Discovery of a New Jupiter Satellite

Abstract. *During detailed analysis of Voyager 2 pictures of the Jupiter ring, a starlike object was identified in the plane of the ring. The same object was subsequently found on a higher-resolution frame and proved to be a satellite of Jupiter. This satellite has a circular orbit whose radius is 1.8 Jupiter radii, a period of 7 hours and 8 minutes, and a diameter of less than 40 kilometers. It is located at the outer edge of the Jupiter ring.*

Voyager 2 frame FDS 20630.53 was taken 23 hours prior to closest approach of the spacecraft to Jupiter. It shows a faint image of the ring in reflected light. At the time of the exposure, the spacecraft was at a range of 1.4×10^6 km from Jupiter and was approximately in the ring plane (Fig. 1). Two starlike objects were obvious in the discovery frame. However, the one in the ring plane could not be identified on plots of predicted star positions.

Subsequent examination of the narrow-angle frame FDS 20630.48 (Fig. 2), taken 5 minutes earlier, showed that the same object was in the ring plane and had trailed in a different direction and by a greater amount than had the known stars. This indicated motion of the object during the 96-second exposure.

Simple calculations revealed the motion of the object to be consistent with a combination of parallax motion and the orbital motion of a satellite of Jupiter. Having eliminated all known satellites as candidates, we made a more refined computation of the orbit, using the Voyager optical navigation program. Three positions were used, one from the wide-angle frame and two from the narrow-angle one (the beginning and end of the exposure). The orbit was found to have a semimajor axis of 1.80 ± 0.01 Jupiter radii (R_J). The longitude of the object at the time of the narrow-angle picture was $309.1° \pm 0.2°$. The orbit was found to have no detectable inclination or eccentricity and the motion was found to be direct. Its period is 7 hours and 8 minutes. Figure 3 illustrates the geometry of the system at the time of discovery. Note that the orbit of the satellite is coincident with the outer edge of the ring ($1.8 R_J$), to within the errors of measurement.

Initial photometric data analyses indicate that the albedo is low, less than 0.05. The satellite trail was several pixels in width, so that an estimate of one of its dimensions was possible. This dimension is less than 40 km. There is no reason to believe the object is spherical.

Further attempts are being made to locate the satellite on other Voyager 1 and 2 images.

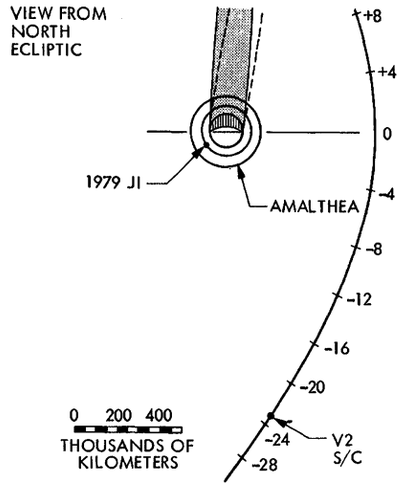

Fig. 3. Line drawing depicting the trajectory of the Voyager 2 spacecraft (*V2 S/C*) on its flyby of Jupiter and the location of 1979J1 in its orbit when it was discovered by Voyager 2. The outer circle is the orbit of Amalthea (2.54 R_J). The orbit of 1979J1 is at $1.8 R_J$, just on the bright outside edge of the Jovian ring. The numbers along the trajectory indicate time relative to Voyager 2's closest approach to Jupiter.

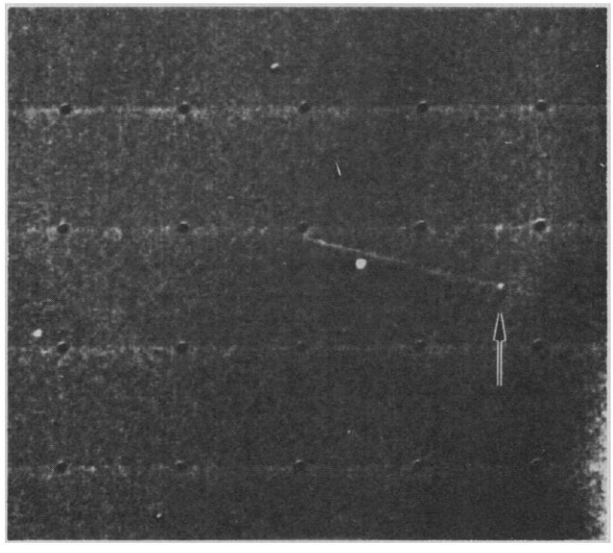

Fig. 1. The very faint line in the right center is the Jovian ring. This wide-angle picture was taken with a 15-second exposure through the clear filter. The satellite, 1979J1, is above the arrow (FDS 20630.53, Picno 85J2-001). This picture was taken at a range of 1.4×10^6 km by the Voyager 2 spacecraft.

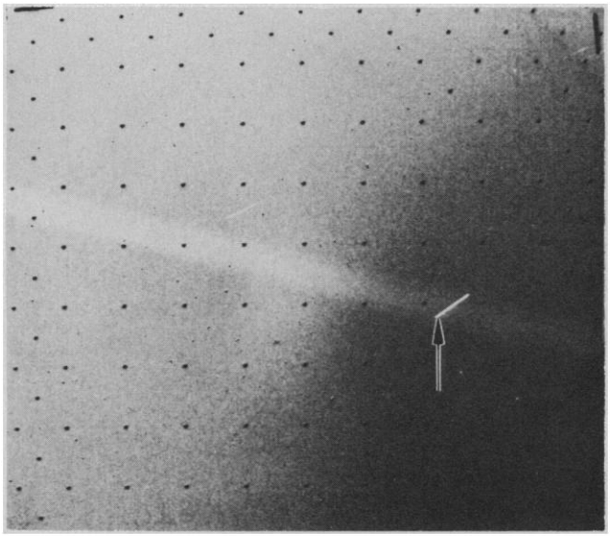

Fig. 2. This narrow-angle Voyager 2 picture of the Jovian ring was obtained 23 hours before closest approach; it was taken through the clear filter with an exposure time of 96 seconds. The light band diagonally crossing the picture is the Jovian ring, which was smeared because of spacecraft motion and parallax motion. The new satellite, 1979J1, is indicated by an arrow. A star is located to the upper left of the new satellite. Note the difference in length and direction between the trailed star and satellite images.

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Notes

1. This is contribution 3342 of the Division of Geological and Planetary Sciences, California Institute of Technology.

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