

**Deep Space 1 Extended Mission:  
Challenges in Preparing for the Encounter with Comet Borrelly**

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Following the successful conclusion of its 11-month primary mission in September 1999, Deep Space 1 embarked on an ambitious extended mission. The spacecraft is using its ion propulsion system to help deliver it to an encounter with comet 19P/Borrelly in September 2001. Along the way, the very small operations team has faced numerous challenges. The spacecraft's sole star tracker failed, but a recovery that relied on new software and new operational procedures has successfully restored the functionality necessary for the long flight to the comet. One of the costs of the recovery however is that the margin for hydrazine, used for attitude control, is now very low. Thus, several techniques have been devised to conserve this scarce resource, including low-power thrusting with the ion propulsion system to allow attitude control with minimal expenditure of hydrazine. In preparation for the comet encounter, another new software load is planned, and several in-flight tests directly related to the encounter will be conducted. The plans for the encounter include the acquisition of panchromatic visible images, infrared spectra, and plasma measurements, all using instruments included in the flight for testing during the primary mission. At the encounter, the spacecraft must rely on gyros in the absence of the star tracker, but the unpredictable nature of the gyro drift represents a significant challenge to the encounter design. The substantial uncertainty in the ephemeris of the nucleus combined with the highly uncertain optical properties of the nucleus and coma present further challenges for targeting the remote sensing instrument. This paper will cover the progress in reaching comet Borrelly and the plans for returning science data from this important encounter, which will help serve as a valuable precursor for dedicated comet missions in flight and in development.