Size Dependence of Dust Particles in Cluster Rotation

Currently, in the field of complex plasmas, there is a strong interest in the dynamical behaviour of these dust clusters. Such interest arises because a better understanding of the dynamics may allow dust particles to be manipulated collectively or individually. Consequently, this knowledge can be used in a wide range of applications such as the removal of dust contamination in semiconductor plasma processing, surface deposition on novel materials, fabrication of micro- and nano-scale mechanical devices and explanation for the dynamical properties observed in planetary rings and space nebulae. Crystal rotation, vortex motion, instabilities and oscillations are some of the different types of particle dynamics that have been observed and reported in the last few years. In particular, crystal rotation has been studied in various plasma conditions since its first observation in a magnetized plasma.

Aim:

To compare the difference in rotational properties (i.e. cluster radius, angular velocity, total angular momentum) of the clusters with 2.71 microns dust with 6.21 microns.

Importance of this particular investigation:

1. Verify the possibility of neutral gas flow in the chamber as the driving mechanism of cluster rotation.
2. Obtain the value of dust charge on dust particles (in collaboration of Project 2).
3. Test whether cluster rotation is dust charge dependent or radial electric field dependent.
4. Verify the validity of the prevalent theory on ion drag as the driving mechanism of cluster rotation.

Things you will learn:

1. Get a first hand experience in analysing real experimental data.
2. Apply your existing knowledge on classical mechanics.
3. Gain knowledge in new frontier plasma physics.

Things you would need to accomplish in the project:

1. Read current papers on the topic of cluster rotation.
2. Understanding how the raw data of the cluster rotation was obtained.

3. Analyse the data from cluster rotation.
4. Make direct comparison between analysed data with existing data.
5. Propose physical explanation for the observed

Related Papers:

Cheung F., Samarian A., and James B.
Rotation of Coulomb clusters in magnetised dusty plasma
Physica Scripta, T98, 143 (2002)

F.M.H. Cheung, A.A. Samarian, and B.W. James
Rotation of Dust Coulomb Clusters in Axial Magnetic Field
AIP Conference Proceedings, Volume 649, Issue 1, p.139 (2002)

F.M.H. Cheung, A.A. Samarian, and B.W. James
Coulomb Clusters in Axial Magnetic Field
Proceedings of 11th International Congress on Plasma Physics, ICPP-2002, Sydney, 15-19 July (2002)

F. Cheung, N. Prior, L. Mitchell, A. Samarian, and B. James
Rotation of Coulomb crystals in magnetized inductively coupled complex plasma
IEEE Transaction on Plasma Science, 31, Issue 1, February (2003)

Felix Cheung, Alex Samarian, and Brian James
The rotation of planar-2 to planar-12 dust clusters in an axial magnetic field
New Journal of Physics, Vol. 5, 75, June (2003)