Statistical Mechanics of Self-Gravitating Systems

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Systems with long-range forces behave very differently from those in which particles interact through short-range potentials. For systems with short-range interactions, for arbitrary initial conditions, the final stationary state corresponds to the thermodynamic equilibrium and can be described equivalently by either a microcanonical, canonical, or a grand-canonical ensemble. On the other hand, for systems with unscreened long-range forces, equivalence between ensembles breaks down. Isolated long-range interacting systems — in thermodynamic limit — do not evolve to the usual Boltzmann-Gibbs equilibrium, but become trapped in a non-ergodic stationary state (SS) which explicitly depends on the initial particle distribution. In this talk I will discuss self-gravitating systems in one, two, and three dimensions. We will see that it is often possible to *a priori* predict the structure of the SS state to which a system will relax and that this structure strongly depends on the properties of the initial particle distribution [1,2,3].

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[2] F. P. C. Benetti, A. C. Ribeiro-Teixeira, R. Pakter, and Y. Levin, Phys. Rev. Lett. **113**, 100602 (2014).

[3] R. Pakter, B. Marcos, and Y. Levin, Phys. Rev. Lett. **111**, 230603 (2013).