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Technology needs for Titan Missions

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Abstract

Cassini-Huygens has provided a wealth of information about Titan, but the mission was designed to survey the saturnian system and the next mission must investigate in depth the nature of Titan as a prebiotic chemical system. Several mission studies over the last decade have concluded that a threeprong approach to studying Titan is required – an orbiter, montgolfière balloon and lake lander and/or submersible. Technology requirements for future missions to Titan are centered on these three platforms as well as the integrated system. The highest priority technology development that the Outer Planets Assessment Group (OPAG) recommended was that NASA should work with the relevant agencies to ensure that Pu-238 production is restarted and provide enough material for future outer planet missions, including Titan. It is also vital to flightqualify ASRG power systems. Development of underlying technologies (thrusters, power and control, propulsion technologies) for solar electric propulsion, to bring these systems to flight readiness and to make the capability affordable to and within the risk postures of different mission classes is also required. Montgolfière balloon development and the autonomy needed to operate it at Titan are critical to the success of a flagship mission. Advances in the technologies required for sampling the high latitude lakes - cryogenic sample acquisition and sample handling - are essential. Components operable in extreme environments would enable low mass options for the landed element.

Science teams have identified investigations on all three platforms that require instruments to have high resolution and high sensitivity but be lightweight and low-power to minimize mass to reduce mission cost. The need for high resolution and sensitivity follow from examining the Cassini-Huygens data and understanding what is required to interpret the complex spectra observed. For example, the Cassini INMS instrument had a mass range of 100 Dalton and mass resolution of 1 amu. Since ions have been observed in the upper atmosphere that have masses of ~10,000 or more, we now realize that we need to have a mass spectrometer with a mass range of at least 10,000 and mass resolution of >10,000 to adequately resolve the vast quantities of organic molecules present. This presentation will discuss technologies required for potential missions to Titan.

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