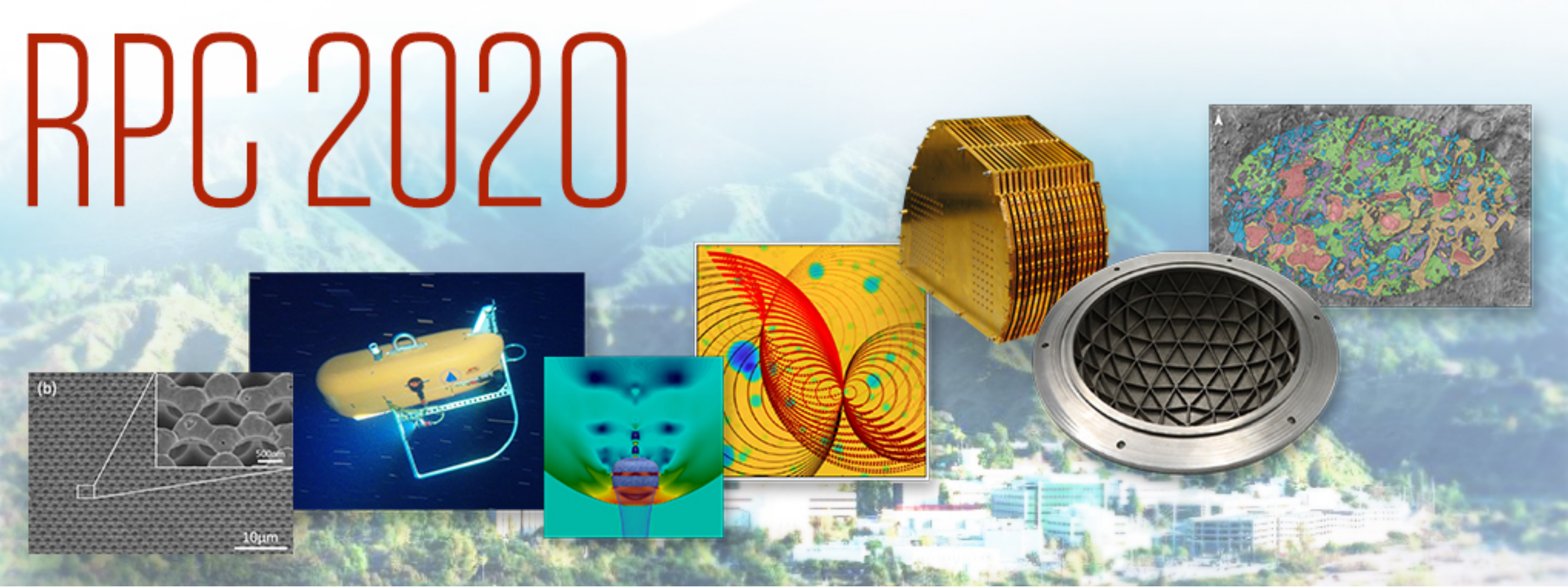


Virtual Research Presentation Conference

Support for NEOWISE Restart Science

Principal Investigator: Joseph Masiero (3224)
Co-Is: Emily Kramer (3224), Jana Chesley (3224), A. Mainzer (U. Arizona)
Program: Strategic Initiative

