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Local equilibrium Wigner function for spin-1/2 particles

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Spin hydrodynamics is one of the leading techniques employed to understand spin polarization in heavy ion collisions. Given the topic is still in its infancy, there is a lot of debate about its most basic aspects like the form of the equilibrium distribution function. Current prevalent forms suffer from significant drawbacks, including issues with the normalization of mean spin polarization. To this end, we propose a new form of the equilibrium distribution function using the general form of a 2×2 matrix and demonstrate how it overcomes the aforementioned issues of normalization of the mean spin polarization that plagued the previous forms, furthermore, this form shows an exact agreement with thermodynamical relations for perfect spin hydrodynamics which were found before using the classical concept of spin. Beyond this, we also explore the range of applicability of this form of the distribution function and show that it works well with the parameters used in the heavy-ion simulations.

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