AP 4010 Introduction to Nuclear Science
Fall 2004

Homework Assignment 3: Due October 5, 2004

[Remember: Quiz #1 will be at the beginning of next week's class. The quiz will last about 90 minutes; it is *open book* and *open notes*; and it covers the material in Chapters 1, 5 and 6 of Lilley's text book.]

1. Do any four of the last nine problems at the end of Chapter 5 in Lilley's *Nuclear Physics*, either Problem 5.7, 5.8, …, or 5.15. [Again notice: the answers are in Appendix G, so show the essential steps of your solution.]

2. A gamma ray is Compton-scattered backward ($\theta = 180$ deg). Calculate the energy of the scattered quantum for a primary quantum with energies equal to 0.01, 0.1, 1.0, 10.0, and 100.0 MeV.

3. In this problem, you are to examine the results from laboratory measurements.

   A radioactive sample is known to emit beta and gamma rays. You are to estimate the energy of the gamma ray and the maximum energy of the beta (in MeV) by measuring the activity passing through aluminum foils. The resulting data is given in the table below.

   (Recall that the density of Al is 2.7 g/cm^3, so that an absorber with thickness 0.130 g/cm^2 is a foil of thickness 0.48 mm, or 0.019 inch—about the thickness of standard aluminum foil. As the thickness of the foil increases, less and less radiation is detected. Hint: plot the data on a log-linear chart, with log(activity) on the *y*-axis and absorber thickness on the *x*-axis. Refer to Figs. 5.5 and 5.6.)

Absorber thickness, g cm^{-2}	*Activity, divisions min^{-1}*	*Absorber thickness, g cm^{-2}*	*Activity, divisions min^{-1}*
0	5.8	0.700	0.11
0.070	3.5	0.800	0.10
0.130	2.2	1.00	0.10
0.200	1.3	2.00	0.092
0.300	0.60	4.00	0.080
0.400	0.28	7.00	0.065
0.500	0.12	10.00	0.065
0.600	0.11	14.00	0.040