

Report on Stellar Occultation by Asteroid (11) Parthenope on 2005/12/09

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Abstract

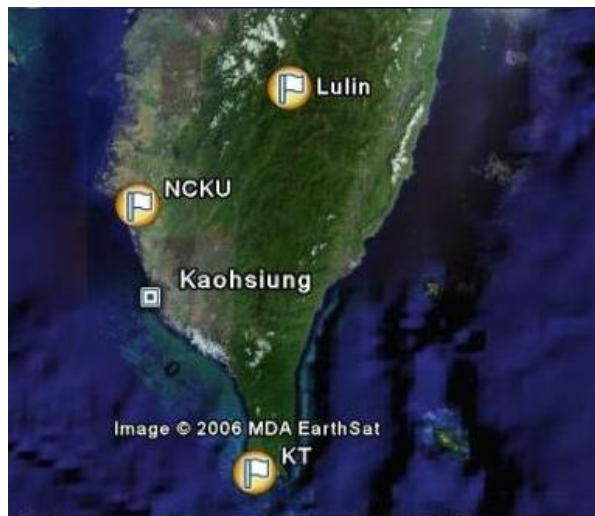
We report the stellar occultation of TYC 128601615 by asteroid (11) Parthenope on 2005 December 9th (UTC). Two sites, KTO and Lulin, joined this observation. The result of KTO is positive with the occultation started at 15h58m53.73s (UTC) with a 7.38s duration recorded while the result of Lulin is negative. In this observation the KTO used an integrative video CCD to improve the equipment's sensitivity and so we used a "partial-occultation time" way to make up its losing of time resolution. The modified trajectory of (11) Parthenope is demonstrated and discussed.

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1. Introduction

One stellar occultation by asteroid (11) Parthenope was observed on 2005 December 9th (UTC). The predictions were provided by Dr. Isao Sato and Steve Preston electronically [1]. Two sites, KTO and Lulin, joined this observation. The KTO result is positive and Lulin result is negative. A way similar to that in Ref.[2] was used to make up the losing of timing accuracy when a video CCD is in its integrating mode. We modified the trajectory of (11) Parthenope with the KTO data and find it may be about 14 km south to that predicted by Dr. Sato. The Lulin observation also support this analysis.

2. Observing Sites



KTO: longitude: 120° 41' 54" E,
latitude: +21° 3' 3".

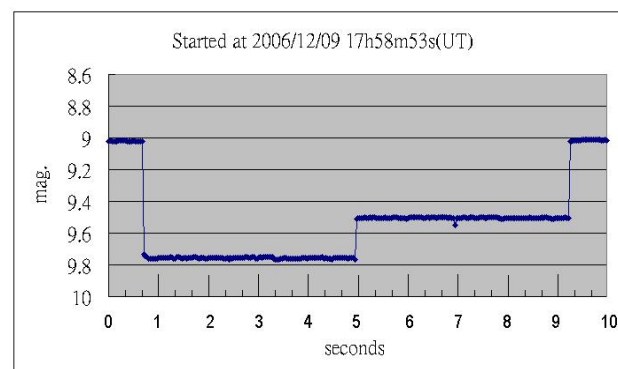
Lulin: longitude: 120° 52' 25" E,
latitude: +23° 28' 07",
altitude: 2,862 m.

3. Observation and Analysis

The KTO used C14+Watec120 at 128X mode to do this observation. The Lulin team used the 1m LOT and TAOS telescopes to observe this event.

