(4337) ARECIBO

Dave Gault, Peter Nosworthy and Dave Herald (all of the Trans Tasman Occultation Alliance and International Occultation Timing Association) report the discovery of a 9-km diameter satellite of the minor planet (4337) Arecibo, from its occultation of the star UCAC4 323-126197 = Gaia EDR3 4064355353554962304 on 2021 May 19, 17:58 UT.

The observers (Gault and Nosworthy) sited on the east coast of Australia at the latitude of Sydney, had a cross-path separation of 0.7km and along path separation of 18km, with the asteroid’s shadow moving across the ground east to west. The observations were obtained using 30cm and 28cm reflectors, Watec 910BD video cameras (which have a response similar to the visual band) and GPS Video Time Inserters used to time stamp the video stream prior to recording to PC hard drives.

The observations were made when the star and asteroid were at an altitude of 65 degrees and was well clear of any local obstacle or obstruction at both sites. The sky was clear of clouds.

Both of their light curves show two occultation events, with all transitions being instantaneous. The light level during all four occultation events was reduced to zero. Their observations are summarised as:

Observer Location (Australia) Chord Lengths

Main body Satellite

Gault Hawkesbury Heights 18.7km 5.6km

Nosworthy Hazelbrook 19.7km 2.6km

The sky-plane separation of the satellite from the main body at 2021 May 19, 17:58 UT was 23.8 mas (35 km), in position angle 91 deg.

The lengths of the main body chords are consistent with the three NEOWISE measurements of the diameter of this asteroid (19.686, 17.840 and 17.704 km). A fit of a circle to the two chords for the satellite indicates a diameter of about 9 km. However the diameter measurement is poorly constrained, with it being within the range of 5 to 15 km.

No other known asteroid or comet was within a radius of 5 arc minutes of (4337) Arecibo at the time of the observation.

The possibility that the observation could be explained by the occultation of two components of a double star is excluded by reason of the complete disappearance of the star during both occultations. If the star was a double star, requires one component being brighter than mag 14.4. The limiting magnitude of the two recordings was 15.4 (Gault) and 15.5 (Nosworthy) determined by comparison with four nearby comparison stars in the range of Gaia EDR3 G-band mag 14.90 to 15.47. The asteroid magnitude was 17.0, well below the limiting magnitude of the recording. The complete disappearance of the star during all occultation events indicates the absence of any stellar component brighter than G-band magnitude 14.7, thereby excluding the possibility of the star being a double star.

The possibility of the asteroid being extremely elongate in a manner that would give rise to the events is excluded by way of its high improbability. In order for a single body to be responsible for both occultation events, it would need to be at least 48km long. To be consistent with the NEOWISE diameter (and consequential volume), it would have an average cross-section along its length of 8 km, and be bean-shaped to an extent that the occultations occurred at both ends but the star path missed the middle section. It would then need to be oriented in an extremely precise manner such that the observed occultations would occur – a configuration that is highly improbable.