The 22 May 2011 Occultation by Pluto

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Based on a prediction from MIT with astrometric observations from the USNO and Lowell Observatory, we observed the 22 May 2011 UT 06:22 occultation of a star by Pluto (www.stellaroccultations.info and occult.mit.edu), predicted time. The star occulted was UCAC2 magnitude 15.3, and the event's geocentric velocity was 18.2 km s^{-1}. We used the 0.6-m telescope of Williams College's Hopkins Observatory in Williamstown, MA, and one of our Portable Occultation, Eclipse, and Transit System (POETS) CCD/GPS. The centerline of the predicted path was just above the north pole, with the southern limit passing through the U.S. mid-Atlantic, so telescopes in the northeast were potentially in the path, though at high air mass. An occultation of approximately 100 s was clearly detected after calibrating on a nearby comparison star (and barely visible on the CCD monitoring screen in real time), given the relatively cloudy and variable nature of the observing conditions. We used the observation to refine the prediction model that is crucial for the 23/27 June respectively. Observations in clear conditions with the Magdalena Ridge Observatory's 2.4-m telescope in New Mexico and another of our POETS did not show an occultation to better than 1%. This nondetection provides a constraint for a Pluto atmospheric graze or the potential shift of the path of Charon sufficiently far north to that site from the predicted path in northernmost South America.

Introduction

Stellar occultations provide ground based astronomers with the best possibility to study the structural and atmospheric properties of occulting bodies, which block the starlight from the occulted star, with a spatial resolution of only a few kilometers.

An occultation of a star with UCAC2 magnitude 15.3 was predicted to be occulted by Pluto and its moon Charon on May 22, 2011.

