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COMPARATIVE ORBITAL PERFORMANCE STUDY OF A SOLAR WIND ION FOCUSING THRUSTER (SWIFT)

Abstract

At the 65th International Astronautical Congress (IAC) we introduced the Solar Wind Ion Focusing Thruster or SWIFT concept for space propulsion. A SWIFT consists of a net of wires arranged as a cone with its large open end facing the sun. The wires are highly positively charged by connection to an electron gun, and their electric field acts to focus solar wind ions into the base of the cone. This higher density plasma is collected by the main part of the spacecraft to which the SWIFT cone is attached and can be efficiently manipulated into a proton beam. The proton beam can then be accelerated to velocities much higher than the solar wind drift velocity, resulting in a net thrust for the spacecraft that can be directed anywhere. Thus, the SWIFT is a new type of propulsion system that combines some of the benefits of other propellantless concepts (e.g. solar and electric sails) with those of solar electric propulsion systems.

In papers for the 65th and 66th IACs, we overviewed the high level feasibility of the SWIFT concept, developed a model for the thrust expected from the system, and examined the orbital performance of a SWIFT for broad mission classes. Here we continue to extend this work, beginning with the development of a more refined generalized model of the thrust produced by a SWIFT. Additionally, we develop similar generalized models for the performance of several similar systems (including solar and electric sails as well as solar electric thrusters) along with orbit optimization routines for all of the systems in the study. This allows us to examine the orbital performance of a SWIFT for specific missions and directly compare its predicted performance with several competitor systems. These data allow us to point out the specific benefits of a SWIFT in terms of mission performance parameters (i.e. time to mission objective, total mission duration, etc.) versus mission specific system parameters (i.e. wet mass to orbit, power requirements, total cost, etc.).