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

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NEAR-TERM EXPLORATION OF THE INTERSTELLAR MEDIUM

Abstract

Following confirmation of the solar wind by Mariner 2 in 1962, scientific speculation turned to the interaction of that wind with the nearby interstellar medium. The Voyager Interstellar Mission (VIM) – an incredible 40-year old "by-product" of the Grand Tour of the outer solar system – has provided initial, but only partial answers to this 50-year old problem. Most of the scientific community concurs that Voyager 1 has entered into the very local interstellar medium (VLISM), albeit still affected by readily identifiable dynamics of Sun-derived activity. The slower Voyager 2 spacecraft remains within a heliosheath of energetic particles and shocked solar-wind plasma. To understand the nature of the interaction, a near-term mission to the "near-by" interstellar medium remains a compelling priority. The Voyagers have, at most, another ∼10 years of lifetime. Remote imaging of energetic neutral atoms (ENAs) by the Ion Neutral CAmera (INCA) on Cassini, in Saturn orbit until September 2017, and from the Interstellar Boundary Explorer (IBEX) in Earth orbit have revealed new insights into the overall global interaction of the solar wind with the VLISM but point to discrepancies with current understanding of that interaction. The interpretation of these data depends upon the radial structure of the ENA production, something not directly measurable from locations near the Sun alone. Any near-term ability to understand the plasma-and-particle context of exoplanet systems – and perhaps the context for the emergence of life both here and there – hinges upon what we can discover within our own neighborhood. Exploring "as far as possible" into a "pristine" interstellar medium means reaching large heliocentric distances rapidly, a driver for an Interstellar Probe. With current spacecraft technology and using high-capability launch vehicles, such as the Space Launch System (SLS), a small, but extremely capable spacecraft, could be dispatched to the near-by interstellar medium with at least twice the speed of the Voyagers. Challenges

remain with payload mass and power constraints for optimized science measurements. Mission longevity, as experienced by, but not designed into, the Voyagers, communications capability, and radioisotope power system performance and lifetime are solvable engineering challenges. Such a robotic craft can be built – and will enable the first deliberate step to the stars.