Project 1 (60 Points)

We are given a mixed source of photon irradiation and must install shielding so that we can accurately measure the counts generated by our detector. As the premier nuclear engineer on staff, you have been tasked with performing the calculations for initial shielding thickness assessments.

Assumptions:

1. The radioisotope is a point source.
2. The intrinsic detection efficiency is 1.
3. The detector is fast enough such that no counts are lost due to deadtime.
4. The detector is a 3" diameter cylindrical detector that is facing the point source.
5. We will assume that we have good geometry due to a series of collimators installed in our experimental facility (ignore buildup factors).
6. The source has an activity of 1 Ci, and the rate of activity change is negligible over the course of the experiment.

Utilize python for the following scenarios:

1. Cylindrical Detector Placed at the following locations
    a. 10 cm away
    b. 20 cm away
    c. 50 cm away
    d. 80 cm away
    e. 100 cm away
2. For each location, use Lead shielding. Repeat the calculation with Aluminum shielding.
3. Determine how much shielding is required to reduce the total number of photons (events) that are registered by the detector to 1×10^6 +/- 1×10^5 counts per second.

Provide the following in a (short) report:

- (25 Points) Two curves (plots).
    - One for Lead shielding. X axis should be detector distance. Y axis should be shielding required. Repeat for Aluminum.
    - **Plots should be generated using python.**

- (25 Points) An overview of the methods and equations used to address the problem (provided in lecture notes). In addition, include some discussion over the approach you took to achieve your final answer.
- (5 Points) Conclusions drawn. Do your results make sense? Why or why not.

In addition:

- (5 Points) Python code successfully runs and generates plots.
- Provide your python code in a zip folder with your LMS submission.
- Grading
    - I should be able to run your python script. Any input files that are needed to run it (i.e., photon data) should be provided in the ZIP folder.

Hints:

- There are two equations that you will need to used to successfully complete this project. Both are available in the lecture notes.
- You will need external data to determine photon attenuation.
- It will be highly impractical to attempt this project by hand. Python is required.
- A python starter script is provided to initiate data reading and writing.