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Small Perihelion Effects on Near-Sun Asteroids

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Many comets and asteroids spend part of their dynamical lifetimes with small perihelion distances (or "low-q") as a result of dynamical interactions with Jupiter. However, there are fewer such asteroids observed than are predicted by dynamical models, even while assuming a deficit due to collisions with the Sun or planets, or an escape from the inner solar system [1]. The lack of observed low-q asteroids is thought to be due to near-complete disintegration when they reach a perihelion distance $q \lesssim 0.076$ au. The extreme processes that cause disintegration likely create surface alteration on low-q asteroids, which can affect properties important to planetary defense (e.g., detectability, inferred composition).

Thermal cracking, spin-up, meteoroid impacts, and subsurface volatile release are disruptive near-Sun processes that are likely to cause surface alteration, which might change the spectral slope of the surface. Such surface alteration is observable from the ground using optical telescopes and provides us with a better understanding of the processes occurring and the effects they have on near-Sun asteroids. Observations are critical in preparing mitigation techniques that account for surface alteration caused by extreme thermal effects. Broadband optical colors (e.g., g'-r', r'-i') can be obtained quickly for fainter objects, which makes such observations optimal for a population study.

There are 51 known asteroids that reach perihelion distances of $q \leq 0.15$ au, twelve of which are potentially hazardous objects (PHAs). Only eight near-Sun objects have been included in previous studies of low-q asteroids [2, 3, 4]. Since 2017, we have undertaken a campaign to measure the optical colors of these objects, primarily using the 4.3-m Lowell Discovery Telescope (formerly the Discovery Channel

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Telescope) and the 4.1-m SOAR telescope, supplemented by data from the 2.5-m Isaac Newton Telescope and Lowell Observatory's 42-in and 31-in telescopes. We have successfully observed 24 low-q asteroids; we attempted to observe nine more low-q asteroids but were unsuccessful, most likely due to the large uncertainties in their orbits. In this work, we report the optical colors of low-q asteroids and resulting implications for planetary defense.

Comments:

Oral, Student Competition

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