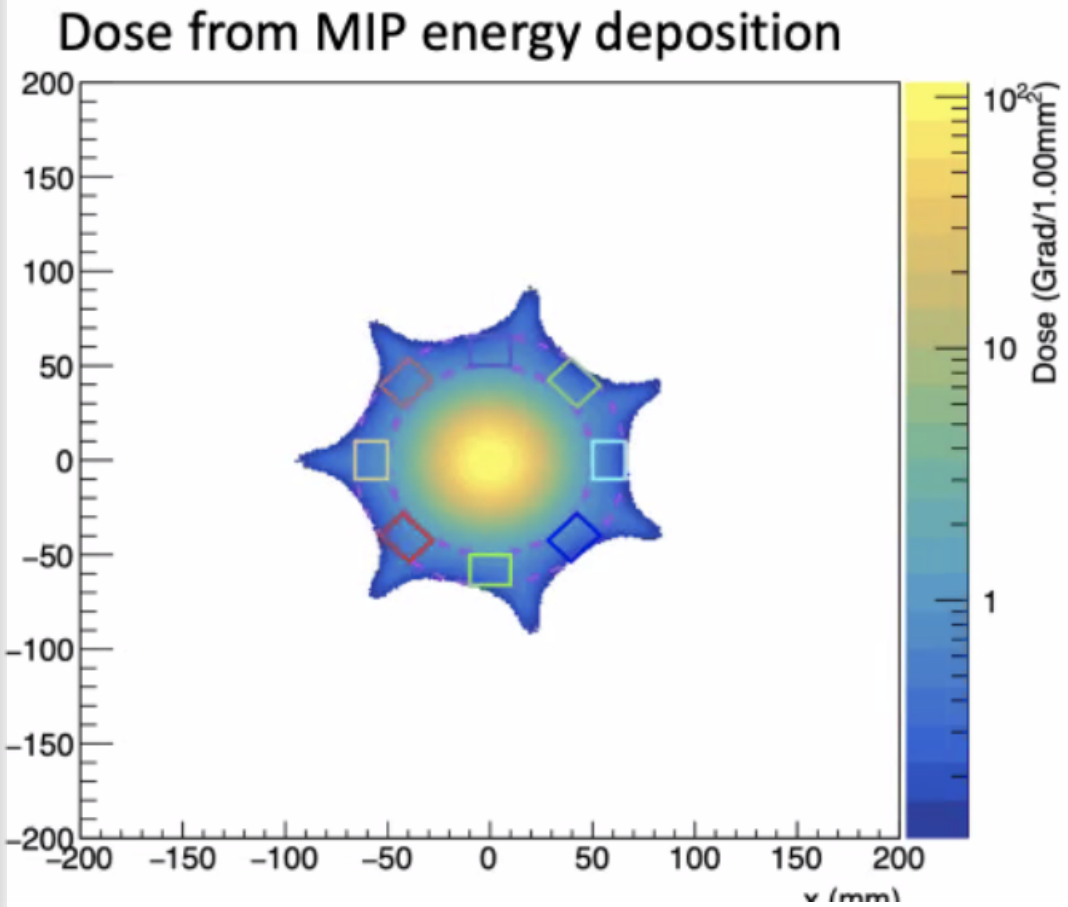


Methods & Information

- Detector 9001: Inner Ring parallel volume
  - 9360 mm to 10360 mm (1 meter thick)
  - Thickness of 30 mm
- Detector 9002: Outer Ring parallel volume
  - Identical dimensions (16550 mm to 17550 mm)
  - Location embedded in the floor
- The third Ring (near the edge of the hall) was not simulated
- Physical volumes located in geometry/hall/hallDaughter_merged.gdml
- Material: G4_STAINLESS-STEEL
- Source for dimensions: https://hallaweb.jlab.org/equipment/Hall-A-NIM.pdf

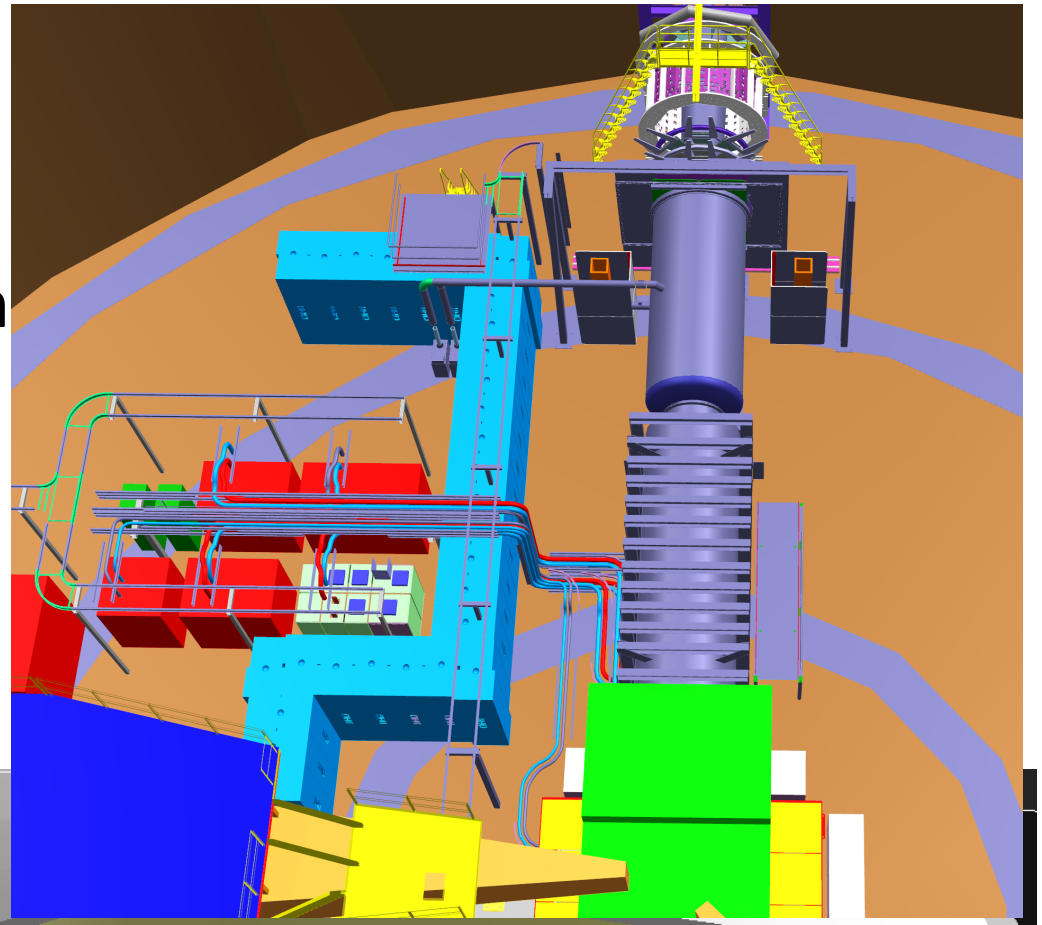
-Distribution of hits on Det 9002 suggests a pattern of rays
-Confirmed that these occur between segments of coils placed axially along the beam line
-Segment gaps provide magnetic fields that bend residual beam out and sprays onto the floor

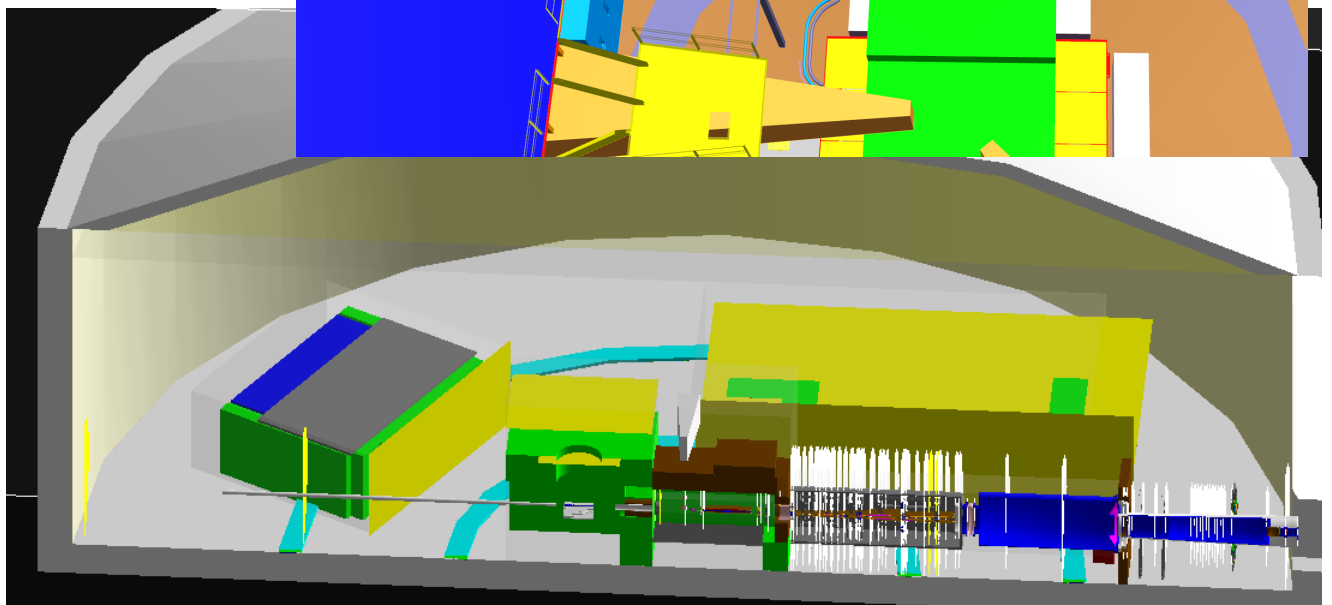




Develop Sims

- 6 inches of Concrete shielding, no aluminum
- Using only asymmetric fields
  - Then Rotated said fields by 180 degrees
- 100 Million Events in the primary
- 1 Million in the secondary
- Includes electrons and positrons





Configurations

- Fields: Default, Asymmetric, also Asymmetric rotated 180° in φ to point at the floor
- Shielded: 6 inches of Concrete placed on top of the steel rings for some runs

Results

- Primary simulations yielded only 20-70 primary hits from 100M.
- Results were somewhat inconsistent regarding shielding and primary illumination, perhaps suggesting showering was important
- pattern of illumination as expected (open sector stripes)
- Inner ring (det 9001) had zero det28 hits in secondary from develop branch
- Secondary hits are 1-10 MeV with <10% from 10-100 MeV
- Results do not consider depolarization, which will be at least a factor of three

configuration, det 9003	*f* [1e-11] eot
unshielded, default field	3.0
unshielded, asym field	4.0
unshielded, asym field with 180deg rotation	6.0
shielded, default field	4.5
shielded, asym field	3.3
shielded, asym field with 180deg rotation	2.0

Does this raise concerns about rebar?

Some assumptions to make an estimate:

- Pi shaped wedges on each side of the barite wall matters
- Nothing much upstream of 16.5 meters matters much (solid angle to the detectors)
- Nothing much downstream of 20.5 meters matters much (angle to the detector)
- so the area of concrete relative to area of the 1-meter wide pivot track is only about 4:1
- fill factor in layer of rebar near surface is only about 10%
- so rebar, even assuming concrete isn't helping, is only about 40% more than the bogie track alone

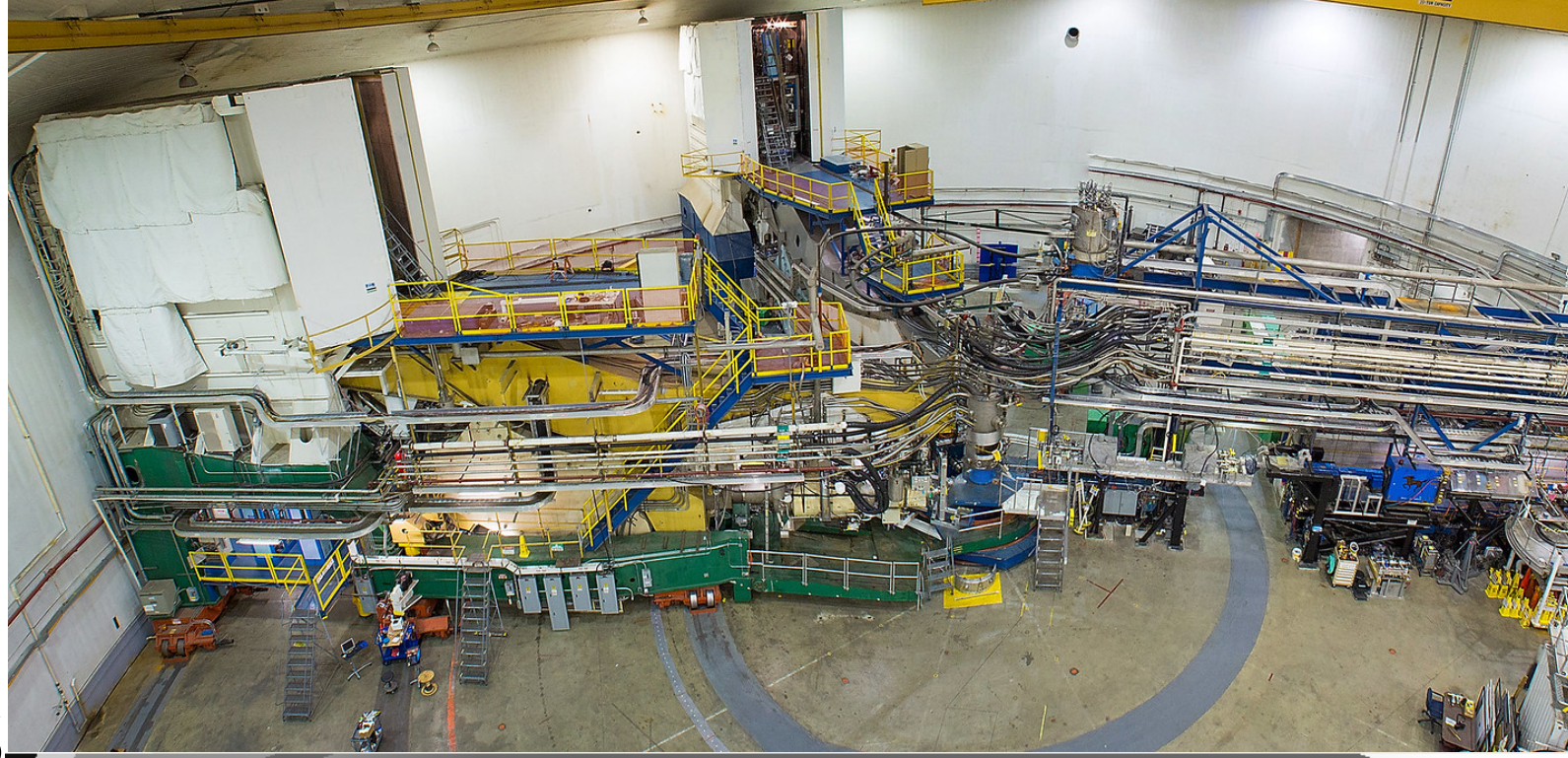
Probably still ok!

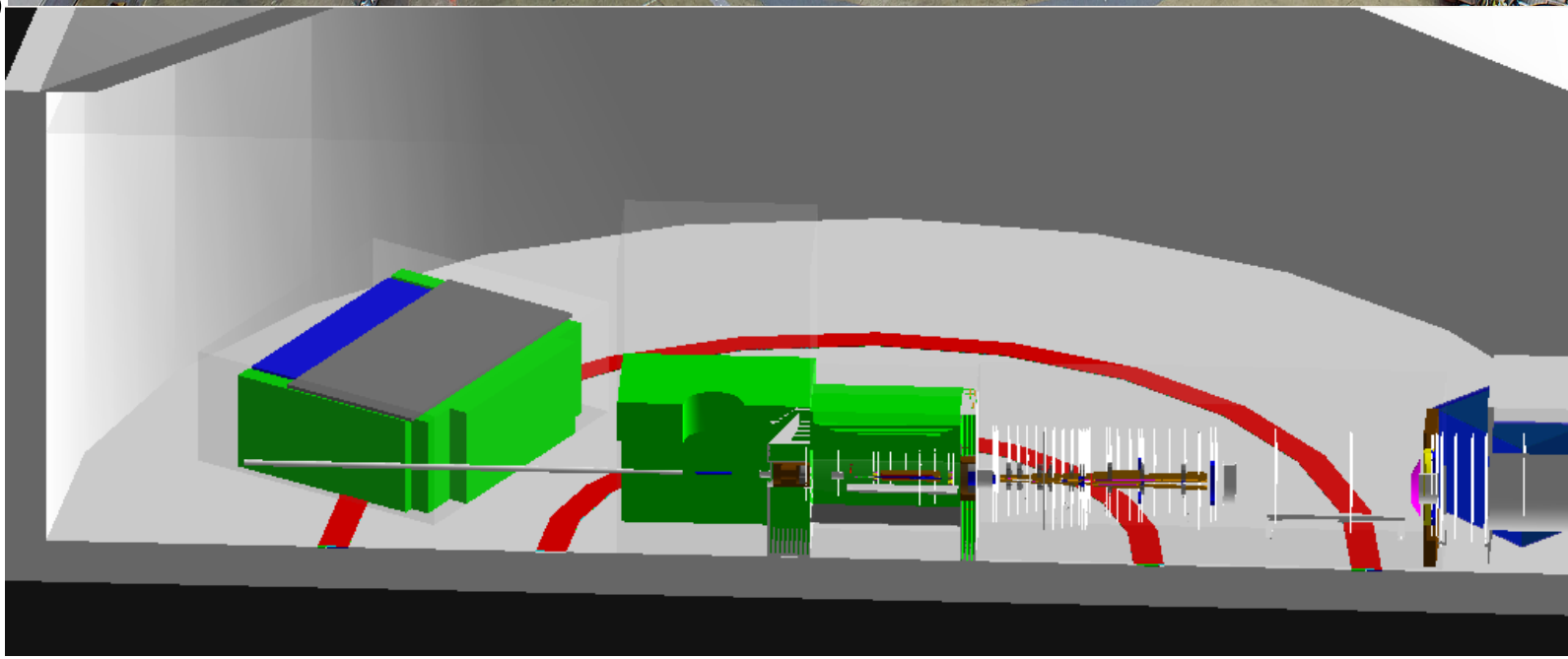
- Just barely exceeding our 1e-11 criterion after consider factor of 3 from depolarization.
  Other factors probably help, too….
- Didn't consider the MPS bunker wall, but it is spec'd with fiberglass rebar

Backup

Ferrous Pivot Rings

Christopher Martin





Methods & Information

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- Material: G4_STAINLESS-STEEL
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-Distribution of hits on Det 9002 suggests a pattern of rays
-Confirmed that these occur between segments of coils placed axially along the beam line
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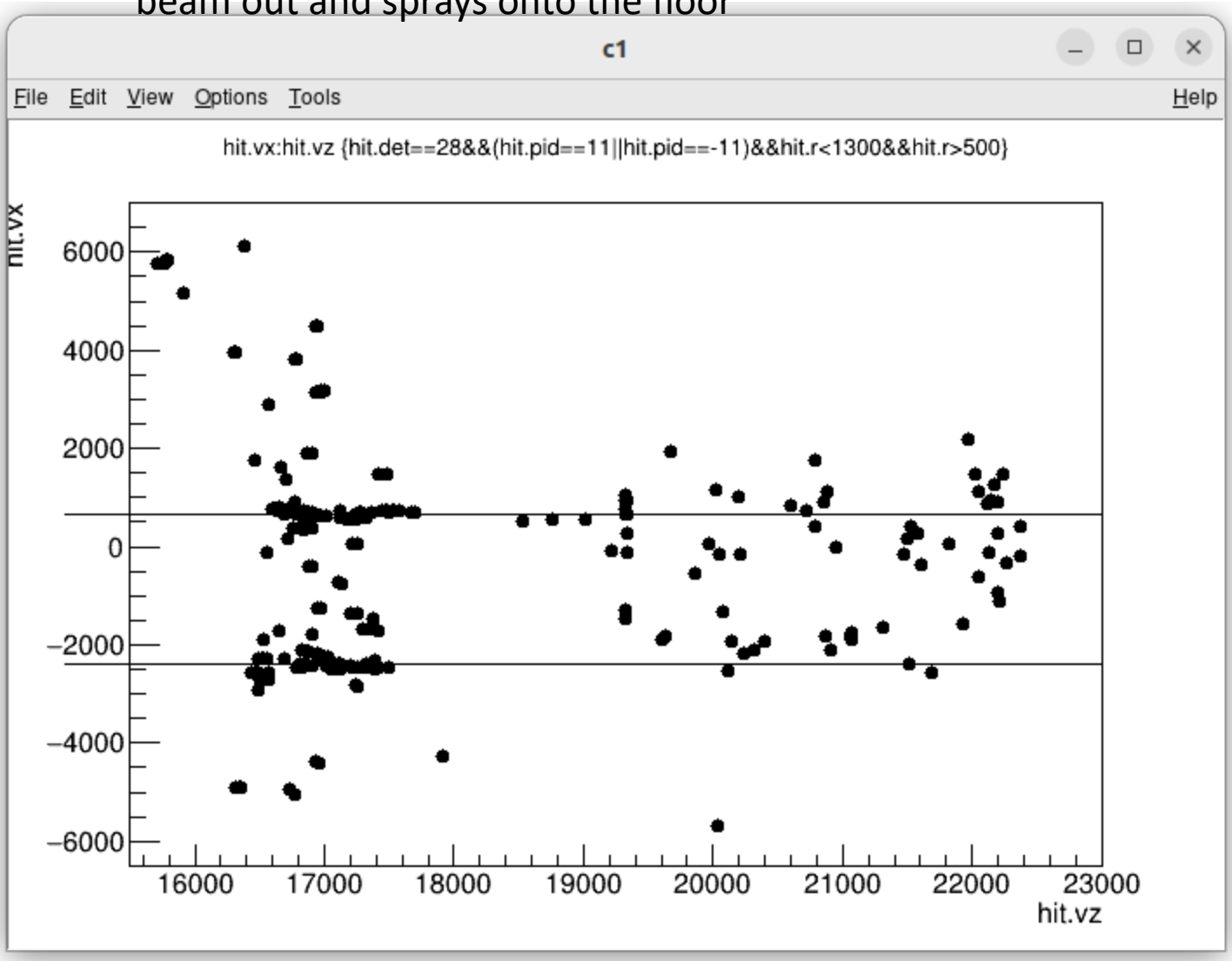
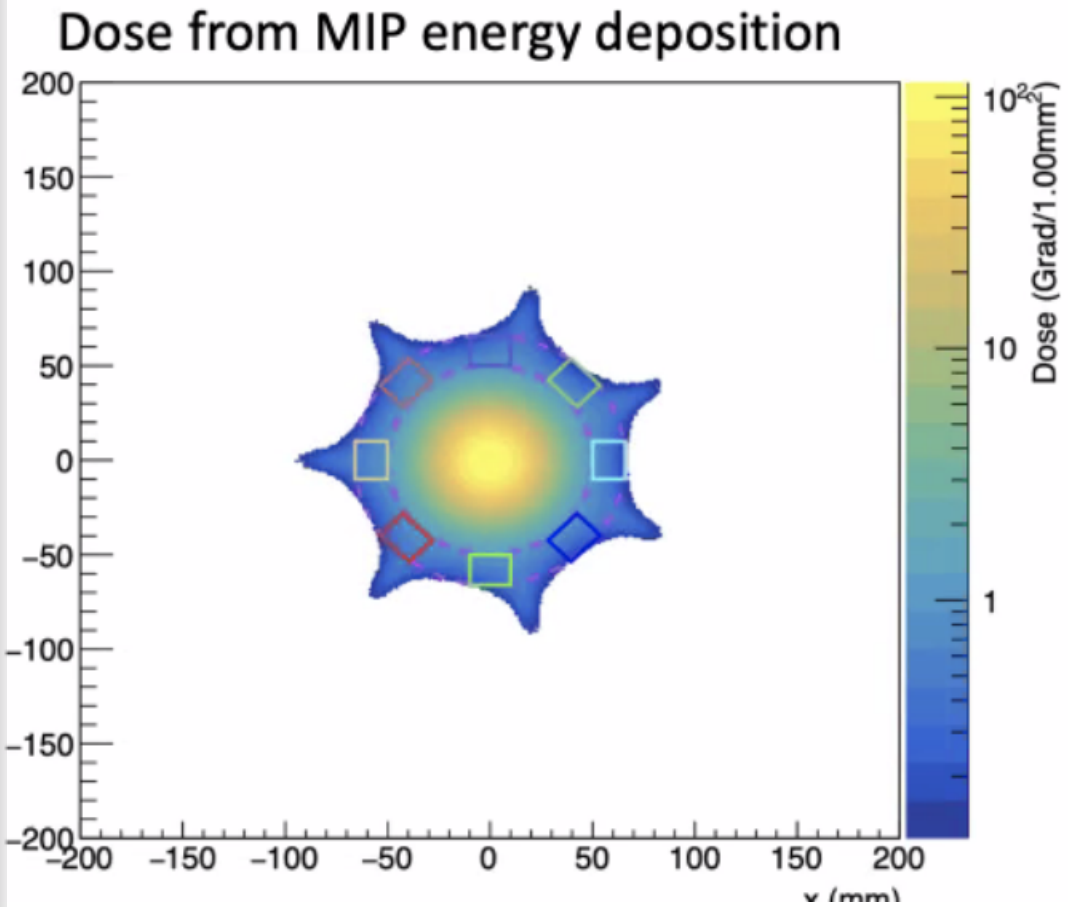




