Occultation results for the (15094) Polymele system – a *Lucy* Target. M. W. Buie[1,2], B. A. Keeney[1], H. F. Levison[1], and the *Lucy* occultation team. [1]Solar System Science & Exploration Division, Southwest Research Institute, 1050 Walnut St., Suite 300, Boulder, CO, 80302, USA; [2]buie@boulder.swri.edu.

Introduction: The smallest prime mission target of NASA's *Lucy* mission is (15094) Polymele, an asteroid with H_V=11.8 that likely has a P-type surface composition [1,2]. The absolute magnitude of Polymele is similar to that of the New Horizons extend mission target, (486958) Arrokoth (H_V = 11.06). As part of the mission-funded effort to obtain better characterization of all targets, we have been conducting occultation observations of all the prime mission targets to collect size, shape, and high-precision astrometry. Here we report on results from our occultation campaigns for Polymele that now include successful detections from six events.

Observations: We have a collection of 90 telescopes ranging in aperture from 20-40 cm that are deployed as needed.   So far, six campaigns have returned at least one positive occultation detection.

PO20200924, Senegal: 19 SkyWatcher8 systems were sent to a local team led by Maram Kaire and supported by a few astronomers from France. The weather conditions were difficult. 14 stations were deployed but only one collected data that provides a single chord 24.4 km long. A second site missed getting useful data by 20 seconds as clouds moved in.

PO20211001, Spain: 27 stations were deployed, mostly with 40 cm systems.   The weather was challenging and there were difficulties with the prediction. There were 3 positive detections that implied an elliptical shape incompatible with the first campaign.

PO20220327, US: 38 stations were deployed with mostly 20- and 28-cm telescopes from Colorado to North Carolina. 31 stations collected useful data with 17 positive detections of Polymele and 2 detections of a new satellite. One station reported multiple events.

PO20220826, Portugal/Spain: 31 stations were deployed with 28- and 40-cm telescopes. 20 stations collected useful data with 8 positive detections of Polymele. One station reported multiple events.

PO20221227, France: 1 station observed with a 28-cm telescope and obtained a positive detection with a 23.8 km chord.

PO20230204, US/Portugal/Spain: 108 stations deployed with 95 in the US and 13 in Portugal/Spain. Of these stations 82 were able to collect useful data. There were 10 positive detections of Polymele and 1 positive detection of the satellite.

Results: The incompatibility between the first two occultations was resolved with the third. All of the data are consistent with an elliptical profile with a minor/major axis ratio of about 0.45. These data imply a highly flattened disk shaped object very similar in size and aspect ratio to the larger lobe of Arrokoth. Polymele now becomes the second in this new class of flattened objects. The shape suggests that Polymele may retain much of a its original accretional shape however, the limb profiles show a much more complicated structure than is seen on Arrokoth (see Fig. 1). The 3D shape is discussed further in [3].

The initial estimate of the semi-major axis from PO20220327 was about 200 km and was used in planning the PO20230204 campaign deployment. More information on the orbit analysis can be found in a companion abstract in the conference [3]. Additional observations will be required to estimate an orbit good enough to usefully predict the satellite position and get a useful system mass.
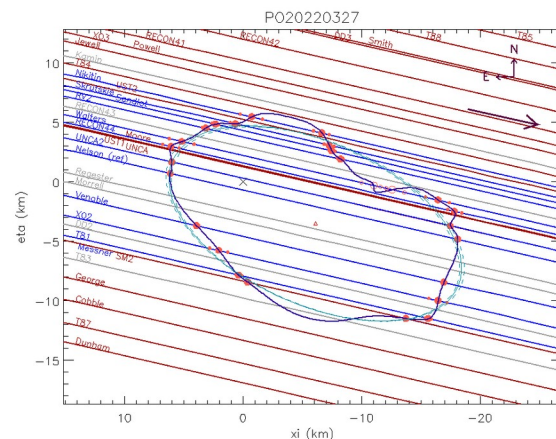

Figure 1: Sky-plane profile of Polymele from PO20220327. Blue lines show detections, red are negative, and gray are for no data. The formal elliptical fit is shown as well as a spline curve that passes through all data points and does not violate any negative observations.

References: [1] Levison H. F. et al. (2021) PSJ, 2, 171. [2] Olkin C. B. et al. (2021) PSJ, 2, 172. [3] Levison, H. F. et al. (2023) *This conference*.