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Spin dynamics in storage ring electric-dipole-moment experiments

Spin dynamics in electric-dipole-moment (EDM) experiments performed in storage rings is considered. If the frozen spin method [1] is used, the spin rotation in the horizontal plane is almost canceled by an appropriate radial electric field. General equations describing the spin dynamics are derived. Characteristic features of the spin behavior for different initial beam polarizations are shown. Advantages and disadvantages of any initial beam polarization are discussed.

Field distortions and misalignments of magnets bring systematical errors imitating the EDM effect. First-order systematical errors do not vanish when one averages the main fields. These errors can be eliminated with clockwise and counterclockwise beams. Second-order systematical errors (or geometrical phases) are caused by the noncommutativity of spin rotations. These errors may not be canceled with clockwise and counterclockwise beams. Methods of their elimination are considered. Systematical errors originated from the gravity and rotation of the Earth are evaluated.

Peculiarities of the spin dynamics in the deuteron EDM experiment caused by the tensor electric and magnetic polarizabilities of the deuteron [2] are discussed. The EDM, the tensor electric polarizability, and main systematical errors condition different spin behaviors [3].

Methods of keeping the spin coherence [4] are considered.

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