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A16 – ADVANCED TECHNOLOGY FOR SPACE EXPLORATION

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NASA's Jet Propulsion Laboratory is noteworthy for its sustained ability to accomplish challenging space missions and measurements. Future instruments and missions depend on advances in technology, as underscored by recent successes. The challenges of creating, developing, and maturing new technologies that enable advanced mission capabilities are significant. A comprehensive assessment of JPL's future space exploration goals and science objectives has been undertaken and the results have been utilized to guide the development of near- and far-term investments in technology research and development. An overview of the JPL Strategic Technology Plan will be presented, along with highlights of recent successes and near-future missions.

Summary:

NASA's Jet Propulsion Laboratory is noteworthy for its sustained ability to accomplish challenging space missions and measurements. Because the space environment is harsh, interplanetary distances are large, and the scientific questions require many measurements, spacecraft are complex and sophisticated. The level of sophistication is at the cutting edge, and therefore, space exploration requires continuous research and development of new technologies, and the infusion of these technologies into flight projects. As an example, the 1998 Mars Pathfinder spacecraft and its Sojourner rover were many times more capable than the 1976 Mars Viking lander.

To ensure that JPL's internal investments in technology research & development are well directed, we have established a strategic planning process. This process links the near- and far-term space science questions with the measurements required to address those questions to the instruments that will make the measurements to the missions that will fly the instruments to the technologies required to enable the missions and instruments. An analysis of the response to this set of linked questions has produced a strategic plan for technology R&D.

JPL is currently operating 17 spacecraft across the solar system, and recently launched the GALEX observatory in April of 2003, the twin Mars Exploration Rover spacecraft (summer of 2003), the Spitzer Space infrared telescope in August, 2003, and the Deep Impact spacecraft in January, 2005. In planetary exploration, most of the key science questions relate to the presence of water. Water can give information about the past geological and Climatological history of a planet, and can provide critical clues to the past (or current) presence of life. Water will also be a critical quantity for human exploration of the planets. Currently, the Mars is the planet of greatest interest, because of its relative proximity to Earth, and the surface features that strongly suggest the past presence of liquid water on the surface.

To help understand the geological history of Mars, and to establish whether liquid water was present on the surface of Mars, NASA initiated the Mars Exploration Rover (MER) program. This program sent 2 spacecraft to the Martian surface, each composed of an interplanetary cruise stage, a planetary atmosphere entry and descent stage, a landing stage, and a rover. The rovers were carefully contained in a tetrahedral landing structure, that was protected with large fabric air-bags during landing. After landing, the 6-wheeled rovers autonomously unfolded themselves, opened solar panels, erected cameras and communication antennas, and called home.

The MER rovers were launched less than 3 years after the project was initiated. Once on the surface of Mars, the rovers have found conclusive evidence of past liquid water on the surface, including lakes. The rovers have survived many times their design lifetime, traversing over 5km over a period in excess of 500 Sols.

NASA plans to continue to develop missions to Mars, including orbital observation spacecraft and landers, taking advantage of the orbital proximity to Earth every 26 months.

Additionally, the moons of Jupiter of keen scientific interest, particularly Europa, which may conceal a liquid ocean under a surface of ice. Planetary exploration has also reached the ringed planet Saturn, with the arrival of the Cassini spacecraft in mid-2004. Saturn's moon Titan is encircled by a cloudy atmosphere, penetrated by the European Space Agency's Huygens probe in January of 2005. This probe sent back the first images of the surface of Titan.

NASA and JPL are also studying primitive bodies: asteroids and comets, believed to contain some of the oldest material in the solar system. The Deep Impact spacecraft sent an impactor probe into a collision with the Tempel 1 comet early on the morning of July 5, 2005, resulting in the first observations and data on the properties of cometary ejecta.

The U.S. Space program also has ambitious programs and plans for space-based astronomical and astrophysics observations, as well as Earth observations, including oceans, the atmosphere, and the solid earth. All of these programs and missions depend on the results of advanced technology research and development.

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