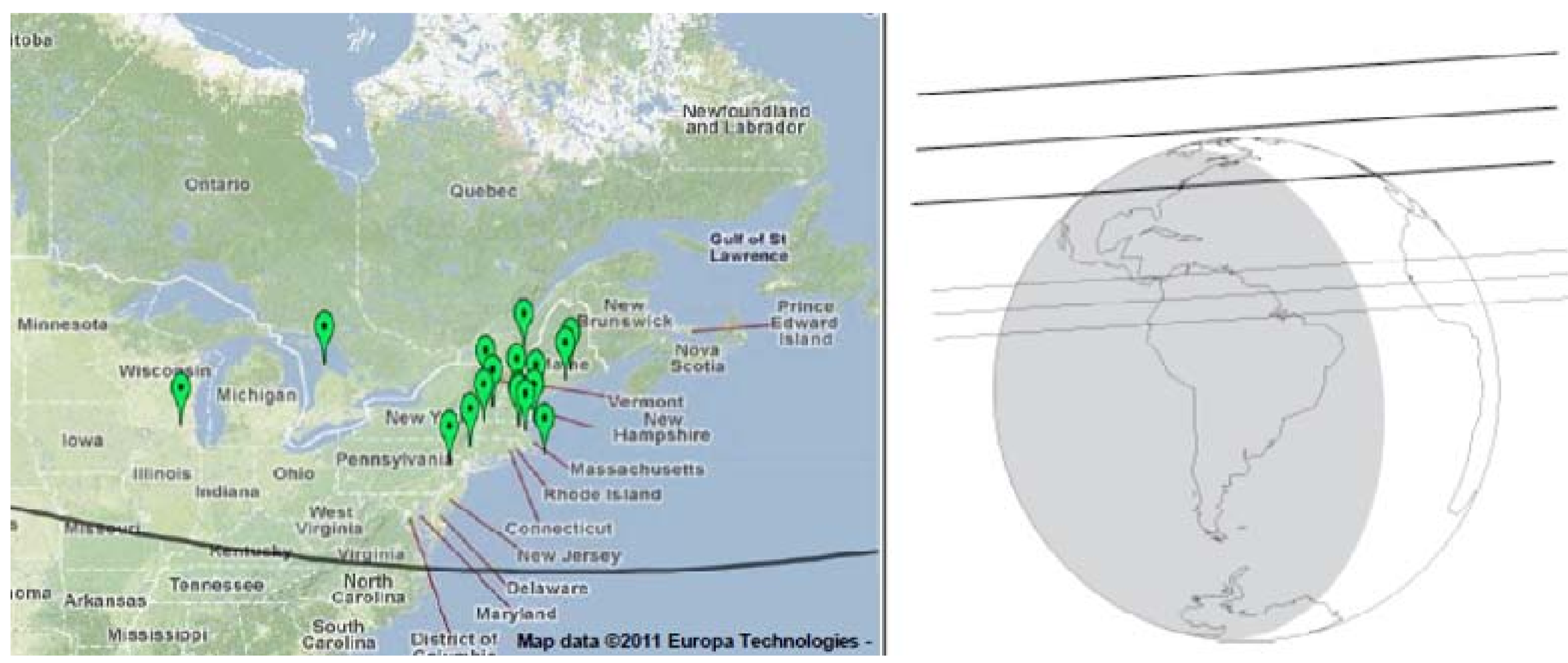

Fig. 1. — A map and a globe showing the predicted path of the shadow for the May 22 occultation, with a 1400 km atmospheric radius for Pluto and a 605 km radius for Charon. The green marks on the map show the locations of the observation sites and the bold line below is the southernmost boundry of Pluto's shadow. Similarly, the three bold lines on the globe represent the predicted path for Pluto while the thin lines represent that for Charon.

Observations

Among the several sites that were ready for observing the event, only Williams College, Middlebury College and Yerkes Observatory, U. of Chicago had suitable weather. Even in these three locations, however, there were intermittant clouds during the period of observation. At Williams, we used a 24-inch telescope with the POETS (Portable Occultation, Eclipse, and Transit System) camera system. At Middlebury, we used a 24-inch telescope with PICO (Portable Instrument for Capturing Occultations) system while at Yerkes, we used a 41-inch telescope. No occultation was seen from the Magdalena Ridge Observatory near Socorro, NM, with their 2.4-m telescope and a POETS.

The immersion was predicted to begin at 6:21:57 UT at Williams, 6:21:58 UT at Middlebury and 6:23:13 UT at Yerkes and end at 6:23:46 UT, 6:23:44 UT and 6:24:41 at the respective sites. The uncertainties on all times were ± 0:28 (28 seconds; one standard deviation). Also, the velocities of Pluto's shadow in these locations were 18.4 ms^{-1}, 18.5 ms^{-1} and 18.4 ms^{-1}, respectively.

Light curve reduction

We reduced the images from all three locations to obtain individual light curves. We performed standard time series photometry on the obtained data to obtain these light curves. Since we did not have images from Williams and Yerkes that had the occulted star and the Pluto–Charon system clearly separated, we were unable to normalize the light curves based on the background fraction. In any case, we are able to note that the occultation was successfully observed in all three locations.

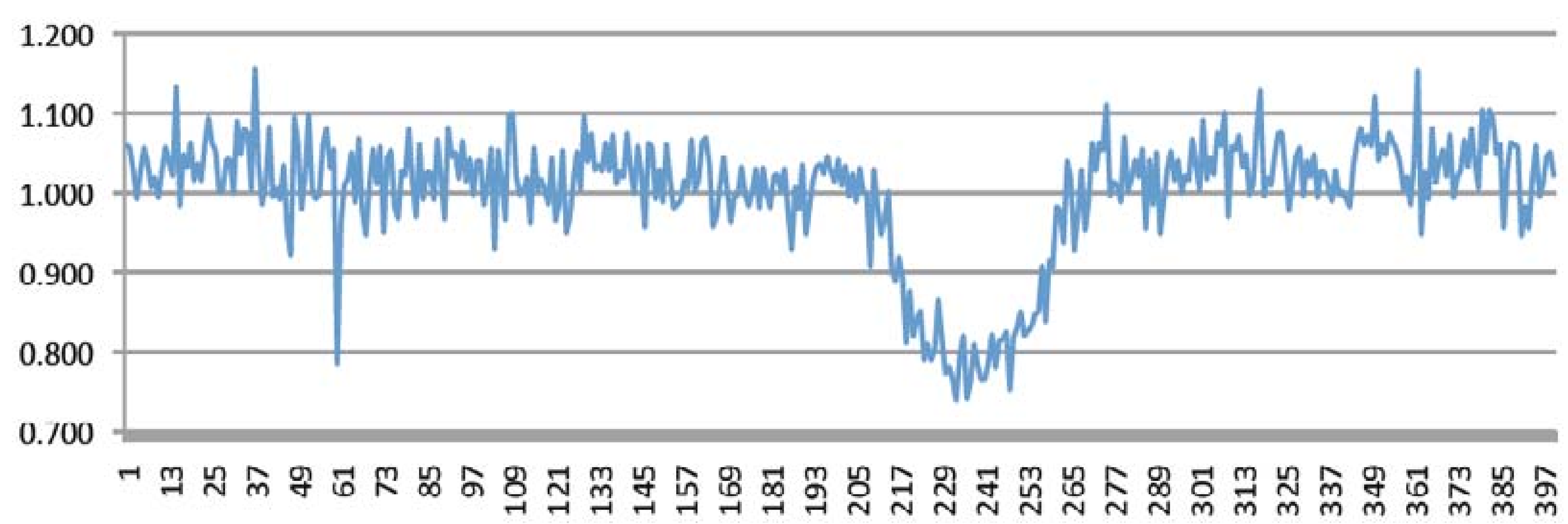

Fig. 2. — Light curve obtained by the Williams College team.

