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Strategies for Rapid Implementation of Interstellar Missions: Precursors and Beyond (4)

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SCIENCE AND TECHNOLOGY STEPS INTO THE INTERSTELLAR MEDIUMT

**Abstract**

The entry into the Interstellar Medium by the Voyager 1 spacecraft was a milestone of exploration. The surprising results, finding a more complex structure from the data taken at the heliopause boundary, have whetted scientific interest in further exploration and characterization of the Interstellar Medium. Other studies have suggested practical possibilities for interstellar precursors which both advance technology and gather scientific data which might be relevant to eventual interstellar flight. Science of and science in the Interstellar Medium is now of interest. A new study, Science and Enabling Technologies to Explore the Interstellar Medium, at the Keck Institute for Space Studies (KISS) about this interest will be described

Practical and meaningful interstellar flight (i.e. reaching another star system) is at least a century, and probably centuries, in the future. However, its scientific goal of habitable planet exploration, and its probable technological means of accomplishment with solar sails and nano-spacecraft have now begun to be established. Science rationale and relevant technology are discussed in the paper.

A series of three missions is derived from the science and technology considerations, to be accomplished in this century. The furthest of these missions might reach 0.1 the distance to the nearest star (25,000 AU), and thus the series might provide the first incremental steps toward interstellar flight. The first mission is the aforementioned Interstellar Medium exploration mission (100-150 AU); the second is a Solar Gravity Lens Focus mission (700-900 AU); and the third is an Oort Cloud explorer (>5000 AU). As a design baseline, each mission would consist of multiple spacecraft, individual relatively low cost nano-spacecraft; although a trade-off will be described to consider larger spacecraft (but still smallsats; 100 kg) with more capable payloads. This and other approaches are being considered in the KISS study. A parametric trade for varying area, mass and perihelion distance for to the Sun will be presented to design trajectories with solar system escape speeds  $\geq 20$  AU/year.

If such a series of missions proves feasible and affordable, the result will be to begin the path to interstellar flight in an affordable manner in this century, with science and public engagement pointing humankind to the stars.