

The relationship between the plasma density profile and penetration of magnetic fields due to the RMF acceleration

YAMANOKUCHI, Kazuki^{1*}, HADA, Tohru², Shunjiro Shinohara³

¹ESST,Kyushu Univ, ²ESST,Kyushu Univ, ³Inst. Eng, TUAT

Electric thrusters, characterized with high specific impulse, are considered to be useful for long-term space missions such as those to outer planets. On the other hand, the performance of many of the conventional electric thrusters (e.g., ion engine) is limited by electrode wastage. In order to overcome this difficulty, we have been engaging in the research and development of the next generation thrusters in which electrodes do not contact the plasma directly (the Helicon Electrodeless Advanced Thruster project).

Among several different types of electrodeless plasma acceleration schemes we propose, in this presentation we discuss the acceleration concept utilizing the Rotating Magnetic Field (RMF), which has been developed primarily for an application to the plasma confinement in the field-reversed configuration [3]. In this scheme, a rotating external magnetic field is applied to the cylindrical helicon plasma [2], in such a way that the external magnetic field drives the azimuthal electron current. If the background magnetic field has a finite radial component, axial Lorentz force is generated, which can be used as a thruster power [4].

We will show the results of numerical modeling of the interaction between the cylindrical plasma and the RMF. In the past, numerical modeling of the RMF has been studied assuming a uniform density profile in the cylindrical plasma geometry [5]. However, the plasma density in the actual experiment is non-uniform and is low near the boundary. While the low density implies easy penetration of the RMF into the plasma and the generation of the axial Lorentz force, it also implies reduced energy flux of the accelerated plasma, and thus it is important to make a systematic parameter survey to determine the conditions that can yield the maximum thrust. Details of the computations will be given in the presentation.

Keywords: Electric thruster, Electrodeless thruster, Rotating Magnetic Field