

Bright flash on Jupiter in 1983

SIR — Predictions that Comet Shoemaker–Levy 9 will collide with Jupiter in July 1994 (refs 1, 2) have spurred interest in the observable consequences of the impact^{3,4}. The collision is predicted to occur on the far side of Jupiter, thus the most likely instantaneous observable effect will be a flash that momentarily illuminates a satellite located behind Jupiter at that time. We present evidence

— in addition to Io. In all frames (up to, including, and following the frame that showed Io as bright) values for the sky and Europa were nominal, indicating that there was no problem with the frame itself. Io was unresolved, but its point-spread function subtended over 12 pixels. All pixels containing Io flux were bright, thus excluding photometry contaminated by a 'hot' pixel. In a charge-coupled device image, a cosmic-ray strike directly on Io could mimic a flash, but Vidicon detectors are not susceptible to such events. Although we cannot exclude a peculiar instrumental effect involving only the pixels containing Io in this frame, this explanation seems unlikely.

Could Io itself have suddenly had a brief intrinsic increase in brightness? Volcanic events are not likely candidates because of the strict constraint on the duration to 118 s. A specular reflection of a large smooth area might cause a brief flash, but such an effect has not been seen before on Io's surface, even at very high spatial resolution in the Voyager data. Io's atmosphere is not thick enough to create a fireball due to a striking body, nor has it shown any evidence for lightning, let alone lightning of this magnitude. Thus an event associated with Io itself is an unlikely explanation for the observed anomalous brightening.

A flash on the far side of Jupiter could have manifested itself as an increase in Io's brightness. One plausible phenomenon is a 'superbolt' of jovian lightning⁷. Alternatively, calculations of the effects of Shoemaker–Levy 9's impact predict a flash as the comet plunges into the jovian atmosphere. The 50 per cent increase seen here, corresponding to an energy of about 10^{28} ergs, would be comparable to a 5-km icy body (with a density of 1 g cm^{-3}) with a velocity of 60 km s^{-1} converting its kinetic energy to luminous energy in 10 s with an efficiency of 0.1. More sophisticated power and energy dissipation estimates for typical cometary bodies predict flashes that would increase a satellite's brightness by 10–30 per cent for a brief interval (less than tens of seconds)^{3,4}. If the flash was caused by an impact, either the body was somewhat larger or faster than a typical comet, or else the luminous efficiency for

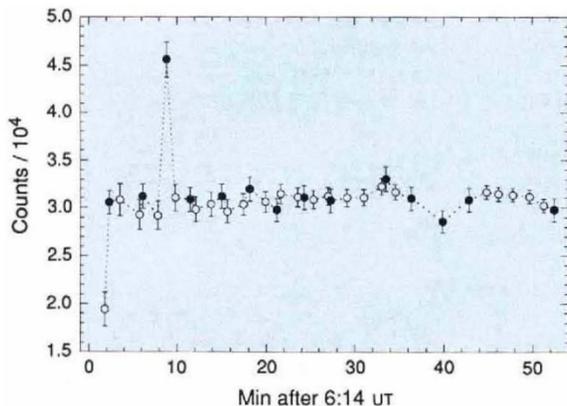
converting energy to brightness — which is not well known for Jupiter — may be somewhat larger than anticipated. An impact could also have had other observable effects on the jovian atmosphere; we encourage investigators with long-term datasets to check Jupiter during this time period to search for such phenomena.

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Brightness of Io on 26 July 1983 as it reappeared from Jupiter eclipse. The brightening at 6:22:50 UT (8.8 min after 6:14 UT) may be evidence for a flash on the far side of Jupiter. Closed circles, data (obtained with the Palomar 1.52-m telescope through a 4,200-Å filter) from Vidicon images that also included sky background and Europa, which was in front of Jupiter at the time of the observations⁵. The sky and Europa showed no unusual brightening in the frame in which Io was anomalously bright; all pixels containing Io in that frame were 50 per cent higher than the preceding and following frames⁶. Open circles, data (taken with a 0.61-m telescope on Mauna Kea through a 4,400-Å filter) from disk-integrated photometry⁷, showing no evidence for a flash, constraining the duration of the event to less than 118 s. The data in ref. 6 were normalized to match the data in ref. 5 in the 50 min after 6:14 UT (excluding the anomalous datum in ref. 6 and the first datum in ref. 5 when Io was still in eclipse; eclipse ended at 6:17 UT).

that such a flash on Jupiter's far side may have been detected in 1983.

On 26 July 1983, we were involved in collecting observations of the jovian moon Io as it reappeared from jovian eclipse^{5,6}. R. M. Nelson *et al.*⁶ took a series of 10-s integrations; one of these data showed an anomalous 50 per cent brightening of Io roughly 6 min after reappearance in one frame (see figure). Several 3-s integrations by H. B. Hammel *et al.*⁵ bracketed the anomalous flash, but did not overlap it; they showed no brightening, thus constraining the flash duration to be less than 118 s. Explanations for Io's anomalous brightening include: (1) instrumental effects in the data; (2) an event on Io itself; and (3) illumination of Io by a bright event on the far side of Jupiter.

The data in ref. 6 were Vidicon images containing sky background (scattered light from Jupiter) and the moon Europa — which was in front of Jupiter at the time

X larger than Y

SIR — The possibility of determining the sex of offspring in humans and animals is a topic of enduring interest. In 1921 it was found that haploid sperm carry either the X or Y chromosome¹, and that after fertilization with the haploid oocyte determine the sex of the offspring. Until now no scientific data have been reported concerning the size differences between X and Y sperm in humans and animals. We have used polymerase chain reaction (PCR) amplification with primers from the human Y-linked testis-determining gene (SRY; ref. 2) on human blood DNA from 41 male and female subjects. We identified that the primers are suitable for distinguishing between human male and female DNA. We then used the same primers (together with common control primers from the human sperm receptor gene ZP3 on chromosome 7; ref. 3) to identify 20 (male and female) single lymphocytes. Our results were 100% correct.

The same primers were used to determine the sex of 233 non-motile sperm (11 donors), which were individually selected for direct photography before PCR amplification. Two hundred and seventeen sperm (93.1%) showed satisfactory amplification, 106 (48.8%) being Y and 111 (51.2%) X. Under 'blind' conditions, we magnified photographs of individual sperm a further 30× and directly measured them. Statistical analysis showed the length, perimeter and area of the heads and the length of the neck and tail in X sperm are significantly larger than those of Y sperm. Thus, in contrast with earlier work^{4,5} our direct methods show for the first