# Seminar

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# Institute for Plasma Research

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| **Title:** | Study of collective excitations in Strongly Coupled Coulomb Systems |
| **Speaker:** | Dr. Prince Kumar<br>Institute for Plasma Research, Gandhinagar |
| **Date:** | 23rd December 2024 (Monday) |
| **Time:** | 10:30 AM |
| **Venue:** | Seminar Hall, IPR |

## Abstract

Studies of the collective excitations in Strongly Coupled Coulomb Systems offer valuable insights into their static and dynamic properties, as well as how to control these excitations for practical applications, such as in ion trap systems where the phonon mode spectrum is manipulated to enhance quantum gate performance efficiency [1-5]. We conduct molecular dynamics simulations to validate existing models describing the collective excitations in strongly coupled Yukawa media [6-7]. The results indicate that the Quasi-localized charged approximation (QLCA) provides a more accurate description of highly screened longitudinal excitations, whereas the Generalized Hydrodynamic (GH) model more effectively captures long-wavelength and transverse excitations [4]. However, the simple fluid model, with an appropriate equation of state, effectively describes the collective excitations over a wide range of parametric space, though it is limited to longer wavelength excitations [6-7]. The scope of the analysis can be extended to understand and manipulate the collective mode spectrum in trapped ion systems [8].

1. *Anders Sorensen and Klaus Molmer, Physical Review Letter, 9, 82 (1999**)***
2. ***Prince Kumar** and Devendra Sharma, Phys. Plasmas 28, 083704 (2021)*
3. ***Prince Kumar** and Devendra Sharma, Phys. Plasmas 27, 063703 (2020);*
4. ***Prince Kumar** and Devendra Sharma, Phys. Plasmas 30, 033702 (2023)*
5. *Sandip Dalui, **Prince Kumar**, and Devendra Sharma, Physica Scripta 98.2 (2023): 025606.*
6. ***Prince Kumar** and Devendra Sharma, Contribution to plasma physics, 64 (2024): e202400026*
7. ***Prince Kumar** and Devendra Sharma, Journal of plasma physics (2024), Accepted*
8. *Y. Suleimen, et al. Physical Review A, 109, 022605 (2024)*