

Mission Design for Deep Space One: A **Low-Thrust** Technology Validation Mission

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Deep Space One (DS 1), scheduled for launch in July 1998, is the first mission of NASA's New Millennium program, chartered to flight validate high-risk, advanced technologies important for future space and Earth science programs. DS1 has a payload of 12 such technologies that will be rigorously exercised during its two-year mission. Several features of the project present unique or unusual opportunities and challenges in the design of the mission that are likely to be encountered in future missions. The principal mission-driving technology is solar electric propulsion (SEP); this will be the first mission to rely on SEP as the primary source of propulsion. Another technology with a significant effect on the mission design is the autonomous navigation system, which requires frequent (at least weekly) intervals of several hours during which it collects optical images of distant asteroids and stars for its use in orbit determination. The mission design accommodates the needs of these and other technologies for operational use and for acquiring sufficient validation data to assess their viability for future missions.

DS 1's mission profile includes encounters with asteroid 3352 McAuliffe, Mars, and comet 76P/West-Kohoutek-Ikemura. To test the compatibility of the new technologies, two of which are science instruments, with the collection of scientifically useful data (and to take advantage of this rare opportunity to visit such interesting solar system bodies), science objectives were formulated for the cruise and at each of these solar system bodies. These science goals were introduced after the basic mission plan was formulated and their integration into the mission was subject to the technology validation requirements and other constraints. An important constraint in developing a very flexible design arises from the low cost. DS 1 has the lowest cost cap of any NASA deep-space mission in modern times. Methods of avoiding cost will be discussed. The implications of the major requirements on the mission design will be described, and the basic mission design will be presented.