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Miniaturization of electrostatic ion engine through ionization/acceleration coupling: corona model

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Content :

Electrostatic ion propulsion systems resist miniaturization due to constraints imposed by the size of the discharge chamber. We introduce a thruster concept where the same field is responsible for both ionization of the neutrals and acceleration of the ions, by letting the neutral propellant gas escape into a high field region through a thin, hollow needle at high electric potential. The ionization mechanism is thus reminiscent of corona ionization. Although the thruster only ionizes a small fraction of the neutral gas, the ions nevertheless impart a great deal of momentum to the plume, creating an ion wind. We propose a model to estimate the electric behavior of the system, and two further models for the obtained thrust. A comparison with experimental data shows that the models capture the dominant physical effects and give a reasonable description of the system. Apart from being about a thousand times less massive than conventional systems, the thruster, which is at the proof-of-concept stage, performed quite well yielding around 0.3 mN/Watt during initial tests. The thruster small size and simplicity are advantageous in many situations, such as for satellite station keeping and deep space probes.

Level (Hons, MSc, PhD, other)? :

MSc

Consider for a student award (Yes / No)? :

yes

Short Paper :

yes

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