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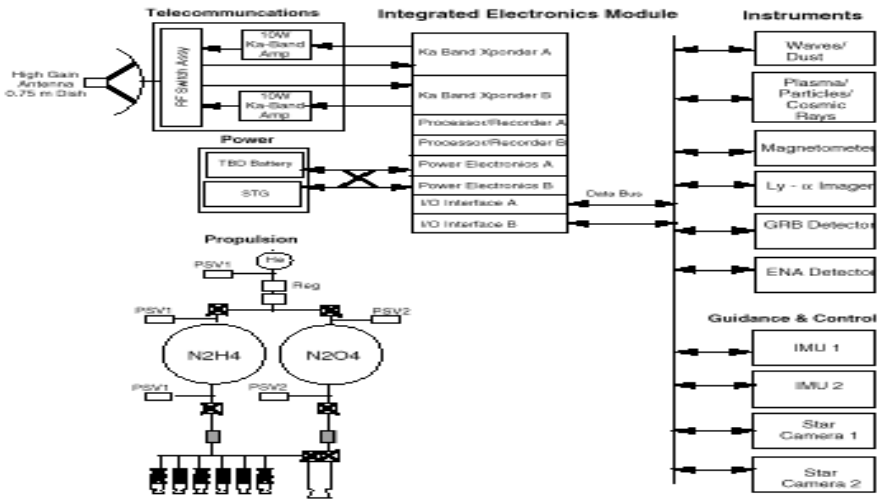
"A Realistic Interstellar Explorer"

For more than 20 years, an “Interstellar Precursor Mission” has been discussed in scientific circles as a high priority for our understanding (1) the interstellar medium and its implications for the origin and evolution of matter in the Galaxy, (2) the structure of the heliosphere and its interaction with the interstellar environment, and (3) fundamental astrophysical processes that can be sampled in-situ. The chief difficulty with actually carrying out such a mission is the need for reaching significant penetration into the interstellar medium (~1000 AU) within the working lifetime of the initiators (< 50 years). Significant solar-system escape speeds can be obtained by “dropping” a probe into the Sun and then executing a DV maneuver at perihelion. This idea has been mentioned but never studied in detail in a spacecraft-systems-and-implementation sense. In particular, to fully realize the potential of this scenario, the required DV maneuver of ~10 to 15 km/s in the thermal environment of ~3 R S remains challenging. Two possible techniques for achieving high thrust levels near the Sun are: (1) using solar heating of gas propellant, and (2) using a scaled-down Orion (nuclear external combustion) approach. We investigate architectures that, combined with miniaturized avionics and miniaturized instruments, will enable such a mission to be launched on a vehicle with characteristics not exceeding those of a Delta III. We will also explore architectures and redundancies that will extend the probe lifetime to well over a century. Such a long-lived probe could be queried at random over decades of otherwise hands-off operations.



This systems approach for such an Interstellar Explorer has not been previously used to address all of these relevant engineering questions and will also lead to (1) a probe concept that can be implemented following a successful Solar Probe mission (concluding around 2010), and (2) system components and approaches for impact on exploration and sample-return missions from the outer planets and Kuiper objects in our own solar system. By assaying the near-interstellar medium, a better understanding of the challenges of eventually crossing the interstellar gulf (e.g., with a Bussard ram jet) will also be realized.