Small Bodies Assessment Group Meeting #14
NEOWISE Reactivation Update

The NEOWISE Team
Presented by James “Gerbs” Bauer, Deputy PI
January 27, 2016
NEOWISE Reactivation Overview

• Science objectives:
  – Survey Near-Earth Objects (NEOs) at mid-infrared wavelengths using WISE channels W1 and W2
  – Obtain physical characterization (including diameters and albedos) of these objects

• Science team members:
  – JPL: Amy Mainzer, PI; James Bauer, Deputy PI; Joe Masiero; Emily Kramer and Sarah Sonnett (postdocs)
  – IPAC: Roc Cutri, Carrie Nugent
  – PSI: Tommy Grav
  – UCLA: Ned Wright

• Project Mgr: Beth Fabinsky

• JPL roles:
  - Div. 32 (PI, Science Team)
  - Div. 31/34/39 (Operations)
  - 7X: Management
  - 8X: ESMC operations facility

• Partners:
  - IPAC Science data processing
  - BATC S/C ops support
  - SDL payload ops support
  - UCLA survey design
  - ATK operations support
  - Alethium GDS support

• Reactivation of NEOWISE mission following hibernation of WISE S/C in February 2011
  - 3.4 and 4.6 µm bands (W1 and W2)
  - ~75K post-cryo operation
  - Low-Earth orbit with downlink through TDRSS
  - Similar mission plan, observing strategy as WISE/NEOWISE
  - 3-year Survey
NEOWISE Reactivation Year 1 Data
Release 3/26, 2015

- MBAs
- NEAs
- Comets
• The reactivated NEOWISE has made infrared detections of 18159 solar system objects as of 1/22/16, including 467 NEOs of which 78 are new discoveries

• Recent discoveries include:
  – Two comets within a single day,
  – First Three NEO discoveries of 2016 are PHAs,
  – An Aten asteroid (2015 XY278) that crosses the orbits of the Earth, Venus and Mercury

• 301 deliveries to the MPC, including 40188 Tracklets
Diameters & Albedos Unchanged by Hibernation

Diameters and albedos using W1 and W2 are consistent with values from original NEOWISE mission

1st year follow-up, Nugent et al. 2015, ApJ 814, 177
NEOWISE Synergies with Other Projects

NEOWISE data:

- enable better predictions for radar target prioritization

2014 HQ124
- Discovered by NEOWISE 4/23/14
- Goldstone-Arecibo Obs. 6/8/14
- NEOWISE diam. 330+/-80m, Goldstone/Arecibo diam. 370m

- allow diameters and albedos to be computed for objects discovered by other surveys
- support precovery of NEO candidates using IRSA services
NEOWISE Supports coordinated campaigns:

- Comet C/2013 A1 Siding Spring observations
- C/2013 US10 Catalina
- Recent jointly coordinated observation campaign of 67P with the Rosetta mission MIRO instrument Team.
NEOWISE Depends on NEOO Program Observatories for Follow-up

YR1 + YR2 Follow-up
Nugent et al. 2016 (in prep.)

Extremely grateful for the follow-up effort of the community!!
Peer-Reviewed Publications

• Total citation count using NEOWISE data & discoveries: >200 refereed publications
  – Total citation count for WISE/NEOWISE >1500 refereed publications

• NEOWISE is a time-domain mid-infrared all-sky survey, so its science spans a wide range of topics
Recent Science Highlights
Diameters & Albedos from Reactivation Year 1

- Diameters accurate to ~20%, albedos to ~40%
- NEOWISE preferentially detects large NEOs
- NEO discoveries tend to be dark
- Nearly a quarter are PHAs
Euphrosyne Family Study

Masiero et al. 2015 (ApJ)

- Euphrosyne family mimics extinct JFCs in NEA populations
- Jupiter Tisserand parameter $< 3$ and albedos of a few percent
- Euphrosyne family populates an otherwise rare region of NEO space, allowing for direct links from NEO to formation

\[ 1.8 < T_j < 2.5 + \frac{0.5 \, q}{1.2} \]
Grav et al. 2015 (ApJ): Jovian Irregular Satellite populations darker than Jupiter Trojans or Hildas, and are a better match with cometary populations.
• Close & contact binaries can sometimes be identified by their large brightness variations

• We identified 77 Trojan and Hilda asteroids w/ large NEOWISE brightness variations:
  • → binary candidates.

• 29 new binary candidates out of 953 Trojans (13-150 km) → estimated fraction of 14-25%

• 48 new binary candidates out of 554 Hildas (4-36 km) → estimated fraction of 30-51%

Sonnett et al. (2015)

• Candidates are in need of follow-up to confirm binarity (follow-up underway)
Dust tails in the NEOWISE data

Example of WISE data dust tail analysis: Kramer et al. 2014 (based on PhD thesis work)

- Kramer et al ApJ (2016, submitted): Dynamical models are used to constrain the size and age of the particles, with the best models selected using a novel analytical tail fitting method.
The NEOWISE CO+CO$_2$ Survey

- Completed largest survey of CO+CO$_2$ to date
- LPCs and SPCs behave the same closer to Sun, but larger fraction of LPCs produce more CO+CO$_2$ further from Sun

- LPCs maintain more of their lighter volatiles
- Differences in CO+CO$_2$ reflect thermal history

Bauer et al. 2015, *The Astrophysical Journal*
Extinct comet candidates

- Licandro et al (2015, Astron. and Astrop.) *Size and albedo distributions of Asteroids in Cometary Orbits using WISE data*

Found that Tancredi-selected extinct comet candidates better-matched Centaur & JFC size distributions.
**NEOWISE 2016 Data Release**
Scheduled for March 2016

- **Single-exposure data** from the second year of the NEOWISE Reactivation Mission
- **Two complete sky coverages**, bringing total to four coverages since start of Reactivation

![C/2013 US10 (Catalina), Aug. 2015](image)

**Data access:**
- Image and source database from the NASA/IPAC Infrared Science Archive (IRSA) [http://irsa.ipac.caltech.edu/wise](http://irsa.ipac.caltech.edu/wise)
- Moving Object tracklets from the IAU Minor Planet Center
Year 2 NEOWISE Data Combined with Year 1 Data In Single Archive

<table>
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<tr>
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<th>Year 1</th>
<th>Year 2</th>
<th>Total</th>
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<tbody>
<tr>
<td>Single-exposure Images (image sets)</td>
<td>2,497,867</td>
<td>2,557,865</td>
<td>5,055,732</td>
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<tr>
<td>Single-exposure Source Database (detections)</td>
<td>18,468,575,596</td>
<td>19,691,230,571</td>
<td>38,159,806,157</td>
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<tr>
<td>Moving Object Tracklets (detections/objects)</td>
<td>136,635 10,200</td>
<td>162,736 11,786</td>
<td>299,371 17,240</td>
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<tr>
<td>Known Solar System Object Possible Assoc. List (entries/objects)</td>
<td>14,383,217 563,059</td>
<td>15,626,395 614,606</td>
<td>30,008,612 640,236</td>
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We are **excited** to see what will be done with this data release!

**Thank You!!**