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First Steps in Neutron Imaging at the Very Low Flux Facility AKR-2

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In 1990, seven research reactors (FRM I, RFR, FRG-1, FRJ2, FRG 2, FMRB, BER II) have been in operation for the field of neutron science in Germany. Since that time, five facilities have been decommissioned with one more (BER II) to be shut down by the end of 2019. Because of this trend of neutron sources going offline in Germany, it is becoming more and more difficult to train staff, to optimize instruments as well as methods, and to provide user beam time for both fundamental and non-fundamental research applications. With the neutron imaging system at the training and research reactor AKR-2 the TU Dresden offers a low flux neutron source so far with the capability of neutron imaging utilizing the thermal neutron spectrum. It will also counter the aforementioned negative development induced by the loss of neutron sources in Germany.

In order to provide a basic platform for training and first contact research in the field of neutron science, (very) low flux facilities represent a sufficient solution. The AKR-2 with a maximum continuous power of two Watts can be categorized as such a facility, where students and the next generation of neutron scientists gain their first experience. In this context, the experimental field of the AKR-2 has been extended by a thermal neutron imaging radioscopy system in the course of the last year. Currently, this setup utilizes thermal neutrons with a 200 µm LiF/ZnS(Ag) scintillator, but with the prospect to be able to switch to the fast neutron spectrum in a later setup. So far, the characterization is in progress through an L/D study, which is the subject of this presentation. This study builds upon a previous investigation with a less advanced imaging system and is intended to demonstrate the limits in neutron imaging at AKR-2.

A two-way cadmium knife-edge with integrated reproduction scale will be used for signal-to-noise analysis. As part of the common procedure, the knife-edges will be tilted against the pixel grid of the deep-cooled camera system known as slanted-edge method. In order to find the best imaging configuration, the collimation setup will be modified and the distance in front of the experimental channel will be varied with respect to the source.

Aside from the limits in neutron imaging at AKR-2, the complete setup will provide prove-of-concept insights for other facilities considering the construction of similar neutron imaging systems. Furthermore, upon familiarizing new generations of scientists with thermal neutron imaging techniques, additional methods shall be applied one after another known as fast imaging and laminography. Finally, experiments not ranked sufficiently high enough for the limited beam time at high flux facilities but with their experimental needs fulfilled by the AKR-2 can be conducted.

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