Technology Needs of the Next Generation of Planetary Missions

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As part of updating NASA's Space Science Enterprise Strategic Plan, recent deliberations by NASA's advisory subcommittee on planetary science strategy (the SSES) have established priorities for technology developments that will enable the next generation of planetary missions. The relative benefits of potential technology advances were assessed within the context of a set of mission concepts developed to satisfy top priority science objectives established by the SSES. A Comet Nucleus Sample Return mission was assigned top priority for the next non-Mars budgetary slot and for technology development (and will be described in another paper). Five other mission concepts were recognized as the top candidates for subsequent new starts. Each of these five requires significant technology advances to realize the science objectives in an affordable program. This paper will describe the five mission concepts and will present the results of trade studies that identified the key technology advances needed to make each concept feasible and affordable.

The five mission concepts are a Europa Lander to investigate pre-biotic chemistry, a Titan in-situ organic chemistry mission, a Neptune Orbiter, a Saturn Ring Observer, and a Venus Surface Sample Return mission. The current trend toward miniaturization of avionics will benefit all of these missions. Several were found to be enabled or strongly enhanced by advances in low thrust propulsion, either solar electric or solar sail. Four of the five would involve orbiting and/or landing on bodies with substantial atmospheres, and aerocapture techniques were found to provide enabling launch mass savings. Another critical area is in-situ technologies, including precision approach; landing; surface mobility; sample collection, analyses and packaging; and sample return to Earth. The scope and benefits of these and other technology keys to the future of planetary science are discussed in detail in the paper.