1. Introduction

PROCYON (PRoximate Object Close flyby with Optical Navigation) is a 50kg-class micro-spacecraft developed by the University of Tokyo and the Japan Aerospace Exploration Agency (JAXA), based on the expertise acquired on past satellites developed at The University of Tokyo[1-3]. PROCYON was launched in an Earth resonant trajectory on December 3rd, 2014 as a secondary payload with Hayabusa 2 mission.

The mission objective is to demonstrate micro-spacecraft bus technology for deep space exploration and proximity flyby to asteroids performing optical measurements.

2. Mission Objectives and Scenario

**Success Criteria:** Summing system is adopted.

<table>
<thead>
<tr>
<th>Point</th>
<th>Sum</th>
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<tbody>
<tr>
<td>Success in the power generation, thermal control, attitude control (by CGJ), communications, and orbit determination in deep space</td>
<td>50</td>
</tr>
<tr>
<td>Success in the Operation of MIPS in deep space</td>
<td>70</td>
</tr>
<tr>
<td>Achievement of a certain level of velocity increase by MIPS</td>
<td>100</td>
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**Primary Mission Objective**

**Secondary Mission Objective**

3. Mission characteristics

Most of the mission design aspect are driven by subsystem requirements.

<table>
<thead>
<tr>
<th>Operations</th>
<th>Spacecraft</th>
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<tr>
<td>Earth to Earth phase</td>
<td>Trajectory phase</td>
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<tr>
<td>Example</td>
<td>Example</td>
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<td>Orbit Determination: R&amp;RR</td>
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<td>Thruster: Cold Gas Jet (CGJ)</td>
<td>Orbit Determination: Optical Image</td>
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</table>

**Orbital Elements of PROCYON (J2000 Eccentric Orbit)**

- Semi-major axis [km]: 1.4988 x 10^6
- Eccentricity: 0.0874
- Right ascension of the ascending node [deg]: 250.6
- Inclination [deg]: 6.820
- Argument of perigee [deg]: 95.59

4. Trajectory Design Result and Current Status

PROCYON is now in Earth-to-Earth transfer phase. The launch result and the ion engine performance are being analyzed. Together with the orbit determination data, the trajectory is redesigned to minimize the propellant mass with jTOP, an in-house trajectory optimization that implements a direct method.

Current Status:

**PROCYON has almost completed its “Primary Mission Objective”.** The acceleration test by MIPS (Miniature Ion Propulsion System) is ongoing and PROCYON’s acceleration was observed. Some parameters of PROCYON (e.g. MIPS and CGJ) will be updated by using orbit determination data and telemetry data for the more precise trajectory design and Proximity Flyby phase.

References:


**MIPS and CGJ**

- **MIPS: Low Thrust & High Isp** — For Interplanetary maneuver
- **CGJ: High Thrust & Low Isp** — For Close approach operation

There is a possibility that some parameters differ from assumptions. Some aspects of the operation and limited information make estimations of actual parameters complicated.