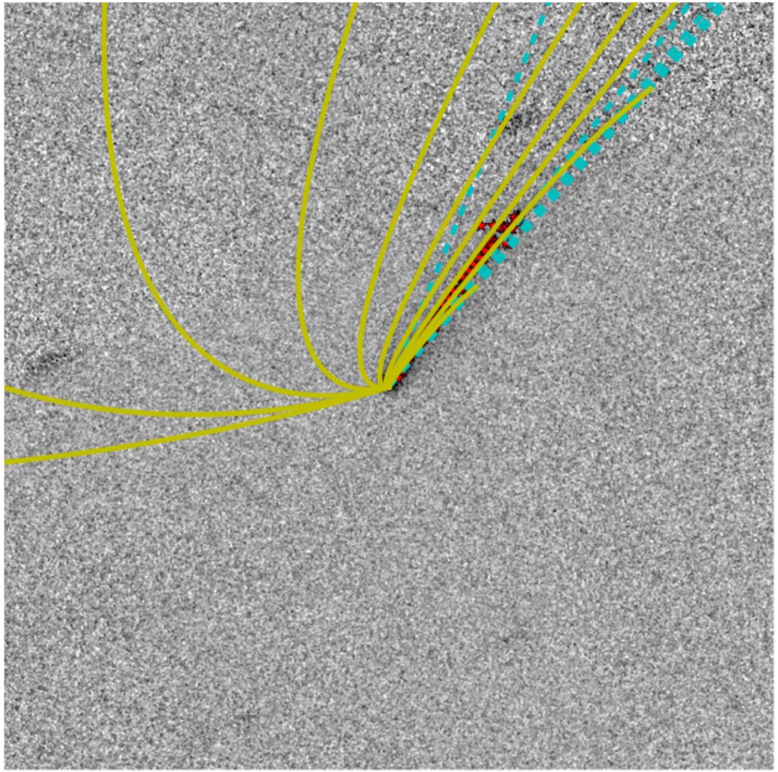
Assigned Presentation #RPC-007

Jet Propulsion Laboratory
California Institute of Technology

Tutorial Introduction

Abstract

The objectives of this task were to perform novel scientific investigations of Solar system objects using data from the NEOWISE mission, above and beyond mission-funded activities. Investigations include: analysis of comet dust tail formation and evolution; recovery of near-Earth objects missed by the automated processing due to high rates of motion; thermophysical modeling of asteroids seen at multiple apparitions by NEOWISE; spectral observations of near-Earth asteroids linked to the Euphrosyne family by NEOWISE data; thermal modeling of stacked detections of known objects too faint to be detected by the automated survey.



Example of comet tail modeling for C/2006 OF2. Cyan lines show the evolution of a distribution of particles released at the same time; yellow shows a single size released continuously. From Kramer et al. (2020).

Problem Description

a) The NEOWISE data archive contains a wealth of data, much of which is untapped.

b) Current survey operations only provide for the detection of moving objects, and characterization of those asteroids automatically detected by the survey.

c) Data from the infrared can be used to determine physical properties for asteroids and comets through thermal modeling and can be used to track the properties and evolution of cometary dust, enabling a better understanding of these populations and their formation and evolution.

d) Our results have demonstrated that the archive of NEOWISE data is a rich resource with important data that was not recognized by the initial processing due to the data requirements used. JPL scientists are at the forefront of NEOWISE analysis and understanding, and this RTD program has helped to expand the reputation of JPL in the world of asteroid and comet science. This RTD program also lays the scientific groundwork for the upcoming NEOSM mission, demonstrating the utility of data like what NEOSM will produce. NEOWISE analysis has helped us to constrain the number of potentially hazardous asteroids, their compositions, and their origins.

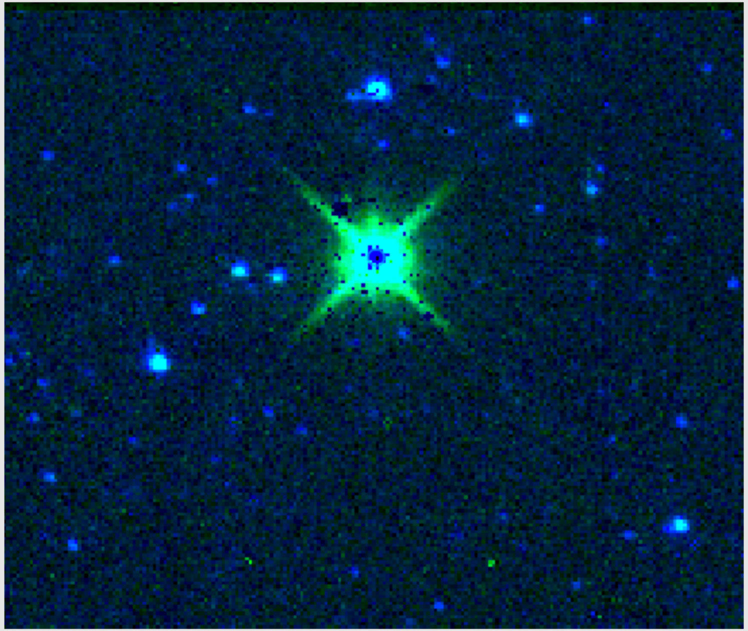
Methodology

a) Manual recovery of objects discovered by other asteroid surveys and observed by NEOWISE but not cataloged
   a) Reasons for this include acceleration of the on-sky motion, curvature in motion, or below the SNR cutoff.

