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THE POCKET ROCKET ELECTRO-THERMAL PLASMA THRUSTER FOR 'CUBESAT' NANO-SATELLITES

Abstract

Up to now radiofrequency thrusters have been rarely but successfully used on spacecrafts, i.e. the Radio-frequency Ion propulsion RIT-10 system aboard EURECA in 1992 and the RITA-10 aboard ARTEMIS which saved the mission in 2002/2003. 'CubeSat' nano-satellites provide low-cost access to space and open doors to unprecedented unique projects accessible to universities and small companies. The process is facilitated by ongoing miniaturization at lower cost of electronics systems and components. Australia is involved in the European Union 'QB50' 'CubeSat' project [www.qb50.eu] of a launch into space of about 50 CubeSats from 27 Countries to study the ionosphere and the lower thermosphere. While many essential CubeSat parts are available off the shelf (electrical power system, attitude control system, on board computer...), low-cost low-volume low-weight and low-power propulsion systems which could provide orbit control and formation flying in future CubeSat missions have yet to be fully developed. In the miniaturised Pocket Rocket thruster, a radiofrequency plasma is employed to heat the gas via charge exchange collisions and ambipolar flow to create a form of electrothermal thruster which has its heating mechanism in the centre of the flowing propellant rather than on the thermally lossy walls. The radiofrequency generates a high-density plasma at about 1Torr having a volume less than 1 millilitre and its characteristics operate in a linear power regime where measured thrust (1 mN) and specific impulse (100 s) performances can now be successfully simulated using computer fluid dynamics codes. Miniaturised power and propellant sub-systems totaling a few hundred grams in weight for a few Watts have

been developed for Pocket Rocket for integration within a U (1 U = 10 cm x 10 cm x 10 cm) CubeSat. This proof of concept aims at getting flight heritage and is a stepping stone towards the development of higher power systems since the radio-frequency power sub-system can be scaled up to a few kWatts and drive the electrode-less neutraliser-free Helicon plasma thruster.