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ヘリコンプラズマ生成の自己無撞着モデル
A self-consistent model of helicon plasma production

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Helicon plasma is a high-density and low-temperature plasma generated by the electromagnetic (Helicon) wave excited in the plasma. Then, helicon plasma is expected for various applications. On the other hand, there still remain a number of unsolved physical issues regarding how the plasma is generated using the helicon wave. The mechanism of helicon plasma production includes the wave propagation in the plasma (dispersion relation), collisional or non-collisional wave damping and plasma heating, and ionization/recombination of neutral particles which causes time evolution of the dispersion relation. In this study, we use the linear theory of helicon plasma, fluid simulation, and particle simulation to construct self-consist model including these physics.

In previous, we studied the helicon wave propagation and the process of plasma heating. And we showed the efficiency of mode conversion in bulk plasma depends strongly on the magnitudes of dissipations. However, there is a problem that has not been much studied: How do the helicon and TG modes influence the plasma density, electron temperature and their profiles? While the helicon mode is absorbed in the bulk plasma, the TG mode is mostly absorbed near the edge of the plasma. The local power deposition in a helicon plasma is mostly balanced by collision loss. This local power balance can give rise to an inhomogeneous electron temperature profile which is related to time evolution of density profile. In our study, we construct a self-consistent discharge model which includes wave excitation, classical electron heat transfer, and diffusion of charged particles.