INSTRUMENTATION FOR INTERSTELLAR EXPLORATION

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The time has arrived for designing, building, and instrumenting a spacecraft for a dedicated foray into interstellar space surrounding our star, the Sun. This region was probed in the past by remote techniques and it will be explored in situ by the Interstellar Probe mission. The mission will significantly advance our understanding of the nature of the local interstellar medium and explore the distant frontier of the solar system by revealing the details of the interaction between the Sun and Galaxy. This mission will also be an important practical step toward interstellar flight of the future. Reaching interstellar space in reasonable time requires high escape velocities and will likely be enabled by non-chemical propulsion such as nuclear-powered electric propulsion or solar sailing. Unusually high spacecraft velocities, enormous distances from the Sun, and non-chemical propulsion will significantly influence the design of the mission, spacecraft and scientific instrumentation. We will review measurement objectives of the first mission into interstellar space and outline constrains on the instrumentation. Measurement of particles, fields, and dust in the interstellar medium will be complemented by search for complex molecules and remote sensing capabilities in various spectral bands. A "look" back at our solar system will also be a glimpse of what a flyby mission of the distant future would encounter in approaching another star. The instrumentation for interstellar exploration presents numerous challenges. Mass, telemetry, and power constraints would place a premium on miniaturization and autonomy. There are, however, physical limits on how small the sensors could be. New instrument concepts may be required to achieve the desired measurement capabilities under the stringent constraints of a realistic interstellar mission.