Angular Velocity Saturation in Double Ring Cluster

Angular Saturation in cluster rotation is currently a hot topic in the study of complex plasma. This is because the nature of the driving mechanism for the cluster rotation is still unclear (ion drag force could be one possible mechanism). And the angular saturation properties which cluster rotation exhibits will give us a better understanding of the nature of the driving mechanism.

Currently there are two laboratory groups around the world which have reported on the observation of angular velocity saturation (Sato *et al.* and Cheung *et al.*). Despite the fact that the experiments were performed in different experimental conditions, Sato *et al.* found that cluster rotation saturates irrespective of the number of particles in the cluster configuration. Whereas, Cheung *et al.* found that the angular velocity saturation occurs at different magnetic field strength for different cluster configuration. Moreover under their experimental conditions, the angular velocity occurs at a much lower magnetic field than that of Sato *et al.*

Aim:

To provide a simulation which aims to explain the angular velocity saturation.

Our current theory assumes that ion drag is the major driving mechanism of cluster rotation. Since electron/ ion charge distribution changes as magnetic field changes, this creates a change in the electric field dependent on the position in the system. Such change can cause the magnitude and the direction of the ion drag force acting on the particles in the cluster to change.

Importance of this particular investigation:

1. Verify the validity of the prevalent theory on the angular velocity saturation
2. Predict the magnetic field at which angular saturation occurs.
3. Understanding the true nature of the driving mechanism for the cluster rotation.

Things you will learn:

1. Get a first hand experience in simulating experimental result.
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 angular velocity saturation.
2. Using mathematical analysis software package to simulate angular velocity saturation.
3. Understanding how boundary conditions are applied to the simulation.
4. Create simulation that is applicable to different cluster configuration.
5. Verify obtained simulation with experimental results.

Related Papers:

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)

Kaw P K, Nishikawa K and Sato N 2002 *Phys. Plasmas* **9** 387