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Collective behavior of spinning particles at fluid/fluid interface[1]
YAOUEN FILY, Syracuse University, APARNA BASKARAN, Brandeis University, M. CRISTINA MARCHETTI, Syracuse Biomaterials Institute and Syracuse University — Rotating particles in a viscous fluid can exhibit interesting behavior due to hydrodynamic interactions. When the particles are driven by an external torque, these interactions result in an effective azimuthal force, leading to swirling motion. It has been shown that small numbers of such particles form precessing atom-like structures. The behavior of large collections of spinning particles is, however, still relatively unexplored. We study the phase diagram of a collection of spinning particles in two dimensions using molecular dynamics simulations. The rotors interact via hydrodynamic interactions and short-range repulsion, in the presence of thermal noise. The repulsive interaction yields transitions from a solid to a liquid to a gas as the density of rotors is decreased. The azimuthal hydrodynamic interaction modifies each of these phases in a distinct way. Both long-range and screened hydrodynamic interactions are considered. Some properties of the various phases are shown to depend critically on the range of the interaction.

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Yaouen Fily
Physics Department, Syracuse University, Syracuse, NY 13244, USA

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