Contribution ID : **135** Type : **Oral**

Design and Construction of Grating-Based Interferometers for the Oak Ridge National Laboratory, High-Flux Isotope Reactor, CG-1D Tomography Beamline

Thursday, 6 September 2018 16:10 (20)

The ORNL HFIR CG-1D neutron tomography beamline will be the future site of grating-based interferometry/tomography. This presentation will give a work-in-progress report describing construction activities and results commencing in late spring, 2018.

Two interferometer designs will be developed: Talbot-Lau and far-field. Talbot-Lau has the advantage of considerable operational experience at several facilities, particularly at the PSI ICON beamline. The far-field interferometer is relatively new to X-ray and neutron imaging and may offer more access to dark-field imaging as a function of interferometer autocorrelation scattering length. In addition, neutron flux through the far-field interferometer should be 2-fold greater than the Talbot-Lau design due to one fewer absorption gratings.

The CG-1D neutron tomography is well suited for the addition of grating interferometry. The beamline is currently operated with a high-flux, polychromatic cold neutron beam offering useful flux in the wavelength range 1.8 to 6 A. Beam divergence is usually set at L/D = 400. The distance from pinhole collimator to detector is 5 m. The neutron path is protected with helium-filled flight tubes having thin aluminum windows. The first grating will be mounted near the pinhole optics, thus sharing the the same radiation enclosure. The other two gratings will be more easily accessible.

The presentation is expected to cover of some these topics:
• Construction of a Talbot-Lau interferometer;
• Construction of a far-field interferometer;
• Optical simulations;
• Fabrication of extremely small period neutron phase gratings;
• A motor control system based on Python and EPICS; and
• Planned applications of interferometry to laser sinter additive manufacturing.

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Session Classification : Speaker Sessions and Seminars

Track Classification : Instrumentation