

## Numerical Study on Ionization Structure and Shock Wave Propagation for Improving Flight Performance of Beaming Propulsion Vehicle

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### ● Abstract

In this study, our objective is designing a beaming thruster for improving its thrust performance by revealing generation mechanism of plasma and shock wave.

### ● Reasons and benefits of using JAXA Supercomputer System

It is necessary to use JAXA supercomputer because a computational cost becomes huge to reproduce a beam-induced breakdown owing to its multi-scale physics between neutral gas dynamics, plasma reaction diffusion, and electromagnetic wave propagation.

### ● Achievements of the Year

We numerically reproduced a multi-dimensional plasma-front propagation induced by a beam irradiation using a coupling simulation code between neutral gas dynamics, plasma reaction diffusion, and electromagnetic wave propagation. A diffusive plasma was obtained at low beam intensity, and a discrete plasma was induced at high beam intensity. The wave reflected by the plasma was examined by putting virtual antennas in the simulation domain, which indicated that a high frequency wave was induced by the discrete plasma. Moreover, a plasma-front propagation speed was measured by monitoring the waves reflected by the plasma. These results indicated that the plasma structure can be identified by using antennas, instead of utilization of optical devices such as high-speed camera.

### ● Publications

N/A

- **Usage of JSS**

- **Computational Information**

Process Parallelization Methods	MPI
Thread Parallelization Methods	N/A
Number of Processes	48 - 480
Elapsed Time per Case	48 Hour(s)

- **JSS3 Resources Used**

Fraction of Usage in Total Resources\*1(%): 0.15

Details

Computational Resources		
System Name	CPU Resources Used (core x hours)	Fraction of Usage*2(%)
TOKI-SORA	461,433.33	0.02
TOKI-ST	1,025,241.94	1.02
TOKI-GP	0.00	0.00
TOKI-XM	0.00	0.00
TOKI-LM	0.00	0.00
TOKI-TST	0.00	0.00
TOKI-TGP	0.00	0.00
TOKI-TLM	0.00	0.00

File System Resources		
File System Name	Storage Assigned (GiB)	Fraction of Usage* <sup>2</sup> (%)
/home	550.00	0.50
/data and /data2	16,340.00	0.13
/ssd	400.00	0.06

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage* <sup>2</sup> (%)
J-SPACE	0.00	0.00

\*<sup>1</sup>: Fraction of Usage in Total Resources: Weighted average of three resource types (Computing, File System, and Archiver).

\*<sup>2</sup>: Fraction of Usage : Percentage of usage relative to each resource used in one year.

#### ● ISV Software Licenses Used

ISV Software Licenses Resources		
	ISV Software Licenses Used (Hours)	Fraction of Usage* <sup>2</sup> (%)
ISV Software Licenses (Total)	0.00	0.00

\*<sup>2</sup>: Fraction of Usage : Percentage of usage relative to each resource used in one year.