Technology Needs of Future Planetary Missions

R. Gershman and R. A. Wallace

ABSTRACT

This paper presents the findings of a series of planetary mission studies which supported development of the Space Science Strategic Plan. The studies evaluated the feasibility, science return, and cost of missions that were candidates for inclusion in the Strategic Plan and also assessed the effects of advanced technology on these parameters. The mission set covered includes all missions to planets and/or comets and asteroids subsequent to Pluto Express and Europa Orbiter (i.e., launching after 2004) except for missions to Mars (handled by a different office at JPL). Technology advances will play a critical role in implementing NASA's faster, better, cheaper rubric and will be particularly important in reducing the launch mass and volume for these missions so that a less expensive launch vehicle can be used.

Seventeen missions were studied with emphasis on two priority groups identified in the Strategic Plan. The first group are leading candidates for launch slots in the middle of the next decade: a comet nucleus sample return mission, a Jupiter deep multi-probe mission, and a Mercury Orbiter/solar physics mission. These arc feasible today but can use advanced technology to enhance performance and/or reduce cost. The second group are future technology drivers, high priority science missions that require technology breakthroughs prior to implementation. These include Europa Lander, Neptune Orbiter, Io Volcano Observer, and investigations of the atmospheres and surfaces of Venus and Titan by aerobots or other means.

The paper describes the mission concepts and the enabling and enhancing technologies developments identified for each mission. The current trend toward miniaturization of avionics will benefit all of the missions. Several were found to be enabled or strongly enhanced by advances in low thrust propulsion, either solar electric or solar sail. Another critical area is in-situ technologies, including precision approach; landing; surface mobility; sample collection, analyses and packaging; and sample return to Earth. The benefits of these and other technology keys to the future of planetary science are discussed in detail in the paper.