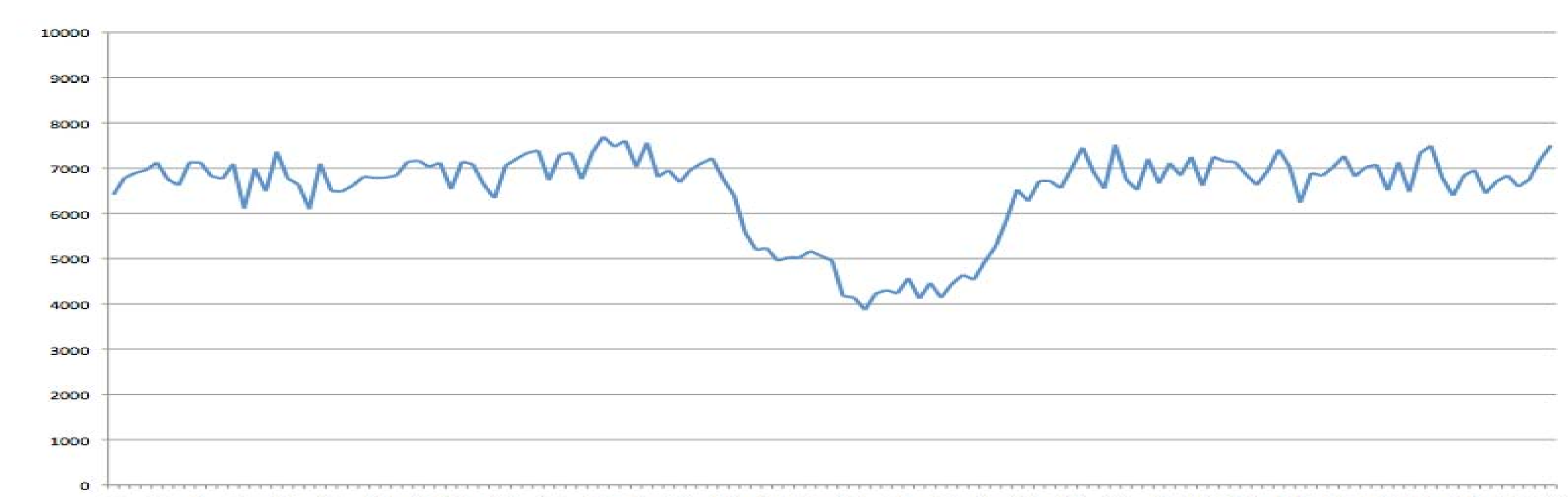

Fig. 3. —Light curve obtained by John Briggs at Middlebury College. The light curve has been normalized such that constant upper baseline is the flux of the occulted star while the zero line is the flux of the Pluto–Charon system only.

