Spin Dynamics Investigation of Quasi-Frozen Spin Lattice for EDM Searches

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Abstract

The Quasi-Frozen Spin (QFS) method was proposed in [*] as an alternative to the Frozen Spin (FS) method for the search of deuteron electric dipole moment (dEDM). This approach simplifies the design of the lattice. In particular, small changes to the currently operating COSY storage ring will satisfy the QFS condition. Spin decoherence and systematic errors fundamentally limit EDM signal detection and measurement. In our method, we will measure spin precession in (1) the horizontal plane to calibrate the magnetic field when changing field polarity and (2) the vertical plane to search for EDM. To address systematic errors due to element misalignments, we track particle bunches in forward and reverse directions. We have modeled and tracked two QFS and one FS lattice in COSY INFINITY. The models include normally distributed random variate spin kicks in magnetic dipoles and in combined E and B field elements. We used Wolfram Mathematica programs to partially automate lattice input file generation and tracking data analysis. We observed additional indications of the advantages of the QFS method.

References

[*] Y. Senichev et al., Quasi-frozen Spin Method for EDM Deuteron Search, in Proc. 6th International Particle Accelerator Conference, Richmond, VA, USA, pp. 213-215, 2015.