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ESA Perspectives on Electric Propulsion

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Today electric propulsion is considered or being used for several applications such as orbit raising/orbit topping and station keeping of telecommunication satellites, orbit maintenance and deorbiting of constellations of small satellites (OneWeb, LEOSAT, SpaceX, etc.), for transfer manoeuvers (e.g. BepiColombo transfer to Mercury), formation flying of satellites, etc. The required thrust levels for all these applications span over a wide range from several micro-Newton up to hundreds of milli-Newton which means that a large variety of thrusters is required to cover the different needs.
In the commercial area, the strong completion among satellite manufacturers is a major driver for advancements in the field of electric propulsion, where improved performance together with reduced costs are required. New scientific and Earth observation missions dictate new and challenging requirements for propulsion systems. Moreover, new interplanetary missions in the frame of exploration will require sophisticated propulsion systems to reach planets such as Mercury or Mars and in some cases bring back to Earth samples from these planets. Finally, electric propulsion might also be used in the Galileo 2G programme to perform orbit raising in order to increase the payload capability and reduce launch costs.
ESA is supporting European Industry in order to be able to provide competitive product. Therefore, ESA is involved in activities related to spacecraft electric propulsion ranging from basic research activities and development of conventional and advanced concepts to the manufacturing, Assembly, Integration and Verification (AIV) and flight control of propulsion subsystems of several European satellites. The exploitation of flight experience is also an important activity at ESA in order to help mission designers to implement the lessons learnt in the development of new propulsion systems.
ESA mission such as Artemis, Smart-1, GOCE and Alphabus have paved the way for the use of electric propulsion in future ESA missions: BepiColombo, Neosat, Electra, LISA, etc.
In the last years, electric propulsion has also been identified by European actors as strategic technology for improving European competitiveness in different space areas such as in-space operations and transportation. For this reason the European Commission has set up the "In-space Electrical Propulsion and Station-Keeping" Strategic Research Cluster (SRC) in Horizon 2020 with the goal of enabling major advances in electric propulsion in order to contribute to guarantee the leadership of European capabilities in electric propulsion at world level within the 2020-2030 timeframe, always in coherence with existing and planned developments at national, commercial and ESA level. The "Electric Propulsion Innovation & Competitiveness"(EPIC) is the Programme Support Activity (PSA) for the Electric Propulsion SRC. ESA is the EPIC project coordinator. In the frame of EPIC a total of six the operational grants have been awarded: three for incremental technologies and three for disruptive technologies.
ESA is also coordination research activities in the field of plasma-spacecraft interactions with the goal to provide an improved modelling tool for electric propulsion induced plasma-spacecraft interactions.
Furthermore, ESA is working on standardization of electric propulsion testing and qualification. Standardization is necessary in order to meet the need for cost reduction that can be achieved through optimised production and verification programmes. This optimisation requires reliable testing, comparability between test facilities and defined qualification standards.
Testing activities for electric propulsion systems can be performed at the ESA Propulsion Laboratory (EPL), that is an operational facility located at the European Space Research and Technology Centre (ESTEC) of the European Space Agency (ESA). The EPL provides test services to the ESA Propulsion and Aerothermodynamics Division, which is responsible for R&D activities and support to projects in the areas of chemical propulsion, electric and advanced propulsion as well as aerothermodynamics.
Since 2004 the EPL holds an ISO 17025 accreditation. Accredited mass-flow, thrust (down to the micro Newton level) and electrical power measurements for electric and cold-gas thrusters and components are performed at the EPL. Furthermore a number of electrostatic probes are available at the EPL for the investigation of plasma parameters in the plume of electric propulsion devices. The EPL also offers support to ESA projects and technology development activities in the field of propulsion. Currently the EPL is involved in activities linked to the standardization of electric propulsion testing. EPL activities have been expanded to chemical propulsion (cold-gas and other non-toxic propellants) and propulsion component (pressure drop characterisation and

waterhammer tests) testing as well as aerothermodynamics (sloshing bench).

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