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Shear-induced polarization at RHIC and LHC

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The local Lambda polarization puzzle associated with the model calculations by thermal vorticity has attracted lots of attention in heavy ion community [1].

In addition to the widely studied thermal vorticity effect, we identify an undiscovered contribution from the fluid shear [2]. We obtain the explicit expression for shear-induced polarization (SIP) from quantum kinetic equation and linear response theory. Using hydrodynamic simulations, we find SIP effect competes with the thermal vorticity effect and shows right sign (trend) to the azimuthal dependent local spin polarization $P_y(\phi)$ and $P_z(\phi)$. Especially, in the scenario that Lambda inherits and memorizes the spin polarization of strange quark, SIP wins the competition and the obtained local $P_y(\phi)$ and $P_z(\phi)$ qualitatively agree with the data measured at top RHIC energy [2].

Furthermore, we extend the calculation to event-by-event simulations for various collision systems at RHIC and LHC. We calculate the 2nd order Fourier coefficient of P_z , which qualitatively agrees with the ALICE measurements in 5.02 A TeV Pb+Pb collisions [3, 4]. We also predict the 3rd order Fourier coefficients, which provide more details for spin polarization and can be measured in the RHIC isobar run with high statics [4].

Refs.

- [1] B. Fu, K.Xu, X. G. Huang and H. Song, Phys. Rev. C103, no.2, 024903 (2021) ; and many related papers from other groups before.
- [2] B. Fu, S.Y.F. Liu, L. -G. Pang, H. Song, Y. Yin, Phys.Rev.Lett. 127 14, 142301 (2021)
- [3] ALICE Collaboration, arXiv:2107.11183 [nucl-ex]
- [4] B. Fu, L. -G. Pang, H. Song, Y. Yin in preparation

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