Critical experiment

Jožef Stefan Institute, Exercise JSI-01

Main topic: Reactor Physics

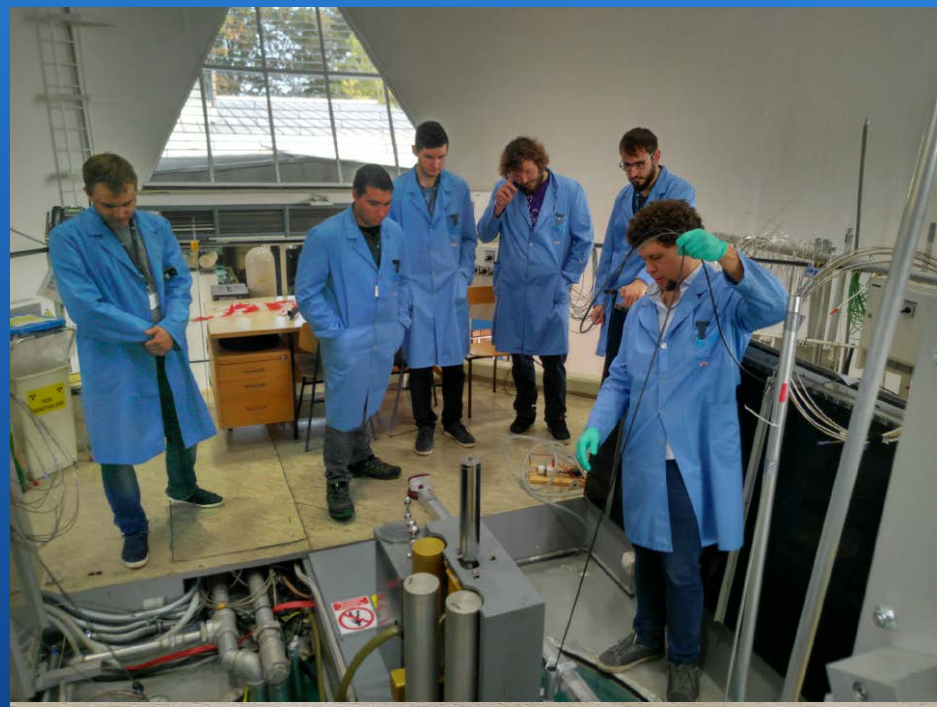
Keywords: Subcritical multiplication, multiplication factor, M^{-1} diagram, neutron source

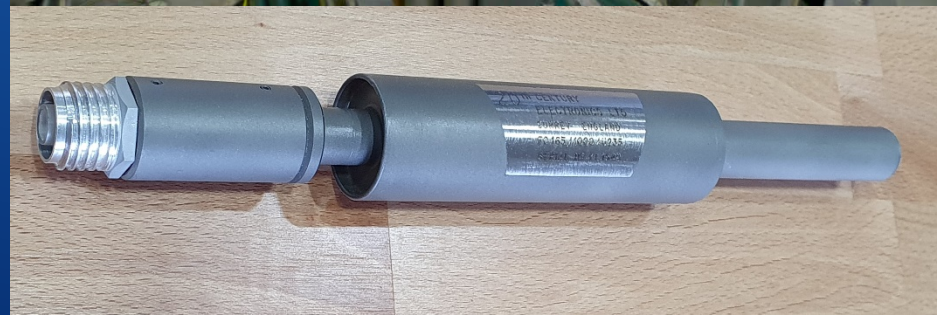
Purpose: The critical experiment is one of the fundamental experiments in Reactor Physics. Its main purpose is to determine the critical number of fuel elements and / or control rod positions in a critical assembly. The experiment is regularly performed both at experimental and power reactors after each core modification. The purpose of the experiment is to demonstrate the procedure to reach criticality starting from a deeply subcritical state in a controlled sequence.

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

What you will learn:
Students will become aware of the importance of the critical experiment, perform the critical experiment by control rod withdrawal and plotting of the M^{-1} diagram as a function of reactivity insertion, observe the transients present when approaching criticality and examine the validity of neutron kinetics models in subcritical state.

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





Critical experiment

Jožef Stefan Institute, Exercise JSI-01

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 of Reactor Physics, in particular: definition of the multiplication factor and reactivity, basics on fission chamber operation.

Instruments required for exercise:
- Two independent fission chambers and associated electronic acquisition systems
- Dedicated software developed by JSI
- Reactor instrumentation
- Stopwatch

Execution:
- Students perform the critical experiment via gradual control rod withdrawal
- Measurement of the neutron signal on the starting channel and plotting the M^{-1} diagram
- At every step, students estimate the critical control rod position by extrapolation
- To experimentally confirm if the achieved state is subcritical, critical or supercritical, the neutron source is withdrawn from the reactor core following multiple steps, and the time dependence of the neutron source is monitored online

Limitations:
None