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INVESTIGATION OF NUCLEAR ELECTRIC VASIMR PROPULSION TECHNOLOGY FOR MARS EXPLORATION MISSION ARCHITECTURE

Abstract

The space may or may not be infinite, but the problems we face while exploring are infinitely many. The race to space in the 50s had led to some breath-taking space missions like Apollo moon landings; interplanetary missions like Juno, Cassini-Huygens; and intergalactic missions like Voyager. Many problems related to distance and travel were solved by developing different revolutionary propulsion systems. As we are approaching the 50s of this century, our affinity to our nearest planet Mars is increased to such a limit that we are in urge to develop new technologies to reach there in minimum time and set up our fully equipped colonies for future generations. On the contrary, our vision to explore space highlights our technological limitations and an urge to develop critical systems. The challenging problem that arises in this domain is extreme space conditions such as high radiation dose, zero gravity sickness, as well as other physiological and psychological condition and demands an advance space propulsion concept. From development of powerful conventional chemical rockets to ion drives, manifolds of deep space propulsion technology are been developed around the globe. Considering multiple technological aspects and mission requirements, the Nuclear- Electric propulsion holds a promising potential in the near future.

This paper focuses on Nuclear Electric- Variable Specific Impulse Magnetoplasma Rocket (VASIMR) engine. Ever since its first demonstration in 1983, the technology has undergone consistent evolution over time. As the current strategies of space industries has been increasingly moving towards human space presence, in particular space tourism, manned mission to moon and mars and colonizing outer planets, the VASIMR technology appears to be an ideal choice, in terms of both technological readiness level and economic feasibility. Its unique architecture provides "High thrust" and "Variable specific impulse" capabilities which can enable faster transit missions to Mars and beyond. A multi- mode operating VASIMR engine can deliver crew to Mars in 39 days, as stated by a simulation studies of mission trajectories.

This paper presents an analysis of conceptual manned mission to Mars. Here, the recent developments and experimental results in VASIMR propulsion are outlined and presents the level of technological readiness within next decade. Comparative study and trajectory analysis for one way and/or round-trip mission to Mars have been made. Various mission trajectories, depending upon mission parameters are investigated.