FriM06

Hall Thruster for Space Applications: Advanced Concepts and Research Challenges

Yevgeny Raitses

Princeton Plasma Physics Laboratory, Princeton, NJ 08543, USA

Corresponding Author: Yevgeny Raitses, email address: yraitses@pppl.gov

The Hall thruster is a plasma propulsion device that holds considerable promise for many space applications, including near-Earth orbital missions and space exploration missions. Unmagnetized ions (usually Xenon) are accelerated electrostatically to energies of 0.1-1 keV in a quasineutral plasma (10^{11}-10^{12} cm^{-3}) with a closed electron $E \times B$ drift. This thruster concept was invented in early 60's to overcome the limitations of a gridded ion thruster, in that the Hall thruster produces neutral plasma flow that is not space-charge limited, but is instead limited by the attainable magnetic fields in the thruster magnetic circuit. Over the years, more than 100 Hall thrusters have been flown in space mainly for station keeping and orbit transfer of satellites. Future space applications, including micropropulsion with the input power of less than 100 W and the thruster level of not exceeding and high power electric propulsion (50-200 kW), can take Hall thruster technology to its technological limit. With recent advances in understanding of Hall thruster physics, further improvements of Hall thrusters were suggested by controlling plasma-wall interaction and electron cross-field transport. This talk will review fundamentals and potential applications of several advanced Hall thruster concepts, including a thruster with reduced plasma-wall interaction effects on the plasma due to the use of engineered wall materials with surface micro-architecture, and novel plasma thrusters with advanced magnetic field topologies including plasma thrusters with cusp-type and mirror-type magnetic field topologies, magnetically-filtered and shielded plasma thrusters proposed for low and high power applications.