Small Perihelion Effects on Near-Sun Asteroids

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Low-q Asteroids

- Small perihelion distance is common for asteroids and comets
- Subject to several potential near-Sun processes → surface alteration
- Characterization crucial for planetary defense
  - Detection
  - Mitigation

Project Goals

- Characterize as many asteroids as possible with perihelion distance $q \lesssim 0.15$ au
- Identify characteristics in objects that closely approach the Sun that can be attributed to thermal effects

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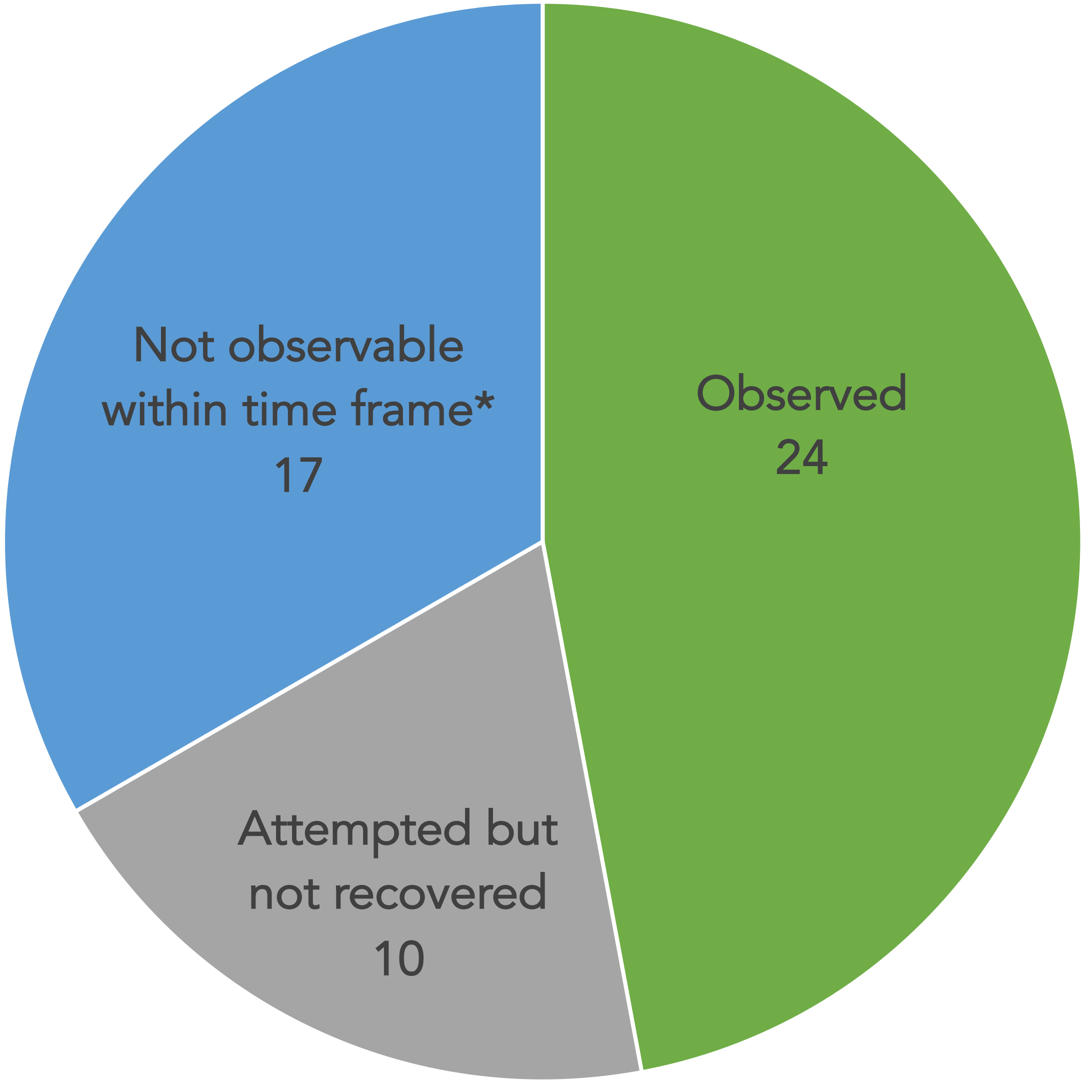
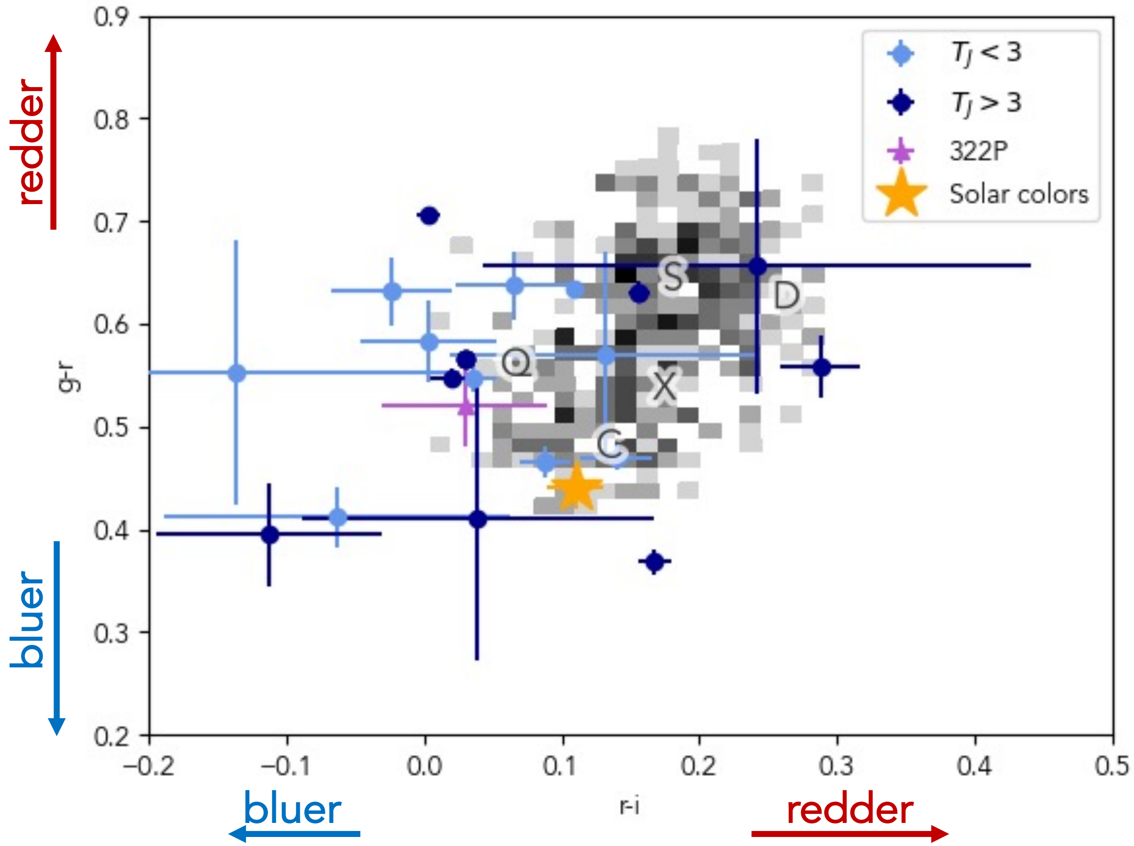
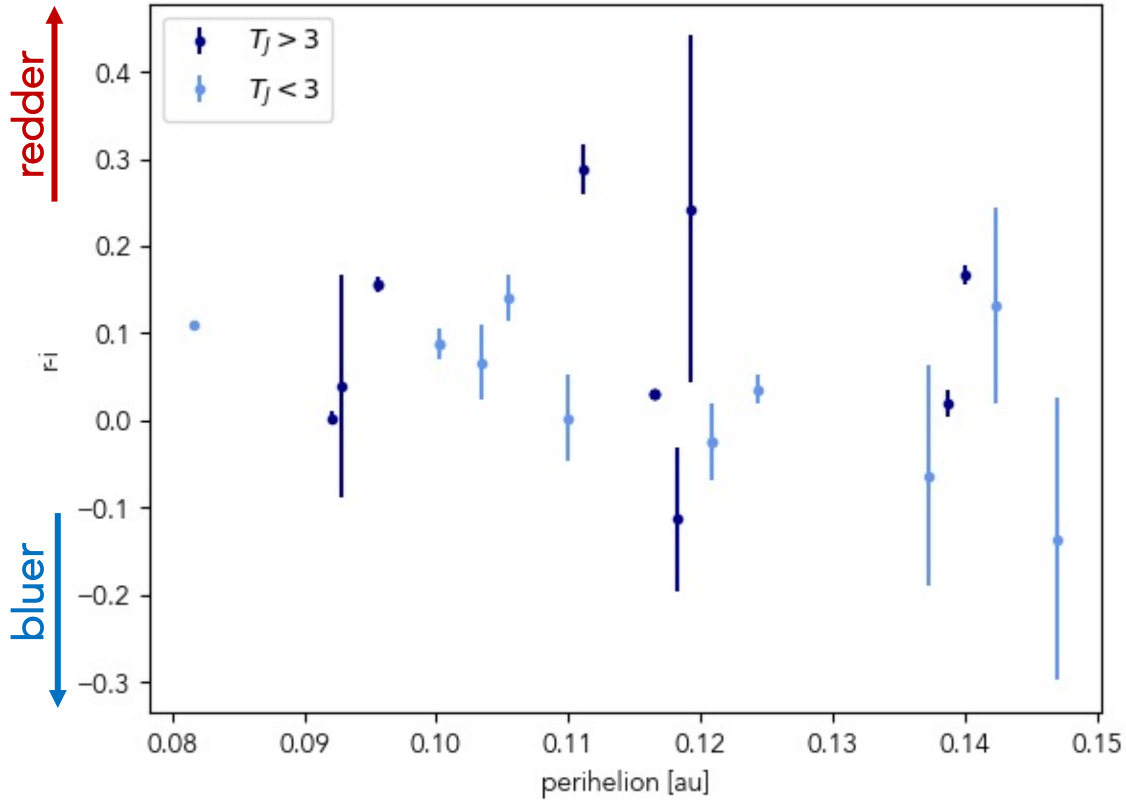
51 asteroids
with $q \lesssim 0.15$ au
(8 of them PHAs)



