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Quadrupole Oscillation for Trapped Dipolar Fermi Gases at Finite Temperatures in the Collisional Regime

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Interest in dipolar gases has been growing since the realization of Bose-Einstein condensates (BECs) of $^{52}\mathrm{Cr}$ atoms that have large magnetic dipole moments [1]. Recently, the experimental effort is put into creating heteronuclear polar molecules that have large electric dipole moments [2]. The anisotropic and long-range nature of the dipolar interaction confers interesting properties to the equilibrium and dynamics of dipolar gases.

We study the dynamical properties of trapped dipolar Fermi gases at finite temperatures within the semiclassical treatment. We include the deformation of equilibrium phase-space distribution function by a variational ansatz. We apply the moment method to the kinetic equation to study quadrupole oscillation. We find that the quadrupole mode of polar molecules at high-temperture regime is in the hydrodynamic regime because of their large dipole moment. Moreover, we study the effect of the dipolar interaction on the dynamics in the hydrodynamic regime by deriving the generalized hydrodynamic equations. We find that measuring the relaxation rates of the quadrupole oscillation can be effective way to obtain the information of the anisotropic nature of the dipolar interaction than measuring the modification of the aspect ratio of the gas directly.

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[2] K. -K. Ni, *et al.*, Nature **464**, 1324 (2010).