Data

Fields: SYM						
Det: 9001	Primary			Secondary		
Energy	Raw	Scaled (to 100M)	Probability	Raw	Probability	EOT
KE<1 MeV	2	2.20E+00	2.20E-08	1	0.00001	1.59E-11
KE: 1-10 MeV	58	6.37E+01	6.37E-07	16	0.00016	2.55E-10
KE: 10-100 MeV	85	9.34E+01	9.34E-07	3	0.00003	4.78E-11
KE: 0.1-1 GeV	0	0.00E+00	0.00E+00	0	0	0.00E+00
KE: 1-10 GeV	0	0.00E+00	0.00E+00	0	0	0.00E+00
KE> 10 GeV	0	0.00E+00	0.00E+00	0	0	0.00E+00
Total Hits	145	1.59E+02	1.59E-06	20	0.0002	3.19E-10

Fields: ANTI						
Det: 9001	Primary			Secondary		
Energy	Raw	Scaled (to 100M)	Probability	Raw	Probability	EOT
KE<1 MeV	1	1.01E+00	1.01E-08	2	0.00002	2.44E-11
KE: 1-10 MeV	27	2.73E+01	2.73E-07	5	0.00005	6.11E-11
KE: 10-100 MeV	93	9.39E+01	9.39E-07	0	0	0.00E+00
KE: 0.1-1 GeV	0	0.00E+00	0.00E+00	0	0	0.00E+00
KE: 1-10 GeV	0	0.00E+00	0.00E+00	0	0	0.00E+00
KE> 10 GeV	0	0.00E+00	0.00E+00	0	0	0.00E+00
Total Hits	121	1.22E+02	1.22E-06	7	0.00007	8.56E-11

- Primary: 100 Sims 1 Millions events each
- Secondary: 100,000 Events in 10 Jobs
- Secondary Includes electrons and positrons
- 100 Millions events in Primary
  - Lost 9 files (9 Million events) in Symmetric sim
  - Lost 1 file (1 Million events) in Antisym sim

Fields: SYM						
Det: 9002	Primary			Secondary		
Energy	Raw	Scaled (to 100M)	Probability	Raw	Probability	EOT
KE<1 MeV	1	1.10E+00	1.10E-08	3	0.00003	7.62E-11
KE: 1-10 MeV	29	3.19E+01	3.19E-07	34	0.00034	8.63E-10
KE: 10-100 MeV	87	9.56E+01	9.56E-07	5	0.00005	1.27E-10
KE: 0.1-1 GeV	114	1.25E+02	1.25E-06	0	0	0.00E+00
KE: 1-10 GeV	0	0.00E+00	0.00E+00	0	0	0.00E+00
KE> 10 GeV	0	0.00E+00	0.00E+00	0	0	0.00E+00
Total Hits	231	2.54E+02	2.54E-06	42	0.00042	1.07E-09

Fields: ANTI						
Det: 9002	Primary			Secondary		
Energy	Raw	Scaled (to 100M)	Probability	Raw	Probability	EOT
KE<1 MeV	0	0.00E+00	0.00E+00	2	0.00002	1.74E-11
KE: 1-10 MeV	10	1.01E+01	1.01E-07	29	0.00029	2.52E-10
KE: 10-100 MeV	58	5.86E+01	5.86E-07	0	0	0.00E+00
KE: 0.1-1 GeV	18	1.82E+01	1.82E-07	0	0	0.00E+00
KE: 1-10 GeV	0	0.00E+00	0.00E+00	0	0	0.00E+00
KE> 10 GeV	0	0.00E+00	0.00E+00	0	0	0.00E+00
Total Hits	86	8.69E+01	8.69E-07	31	0.00031	2.69E-10

Data Symmetric Fields

Fields: SYM						
Det: 9001	Primary			Secondary		
Energy	Raw	Scaled (to 100M)	Probability	Raw	Probability	EOT
KE<1 MeV	2	2.20E+00	2.20E-08	1	0.00001	1.59E-11
KE: 1-10 MeV	58	6.37E+01	6.37E-07	16	0.00016	2.55E-10
KE: 10-100 MeV	85	9.34E+01	9.34E-07	3	0.00003	4.78E-11
KE: 0.1-1 GeV	0	0.00E+00	0.00E+00	0	0	0.00E+00
KE: 1-10 GeV	0	0.00E+00	0.00E+00	0	0	0.00E+00
KE> 10 GeV	0	0.00E+00	0.00E+00	0	0	0.00E+00
Total Hits	145	1.59E+02	1.59E-06	20	0.0002	3.19E-10

Fields: SYM						
Det: 9002	Primary			Secondary		
Energy	Raw	Scaled (to 100M)	Probability	Raw	Probability	EOT
KE<1 MeV	1	1.10E+00	1.10E-08	3	0.00003	7.62E-11
KE: 1-10 MeV	29	3.19E+01	3.19E-07	34	0.00034	8.63E-10
KE: 10-100 MeV	87	9.56E+01	9.56E-07	5	0.00005	1.27E-10
KE: 0.1-1 GeV	114	1.25E+02	1.25E-06	0	0	0.00E+00
KE: 1-10 GeV	0	0.00E+00	0.00E+00	0	0	0.00E+00
KE> 10 GeV	0	0.00E+00	0.00E+00	0	0	0.00E+00
Total Hits	231	2.54E+02	2.54E-06	42	0.00042	1.07E-09

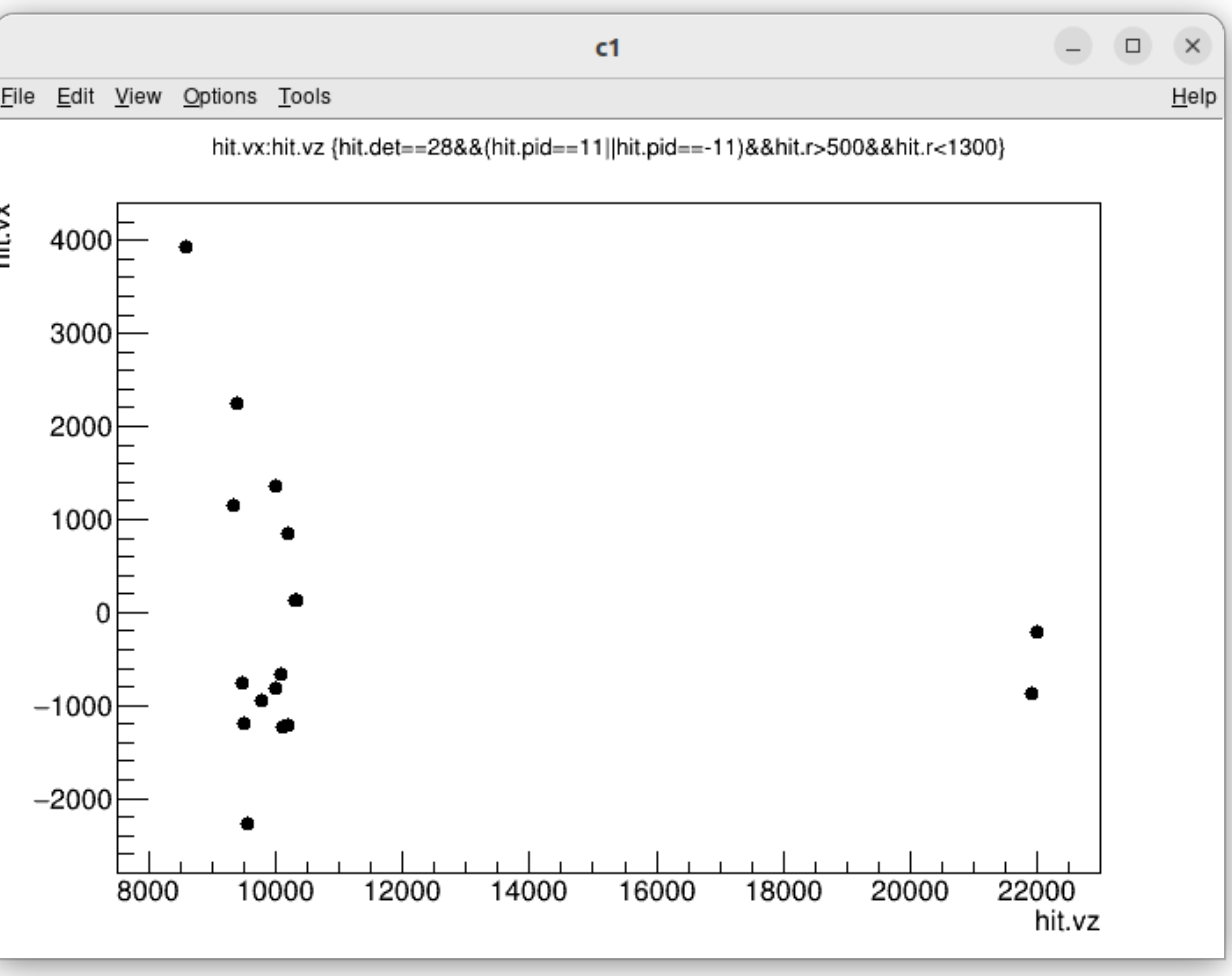
Data Anti-Symmetric Fields

Fields: ANTI						
Det: 9001	Primary			Secondary		
Energy	Raw	Scaled (to 100M)	Probability	Raw	Probability	EOT
KE<1 MeV	1	1.01E+00	1.01E-08	2	0.00002	2.44E-11
KE: 1-10 MeV	27	2.73E+01	2.73E-07	5	0.00005	6.11E-11
KE: 10-100 MeV	93	9.39E+01	9.39E-07	0	0	0.00E+00
KE: 0.1-1 GeV	0	0.00E+00	0.00E+00	0	0	0.00E+00
KE: 1-10 GeV	0	0.00E+00	0.00E+00	0	0	0.00E+00
KE> 10 GeV	0	0.00E+00	0.00E+00	0	0	0.00E+00
Total Hits	121	1.22E+02	1.22E-06	7	0.00007	8.56E-11

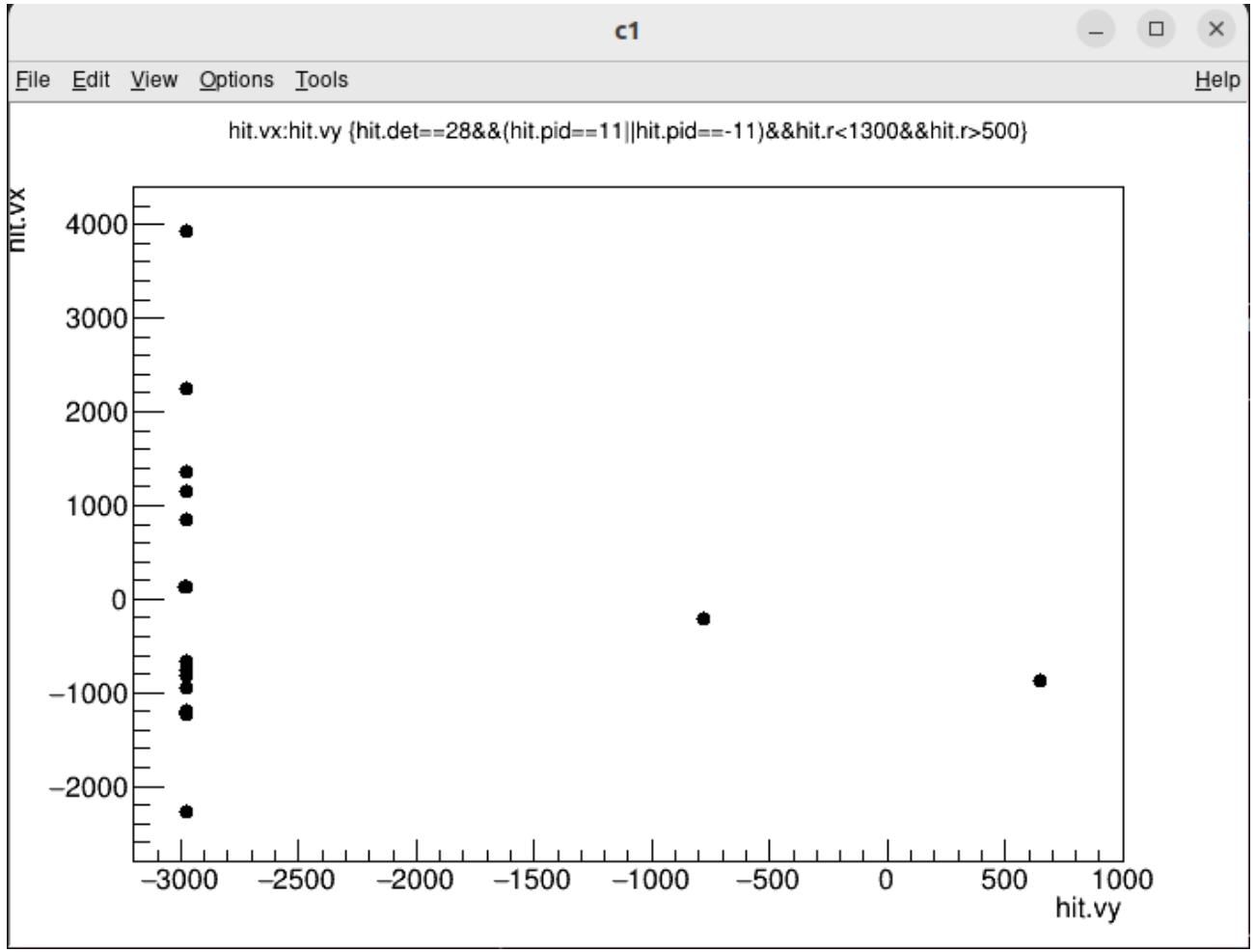
Fields: ANTI						
Det: 9002	Primary			Secondary		
Energy	Raw	Scaled (to 100M)	Probability	Raw	Probability	EOT
KE<1 MeV	0	0.00E+00	0.00E+00	2	0.00002	1.74E-11
KE: 1-10 MeV	10	1.01E+01	1.01E-07	29	0.00029	2.52E-10
KE: 10-100 MeV	58	5.86E+01	5.86E-07	0	0	0.00E+00
KE: 0.1-1 GeV	18	1.82E+01	1.82E-07	0	0	0.00E+00
KE: 1-10 GeV	0	0.00E+00	0.00E+00	0	0	0.00E+00
KE> 10 GeV	0	0.00E+00	0.00E+00	0	0	0.00E+00
Total Hits	86	8.69E+01	8.69E-07	31	0.00031	2.69E-10