* 8 discovered in 2020/21

Results & Summary





- We attempted to **observe two-thirds** of known asteroids with q ≤ 0.15 au (34/51)
- Multiple interacting processes and varying orbital histories create a **wide range of colors of near-Sun asteroids** and an **unclear trend with decreasing perihelion distance**
- However, a slight preference to bluer colors suggests that **resurfacing mechanisms are dominant** (e.g. thermal fatigue)

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Audio Transcript

Hi, my name is Carrie Holt. My pronouns are she/her and I am a fifth-year graduate student at the University of Maryland. Today I am going to be talking about Small Perihelion Effects on Near-Sun Asteroids.

Small perihelion distance (or "low-q") is a common dynamical state for asteroids and comets. Near the Sun, these objects are subjected to processes that can alter their surfaces. These processes could include space weathering caused by irradiation from the Sun and other processes that cause resurfacing such as thermal degradation, sublimation, YORP spinup, or impacts. Characterizing low-q asteroids is important for planetary defense because surface alteration can affect how easily we can detect these objects and some extreme alterations could require unique mitigation techniques.

For our project, we attempted to observe as many asteroids as possible with $q < 0.15$ au over a three-year period. We use optical colors because they can be obtained quickly and for fainter objects so that we have a large sample size. We use this cutoff because it is SOHO's coronagraph's field of view. SOHO is a solar observatory, so while the observatory is focused on the Sun, all of our objects are in the telescope's view, though they are not bright enough to see.

There are a total of 51 asteroids with $q \leq 0.15$ au, 8 of which are potentially hazardous objects. We attempted to observe 34 of these objects and successfully observed 24, nearly half of the population. You can see a summary of observations in the pie chart.

By measuring the colors of these asteroids, we hope to identify any characteristics or trends that can be attributed to thermal effects.

Now our results….

Breaking down the left plot, you can see a large spread of data. Each point represents the color of an individual near-Sun asteroid. The 2D histogram in the background shows the average colors of near-Earth asteroids and the letters are the average color for the most common NEA spectral types. Looking at the spread, we see a potential trend of more objects to the lower left of the plot (which is bluer) compared to the redder upper right. Breaking down the right figure, we plot the colors with perihelion distance and we do not see any clear trend. In both plots, there is no apparent difference between the colors of objects with asteroidal orbits (the dark blue points) and cometary orbits (the light blue points).

The wide range of colors and unclear trend with decreasing perihelion distance is likely due to multiple interacting processes and varying orbital histories. However, our results do show a slight preference for bluer colors suggesting that resurfacing mechanisms such as thermal degradation could be dominant. Thank you for listening to my talk. I would love to chat with you about any questions or comments.