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Unique Multi-Tailed Active Asteroid 311P/(2013 P5) Panstarrs

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Abstract

The unique inner-belt active asteroid 311P/(2013 P5) PANSTARRS is notable for its sporadic, comet-like ejection of dust in nine distinct epochs spread over ∼250 days in 2013. This curious behavior has been interpreted as the product of localized, equator-ward landsliding from the surface of an asteroid rotating at the brink of instability [1,2,3, but see also 4]. We obtained new Hubble Space Telescope observations to directly measure the nucleus and to search for evidence of its rapid rotation. We find a nucleus with mid-light absolute magnitude H_V = 19.14±0.02, corresponding to an equal-area circle with radius 190±30 m (assuming geometric albedo p_V = 0.29). However, instead of providing photometric evidence for rapid nucleus rotation, our data set a lower limit to the lightcurve period, $P \geq 5.4$ hour. The dominant feature of the lightcurve is a V-shaped minimum, ∼0.3 magnitudes deep, that is suggestive of an eclipsing binary. Under this interpretation, the time-series data are consistent with a secondary/primary mass ratio, $m_s/m_p \sim$ 1:6, a ratio of separation/primary radius, $r/r_p \sim 4$ and an orbit period ∼0.8 days. These properties lie within the range of other asteroid binaries that are thought to be formed by rotational breakup. While the lightcurve period is long, centripetal dust ejection is still possible if one or both components rotates rapidly ($\leq$ 2 hour) and has a small lightcurve variation because of azimuthal symmetry. Indeed, radar observations of asteroids in critical rotation reveal "muffin-shaped" morphologies which are closely azimuthally symmetric and which show minimal lightcurves. Our data are consistent with 311P being a close binary in which one or both components rotates near the centripetal limit. The mass loss in 2013 suggests that breakup occurred recently and could even be on-going. A search for fragments that might have been recently ejected beyond the Hill sphere reveals none larger than effective radius $r_e \sim$ 10 m. These results are described in detail in the literature [5].

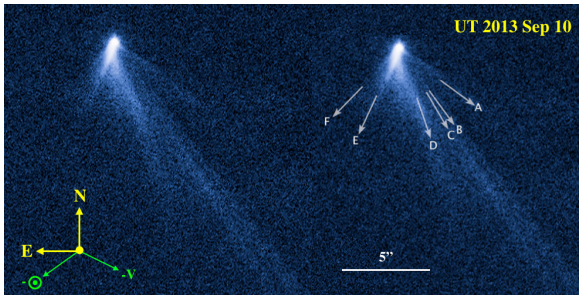

Figure 1: 311P imaged in an active state on UT 2013 September 10 (Jewitt et al. 2013). Letters mark individual dust tails. Three additional tails (G - I) were ejected after this image was taken (Jewitt et al. 2015b). The cardinal directions are indicated by yellow arrows while the projected antisolar vector (-⊙) and the negative heliocentric velocity vector (-V) are shown in green..

References

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