MICROSPACECRAFT FOR LOW COST PLANETARY SCIENCE MISSIONS: RECENT TECHNOLOGY DEVELOPMENTS**

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Studies conducted at JPL in recent years have highlighted the potential for using advanced miniature space systems technologies in future spacecraft for planetary and solar system exploration missions. When employed appropriately, these technologies hold the potential to dramatically reduce the spacecraft mass, power and volume for a variety of missions, which in turn leads to significantly reduced launch costs by enabling missions using much smaller launch vehicles. For some mission applications, more than one vehicle can be launched on Earth escape trajectories from launchers as small as the Pegasus winged rocket. These technological trends lead to a vision of planetary microspacecraft: spacecraft having a total dry mass of 10 to 30 kg.

Many of the advanced miniaturized technologies for microspacecraft are derived from several years of research and development activity sponsored by the U.S. Strategic Defense Initiative Office — SDIO. A range of advanced microsensor technologies has also been developed by JPL's Microdevices Laboratory and other U.S. laboratories and companies. In 1992, JPL initiated a multi-year effort to acquire a representative sample of these technologies and integrate them into a microspacecraft breadboard, with the ultimate goal of demonstrating how these advanced components can be appropriately interfaced to perform the functions required of a typical microspacecraft. The reference design for the breadboard is a microspacecraft for asteroid, comet and lunar exploration. Initial breadboard efforts in 1992 and 1993 are focused on the attitude determination and control subsystem and command and data subsystem, with some work in the structures and microinstruments area. Candidate microtechnologies for the telecommunications (RF and optical), power and propulsion subsystems are also identified and are being worked into the breadboard plan.

In a parallel activity, JPL is investigating microspacecraft technologies in more detail than past efforts. The present state-of-the-art has been surveyed across the range of spacecraft subsystems and science instrument disciplines. Potential effects microspacecraft might have on the future of mission operations architectures and launch vehicle/upper stage technology were also investigated. This work is being used to help define the vision for microspacecraft: What is a microspacecraft? What are the system design drivers, design trade spaces, and technology development priorities for microspacecraft? How do these priorities change for different mission types? What level and quality of science return might we expect from these spacecraft? What *can't we expect* microspacecraft to do for us?

JPL is using the results of this work to help shape the future course of NASA's solar system and space science programs. It is expected that the vision of microspacecraft will be a major element in NASA's important long-term thrust toward faster, better and cheaper space missions.

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