9001 Symmetric Fields

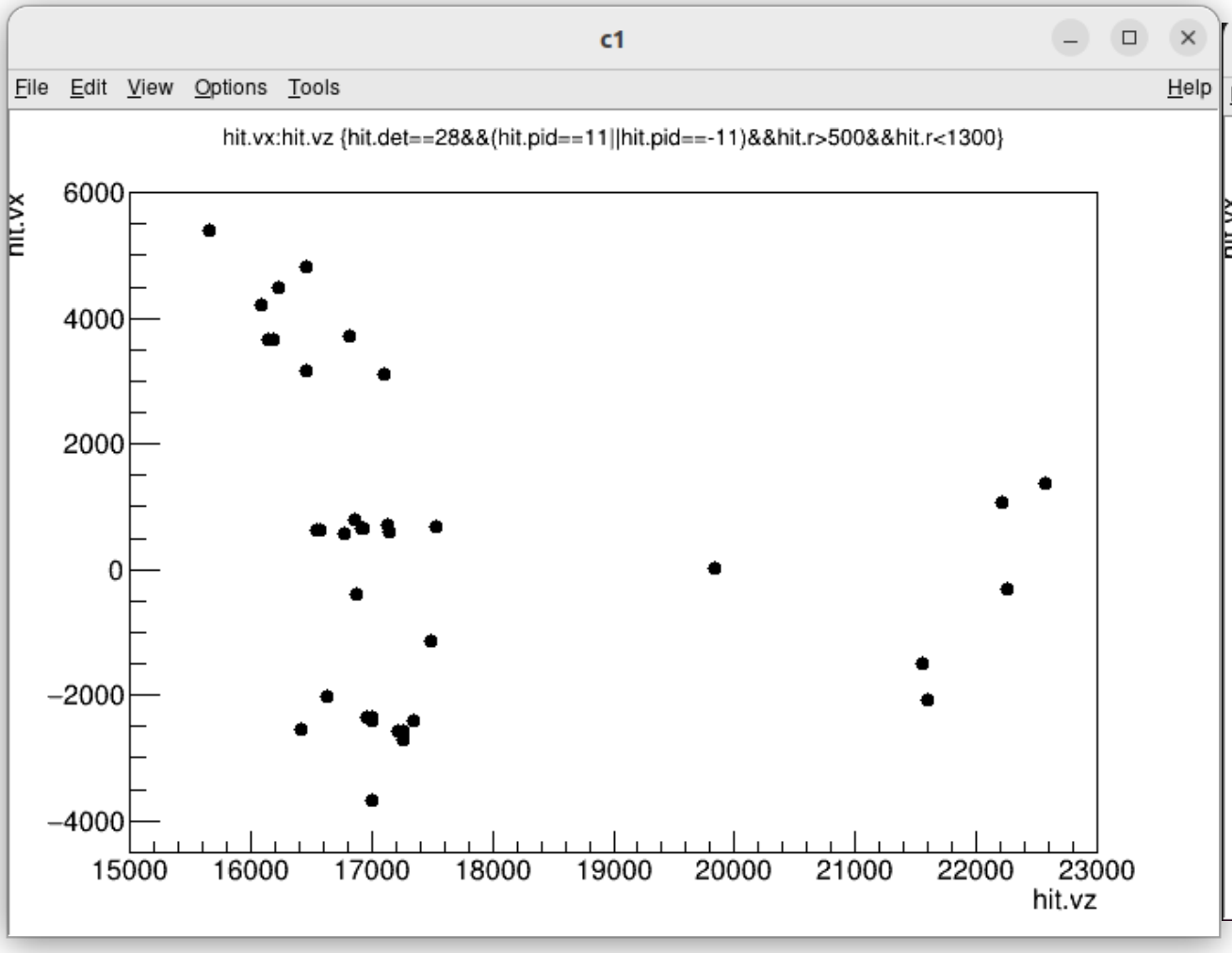
hit.vx vs hit.vz

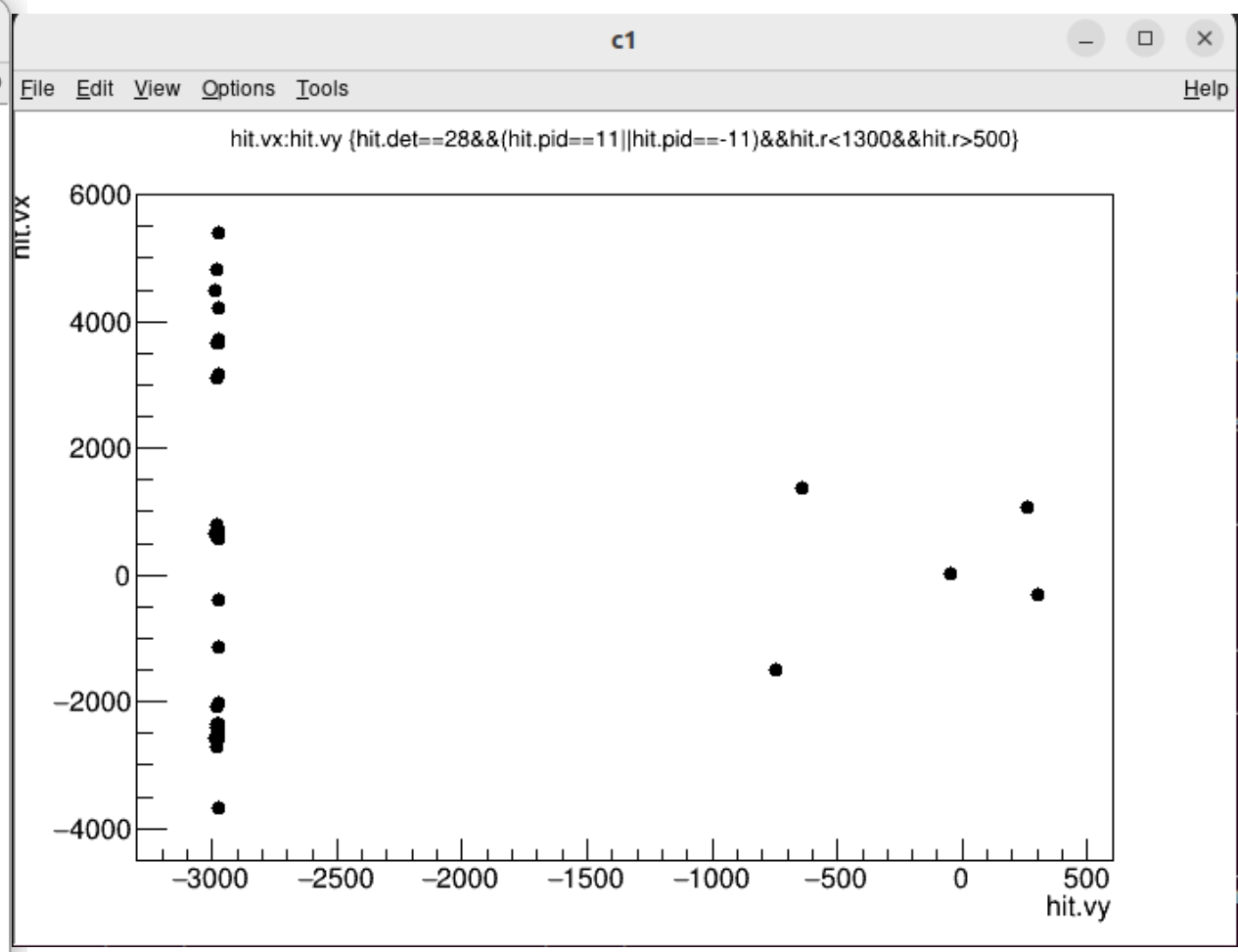


hit.vx vs hit.yz

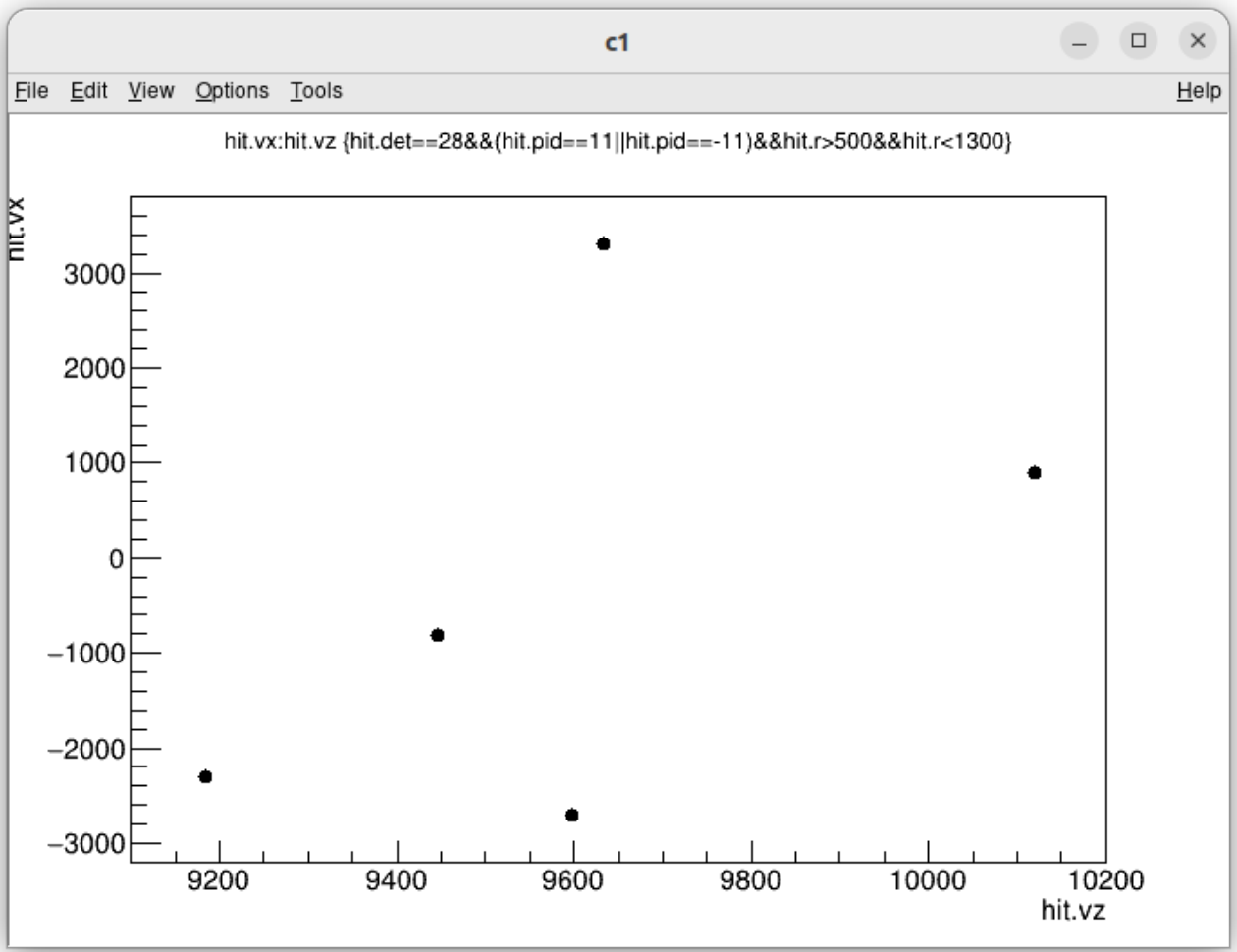


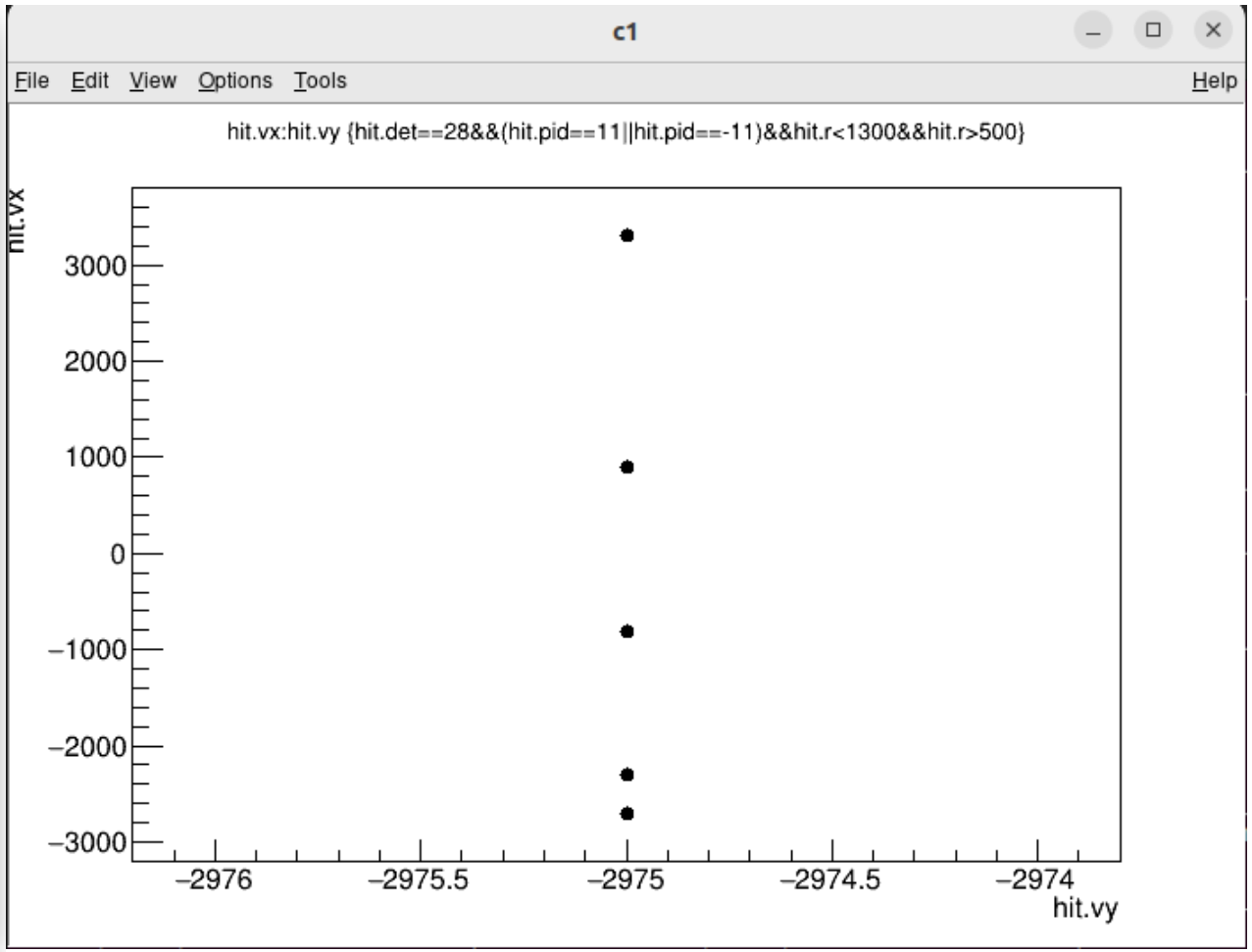
9002 Symmetric Fields



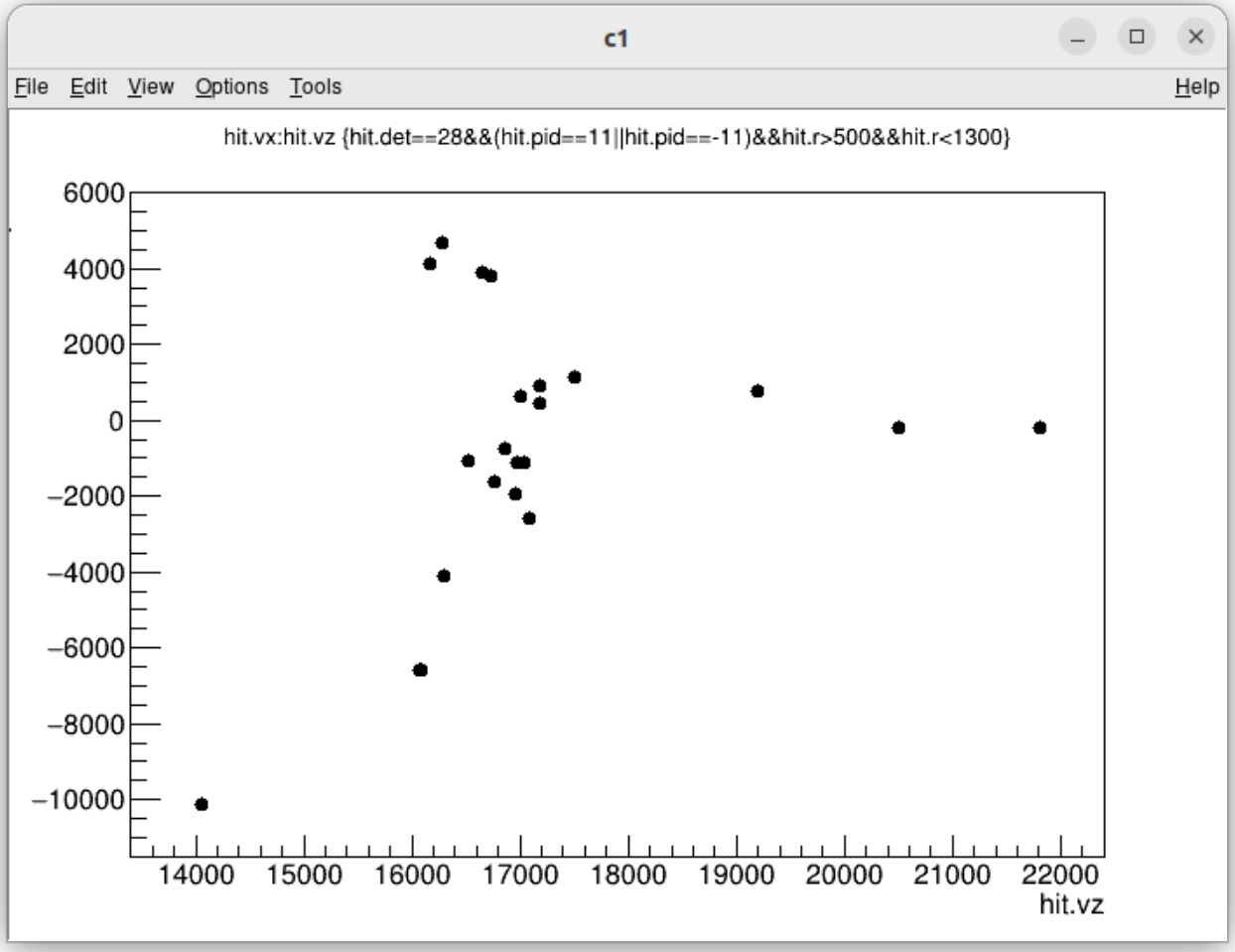


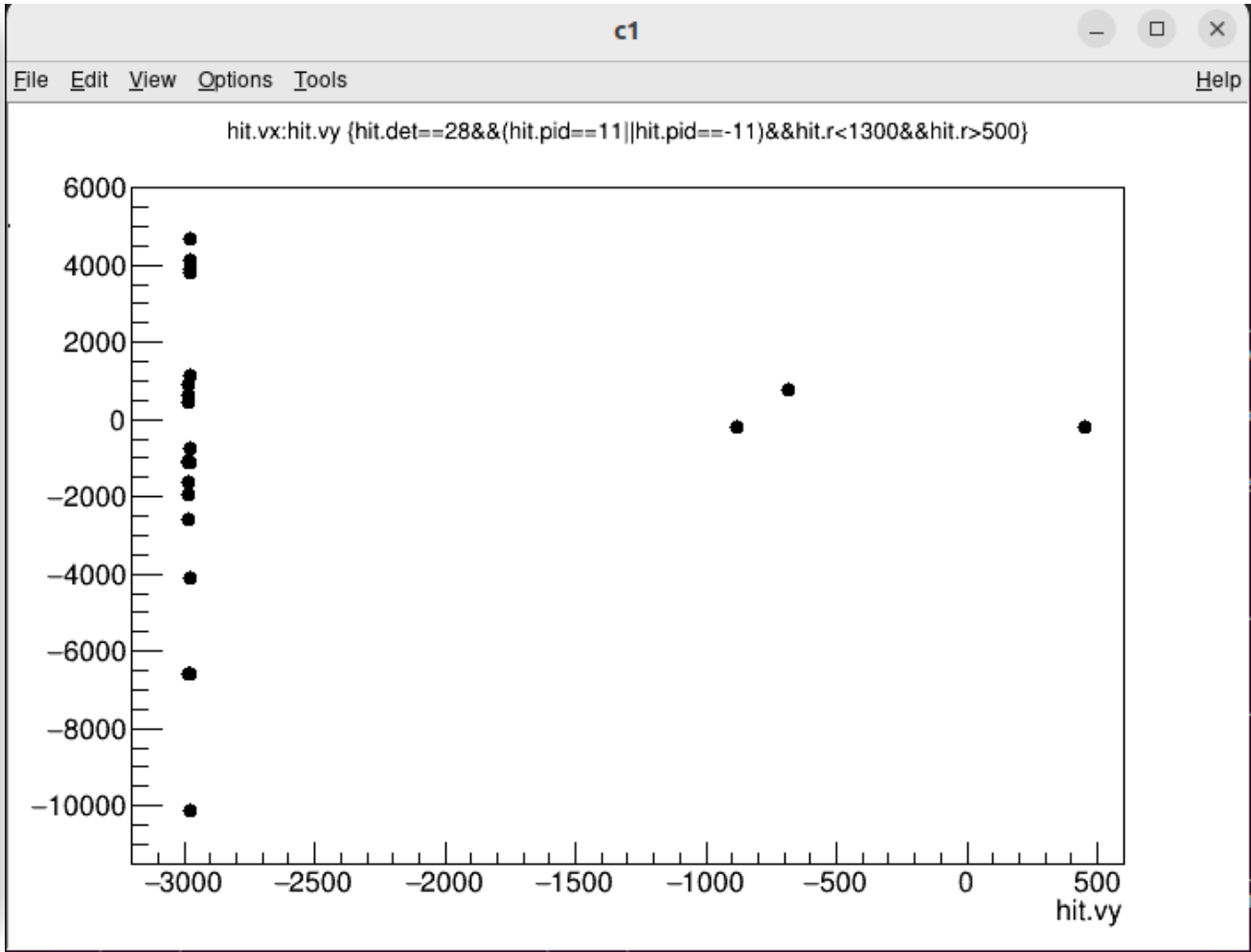
9001 Antisymmetric





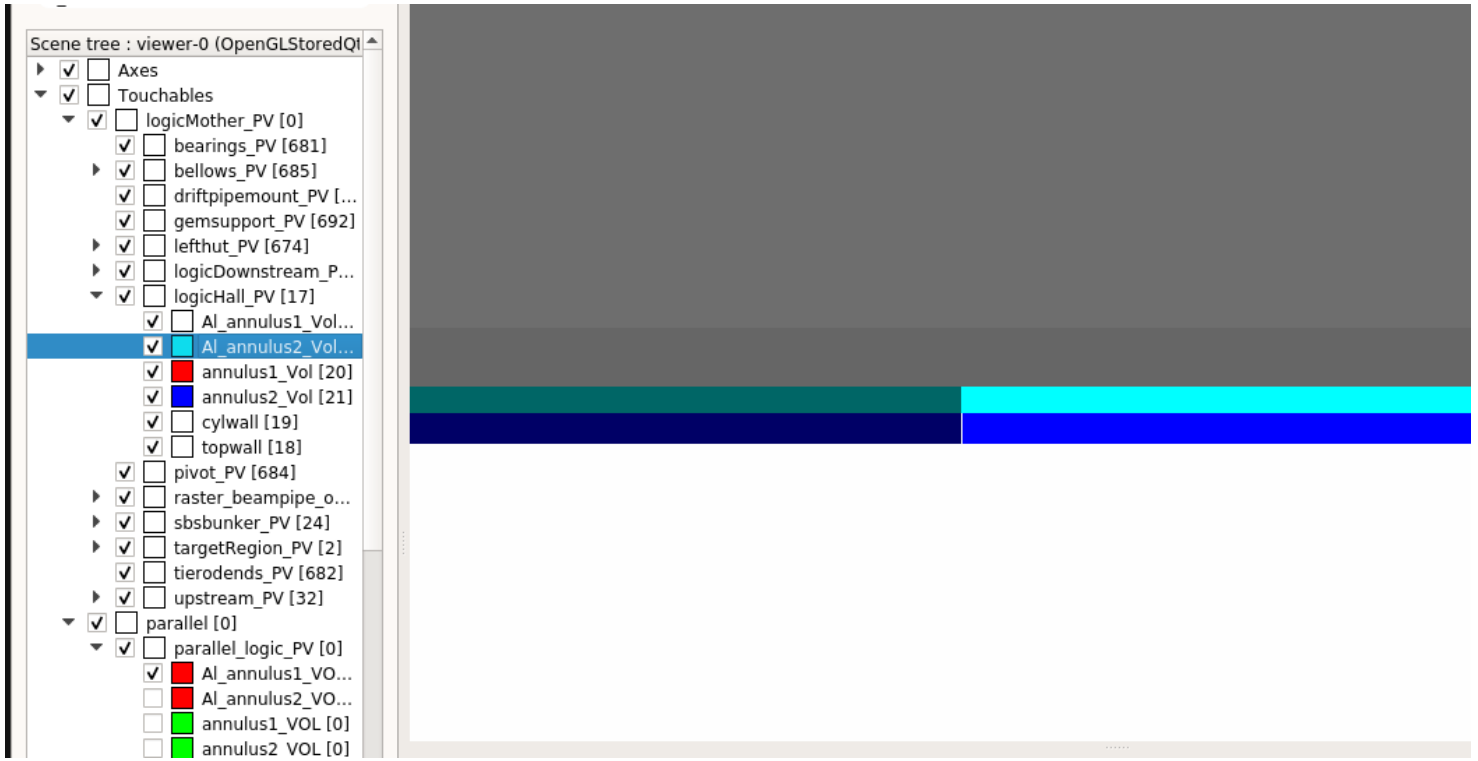
9002 Antisymmetric





Update: Aluminum Rings

- Same dimensions as steel rings except thickness is 25 mm ~1 inch thick
- Located just above the steel rings on the floor
- Material: pure Aluminum
- Located in hallDaughter_merged.gdml as well
- Left the aluminum rings enabled during all simulations



Data
(Aluminum Rings Added)

Fields: SYM						
Det: 9001	Primary			Secondary		
Energy	Raw	Scaled (to 100M)	Probability	Raw	Probability	EOT
KE<1 MeV	1	1	1.00E-08	5	5.00E-05	3.10E-11
KE: 1-10 MeV	16	16	1.60E-07	16	1.60E-04	9.92E-11
KE: 10-100 MeV	45	45	4.50E-07	0	0.00E+00	0.00E+00
KE: 0.1-1 GeV	0	0	0.00E+00	0	0.00E+00	0.00E+00
KE: 1-10 GeV	0	0	0.00E+00	0	0.00E+00	0.00E+00
KE> 10 GeV	0	0	0.00E+00	0	0.00E+00	0.00E+00
Total Hits	62	62	6.20E-07	21	2.10E-04	1.30E-10

Fields: ANTI						
Det: 9001	Primary			Secondary		
Energy	Raw	Scaled (to 100M)	Probability	Raw	Probability	EOT
KE<1 MeV	1	1.01E+00	1.01E-08	1	1.00E-05	1.09E-11
KE: 1-10 MeV	29	2.93E+01	2.93E-07	5	5.00E-05	5.45E-11
KE: 10-100 MeV	78	7.88E+01	7.88E-07	1	1.00E-05	1.09E-11
KE: 0.1-1 GeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
KE: 1-10 GeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
KE> 10 GeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
Total Hits	108	1.09E+02	1.09E-06	7	7.00E-05	7.64E-11

- Primary: 100 Sims 1 Millions events each
- Secondary: 100,000 Events in 10 Jobs
- Secondary Includes electrons and positrons
- Lost 1 file (1 Millions events) for antisym sim

Fields: SYM						
Det: 9002	Primary			Secondary		
Energy	Raw	Scaled (to 100M)	Probability	Raw	Probability	EOT
KE<1 MeV	0	0	0.00E+00	12	1.20E-04	9.96E-11
KE: 1-10 MeV	10	10	1.00E-07	33	3.30E-04	2.74E-10
KE: 10-100 MeV	36	36	3.60E-07	2	2.00E-05	1.66E-11
KE: 0.1-1 GeV	37	37	3.70E-07	0	0.00E+00	0.00E+00
KE: 1-10 GeV	0	0	0.00E+00	0	0.00E+00	0.00E+00
KE> 10 GeV	0	0	0.00E+00	0	0.00E+00	0.00E+00
Total Hits	83	83	8.30E-07	47	4.70E-04	3.90E-10

Fields: ANTI						
Det: 9002	Primary			Secondary		
Energy	Raw	Scaled (to 100M)	Probability	Raw	Probability	EOT
KE<1 MeV	0	0.00E+00	0.00E+00	3	3.00E-05	2.52E-11
KE: 1-10 MeV	7	7.07E+00	7.07E-08	35	3.50E-04	2.93E-10
KE: 10-100 MeV	63	6.36E+01	6.36E-07	5	5.00E-05	4.19E-11
KE: 0.1-1 GeV	13	1.31E+01	1.31E-07	0	0.00E+00	0.00E+00
KE: 1-10 GeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
KE> 10 GeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
Total Hits	83	8.38E+01	8.38E-07	43	4.30E-04	3.61E-10

Data Symmetric Fields (Aluminum Shield)

Fields: SYM						
Det: 9001	Primary			Secondary		
Energy	Raw	Scaled (to 100M)	Probability	Raw	Probability	EOT
KE<1 MeV	1	1	1.00E-08	5	5.00E-05	3.10E-11
KE: 1-10 MeV	16	16	1.60E-07	16	1.60E-04	9.92E-11
KE: 10-100 MeV	45	45	4.50E-07	0	0.00E+00	0.00E+00
KE: 0.1-1 GeV	0	0	0.00E+00	0	0.00E+00	0.00E+00
KE: 1-10 GeV	0	0	0.00E+00	0	0.00E+00	0.00E+00
KE> 10 GeV	0	0	0.00E+00	0	0.00E+00	0.00E+00
Total Hits	62	62	6.20E-07	21	2.10E-04	1.30E-10

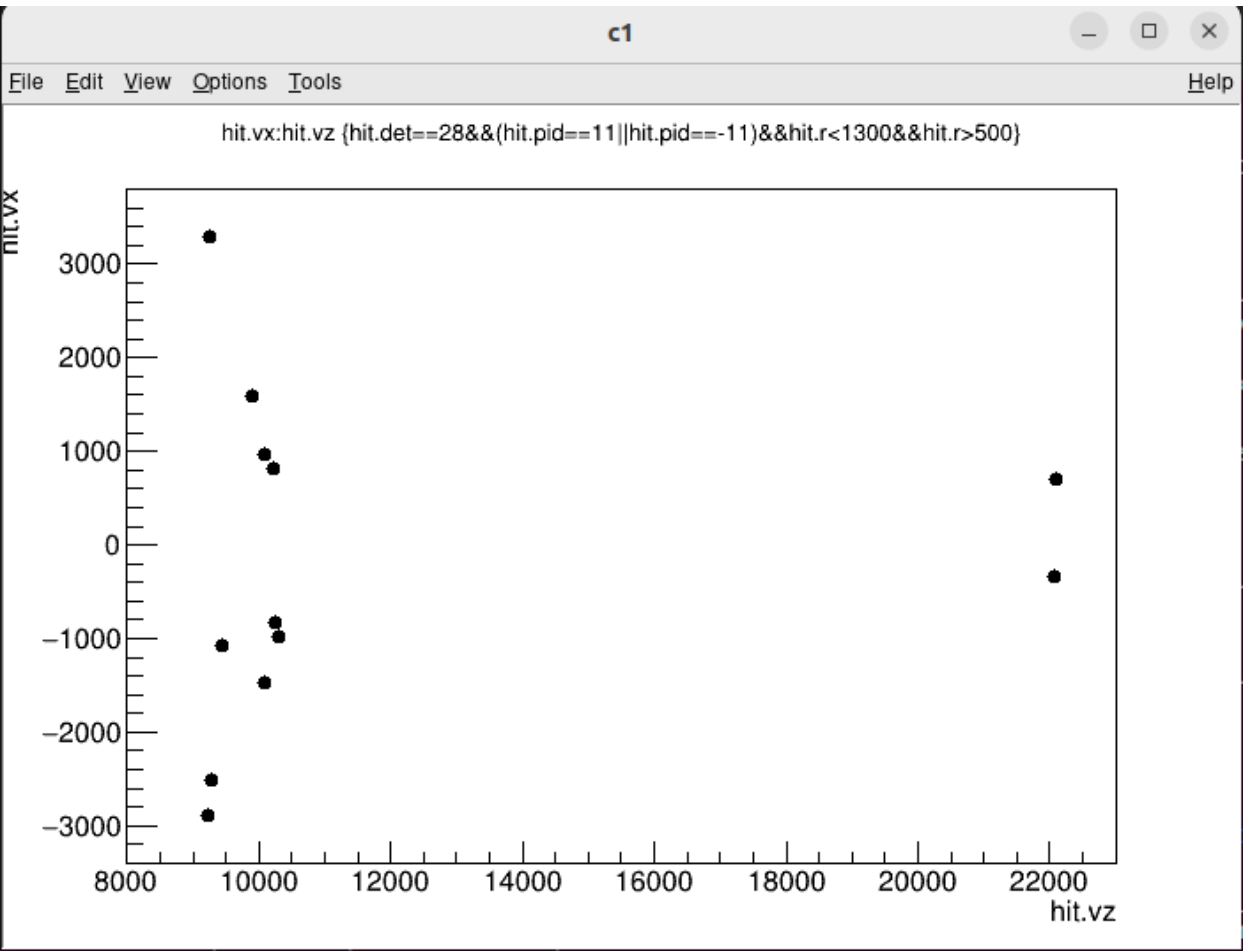
Fields: SYM						
Det: 9002	Primary			Secondary		
Energy	Raw	Scaled (to 100M)	Probability	Raw	Probability	EOT
KE<1 MeV	0	0	0.00E+00	12	1.20E-04	9.96E-11
KE: 1-10 MeV	10	10	1.00E-07	33	3.30E-04	2.74E-10
KE: 10-100 MeV	36	36	3.60E-07	2	2.00E-05	1.66E-11
KE: 0.1-1 GeV	37	37	3.70E-07	0	0.00E+00	0.00E+00
KE: 1-10 GeV	0	0	0.00E+00	0	0.00E+00	0.00E+00
KE> 10 GeV	0	0	0.00E+00	0	0.00E+00	0.00E+00
Total Hits	83	83	8.30E-07	47	4.70E-04	3.90E-10

