TIME-RESOLVED PHOTOMETRY OF HIGHLY ELONGATE

ISO 1I/‘OUMUAMUA

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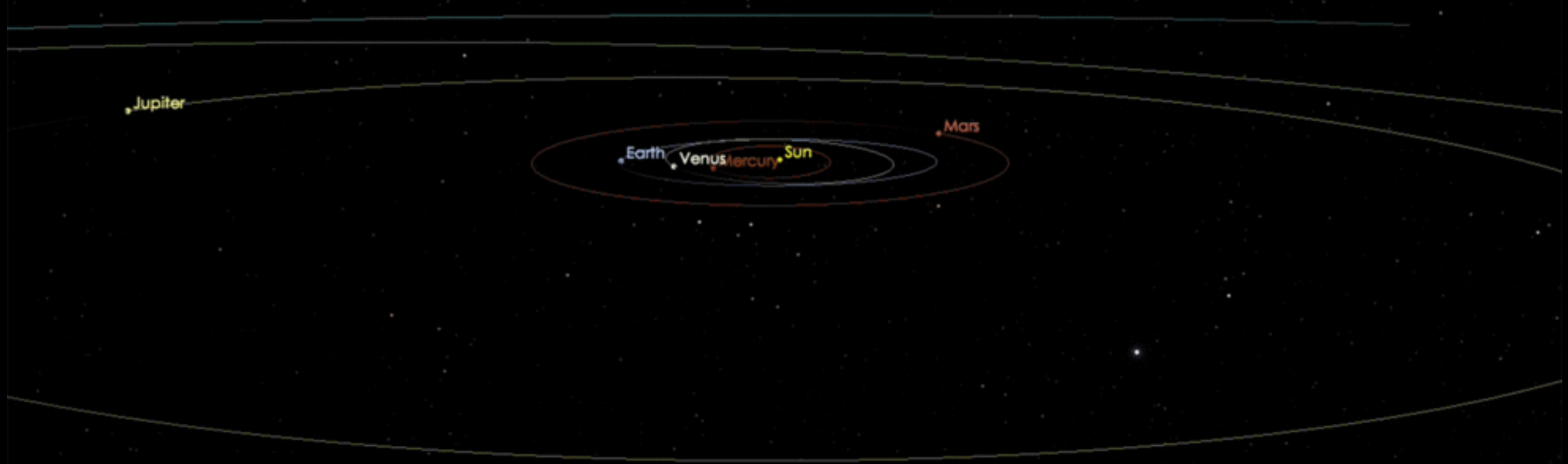
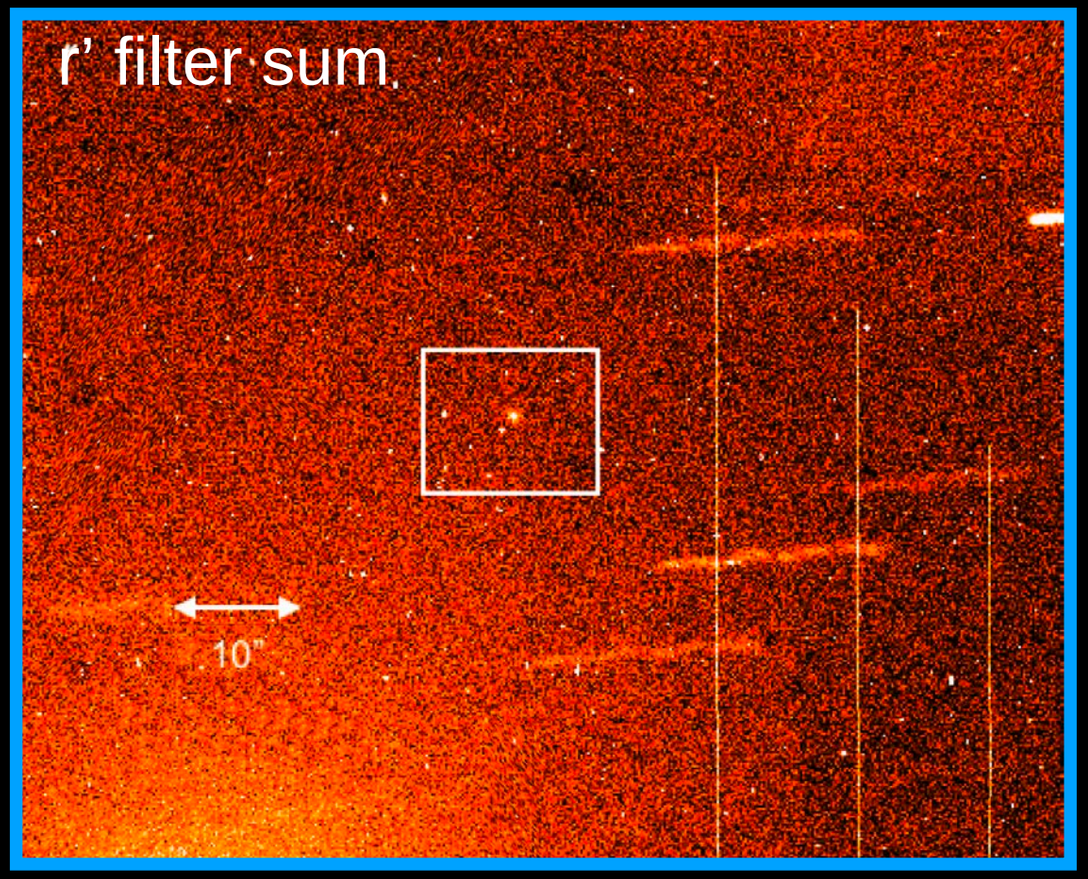
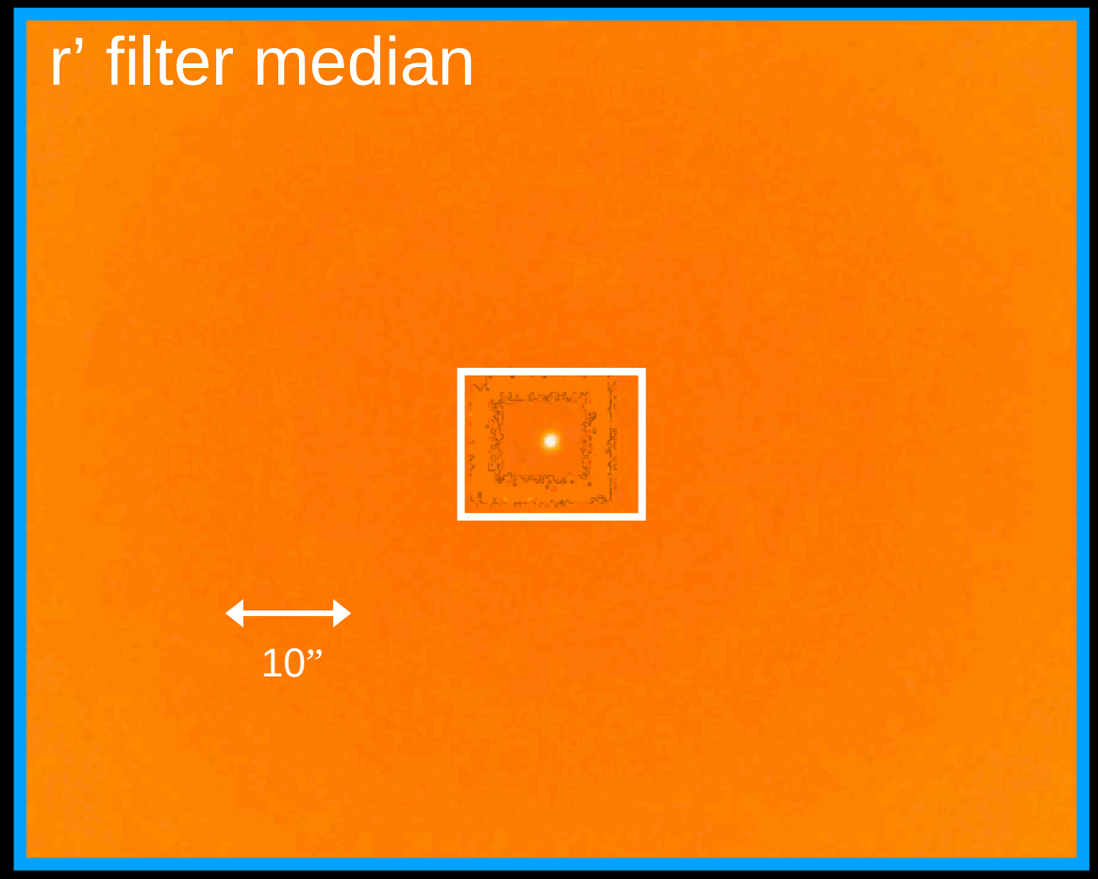
WHAT IS 1I/'OUMUAMUA?



