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# 磁気ノズル効果によるヘリコンプラズマスラスターの性能向上

# Improvement of helicon plasma thruster performance by magnetic nozzle effect

高橋和貴[1-3], Christine CHARLES[3], Rod W BOSWELL[3]
岩手大工[1], 岩手大ソフトパス[2], オーストラリア国立大学
Kazunori TAKAHASHI[1-3], Christine CHARLES[3], and Rod W BOSWELL[3]
[1]Department of Electronic Engineering and Computer Science, Iwate University
[2]Soft-Path Engineering Research Center (SPERC), Iwate University
[3]Space Plasma, Power and Propulsion Laboratory, The Australian National University

Understanding of plasma momentum in bounded and unbounded plasma system is essential to clarify particle acceleration mechanisms in space and terrestrial plasmas, such as solar flare, astrophysical jet, auroral plasma, and electric propulsion devices such as a helicon thruster. In the natural plasmas, the accelerated plasma flows are observed under the presence of non-uniform magnetic fields; further some of the phenomena are current-free. A number of laboratory helicon plasmas have shown the electrostatic ion acceleration by a current-free double layer or an ambipolar electric field [1]. Simultaneously with that, energetic electrons in the source can overcome the potential drop and neutralize the accelerated group of ions [2]. Hence this system can be applicable to a neutralizer-free electric propulsion system. More recently, direct measurement of the plasma momentum, which is called as thrust in electric propulsion, has been performed by using a pendulum thrust balance [3].

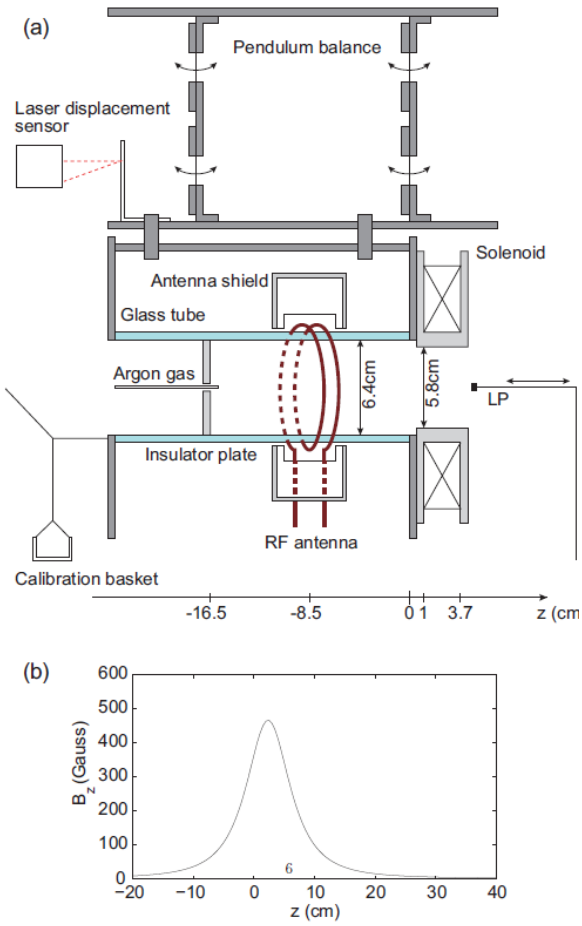


Fig1: (a) Experimental setup. (b) Calculated magnetic field on axis for a solenoid current of 10 A.

Here we report an experimental demonstration of an increase in the plasma momentum or thrust by the nozzle field strength. Figure 1 shows the schematic of the experimental setup and the calculated magnetic field strength for the solenoid current of 10 A. The solenoid current can be increased up to 20 A, which gives about 960 Gauss near the source exit. When the high-density argon plasma is produced by a 13.56 MHz argon discharge, the thrust is measured by the pendulum thrust balance having a laser-displacement sensor. The increase in the thrust up to ~10 mN is observed with no measurable change of the upstream plasma production. The plume diagnosis in the magnetic nozzle indicates the increase in the Lorentz force onto the nozzle due to the inhibition of the radial diffusion process across the magnetic field lines. The detail will be discussed in the talk.

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