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NASA'S ELECTRIC SAIL PROPULSION SYSTEM INVESTIGATIONS OVER THE PAST THREE YEARS

Abstract

Personnel from NASA's MSFC have been investigating the feasibility of an advanced propulsion system known as the Electric Sail. This team initially won a NASA Space Technology Mission Directorate (STMD) Phase I NASA Innovative Advanced Concept (NIAC) award and then a two year follow-on Phase II NIAC award. This paper documents the findings from this three year investigation.

An Electric sail propulsion system is a propellant-less and extremely fast propulsion system that takes advantage of the ions that are present in the solar wind to provide very rapid transit speeds whether to deep space or to the inner solar system. Scientific spacecraft could arrive to Pluto in 5 years, to the each of the solar system in ten to twelve years.

The team's recent focused activities are: 1) Developing a Particle in Cell (PIC) numeric engineering model from the experimental data collected at MSFC's Solar Wind Facility on the interaction between simulated solar wind interaction with a charged bare wire that can be applied to a variety of missions, 2) The development of the necessary tether deployers/tethers to enable successful deployment of multiple, multi km length bare tethers, 3) Determining the different missions that can be captured from this revolutionary propulsion system 4) Conceptual designs of spacecraft to reach various destinations whether to the edge of the solar system, or as Heliophysics sentinels around the sun , or to trips to examine a multitude of asteroids.

These above activities, once demonstrated analytically, will require a technology demonstration mission (2021 to 2023) to demonstrate that all systems work together seamlessly before a Heliophysics Electrostatic Rapid Transit System (HERTS) could be given the go-ahead. The proposed demonstration mission will require that a small spacecraft must first travel to cis-lunar space as the Electric Sail must be outside of Earths Magnetic fields to produce thrust. The paper will outline what was done over the past three years from performing various plasma chamber tests to obtain data for the PIC model development, investigation of tether material trades, and conceptual designs of proposed spacecraft.