Electron Scattering Benchmark

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Monoenergetic 13.00 MeV and 20.00 MeV electron beams, with a Gaussian-shaped spatial distribution of 0.042 cm sigma (0.1 cm FWHM). Simulations are done with select foils with normal incidence on the exit window and for all foils with a point source at a position to match the measured no-foil profiles. The titanium exit window is followed by the scattering foil (of various materials and thickness), monitor chamber, and helium-filled bag. Fluence is scored at the back of the mylar bag, filled with helium at atmospheric pressure.

The geometry is shown in Figure 1. The position and thickness of each layer are presented in Table 1. The material, density and thickness of each scattering foil are specified in Table 2.

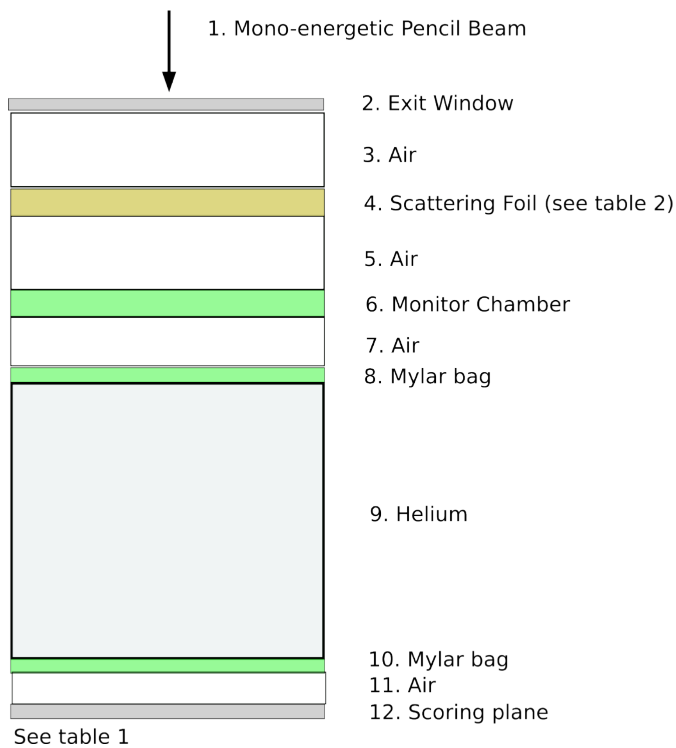

Figure 1: Simulation geometry. There are two support rings at either end of the mylar bag (slabs 8 and 10) made of Al of 20 cm inner radius, 23.3 cm outer radius, and 1.4 cm thick. Simulate the rings (Figure 2). Simulate out to a 23.3 cm radius cylinder, the lateral extent of the bag.

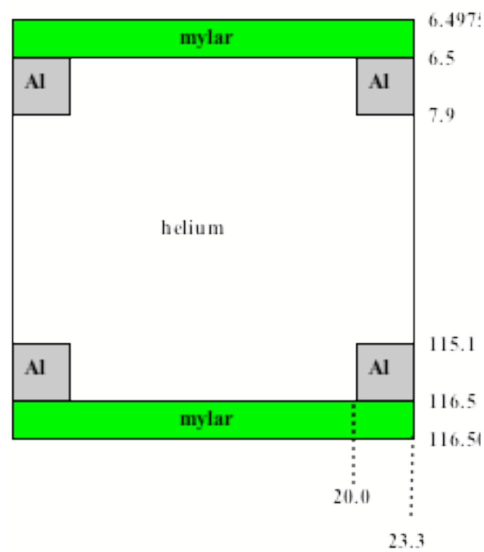

Figure 2: Geometry for simulation of helium filled mylar bag with Al rings. Distances in centimeters.

In Table 2, titanium scatterer thickness does NOT include the 0.00412 cm thick titanium exit window. Thus for all foil materials and thicknesses there is a 0.00401 cm thick Ti exit window plus the scattering foil. The 0.0 cm titanium scatterer thickness is the exit window with no scattering foil.