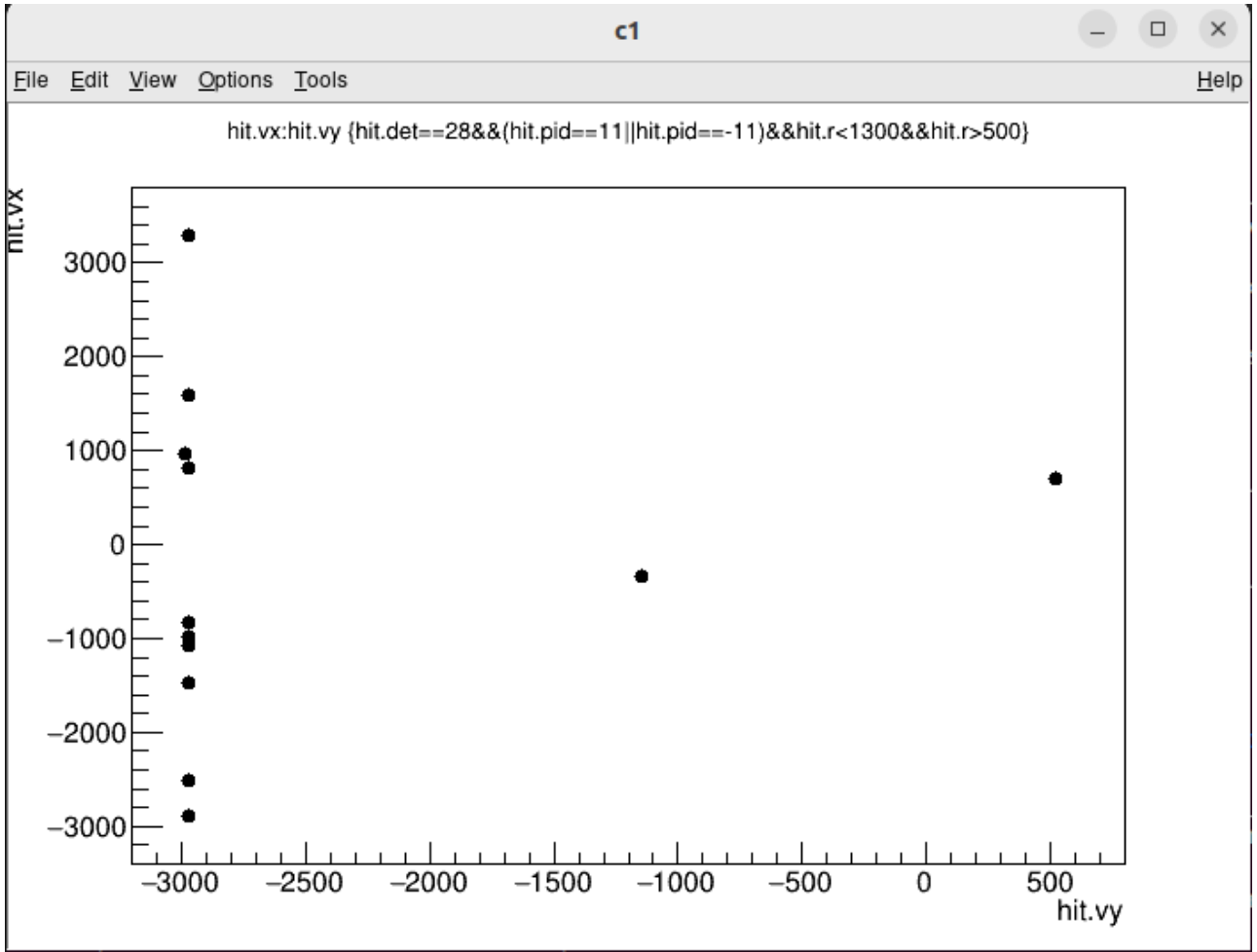
Data Anti Symmetric Fields (Aluminum Shield)

Fields: ANTI						
Det: 9001	Primary			Secondary		
Energy	Raw	Scaled (to 100M)	Probability	Raw	Probability	EOT
KE<1 MeV	1	1.01E+00	1.01E-08	1	1.00E-05	1.09E-11
KE: 1-10 MeV	29	2.93E+01	2.93E-07	5	5.00E-05	5.45E-11
KE: 10-100 MeV	78	7.88E+01	7.88E-07	1	1.00E-05	1.09E-11
KE: 0.1-1 GeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
KE: 1-10 GeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
KE> 10 GeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
Total Hits	108	1.09E+02	1.09E-06	7	7.00E-05	7.64E-11

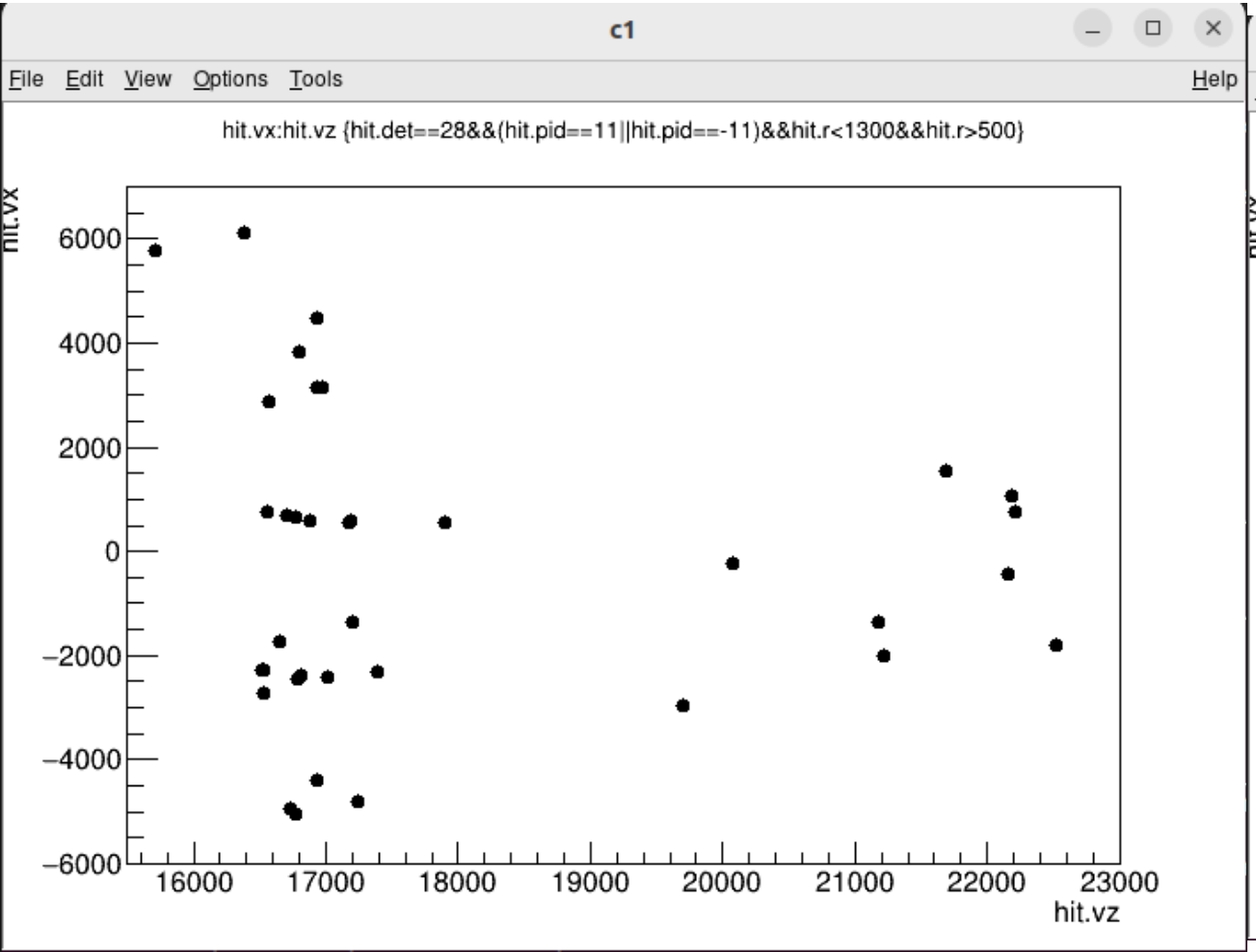
Fields: ANTI						
Det: 9002	Primary			Secondary		
Energy	Raw	Scaled (to 100M)	Probability	Raw	Probability	EOT
KE<1 MeV	0	0.00E+00	0.00E+00	3	3.00E-05	2.52E-11
KE: 1-10 MeV	7	7.07E+00	7.07E-08	35	3.50E-04	2.93E-10
KE: 10-100 MeV	63	6.36E+01	6.36E-07	5	5.00E-05	4.19E-11
KE: 0.1-1 GeV	13	1.31E+01	1.31E-07	0	0.00E+00	0.00E+00
KE: 1-10 GeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
KE> 10 GeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
Total Hits	83	8.38E+01	8.38E-07	43	4.30E-04	3.61E-10

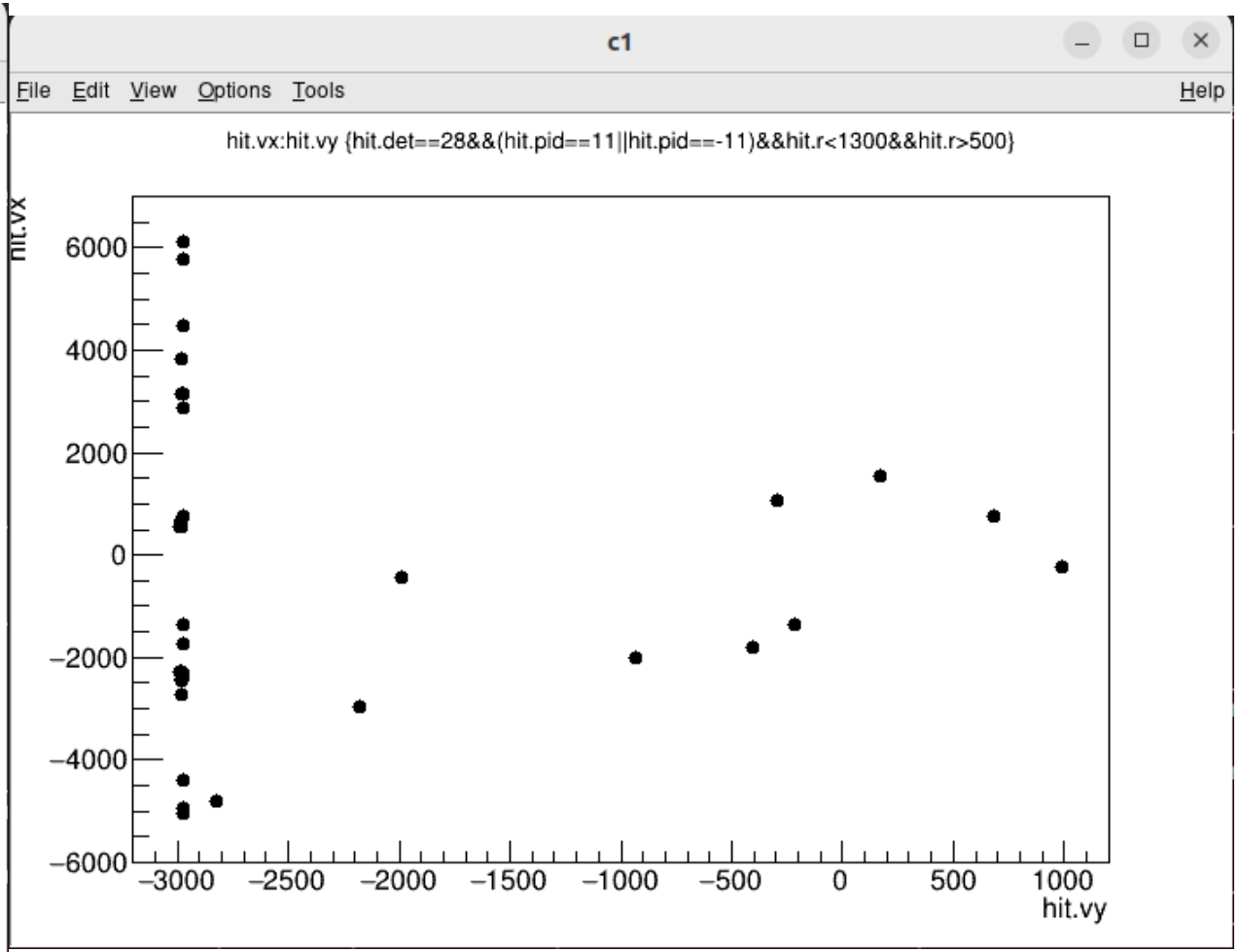
9001 Symmetric Fields



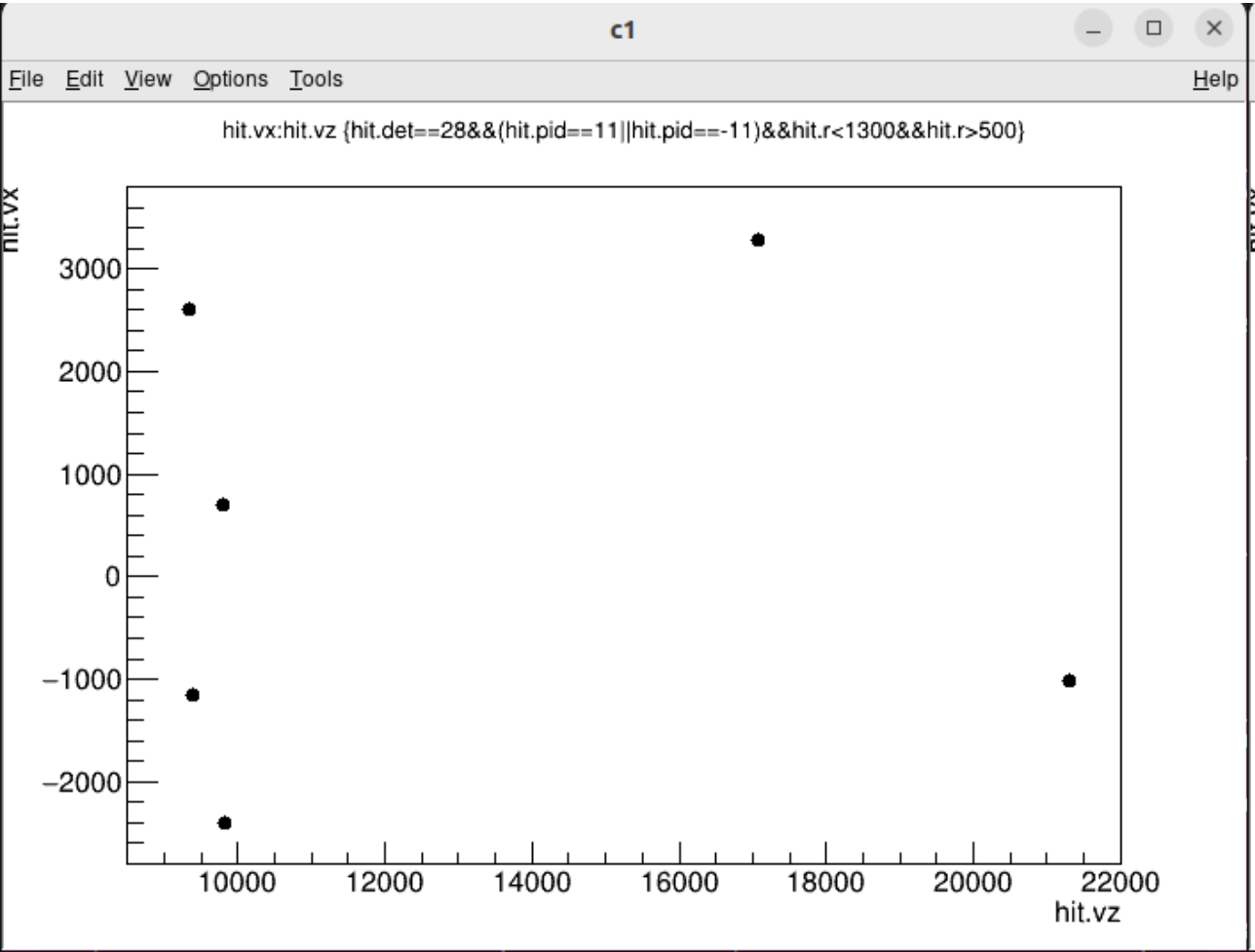


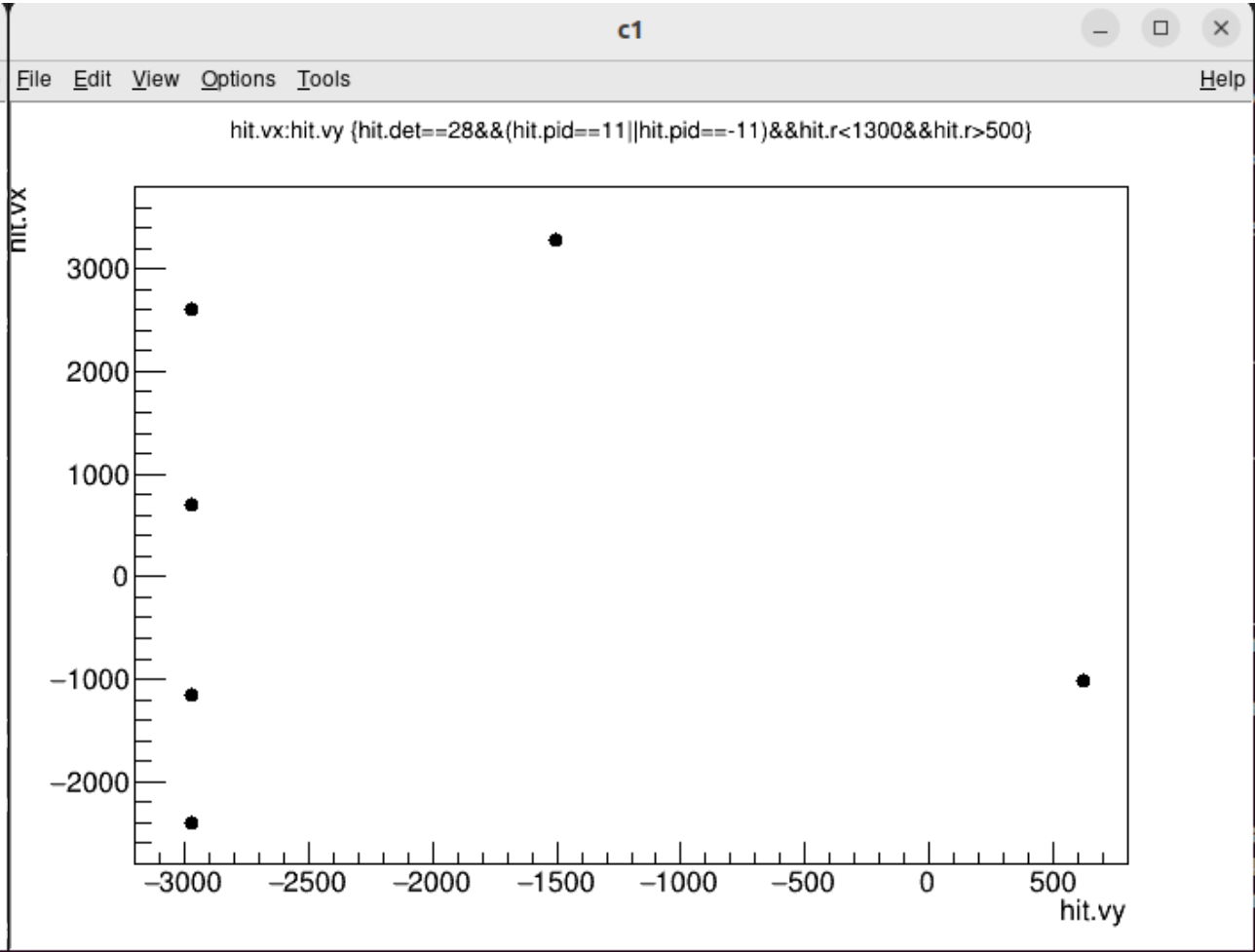
9002 Symmetric Fields



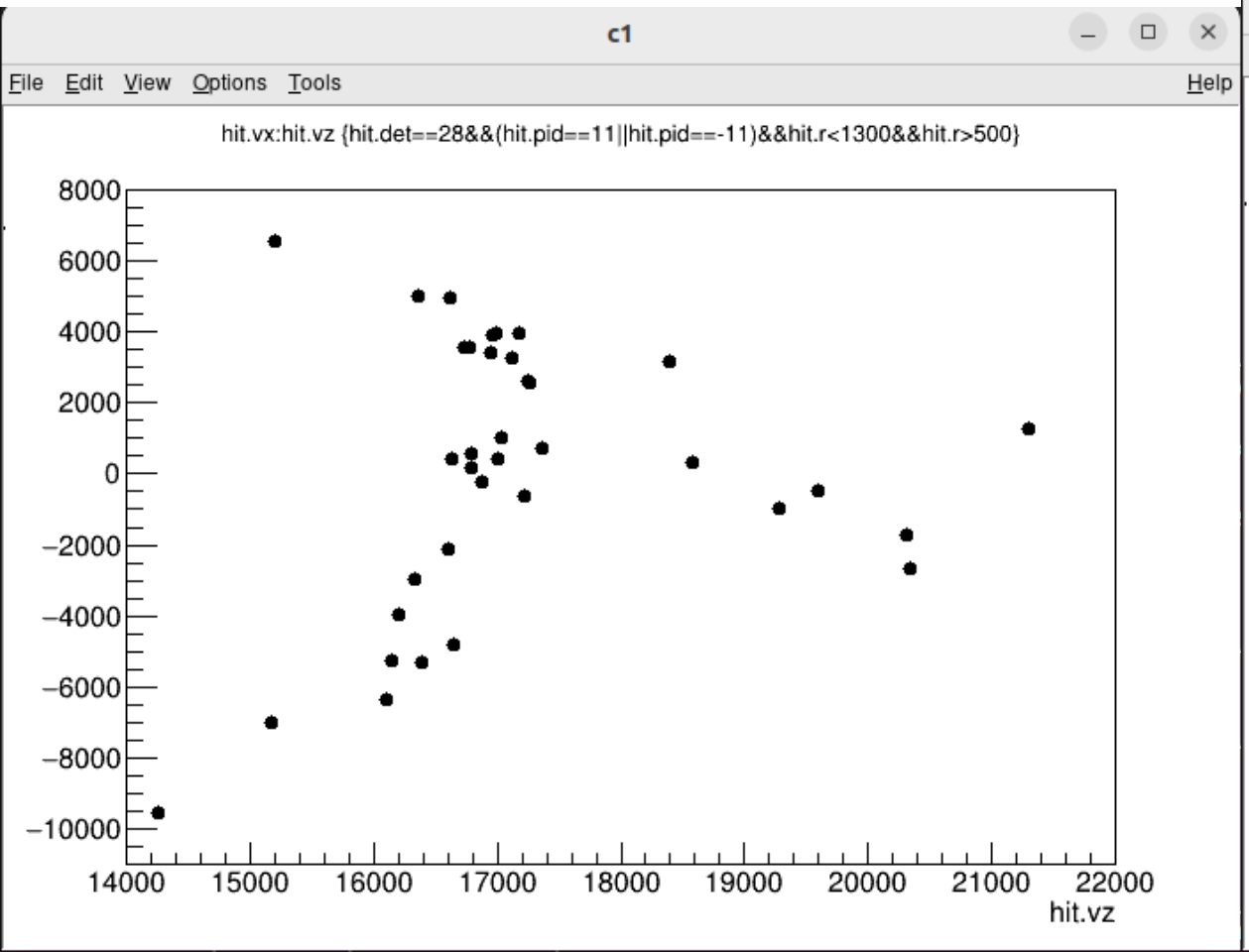


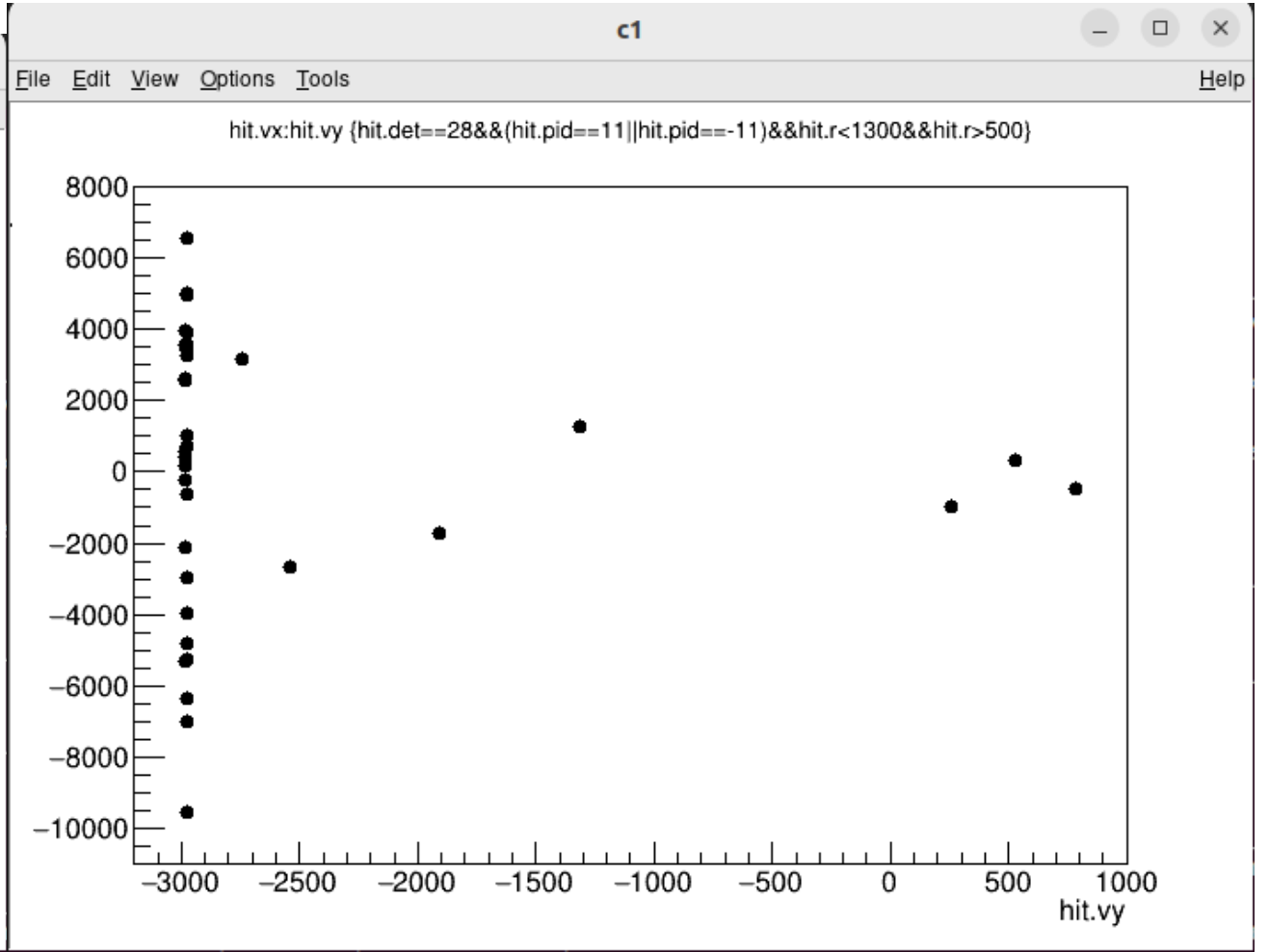
9001 Antisymmetric Fields





9002 Antisymmetric Fields





Data Comparison Symmetric Fields

Fields: SYM Det: 9001	NO ALUM			ALUM		
Energy	Probability	Probability	EOT	Probability	Probability	EOT
KE<1 MeV	2.20E-08	0.00001	1.59E-11	1.00E-08	5.00E-05	3.10E-11
KE: 1-10 MeV	6.37E-07	0.00016	2.55E-10	1.60E-07	1.60E-04	9.92E-11
KE: 10-100 MeV	9.34E-07	0.00003	4.78E-11	4.50E-07	0.00E+00	0.00E+00
KE: 0.1-1 GeV	0.00E+00	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00
KE: 1-10 GeV	0.00E+00	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00
KE> 10 GeV	0.00E+00	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total Hits	1.59E-06	0.0002	3.19E-10	6.20E-07	2.10E-04	1.30E-10

