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Title

ECRA Thruster latest development at ONERA

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Abstract

ECRA thruster is an electric propulsion device developed at ONERA since 2010 [1]. The thruster is composed of a magnetic nozzle and a microwave plasma source at 2.45 GHz to ionize the propellant gas. So far, it was tested and characterized using Xenon but is a priori compatible with any propellant gas. The thruster self generates an axial electric field thanks to the mobility difference of the electrons population to the ion population. This electric field is responsible for the ion acceleration and thrust production. This mechanism of acceleration implies that the plasma flux is naturally neutral which and that the thruster does not need a neutralizer contrary to most of electric propulsion devices. The potentiality of this technology was fully demonstrated during the H2020 MINOTOR project from 2017 to 2020 with a jump in total thrust efficiency from about 20 percent to about 45 percent. Performances as high as Specific impulse above 2000 sec and thrust to power ratio above 60 mN/kW were reached. Two prototypes were developed: a 30W and a 200W version with similar performances [2]. This study also demonstrates the potentiality of the ECRA technology to reduce mission cost and improve the propulsion reliability compare to leading technologies by simplifying the thruster and the PPU design. The recent studies led at ONERA since this project have focused on explaining the source of this efficiency jump. In particular, they focus on the interaction between plasma and thruster walls and on electric boundary conditions applied to the plasma. The oral presentation will expose both the latest performances measurements of the ECRA thrusters and the mechanisms at play in the performance increase.

References

[1] S. Larigaldie, Plasma thruster and method for generating a plasma propulsion thrust, PCT/FR2012/052983, Dec, 2012.

[2] Victor Désangles, Denis Packan, Julien Jarrige, Simon Peterschmitt, Patrick Dietz, *et al.*. ECRA thruster advances, 30W and 200W prototypes latest performances. *IEPC 2022 : International Electric Propulsion Conference 2022*, Jun 2022, BOSTON, United States.