# Study on dusty plasma waves in planetary rings

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The material of the universe consists of 99% of ionized gases and 1% of dusts. Dust exists everywhere in space in charged up state in plasma media. Plasma containing charged dust is called dusty plasma and it is roughly classified into two. When intergrain distance is longer than the Debye length, a grain can be treated as a single particle (dust-in-plasma). On the other hand, collective effects of the charged dust become important when the Debye length is longer than intergrain distance (dusty plasma). The latter dusty plasma is treated in this research.

The study on dusty plasma is a new area of investigation that began to be paid attention since the discovery of Saturn B ring spoke phenomenon by the Voyager experiment at the beginning of 1980's. The research of dusty plasma has not become enough systematization yet even though dust exists everywhere in space and makes the characteristic of plasma significantly modified.

By Li and Havnes(2000), the dispersion relation of dusty plasma waves is investigated that took into the effect of the gravity. They found the gravity-drift wave and the dust-magnetosonic wave as the peculiar mode of the dusty plasma. In addition, they suggested that the gravity-drift wave instability could be of some importance for the evolution of spokes in Saturn B ring.

In this study, in order to complete the reserch started by Li and Havnes(2000), the gravity-drift wave instability was apllied to Saturn ring and we examined influence on the spoke with solving the dispersion relation of dusty plasma waves and the propagation characters.

As a result of this reserch, following three dusty plasma waves were identified, the dispersion characteristic and propagation characteristic were revealed.

(1) gravity-drift wave

transverse wave, right-handed and left-handed, growth rate:10^-2 per around ring,Vg=-Vd

(2) dust-magnetosonic wave

longitudinal wave for perpendicular propergation and hybrid mode both transverse and longitudinal wave for parallel propergation, right-handed, growth rate:10^-4 per around ring,Vg=-Vd

(3) new dusty mode

transverse wave, left-handed, growth rate:negative value

Because these waves are directed to the opposite direction to the drift of dust particles, it was thought that these waves would work for controling the drift of dust. However, due to the low growth rate of the plasma instability, these waves have no significant effect on the formation on spokes.

It was expected that these waves would have a long term dffect such as the formation of planets in solar nebula and the planetary rings, so in future works, application of these dusty plasma waves may have an important role.