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Hi’iaka’s physical and dynamical properties using long-term photometric data

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Hi’iaka is the largest satellite of the dwarf planet Haumea, with an estimated area-equivalent diameter of 300 km (Fernández-Valenzuela et al., 2021). It is the best studied satellite in the trans-Neptunian region. Its rotational light-curve was observed with Hubble, for which an approximate rotation period of 9.8 h was obtained (Hastings et al. 2016). The system is very peculiar because it stands out from all other TNO-binary systems. While all other known satellites are thought to be synchronous, Hi’iaka’s rotation period is fast compared to the 49 days that takes to complete an orbit around Haumea. Therefore, the study of Haumea-Hi’iaka system yields important information about the formation processes of the whole Haumea’s system, which includes another moon (Brown et al. 2006), a ring (Ortiz et al. 2017) and a family of objects (Brown et al. 2007).

Our group has been observing Haumea since its discovery, compiling a large database of images since around 20 years ago. Using this set of images we have obtained high accuracy astrometric measurements of the photocenter of the Haumea-Hi’iaka system. We have applied a similar procedure as in Ortiz et al. (2017) to disentangle the position of Haumea from the contribution of Hi'iaka, but for a much larger time span as mentioned above. Therefore, we have been able to determine more accurate orbits for Haumea and Hi'iaka.

Additionally, we have carried out two specific observational runs of several days in order to obtain the rotational phase of Hi’iaka at that moment of the two stellar occultations that occurred last year (in April 2021). We used the 1.23-m telescope at Calar Alto Observatory, the Artemis telescope at Teide Observatory and the 1.5-m telescope at Sierra Nevada Observatory to acquire images of the unresolved system. The resulting photometry of these images give rise two rotational light-curves of Haumea in 2021 and 2022. We fitted a fourth-order Fourier function, which represents Haumea’s body-shape contribution to the rotational light-curves. From this fit, we took the residuals of the observational data and searched for periodicities within them. We obtained a rotation period in agreement with the estimations in Hastings et al. (2016), but much more accurate. These residuals, when folded to the resulting period, provide Hi’iaka’s rotational light-curve. The amplitude obtained

for Hi’iaka’s rotational light-curve is 0.015 mag, which agrees with the expected signal induced in Haumea’s rotational light-curve when accounting for a variable source as that produced by Hi’iaka, i.e., considering the rotational light-curve obtained in Hastings et al. (2016). We have not detected a change in the amplitude of Hi’iaka’s rotational light-curve when comparing our data, taken in 2021 and 2022, with those from Hastings et al. (2016), taken in 2010. This means that the obliquity of Hi’iaka must be close to 90º in its orbit around Haumea.

Brown et al. (2006), The Astrophysical Journal, Volume 639, Issue 1, pp. L43-L46.

Brown et al. (2007), Nature, Volume 446, Issue 7133, pp. 294-296.

Fernández-Valenzuela et al. (2021), AAS Division of Planetary Science meeting #53, id. 503.05. Bulletin of the American Astronomical Society, Vol. 53, No. 7 e-id 2021n7i503p05.

Hastings et al. (2016), The Astronomical Journal, Volume 152, Issue 6, article id. 195, 12 pp.

Ortiz et al. (2017), Nature, Volume 550, Issue 7675, pp. 219-223.