Contribution ID: **51** Type: **Poster**

From ECR Ion Source to Electrostatic Thruster

Tuesday, 9 September 2025 16:30 (1h 30m)

An electrostatic thruster is an Electric Propulsion [0] technology that ionizes its propellant to accelerate it using electric force. Its performance is measured by the thrust $T = \dot{m}v$ it develops and its specific impulse $I_{sp} = \frac{v}{g}$, the fuel combustion efficiency, with $\dot{m}$ and v the mass flow rate and the velocity of exhaust, and g the standard gravity. The Electron Cyclotron Resonance Ion Sources have demonstrated their ability to produce highly charged ions and powerful currents. Integrated to a propulsion system, the high ejection speeds of these multicharged ions allow to reach high specific impulses thus decreasing its gas consumption. Furthermore, it is necessary to increase simultaneously the puller and plasma electrodes'hole diameters to extract a maximum of ion current intensity without destabilizing the plasma. This extra expelled mass can develop greater thrust.

The study and the results presented here are obtained on a 10 GHz Microgan ECR ion source supplied by the company Pantechnik, and mounted on the Tancrede test bench of the Mosaic platform. The goal of this work is to study the influence of electrodes diameters change in the Ar ions charge distribution and their intensities. The measurements are performed with and without magnetic deviation, to obtain the charge distribution and the transmission. The different diameters studied are $_{plasma}$={6,8} mm, and $_{puller}$={8,12} mm.

Increasing the diameter of the puller electrode increases intensity, but this gain is offset by an increase in divergence, which reduces efficiency of an electric propulsion application. The aim of this study is to find a configuration by adjusting the puller and plasma electrodes diameters, extraction voltage and acceleration distance.

[0]: S Mazouffre, "Electric propulsion for satellites and spacecraft,"Plasma Sources Sci. & Tech., 25(3), 033002. (2016)

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Session Classification: Poster Session

Track Classification: Applications of ion sources