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Testing the Yarkovsky-driven evolution of the Eureka cluster with LSST

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The Trojan clouds of Mars are occupied by a handful of asteroids, the orbits of which, rather than being random, form a tight cluster around the 2-km body (5261) Eureka (Christou 2013, see Fig. 1). Of all clusters known to exist, this genetic association of asteroids is the closest to the Sun. How this family formed is still under investigation (Ćuk *et al.* 2015; Christou *et al.* 2017) but its proximity to the Sun, family member physical properties and existence of similar clusters of asteroids (Pravec *et al.* 2010; Pravec *et al.* 2018) thought to have arisen from YORP-induced fission of a parent body, all point to this latter mechanism as the culprit.

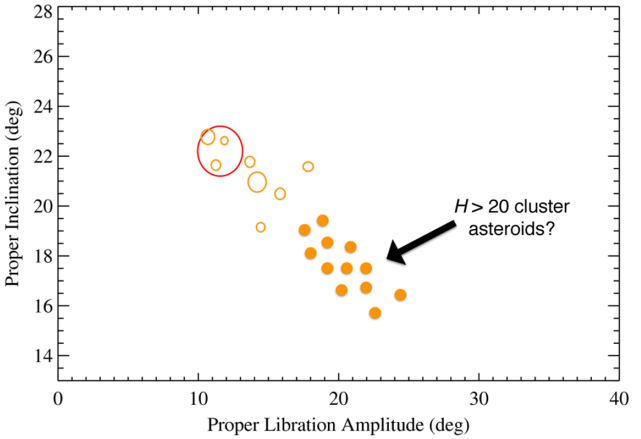

Figure 1. Eureka (red circle) and known cluster members (amber circles) in proper inclination vs proper libration amplitude space. Circle size is proportional to asteroid size. Solid amber symbols indicate the likely location of fainter, as-yet-undiscovered, members of this cluster if Yarkovsky efficiently modifies their orbits as per Ćuk *et al.* (2015).

The question of family age is closely related to its post-formation dynamical history. Christou (2013) and Ćuk *et al.* (2015) showed that, over a period $>10^8$ yr, the orbits gradually disperse due to the Yarkovsky effect. In particular, Ćuk *et al.* found that family member orbits plot along the locus of negative Yarkovsky acceleration suggesting that the observed distribution may reflect a long-term dominance of seasonal over diurnal Yarkovsky and proposed a ∼1 Gyr age for the family. If correct, smaller objects evolve faster than larger ones; this can be used to confirm the role of Yarkovsky. We estimate that the Large Synoptic Survey Telescope will push observational completeness of the population up to H∼23 and discover a few hundred additional members. The location

of the smaller objects relative to Eureka and the other Trojans will test the Ćuk *et al.* hypothesis (Fig. 1). Also, because the path in the space of libration amplitude vs inclination is largely deterministic, an approach similar to Milani *et al.* (2017) may constrain the family age.

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