§21. Potential Structure Formed by Local Production of Negative Ions in a Magnetized Plasma

Ishiguro, S., Oohara, W., Hatakeyama, R., Sato, N.
(Dept. Electronic Eng., Tohoku Univ.)

A growing attention has been paid to phenomena on dusty plasmas since fine particles were recognized to be present in space, fusion-oriented and materials-processing plasmas. As fine particles are often negatively charged in such plasmas, it is of considerable interest to investigate effects of the negative ion production on microscopic and macroscopic plasma structures. In particular, formation of potential structure and fluctuation accompanied by localized production of negative ions have been observed in a particle simulation and Q machine experiment [1].

We have investigated formation process of the localized structure and the dependence of plasma structure on the negative ion production rate in detail by means of one-dimensional electrostatic particle simulations. It is found that the plasma behavior is dependent on the negative ion production rate, being often followed by bifurcation. Figure 1 shows the negative ion exchange rate (ϵ) dependence on the negative ion production rate (α). Below the critical production rate($\alpha \simeq 0.05$), the negative ion density increases with an increase in the production rate(α). On the other hand, above the critical production rate, there is no appreciable increase in the negative ion density in spite of an increase in the production rate. Figure 2 shows the potential profiles for the case with $\alpha = 0.04$ and $\alpha = 0.2$. While a potential profile is stationary and monotonically changes in the system for $\alpha = 0.04$, a series of negative soliatary wave structure appear for $\alpha = 0.2$. It is observed that these negative wave structures are intermittently generated in the negative ion production region and flow to the downstream side. The wave structures are formed with the result that a plasma gives a boot to eject negative ions from the system. This phenomenon may be considered as a kind of kinetic self-organization.

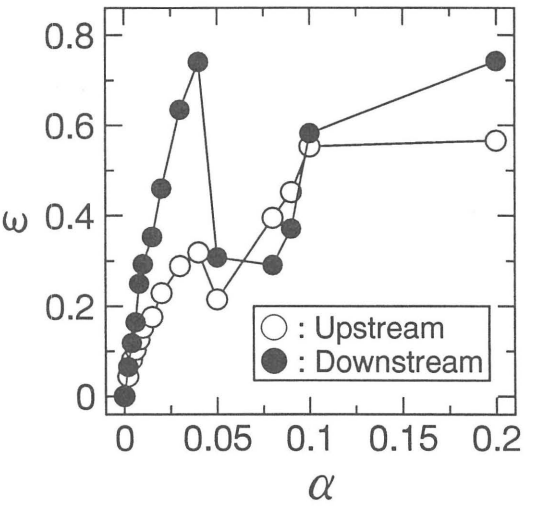

Fig. 1. Negative ion exchange rate (ϵ) as a function of the negative ion production rate (α).

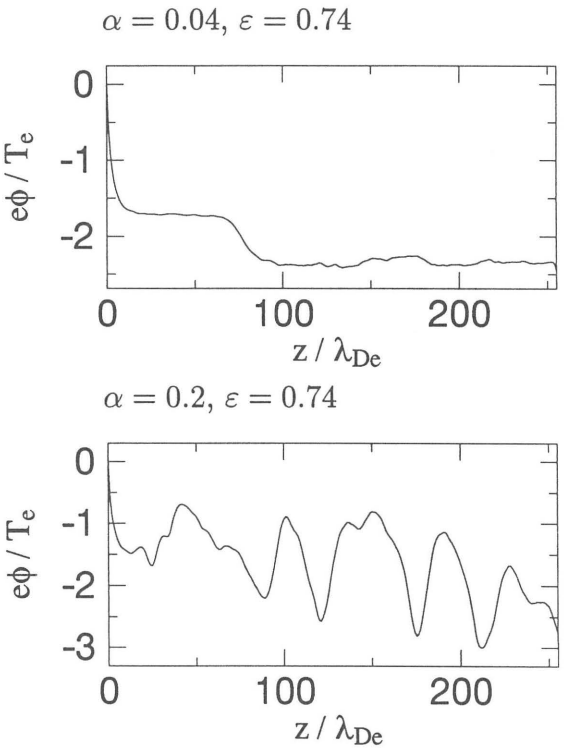

Fig. 2. Potential profiles for the case with $\alpha = 0.04$ and 0.2.

Reference

1) Sato,N. *et al.*: Phys. Plasmas 1 (1994) 3480.