- Discovered by Pan-STARRS, first clearly hyperbolic macroscopic object announced on 2017 October 25 (Williams, 2017)
- perihelion dist./date = 0.25 au / 2017-09-09, eccen. = 1.19, inc. = 122.59°, v_∞ ~10 km/s (Meech et al., 2017).

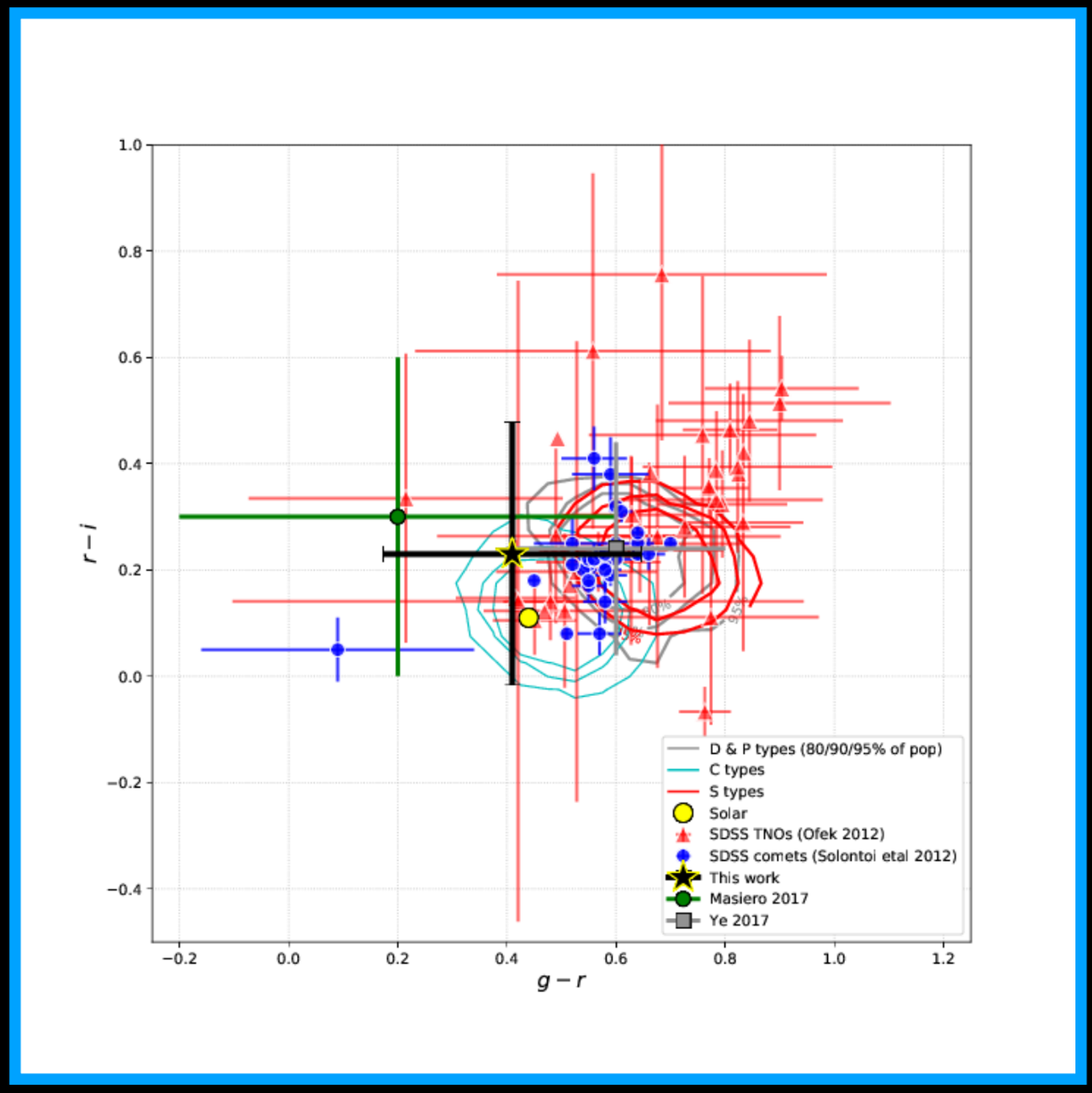