Scoring: Score fluence of electrons (NOT planar fluence; i.e., account for the angle of the particle). Use radial spatial bins 1 mm in width. Results should be in ASCII data files, format optional, filename convention optional (but hopefully obvious).

Procedure:

1. Preliminary simulation set to finalize source and geometry:
   a. Simulate the 13.0 and 20.0 MeV beams with normal incidence for the following foils; no foil, Ti foil number 4 (54.6 mg/cm^2), Au foil number 3 (93.7 mg/cm^2). Get these back to me for a preliminary comparison by the end of October.
   b. Place a point source at a position that gives the closest match to the no-foil measurement. The point source position may be different for the 2 energies. Simulate Ti foil number 4 and Au foil number 3 with this point source position. Get these back to me for a preliminary comparison by the end of October.
2. Make a joint decision on how to proceed with the simulation of all foils by mid-November. Get the simulation results into me by the end of the year.

1. Mono-energetic beam	**Energy**	**Type**	**FWHM (cm)**		
	13 MeV	Gaussian	0.1		
	20 MeV	Gaussian	0.1		
	Material	**Thickness (cm)**	**SSD to front (cm)**	**Density (g/cm3)**	**Composition or Radius**
2. Exit Window	Ti	0.00412	0.000000	4.42	90% Ti
					6% Al
					4% V
3. Air	AIR	2.64588	0.004120	0.001205	75.52% N
					23.18% O
					1.283% AR
					0.0124% C
4. Scattering Foil	*See Table 2*	*t*	2.650000		
5. Air	AIR	2.35-*t*	2.65+*t*	0.001205	
6. Monitor Chamber	Mylar	0.01127	5.000000	1.400000	H4
					C5
					O2
7. Air	AIR	1.48623	5.011270	0.001205	
8. Mylar bag	Mylar	0.00250	6.497500	1.400000	
9a. Aluminum ring	Al	1.40000	6.500000	2.700000	Radius 20.0-23.3 cm
9b. Helium between mylar	He	110.00000	6.500000	0.000166	Radius 0-20 cm
9c. Helium between Al	He	107.20000	7.900000	0.000166	Radius 20-23.3 cm
9d. Aluminum ring	Al	1.40000	115.100000	2.700000	Radius 20.0-23.3 cm
10. Mylar bag	Mylar	0.00250	116.500000	1.400000	
11. Air	AIR	1.69750	116.502500	0.001205	
12. Scoring Plane	Not Applicable		118.200000		

Table 1. Source and Geometry details. Foil position is an average of the 2 positions used: 2.5 cm for Be and C foils, 2.8 cm for the other foils. Each component is a cylinder, except for the scoring plane, which is a circle. Each cylinder has a radius of 23.3 cm unless otherwise stated.

4. Scattering Foil					
Material	**Density (g/cm3)**	**Foil**	**Mass/Area (mg/cm2)**		**Thickness, *t* (cm)**
			13 MeV	**20 MeV**	
Be	1.85	1	926	926	0.5005
C	2.18	1	546	546	0.2505
Al	2.70	1	70.1	70.1	0.02596
		2	140	140	0.05185
		3	N/A	274	0.1015
		4	N/A	414	0.1533
Ti	4.42	1	0	0	0.00000
		2	18.21	18.21	0.00412
		3	36.4	36.4	0.00824
		4	54.6	54.6	0.01235
		5	72.8	72.8	0.01647
Cu	8.92	1	43	43	0.00482
		2	86.4	86.4	0.00969
		3	129.6	129.6	0.01453
		4	174.5	174.5	0.01956
Ta	16.65	1	44.3	N/A	0.00266
		2	N/A	206.3	0.01239
Au	19.30	1	31.2	N/A	0.00162
		2	54.8	54.8	0.00284
		3	93.7	N/A	0.00485
		4	N/A	109.5	0.00567
		5	N/A	164.2	0.00850
		6	N/A	219	0.01134

Table 2. Scattering foil specifications. No measured data for N/A. A different density may be used in the simulation if the thickness is scaled to give the same mass per unit area.