Magnetospheric Sailing Propulsion

Background:
The travel times resulting from conventional chemical or even electrical propulsion are long, especially when considering travels to the outer solar system and beyond. It also requires large amounts of, or rare elements like Xe for, propulsion. The solar sail ideas have been tested, but here the radiation pressure from the Sun is weak in the outer solar system. Another sustainable propulsion method is needed if future exploration and/or expansion shall be made effectively in the solar system. A reasonably new idea (Winglee et al., 2000, Mini-Magnetosphere Plasma Propulsion, M2P2) of propulsion exist where one uses a dipole magnetic field around a spacecraft and then fill it with plasma like blowing a balloon. The solar wind dynamic pressure (or any other plasma wind dynamic pressure) can then be used to push the spacecraft forward. This method differs from a normal solar sail in that the spacecraft magnetosphere expands in the outer solar system and keep a steady propulsion also at long distances from the Sun. Later developments have been tested on ground using different methods. A potential drawback could be that most of the solar wind dynamic pressure will cause the injected plasma in the mini magnetosphere to be accelerated down the tail and become lost, instead of providing the dynamic propulsion push forward by magnetic stress near the spacecraft. This need be investigated.

Proposal:
We propose to test this sustainable & cheap propulsion method, with the use of two small spacecraft in the solar wind near Earth. One has a magnetic field and a plasma source and the other is a "normal" spacecraft. There is an accurate ranging determination system in both (so called inter-satellite link, ISL) to determine the relative distance between them. Different configurations are then tested (no magnetic field, magnetic field on, plasma expands the magnetic field) while the relative acceleration induced by the solar wind dynamic pressure is measured. IRF with its plasma and magnetosphere knowledge together with e.g., OHB Sweden could develop and carry out this test of new propulsion technique for the future.

Technological Readiness Level:
Concept status. Requires two spacecraft evaluation tests near Earth preferably in the solar wind. Requires IRF payload for diagnostics. Guestimated cost: ≈100 MSEK. Project time: 5-10 år.

Project Owner:
IRF

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