OUR OBSERVATIONS





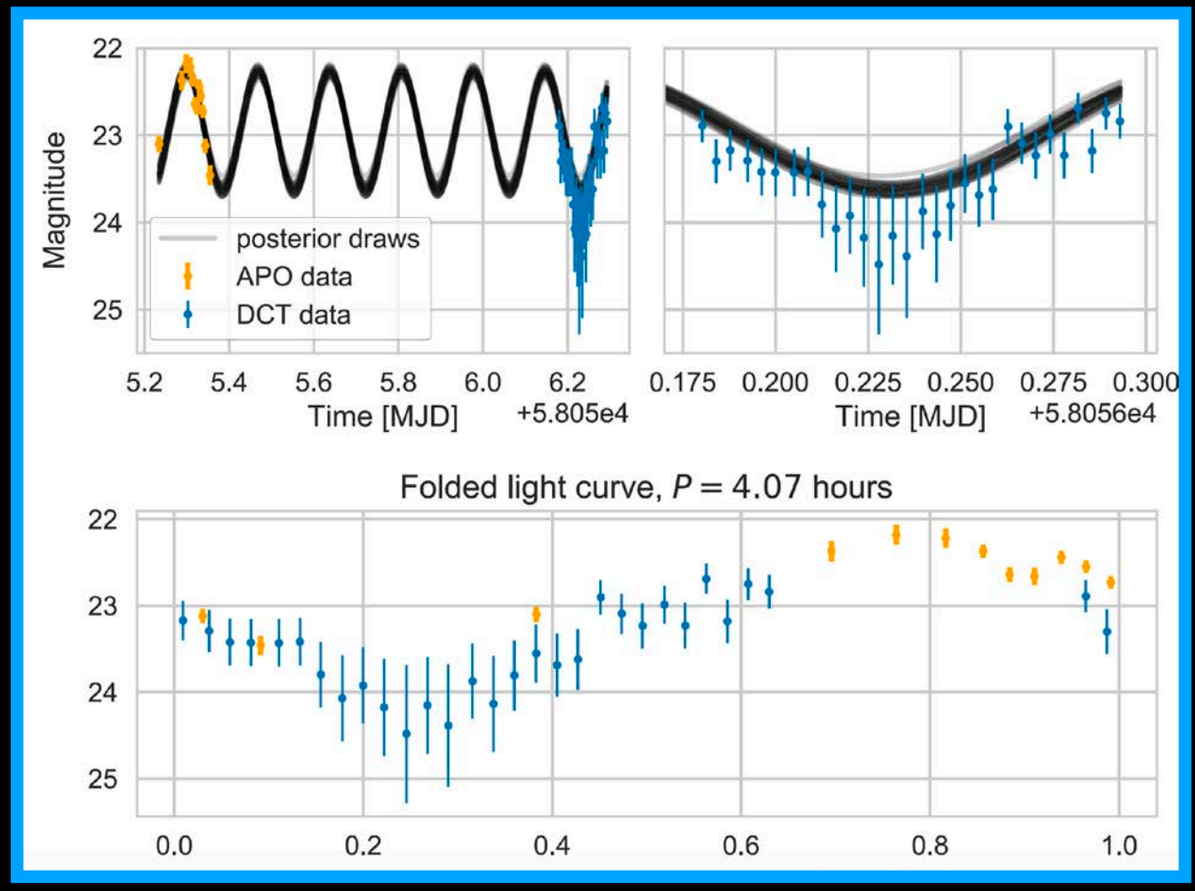
- We observed 1I in g’, r’ and i’ bands on 2017 October 29 obtaining 72 180 s exposure images with APO 3.5 m
- Geo. dist. = 0.53 au, helio. dist. = 1.46 au
  phase angle = 23.8°
- No coma detected