The time resolution of commercial video CCDs is 1/30 seconds for each frame. So they are good for timing asteroid occultation. But one of their weakness is even the best commercially available video CCDs can only detect stars as faint as 13th or 14th magnitude. Integrative video CCD is a way to solve this problem. However, integrating also means losing time resolution. In this observation the KTO used a Watec-120 at its 128X integrating mode. So the time resolution is no more 1/30 seconds rather than $128/30 = 4.27$ seconds. To make up for this imperfection, we took a way to estimate the percentage of occultated and un-occultated periods

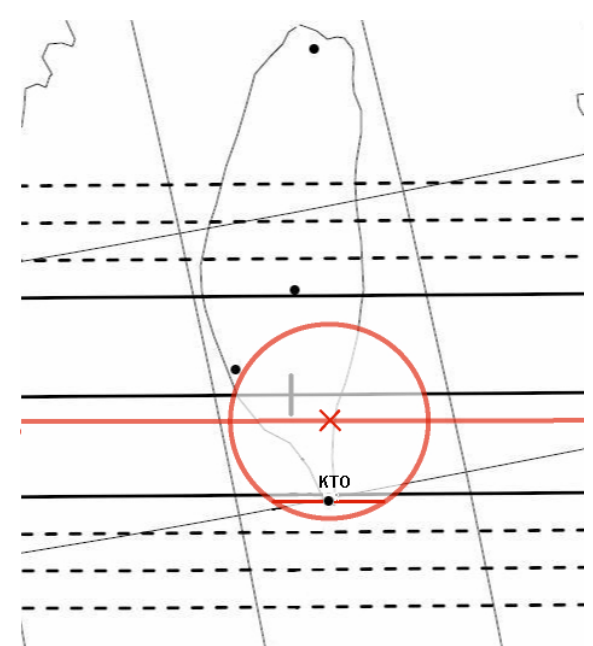
during one 4.27 seconds interval. A similar way was reported in Ref.[2].



The KTO observed magnitude drops occurred in two sequent durations each has 4.27 seconds. We estimated the occultation time by comparing the flux intensities before and during the occultation. The flux intensity of the 9.05m star was measured to be $F_s = 39168$ in average. During the first 4.27 seconds, the measured flux intensity $F = 19568$ is very close to the assumed flux intensity $F_a = 39168 \times 2.512^{(9.05-9.8)} = 19603$ of the 9.8th magnitude asteroid. So we assume that during the whole first 4.27 seconds the star was occulted. During the second 4.27 seconds, it was measured to be 9.50 magnitudes which correspond to a flux intensity ~ 25082 . So we estimated that during its first $25082/39168 = 73\%$ (3.11 seconds) the star was occulted to has a 9.8 magnitude and during the latter 27% (1.16 seconds) the star came out to get a 9.05 magnitude brightness. So the total duration was summarized to be $4.27+3.11 = 7.38$ seconds.

With this time duration we may estimate the length of shadow of the asteroid projected on KTO. According to the data on Sato's prediction, the angular velocity of Parthenope is about 1.063×10^{-2} /sec which corresponds a shadow velocity 12.04 km/sec on earth. So the length of shadow passed KTO is $7.38 \times 12.04 = 88.8$ km.

Since the diameter of (11) Parthenope was estimated to be 153 km and its shadow passed KTO was 88.8 km long, the trajectory of (11) Parthenope modified with this observation is demonstrated as follow if we assume the asteroid to be round. In our calculation the trajectory is about 14 km south to the predicted one and this also explains the negative result of Lulin team.



4. Summary

In this event the KTO used an integrative video CCD to get a better sensitivity. However, it will generally lose its time resolution at the mean while. We used a way, which may increase its sensitivity without losing its time resolution, to solve this problem.

Only two sites joined the observation and only one site get a positive result. So we assumed the asteroid to be round with a 153 km diameter. The trajectory calculated is about 14 km south to the one predicted by Dr. Sato. The negative result of Lulin observation also supports this point. If we can get more sites to join the future observation, then we will know more about the target asteroids and depict the profile of them better.

Reference

1. The predictions of stellar occultation by asteroids around Taiwan are available at the following websites: D. Kinoshita's website, predicted by I. Sato: <http://chunjiao.astro.ncu.edu.tw/~daisuke/occultation/>; Asteroid Occultation Updates, predicted by Steve Preston: <http://www.asteroidoccultation.com/>.
2. Y. W. Ma, F. Yan, J. Zhu and W. Kou., 2005. Timing asteroid occultations by photometry. ICARUS, 178, 284-288.