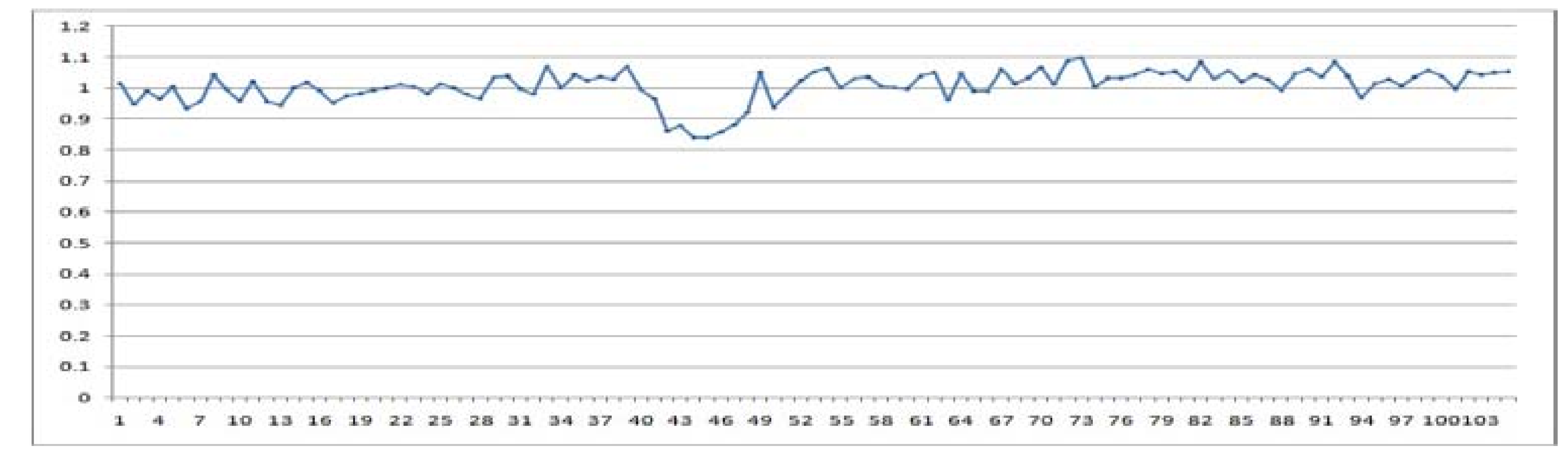

Fig. 4. — Light curve from Yerkes Observatory.

Conclusion

From the light curves, we determined the duration of the occultation for three locations, to be 100 seconds, 113 seconds and 87 seconds, respectively. We also found the lengths of chords for the three locations which allows us to obtain a circular fit for Pluto. More importantly, we used this information to refine the prediction model that was crucial for the successful observations of the 23 June double occultation by Pluto and Charon and for the attempted double occultation on 27 June by Pluto and Hydra.

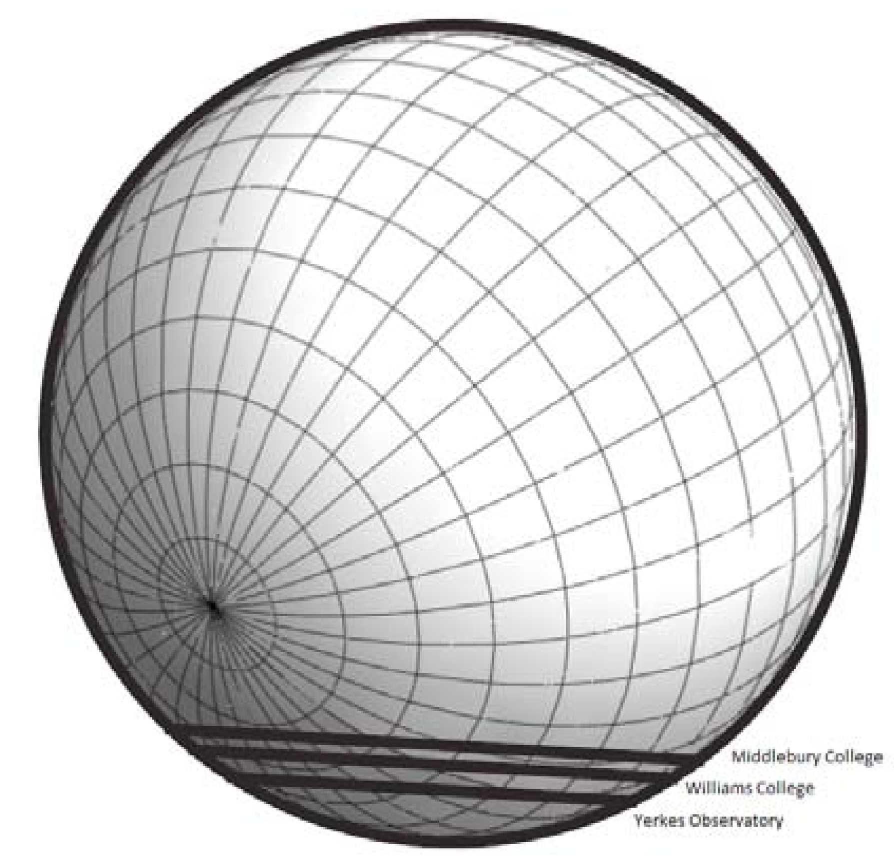

Fig. 5. — The globe of Pluto with the chords for the three sites. The chords from north to south are Middlebury, Williams, and Yerkes.

Acknowledgments

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