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IAF SPACE PROPULSION SYMPOSIUM (C4)
New Missions Enabled by New Propulsion Technology and Systems (6)

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A 20KW-CLASS HALL EFFECT THRUSTER TO ENHANCE PRESENT AND FUTURE SPACE MISSIONS

Abstract

"The journey of a thousand miles begins with one step". Several critical technologies have been identified as the foundation of future exploration of the Solar System, driving the human presence beyond Low Earth Orbits. Among them, space agencies agree on the role of Solar Electric Propulsion (SEP) as key enabler for manned missions to Mars to propel cargo missions to Deep Space in advance of crewed missions much more efficiently than conventional chemical propulsion systems. Following acknowledged mission guidelines based on modularity, commonality, extensibility and affordability, the improvement of the actual electric propulsion capabilities would allow the development of a common SEP module to be adopted for multiple and assorted missions in the mid/long-term future. The first outstanding milestone to pave the way towards the Deep Space and beyond is represented by the Deep Space Gateway (DSG). Current plans envision a power bus, a small habitat to extend crew time, docking capability, an airlock, and serviced by logistics modules to enable research. In particular, in addition to two pairs of NASA's small electric thrusters, the station will be supported by a high-power Hall Effect Thruster (HET), representing the ESA contribution to the propulsion module. This 15-20 kW HET string should be used for orbit maintenance, electric orbit raising (EOR) and attitude control. The technological and economic efforts that the space agencies are posing in developing this thruster lays the foundations to an extended adoption of the HET itself. In this paper, three families of present and future missions have been identified, in which an electric platform based on 20kW HETs could be exploited for: (i) EOR of telecommunication and navigation satellites; (ii) disposal of satellites at the end of their operational lifetime; and (iii) resupply, cargo-transfer and logistic missions. For each of these families, several scenarios have been conceived and analyzed, exploiting the typical space mission analysis approach and tools. Moreover, a preliminary design of the corresponding platforms has been obtained, to investigate how much this technology could represent a shared common thread. Special relevance was given to the identification of a possible optimal working point with respect to which it could be adopted for a substantial number of missions for which

the electric platform could represent a valid alternative solution compared to the common systems based on chemical propulsion. Main results are presented and discussed, and main conclusions are drawn.