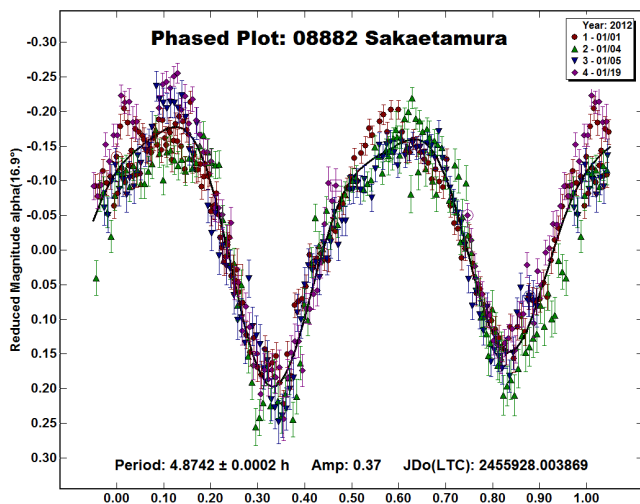
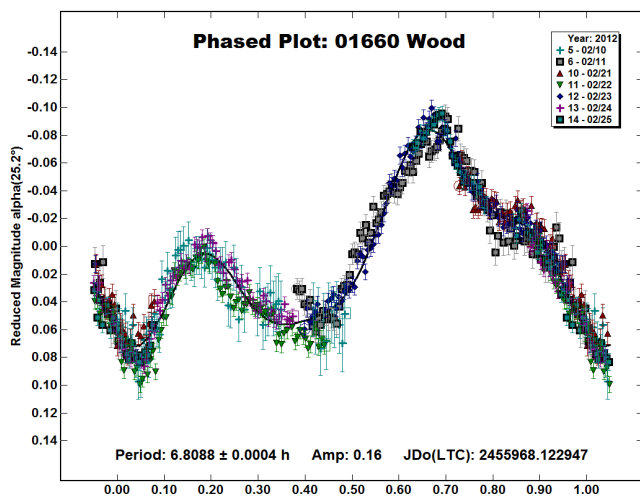
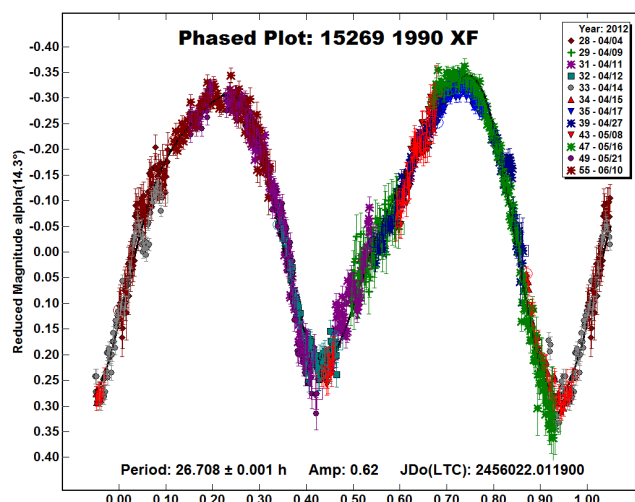
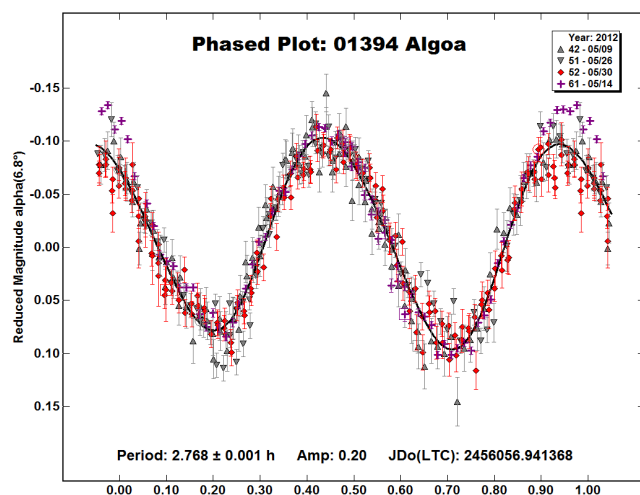




LIGHTCURVE FOR 7958 LEAKEY: A NEW HUNGARIA BINARY

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(Received: 10 July)

Analysis of CCD photometric observations of the Hungaria asteroid 7958 Leakey made in 2012 reveals that the object is mostly likely a binary with a primary rotation period of 2.34843 ± 0.00006 h, $A = 0.22$ mag. The orbital period of the tidally-locked satellite is likely 50.29 ± 0.08 h, although it's possible that the period is 25.26 ± 0.04 h. The secondary lightcurve shows a bowing (amplitude) of about 0.05 mag, indicating that satellite has a projected a/b ratio of 2/1. Two possible mutual events (occultations/eclipses) were observed. From these, the estimated size ratio of the two bodies is $D_s/D_p = 0.30 \pm 0.03$. Additional observations are needed to confirm these results.

The Hungaria asteroid was observed starting the middle of 2012 June at the Palmer Divide Observatory (PDO) using a 0.35-m Schmidt-Cassegrain (SCT) with an SBIG STL-1001E CCD camera. Analysis of the data after several observing runs indicated the possibility that the asteroid was a binary with a somewhat long orbital period, $P > 24$ hours. A request for assistance was made to the Center for Solar System Studies (CS3) when poor weather and other conditions prevented additional observations at PDO. The observations at CS3 used a 0.35-m SCT and SBIG ST-10 and were mostly at the end of June, which helped considerably by filling in missing sections of the secondary period. All images were unfiltered. The data were put onto an internal standard system

using V magnitudes derived from the APASS catalog (Henden *et al.*, 2012).

