National Aeronautics and Space Administration

Support for NEOWISE Reactivation Science

Principal Investigator: Joseph Masiero (322)
Emily Kramer (322), Jana Chesley (322), Amy Mainzer (U. Arizona)
Program: Strategic Initiative

Project Objective:

The goal of this program is to carry out scientific analyses of the Solar System objects observed by NEOWISE that are beyond the scope of the mission-supported work, but provide a significant benefit to JPL science leadership. Topics of study include:

- Diameter and albedo characterization of objects detected by the survey
- Thermophysical modeling of NEOs seen at multiple epochs
- Characterization of cometary dust and gas emission
- Identification and characterization of asteroids just outside the automated detection thresholds

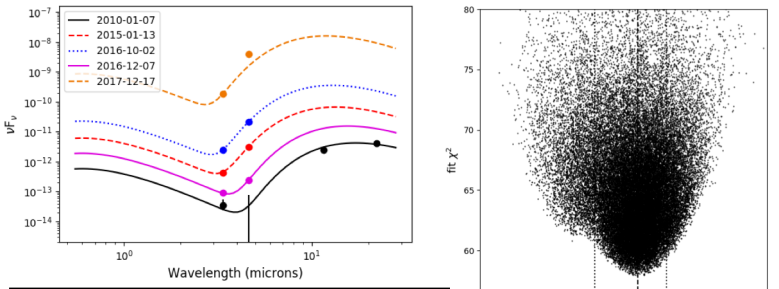
FY19 Results:

The team, with the assistance of four summer students, has been analyzing the data produced by the mission to help characterize the sizes and albedos of objects detected in the survey (following the work of Nugent et al. (2015), Nugent et al. (2016), and Masiero et al. (2017)). A paper describing the results from years 4 and 5 of the survey is about to be submitted for publication. In FY19 the team also produced a second release of compiled physical properties for asteroids and comets, which was published by the NASA Planetary Data system. Team members have also begun releasing light curve analysis for NEOs of interested detected in the survey (Cutri et al. 2019). Following the work of Mainzer et al. (2014) and Masiero et al. (2018), summer student Patrice Smith developed an automated routine that recovered detections of over 400 NEOs during the 5.5 years of survey to date that fell in this regime. Thermal fits are ongoing and a paper is in preparation; these data will result in an ~40% increase in the number of NEOs with diameters from the restarted NEOWISE survey and an ~20% increase in the total number of NEOs with measured physical properties. Finally, we conducted initial analysis of two NEOs with multiple NEOWISE observations that are targets of JAXA's DESTINY+ mission (Masiero et al 2019). We find that their albedos are consistent with B-type asteroids, and support the claim that they may have formed from the breakup of a larger body. Our thermophysical diameter, while consistent with previous infrared-based sizes, is significantly smaller than the observed maximum extent of Phaethon from radar. This conundrum has motivated the DESTINY+ team to conduct an occultation campaign to better characterize this asteroid.

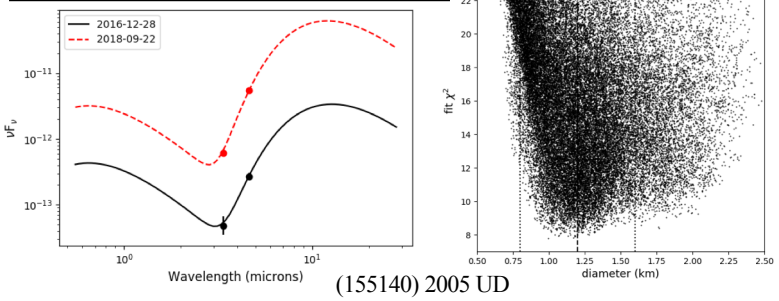
Benefits to NASA and JPL (or significance of results):

The restarted NEOWISE mission has discovered 166 new NEOs and 13 comets since the mission was restarted and began surveying in December 2013. These data allow us to find large, dark NEOs that are missed by other surveys. To date the NEOWISE reactivated mission has observed over 35,000 objects, of which over 1000 are NEOs. These data, which are sufficient to constrain diameters and albedos of the objects, will be critical to constraining the physical properties of Earth's nearest neighbors and allowing us to better understand the formation and evolution of the near-Earth population. The data from the all phases of NEOWISE mission has been cited in over 174 publications in 2019 alone, and in over 1100 publications since inception, across a range of scientific fields. The data taken as part of the Restart mission is thus useful for a large number of disciplines. However, the operations contract for the mission does not provide funding for scientific analysis tasks. The work conducted as part of this R&TD project will ensure that JPL maintains its place as leader in the use of NEOWISE data for scientific projects and the go-to destination for future NEO surveys.

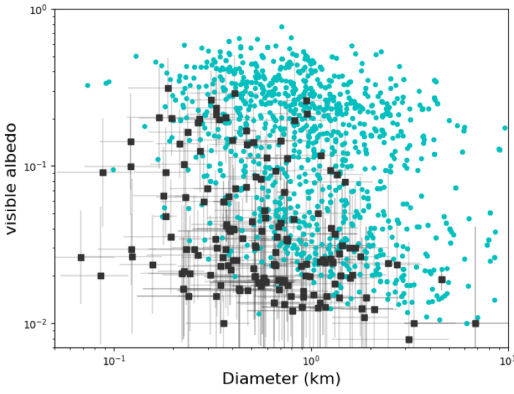
(3200) Phaethon



Best-fit spectral energy distribution (left) and diameter vs fit chi-squared (right) for near-Earth objects (3200) Phaethon (above) and (155140) 2005 UD (below). Thermophysical models require multiple viewing geometries to constrain surface properties like thermal inertia, but can provide better fits than more simple models when available. Figures from Masiero et al. (2019)



(155140) 2005 UD



Thermal modeling results for all near-Earth asteroids detected by NEOWISE's automated moving object processing system during the first 5 years of survey. Black points show objects discovered by NEOWISE, while cyan points show all other NEOs. NEOWISE preferentially discovers the large, low albedo NEOs missed by the ground-based surveys. For the whole population, albedo characterization can provide an initial estimate of composition, while the distribution of sizes allows us to trace the evolutionary history and formation of the NEO population.

Publications:

Masiero, J., et al., "Thermophysical Modeling of NEOWISE Observations of DESTINY+ Targets Phaethon and 2005 UD", 2019, AJ, 158, 97

Cutri, R., et al., "Mid-infrared Lightcurves of (523806) 2002 WW17", 2019, Minor Planet Bulletin, 46, 216.

Masiero, J., et al., "Asteroid Diameters and Albedos from NEOWISE Reactivation Mission Years Four and Five", 2019, in prep

PI/Task Mgr. Contact Information:

Joe Masiero, 3-5614, joseph.masiero@jpl.nasa.gov

National Aeronautics and Space Administration
Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

www.nasa.gov

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