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Epithermal neutron radiography and tomography on large and strongly scattering samples

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While neutron imaging with thermal and cold neutrons has become a standard method at many neutron facilities world-wide, little research has been done on epithermal neutron imaging with electronic detectors. Indirect methods with dysprosium foils and film or imaging plates have been used for the examination of nuclear fuel at Idaho National Laboratory (INL) and other places, but a fully digital imaging system has rarely been employed beyond simple cadmium-filtered radiography. In a collaboration between INL in the USA and Heinz Maier-Leibnitz Zentrum (MLZ) of Technische Universität München in Germany, several tests were conducted with a cadmium-filtered beam. At INL, the Neutron Radiography Reactor (NRAD) is optimized for high epithermal neutron output with a beam tube source position in close contact to the reactor core. At MLZ, the primarily cold and thermal energy spectrum of the ANTARES neutron imaging facility still contains sufficient epithermal neutrons that penetrate the undermoderated cold source to allow for reasonable measuring times with a cadmium-filtered beam.

Measurements include the effects of thermalizing epithermal neutrons in a heavily scattering sample, which can be removed by a second cadmium filter on the detector, and the first full epithermal neutron computed tomography on large technical samples in direct comparison to cold neutron tomography with the same setup without filters. Several examples of epithermal neutron imaging are included.

Primary authors: SCHILLINGER, Burkhard (Heinz Maier-Leibniz-Institut (FRM II) , TU München); CRAFT, Aaron (Idaho National Laboratory)

Presenters: SCHILLINGER, Burkhard (Heinz Maier-Leibniz-Institut (FRM II) , TU München); CRAFT, Aaron (Idaho National Laboratory)

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