Development of Neutron Interferometer with Wide-Gapped BSEs for Precision Measurements

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We are developing large-dimension interferometers for long-wavelength neutron, which enable us to carry out highly sensitive searches for minute interactions. Our development is based on multilayer-neutron-mirror techniques, especially beam splitting etalons (BSE[1]). A pair of wide-gapped BSEs constitutes a Jamin type interferometer, which encloses a large area with the divided two paths and provides us with various experimental configurations. One of the experimental targets is geometrical Aharonov-Casher (AC) phase, a dual of the phase by the AB effect[2]. The AC phase has so far been measured precisely only in the limited condition that a probing neutral particle with a magnetic moment does not go around the charge distribution in actual. It is worth while to investigate the influence of the geometrical difference on the AC effect. Our interferometer is capable of realizing such study with the arrangement that the charge is really surrounded by the divided two paths.

As a pilot study we have attempted to measure the AC phase with a neutron spin interferometer (NSI) in the basic form. Although the two coherent beams are divided in spin space not in real space, our purpose of the measurement is confirming the sensitivity to the AC phase against the environmental disturbances at our cold-neutron beamline MINE2 on JRR-3M reactor in JAEA. The relative phase between the spin up and down components was shifted by the relative RF phase between the $\pi/2$ and π spin flipper. In order to make AC phase two electrodes of 20cm long and of 2mm gapped were placed and an electric field of 33.5kV/cm was applied. The expected value of AC phase shift was 2.73mrad. We extracted AC phase from phase differences resulted from inverting the direction of the electric field. We will describe our developments and pilot measurements in detail.

[1] M. Kitaguchi *et al*., Phys. Rev. A **67**, 033609 (2003).
[2] Y. Aharonov and D. Bohm, Phys. Rev. **115**, 485 (1959).