

IAF SPACE EXPLORATION SYMPOSIUM (A3)
Moon Exploration – Part 3 (2C)

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HIGH-POWER ELECTRIC PROPULSION AS AN ENABLER FOR MOON MISSIONS

Abstract

The past decade has seen a significant increase in activities related to the lunar space economy, including plans for colonisation, mining, rovers, and power generation on the moon. Yet an area which has been comparatively neglected is the question of logistics and transportation needed to support these activities. For small-scale experimental and initial efforts, current propulsion capabilities are sufficient. However, as the lunar space industry is scaled up and all of these endeavours are put into motion, a new approach will be needed. Engineers wishing to transport something to the moon have two main options: A direct Trans-Lunar injection launch, or an orbital transfer from Low Earth orbit to one of several lunar orbits. The former provides significant advantages in regard to transfer time and simplicity, but is limited by the maximum payload of a launch vehicle. Currently, the Delta IV Heavy rocket provides the highest capacity to Trans-Lunar Injection with a payload of 11,290kg. Any payloads heavier than this, such as cargo payloads, must first be launched into Earth orbit and then transported to the moon by means of in-space propulsion. At such masses, the inefficiency of chemical propulsion systems imposes a severe propellant requirement on such transfers to the point where they become economically unfeasible. On the other hand, Electric Propulsion (EP) systems can fulfil such needs far more efficiently with only a fraction of the propellant. The trade-off is that the transfer time is increased due to the low thrust of EP systems. The only solution offering both low fuel consumption and fast transfer is the use of high power electric propulsion. However, existing technologies cannot be scaled up for these applications. The combination of High Temperature Superconductors (HTS) with Applied-Field Magnetoplasmadynamic (AF-MPD) Thrusters, SUPREME technology, offers a solution to this problem. This presentation will cover AF-MPD technology and summarise recent advancements in the HTS industry. The combination of the two as SUPREME technology will be introduced, and its effect on Lunar logistics and transportation will be discussed. The impact of the technology on such missions will be evaluated from an economical and technical perspective.