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# Spin polarization and spin alignment in relativistic heavy-ion collisions

In noncentral relativistic heavy-ion collisions, the system carries a large initial orbital angular momentum, inducing strong vorticity fields and magnetic fields in the quark-gluon plasma. These fields will in turn polarize partons and are converted into spin polarization for baryons and spin alignment for vector mesons at the hadronization stage. Based on the Kadanoff-Baym equations on the closed-time-path contour, we propose a relativistic theory for the quark combination processes with spin degrees of freedom. Within this theory, we formulate the spin alignment for vector mesons as a function of spin polarizations for the constitute quark and antiquark. We argue that the nontrivial spin alignment for the $\phi$ meson, observed in experiments by the STAR collaboration, is mainly attribute to the strong field fluctuations in the quark-gluon plasma, while contributions from vorticity and magnetic fields are negligible. This may open a potential new avenue for studying the behaviour of strong fields.

**Autore principale:** SHENG, Xin-Li (INFN Firenze)

**Coautore:** BECATTINI, Francesco (Istituto Nazionale di Fisica Nucleare)

**Relatore:** SHENG, Xin-Li (INFN Firenze)