

Phys 4910 Spectroscopy

Gamma ray spectroscopy

Introduction

During this semester we have been looking exclusively at the electronic spectra of atoms, with photon energies which correspond to the visible portion of the electromagnetic spectrum, including those portions of the infra red and ultraviolet portions which lie just outside the visible range. However, the same principles (but with different instrumentation) can be applied to the whole range of the electromagnetic spectrum

- radio and microwaves – usually from the rotational motion of molecules
- infra red – from the vibrational motion of molecules
- visible and ultra violet – from the outer electrons of atoms and molecules
- X rays – from the inner electrons of atoms and molecules
- γ rays – from the nuclei of atoms.

Because the nuclear forces between protons and neutrons in the nucleus are that much stronger than the electrostatic force between the nucleus and electrons, the nuclear energies are that much stronger. Typical electron energies are in the range 1 to 10 eV, whereas nuclear energies are in the MeV range.

γ ray Spectra

There are four parts to this project

- To describe the central piece of equipment needed for γ ray spectroscopy, the NaI detector. You should be able to describe how the detector distinguishes between different photon energies.
 - What is the function of the Multichannel Analyzer (MCA, or counter)
- To obtain sample spectra from a few γ ray sources. Start with ^{137}Cs , then try Co and Na.
- To demonstrate how to calibrate the detector using the known energy of the ^{137}Cs source in order to determine the energy of the other sources.
 - As part of this try to obtain (and explain) peaks at twice the energy. This might need counting for some considerable time.
- To determine the resolving power of the instrument using the ^{137}Cs source.

Some resources

- <http://www.ntanet.net/how-do-sodium-iodide-scintillation-detectors-work>
- <https://www.ortec-online.com/products/radiation-detectors/scintillation-detectors/scintillation-detector-types/905-series>
- https://en.wikipedia.org/wiki/Gamma_spectroscopy
- <https://www.canada.ca/en/health-canada/services/environmental-workplace-health/environmental-contaminants/environmental-radiation/fixed-point-surveillance-network/sodium-iodide-detectors-fixed-point-surveillance.html>
- https://en.wikipedia.org/wiki/Scintillation_counter
- <https://www.youtube.com/watch?v=DNnzHQ5p0nc>