b) Comet tail modeling employs Finson-Probstein modeling of the dust evolution to constrain the sizes of the tail particles, and the most likely date of peak particle release.

c) Thermophysical modeling of NEOs detected at multiple epochs allows to to constrain not just size, but also thermal inertia of the surface.

d) Stacking the predicted positions of known asteroids allows us to recover objects that were below the single-frame detection threshold, greatly increasing the number of objects we can characterize.



Example of a manually-recovered single-frame detection of asteroid (3200) Phaethon in the NEOWISE Reactivation data during a very close pass. The two-color image shows 3.4 microns in blue and 4.6 microns in green. Phaethon is the overwhelmingly-bright, green source. This observation was critical to thermophysical modeling of the asteroid.

Results

a) Through manual searching, we recovered observations of 299 NEOs not previously found in the NEOWISE automated processing.

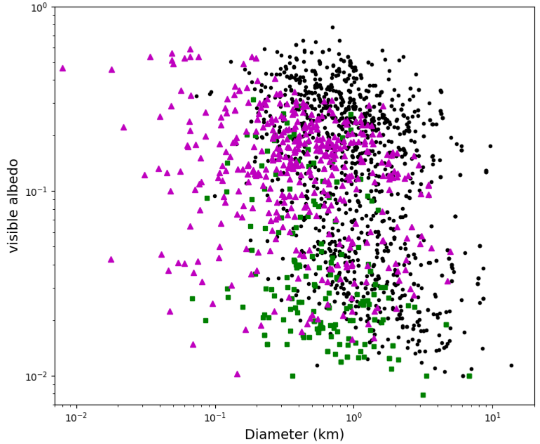
    a) Top figure shows our physical property results; previously characterized objects are in black, manual recoveries are in green (from Masiero et al. 2018) and magenta (from Masiero et al. 2020)

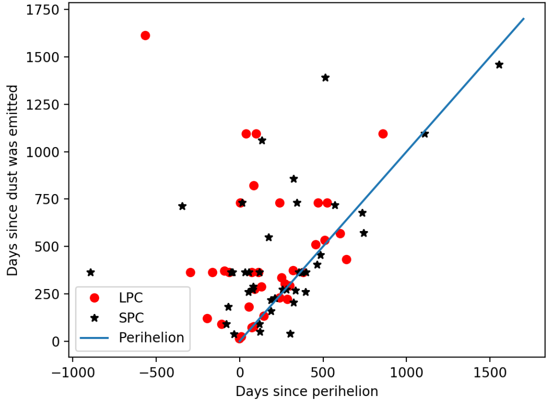
b) Physical properties distributions indicate that our sample shows a moderate bias in favor of high albedo objects, as would be expected as the input search catalog was found by visible light surveys.

c) Manual recovery also recovers smaller objects than found through automated searches

d) Comet tail modeling shows that dust emission for the vast majority of comets peaks at or before perihelion, with a rapid decrease in activity once the body is past perihelion (bottom figure)

    a) The figure here compares the amount of time prior to observation that the model determined the dust was emitted, compared with the amount of time since the perihelion of the body. Objects emitting at perihelion would fall on the blue line; objects with negative values on the x axis were observed prior to reaching perihelion (figure from Kramer et al. 2020)





Publications and References

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-Masiero, Redwing, Mainzer, et al., 2018, “Small and Nearby NEOs Observed by NEOWISE During the First Three Years of Survey: Physical Properties” Astronomical Journal, 156, 60.

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