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Anomalous spin polarization from turbulent color fields

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Recent observations for the spin polarization and alignments in RHIC and LHC have triggered intensive studies for vorticity-induced polarization and spin dynamics in relativistic fluids. We study the important, yet widely overlooked, role of gluons for spin transport with a connection to local parity violation in quark gluon plasmas. We extend the newly developed quantum kinetic theory for relativistic fermions coupled with background electromagnetic fields to the case coupled with non-Abelian chromo-electromagnetic fields and employ this formalism to derive the source terms in the axial-vector Wigner function and kinetic equation for spin polarization of quarks. These source terms, which may dominate over collisional effects at weak coupling, involve parity-odd correlators of dynamically generated color fields in near-equilibrium quark gluon plasmas and give rise to locally fluctuating axial charge currents. Our results provide a possible explanation for the spin alignment of vector mesons measured in high-energy nuclear collisions and allude to its connection with local parity violation.

References :

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- [2] Di-Lun Yang, Koichi Hattori, Yoshimasa Hidaka, Effective quantum kinetic theory for spin transport of fermions with collisional effects, JHEP 07 (2020) 070.
- [3] Axial Kinetic Theory and Spin Transport for Fermions with Arbitrary Mass, Koichi Hattori, Yoshimasa Hidaka, Di-Lun Yang, Phys. Rev. D 100 (2019) 9, 096011.

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