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Spin alignment of vector mesons in relativistic heavy-ion collisions

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The ALICE collaborations at the LHC and the STAR collaboration at RHIC have observed the spin alignment of various vector mesons such as ϕ, K^{*0}, J/ψ, and Υ (1S) in heavy-ion collisions. This spin alignment can be induced by the formation of a vorticity field during these collisions. In addition to the vorticity field, the magnetic field and momentum-space anisotropies in the medium are also expected to contribute to the spin alignment of vector mesons. In the current study, we explore the spin alignment of various vector mesons in the presence of vorticity, magnetic field, and anisotropies present in the QGP medium. The spin alignment of vector mesons is characterized in terms of the spin density matrix. Our findings predict how the diagonal and off-diagonal elements of the spin density matrix are sensitive to medium temperature, rotation, magnetic field, and medium anisotropy. In our investigations, we obtained a non-zero value of the off-diagonal matrix elements, which signifies the presence of local spin-alignment and quantum decoherence effect in the system. Further, we propose that a spin-dependent dissociation mechanism could be used as a possible probe for deconfined hot QCD matter through spin-alignment observables.

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