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The scattering length difference between the b_1 and b_0 states of n-^{3}He using a neutron interferometer[1]

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We report a determination of the $n-{}^3$He scattering length difference $\Delta b' = b'_1 - b'_0 =(-5.411 \pm 0.051)$ fm between the triplet and singlet states using a neutron interferometer. This revises our previous result $\Delta b' =(-5.610 \pm 0.042)$ fm obtained using the same technique in 2008. A sample placed in one of the beam paths of the interferometer causes a phase shift that is proportional to sample's scattering length density, thickness and n wavelength. For this experiment, polarized neutrons were incident on the interferometer and the relative phase shift caused by a spin-dependent interaction with a polarized ^{3}He target was measured. The neutron polarization and spin flipper efficiency were determined separately using helium-3 analyzers to < 0.1 % relative uncertainty. This re-evaluation comes from new phase shift data taken in 2013 and a partial reanalysis of the 2008 data that includes a systematic correction caused by magnetic field gradients which was previously underestimated. Scattering lengths of low Z materials are important for both providing inputs into effective field theories and testing nuclear models. This result along with other measured values of b for ^{3}He will be compared to nucleon models.

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