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# The First Year of the NEOWISE Restarted Mission

**J. M. Bauer(1,9), A. K. Mainzer(2), T. Grav(3), J. R. Masiero(4), E. A. Kramer(5), C.R. Nugent(6,9), S. Sonnett(7), R. A. Stevenson(8), R. M. Cutri(9), E. L. Wright(10)**

(1) *Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Dr., Pasadena, CA 91109, USA, +1 818-393-6200,*
(2) *Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Dr., Pasadena, CA 91109, USA,*
(3) *Planetary Science Institute, 1700 East Fort Lowell, Suite 106, Tucson, AZ 85719-2395, USA, +1 812-272-6336,*
(4) *Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Dr., Pasadena, CA 91109, USA, +1 818-393-5614,*
(5) *Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Dr., Pasadena, CA 91109, USA, +1 818-354-0232,*
(6) *Infrared Processing and Analysis Center, California Institute of Technology, Pasadena, CA 91125, USA,*
(7) *Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Dr., Pasadena, CA 91109, USA, +1 818-354-4429,*
(8) *Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Dr., Pasadena, CA 91109, USA, +1 626-395-1938,*
(9) *Infrared Processing and Analysis Center, California Institute of Technology, Pasadena, CA 91125, USA, +1 626-395-1828,*
(11) *Department of Physics and Astronomy, University of California, P.O. Box 91547, Los Angeles, CA 90095-1547, USA, 818-354-0371,*

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***Extended Abstract—***

**NASA's Wide-field Infrared Survey Explorer (WISE) post-cryogenic mission reached its conclusion on February 1, 2011. On February 17, 2011, the WISE spacecraft was then placed into a hibernation state, and communications with it ceased. The WISE spacecraft has been brought out of hibernation to resume surveying the sky at 3.4 and 4.6 microns, and renamed NEOWISE for its new mission.**

**Operating in a terminator-following orbit, NEOWISE covers the sky twice over the course of a year, with an average of ~10 exposures per region of sky for each of the two visits, so that planetary objects are often observed at several different times, over short and long time-scales, throughout their orbit. The scientific objectives of the NEOWISE reactivation mission are to detect, track, and characterize near-Earth asteroids and comets[1,2].**

**Understanding the numbers, orbits, and physical properties of the asteroids and comets that approach Earth is essential both for characterizing the population of objects that pose a potential impact hazard, as well as for planning an appropriate mitigation strategy should one be discovered on a threatening trajectory. Of the approximately 10,700 near-Earth objects (NEOs; asteroids and comets with perihelia less than 1.3 AU) discovered to date, only the most basic properties (orbital parameters and absolute magnitude H) are known for all but ~2000 at present. Well-determined physical measurements such as taxonomic classification, sizes, shapes and rotational states are being determined for ~100 additional NEOs each year.**

**Over the course of its three-year mission, NEOWISE will determine radiometrically-derived diameters and albedos from its infrared observations for thousands of NEOs and tens of thousands of Main Belt asteroids. The 32 months of hibernation have had no significant effect on the mission's performance (Figure 1). Image quality, sensitivity, photometric and astrometric accuracy, completeness, and the rate of minor planet detections are all essentially unchanged from the prime mission's post-cryogenic phase.**

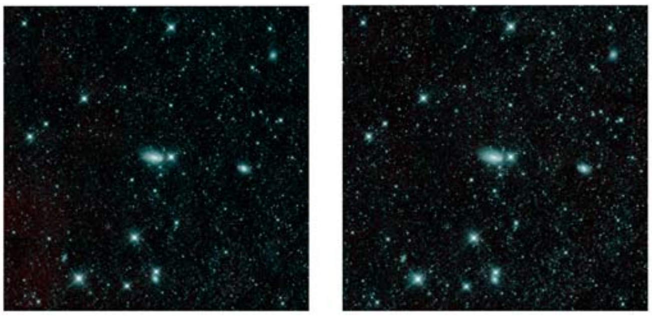

*Figure 1: 60 x 60 arc minute images created from two different phases of the mission of the same patch of sky. Left: Coadded exposures from the prime mission's post-cryogenic phase. Right: Coadd created from exposures obtained from the reactivated NEOWISE mission [2].*

The search for minor planets resumed on 2013 December 23, and has been active for over a year now. Within the first six days of the survey, the NEOWISE reactivated mission's first Potentially Hazardous Asteroid (PHA; an asteroid about 140 meters in size or larger and with an Earth minimum orbit intersection distance of less than 0.05 AU) discovery, 2013 YP139, was made (Figure 2). More than 10000 small bodies were observed during the first year of observations, including hundreds of NEOs for which accurate diameters can be determined [3]. Because the survey is in the infrared, NEOWISE detects asteroids based on their thermal emission and is equally sensitive to high and low albedo objects; consequently, NEOWISE-discovered NEOs tend to be large and dark.

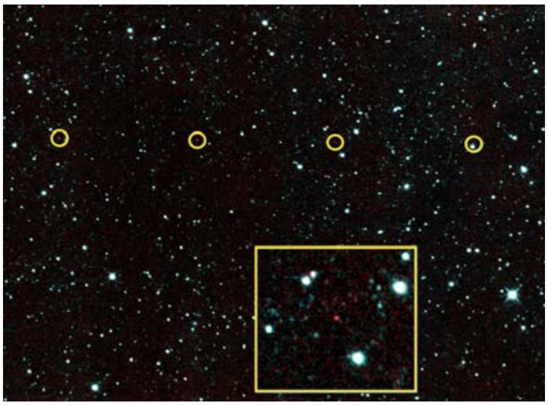

*Figure 2: The first new NEO discovered by the reactivated NEOWISE mission, 2013 YP139 (circled), is revealed to be large, 660±190 m, and dark ($p_V$~0.01). The inset shows a zoomed-in view of one of the detections [2].*

With over 60 comets detected [5], including 3 comets discovered [3], the survey will also yield the largest survey of comets in the infrared, providing unique constraints on nucleus size, dust temperature, dust production rates, and dust particle size and age for these active bodies, while sampling their behavior over a range of in-bound and out-bound heliocentric distances, as is being done for comet C/2013 A1 (Siding Spring; Figure 3) [4].

References: [1] Mainzer, A. et al. (2011) *ApJ,* 731:1, [2] Mainzer, A. et al. (2014) *ApJ,* 792:30, [3] Cutri, R. et al. (2015) *The NEOWISE Explanatory Supplement,* http://wise2.ipac.caltech.edu/docs/release/neowise/expsup/index.html, [4] Stevenson et al. (2015) *ApJ,* 798:L31. [5] Bauer et al. (2015) *WISE at 5 Conference,* http://wise5.ipac.caltech.edu/abstracts/bauer.html


*Figure 3: Two-band false-color images of Comet C/2013 A1 (Siding Spring) as observed by the NEOWISE mission in 2014 January (left panel), July (middle panel), and September (right panel). The 3.4 μm band is shown as blue, while the 4.6 μm band is shown in red. The contrast and stretch of each image is adjusted for clear viewing and are not constant across the panels. However, the scale and orientations, as indicated in the left panel, are the same for all images [4].*