Seminar

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Institute for Plasma Research

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Title: Study on rotating dusty plasma equilibria and their excitations in strongly coupled quasi-localized regime

Speaker: Mr. Prince Kumar

Institute for Plasma Research, Gandhinagar

Date: 25th January 2023 (Wednesday)

Time: 03:00 PM

Venue: Seminar Hall, IPR

Join the seminar online: https://meet.google.com/dyy-zvrc-nfp

Abstract

Linear and nonlinear collective excitations of the dusty plasma have been extensively studied in its continuum or weak coupling limit. In the strong coupling limit, where particles are quasi-localized and their movement are restricted, a more sophisticated theoretical framework such as Quasi-localized charge approximation (QLCA) model is required [1]. The rotating dust flow, which can be used to "effectively magnetize" a dusty plasma in laboratory conditions, has been observed in purely non-conservative force field environments [1, 2]. The rotating dusty plasma extends the scope of the analysis to the cosmological scales where observations confirm the presence of magnetic fields strong enough to magnetize the strongly correlated astrophysical dust clouds. Interestingly, a laboratory realization of such cosmological magnetization is possible when measurements are done in their co-rotating frame where the Coriolis force produce effects analogous to the Lorentz force. First, we explore a novel mechanism to generate the rotating dust flow equilibria which are driven by purely conservative force fields, e.g., in the absence of any ion and neutral drag. The time-dependent evolution of the perturbations in such rotating dust flow in its discrete or strong coupling limit can be used to understand various dynamical processes, for example, phase transition, collective mode structure [1], and nucleation processes, in a strongly coupled magnetized medium. Therefore, the non-inertial QLCA approach has been used to analyze linear collective excitations in a strongly coupled rotating dusty plasma by explicitly accounting for the localization of the dust particles [1]. The nonlinear waves in such systems have potential applications in many areas of research which includes solid-state physics, complex plasma, etc. While the existing studies on nonlinear waves in a strongly coupled dusty plasma are limited to continuum models, the experimental developments have motivated a huge range of theoretical advances in connection to the properties and interactions of lattice non-linear waves and how these are modified in comparison to their continuum counterparts. The nonlinear QLCA model has been developed, for the first time, to recover the effects of dust localization on nonlinear coherent structures in a slowly rotating or non-rotating strongly coupled dusty plasma [3,4]. The focus of studies presented in this thesis is on generating and analyzing the rotating dusty plasma equilibria within the Quasi-localized charge approximation (QLCA) theory.

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1. ***Prince Kumar*** *and Devendra Sharma, Phys. Plasmas 28, 083704 (2021)*
2. ***Prince Kumar*** *and Devendra Sharma, Phys. Plasmas 27, 063703 (2020);*
3. ***Prince Kumar*** *and Devendra Sharma, under review (POP 2023)*
4. *Sandip Dalui,,* ***Prince Kumar****, and Devendra Sharma,* Physica Scripta *98.2 (2023): 025606.*