

GALILEO NIMS DIRECT OBSERVATIONS OF THE SHOEMAKER-LEVY 9 FIREBALLS AND FALL BACK

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In July 1994 the Galileo spacecraft was situated 1.6 AU from Jupiter, at a phase angle of 51°, providing a direct view of the impacts of the fragments of comet Shoemaker-Levy 9 with the planet. The Galileo Near Infrared Mapping Spectrometer (NIMS) observed the C, F, G, and R impact events at 17 wavelengths between 0.7 and 5.0 microns, recording a full disk spectrum of Jupiter every 5.33 seconds. The NIMS spectra can be used to study the early evolution of the impact generated fireballs as well as the fall back of impact ejecta onto the Jovian atmosphere.

Preliminary analysis of the NIMS data received for the G event on July 18, 1994 shows an initial fireball, detected at 07:33:37 UT (time corrected to Earth-observed time), with a temperature of 4000 K or greater and an effective source diameter of 20 km or less. These spectra show absorption by molecular hydrogen and methane which place the emitting surface in the upper troposphere, above the ammonia cloud level. As time progresses, the fireball cools and the effective diameter of the radiating area increases at ~2 km/sec. In 30 seconds, the fireball cools to approximately 1000 K and exhibits a diameter of about 100 km. The strength of the hydrogen and methane absorption decreases with time, indicating that the radiating surface is rising, due to expansion and buoyancy. The fireball appears to expand adiabatically, with a ratio of specific heats of 1.2. After about 30 seconds, the data indicate a multiple temperature (or opacity) structure, with the hotter component emitting in wavelength bands suggestive of hot water vapor.

A second heating event for the G impact was detected beginning at 07:39:41 UT, 6 minutes and 9 seconds after the initial G entry event as determined by the Galileo PPR and UVS instruments (PPR and UVS detected the G impact 5.3 seconds prior to the first NIMS detection). Based on Earth-based observations and relative timings, we interpret this second heating as the fall back of impact ejecta onto the upper atmosphere of Jupiter. The heating is observed to brighten steadily over 2 minutes following its first detection. The timing of the event implies a minimum ejecta velocity of 4.1 km/sec.

Galileo NIMS data covering 8 minutes of the R impact event is expected to be returned during January 1995, and will be displayed and discussed. No playback of data from the C or F impact events is planned because of operational and time constraints on the spacecraft.