Statistical methods in the measurement of radioactivity

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Abstract

Due to the random nature of radioactive decay, it is not possible to make consistent and repeatable measurements of a substance's radioactivity. This stems from the fact that it is impossible to know exactly when a single atom will undergo radioactive decay. However, when looking at a large collection of atoms it is possible to estimate the number of atoms that will decay over a certain period of time, which generally serves as a basis for measuring a sample's radioactivity. To achieve this, one must employ statistical methods when analyzing radioactivity data. In this exercise, we will explore the statistical methods involved in effectively measuring radioactivity.

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1 Introduction

The random nature of radioactive decay introduces difficulties into the process of making consistent measurements of the overall radioactivity of any given sample, which leads to the question of how to effectively quantify "radioactivity", or the amount of interactions observed due to the energy released during the radioactive decay of atoms. Radioactivity is measured by simply counting the number of interactions occurring between the high energy particles (or gamma rays) and a detector over a period of time. Thus, due to the fact that any given atom will decay spontaneously, it is not possible to observe the same number of interactions per any given period of time. By employing statistical methods however, it is possible to make inferences about the number of interactions that will occur from a large collection of atoms undergoing decay, which turns out to be relatively predictable. This forms the basis of measuring radioactivity, and allows one to effectively quantify the overall radioactivity of any given sample. In the following experiment, we will be quantifying the radioactivity of a sample emitting gamma radiation. First, data on the radiation counts of our sample will be collected using a Geiger-Müller tube, and afterwards the counts will be analyzed statistically to obtain an accurate representation of our gamma sample's radioactivity.

2 Theory

3 Experimental Procedure

4 Graphs and Data

5 Calculations

6 Analysis and Conclusions