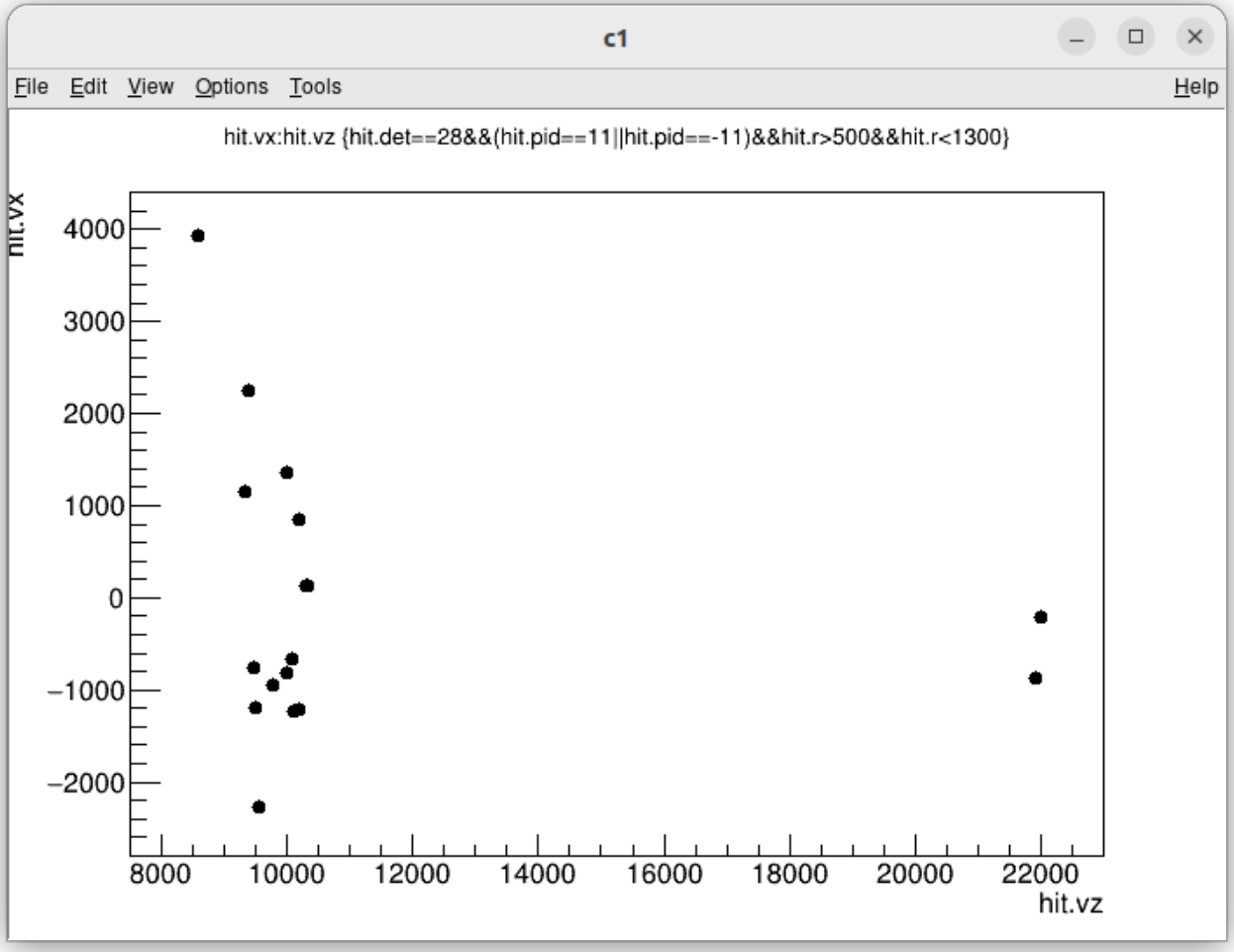
Det: 9002	NO ALUM			ALUM		
Energy	Probability	Probability	EOT	Probability	Probability	EOT
KE<1 MeV	1.10E-08	0.00003	7.62E-11	0.00E+00	1.20E-04	9.96E-11
KE: 1-10 MeV	3.19E-07	0.00034	8.63E-10	1.00E-07	3.30E-04	2.74E-10
KE: 10-100 MeV	9.56E-07	0.00005	1.27E-10	3.60E-07	2.00E-05	1.66E-11
KE: 0.1-1 GeV	1.25E-06	0	0.00E+00	3.70E-07	0.00E+00	0.00E+00
KE: 1-10 GeV	0.00E+00	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00
KE> 10 GeV	0.00E+00	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total Hits	2.54E-06	0.00042	1.07E-09	8.30E-07	4.70E-04	3.90E-10

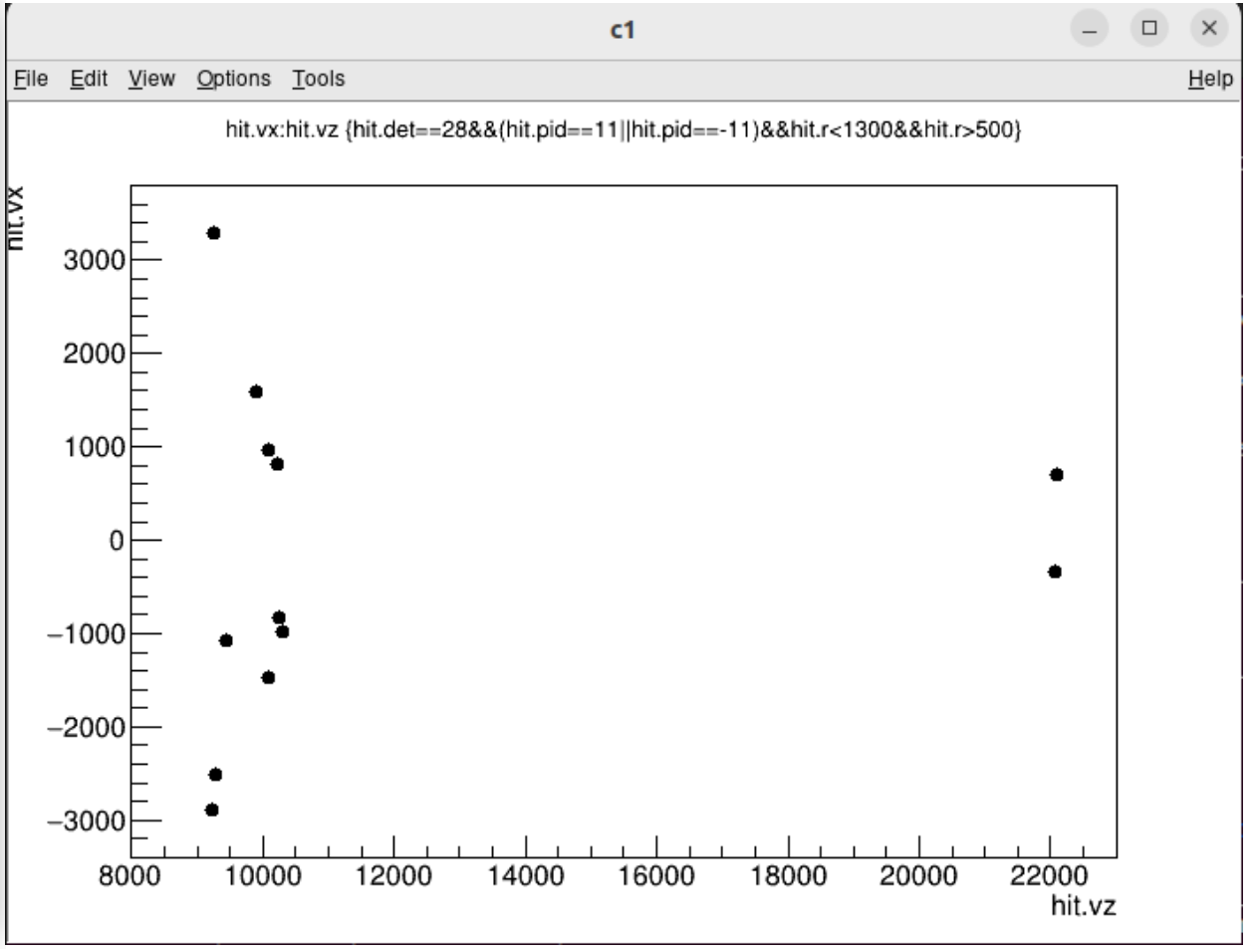
Data Comparison: Antisymmetric Fields

Fields: ANTI						
Det: 9001	NO ALUM			ALUM		
Energy	Probability	Probability	EOT	Probability	Probability	EOT
KE<1 MeV	1.01E-08	0.00002	2.44E-11	1.01E-08	1.00E-05	1.09E-11
KE: 1-10 MeV	2.73E-07	0.00005	6.11E-11	2.93E-07	5.00E-05	5.45E-11
KE: 10-100 MeV	9.39E-07	0	0.00E+00	7.88E-07	1.00E-05	1.09E-11
KE: 0.1-1 GeV	0.00E+00	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00
KE: 1-10 GeV	0.00E+00	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00
KE> 10 GeV	0.00E+00	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total Hits	1.22E-06	0.00007	8.56E-11	1.09E-06	7.00E-05	7.64E-11
Det: 9002	NO ALUM			ALUM		
Energy	Probability	Probability	EOT	Probability	Probability	EOT
KE<1 MeV	0.00E+00	0.00002	1.74E-11	0.00E+00	3.00E-05	2.52E-11
KE: 1-10 MeV	1.01E-07	0.00029	2.52E-10	7.07E-08	3.50E-04	2.93E-10
KE: 10-100 MeV	5.86E-07	0	0.00E+00	6.36E-07	5.00E-05	4.19E-11
KE: 0.1-1 GeV	1.82E-07	0	0.00E+00	1.31E-07	0.00E+00	0.00E+00
KE: 1-10 GeV	0.00E+00	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00
KE> 10 GeV	0.00E+00	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total Hits	8.69E-07	0.00031	2.69E-10	8.38E-07	4.30E-04	3.61E-10

