Radiation shielding for the future deuteron EDM experiment

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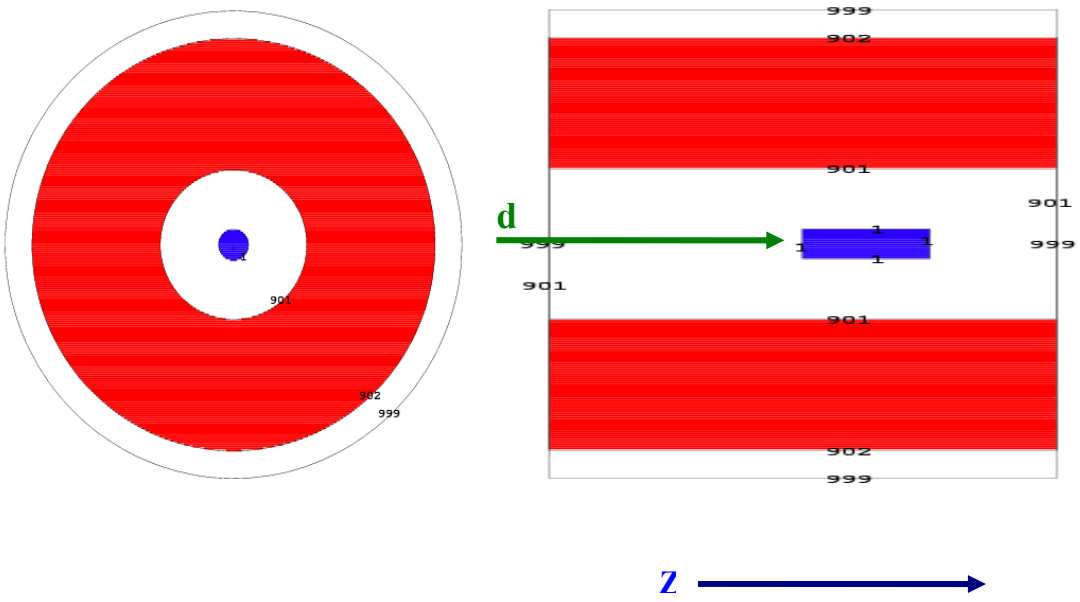
The following are the cross-sectional and side views of the cylindrical tunnel with 8 ft in diameter and a cylindrical steel structure with a length of 1 m and 50 cm in diameter.



Left: A view on the XY plane; Right: a view on the XZ plane. The "red" area indicates the concrete tunnel whereas the "blue" area indicates the steel structure.

The purpose here is to see what the radiation dose is when the steel structure is bombarded by 700 MeV deuterons. The deuteron intensity is assumed to be 10^{11} deuterons per 8 s cycle. Radiation doses for the two values of thickness (the "red" area in the above), 7 & 8 ft, are calculated.

The axis of the cylindrical tunnel is the z axis. z = 0 cm is the end of the steel structure where the deuteron beam hits first and z = 100 cm is the other end of the steel structure. Table 1 shows the results of the Monte Carlo simulation using MCNPX 2.5.d.

No. of deuterons	cycle (s)	Loss Percentage	Effective deuterons per second
1.00E+11	8	100.00%	1.25E+10
With 8 ft shield wall			
z (cm)	Dose (rem/electron)	dose rate (rem/hour)	
-50	1.50E-17	6.75E-04	
0	2.70E-17	1.22E-03	
50	4.00E-17	1.80E-03	
100	5.00E-17	2.25E-03	
With 7 ft shield wall			
z (cm)	Dose (rem/electron)	dose rate (rem/hour)	
-50	3.00E-17	1.35E-03	
0	5.40E-17	2.43E-03	
50	8.00E-17	3.60E-03	
100	9.90E-17	4.46E-03	

Table 1: The radiation doses at different positions along the z-axis for 8 ft and 7 ft concrete shieldings respectively.