

22.S902 IAP 2015 (DIY Geiger Counters), Problem Set 2

Due January 8th in class

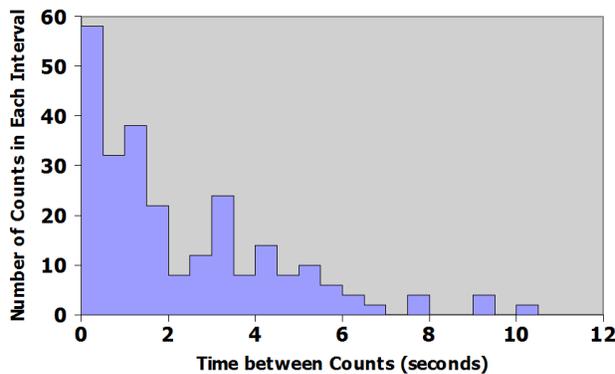
January 6, 2015

1 (15 points) Geiger Counter Stress Testing

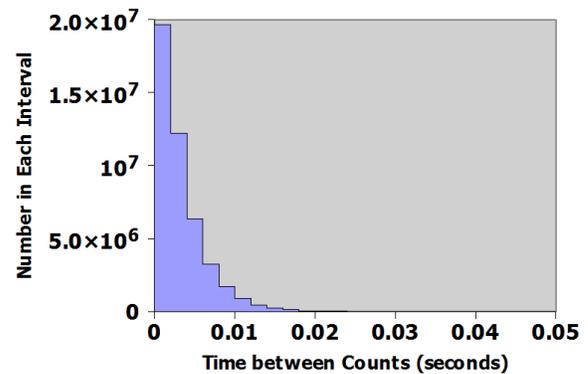
1. What do you expect to happen if you keep raising the Geiger tube voltage waaay beyond the saturation region, and why?
2. We have noticed that the Geiger tubes still “work” even when bent or dented. How do you expect their operation to change when the tube gets dented, and why? Be specific about things like the current, the minimum operating voltage, the plateau voltage, and very high voltages based on your answer to Problem 1.1.

2 (15 points) Predicting Dead Time Response

Below are two hypothetical count rate distributions: one low (background counting), one high (counting near a source). These distributions were gathered on a detector with a negligibly low dead time:



Counting background levels



Counting near an intense source

Now suppose you were to collect similar distributions from a detector with a high (5ms) dead time. Sketch the expected change in each distribution, for both a paralyzable and a non-paralyzable detector (four sketches in total).

3 (40 points) Dead Time Experimental Design

Design an experiment to measure the dead time τ of your Geiger tube. Be as specific and quantitative as you can, use formulas from the reading to inform your experiment. Approximately what minimum *count rate* (not activity, we'll do that later) will you require in order to produce 10% dead time in your experiment?

4 (30 points) More Sources of “Dead Time”

We are going to use a computer to register our counts, to automatically produce the distributions in Problem 2. Attached is an example file showing the actual output after counting for 5 minutes near two intense $1\mu\text{Ci}$ sources. Design a method, script, or other tool to discover the dead time of our Geiger tube, accounting for the artificial “dead time” introduced by the computer. Do you think that the dead time you observe in the attached file is due to the Geiger tube, or the computer? How do you know (is it paralyzable or non-paralyzable), and why? What is the value for the attached data file?

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