Physical and orbital properties of the (22) Kalliope system from mutual eclipse observations.

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Motivation: In February of 2012 the binary asteroid system (22) Kalliope and its moon, Linus, reached an annual equinox, resulting in a season of mutual eclipse events as seen from earth. Mutual eclipse season for the (22) Kalliope system occurs every five years, and was last observed in 2007 [1]. The current observational campaign is the second one of its kind and involves an international network of observers organized by IMCCE and the SETI Institute. Lasting less than a month, the series of mutual eclipses were observed in February 2012. A refined orbit model of Linus, obtained by a genetic-based algorithm [2] and accurate to 15 milliarcseconds relative to the system primary, was used to predict the timing of mutual eclipses and occultations between the two components of the system. Photometric observations of mutual eclipses in the system will further our knowledge of both the shape of Kalliope and the orbital properties of Linus in this binary asteroid system.

Event Predictions: Lightcurve attenuation due to the shadow of the primary crossing the secondary, and vice versa, are predicted to last approximately two hours with a detectable dip in lightcurve amplitude ranging from 0.03 to 0.07 magnitudes. This is a small drop in flux and depends heavily on the shape of the primary as well as the orbit of the secondary and its size. As (22) Kalliope is bright ($m_V = 11$) it should be possible to detect these events from small aperture telescopes. The large secondary-to-primary size ratio of Linus to Kalliope of 0.2 is considered to be at the lower photometric detection limit for a binary system [3]. Detection of such photometric variation requires a photometric precision of approximately ±0.02 magnitudes, and require that reference lightcurves of the system are obtained either the night prior or after the predicted event.

Observations: Reference and event lightcurves were obtained in February and March 2012 using the 1-meter Nickel telescope at Lick Observatory at Mount Hamilton, CA, both on site and remotely from a facility at UC Berkeley. Observations were carried out on February 16, 22, 23, 24, and 25 in 2012, with more observations planned for March 4.

Additional lightcurves were obtained using the 152-mm Astro-Physics refractor at the University of Maryland Observatory in College Park, MD on February 6 and 7, as well as a 0.4-m Newton reflector telescope at Borowiec Observatory, Poznań Astronomical Observatory, Adam Mickiewicz University, Poznań, Poland on February 9, 10, 26, and 27. Other stations in the IMCEE and SETI Institute network also report successfully collecting event data.

Results: The data are being currently processed since the last event visible from Lick Observatory is predicted for March 4, 2012. Preliminary analysis from stations in the IMCCE and SETI Institute network suggest detection of lightcurve attenuation due to mutual eclipses. We will present the complete analysis of the observations preformed during this campaign. Based on Kalliope primary size and shape previously derived [1] we will determine the relative position and refine the size of the satellite. Ultimately, we hope to incorporate these astrometric positions to refine the size of Linus, and confirm the orbital model of this satellite.

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