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Challenging Requirements for Molecular Dynamics Simulations of Strongly Magnetized Plasmas[1] KEITH VIDAL, Univ of Iowa, JEROME DALIGAULT, Los Alamos National Laboratory, SCOTT BAALRUD, Univ of Iowa
— Molecular Dynamics (MD) simulations are an important tool in plasma physics and are often used to compute transport coefficients in plasmas in the moderate or strong Coulomb coupling regimes. This work investigates the required number of particles needed in MD simulations of the strongly magnetized One-Component Plasma (OCP) in order to compute accurate self-diffusion coefficients. Here we define strongly magnetized as when the gyrofrequency is greater than the plasma frequency. We find that far more particles are required to reach convergence in the strongly magnetized OCP than is required in the unmagnetized OCP, and increases with the strength of the magnetic field. The reason is that a long-range correlation parallel to the magnetic field develops when particles are confined to gyrate within very narrow gyrocylinders aligned along the magnetic field. The simulations also reveal that this correlation significantly increases the timescale required to reach a hydrodynamic diffusive regime. We conclude that compared to previous expectations it is more computationally expensive to simulate plasmas that are strongly magnetized.

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