Development of active nuclear spin maser with time-separated feedback scheme for Xe-EDM search

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CP violation is one of the critical requirements for generating matter-antimatter asymmetry in the Universe. It is known that the magnitude of CP violation in the Standard Model (SM) of particle physics is insufficient to explain the observed matter dominance in the Universe, and therefore the discovery of extra CP violations originating from new physics beyond the SM is much awaited. A finite permanent electric dipole moment (EDM) of a particle or a system implies the violation of time reversal and CP symmetry. The value of EDMs that are predicted by theories beyond the SM are typically many orders of magnitude larger than those predicted by the SM, and therefore the EDM is one of the most promising probes to search for new physics.

In the current study, we focus on the atomic EDM of Xe, which is sensitive to T, P-odd nucleon-nucleon and nucleon-electron interaction. The EDM is detected by measuring the Larmor frequency of a nuclear spin under the static magnetic and electric field applied at the same time. In order to improve the upper limit of Xe EDM, which contains oscillation of the masers (black arrows). Xe spins. When the feedback field is superimposed on the Xe spin field, the Rb spin will follow the resultant Xe plus feedback field, and hence the Rb precession phase will be shifted from the Xe precession.

We recently found that systematic errors can be further eliminated by reducing the phase deviation between the observed signal and the actual Xe precession caused by the feedback field for masing. The spin precession of Xe is detected through the motion of Rb spins, which adiabatically follow the rotating field produced by the

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