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A search for Parity Violation in Neutron Transmission through Polarized 139La

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We propose to measure a parity-odd asymmetry A in the forward scattering amplitude for neutrons on the p-wave resonance in 139La at 0.73 eV from the correlation k•I, where k is the neutron momentum and I is the spin of the nucleus. One motivation is to take another step towards a future time reversal (T) violation experiment in polarized neutron transmission through polarized 139La [1]. The search for new sources of time reversal (T) violation is one of the highest intellectual priorities in nuclear/particle/astrophysics. Our long-term plan is to investigate T violation in neutron interactions with heavy nuclei by searching for a parity (P)-odd and T-odd component in the neutron forward scattering amplitude using polarized neutrons and polarized 139La nuclei from some new interaction beyond the Standard Model of particles and interactions. It is important to measure this k•I correlation, which is an important source of systematic error. Second, this measurement can also fix the key spectroscopic parameter that determines the sensitivity of the T violation search, which depends on the fractions ΓpI±1/2/(ΓpI-1/2+ΓpI+1/2) of the total width of the 0.73 eV resonance in the I±1/2 channels [2]. A previous measurement by Alfimenkov et al [3] of A=0.31±0.09 is not accurate enough for this purpose. If we confirm the size of A implied by this previous work, it would represent the largest amplification of a symmetry-violating amplitude in nuclear/particle physics and therefore a scientific result of general interest.

[1] P. Fadeev and V. V. Flambaum, Physical Review C 100, 015504 (2019), [2] V. P. Gudkov and H. M. Shimizu, Physical Review C 97, 065502 (2018), [3] V. P. Alfimenkov et al, Physics of Atomic Nuclei 59, 1861 (1996), [4] T. Okudaira et al, Physical Review C 97, 034622 (2018).

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