Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)

PEM29-13 Room:503 Time:April 30 14:15-14:30

Helicon wave propagation, mode conversion, and plasma heating

ISAYAMA, Shogo[1*] ; HADA, Tohru[1] ; TANIKAWA, Takao[2] ; SHINOHARA, Shunjiro[3]

[1]Graduate School of Engineering Sciences, Kyushu University, [2]Research Institute of Science and Technology Tokai University, [3]Tokyo University of Agriculture and Technology, Institute of Engineering

Helicon plasma is a high-density (number density ~10^{19} /m^3) and low-temperature (electron temperature ~a few eV) plasma generated by the helicon wave, i.e., electromagnetic whistler wave in a bounded plasma. Helicon plasma is thought to be useful for various applications including plasma processing and electric thrusters. On the other hand, there remain a number of unsolved fundamental issues regarding how the plasma is generated. Some of the key processes involved are the wave propagation (dispersion relation), mode conversion, collisional and non-collisional damping and resultant plasma heating, ionization and re-combination of neutral particles due to electrons accelerated by the wave, and modification of the dispersion relation due to addition of newly produced plasma.

In this presentation, as a first step to understand the helicon plasma production mechanism, we study the helicon wave propagation, mode conversion, and the plasma heating. According to Shamrai (1996), the helicon wave is linearly mode converted to an electrostatic Trivelpiece-Gould (TG) wave, which can accelerate electrons efficiently. However, the mode conversion and the production of the TG wave strongly depend on the dissipation included in the plasma. Using fluid and particle-in-cell (PIC) simulations, we discuss the mode conversion efficiency, wave damping, and plasma heating due to wave-particle interactions. We show that direct damping of the helicon waves can play major roles in the plasma heating under circumstances relevant to actual laboratory experiments.

Keywords: Helicon plasma, Helicon wave, TG(Trivelpiece-Gould) wave, Mode conversion, PIC simulation