The Abdus Salam International Centre for Theoretical Physics

Conference on Long-Range Interacting Many-Body Systems: from Atomic to Astrophysical Scales (25 - 29 July 2016)

Venue: ICTP Leonardo da Vinci Building - Budinich Lecture Hall
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Title:
Integrable versus ergodic approaches to describe quasi-stationary states

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Abstract:

In systems with long-range interactions, the predominantly collisionless initial dynamics leads to out-of-equilibrium quasi-stationary states (QSS). These states are notoriously difficult to predict given an arbitrary initial condition, and there is still no unified theory to treat them. One thing, however, is clear: unlike thermodynamic equilibrium, the system's initial dynamics plays a fundamental role in determining the profile of the QSS. If strong mean-field oscillations occur â€“ a process known as violent relaxation â€“ a core-halo configuration can be formed, in which ergodicity is broken. In these cases, the core-halo theory of Levin et al successfully characterizes the QSS profiles [1]. If the initial condition is such that there are no strong oscillations â€“ for example, in a virialized initial state â€“ the dynamics is close to integrable and there is no core-halo formation, so this theory does not apply. Previously, it has been shown that Lynden-Bell statistics, a theory that relies on an assumption of ergodicity and violent relaxation, has reasonable results for such cases. However, we show that another model, based on uncoupled particles, gives more accurate results for the HMF model and self-gravitating systems [2,3].

[1] Levin, Y. et al, Phys. Rep. 536 (2014).
[2] Ribeiro-Teixeira, A.C. et al, Phys. Rev. EÂ 89 (2014).
[3] Benetti, F.P.C. et al, Phys. Rev. Lett. 113 (2014).