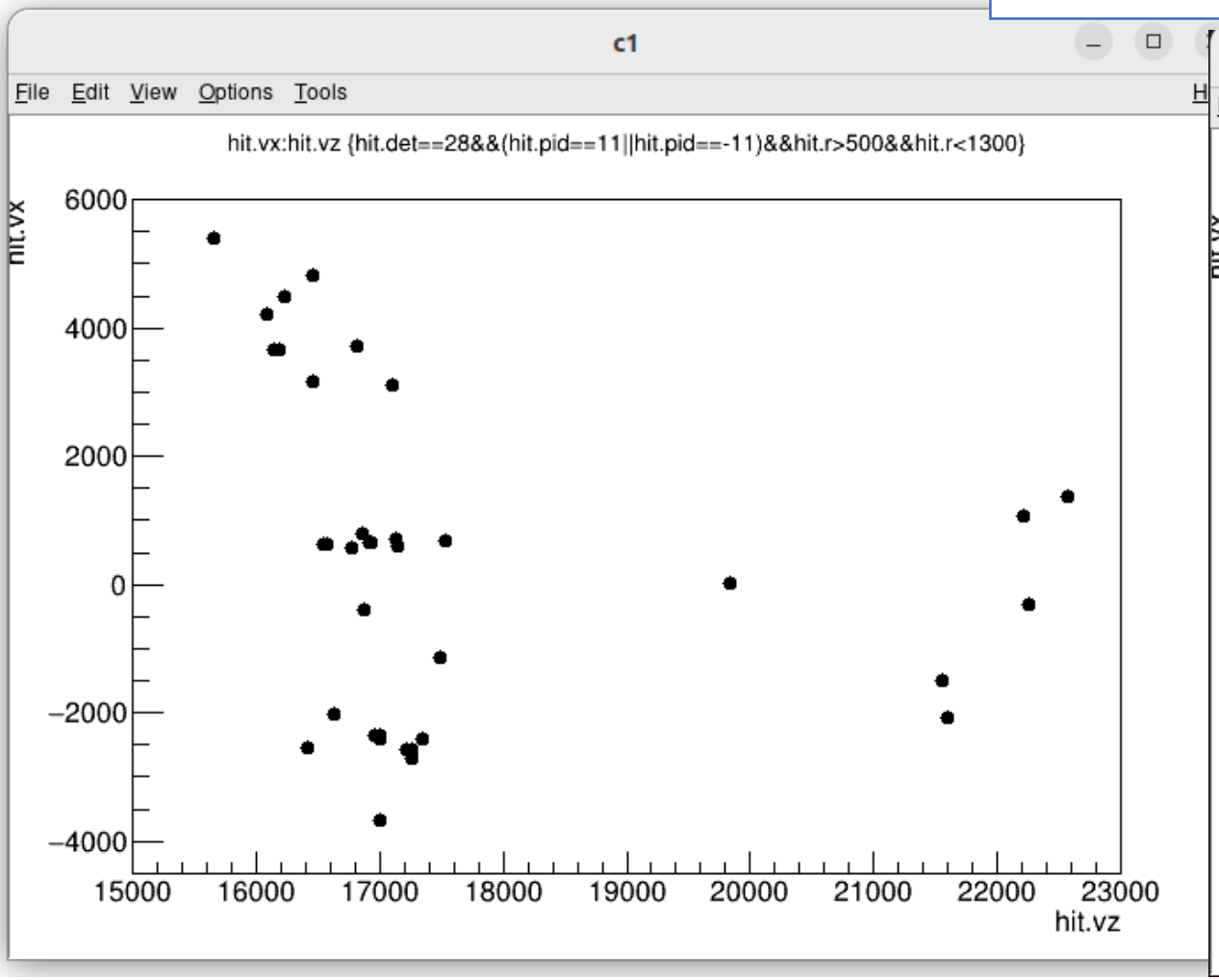
9001 Symmetric

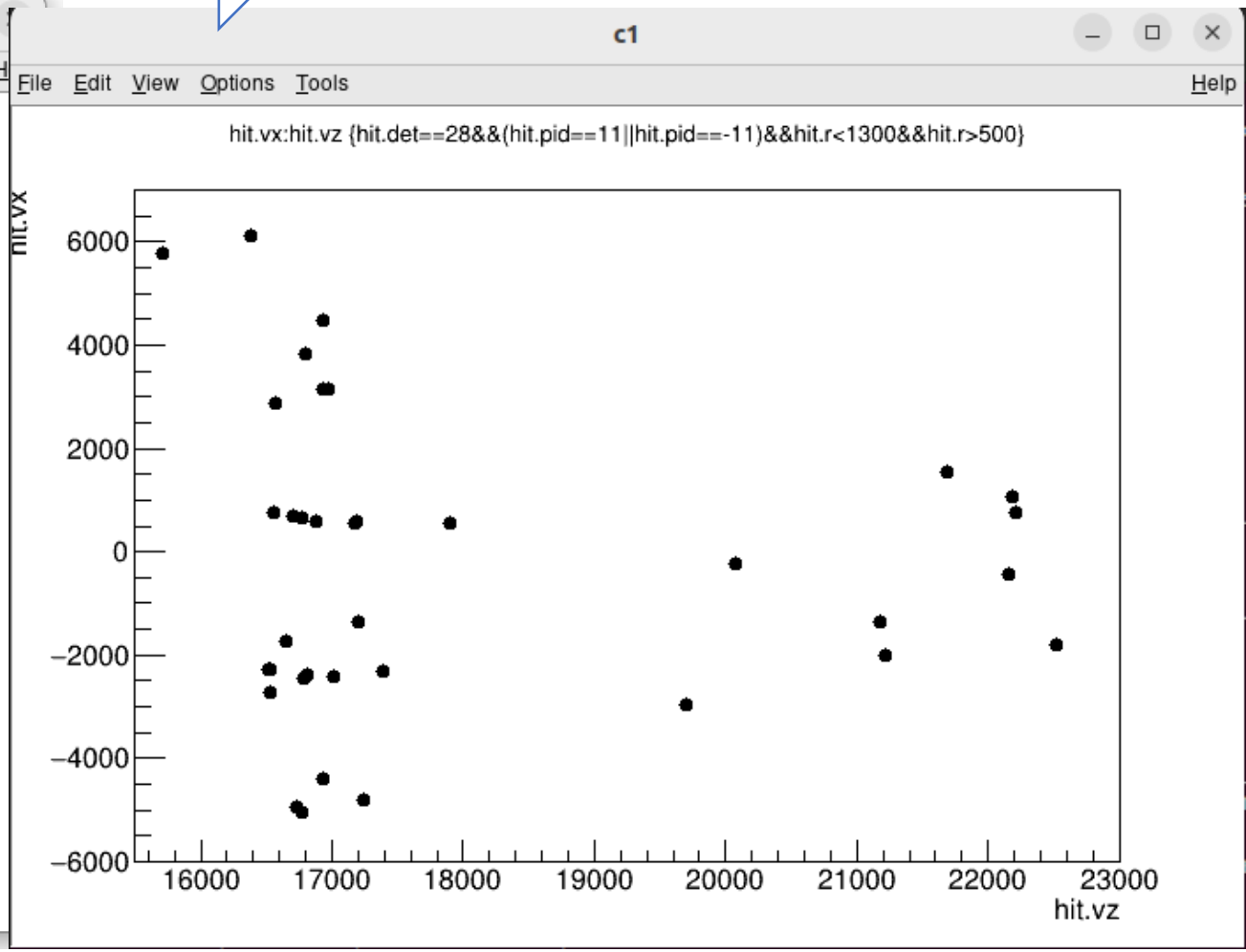
Adding Aluminum



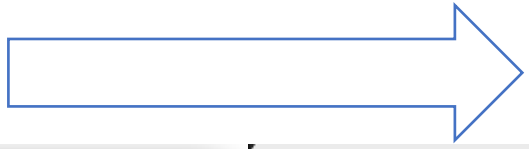


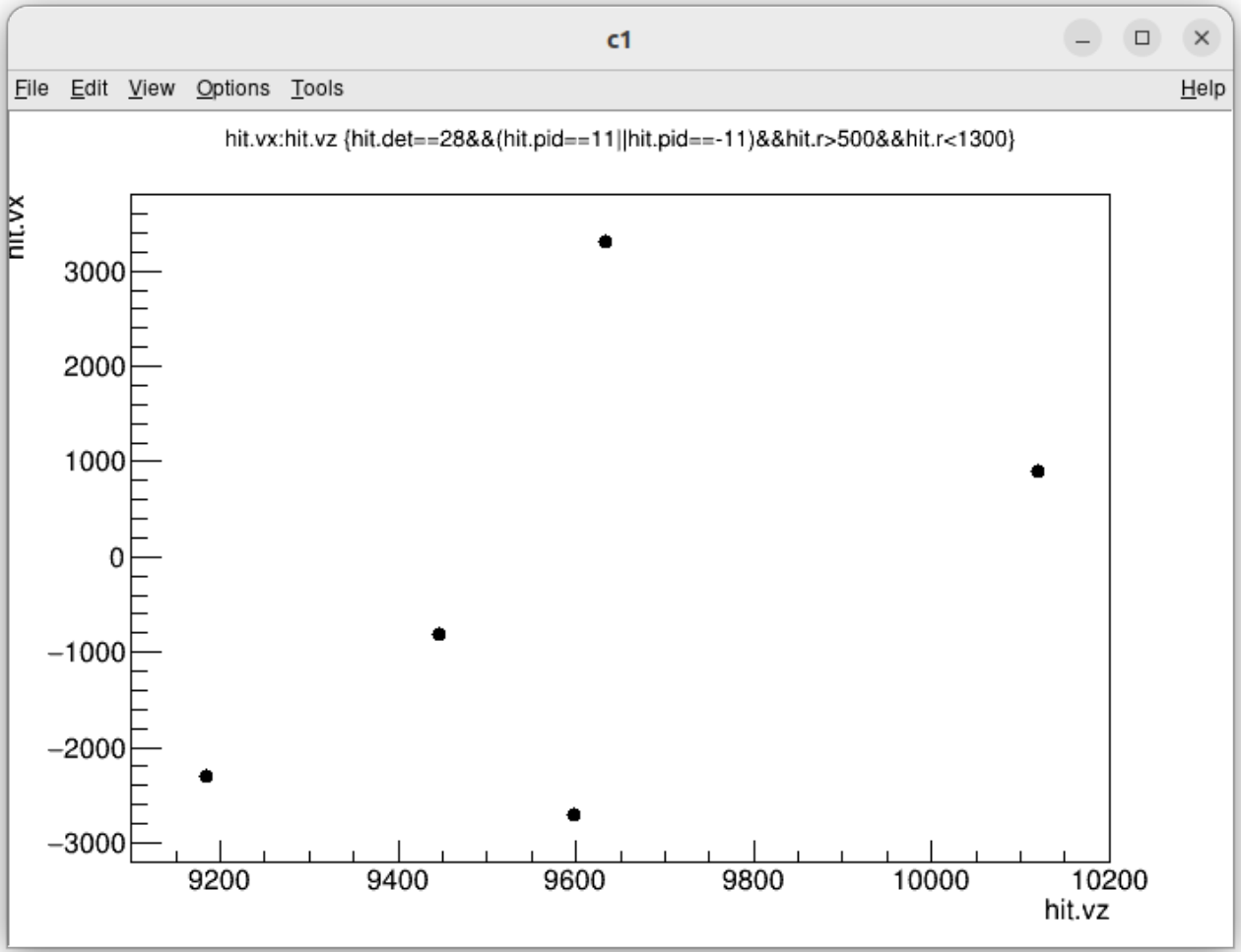
9002 Symmetric

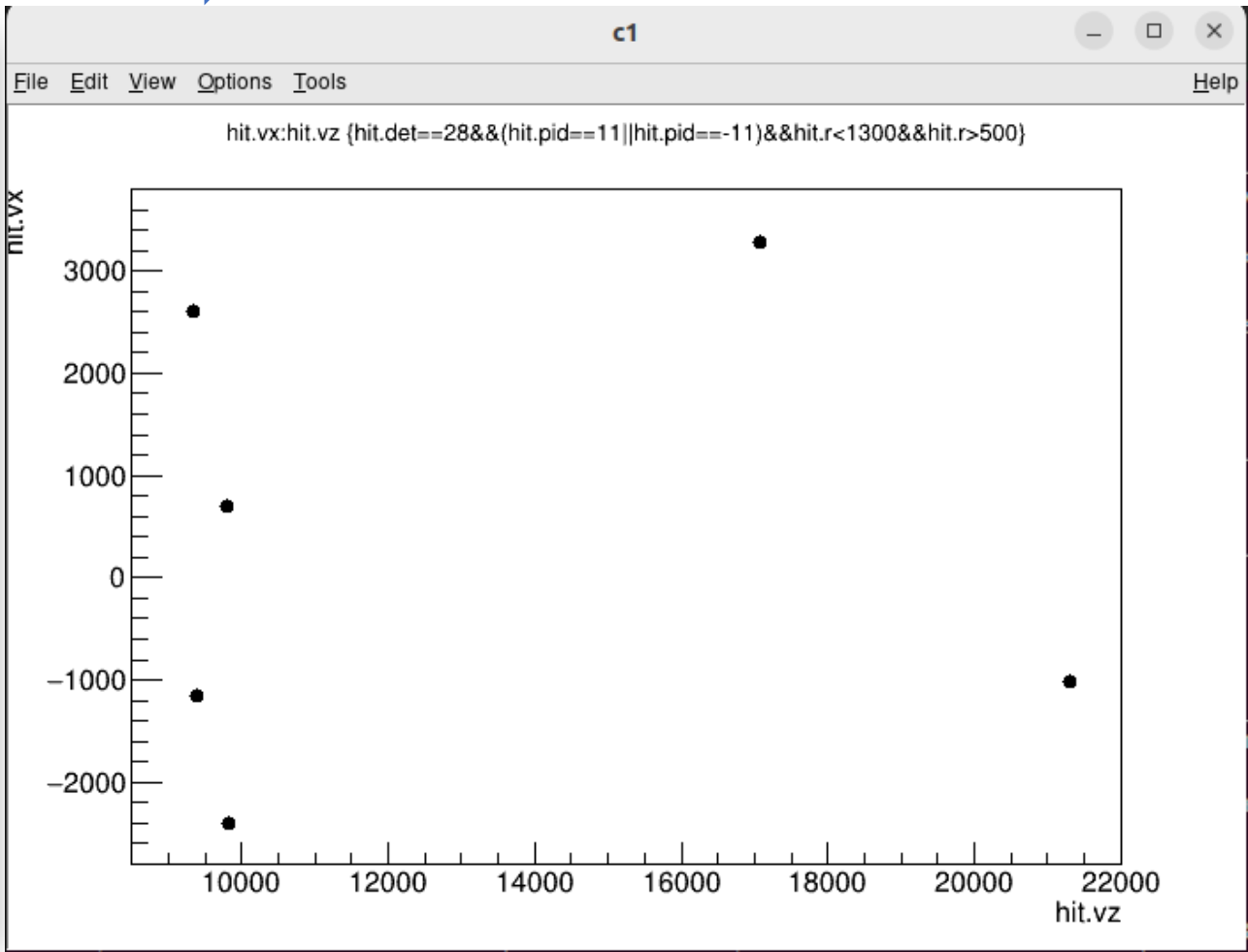




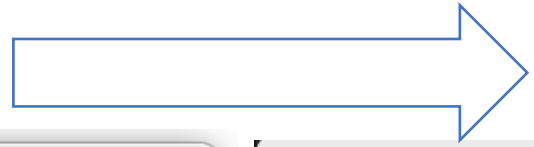
9001 Antisymmetric

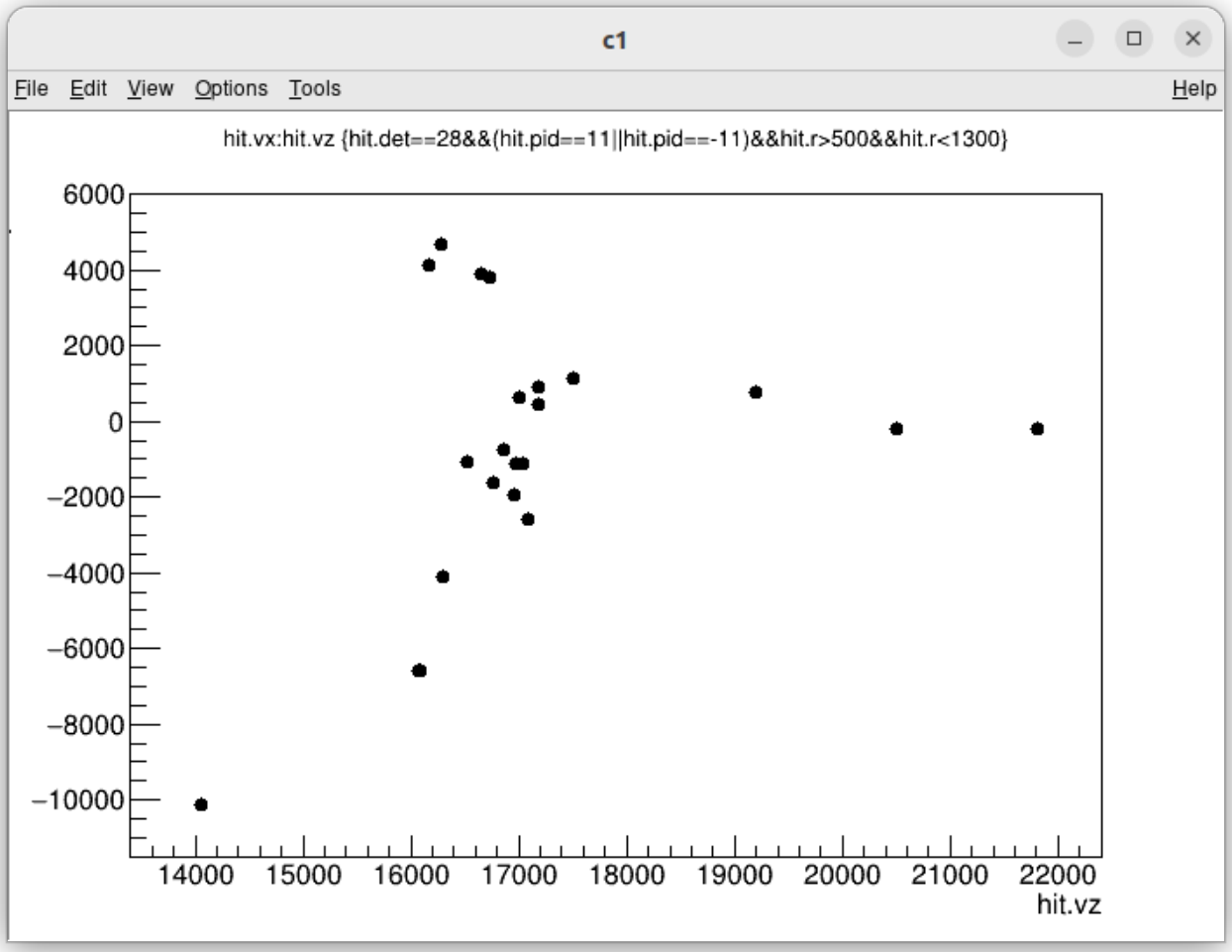


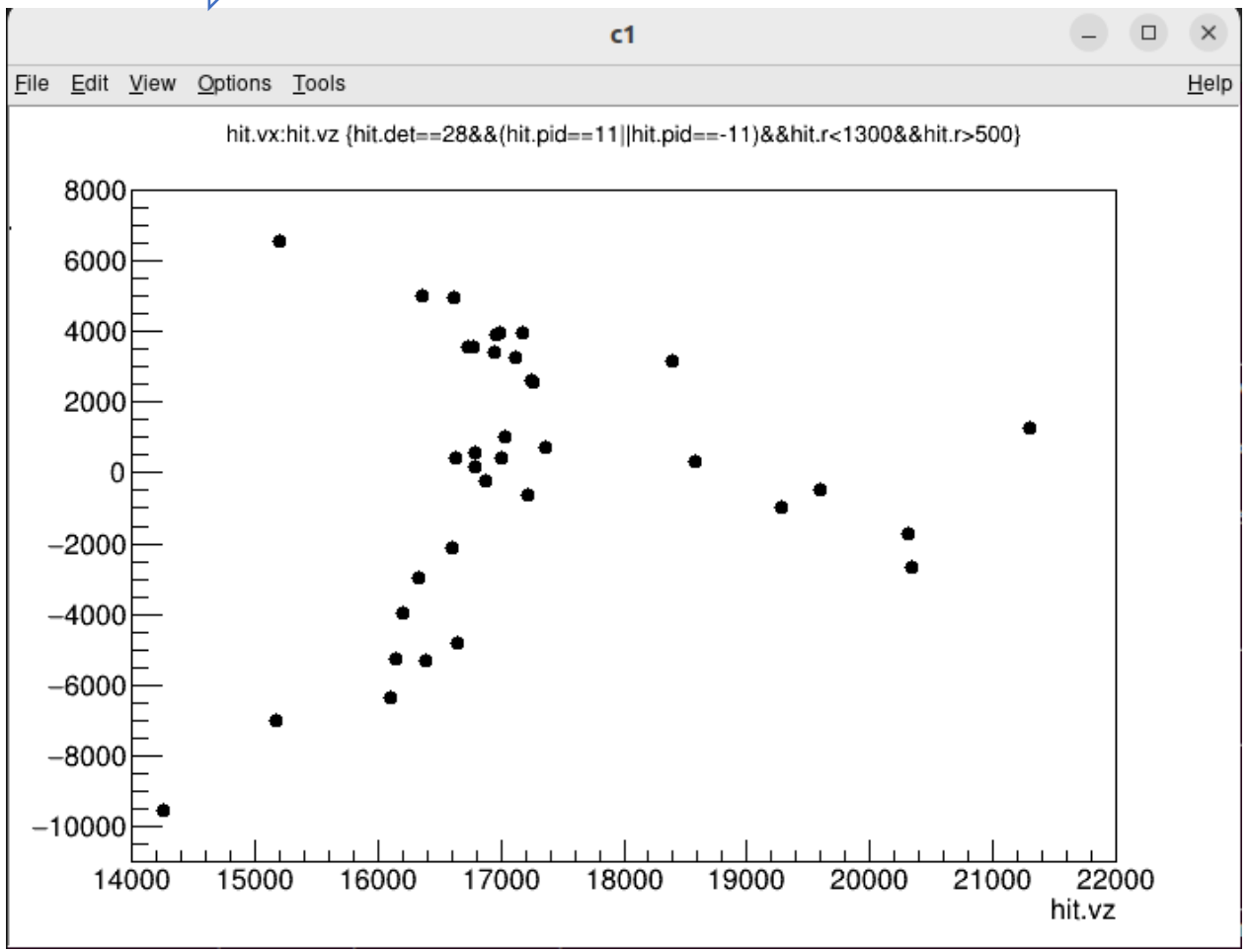




9002 Antisymmetric







Increasing Data

- Running 1 Million Events on the Secondary Symmetric simulations

Secondary Sym With 1 Million Events

ALUMINUM ADDITION

e and e+

Fields: SYM							
Det: 9001	Primary			Secondary			**Previous**
Energy	Raw	Scaled (to 100M)	Probability	Raw	Probability	EOT	EOT
KE<1 MeV	1	1	1.00E-08	19	1.90E-05	1.18E-11	3.10E-11
KE: 1-10 MeV	16	16	1.60E-07	189	1.89E-04	1.17E-10	9.92E-11
KE: 10-100 MeV	45	45	4.50E-07	16	1.60E-05	9.92E-12	0.00E+00
KE: 0.1-1 GeV	0	0	0.00E+00	0	0.00E+00	0.00E+00	0.00E+00
KE: 1-10 GeV	0	0	0.00E+00	0	0.00E+00	0.00E+00	0.00E+00
KE> 10 GeV	0	0	0.00E+00	0	0.00E+00	0.00E+00	0.00E+00
Total Hits	62	62	6.20E-07	224	2.24E-04	1.39E-10	1.30E-10

Most Notable Change

e and e+

Fields: SYM							
Det: 9002	Primary			Secondary			**Previous**
Energy	Raw	Scaled (to 100M)	Probability	Raw	Probability	EOT	EOT
KE<1 MeV	0	0	0.00E+00	104	1.04E-04	8.63E-11	9.96E-11
KE: 1-10 MeV	10	10	1.00E-07	359	3.59E-04	2.98E-10	2.74E-10
KE: 10-100 MeV	36	36	3.60E-07	18	1.80E-05	1.49E-11	1.66E-11
KE: 0.1-1 GeV	37	37	3.70E-07	0	0.00E+00	0.00E+00	0.00E+00
KE: 1-10 GeV	0	0	0.00E+00	0	0.00E+00	0.00E+00	0.00E+00
KE> 10 GeV	0	0	0.00E+00	0	0.00E+00	0.00E+00	0.00E+00
Total Hits	83	83	8.30E-07	481	4.81E-04	3.99E-10	3.90E-10

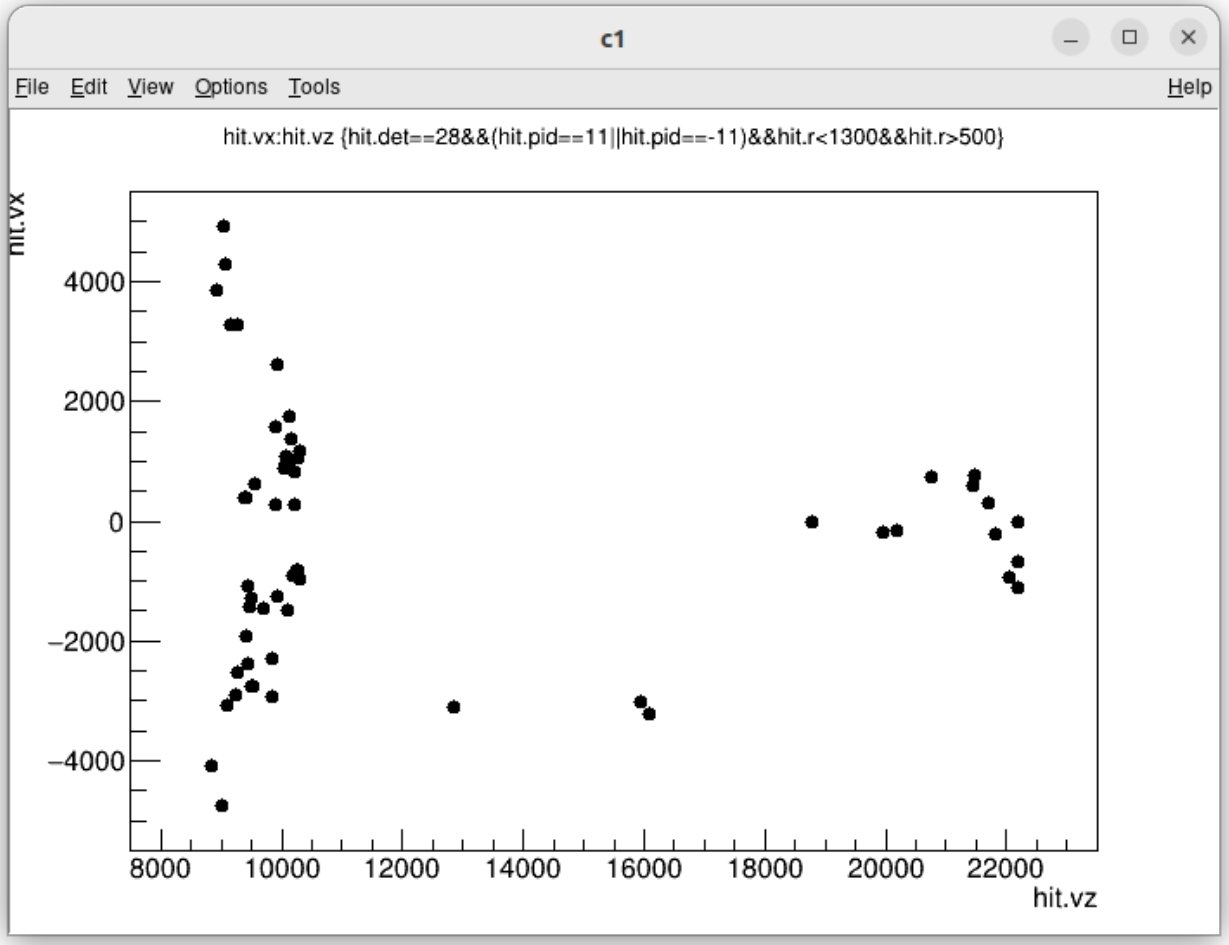
Editing Radial Cut

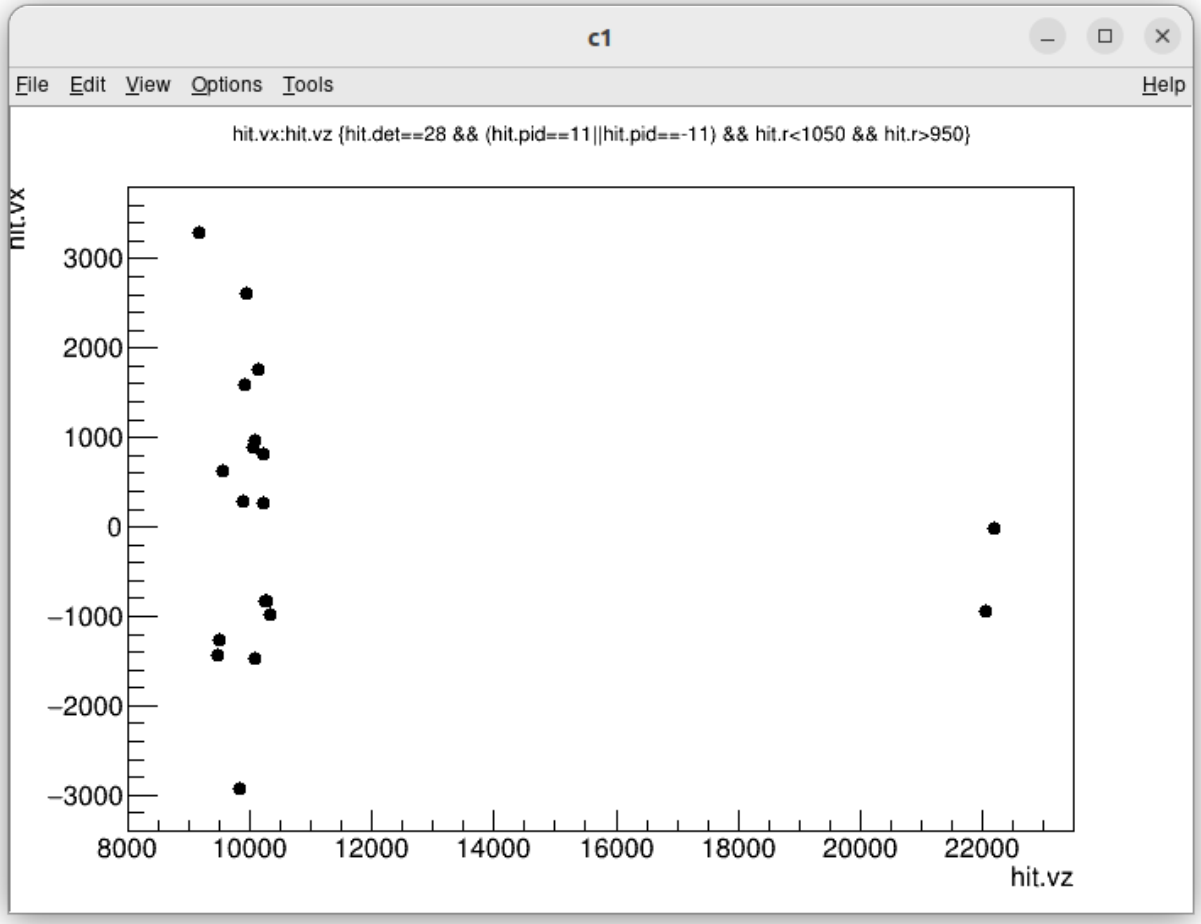
- Instead of observing hits on Det 28 between [500,1300], taking those between [950,1050]

[500,1300]:
→224 Hits

9001 Sym (Alum, Million Events)

[950,1050]:
→35 Hits



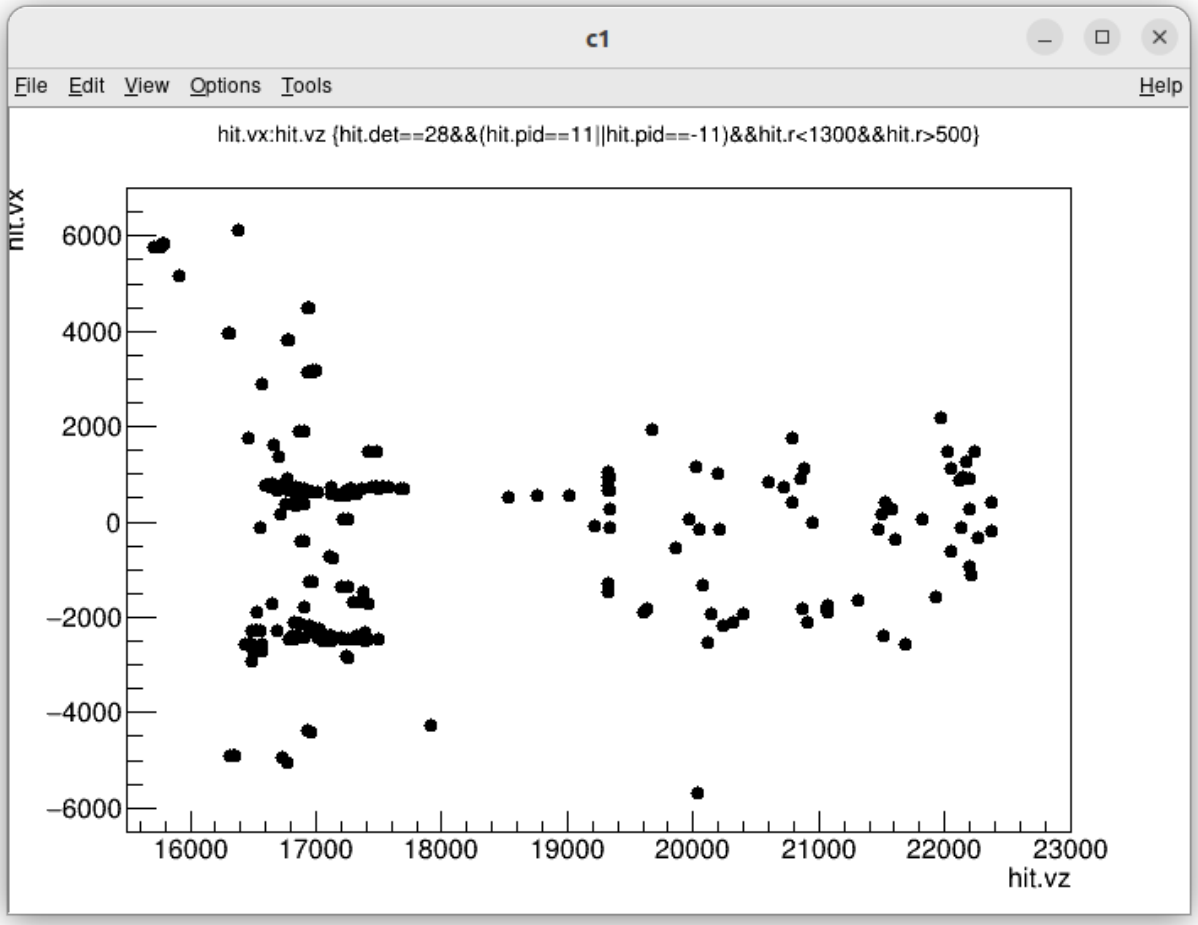


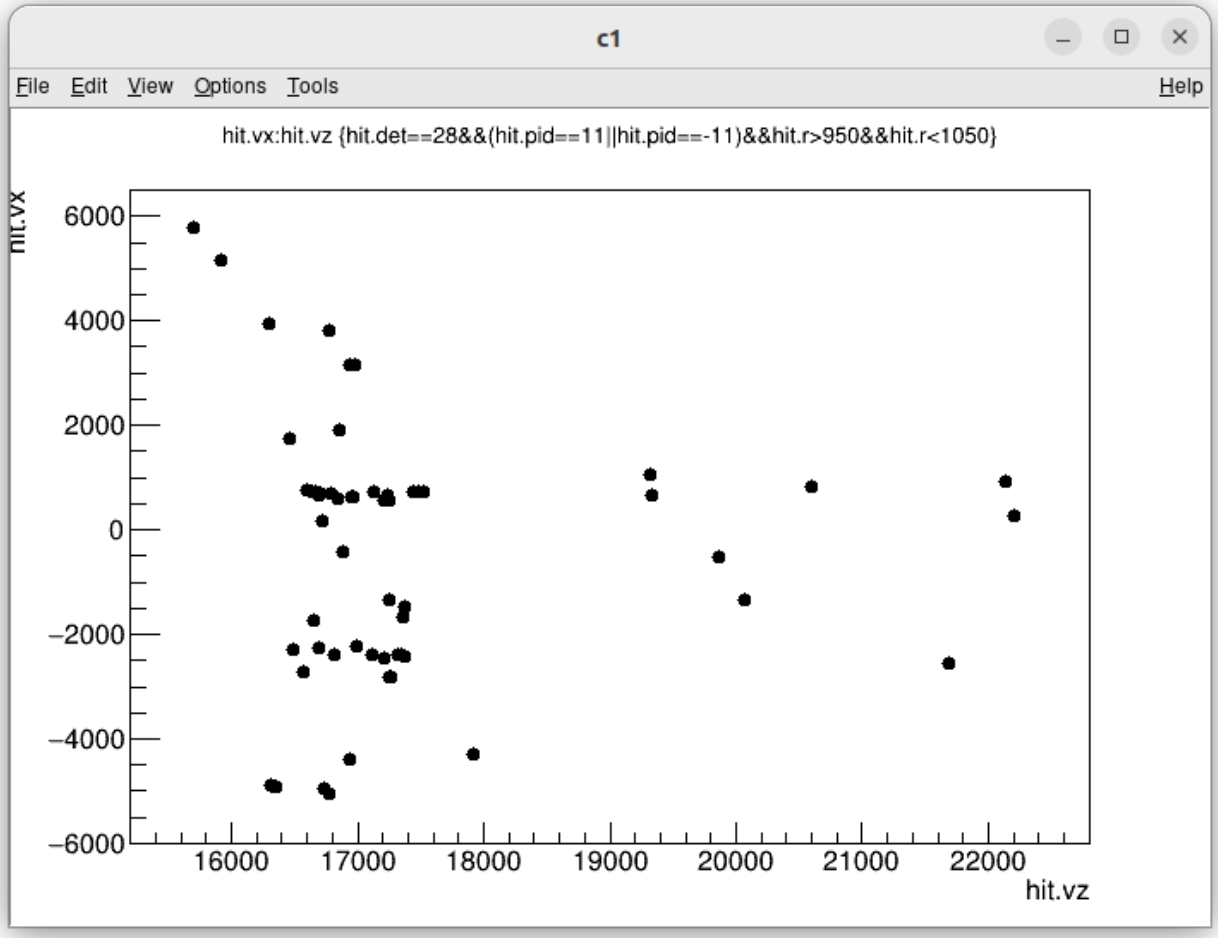
Editing Radial Cut

[500,1300]:
→481 Hits

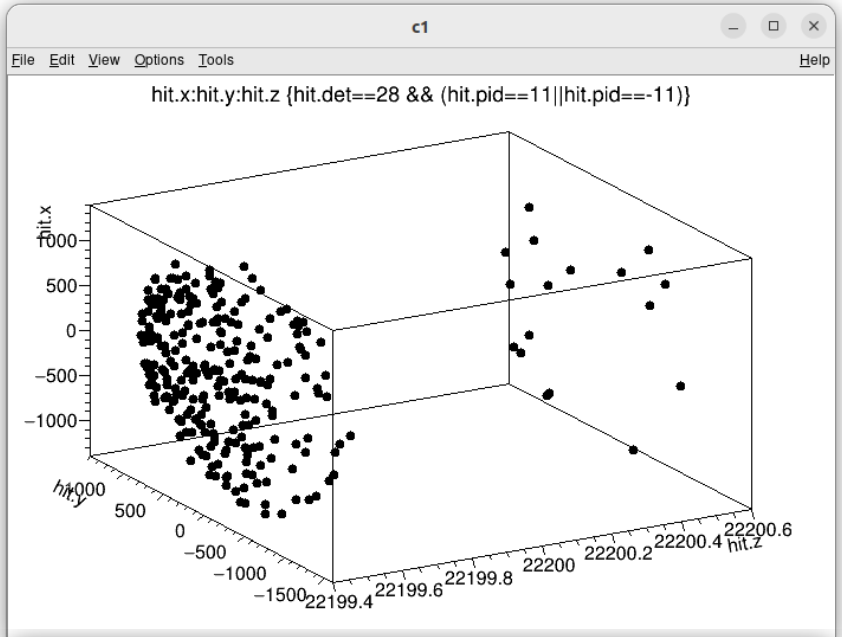
9002 Sym (Alum, Million Events)

