Stability Coefficient in a Cluster Configuration

Self-arrangement in dust structure is one of the fascinating properties in complex plasma. There are many theories proposed which aims to explain the many unexpectedly observed cluster configuration. This project can provide verification in such theories.

Also there are many parameters in complex plasma which are difficult to measure. Dust charge and interparticle force are some examples. By using the values of the cluster radius, information about these important parameters might be obtained. Moreover the use of dust as a diagnostic tool for various plasma conditions can be demonstrated in this particular project,

Aim:

To investigate in the stability coefficient (*S*) where

$$S = \frac{\Delta\rho}{\rho} \times 100\% \quad , \rho \text{ - cluster radius}$$

is defined as the degree of constancy of the position of the particles in a cluster under a particular set of operating conditions as a function of time, with zero being the maximum stability.

Importance of this particular investigation:

1. Verify the validity of the prevalent theory on the prediction of the metastable state of clusters.
2. Measure the magnitude of the interparticle force and hence the radial electric field of confinement potential
3. Calculate the dust charge of the particle and examine the charge dependence as a function of electric and magnetic field.

Things you will learn:

1. Get a first hand experience in analysing real experimental data.
2. Apply your existing knowledge on electrodynamics.
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 configuration.
2. Read publications on the stability of a system.
3. Understanding how the raw data of cluster radius was obtained.
4. Analyse the data for different cluster configuration.
5. Verify obtained measurements with theory.
6. Calculate the interparticle force, radial electric field and dust charge for the different cluster configuration.
7. Examine the charge dependence of dust as a function of electric and magnetic field.
8. Make comment from the stability coefficients obtained.

Related Papers:

Ordering and phase transitions of charged particles in a classical finite two-dimensional system
by V.M. Bedanov and F.M. Peeters
Phys. Rev. {B 49}, 2667-2676 (1994)
For the first time a Mendeleev table for the planar clusters was presented. Also the melting of such clusters were studied.

Spectral properties of classical two-dimensional clusters
by V.A. Schweigert and F.M. Peeters
Phys. Rev. {B 51}, 7700-7713 (1995).
The normal modes of the clusters were investigated in this paper. And 'magic clusters' were identified. In particular the sensitivity of the normal modes on the configuration of the particles in the cluster was noticed.

Transition between ground state and metastable states in classical 2D atoms
by M. Kong, B. Partoens, and F.M. Peeter
Phys. Rev. E {65}, 046602 (2002) (13 pages).
Detailed study of all the possible stable cluster configurations for a given number of particles was presented. Also the important saddle points were identified which are related to the energy barriers between different configurations.