# Numerical Plasma Simulation on Advanced Space Propulsion Systems

● **Responsible Representative**

Ikkoh Funaki, Associate Professor, ISAS

● **Contact Information**

Ikkoh Funaki(funaki.ikkoh@jaxa.jp)

● **Members**

Shitan Tauchi, Ryota Hara, Ryuta Futada, Yuki Murayama

● **Abstract**

Due to the limitation of the existing spacecraft technology level, it is very difficult to enable solar system explorations in a quick and cost-effective mannger. Objective of this study is to obtain a breakthrough spacecraft propulsion technology that enables solar system exploration of the next generations.

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

Design optimization of spacecraft propulsion requires a huge computer resource, hence supercomputer usage is very important.

● **Achievements of the Year**

Magneto Plasma Sail (MPS) is one of the propulsion systems. There are two types of MPS, the M2P2 type and ring current type. In preceding studies, the M2P2 type is treated as that the dynamic pressure of the injection plasma is dominant, and the ring current type is treated as that the static pressure of the injection plasma is dominant. However, there is no study about MPS that both dynamic pressure and static pressure are simultaneously considered. In this study, MPS considering both dynamic pressure and static pressure of injection plasma is evaluated by numerical analysis and investigated the influence of the injection angle which is the circumferential position of the injection area on flow field and thrust characteristic of MPS. As a result, we confirmed that the thrust was maximum at a minimum injection angle also there was injection angle where the no thrust is generated.

● **Publications**

N/A

● **Usage of JSS**

●     **Computational Information**

| Process Parallelization Methods | N/A |
|---|---|
| Thread Parallelization Methods | Automatic Parallelization |
| Number of Processes | 1 |
| Elapsed Time per Case | 10 Hour(s) |

●   **Resources Used(JSS2)**

Fraction of Usage in Total Resources[*1](%): 0.10

Details

| Computational Resources | | |
|---|---|---|
| System Name | Amount of Core Time (core x hours) | Fraction of Usage[*2](%) |
| SORA-MA | 29,542.12 | 0.01 |
| SORA-PP | 159,006.38 | 1.25 |
| 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 | 57.22 | 0.05 |
| /data | 572.20 | 0.01 |
| /ltmp | 11,718.76 | 1.00 |

| 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.

- **Resources Used(JSS3)**

Fraction of Usage in Total Resources[*1](%): 0.01

Details

| Computational Resources | | |
|---|---|---|
| System Name | Amount of Core Time (core x hours) | Fraction of Usage[*2](%) |
| TOKI-SORA | 0.01 | 0.00 |
| TOKI-RURI | 1,409.73 | 0.01 |
| TOKI-TRURI | 0.00 | 0.00 |

| File System Resources | | |
|---|---|---|
| File System Name | Storage Assigned (GiB) | Fraction of Usage[*2](%) |
| /home | 123.98 | 0.08 |
| /data | 762.94 | 0.01 |
| /ssd | 762.94 | 0.40 |

| 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.