The Double-Double Pluto-Charon and Pluto-Hydra Predicted Stellar Occultations of June 2011

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MIT-Lowell-USNO astrometry predicted occultations by Pluto and Charon within 11 minutes of each other on 23 June 2011 and an occultation by Pluto on 27 June 2011 with an occultation of Hydra following in a narrow shadow-path 33 minutes later. Our Williams-MIT team organized a network of telescopes around the Pacific-Asia region, including use of two telescopes on Oahu, on which we report here. On 23 June, we successfully observed a 49 s occultation by Charon at 2 Hz with our Portable Occultation, Eclipse, and Transit System, POETS, from Leeward Community College's 0.5-m telescope in Pearl City. Our site at Windward Community College in Kaneohe with its 0.4-m telescope and a POETS was cloudy for both events, as was the Leeward Community College site for the second event with a 0.3-m telescope, used because the event was only 16° above the horizon, too low for their larger telescope, and a POETS. We note that our successful Charon occultation occurred in the context of observations by others, including our collaborators on SOFIA and at the IRTF, and we discuss the predictions, observations, and prospective scientific value of the predicted double events with Pluto (radius 1400 km) and Charon (radius 605 km) occulting the same star on 23 June UT and Pluto and Hydra (possibly only 50 km in radius) prospectively occulting a different star on 27 June UT.

Introduction

A stellar occultation occurs when the light from a star is blocked or occulted by an intervening body, such as a planet, ring, asteroid or a satellite. It is the best ground-based method to probe the structural and atmospheric properties of the occulting body and it does that with a spatial resolution of a few kilometres.

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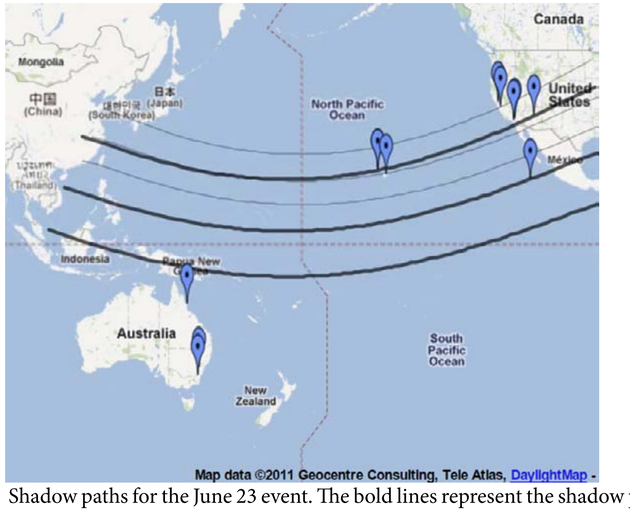

Fig. 1.— Shadow paths for the June 23 event. The bold lines represent the shadow path for Pluto with the two outer ones showing the northern and southern limits for the shadow. The fainter lines mark the same for Charon.

Fig. 2.— Shadow paths for the June 27 event.

Observations

The Williams team used the POETS high speed camera systems installed on telescopes at Leeward Community College (LCC) and Windward Community College (WCC) in Pearl City and Kaneohe, respectively, to observe both the events. However, due to cloudy weather, the only useful data were obtained from LCC on June 23.

The Charon occultation on June 23 for LCC was predicted to start at 11:13:28 UT and end at 11:14:17 UT with midtime at 11:13:53. The midtime for the occultation by Pluto for the same day and location was predicted to be 11:24:15 UT. The 1-sigma uncertainties on all times were ±0:20 seconds. Therefore, 9600 frames of the field of view were taken at 2 Hz starting from 11:04:00 UT. The 1.63 arcsec pixels were binned 2 x 2.

Light curve reduction

We reduced the images to obtain the following light curve. Our reduction process was aimed at obtaining a time series of the flux of the occulted star. For this, however, we had to make a careful choice of a reference star for determining the relative flux as a ratio between the occulted star and the reference star. Also, we had to take into account the background flux around these objects. The constant flux before and after the drop represents the total flux of Pluto, Charon, and the occulted star.

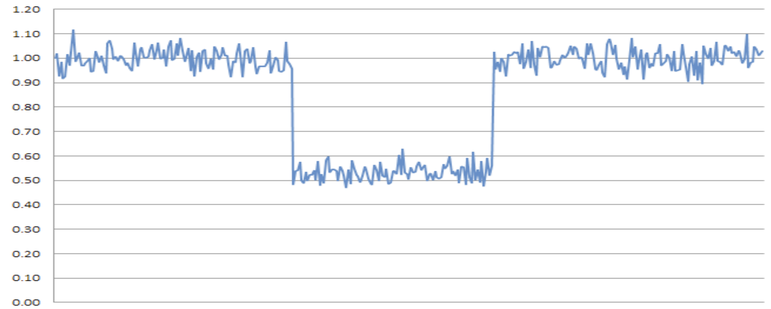

Fig. 3.—Williams College light curve from LCC for the occultation by Charon.

From the above light curve, we determined the length of the chord of Charon we observed to be 594 km. This information will be used together with the chords from other sites to improve our prior results from a 2005 occultation for the diameter of Charon.

Future Work

Since we obtained the light curve for occultation only by Charon, we are working in conjunction with the MIT team to further analyze the Pluto—Charon double occultation light curve. This rare double event observed for Pluto—Charon system, with occultation by both objects obtained by Gulbis and Emery with the IRTF, will allow us to calculate the separation between Pluto and Charon very accurately. Additionally, we hope to obtain the temperature, pressure and number density profiles for Pluto's atmosphere as we analyze the results obtained by other teams from other sites, not to mention the MIT/Lowell SOFIA results from close to the Pluto occultation's centerline.

Acknowledgments

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