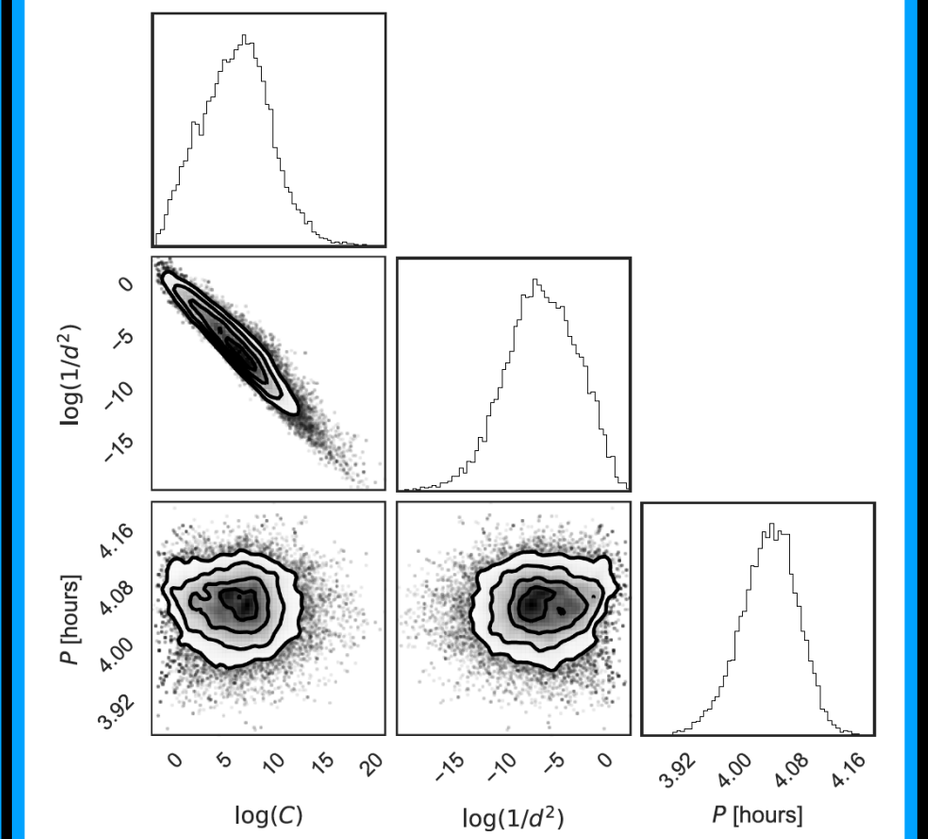
RESULTS



- g’ - r’ = 0.41 +/- 0.24, r’ - i’ = 0.23 +/- 0.25 consistent with visible spectra (Masiero et al. 2017, Ye et al. 2017, Fitzsimmons et al. 2017) and C/D asteroid type colors.

