COMETARY DUST TAILS IN NEOWISE E. A. Kramer[1], J. M. Bauer[1], Y. R. Fernández[2], A. K. Mainzer[1], J. R. Masiero[1], T. Grav[3], C. R. Nugent[1], S. Sonnett[1], C. M. Lisse[4], K. J. Meech[5], and the WISE Team. [1]Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Dr., Pasadena, CA 91109; [2]University of Central Florida, 4000 Central Florida Blvd., Orlando, FL 32816; [3]Planetary Science Institute, 1700 East Fort Lowell, Suite 106, Tucson, AZ 85719-2395; [4]Johns Hopkins University Applied Physics Laboratory, 11100 Johns Hopkins Road, Laurel, MD 20723; [5]Institute for Astronomy, University of Hawaii, 2680 Woodlawn Drive, Honolulu, HI 96822.

Introduction: Comets are among the most primitive objects in our Solar System, having undergone little alteration since their formation in the protoplanetary disk. Yet the comets have still experienced some changes due to different heating processes such as impacts and insolation [1]. These processes may have caused significant structural changes to the comet, possibly depleting the comet of volatiles at the same time. As a comet approaches perihelion, the thermal energy from the Sun warms the comet, causing volatiles to be released, and intermixed dust particles to be carried along with the escaping gas. The dust and gas form the characteristic tails for which comets are so well-known. Since the comets themselves are relatively pristine, the dust particles that comprise their tails are thought to be similar to particles in the protoplanetary disk. By studying the dust tails of comets in different populations (long-period comets [LPCs] and short-period comets [SPCs]), we can investigate the effect of heating on the structure of comets.

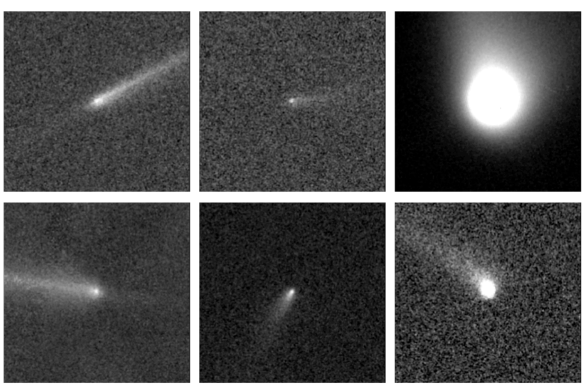

Figure 1: Montage of six comets observed by NEOWISE during the cryogenic mission, showing the variety of activity levels present in the data. The images are in 22-micron, and each image is 10' across.

NEOWISE is the planetary-funded mission that utilizes data from the Wide-field Infrared Survey Explorer (WISE) spacecraft to detect and characterize moving objects. The WISE mission surveyed the sky in four infrared wavelength bands (3.4, 4.6, 12 and 22-micron) between January 2010 and February 2011 [2, 3]. During the course of the prime mission, over 160 comets were serendipitously observed, including 22 newly discovered comets. About 89 of the comets observed by NEOWISE displayed a significant dust tail in the 12 and 22-micron (thermal emission) bands, showing a wide range of activity levels and dust morphology. A sample of six comets are shown in Figure 1. Since the observed objects are a mix of about 1/3 LPCs and 2/3 SPCs, differences in their activity can be used to better understand the thermal evolution that each of these populations has undergone.

Methods: Each comet was serendipitously observed multiple times by NEOWISE, and the individual images were stacked to increase the signal-to-noise ratio. For the comets that displayed a significant dust tail, we have estimated the sizes and ages of the particles using dynamical models based on the Finson-Probstein method [4, 5]. The Finson-Probstein method assumes that the motion of cometary dust particles is controlled only by solar radiation pressure and solar gravity, which can be parameterized by the ratio $\beta = F_{rad}/F_{grav}$. β can be thought of as a proxy for particle size, with larger β corresponding to larger particles. β is incorporated into the equation of motion that can be integrated to track the motion of particles with different β values.

For a selection of 40 comets, we have then compared these models to the data using a novel tail-fitting method that allows the best-fit model to be chosen analytically rather than subjectively [6]. For comets that were observed multiple times by WISE, the dust tail particle properties were estimated separately, and then compared.

Results: We find that the dust tails of both LPCs and SPCs are primarily comprised of ~mm to cm sized particles, which were the result of emission that occurred several months to several years prior to the observations. The LPCs nearly all have strong dust emission close to the comet's perihelion distance, and the SPCs mostly have strong dust emission close to perihelion, but some have strong dust emission well before perihelion. When comparing the two populations as a whole, we find that there is no statistical difference in the size of the particles between the two populations. Similar sized particles suggest similar internal structure and possibly a similar origin for the two populations. Further implications of these results will also be discussed.

NEOWISE Restart: Since the restart of NEOWISE in late 2013, over 60 comets have been observed in the 3.4 and 4.6-micron bands, including a roughly even mix of both SPCs and LPCs and three (as of early January 2015) newly discovered comets. As during the prime mission, the comets seen by NEOWISE have a wide range of activity levels, dust morphology, and gas morphology over a wide range of heliocentric distances. These data can be used to provide estimates of CO/CO_2 production rates, nucleus size, dust temperature, dust production rates, and dust particle size and age. We will showcase some preliminary results from the new data, highlighting several interesting cases.

References: [1] Prialnik, D. and Bar-Nun, A. (1987) *ApJ*, 313:893-905; [2] Wright, E.L. et al. (2010) *AJ*, 140; [3] Mainzer, A. et al. (2011) *ApJ*, 731:1; [4] Finson, M. and Probstein, R. (1968) *ApJ*, 154; [5] Lisse, C.M. et al. (1998) *ApJ*, 496; [6] Kramer, E.A. (2014) PhD diss.

Acknowledgments: This publication makes use of data products from (1) WISE, which is a joint project of UCLA and JPL/Caltech, funded by NASA; and (2) NEOWISE, which is a project of JPL/Caltech, funded by the Planetary Science Division of NASA. EK was supported by a NASA Postdoctoral Program Fellowship.