APPLICATION OF THE PHYSICS OF THE AURORAL CURRENT REGION IN THE VASIMR ROCKET

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The greater scope of space exploration is making increasing demands on spacecraft capabilities. Solar radiation and long flight times make manned interplanetary flight quite dangerous. The limitations of chemical rockets is making electric propulsion systems more important to space exploration. One of these electric propulsion systems is the variable specific impulse magnetoplasma rocket (VASIMR). The VASIMR uses a helicon discharge as an ion source using lower hybrid heating then has a separate downstream stage that uses ion cyclotron resonance heating (ICRH) to provide the bulk of the ion energy. The selective partitioning of input power to the helicon and ICRH systems will provide thrust/ specific impulse ratio control to the VASIMR. The VASIMR applies and simulates several important physical processes occurring in the magnetosphere. These processes include the mechanisms involved in the ion heating and acceleration that occur in the Birkeland currents of an auroral arc system. Several auroral current region processes, such as lower hybrid heating, parallel electric field acceleration, and ion cyclotron acceleration are also simulated in the VASIMR. This paper will summarize the physics in the VASIMR engine. The helicon discharge uses lower hybrid heating as the physical mechanism of the ionization source of the VASIMR. Ion exit energy measurements show a substantial parallel field due to ambipolar charge separation in the axial magnetic field of the VASIMR engine. Ion cyclotron heating during a single pass through the resonance region has been achieved. Perpendicular ion cyclotron heating in the VASIMR is shown in ion velocity phase space distribution data.

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