PLUTO'S LIGHTCURVE IN 1999

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The Voyager II spacecraft revealed that even frozen icy bodies at the edge of the solar system exhibit active vulcanism and seasonal transport of condensed volatiles such as water ice, methane, and nitrogen. Several geysers and many plume-deposits were observed on Triton, the large satellite of Neptune. A long term record of seasonal change on Triton is provided by telescopic observations of Triton's albedo variegations and color through the historical period it has been known to astronomers (Buratti et al., 1994).

Pluto, a body similar to Triton in many ways, is the only planet in the solar system that has not been scrutinized by a spacecraft. Theoretical models predict seasonal transport of methane and nitrogen on the planet (Stern and Trafton, 1984; Stern et al., 1988; Hansen and Paige, 1996). With its high eccentricity - Pluto's distance from the sun varies from about 30 to nearly 50 AU - and obliquity of 122 degrees, seasonal changes on the planet should be significant. The vapor pressures of the major atmospheric components (nitrogen, methane, and carbon dioxide) vary by several orders of magnitude during Pluto's transit around the sun. The planet's entire atmosphere may be seasonal, sublimating only in the period around perihelion, and "collapsing" back onto the surface after as little as two decades.

Evidence for the seasonal deposition or sublimation of ice on Pluto's surface should be detectable with Earth-based telescopes. Rotational lightcurves obtained between 1954 and 1983 have increased markedly in amplitude, and concomitant decreases have occurred in the planet's geometric albedo (see summary by Stern et al., 1988). These lightcurves can be deconvolved to provide rough albedo maps (Marcialis, 1983) as a function of epoch, once the effects of viewing geometry are modeled. More accurate albedo maps were derived from the mutual events that occurred between 1985 and 1990 (Buie et al., 1992; Young and Binzel, 1993) and from HST images (Stern et al., 1997). It is especially important to detect evidence for volatile transport at this unique time, as Pluto passes through its perihelion.

As part of an effort to obtain a current lightcurve of Pluto, 25 nights of photometric measurements of Pluto were obtained with the BVR filter system at JPL's Table Mountain Observatory in Wrightwood, California during its apparition in 1999. We used a 24-inch telescope with a 1024 square CCD camera covering a field of 10 arcminutes. Relative photometry from image-to-image and from night-to-night was obtained by comparing Pluto's brightness to that of several on-chip standard stars. Absolute photometry was accomplished with five stars in a Landolt field. Pluto's entire 6.4 day rotational phase curve was covered several times to minimize gaps in longitudinal coverage. The observations are summarized in the Table.

Table - Summary of BVR Observations of Pluto at Table Mountain Observatory

Observing Run (CT 1999)	Total Images Obtained	Solar Phase Angle
June 5-8	97	0.44 - 0.48
June 17-22	150	0.69 - 0.83
July 12-17	87	1.30 - 1.43
July 30-August 7	198	1.67 - 1.78

We have performed a preliminary reduction of the B images from the above observations. The lightcurve has the same overall shape as the one obtained in 1980-1983 (Tholen and Tedesco, 1994), although the amplitude appears to have increased by about 10% over the past decade (we stress these results are based on preliminary reductions).

In addition to detecting the seasonal transport of volatiles on Pluto, a current lightcurve of Pluto is required as background for understanding whether there is a non-zero eccentricity in Charon's orbit. Finally, changes in Pluto's lightcurve can offer evidence for active geologic processes on the planet.

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