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Neutron Pendellösung interferometry to search for exotic interactions

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The standard model of particle physics cannot explain the origin of the accelerating expansion of the universe or the hierarchy problem of gravity. Theories beyond the standard model of physics created to solve these problems often also predict the existence of a fifth fundamental force. We search for the existence of a fifth force using neutron pendellösung interference, where the neutron intensity diffracted from a nearly-perfect crystal oscillates as a function of neutron wavelength, crystal thickness, and neutron material structure factors. Recent experiments have produced precise measurements of the neutron structure factors for the (111), (220), and (400) Bragg reflections in silicon. These data update the limits on the strength of a fifth force on the atomic length scale and include new measurements of the neutron mean square charge radius and silicon Debye-Waller factor. Extension of this experiment to germanium or other crystals will measure the material-specific Debye-Waller factors and increase our sensitivity to the neutron charge radius and fifth forces. In this talk, I report the experiment result using silicon crystal and the current status of the neutron structure factor measurements using germanium.

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