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Occultations by Pluto and Charon observed by the PHOT team, 2011 June 23 & 27

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Abstract

The PHOT (Portable High-speed Occultation Telescope) team is chasing two bright occultations by the Pluto system on June 23 and June 27, 2011. Both stars are very bright in the IR, being brighter than Pluto in I, J, H, and K. The June 27 star is brighter than Pluto in B and V as well (Table 1). The June 23 star is occulted by both Pluto and Charon, and the June 27 star is occulted by both Pluto and Hydra. We report in this abstract our plans for the Pluto and Charon observations, as of May 31, 2011. We will report on our results at the meeting.

Table 1: Overview of targets

Target	V	I	J	K
2011-06-23 star	15.2	12.7	11.0	9.7
2011-06-27 star	13.7	13.0	12.3	11.9
Pluto	14.4	13.6	12.9	13.0

1. Introduction

The technique of stellar occultation is well-known for its ability to probe planetary atmospheres at high vertical resolution. We are observing four occultations from the Pacific over four days. The June 23 star is occulted by both Charon and Pluto, and the June 27 star is occulted by both Pluto and Hydra. The Charon and both the Pluto occultations are observable from the Pacific at equatorial or small northern latitudes. These stars are bright, which allows us to address a number of goals.

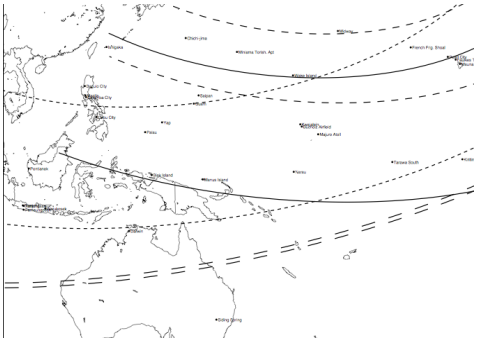

Figure 1: Shadow paths of the targets based on the Pluto-Charon predictions of Bruno Sicardy and the Hydra ephemeris of Dave Tholen and Marc Buie. June 23: Charon (medium dash) and Pluto (solid). June 27: Pluto (short dash) and Hydra (long-dash).

2. Science motivation

Because Pluto's N_2 atmosphere varies seasonally, we have measured the pressures and temperatures in Pluto's atmosphere at least once a year since 2006. Some models [1] predict that when Pluto's atmosphere begins to collapse, it will collapse rapidly. If we observe two or more chords for astrometry, and one or more with moderate or high (signal-to-noise ratio), we will be able to continue our time-resolved measurements of Pluto's changing atmosphere.

The two June events, separated by 2/3 of a Pluto day, provide the first opportunity to look for changes in Pluto's atmosphere at short time scales. While recent work has shown that Pluto's surface pressure should not change on these time scales [3], we can look for differences in lightcurve spikes, indicative of changing wave activity, or in temperatures, indicative of different energetics. The density of observations on the Hawaiian Islands and Marshall Islands (Majuro, two sites on Kwajalein) will allow us to look for spatial variation along Pluto's limb.

Previous occultations that probe within 0.6 Pluto radii of the center of Pluto's shadow have revealed thermal inversions in the atmosphere due to the balance between thermal conduction and methane heating and cooling. Closer to the shadow center, previous occultations have revealed central flashes that are evidence of a non-spherical atmosphere. We pick our sites to have moderately large telescopes near the predicted center of the Pluto's shadow for each night. Where possible, we will observe at dual wavelengths to distinguish extinction and refraction effects; plans for IR observations are in place at Hale A'a and San Pedro Martir (See E. Young et al., 2011, this meeting).

The June 23 double occultation by both Pluto and Charon is a rare opportunity. Such a double event has only been observed once before, with a single chord on Charon [2]. We designed our deployment to observe two or more chords on Pluto and two or more on Charon on June 23. If successful, this will measure the Pluto-Charon relative astrometry to roughly 10 km. Combined with recent HST images of the system, this astrometry will improve the orbit of all four bodies. Because Pluto-Charon-Nix-Hydra is a perturbed system, every double occultation by Pluto and Charon adds new constraints to the orbit solution.

The June 23 Pluto and Charon occultations will allow us to measure the precise position of the Pluto system relative to the June 23 star. As described in a related presentation by Buie et al., this will allow us to attempt the first Hydra occultation. (See M. Buie et al., 2011, this meeting).

Table 2: Planned sites for observing occultations by Charon (V6/23) and Pluto (P6/27 and P6/27)

Site & Planned Observers	Size (m)	Predicted miss distance (target radii) C6/23	P6/23	P6/27
SPM, Mexico RRH, RGF	0.84 2.1	-0.30	0.86	n/a
Sedgewick, CA FB	0.4	0.38	1.19	n/a
Hale A'a, HI EFY, KS, WF, TV	0.56 0.61	-0.43	0.84	0.24
UH 2.2-m, HI DJT	2.2	-0.34	0.89	0.29
Waikoloa, HI CE, CN	0.41	-0.25	0.94	0.34
LCO-FNT, HI FB	2.0	-0.19	0.96	0.38
Kauai, HI TH, MWB	0.28 0.36	0.07	1.09	0.57
Majuro, Marshall I. CBO, HJR	0.36	-2.04	0.14	0.12
Kwajalein, Mar. Is. JRR, JD, RW	0.61 0.61	-1.76	0.27	0.32
Nauru LHW, PT	0.36	-3.40	-0.50	-0.40
Cebu, Philippines LAY, MJB, CG	0.36	-2.97	-0.23	0.84
Java, Indonesia MAB, JAS, HLM	0.60	n/a	n/a	-0.66

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