Precision Measurements of Neutron Scattering Lengths of Helium Isotopes Using Neutron Interferometry

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The low energy neutron scattering length is an important feature of the neutron-nucleus strong interaction. Neutron scattering lengths have many applications in neutron science and nuclear engineering. They can also be used to test nucleon potential models and low energy few body effective field theories. A neutron interferometer splits the wave function of a single neutron into two separated coherent paths by Bragg diffraction. The relative phase shift caused by a target in one path produces an interference signal that is measured by a neutron counter. This gives direct and precise access to the neutron scattering length. I will describe measurements of neutron scattering lengths of helium isotopes using the NIST neutron interferometer, including our most recent result for helium-4 which improved its precision by a factor of nine.