Prague, Czech Republic June 21-25, 2021

Contribution ID: **194** Type: **Poster**

# #04-194 Diamond detectors for neutron flux measurement during transient neutron flux changes

*Wednesday, June 23, 2021 4:25 PM (5 minutes)*

Precise measurement of neutron flux is crucial for reactor operation, especially during fast reactor transients. Measurement is valuable not only in reactor operation itself, but also for the prediction of reactor behavior via calculation or experiments. Especially fast transients with significant change in neutron flux are interesting and in order to analyse them, an advanced detection system is needed.

Since 2017, diamond-based detectors are being developed in collaboration with CEA Saclay. Detectors are now in the testing phase at the VR-1 reactor. Diamond detectors are rarely used in reactor core measurements but are promising for this particular application.

To cover changes in neutron flux during a very short time, a large number of interactions must be recorded, especially if significant changes in neutron flux are measured. Due to this prerequisite, the detection system and data processing must be advanced.

Several approaches are available to process the signal from diamond detectors. In a nuclear reactor, detector signal contains plenty of different pulses. Some are created by noise or by other electronic influences should be separated. Others that have an origin in particle interactions must by sorted by the source particle, as not only neutrons interact in the detector volume. For example, gamma radiation creates a significant amount of impulses that needs to be identified and separated, so only the count rate from neutron detection can be obtained. In order to solve the separation problem, several approaches are used in current detection systems. For diamond detectors, we tested pulse shape analysis, where pulses are separated by their shape. This approach is very accurate, however, it requires a robust detection system, including a fast AD convertor that allows continuous data recording, if the experiment is performed in reactor core. Alternatively, the subtractive gamma compensation may be a better solution for online measurement signal analysis.

In order to examine the subtractive gamma compensation, we are testing a set of diamond detectors that allows to collect data that can be analysed by subtractive gamma compensation. Experimental work is performed at the VR- 1 reactor and adjacent laboratories, where various radiation sources are used. Preliminary data should be available at the beginning of the year 2021.

This detection approach should be used in detection part of a new experimental device that focuses on the rod SCRAM transient. This device is currently under development at the Department of Nuclear Reactors, Faculty of Nuclear Sciences and Physical Engineering, Czech Technical University in Prague and should be installed at the VR-1 reactor.

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**Session Classification:** 04 Research Reactors and Particle Accelerators

**Track Classification:** 04 Research Reactors and Particle Accelerators