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Search for Pluto's aerosols: simultaneous IR and visible stellar occultation observations

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Abstract

Pluto is expected to occult two separate stars on June 23 and 27, 2011 (UT). Both of these stars are significantly brighter than Pluto in infrared wavelengths. We plan to observe the June 23 event from San Pedro Martir, Mexico and both the June 23 and 27 events from Hale A'a, Hawaii (47 km from Mauna Kea). We plan to use two telescopes at each site to acquire simultaneous visible and IR light curves. The goal of these observations is to provide tight constraints on the extinction due to haze in Pluto's lower atmosphere.

1. Introduction

A long-standing question – since the discovery of Pluto's atmosphere in 1988 – has been whether aerosols exist in Pluto's atmosphere and whether aerosols are, in fact, responsible for some of the attenuation in Pluto's stellar occultation light curves. Eshleman (1989) showed that the observed light curves, which showed a dramatic drop at altitudes corresponding to roughly 1215 km in Pluto's atmosphere, could be modeled entirely with specific temperature profiles, as opposed to the haze layer originally suggested by Elliot et al. (1989). On the other hand, hazes have been detected and characterized on Triton (Hillier and Veverka 1994), an object with similar size, insolation, period and atmospheric composition to Pluto. The presence or absence of hazes will affect the interpretations of organics that New Horizons is expected to find on Pluto's surface, since the chemistry of aerosol production and evolution in the atmosphere is different from processes that take place in the nitrogen and methane surface ice matrices.

2. Planned Observations

One straightforward way to distinguish aerosols from atmospheric temperature inversions is to observe a stellar occultation in separate wavelengths. Hazes will presumably scatter less effectively at longer wavelengths and the difference in visible vs. IR light curves will reveal the presence or absence of aerosols. Observations from the Mt. John observatory on 2007-JUL-31 (Fig. 1) at two wavelengths (roughly 0.51 and 0.76 μm), obtained with a dichroic centered at 0.627 μm) revealed no significant differences between the two light curves, but Rannou and Durry (2009) point out that a larger separation in wavelength is necessary to put useful constraints on the optical depth due to aerosols.

We observed an occultation on 2007-MAR-18 from Red Buttes Observatory (WY), Lick Observatory (CA) and Lowell Observatory (AZ) in Johnson R-, K-, and I-band filters, respectively. Like the Mt. John observations, these show no strong evidence for extinction by haze, but the geometry of these events was such that the IR light curves did not probe Pluto's lower atmosphere, where the extinction due to aerosols might be strongest.

Figure 2 shows the predicted path of Pluto's shadow across the Pacific Ocean for the 2011-JUN-27 event. Because Hale A'a is located at the edge of the predicted shadow path on June 23 and near the center on June 27, we expect to probe Pluto's lower atmosphere during one of the two events.

3. Figures

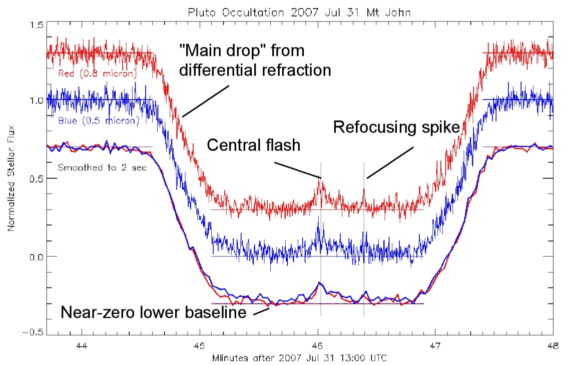

Figure 1: Pluto light curves observed at 0.51 and 0.76 μm from Mt. John Observatory in New Zealand (Olkin et al. 2011). Because this event recorded a central flash, it probed relatively far into Pluto's atmosphere. The blue and red channels, although somewhat close in wavelength, do not show evidence of extinction by haze.

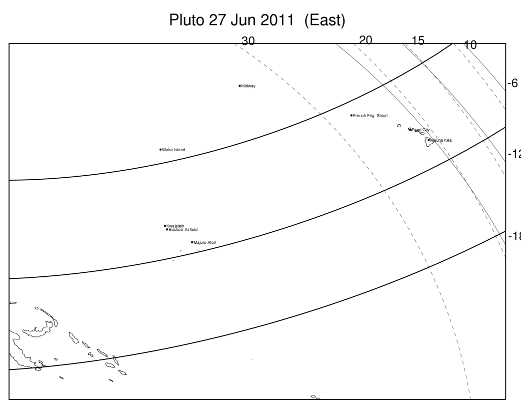

Figure 2: Pluto's predicted shadow path for the 2011-JUN-27 event. Hale A'a (close to Mauna Kea) is near the center of the prediction.

4. Tables

Table 1: Occultation stars on June 23 and 27, 2011.

Date/Time (UT)	V-mag	K-mag
2011-JUN-23/11:24:49	15.18	9.74
2011-JUN-27/14:18:41	13.71	11.93

Acknowledgements

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References

[1] Elliot, J.L. et al. (1989), "Pluto's atmosphere." Icarus 77, 148.

[2] Eshleman, V. (1989), "Pluto's atmosphere - Models based on refraction, inversion, and vapor-pressure equilibrium." Icarus 80, 439.

[3] Hillier, J. Veverka, J. (1994), "Photometric properties of Triton hazes." Icarus 109, 284.

[4] Olkin, C.B. et al. (2011), "Pluto's atmosphere from the July 2007 stellar occultation." In preparation.

[5] Rannou, P. and Durry, G. (2009), "Extinction layer detected by the 2003 star occultation on Pluto." JGR 114, E11, 11013.