ID de Contribution: **66**

Type: **Talk**

Spin alignment of vector mesons by glasma fields

mercredi 5 juin 2024 08:50 (20 minutes)

Recent measurements of large spin alignment of vector mesons beyond the expectation from vorticity may imply substantial spin correlation of the constituent quark and antiquark led by fluctuating strong-interaction forces. We explain how spin alignment of vector mesons can be induced by background color fields. Our study is based on the quantum kinetic theory of spinning quarks and antiquarks and incorporates the relaxation of the dynamically generated spin polarization. The spin density matrix of vector mesons is obtained by quark coalescence via the Wigner function and kinetic equation. We estimate the magnitude of such local correlations in the glasma model of the preequilibrium phase of relativistic heavy ion collisions. The dominant longitudinal chromo-magnetic fields from the glasma intrinsically break the rotational symmetry of spin polarization for quarks and antiquarks, which yield $\rho_{00} < 1/3$ for ρ_{00} being the 00-th component of the spin density matrix of vector mesons. It is also found that the strength of the resulting spin alignment could be greatly enhanced and may be comparable to the experimental measurement in order of magnitude. We further propose new phenomenological scenarios to qualitatively explain the transverse-momentum and centrality dependence of spin alignment in a self-consistent framework. Our approach may be applied to not only the light mesons but also heavy mesons such as J/ψ with small momenta especially in high-energy collisions.

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Classification de Session: Track4-Bulk&Phase

Classification de thématique: Bulk matter phenomena, QCD phase diagram and Critical point