Calibration of radionuclide neutron source

Czech Technical University in Prague, Experiment CTU16

Main topic: Experimental neutron physics

Keywords: Emission rate, source calibration

Purpose: Radionuclide neutron source is a key element for many experiments in the field of neutron physics. The neutron emission rate of neutron source is a common important information for these experiments. Even though this information is nowadays added to every neutron source, experiments focused on measurement of a neutron emission rate are still considered to be a part of the basic knowledge of any experimental researcher.

Level of exercise: ☐ Basic ☒ Advanced ☒ Complex
Level of education: ☒ BSc ☒ MSc ☒ PhD

What you will learn:
Students will learn a basic technique of measurement of an emission rate, i.e. calibration with a manganese bath. The outcome of this task will provide understanding of irradiation and decay processes in a simple and well-defined environment (manganese). Calibration of radionuclide neutron source is highly suitable for students studying nuclear engineering as their major curriculum.

Important information:
- Minimal size of student group: 3
- Maximal size of student group: 6
- Overall duration of the experiment (in wall clock hours): 3

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Possibility to perform experiment on demand:	☒ Yes ☐ No
Frequency of occurrence:	On demand, ca 30 times/year
Examination modalities:	Protocol, evaluation, discussion
Teaching languages:	English, Czech

Pre-knowledge required: The students should be familiar with the introduction to neutron physics, particularly with the concepts of neutron interactions, and also radioactive decays.

Instruments required for exercise:

- Radionuclide neutron source
- Manganese bath
- Apparatus for gamma ray spectrometry

Execution:

The examined neutron source is placed inside a manganese bath. Neutrons coming from the source are irradiating the manganese, thus creating Mn-56 that will decay to Fe-56. After the irradiation, the neutron source is removed, the manganese bath is stirred, and a sample is taken for further gamma spectrometry measurement. The decay of Mn-56 is followed by gamma emission that can be measured using a HPGe detection system. Intensity of gamma emission is proportional to the amount of Mn-56 in the sample. The final emission rate can be calculated from the measured data.

Limitations:

No particular limitation for this experiment, only general requirements for entry to research nuclear installation according to the Czech nuclear legislation should be fulfilled.