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#04-184 Local and high distance neutron and gamma measurements of fuel rods oscillation experiments

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Within the COLIBRI program, reactor noise related to fuel vibrations is investigated in the CROCUS zero power reactor. It consists in experiments on rod lateral displacement (static) and oscillation (dynamic) with different rods' numbers at various relevant amplitudes and frequencies. Its main motivation is the increased amplitudes in the neutron noise distributions recorded in ex- and in-core detectors that have been observed in recent years in Siemens pre-Konvoi type of PWR reactors. In particular, with this program, the Laboratory for Reactor Physics and System behaviour (LRS) is contributing to the Horizon 2020 European project CORTEX, which is dedicated to the understanding and simulation of reactor perturbations for the development of novel core monitoring techniques.

During the first phase of COLIBRI, the observation of a spatial dependence of the induced noise, also called neutron modulation, was demonstrated. In the second phase of COLIBRI starting 2021, it is planned to use a core mapping array of neutron detectors to record its propagation. It consists in about 150 miniature scintillators coupled to optical fibers and SiPM readouts, to be distributed in the reactor core. As a feasibility test, experiments were performed using a miniature scintillator prototype placed on one moving fuel rod, or the one directly adjacent to it. In addition, it is theoretically possible to measure branching or induced reactor noise using gamma radiation. Following recent developments on gamma measurements in CROCUS, the fuel oscillation was simultaneously recorded with a gamma detection array, LEAF. Its two large and high efficiency BGO detectors were used by placing them at the maximum distance to the core, i.e. seven meters away with a clear line of sight using an experimental channel through the reactor cavity.

We report here on the successful observation of the lateral oscillation of one fuel rod ±2.5 mm around nominal and 0.1 Hz frequency, using the miniature neutron scintillator at the rod level, and the BGO gamma detectors seven meters away from the reactor core.

Primary authors: LAMIRAND, Vincent (Ecole Polytechnique Fédérale de Lausanne); VITULLO, Fanny (École polytechnique fédérale de Lausanne (EPFL)); PAKARI, Oskari (EPFL)

Co-authors: Dr FRAJTAG, Pavel (EPFL); Prof. PAUTZ, Andreas (EPFL)

Presenter: LAMIRAND, Vincent (Ecole Polytechnique Fédérale de Lausanne)

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