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Ion Acceleration Mechanism in a Quad Confinement Thruster

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The Quad Confinement Thruster is a DC magnetized plasma propulsion system invented and developed within the Surrey Space Centre (University of Surrey). The QCT contains a square discharge channel with the anode located at the closed, upstream end. An external hollow cathode neutralizer provides primary electrons for triggering the ionization process (via electron-neutral collisions) and neutralizes the ejected ion beam. The magnetic field is characterized by cusps at the four lateral walls, which enhance plasma confinement and electron residence time inside the device. The magnetic field topology is manipulated using four independent electromagnets on each edge of the channel, tuning the properties of the generated plasma and steering the ion trajectories. This peculiar feature enables to perform active thrust vector control.
We characterize the plasma ejected from the device applying a non-intrusive laser-based technique. In particular, Laser-Induced-Fluorescence measurements map the 2-D ion velocity field throughout the plume for multiple plasma discharge conditions. Measurements show a free-space ion acceleration layer located 8 cm downstream of the exit plane with an observed ion velocity increase from 3 km/s to 10 km/s within a region of 1 cm thickness or less. Moreover, the ion velocity field is investigated with different magnetic configurations, demonstrating how ion trajectories may be manipulated in real time.

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