VASIMR thruster operation with hydrogen and helium gas propellants

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The VASIMR thruster [1-3] consists of three major sections or stages: plasma production, plasma heating, and plasma exhaust. In our previous works [6-10] we have performed an extensive study of plasma dynamics in the plasma source. We have developed several models of helicon plasma discharge utilizing hydrogen (deuterium) gas, and analyzed its performance in the experimental set-up [4-5].

In the present work we are trying to expand and apply existing models to the helium gas propellant case. Though the specific impulse is somewhat lower with heavier helium atoms, but unlike hydrogenic species helium doesn't form molecules, and has less radiative losses. We extend 0-D plasma-chemistry, 1-D mixed-collisional and kinetic gas flow models [11] to characterize gas/plasma composition and condition in the helium helicon discharge. We study scalability of both hydrogen and helium discharges.

Recent experiments suggest that there is a strong dependence of both VASIMR 1st and 2nd stage performance on the magnetic field mirror ratio in the VX-10 experimental configuration. We study effects of the plasma particles trapping by a magnetic field and their acceleration by the mirror force in the VASIMR experiment conditions.

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