ICTS | INTERNATIONAL CENTRE for THEORETICAL SCIENCES

TATA INSTITUTE OF FUNDAMENTAL RESEARCH

ICTS Astrophysics & Relativity Seminar

Title : The relaxation of collisionless and weakly collisional many-body systems with long-range interactions

Speaker : Uddipan Banik (Princeton University)

Date : Thursday, 02nd November 2023

Time : 3:30 PM (IST)

Abstract : The dynamics of many-body systems is a hard problem and is generally studied using the tools of statistical mechanics and kinetic theory. Depending on the number of particles and the range of interactions, the dynamics can be vastly different. Many-particle systems governed by short range interactions such as neutral gas typically relax/equilibrate fast, via two-body encounters, attaining the maximum entropy state of thermal equilibrium, characterized by a Maxwell-Boltzmann distribution function (DF). However, many-body systems governed by long range interactions (e.g., Coulomb forces), such as self-gravitating systems and plasmas, relax very differently. Such systems often turn out to be collisionless or weakly collisional in nature, i.e., they relax not via two body encounters but via 1. kinematic processes like phase-mixing and 2. collective processes like Landau damping and violent relaxation. These processes are either slow (secular evolution) or self-limiting, implying that the system takes very long to attain a Maxwellian DF, and often settles in a quasi-equilibrium state characterized by a non-Maxwellian DF. In this talk, I shall describe how the collisionless relaxation mechanisms of phase-mixing and Landau damping operate in self-gravitating systems and plasmas. I shall elucidate how these relaxation processes drive structure formation in astrophysical systems (e.g., spiral arms in disk galaxies), and produce non-equilibrium features in the phase-space distribution of constituent particles (e.g., phase-space spirals). Finally, I shall describe how collisional dissipation can erase some of these features.

Venue : Emmy Noether Seminar Room & Online
Zoom link: https://zoom.us/j/99541353022?pwd=SENLL0JuRlE0ampzUkF0blcyY3pWdz09
Meeting ID: 995 4135 3022
Passcode: 957404