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# ON THE ELECTRICAL PROPULSION OF A SOLAR SAIL

**Abstract**

The Solar radiation consists of two parts: electromagnetic and corpuscular radiation. Typically, when considering solar sails, the interest is in the electromagnetic radiation, since photons can transfer momentum to the sail, although they do not have mass. Moreover, being the solar photons flow almost constant and homogeneous, it guarantees a continuous thrust. But what if also the corpuscular part of the solar radiation could be exploited for the sailcraft propulsion? In this study we investigate the advantage related to the electrical propulsion of a solar sail by the solar wind plasma, a mixture of protons and electrons that moves away from the Sun at supersonic speeds. Due to the fact that the proton mass is almost two-thousand times bigger than the electron's, the total momentum carried by the proton flux is significantly higher than that of the electron component, although the electrons in the solar wind plasma have higher velocities. The proposed scenario is the following: the sail is carried as a payload to a relatively small heliocentric distance (0.1 - 0.3 AU); once at the perihelion, the sail is deployed and electrically charged by a device. The sail experiences additional propulsive force due to the extraction of the momentum from solar wind protons deflection. Neutralization phenomena are also addressed in the present study [1]. Besides electrical repulsion, another mechanism could be convenient: thermal desorption, a physical process of mass loss which can provide additional thrust as heating liberates atoms, embedded on the surface of a solar sail [2, 3].

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[2] G. Benford and J. Benford, "Acceleration of sails by thermal desorption of coatings", Acta Astronaut. 56 (2005), pp. 593-599.
[3] E. Ancona, R. Ya. Kezerashvili, Orbital dynamics of a solar sail accelerated by thermal desorption of coatings, arXiv:1609.03131v1 [physics.space-ph], Sep 2016; Paper IAC-16-C1.6.7.32480, IAC 2016.