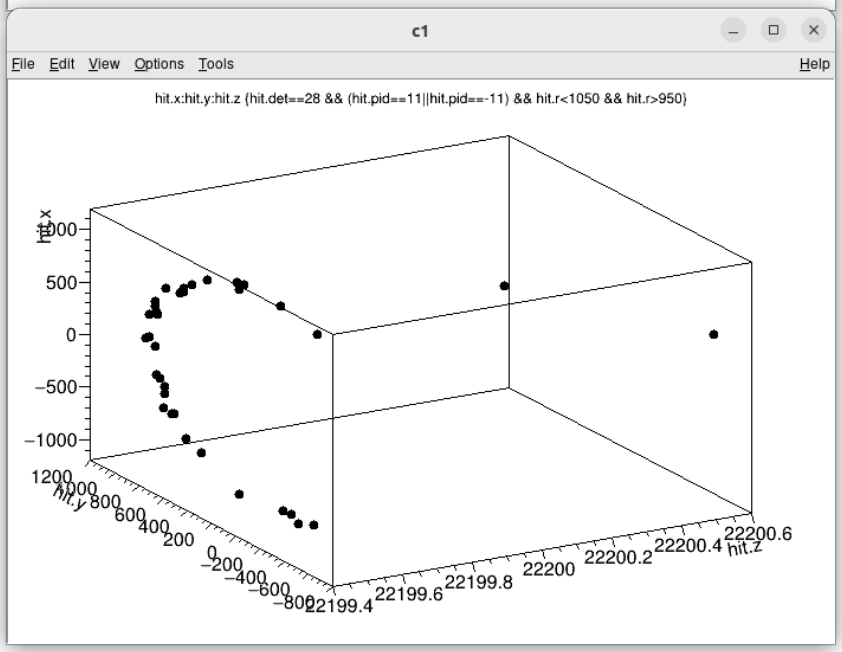
[950,1050]:
→71 Hits

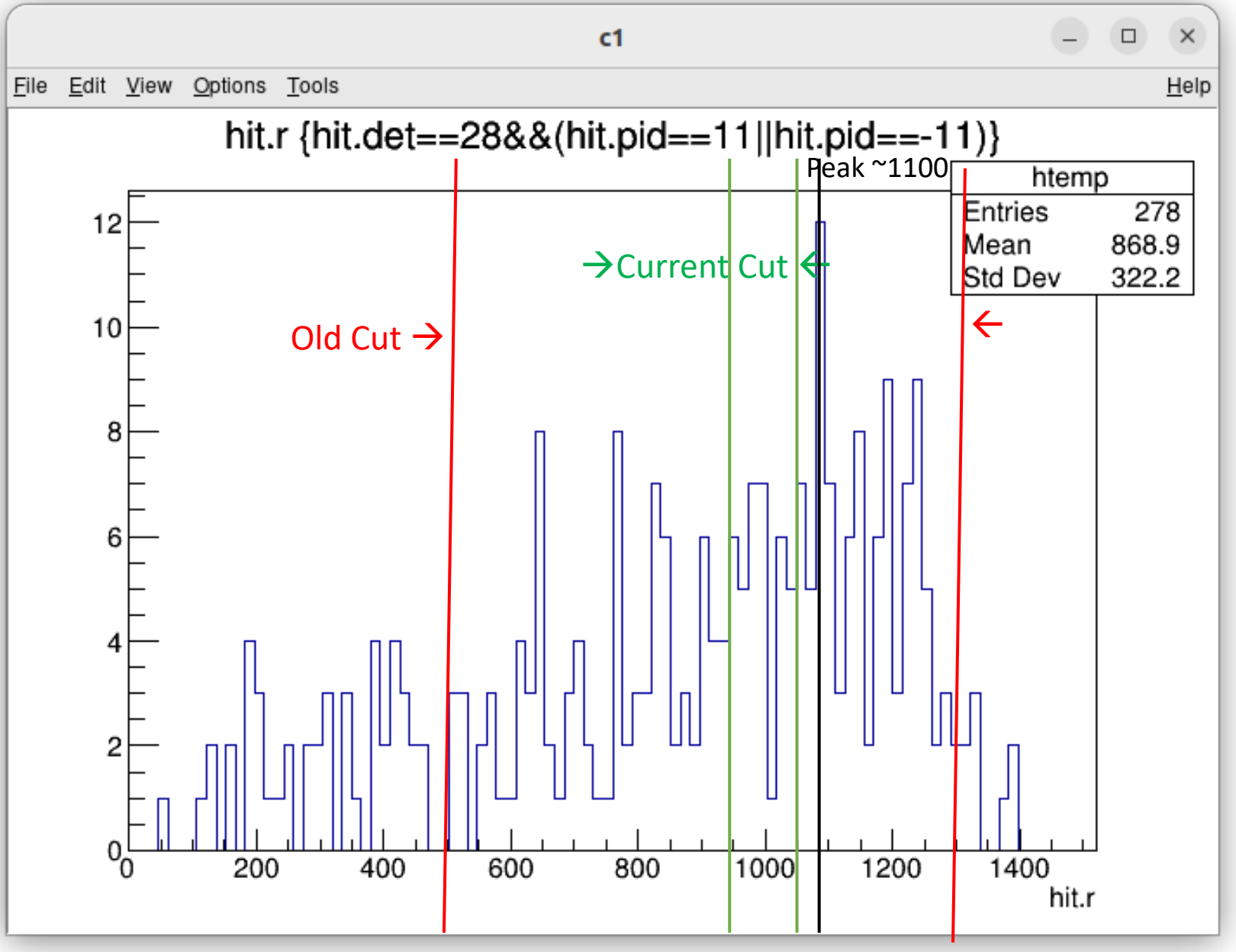




Radial Cuts Distribution 9001 Sym



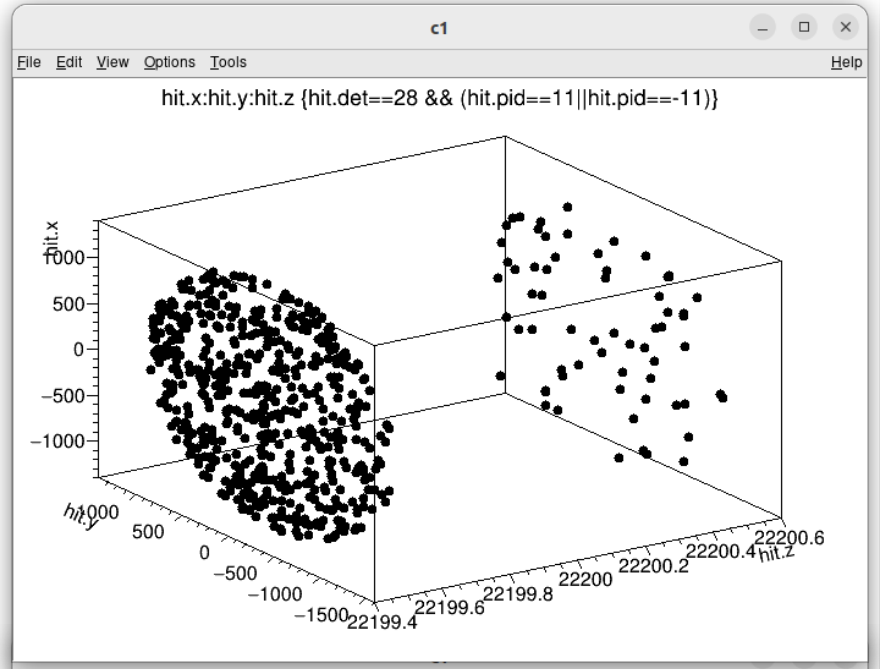


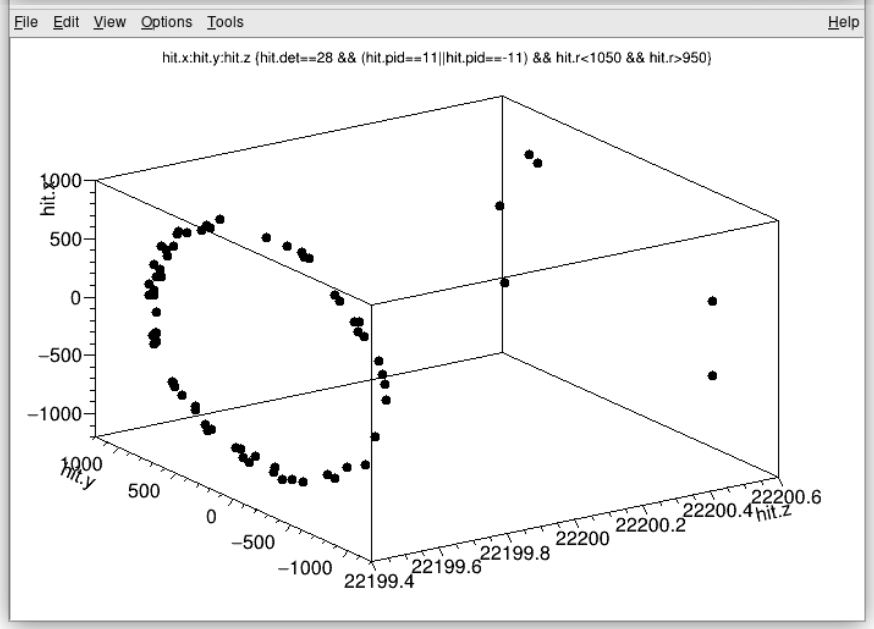


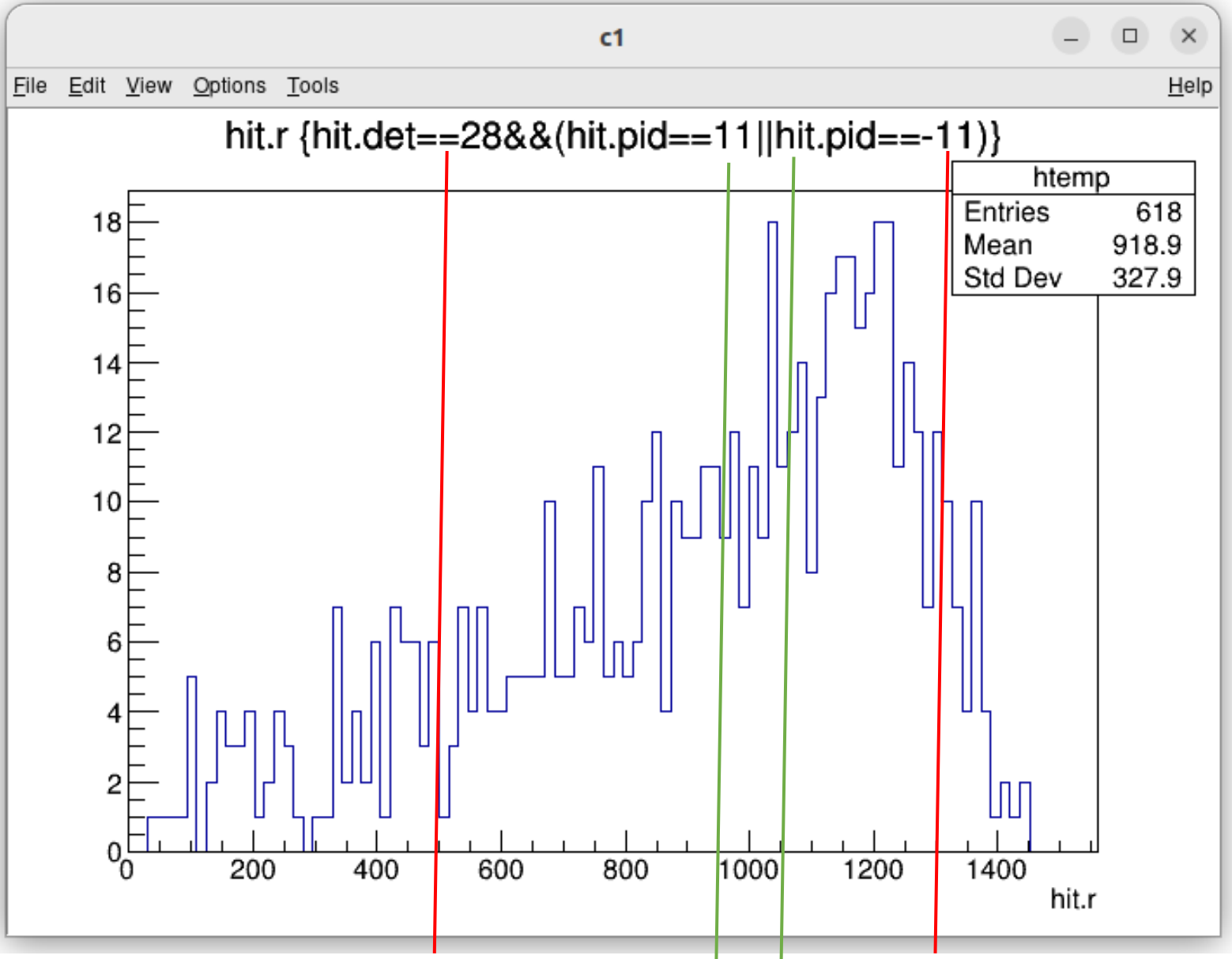
224 Hits,35 Hits,(278 Hits Total)

95 Hits [1050,1300]

Radial Cuts Distribution 9002 Sym



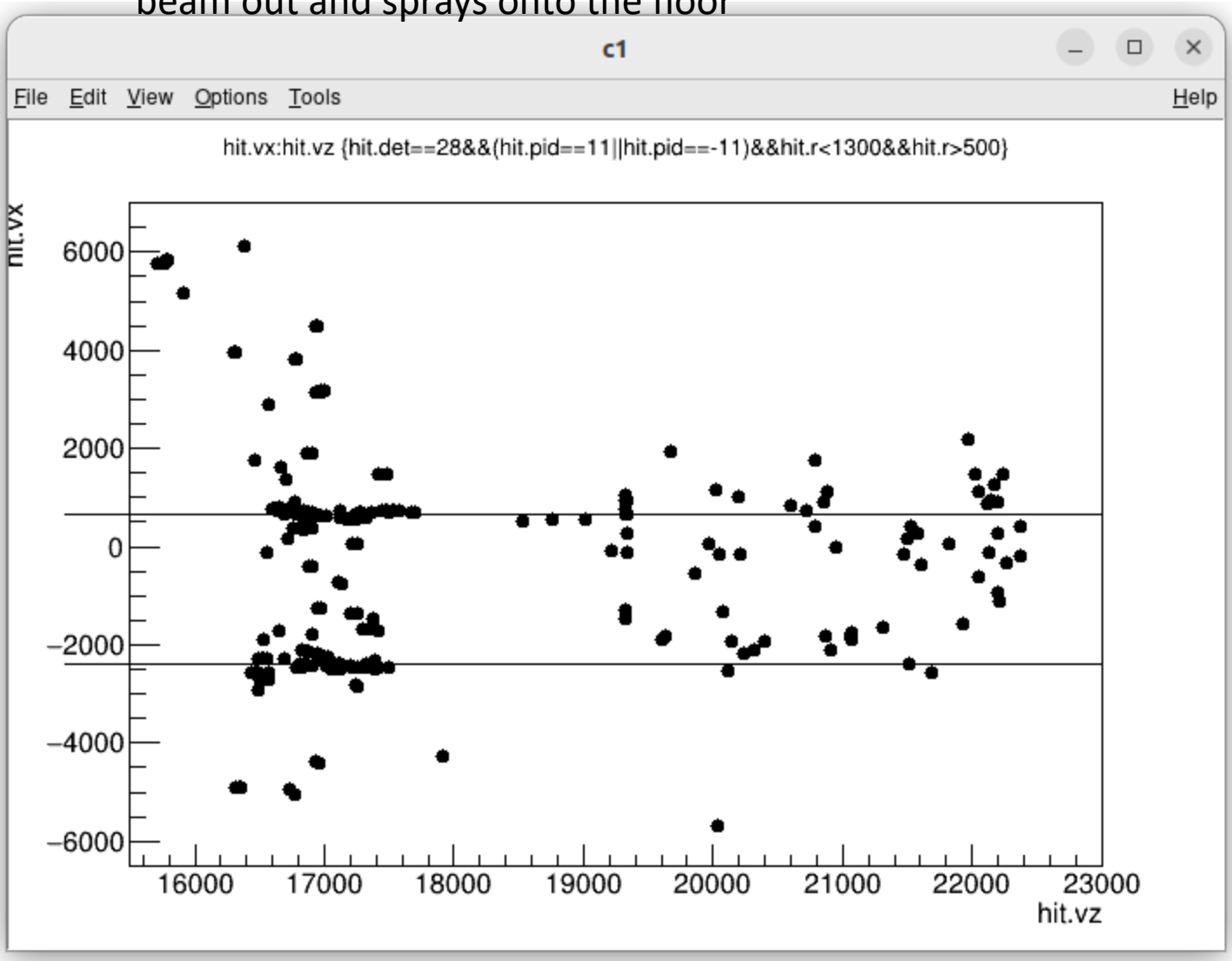


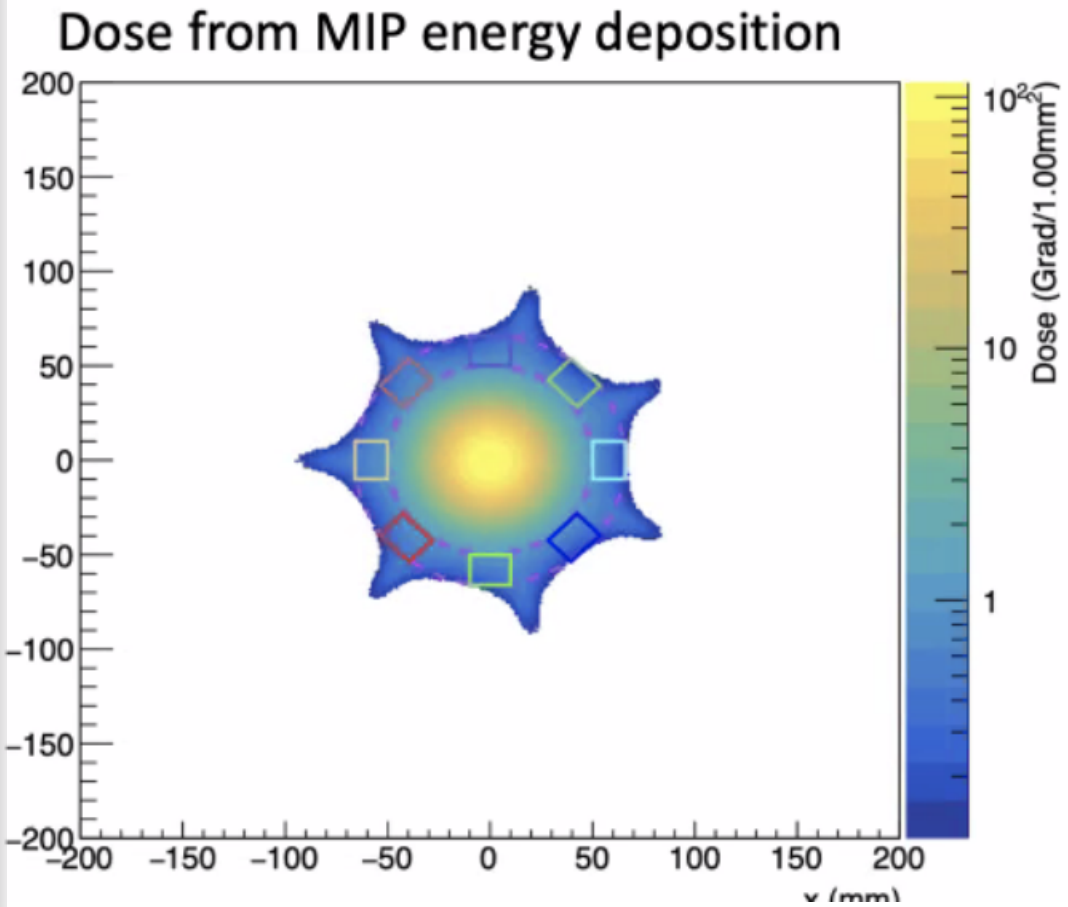


481 Hits,71 Hits,(618 Hits Total)

260 Hits [1000,1300]

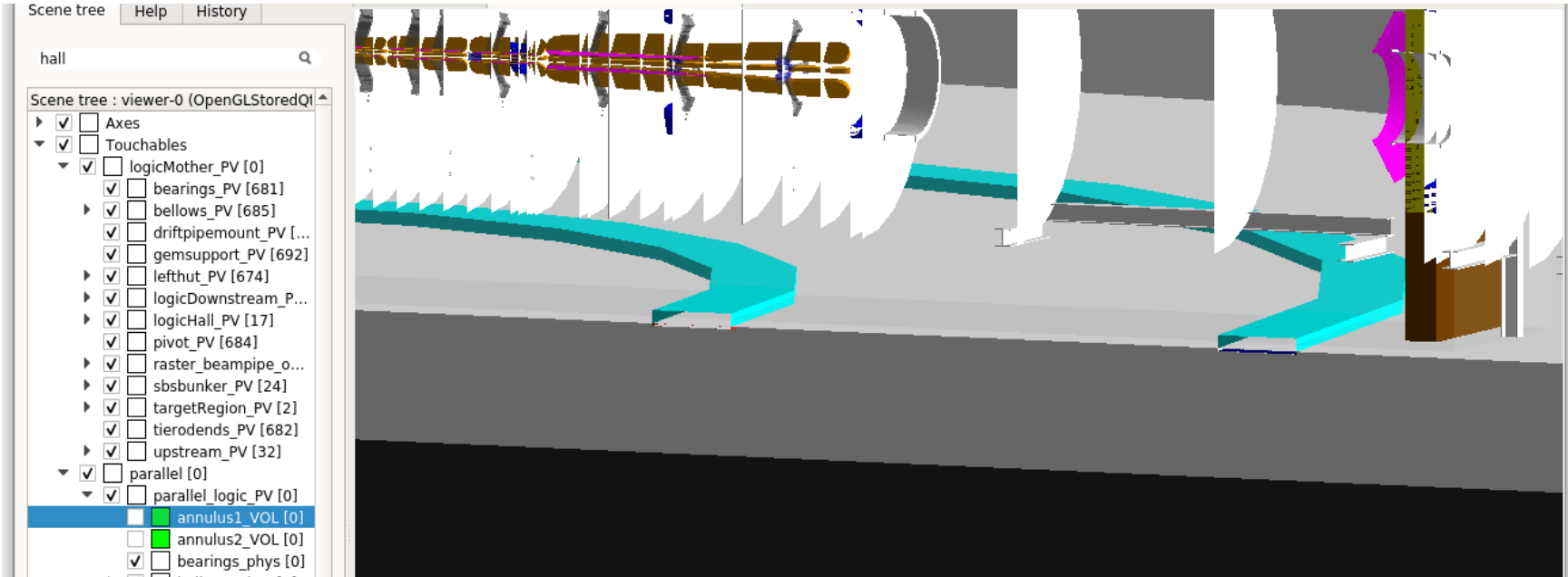
-Distribution of hits on Det 9002 suggests a pattern of rays
-Confirmed that these occur between segments of coils placed axially along the beam line
-Segment gaps provide magnetic fields that bend residual beam out and sprays onto the floor





