LARGE-AMPLITUDE PHOTOMETRIC VARIATIONS OF NEREID; M. W. Schaefer and B. E. Schaefer, Goddard Space Flight Center, Greenbelt, MD 20771

Nereid, one of the satellites of Neptune, was discovered in 1949 by Kuiper (1). It has an extremely eccentric orbit (e ≈ 0.75), such that its distance from Neptune varies from about 1.4 to 9.7 million kilometers, with a period of about 360 days. No photometric data exists for Nereid (2) other than the rough estimate of photographic magnitude (mp = 19.5) determined by Kuiper (1).

In June 1987 we collected UBVRI photometry of Nereid using the 0.9 m telescope and CCD camera at the Cerro Tololo Inter-American Observatory (CTIO). Our data spanned 8 days. Photometric standard stars (3) were observed with U, B, V, R, and I filters and a wide range of airmasses, to make accurate airmass and color corrections. Color equations suitable for the filters used were derived from measurements of the standard stars. The brightness of Nereid is seen to vary similarly in all colors (Figure 1). The range in V-band brightness is from 18.01 to

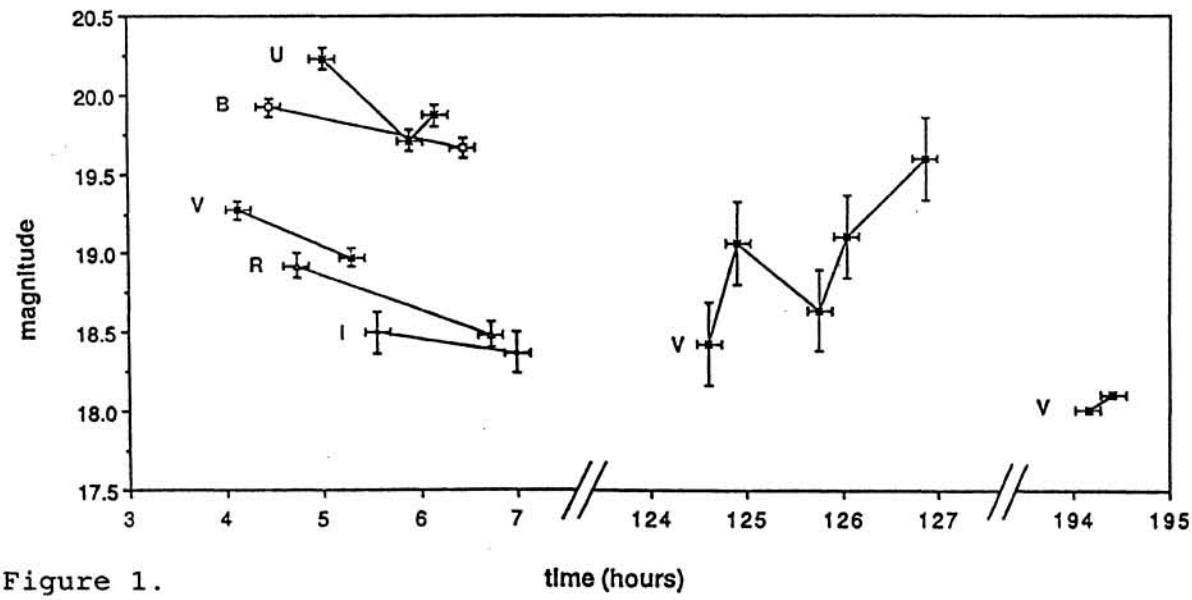

Figure 1.

19.59, giving an observed amplitude of over one and a half magnitudes. The total amplitude of the variation may well be larger as we may not have observations from both a maximum and a minimum. The variations are likely to be due to rotation effects, with a rotation period that seems to be between 8 hours and 24 hours. Attempts to fit a period to the data by means of a Fourier transform were ambiguous, due to the sparseness of the data.

The observed variability in reflectivity of Nereid could be caused either by albedo differences on its surface (similar to those on Iapetus), or by a non-spherical shape. The roughly estimated period for this variability is consistent with either of these causes.

If the variability is caused solely by a non-spherical shape,

a ratio of areas (maximum cross-section / minimum cross-section) of over four is implied. Based on the observed brightness, even in the most conservative case (amplitude of variability = 1.5 mag, rotation axis perpendicular to the line of sight, prolate spheroidal shape, and albedo = 0.6), Nereid must have dimensions of over 870 x 200 x 200 km. But satellites the size of Mimas or larger (r = 195 km) are all closely spherical(4). This would seem to imply that the observed brightness contrasts are not due to shape alone.

If the variability is caused solely by albedo differences, an albedo ratio ("bright side" / "dark side") of at least four is implied [the albedo ratio of Iapetus is over ten]. This ratio could be produced by a minimum-size spherical body of diameter 422 km with an albedo on one side of 0.6 and on the other side of <0.15, or by a maximum-size spherical body of diameter 910 km with an albedo on one side of >0.12 and on the other side of 0.03.

The colors of Nereid were estimated by interpolation from the magnitudes at closely-separated times, assuming a similar slope for the variation in all colors, and compared to the Sun's colors(5) to obtain reflectances, shown in Figure 2. We were able

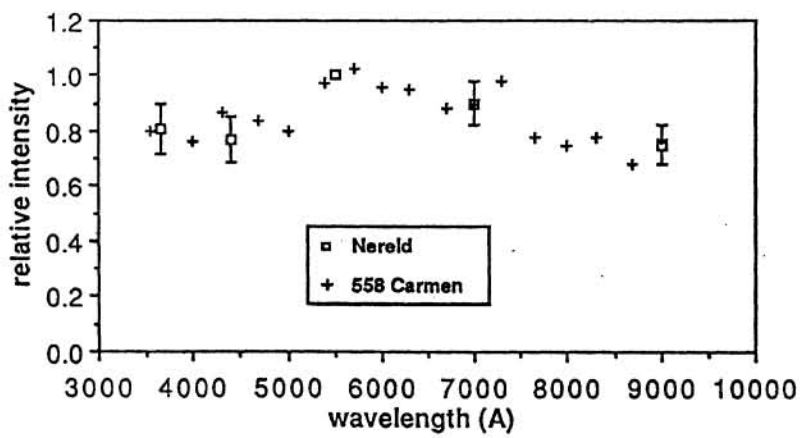

Figure 2.

to find only one good match to this reflectance curve, that of the asteroid 558 Carmen, a U-type asteroid of low albedo in the main asteroid belt.

Interesting speculations may be be made on the history of Nereid and the Neptune (+Pluto?) system in light of these observations. We plan more photometric observations of Nereid in the near future.

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