Neutron activation analysis

Jožef Stefan Institute, Exercise JSI-12

Main topic: Radioanalytical Chemistry, Reactor Physics

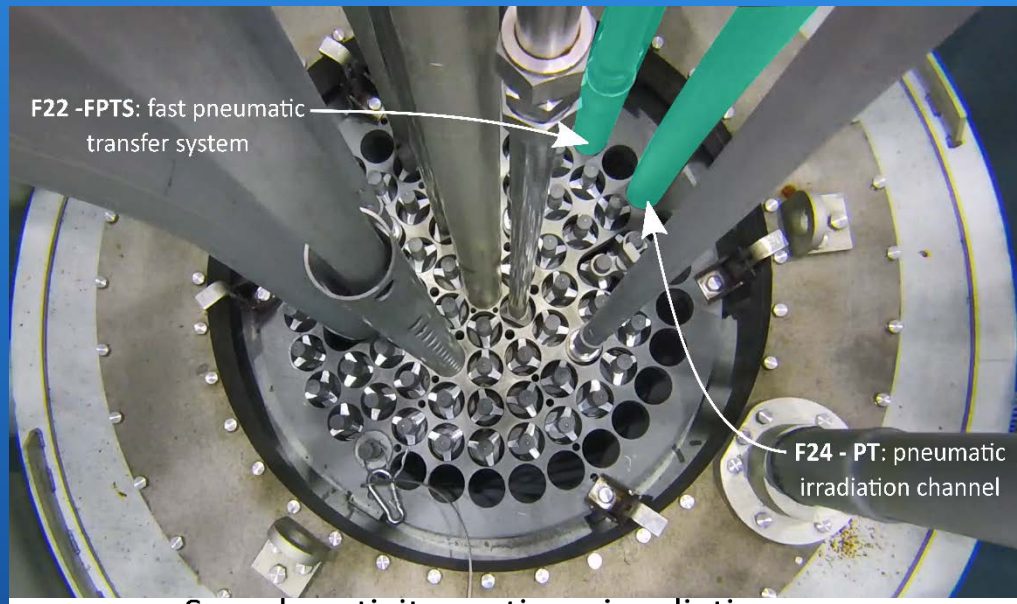
Keywords: Neutron activation, sample irradiation, gamma spectroscopy, HPGe detector

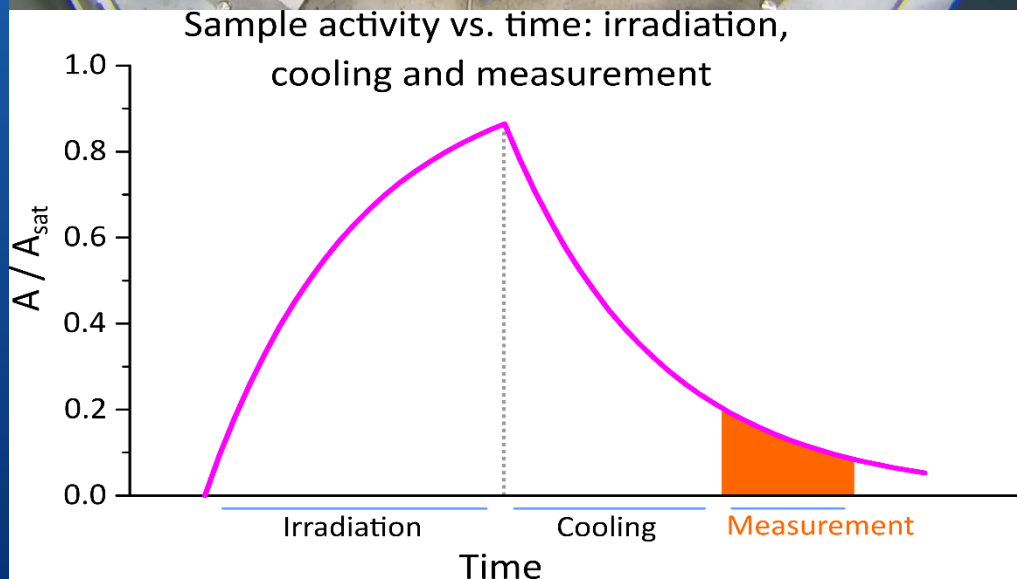
Purpose: The purpose of the experiment is a demonstration of the relative neutron activation analysis technique (NAA). This technique is widely used in a variety of fields (e.g. environmental sciences, forensic science, analysis of geological and inorganic materials, foodstuff, etc.). It plays a key role within environmental specimen banking programmes.

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

What you will learn:
Students will prepare samples and standards for irradiation in the neutron field of a nuclear reactor, perform the irradiations and measure the gamma spectra of the irradiated samples and standards, analyse gamma spectra and determine analyte concentrations.

Important information:
- Minimal size of student group: 4
- Maximal size of student group: 12
- Overall duration of the experiment (in wall clock hours): 3-4





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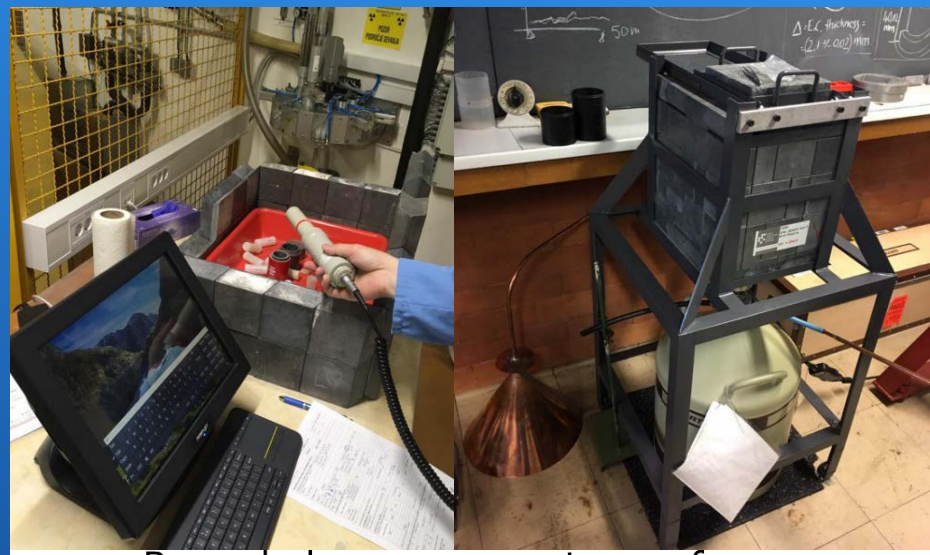
Possibility to perform experiment on demand: ☒ Yes ☐ No
Frequency of occurrence: on demand
Examination modalities: report
Teaching languages: English, Slovenian, Serbian/Croatian, Italian, French

Pre-knowledge required: Basics on activation of nuclides, basics on gamma spectroscopy.

Instruments required for exercise:
- Reactor instrumentation
- HPGe detector and related software
- Handheld dosimeter

Execution:
- Preparation and weighing of samples and standards,
- Encapsulation of the test portions and standards in e.g. polyethylene foil / capsules
- Neutron irradiation of samples and standards
- Sequential measurements of the induced radio activities in samples and standards by gamma-ray spectrometry
- Interpretation of the gamma-ray spectra (i.e. peak fitting)
- Calculation of the concentrations in the samples

Limitations:
It is strongly advisable that prior to this exercise, students perform the "Gamma spectrometry" exercise in which the gamma spectrometry technique is explained and demonstrated.



Recorded gamma spectrum of an irradiated sample of metallic cerium