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THE DIPOLE DRIVE A NEW CONCEPT IN PROPELLANTLESS PROPULSION

Abstract

The dipole drive is a new propulsion system which uses ambient space plasma as propellant, thereby avoiding the need to carry any of its own. The dipole drive remedies two shortcomings of the classic electric sail in that it can generate thrust within planetary magnetospheres and it can generate thrust in any direction in interplanetary space. In contrast to the single positively charged screen employed by the electric sail, the dipole drive is constructed from two parallel screens, one charged positive, the other negative, creating an electric field between them with no significant field outside. Ambient solar wind protons entering the dipole drive field from the negative screen side are reflected out, with the angle of incidence equaling the angle of reflection, thereby providing lift if the screen is placed at an angle to the plasma wind. If the screen is perpendicular to the solar wind, only drag is generated but the amount is double that of electric sail of the same area. To accelerate within a magnetosphere, the positive screen is positioned forward in the direction of orbital motion. Ions entering are then propelled from the positive to the negative screen and then out beyond, while electrons are reflected. There are thus two exhausts, but because the protons are much more massive than the electrons, the thrust of the ion current is more than 42 times greater than the opposing electron thrust, providing net thrust. To deorbit, the negative screen is positioned forward, turning the screen into an ion reflector. The dipole drive can achieve more than 6 mN/kWe in interplanetary space and better than 20 mN/kWe in Earth, Venus, Mars, or Jupiter orbit. In contrast to the electric sail, the ultimate velocity of the dipole drive is not limited by the speed of the solar wind. It therefore offers potential as a means of achieving ultra-high velocities necessary for interstellar flight.