SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
New missions enabled by Extra-large launchers (8)

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# ENABLING INTERSTELLAR PROBE

**Abstract**

The scientific community has advocated a scientific probe to the interstellar medium for over 30 years. While the Voyager spacecraft have passed through the termination shock of the solar wind, they have limited lifetimes as their radioisotope power supplies decay. It remains unclear whether they can reach the heliopause, the boundary between shocked solar wind and interstellar plasmas, and, in any case, they will not reach the undisturbed interstellar medium. As with most exploratory space missions, their ongoing observations continue to raise even more questions about the nature of the interaction of our heliosphere and the interstellar medium. Scientific questions including: 1. What is the nature of the nearby interstellar medium? 2. How do the Sun and galaxy affect the dynamics of the heliosphere? 3. What is the structure of the heliosphere? 4. How did matter in the solar system and interstellar medium originate and evolve? can only be answered by an "interstellar precursor" probe. Such a mission is required to make in situ measurements in the interaction region and interstellar medium itself at distances far from the Sun, but in a finite mission lifetime. By launching a probe toward the incoming "interstellar wind," whose direction is known, the distance to be traveled can be minimized but is still large. The current consensus is that a scientifically compelling mission must function to at least a distance of 200 astronomical units (AU) from the Sun and return a reasonable stream of data during the voyage. The central problem is that of providing a means of propulsion to accelerate a probe from the Solar System. Even with a low-mass payload and spacecraft, achieving the high speeds needed, even with gravity assists, have remained problematic. Voyager 1, the fastest object ever to leave the system is now traveling 3.6 AU/yr, and a credible probe must reach at least 2 to 3 times this speed. The use of an Ares V is an approach for enabling a fast interstellar precursor mission. Maximum capability uses the combination of an Ares V, two-engine Centaur upper stage, close fly-by of Jupiter, and radioisotope electric propulsion (REP). Deletion of any of these pieces does not disable the mission, but does increases the flyout time to a given distance. This approach is more robust and provides a faster probe than an earlier alternative, designed for launch by a Delta IV 4050H plus twin Star 48A upper stages.