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Precision Measurements of Neutron-Silicon Structure Factors Using Pendellösung Interferometry BENJAMIN HEACOCK, MICHAEL HUBER, National Institute of Standards and Technology, TAKUHIRO FUJIIE, KATSUYA HIROTA, MASAAKI KITAGUCHI, HIROHIKO SHIMIZU, Nagoya University, TAKUYA HOSOBATA, YUTAKA YAMAGATA, RIKEN, DMITRY PUSHIN, University of Waterloo, ROBERT VALDILLEZ, ALBERT YOUNG, North Carolina State University — Neutron dynamical diffraction in a crystal slab exhibits pendellösung interference, where the diffracted intensity oscillates as a function of neutron wavelength, crystal thickness, and the neutron-lattice potential. The phase of pendellösung oscillations is used to perform precision measurements of the (111), (220), and (400) neutron structure factors in silicon. These data are sensitive to lattice dynamics, the neutron mean square charge radius, and a beyond the standard model of particle physics force mediator with a mass between 10 eV and 10 keV. Preliminary data will be presented, including a new measurement of the neutron charge radius and the silicon Debye-Waller B parameter. Previous experimental limits on the strength of a beyond the standard model force mediator with mass range 10 eV to 10 keV are improved by nearly an order of magnitude over most of the mass range and almost two orders of magnitude for a 25 eV force mediator. Extending the experiment to higher order Bragg reflections and/or other crystal species will be sensitive to anharmonic contributions to lattice dynamics and further improve sensitivity to the neutron charge radius and beyond the standard model forces.

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