Concrete Addition

- 6 inches of Concrete placed on top of the steel rings
- Data consists of electrons and positrons
- Same parallel detectors 9001 and 9002 analyzed
- 100 Millions Primary events
  - 1 Million Lost in Raw
- 1 Million events for Secondaries



Fields: SYM

Det: 9001	Primary			Secondary		
Energy	Raw	Scaled (to 100M)	Probability	Raw	Probability	EOT
KE<1 MeV	2	2.02E+00	2.02E-08	22	2.20E-05	1.76E-11
KE: 1-10 MeV	29	2.93E+01	2.93E-07	194	1.94E-04	1.55E-10
KE: 10-100 MeV	48	4.85E+01	4.85E-07	12	1.20E-05	9.58E-12
KE: 0.1-1 GeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
KE: 1-10 GeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
KE> 10 GeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
Total Hits	79	7.98E+01	7.98E-07	228	2.28E-04	1.82E-10

Det: 9002	Primary			Secondary		
Energy	Raw	Scaled (to 100M)	Probability	Raw	Probability	EOT
KE<1 MeV	0	0.00E+00	0.00E+00	102	1.02E-04	1.25E-10
KE: 1-10 MeV	14	1.41E+01	1.41E-07	385	3.85E-04	4.71E-10
KE: 10-100 MeV	40	4.04E+01	4.04E-07	38	3.80E-05	4.64E-11
KE: 0.1-1 GeV	67	6.77E+01	6.77E-07	0	0.00E+00	0.00E+00
KE: 1-10 GeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
KE> 10 GeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
Total Hits	121	1.22E+02	1.22E-06	525	5.25E-04	6.42E-10

Fields: ANTI

Det: 9001	Primary			Secondary		
Energy	Raw	Scaled (to 100M)	Probability	Raw	Probability	EOT
KE<1 MeV	2	2.02E+00	2.02E-08	21	2.10E-05	2.63E-11
KE: 1-10 MeV	30	3.03E+01	3.03E-07	70	7.00E-05	8.77E-11
KE: 10-100 MeV	92	9.29E+01	9.29E-07	8	8.00E-06	1.00E-11
KE: 0.1-1 GeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
KE: 1-10 GeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
KE> 10 GeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
Total Hits	124	1.25E+02	1.25E-06	99	9.90E-05	1.24E-10

Det: 9002	Primary			Secondary		
Energy	Raw	Scaled (to 100M)	Probability	Raw	Probability	EOT
KE<1 MeV	0	0.00E+00	0.00E+00	79	7.90E-05	6.86E-11
KE: 1-10 MeV	13	1.31E+01	1.31E-07	305	3.05E-04	2.65E-10
KE: 10-100 MeV	52	5.25E+01	5.25E-07	15	1.50E-05	1.30E-11
KE: 0.1-1 GeV	21	2.12E+01	2.12E-07	0	0.00E+00	0.00E+00
KE: 1-10 GeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
KE> 10 GeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
Total Hits	86	8.69E+01	8.69E-07	399	3.99E-04	3.47E-10

EOT	EOT
1.18E-11	1.76E-11
1.17E-10	1.55E-10
9.92E-12	9.58E-12
0.00E+00	0.00E+00
0.00E+00	0.00E+00
0.00E+00	0.00E+00
1.39E-10	1.82E-10

9001 Symmetric
Fields Million Event
Secondaries

With Aluminum (Left)
With Concrete (Right)

EOT	EOT
8.63E-11	1.25E-10
2.98E-10	4.71E-10
1.49E-11	4.64E-11
0.00E+00	0.00E+00
0.00E+00	0.00E+00
0.00E+00	0.00E+00
3.99E-10	6.42E-10

9002 Symmetric
Fields Million Event
Secondaries

With Aluminum (Left)
With Concrete (Right)

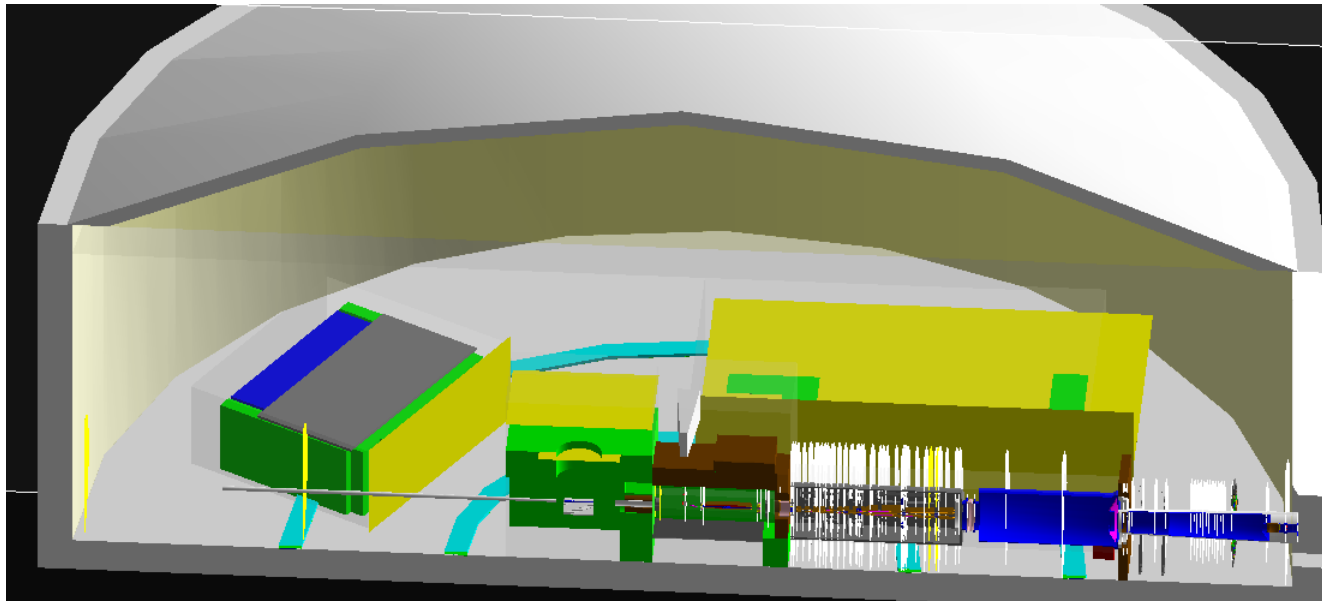
Since Last Time

- Migrated to Develop
- Updated code to allow rotation of fields
- Inserted previous geometry into develop

Develop Sims

- 6 inches of Concrete shielding, no aluminum
- Using only asymmetric fields
  - Then Rotated said fields by 180 degrees
- 100 Million Events in the primary
- 1 Million in the secondary
- Includes electrons and positrons

Develop Branch Geometry



Develop Shielded Sym

Fields: SYM						
Det: 9001	Primary			Secondary		
Energy	Raw	Scaled (to 100M)	Probability	Raw	Probability	EOT
KE<1 MeV	5	5.00E+00	5.00E-08	0	0.00E+00	0.00E+00
KE: 1-10 MeV	21	2.10E+01	2.10E-07	0	0.00E+00	0.00E+00
KE: 10-100 MeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
KE: 0.1-1 GeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
KE: 1-10 GeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
KE> 10 GeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
Total Hits	26	2.60E+01	2.60E-07	0	0.00E+00	0.00E+00

Fields: SYM						
Det: 9002	Primary			Secondary		
Energy	Raw	Scaled (to 100M)	Probability	Raw	Probability	EOT
KE<1 MeV	4	4	4.00E-08	24	2.40E-05	1.58E-11
KE: 1-10 MeV	22	22	2.20E-07	68	6.80E-05	4.49E-11
KE: 10-100 MeV	38	38	3.80E-07	1	1.00E-06	6.60E-13
KE: 0.1-1 GeV	2	2	2.00E-08	0	0.00E+00	0.00E+00
KE: 1-10 GeV	0	0	0.00E+00	0	0.00E+00	0.00E+00
KE> 10 GeV	0	0	0.00E+00	0	0.00E+00	0.00E+00
Total Hits	66	66	6.60E-07	93	9.30E-05	6.14E-11

Develop Unshielded Sym

Fields: SYM						
Det: 9001	Primary			Secondary		
Energy	Raw	Scaled (to 100M)	Probability	Raw	Probability	EOT
KE<1 MeV	6	6.00E+00	6.00E-08	0	0.00E+00	0.00E+00
KE: 1-10 MeV	22	2.20E+01	2.20E-07	0	0.00E+00	0.00E+00
KE: 10-100 MeV	3	3.00E+00	3.00E-08	0	0.00E+00	0.00E+00
KE: 0.1-1 GeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
KE: 1-10 GeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
KE> 10 GeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
Total Hits	31	3.10E+01	3.10E-07	0	0.00E+00	0.00E+00

Fields: SYM						
Det: 9002	Primary			Secondary		
Energy	Raw	Scaled (to 100M)	Probability	Raw	Probability	EOT
KE<1 MeV	0	0.00E+00	0.00E+00	30	3.00E-05	1.14E-11
KE: 1-10 MeV	15	1.50E+01	1.50E-07	79	7.90E-05	3.00E-11
KE: 10-100 MeV	22	2.20E+01	2.20E-07	1	1.00E-06	3.80E-13
KE: 0.1-1 GeV	1	1.00E+00	1.00E-08	0	0.00E+00	0.00E+00
KE: 1-10 GeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
KE> 10 GeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
Total Hits	38	3.80E+01	3.80E-07	110	1.10E-04	4.18E-11

Develop Shielded Asym (0 Rot)

Fields: ANTI						
Det: 9001	Primary			Secondary		
Energy	Raw	Scaled (to 100M)	Probability	Raw	Probability	EOT
KE<1 MeV	3	3.00E+00	3.00E-08	0	0.00E+00	0.00E+00
KE: 1-10 MeV	16	1.60E+01	1.60E-07	0	0.00E+00	0.00E+00
KE: 10-100 MeV	1	1.00E+00	1.00E-08	0	0.00E+00	0.00E+00
KE: 0.1-1 GeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
KE: 1-10 GeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
KE> 10 GeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
Total Hits	20	2.00E+01	2.00E-07	0	0.00E+00	0.00E+00

Fields: ANTI						
Det: 9002	Primary			Secondary		
Energy	Raw	Scaled (to 100M)	Probability	Raw	Probability	EOT
KE<1 MeV	1	1.00E+00	1.00E-08	10	1.00E-05	7.90E-12
KE: 1-10 MeV	38	3.80E+01	3.80E-07	42	4.20E-05	3.32E-11
KE: 10-100 MeV	39	3.90E+01	3.90E-07	1	1.00E-06	7.90E-13
KE: 0.1-1 GeV	1	1.00E+00	1.00E-08	0	0.00E+00	0.00E+00
KE: 1-10 GeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
KE> 10 GeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
Total Hits	79	7.90E+01	7.90E-07	53	5.30E-05	4.19E-11

Develop Unshielded Asym (0 Rot)

Fields: ANTI						
Det: 9001	Primary			Secondary		
Energy	Raw	Scaled (to 100M)	Probability	Raw	Probability	EOT
KE<1 MeV	6	6.19E+00	6.19E-08	0	0.00E+00	0.00E+00
KE: 1-10 MeV	22	2.27E+01	2.27E-07	0	0.00E+00	0.00E+00
KE: 10-100 MeV	2	2.06E+00	2.06E-08	0	0.00E+00	0.00E+00
KE: 0.1-1 GeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
KE: 1-10 GeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
KE> 10 GeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
Total Hits	30	3.09E+01	3.09E-07	0	0.00E+00	0.00E+00

Fields: ANTI						
Det: 9002	Primary			Secondary		
Energy	Raw	Scaled (to 100M)	Probability	Raw	Probability	EOT
KE<1 MeV	1	1.03E+00	1.03E-08	17	1.70E-05	1.38E-11
KE: 1-10 MeV	38	3.92E+01	3.92E-07	49	4.90E-05	3.99E-11
KE: 10-100 MeV	40	4.12E+01	4.12E-07	0	0.00E+00	0.00E+00
KE: 0.1-1 GeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
KE: 1-10 GeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
KE> 10 GeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
Total Hits	79	8.14E+01	8.14E-07	66	6.60E-05	5.38E-11

Develop Shielded Asym (180 Rot)

Fields: 180 ANTI						
Det: 9001	Primary			Secondary		
Energy	Raw	Scaled (to 100M)	Probability	Raw	Probability	EOT
KE<1 MeV	3	3.00E+00	3.00E-08	0	0.00E+00	0.00E+00
KE: 1-10 MeV	14	1.40E+01	1.40E-07	0	0.00E+00	0.00E+00
KE: 10-100 MeV	1	1.00E+00	1.00E-08	0	0.00E+00	0.00E+00
KE: 0.1-1 GeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
KE: 1-10 GeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
KE> 10 GeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
Total Hits	18	1.80E+01	1.80E-07	0	0.00E+00	0.00E+00

Fields: 180 ANTI						
Det: 9002	Primary			Secondary		
Energy	Raw	Scaled (to 100M)	Probability	Raw	Probability	EOT
KE<1 MeV	0	0.00E+00	0.00E+00	33	3.30E-05	8.25E-12
KE: 1-10 MeV	16	1.60E+01	1.60E-07	75	7.50E-05	1.88E-11
KE: 10-100 MeV	9	9.00E+00	9.00E-08	0	0.00E+00	0.00E+00
KE: 0.1-1 GeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
KE: 1-10 GeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
KE> 10 GeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
Total Hits	25	2.50E+01	2.50E-07	108	1.08E-04	2.70E-11

Develop Unshielded Asym (180 Rot)

Fields: 180 ANTI						
Det: 9001	Primary			Secondary		
Energy	Raw	Scaled (to 100M)	Probability	Raw	Probability	EOT
KE<1 MeV	3	3.00E+00	3.00E-08	0	0.00E+00	0.00E+00
KE: 1-10 MeV	19	1.90E+01	1.90E-07	0	0.00E+00	0.00E+00
KE: 10-100 MeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
KE: 0.1-1 GeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
KE: 1-10 GeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
KE> 10 GeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
Total Hits	22	2.20E+01	2.20E-07	0	0.00E+00	0.00E+00

Fields: 180 ANTI						
Det: 9002	Primary			Secondary		
Energy	Raw	Scaled (to 100M)	Probability	Raw	Probability	EOT
KE<1 MeV	0	0.00E+00	0.00E+00	51	5.10E-05	1.33E-11
KE: 1-10 MeV	9	9.00E+00	9.00E-08	225	2.25E-04	5.85E-11
KE: 10-100 MeV	16	1.60E+01	1.60E-07	5	5.00E-06	1.30E-12
KE: 0.1-1 GeV	1	1.00E+00	1.00E-08	0	0.00E+00	0.00E+00
KE: 1-10 GeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
KE> 10 GeV	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
Total Hits	26	2.60E+01	2.60E-07	281	2.81E-04	7.31E-11

*Using Probability (Rawhits/#events) as “Primary Signal”

Takeaways for Det. 9001

- Across the board, consistently, Det. 9001 produces zero signal on the main detector, no matter the configuration
- 9001: Lowest Primary signal: 180 Rotated Field, Shielded (1.80E-07)
- 9001: Highest Primary signal: Sym field Unshielded (3.10E-07)
- 9001: Lowest Sym field primary signal: Shielded (2.60E-07)

Takeaways for Det. 9002

- 9002: still has generally larger **primary** signal compared to 9001 (just as we saw in Ferrous)
- 9002: Lowest EOT: 180 Rotated Asym Fields, Shielded (2.70E-11)
- 9002: Highest EOT: 180 Rot Asym, Unshielded (7.31E-11)
- 9002 Lowest EOT with Sym field: Unshielded (4.18E-11)
- 9002: between 0 and 180 Asym Field rotation: larger EOT for 180 rotation when Unshielded
  - Larger EOT for 0 rotation in Shielded config

Comparing to Previous Ferrous Branch

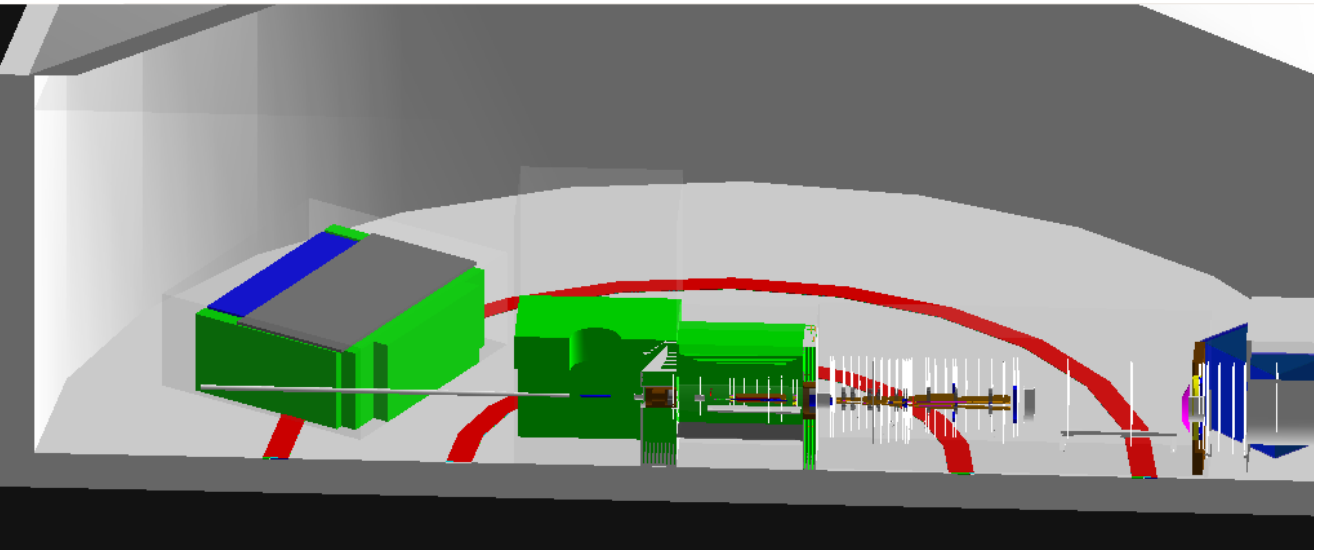
- The primary signals are lower in Develop compared to Ferrous
- 9002: EOT decreases in Develop compared to Ferrous (and 9001 goes to zero)
- 9001: Primary Signal decreases in Develop compared to Ferrous

Conclusions:

- Develop Geometry is less prone to produce scattering in the first place
- The inner most ferrous ring (Det. 9001) produces no signal on the main detector
- The outer ring produces at most 7.31E-11 EOT in Asym Fields with no Shielding
- With Shielding, **at most**, 9002 Produces 6.14E-11 EOT (Symmetric fields)
    - In an Ideal setting, with symmetric fields and 6 inches of concrete shielding on the floors, this is the only signal on the main detector, only from 9002

The only question remaining: is the lack of signal from Det. 9001 True or an error?

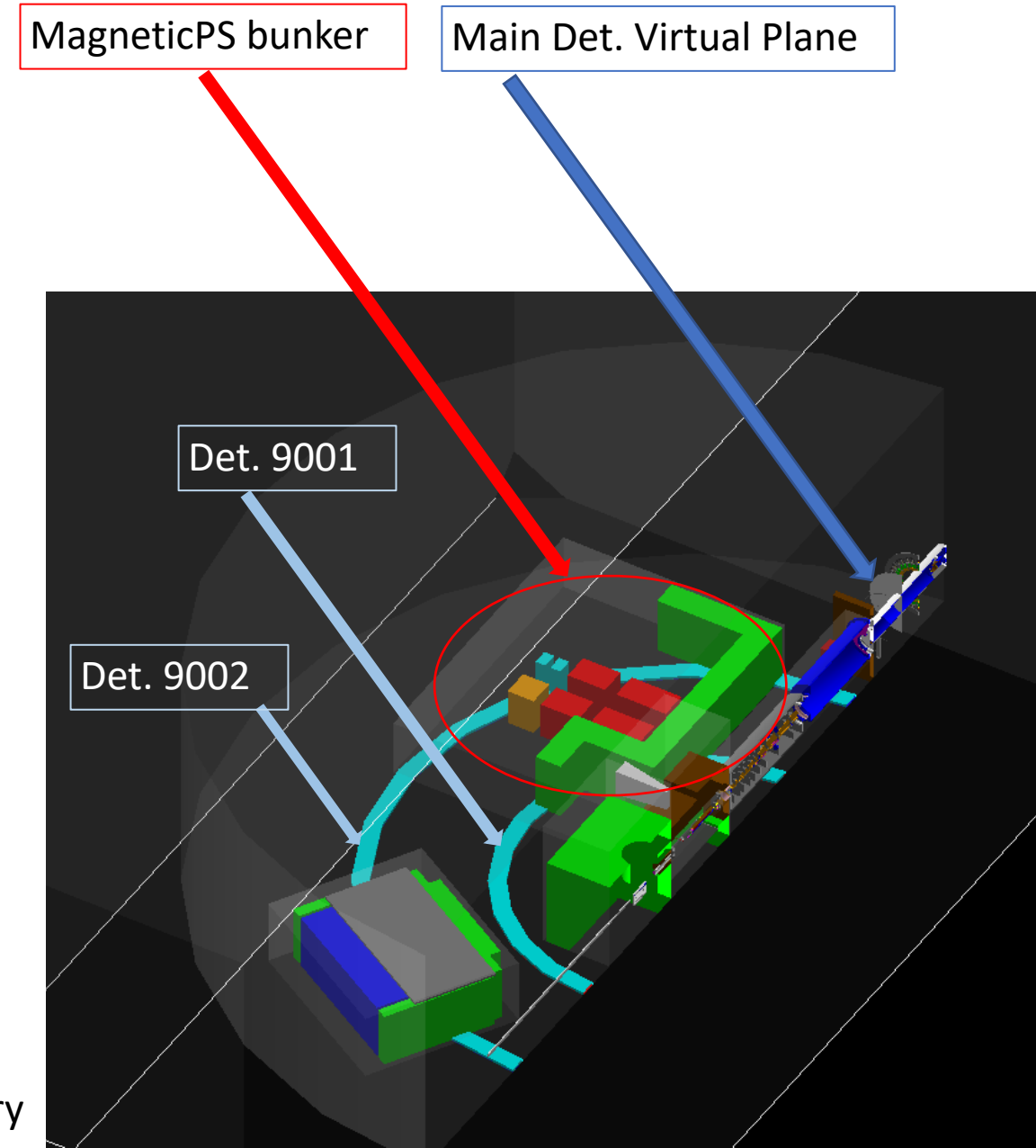
Possible Reasons



Ferrous Branch Geometry

The geometry in Develop may be directly interfering with scattering from Det. 9001

In particular, this electronics bunker was not present in previous ferrous branch geometry



Develop Branch Geometry

Relevant Information

Simulation stats:

>Primary: Always 100 Million Events

>Secondary: 1 Million Events

>Secondary Simulations Include both electrons and positron counts

>Secondary analysis done via ferrous_gettable.C from Caryn as I did with ferrous sims (for consistency)

>Trackid==1

>Geometry implemented in Develop was done identically to that in Ferrous

Interesting Points:

- in previous simulations, I had been disabling ferrous geometry in the primary simulations and reenabling the same geometries for secondaries. I did this in all Ferrous sims and in the Asym+Shielded configuration simulations (both 0 and 180 rotation) in Develop. Once learning this was irrelevant and unnecessary, I kept relevant geometries enabled in all simulations. Regardless, Det. 9001 still produced 0 signal in secondary sims.
- Searched geometry for other detectors given auxvalue of 9001, only my ferrous ring has this det number.
- Methodology was identical between det. 9001 and det. 9002 sims. Relevant files and changes were made to scripts. Yet, 9002 produces reasonable data, but 9001 produces zero hits
- When looking at secondary sim output for 9001, photons are reported on the main detector, just no electrons/ positrons
- Also, Drawing just “hit.e” with no cuts, 9001 reports several hundred thousand hits.
    - Meaning, data was written, it’s not an empty file