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Detection of T-violation in "elastic" pp scattering in a single beam figure-eight storage ring

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A storage ring experiment with frozen spin polarized colliding proton beams, capable of detecting time reversal (T) symmetry violation in "elastic" *pp* (or *dd*) scattering is described. Operating below the pion production threshold (laboratory fixed hydrogen target proton kinetic energy 400\,MeV) but above the 69.5\,MeV laboratory energy at which proton-carbon scattering asymmetry polarimetry analysing power exceeds 99\%, both scattered protons come to rest in graphite polarimeter chambers which provide more than 3/4 of full directional coverage. Both initial proton polarization states are pure and both scattered proton polarizations are measured with maximum possible efficiency and analysing power. The possible existence of such a semi-strong, symmetry-violating nuclear force was proposed by Lee and Wolfenstein, by Prentki and Veltman, and by Okun in 1965, The presence or absence of T-violation in nuclear forces is thought to bear significantly on important cosmological issues, especially missing mass, dark energy, and the matter/anti-matter imbalance in our universe. Unlike all fixed target tests of T-symmetry in elastic *pp* scattering, rather than being collinear, incident beams will collide at right angles. A beam-bunch-specific polarization preparation capability has already been partially demonstrated at COSY, using polarized deuterons. Preparation of the bunch spin pattern suggested in the present paper could proceed immediately as a significant step in this T-violation program.

Category

Polarization Applications for Fundamental Symmetry Tests

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