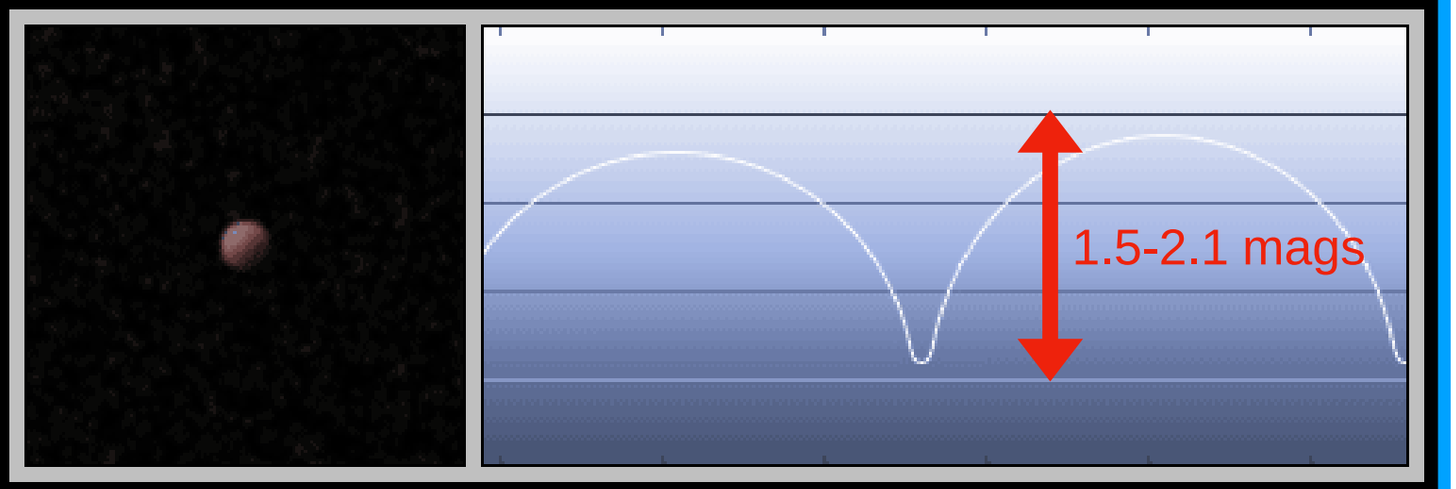
RESULTS

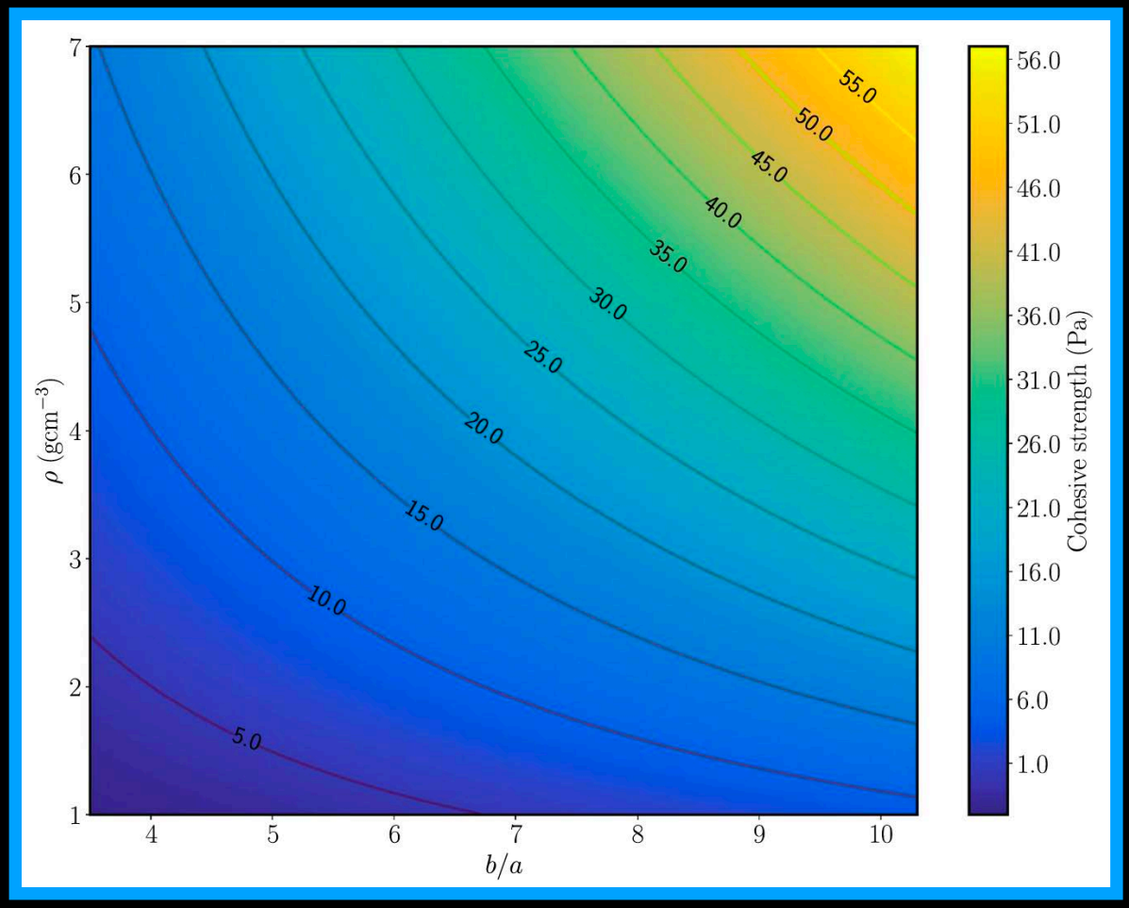




- 100 m < R_{EFF} = sqrt(a * b) < 200 m, assuming albedo 0.02 - 0.10.
- Significant brightness variability, ~4 hour lightcurve period when combined with DCT data taken on 2017-10-30 (Knight et al. 2017) Implies 8.1 +/- 0.02 double-peaked rotation period.

RESULTS





- Peak-to-trough amplitude of about 1.5 - 2.1 mag implying an a:b axial ratio of 3.5 to 10.3
- Probably has modest cohesive strength > 10 Pa

WHAT IS 1I?

- Likely came from a nearby binary star system (Meech et al. 2017, Portegies Zwart et al. 2017)
- May have obtained elongated shape in a tidal disruption event before being ejected from home system (Ćuk et al., 2017, Raymond et al. 2018)
- Has a tumbling rotation state (Fraser et al. 2017, Drahus et al. 2017)
- Non-detection of radio emissions (Enriquez et al. 2018)

PLEASE SEE OUR PAPER

The Astrophysical Journal Letters, 852:L2 (10pp), 2018 January 1 https://doi.org/10.3847/2041-8213/aaa0c9

APO Time-resolved Color Photometry of Highly Elongated Interstellar Object 1I/'Oumuamua

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Received 2017 November 13; revised 2017 December 3; accepted 2017 December 6; published 2017 December 22

Abstract

