



***Space-based NEO Detection
and Tracking:
NEOWISE and Beyond***

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Target NEO Workshop

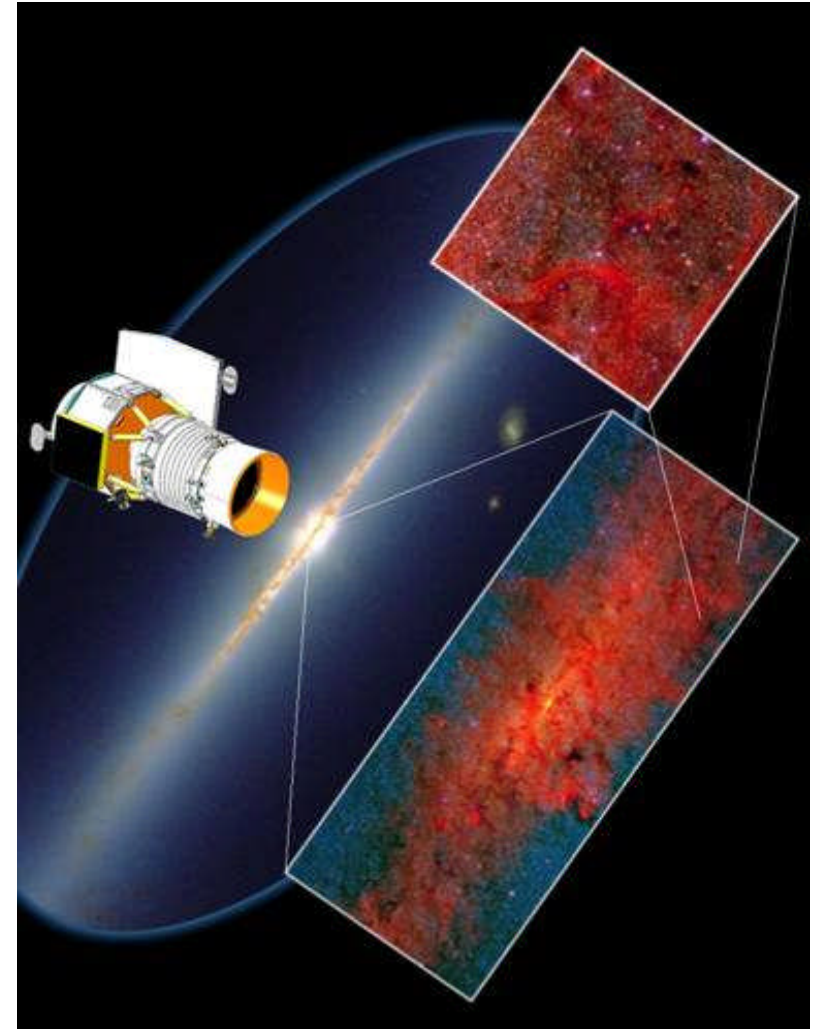
Science

- ***Sensitive all sky survey with 8X redundancy***
 - ***Find the most luminous galaxies in the universe***
 - ***Find the closest stars to the sun***
 - ***Provide an important catalog for JWST***
 - ***Study darkest asteroids & comets***

Salient Features

- ***4 imaging channels covering 3 - 25 microns wavelength***
- ***40 cm telescope operating at <17K***
- ***Two stage solid hydrogen cryostat***
- ***Delta launch from Vandenberg: 14 Dec 2009***
- ***Sun-synchronous 6am/6pm 500km orbit***
- ***Scan mirror provides efficient mapping***
- ***Cryogen exhausted October, 2010 as planned***
- ***PI: Ned Wright, UCLA***

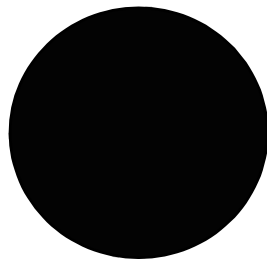
Wide Field Infrared Survey Explorer



Value of IR Asteroid Data



- The total flux of an asteroid, integrated over frequency and angle, gives the power intercepted from the Sun and thus the diameter.
- The range in optical albedo (Stuart & Binzel, 2004) corresponds to more than a factor of 5 in diameter, for the same (reflected) optical flux.



