Physics 225b Lab Report

Experiment: Attenuation of Gamma Radiation by matter Part II

Hypothesis to test: We can improve our result for measuring the attenuation of photons at a single energy through a given thickness of material, x, which obeys the relationship:

$$N_{Surviving}(x) = N_0 e^{-mx},$$

by collimating the photon source.

Additional Procedural Information not in Write-up: Actually, we are building on last year's lab report. We found in the first period that shielding with lead blocks was needed to really collimate the beam. A stack of steel washers proved insufficient in stopping photons, providing perhaps a factor of 2 difference between collimated counting and un-collimated counting, whereas the lead brick collimation produced a factor of roughly 4 difference. The first lab period was spent setting up for collimated counting. In the second class period, we performed experimental runs with, and without collimation present to try and see if the effect was significant.

Analysis: We followed the same procedure used last year to analyze the data. There are files with the analysis of the collimated data included on the web page labeled as: massab06c.xls and un-collimated: massab06.xls . Note that we again averaged the background results.

Results: The results from the analysis indicate that collimated (Coll:) results are significantly different from the un-collimated (Un-Coll:) results. As with the results last year, we didn't get ideal Chi-square per degree of freedoms (1.6 and 1.23 respectively for 12 DOF). Additionally, the collimated measurement has a better agreement with the expected value. The 2006 values have a larger error due to counting statistics.

$2006:$

$Coll: m = (1.166 \pm 0.015)/cm$

$Un-Coll: m = (1.036 \pm 0.011)/cm$

$2005:$

$Period\ 1: m = (1.057 \pm 0.007)/cm$

$Period\ 2: m = (0.955 \pm 0.007)/cm$

$Expected = 1.2/cm$

Discussion: This year, there seems to be a confirmation that our results are sensitive to the experimental setup. We confirmed that there was a significant difference between trials where we collimate the source with lead and where the source was un-collimated. (See included figure) Our conclusion is that the collimation should be included in the future.

What's next: I would like to try the experiment again with the remaining changes suggested in 2005 and 2 new suggestions:

1) Use the Solid State Detector. The peak from the source should be much narrower and we can tighten up the window in the SCA to try and ensure a single gamma energy.
2) Get some space between the sheets without adding any significant additional material in the path of the radiation. Along with this can be to see if there are effects from the way we held the source in place.
3) NEW: Collimate the detector
4) NEW: Get some new lead sheets

Arrangement of blocks forming collimator