

IAF SPACE PROPULSION SYMPOSIUM (C4)  
Electric Propulsion (1) (5)

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## AIR BREATHING ELECTRIC THRUSTER: TOWARDS VERY LOW EARTH ORBIT MISSIONS

### Abstract

The possibility of efficiently exploiting Very Low Earth orbits (VLEO) poses significant technological challenges due to the critical operative environment. One of the most demanding constraints is the need to counteract the drag generated by the interaction of the spacecraft with the surrounding atmosphere. Nonetheless, the advantages in the exploitation of this region could either improve the current mission scenario or open new possibilities, which can represent true game changers in the exploitation of the close Earth orbits. Earth observation, communication as well as scientific mission are the target applications of these orbits owing to the Earth proximity, which guarantee higher resolution performance in Earth Observation and shorter lag time compared to traditional Low Earth Orbits.

The ram-EP concept combines the advantages of electric propulsion with the possibility to gather the propellant in the upper atmosphere. The most advanced result in this field was achieved in 2017, when SITAEL managed to obtain the first ignition and operation of a full air-breathing electrical system operating in representative conditions.

Funded by the European Commission under the H2020 programme, the AETHER project (GA number 870436), Air-breathing Electric THRusterER, aims at developing the first propulsion system able to maintain a spacecraft at very-low altitudes for an extended period of time. The main objective of the project is to demonstrate, in a relevant environment, the critical functions of an air-breathing electric propulsion system, and its effectiveness in compensating atmospheric drag. This achievement will involve multiple research activities, among which: (i) the characterization of specific application cases through an extensive market analysis in order to define specific requirements and constraints at different design levels, (ii) fulfilment of pertinent testing conditions of flight conditions on-ground, relevant to the specific mission cases, (iii) the development of critical technologies, in particular those relevant to the collection, the ionization and the acceleration of rarefied atmospheric mixtures and (iv) the testing of the ram-EP thruster in order to assess the system performance.

In this paper, the main activities of the AETHER project will be described, providing the detailed perspective towards an effective exploitation of the project outcomes toward the in-orbit demonstration.