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High resolution gamma spectroscopy

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Abstract

In these experiments a high sensitive germanium detector is used to measure x- and gamma- rays from several sources in an energy range of 40 keV up to 10 MeV. Several natural and artificial sources of radiation are analyzed.

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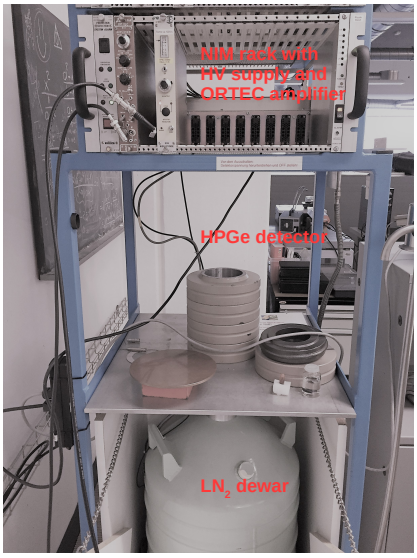

Figure 1: Experimental setup of the gamma spectrometer

1 Introduction

Photons occur in a wide range of energy from extreme low energies of a few feV ($= 10^{-15}eV$) in frequency waves up to high energy particle from cosmic ray in the PeV ($= 10^{15}eV$) regime.

In these experiments a high sensitive germanium detector is used to measure x- and gamma- rays from several sources in an energy range of about 40 keV up to 10 MeV. Several natural and artificial sources of x- and gamma rays are analyzed.

Figure 1 shows the setup for the high sensitive spectrometer. The heart of the system is a high purity Germanium crystal. For running the system the crystal has to be cooled to liquid nitrogen temperature. The liquid nitrogen is stored in a dewar. The high voltage of up to 4 kV applied to the detector is generated by a power supply in the NIM rack. The signals from the detector are amplified and shaped with an ORTEC 572 amplifier. The data is then pulse height analyzed by a multi channel analyzer (MCA) with 8192 channels installed in a PC.

2 Questions and tasks

- Make you familiar with the different types of radiation detectors for measuring energy of the particle. A good overview can be found in the book of Leo[1]. What are the advantages and disadvantages of the several types of detectors?
- All information about the isotopes can be found in [2].

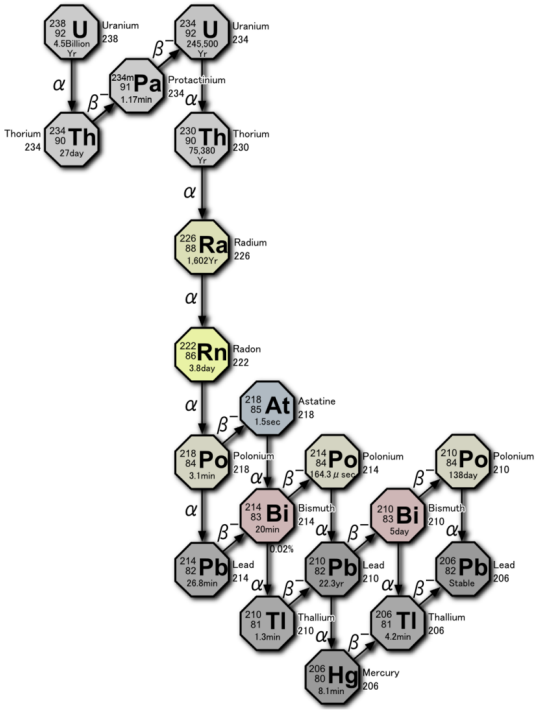

Figure 2: Radon ^{222}Rn is in the decay chain of Uranium ^{238}U

- Measure the gamma spectra from ^{137}Cs and ^{60}Co. Calibrate the detector with the ^{60}Co measurement. What kind of radiation can you interpret? And calculate the energy of them
- Now after calibration you can measure mushrooms, Bananas, carrots or what ever you want. But pack the food in plastic bags that the detector can not contaminated.
- Measure your breathing air. For that purpose you can fill some balloons with your breath, make the balloon electrostatic loaded by rubbing on a part of your clothes or somewhere else and then let the air out. Figure 2 presents the uranium ^{238}U decay chain, where radon is part of it. Can you find out what the separate peaks are?
- Is there another decay chain where Radon occurs?

References

[1] William R. Leo, Techniques for Nuclear and Particle Physics Experiments, Springer-Verlag Berlin Heidelberg GmbH

[2] https://www-nds.iaea.org/relnsd/vcharthtml/VChartHTML.html