

Numerical Study of Breakdown and Shock Wave Structures for Improvement of Flight Performance in a Beamed-energy Vehicle

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● Abstract

The microwave-driven in-tube accelerator concept was proposed as a novel beamed-energy propulsion system, and breakdown and shock wave propagations are numerically reproduced to compare with conventional system.

● Reasons and benefits of using JAXA Supercomputer System

It is necessary to use the JAXA supercomputer because multiscale physics, which has plasma transport, neutral gas compression and expansion, and electromagnetic wave propagation, is simulated and a computational cost becomes high.

● Achievements of the Year

Electromagnetic wave propagation, plasma drift-diffusion, and shock wave propagation were numerically reproduced in the microwave-driven in-tube accelerator, which indicated that the electromagnetic wave was focused at the rear of the vehicle and plasma was generated. A shock wave was induced because the plasma transported energy to neutral particles, and we can obtain thrust. The microwave-driven in-tube accelerator concept is a hopeful transportation system because its thrust performance is higher than conventional system.

● Publications

- Peer-reviewed papers

Masayuki Takahashi and Naofumi Ohnishi, "Gas Propellant Dependency of Plasma Structure and Thrust Performance of Microwave Rocket," *Journal of Applied Physics*, Vol. 125, 163303 (2019).

- Usage of JSS2

- Computational Information

Process Parallelization Methods	MPI
Thread Parallelization Methods	N/A
Number of Processes	1 - 100
Elapsed Time per Case	50 Hour(s)

- Resources Used

Fraction of Usage in Total Resources*1(%): 0.11

Details

Computational Resources		
System Name	Amount of Core Time (core x hours)	Fraction of Usage*2(%)
SORA-MA	961,450.13	0.12
SORA-PP	0.00	0.00
SORA-LM	0.00	0.00
SORA-TPP	0.00	0.00

File System Resources		
File System Name	Storage Assigned (GiB)	Fraction of Usage*2(%)
/home	476.84	0.40
/data	9,765.63	0.17
/ltmp	1,953.13	0.17

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

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

*2: Fraction of Usage : Percentage of usage relative to each resource used in one year.