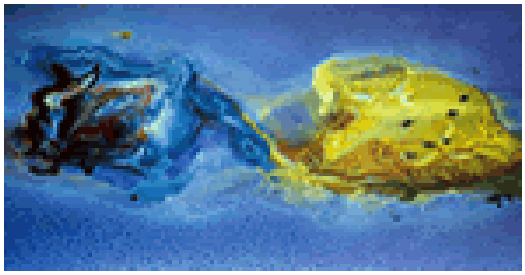

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Wigner function approach to polarization-vorticity coupling and hydrodynamics with spin

Friday, August 3, 2018 3:20 PM (20 minutes)

We critically compare thermodynamic and kinetic approaches, that have been recently used to study relations between the spin polarization and fluid vorticity in systems consisting of spin-1/2 particles. The thermodynamic approach refers to general properties of global thermal equilibrium with a rigid-like rotation and demonstrates that the spin-polarization and thermal-vorticity tensors are equal. On the other hand, the kinetic approach uses the concept of the Wigner function and its semi-classical expansion. In most of the works done so far, the Wigner functions satisfy kinetic equations with a vanishing collision term. We show that this assumption restricts significantly applicability of such frameworks and, in contrast to many claims found in the literature, does not allow for drawing any conclusions regarding the relation between the thermal-vorticity and spin-polarization tensors, except for the fact that the two should be constant in global equilibrium. We further show how the kinetic-theory equations including spin degrees of freedom can be used to formulate a hydrodynamic framework for spinning particles. This analysis suggests the use of the spin tensor introduced by de Groot, van Leuwen, and van Weert, which should be conserved in the leading order of the semiclassical expansion.

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