

Propulsion Technology Assessment: Science and Enabling Technologies to Explore the Interstellar Medium

Randall C. Hopkins, Herbert D. Thomas, Bruce M. Wiegmann and Andrew F. Heaton
NASA, George C. Marshall Space Flight Center, AL, 35812, United States

Les Johnson
NASA, George C. Marshall Space Flight Center, AL, 35812, United States

Benjamin R. Beers
Geocent, LLC. – Jacobs ESSSA Group, Huntsville, AL, 35806, United States

The Advanced Concepts Office at NASA's George C. Marshall Space Flight Center conducted a study to assess what low-thrust advanced propulsion system candidates, existing and near term, could deliver a small, Voyager-like satellite to our solar system's heliopause, approximately 100 AU from the sun, within 10 years. The advanced propulsion system trade study consisted of three candidates, including a Magnetically Shielded Miniature Hall thruster, a solar sail and an electric sail. A second analysis was conducted to determine which solid rocket motor kick stage(s) would be required to provide additional thrust at various points in the trajectory, assuming a characteristic energy capability provided by a Space Launch System Block 1B vehicle architecture carrying an 8.4 meter payload fairing. Two trajectory profiles were considered, including an escape trajectory using a Jupiter gravity assist and an escape trajectory first performing a Jupiter gravity assist followed by an Oberth maneuver around the sun and an optional Saturn gravity assist. Results indicated that if the Technology Readiness Level of an electric sail could be increased in time, this technology could not only enable a satellite to reach 100 AU in 10 years but it could potentially do so in even less time.