Casimir-like forces: effects of fluctuation confinement in non-equilibrium fluids.

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Long-ranged spatial correlations are the only ingredient needed to generate Casimir-like forces between two large objects immersed in a fluid. Casimir forces have been studied since 1948, when Casimir predicted the existence of an attractive force between two metal plates in vacuum, and are present in all systems with long-ranged fluctuations, like in critical fluids or superconducting films. More recently, the same mechanism has been proposed for different non-equilibrium systems, such as granular fluids[1], which reach a homogeneous stationary state characterized by long-ranged correlations[2].

We present a numerical study using dissipative particle dynamics, a mesoscopic simulation method with molecular dynamics structure useful to reproduce the hydrodynamic behaviour of a fluid. The long-ranged correlations appear in our simulations as a consequence of breaking the detailed balance condition in a DPD-ideal gas, a very useful model in which all the other nature effects in granular systems, like depletion forces, are avoided, permitting us to focus on the correlation effects on the effective force between large immersed objects.

We estimate the fluctuation-induced forces between two plates and analyse its nature and the effects of confinement on the different thermodynamic properties, not only for long separations but also for short ones. This simple one-dimensional experiment allows a detailed analysis, paving the way for the following two disks configuration (two-dimensional case).

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[1] C. Cattuto, R. Brito, U.M.B. Marconi, F. Nori and R. Soto, Phys. Rev. Lett. **96**, 178001 (2006).
[2] T.P.C. van Noije, M.H. Ernst, E. Trizac, I. Pagonabarraga, Phys. Rev E **59**, 4326 (1999).