2.3% albedo, 2.6 km diameter



63% albedo, 0.5 km diameter

- **The range in IR emission due to absorbed and reradiated sunlight for a given diameter asteroid is much smaller (Walker 2003).**
- **With both IR & optical data the diameter and albedo are well determined.**
 - **Albedo also provides an estimate of asteroid composition and density, hence mass.**
 - **Asteroid mass is essential for hazard assessment.**

NEOWISE: An Enhancement to WISE

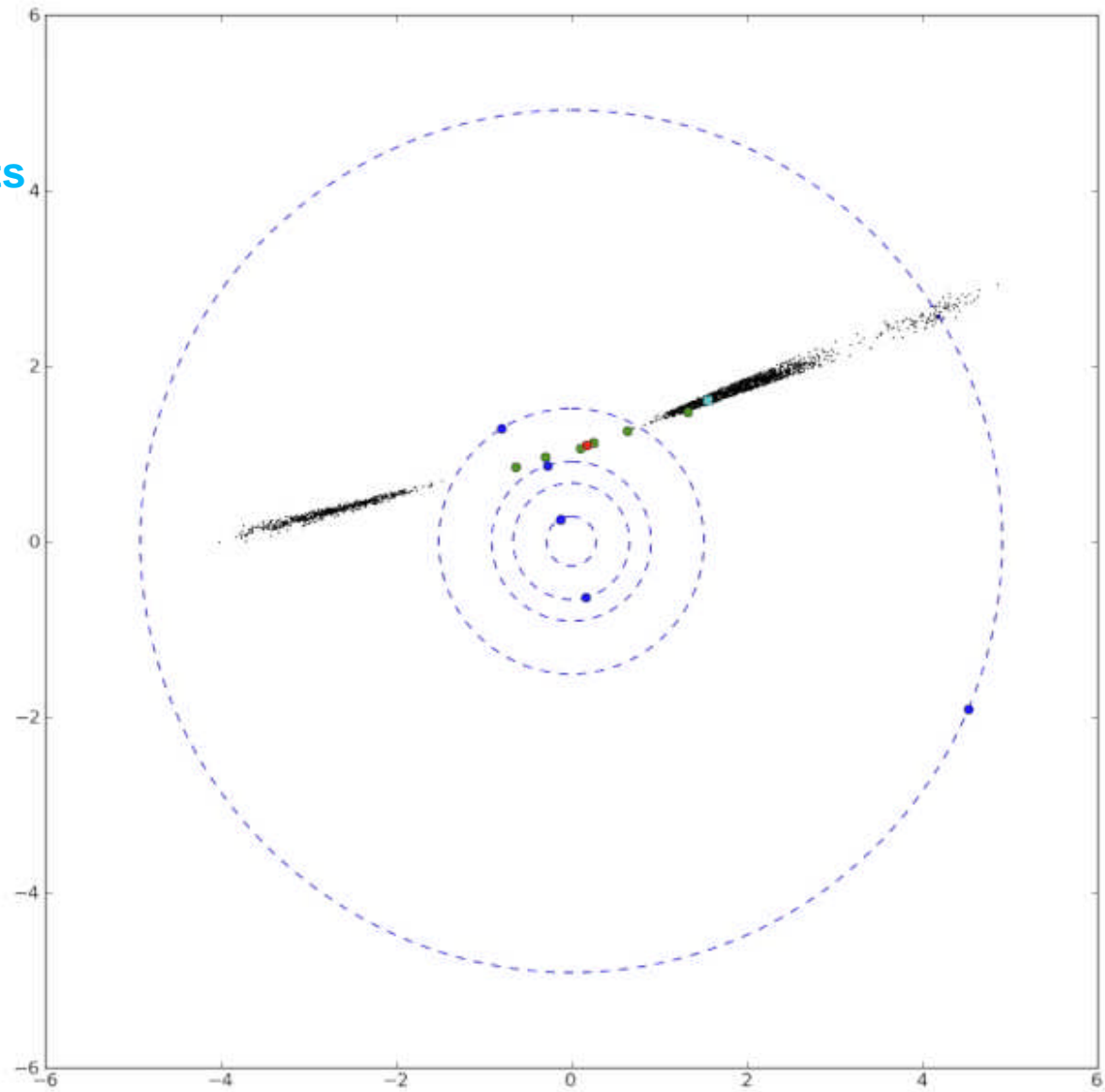


- The baseline WISE mission only identifies previously known solar system objects
 - WISE IS NOT A DEDICATED ASTEROID MISSION
- NEOWISE
 - Funded by NASA Planetary Science Division
 - Creates an archive of individual epoch images + a tool for accessing them, allowing moving objects discovered after WISE catalog production to be identified retroactively
