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Electromagnetic Dipole Moment and Time Reversal Invariance Violating Interactions for High Energy Baryons in Bent and Straight Crystals at LHC

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Spin rotation of channelled particles at the LHC enables measuring constants, which determine Todd, Podd (CP) violating interactions and Podd, Teven interactions of baryons with electrons and nucleus, similarly to possibility of measuring electric and magnetic moments of charm, beauty and strange baryons.

For a particle moving in a bent crystal a new effect, which is caused by nonelastic processes, arises: the spin hyperbolic rotation to the direction of the effective magnetic field (bend axis), the direction of the electric field and the direction of the particle momentum also appears.

Summary

A channelled particle, which moves in a crystal, alongside with electromagnetic interaction also experiences strong interaction with nuclei and weak interaction with electrons and nuclei [1-3].

When analyzing particle's spin rotation, which is caused by electric dipole moment interaction with electric field, one should consider both Podd, Teven and Podd, Todd non-invariant spin rotations, resulting from weak interaction with electrons and nuclei.

As obtained here, spin rotation of channelled particles in either straight or bent crystals at the LHC gives unique possibility for measurement of constants determining Todd, Podd (CP) violating interactions and Podd, Teven interactions of baryons with electrons and nucleus (nucleons), similarly to possibility of measuring electric and magnetic moments of positive and negative charged and neutral charm, beauty and strange baryons.

For a particle moving in a bent crystal a new effect, which is caused by nonelastic processes, arises: in addition to the spin precession around three directions, namely, the direction of the effective magnetic field (bend axis), the direction of the electric field and the direction of the particle momentum the spin hyperbolic rotation to the mentioned directions also appears.

1. Baryshevsky V.G., Nucl. Instr. Nethods B, 402 (2017), 5-10.
2. Baryshevsky V. G., arXiv:1708.09799 [hep-ph], (2017).
3. Baryshevsky V. G., arXiv:1803.05770v1 [hep-ph], (2018).

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