H2020 project “MINOTOR”

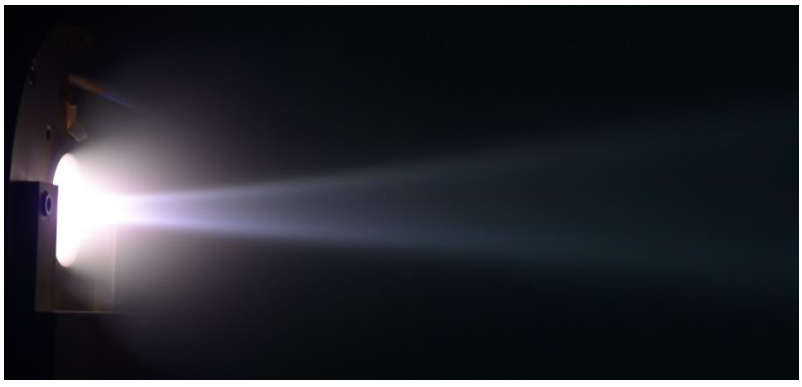
MINOTOR

Magnetic nozzle thruster with electron cyclotron resonance

The EP2 group is participating in the **MINOTOR** project (**M**agnetic **NO**zzle thruster with elec**T**ron cycl**O**tron **R**esonance), coordinated by ONERA and selected by the EU during the H2020 call for emerging technologies of electric propulsion. Within the 3 years of the project (2017-2019), **the goal is to mature a new technology of electric propulsion for satellites**, named ECRA for Electron Cyclotron Resonance Accelerator, up to TRL* 4/5.

The MINOTOR consortium is composed of 7 partners from 4 countries:

- ONERA (coordinator - France)
- Universidad Carlos III de Madrid (Spain)
- Thales Microelectronics (France)
- Justus-Liebig-Universitaet Giessen (Germany)
- Thales Alenia Space Belgium (Belgique)
- SAFRAN Aircraft Engines (France)
- LUP (France)



Based on electron cyclotron resonance as the sole ionization and acceleration process, ECRA is a cathodeless and gridless microwave thruster with magnetic nozzle, allowing thrust vectoring. It has significant advantages in terms of global system cost and reliability compared to mature technologies, and these advantages will be more precisely quantified in MINOTOR by the industrial partners of the project. However, in spite of its relative simplicity, this disruptive technology is based on physical phenomena that are quite complex and not fully understood yet, which has been an obstacle to its development. Thus, in MINOTOR, an important effort will be devoted to the mathematical and numerical modeling of the physics, and to extensive experimental development tests and investigations. The EP2 contribution will establish a complete

mathematical model of the thruster, and develop a numerical simulation code composed of four interlinked modules: plasma-wave interaction, ion and neutral code, electron code, and magnetic nozzle code.

Electric propulsion has recently become a critical technology for satellites, as it can lead to a 40% total mass saving for a geostationary satellite (“all electric” satellite) thanks to its low fuel mass consumption. MINOTOR’s ECRA technology could lead to significant cost reductions and performance improvements, thus allowing Europe to maintain its leadership in electric propulsion.

*TRL Technology readiness level, scale from 1 to 9 characterizing the maturity of a technology, concept or product.

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