 - Permits the discovery of new asteroids with WISE
 - Tracklets are delivered to Minor Planet Center within 10 days
 - WISE Moving Object Pipeline (WMOPS) derived from PS MOPS
 - Run 2x/week
 - Proposed augmentation will allow for final reprocessing at end of survey

NEOWISE Team

- A. Mainzer (PI)
- James Bauer (JPL)
- Roc Cutri (IPAC)
- John Dailey (IPAC)
- Tommy Grav (Johns Hopkins)
- Robert Jedicke (University of Hawaii)
- Bob McMillan (University of Arizona)
- Joe Masiero (JPL/NASA Postdoctoral Fellow)
- Dave Tholen (University of Hawaii)
- Russ Walker (MIRA)
- Students! (10 so far)

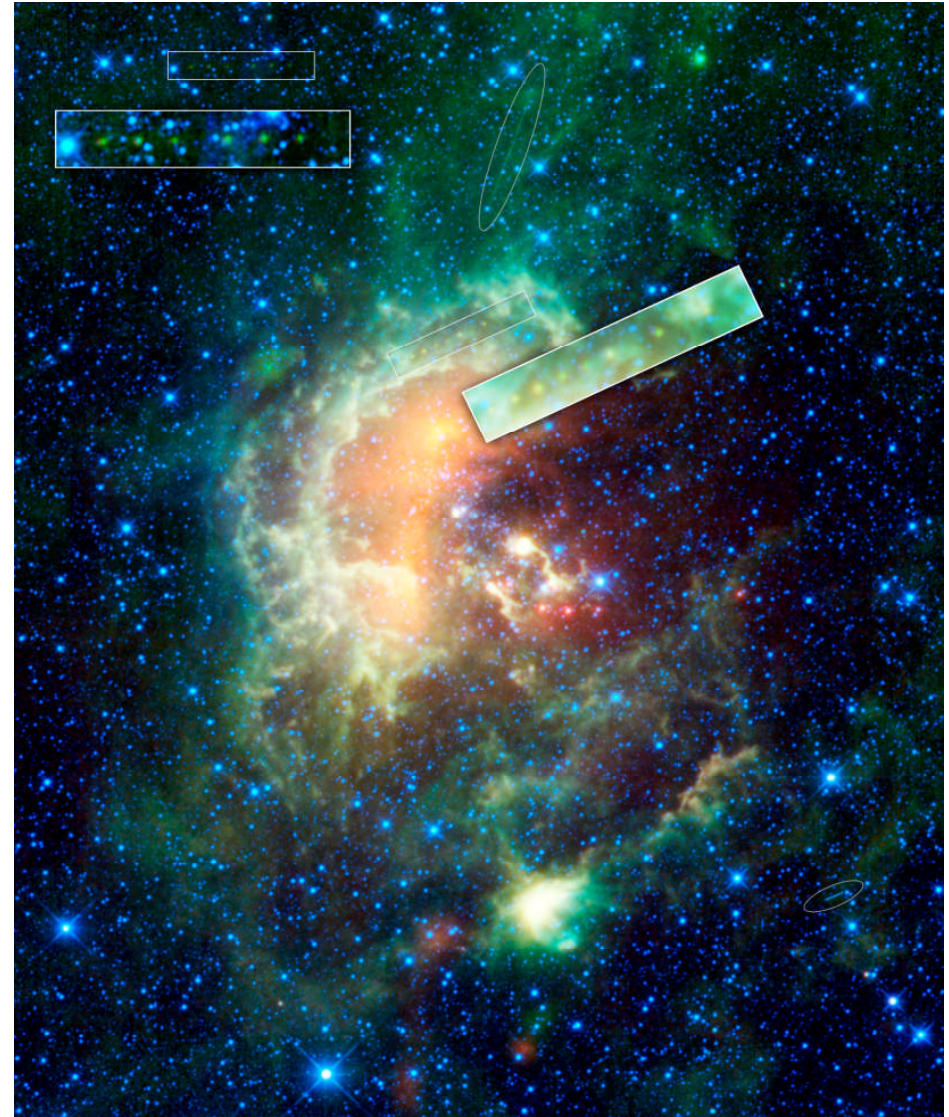
New NEOs
Known NEOs
New Comets
Known Comets