Warner used the dual period search feature in *MPO Canopus* to find the period of the primary ($P_1 = 2.34843 \pm 0.00006$ h, $A = 0.22$ mag). Two possible solutions were found for the secondary (orbital) period: 25.26 ± 0.04 h and 50.29 ± 0.08 h, both with a total amplitude (satellite rotation and events) of 0.12 mag. We adopted the longer period based on the following logic.

Keeping in mind that the secondary lightcurve is “diluted” by the light of the primary, then if the secondary is only 10% of the total light and it has an amplitude of 0.05 mag, the “undiluted” lightcurve would have an amplitude around 0.5 magnitude. This is out of the range of ambiguity for the number of extrema per rotation cycle. In this case, meaning that a bimodal lightcurve and its corresponding longer period are more likely. Additionally, in order to have events at only one phase and not at the opposite phase requires either a very strange geometry or an eccentric orbit. The unusual situation where only one event is seen is for a period where the rotation phase 0.5 around is not covered. The 25 h period is 100% covered, but with only one minimum. This is unlikely for the reasons given before. Therefore, the 50.29 h solution for the secondary period was adopted.

The overall amplitude of the secondary lightcurve indicates an approximate projected a/b ratio of 2/1 for the satellite. Two apparent mutual events (occultations or eclipses) were observed. From these, the estimated size ratio of the pair is $D_s/D_p = 0.30 \pm 0.03$. Since only two events were observed, neither completely covered, these results are hardly definitive. Observations at future apparitions are strongly encouraged.

Acknowledgements

Funding for observations at the Palmer Divide Observatory is provided by NASA grant NNX10AL35G and by National Science Foundation grant AST-1032896. This research was made possible through the use of the AAVSO Photometric All-Sky Survey (APASS), funded by the Robert Martin Ayers Sciences Fund.

References

Henden, Arne A., Smith, T.C., Levine, S.E., and Terrell, D. (2012). “The AAVSO Photometric All-Sky Survey Completes the Sky.” American Astronomical Society, AAS Meeting #220, #133.06.

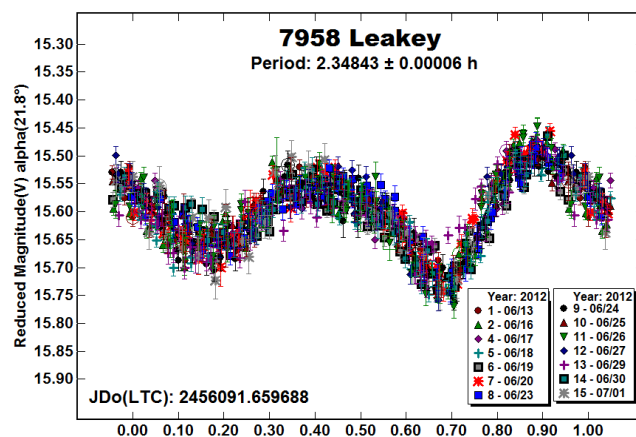


Figure 1. Lightcurve for 7958 Leakey due only to the rotation of the primary in a binary system.

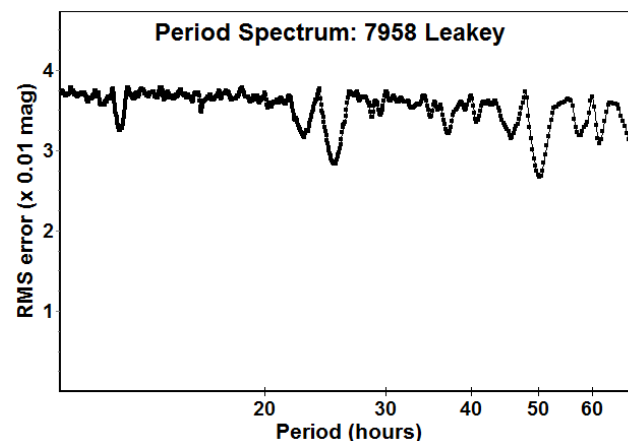


Figure 2. The period spectrum for 7958 Leakey after subtracting the rotation of the primary. The period of about 50 hours has the lowest RMS. A period near 25 h cannot be formally excluded but it is not likely. See the text for a discussion on why the longer period is considered correct.

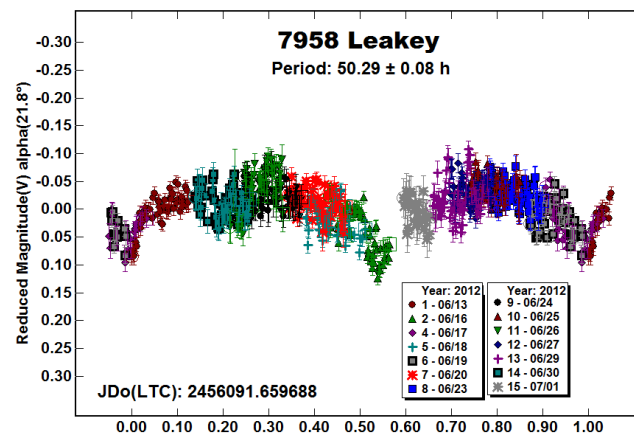


Figure 3. The lightcurve for the preferred secondary (orbital) period for 7958 Leakey after subtracting the rotation of the primary. In this case, the significant bowing is due to the rotation of an elongated satellite that is tidally-locked to the orbital period of 50.29 h. The sharp “dips” at about 0.0 and 0.5 rotation phase are most likely mutual events (occultation or eclipse).