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Spin alignment of vector mesons in heavy-ion collisions

Polarized quarks and antiquarks in high-energy heavy-ion collisions can lead to the spin alignment of vector mesons formed by quark coalescence. Using the relativistic spin Boltzmann equation for vector mesons derived from Kadanoff-Baym equations with an effective quark-meson model for strong interaction and quark coalescence model for hadronizaton, we calculate the spin density matrix element ρ_{00} for ϕ mesons and show that anisotropies of local field correlations with respect to the spin quantization direction lead to ϕ meson's spin alignment. We propose that the local correlation or fluctuation of ϕ fields is the dominant mechanism for the observed the ϕ meson's spin alignment and its strength can be extracted from experimental data as functions of collision energies. The calculated transverse momentum dependence of ρ_{00} agrees with STAR's data. We further predict the azimuthal angle dependence of ρ_{00} which can be tested in future experiments.

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