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

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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) [1].

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 [4]. 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 [5].

We will show the results of two dimensional numerical modeling of the RMF acceleration by Particle-in-Cell method. The axial thrust is generated by Lorentz force, so high azimuthal electric current is effective for electric thruster. We will show how the penetration of RMF depends on the parameters of plasma and RMF, 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.

[1] Grants-in-Aid for Scientific Research (S).Research and Develpoment of a Novel Electordeless Plasma Rocket Engine Using a Helicon Source FY2009-2013
[2] cf. Shinohara, S. et al., Phys. Plasmas vol. 16, 057104, 2009.
[3] Jones, I. R., Phys. Plasmas vol. 6, 1950, 1999.
[4] A.L.Hoffman, Nuclear Fusion, vol. 40, No.8, 1523, 2000.
[5] Inomoto, M., I.E.E.J. Trans. vol. 128, 319, 2008.

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