

§28. Dust Plasma Experiments and Collisional Oscillations

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In Plasmas, the diverter is bearing an important role in the study, which aims at combustion plasmas. However, the impurities are incorporated into plasmas in many cases, which cause the problems of decreasing the temperature of the plasma and of damaging the wall of devices. It is because impurities are charged negatively and evolve the collective motion. Positive ions and negatively charged particles easily collide the neutral particles because the neutrals are independent on the external fields. Large amplitude oscillation may occur due to the collision between ions (dust grain) and neutral. The oscillation propagates and causes the damage of the wall.

The present purposes of the study are to obtain the parameters on the dust plasma and to analyze these problems numerically by proposed model, to compare experimental observations with the results based on the present model and to simulate oscillation

phenomena due to interparticle collisions.

We propose a model of the system as follows:

$$n_e = n_{e0} \exp(e\Phi/T_e),$$

$$n_i = n_{i0} / (1 - (2e\Phi/m_i v_i^2)^{0.5}),$$

$$n_d = (n_{i0}/n_{e0} - 1) / (Z(1 - 2Ze\Phi/m_d v_d^2)^{0.5})$$

together with the Poisson equation,

$$\epsilon_0 \frac{d^2\Phi}{dx^2} = e(n_e - n_i + Zn_d).$$

We investigated the properties of dust grains and oscillating phenomena in plasmas. The potential profile obtained in the experiment coincides with our results based on the present model. Also, an electric double layer is obtained. It turns out that the variation of the dust density and it depends on the input voltage. Oscillations near the wall due to ion-neutral and dust-neutral collisions. Although these oscillating phenomena have not been found, they may be observed in experiments in the near future.

References:

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