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#4-109 HONEY: High-Resolution Reactor Kinetics experiments in the CROCUS reactor

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The first HONEY (High-resolution Online Neutronics Experiments for dYnamics) experiment took place in the CROCUS research reactor of EPFL (Switzerland) in April 2024. With this campaign, designed to enhance our knowledge of the physical parameters governing the reactor kinetics, we aim to achieve a high spatial resolution analysis of the reactor's time response to both reactivity insertions and withdrawals, obtained through adjustments in the absorber rod positions and water level.

The campaign targets comprehensive experimental measurements of the global kinetic responses to reactivity perturbations, relying primarily on two reference fission chambers located outside the core that serve as reactor power monitors. More importantly, it exploits high-resolution detection to enable the analysis of local spatial effects, through the SAFFRON detection system, previously developed within the H2020 CORTEX framework and during a doctoral thesis at EPFL. SAFFRON consists of an array of 160 miniature scintillation-based detectors, known as MiMi, which can measure the thermal neutron flux via the lithium-6 reaction. Placed at various inter-pin positions and on three main heights, these detectors provide exceptional spatial and temporal resolution, allowing for a precise mapping of the reactor core and recording of localized time-dependent phenomena that would otherwise remain undetected.

The experimental results of the first HONEY campaign are used to validate the reactor kinetic simulation capabilities of TRIPOLI-4, a high-fidelity Monte Carlo particle-transport code developed at CEA (France). HONEY enables unique insights for a significantly robust code validation: while exploiting global results in the context of code validation is essential to improve the predictive power of simulation tools, the true breakthrough of this work lies in its focus on localized effects. The approach proposed not only addresses the challenge of obtaining precise local data using the SAFFRON detection system, but also paves the way towards a detailed analysis of how effectively computational models can reproduce the local phenomena.

In this contribution, we present the experimental setup, methodologies and key results, with strong emphasis on comparing experimental and computational outcomes. Particular attention is given to the miniature detectors positioned near the perturbations (i.e., the lifted or inserted absorbers rod), with the objective of characterizing their magnitude and determining their propagation distance. This includes identifying the point at which localized effects vanish and the detector response relaxes to the global behavior, with the complementary goal of assessing whether the TRIPOLI-4 code can accurately replicate these experimentally observed effects.

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