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THE MARS MICROMISSIONS PROGRAM

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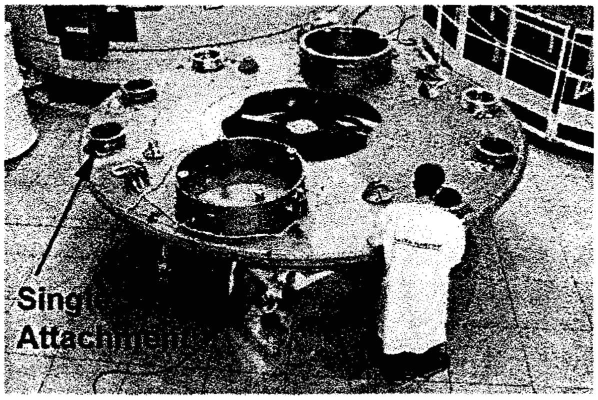
Abstract

There are two Mars micromissions scheduled for Ariane 5 secondary launch as early as November 1, 2002. One mission is a comm/nav micromission orbiter. The other mission is a Mars airplane. Both missions are enabled by a low-cost, common micromission bus design. The future of Mars micromissions has at least two micromissions per opportunity in cooperation with CNES. Other destinations besides Mars are possible by small changes to the micromission system design detailed here. Micromissions enable a new class of science investigations and comm/nav orbiters due to low-cost, focused design. Finally, we discuss the philosophy of technology infusion that will increase the micromission capabilities over time while still holding the per mission cost to unheard of levels for planetary missions.

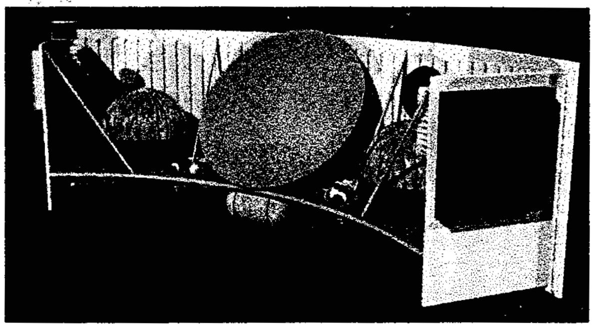
I. Current Mars Micromissions Program

Starting in 2003, two micromissions launch to Mars as secondary payloads on the Ariane 5 in cooperation with CNES. After 2003, 2-4 Mars micromissions launch per Mars opportunity. The Mars Micromissions Program supplies the common spacecraft buses to accomplish these missions for a per mission cost of less than $50M. Other science missions (to Venus, Mercury, asteriods, or small bodies, for example) are possible with only small changes to the common Mars micromission spacecraft bus.



II. Common Micromission System Design

The Ariane 5 Structure for Auxiliary Payloads (ASAP) allows single or dual slot launches of 100 - 200 kg. Planetary missions require the dual (or "twin") configuration due to ΔV requirements to escape the Earth. After flying around the Earth-Moon system for 1 - 6 months, the spacecraft swings by the Moon to obtain the correct Earth flyby geometry. After the powered Earth flyby, the spacecraft cruises to Mars (or other planetary target) as a prime-launched planetary mission would. The micromissions are unusually shaped due to volume and dual attachment constraints imposed by the ASAP structure. Pictured below is an artist's concept of a probe carrier shortly after ASAP separation.



III. Micromissions to Other Destinations

Small changes to the Mars micromission bus design enable missions to Venus (every 18 months), Mercury, Small Bodies, Asteroids, and possibly even Jupiter. Since the changes are small, the added cost for these missions is also small. Since there is a "production line" of Mars micromissions already in place, other planetary missions can take advantage of this micromission capability.

IV. Micromission Technology Infusion

The following areas are identified as areas for technology infusion:

- low mass, high performance bi-propellant systems
- low mass power systems
- low mass surface/atmosphere probe communications
- low mass structures
- in-situ comm/nav orbiter capabilities
- ballute aeroassist for orbiter capture

These technology areas insure that micromissions continue to adapt to focused science missions. A key challenge of technology infusion is to keep the cost of the program low while increasing capabilities over time.