We report on *g*-, *r*-, and *i*-band observations of the Interstellar Object 1I/'Oumuamua (1I) taken on 2017 October 29 from 04:28 to 08:40 UTC by the Apache Point Observatory (APO) 3.5 m telescope's ARCTIC camera. We find that 1I's colors are $g - r = 0.41 \pm 0.24$ and $r - i = 0.23 \pm 0.25$, consistent with visible spectra and most comparable to the population of solar system C/D asteroids, Trojans, or comets. We find no evidence of any cometary activity at a heliocentric distance of 1.46 au, approximately 1.5 months after 1I's closest approach distance to the Sun. Significant brightness variability was seen in the *r* observations, with the object becoming notably brighter toward the end of the run. By combining our APO photometric time series data with the Discovery Channel Telescope data of Knight et al., taken 20 hr later on 2017 October 30, we construct an almost complete lightcurve with a most probable single-peaked lightcurve period of $P \simeq 4$ hr. Our results imply a double-peaked rotation period of 8.1 ± 0.02 hr, with a peak-to-trough amplitude of 1.5–2.1 mag. Assuming that 1I's shape can be approximated by an ellipsoid, the amplitude constraint implies that 1I has an axial ratio of 3.5–10.3, which is strikingly elongated. Assuming that 1I is rotating above its critical break up limit, our results are compatible with 1I having modest cohesive strength and may have obtained its elongated shape during a tidal distortion event before being ejected from its home system.

Key words: local interstellar matter – minor planets, asteroids: individual (1I/2017 U1 ('Oumuamua)