NEOWISE Results to Date



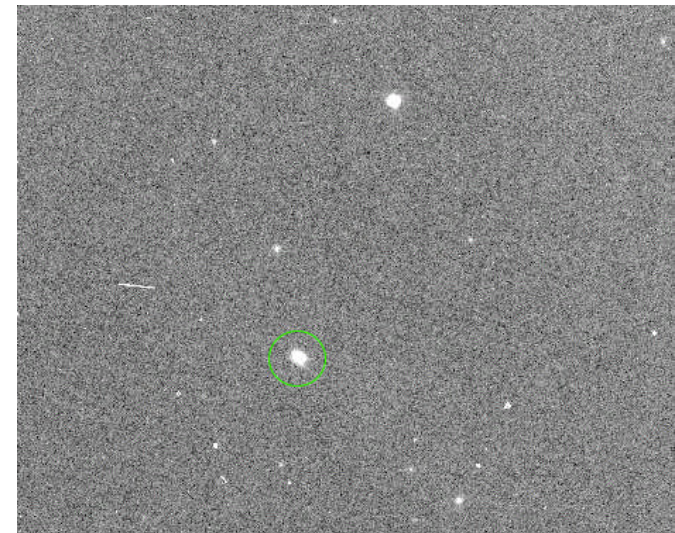
- **>157,000 objects observed, ~34,000 discoveries**
- **>585 NEOs observed to date, 135 discoveries (incl. 18 PHAs)**
- **~1800 Trojans observed, both L4 and L5 covered**
- **123 comets observed, 20 discoveries (16 named WISE, four named for other observatories)**
- **18 Centaurs and SDOs observed**
- **NEOWISE was leading observer of minor planets in 2010**



NEOs



- NEOWISE has observed 585 NEOs to date, 123 comets
 - Have derived preliminary size and albedo distributions for NEOs, as well as cometary fraction
- Great advantage of NEOWISE is that survey is uniform
 - No weather
 - No day/night
 - No seeing
 - Sample is independent: capable of discovering new NEOs
 - Not biased against dark NEOs
 - All sky coverage



2010 GM23: observed @ 3 lunar distances, $V \sim 17$

NEO Characterization



- NEOWISE data will yield
 - Fraction of population that is high inclination
 - Fraction of population that is dark
 - Fraction of population that is of cometary origin
 - Lightcurves in thermal
 - Can get shapes with optical lightcurves and radar
 - Get rotational pole, thermal inertia, Yarkovsky force

Examples



- 2010 DM56 (NEOWISE discovery)
 - $H=20.5$ indicates $D \sim 150\text{-}470$ m, but thermal fits to NEOWISE data give
 - $D=900$ m with $pV = 1.5\%$
- 2010 KH (NEOWISE discovery)
 - $H=20.1$ implies $D \sim 190\text{-}590$ m, but thermal fits give
 - $D=1$ km, $pV=2\%$
- 2006 JT6
 - $H=19.3$ implies $D \sim 270\text{-}840$ m, but thermal fits give
 - $D=2.2$ km, $pV=1\%$

Summary



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- NEOWISE has yielded a treasure trove of new information about minor planets that will keep the community busy for decades
 - NEOWISE demonstrates the power of space-based IR surveys to rapidly discover and characterize large numbers of asteroids & comets