



Performance of Solar Electric
Powered Deep Space Missions
Using Hall Thruster Propulsion

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Power limited, low-thrust trajectories were assessed for missions to Jupiter, Saturn, and Neptune utilizing a single Venus Gravity Assist (VGA) and a primary propulsion system based on either a 3-kW high voltage Hall thruster, of the type being developed by the NASA In-Space Propulsion Technology Program, or an 8-kW variant of this thruster. These Hall thrusters operate with specific impulses below 3,000 seconds. A trade study was conducted to examine mission parameters that include: net delivered mass (NDM), beginning-of-life (BOL) solar array power, heliocentric transfer time, required launch vehicle, number of operating thrusters, and throttle profile. The top performing spacecraft configuration was defined to be the one that delivered the highest mass for a range of transfer times. In order to evaluate the potential future benefit of using next generation Hall thrusters as the primary propulsion system, comparisons were made with the advanced state-of-the-art (ASOA), 7-kW, 4,100 second NASAs Evolutionary Xenon Thruster (NEXT) for the same mission scenarios. For the BOL array powers considered in this study (less than 30 kW), the results show that the performance of the Hall thrusters, relative to NEXT, is largely dependant on the performance capability of the launch vehicle, and that at least a 10 percent performance gain, equating to at least an additional 200 kg dry mass at each target planet, is achieved over the higher specific impulse NEXT when launched on an Atlas 551.

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