Space-based NEO Detection and Tracking: NEOWISE and Beyond

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Target NEO Workshop

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WISE

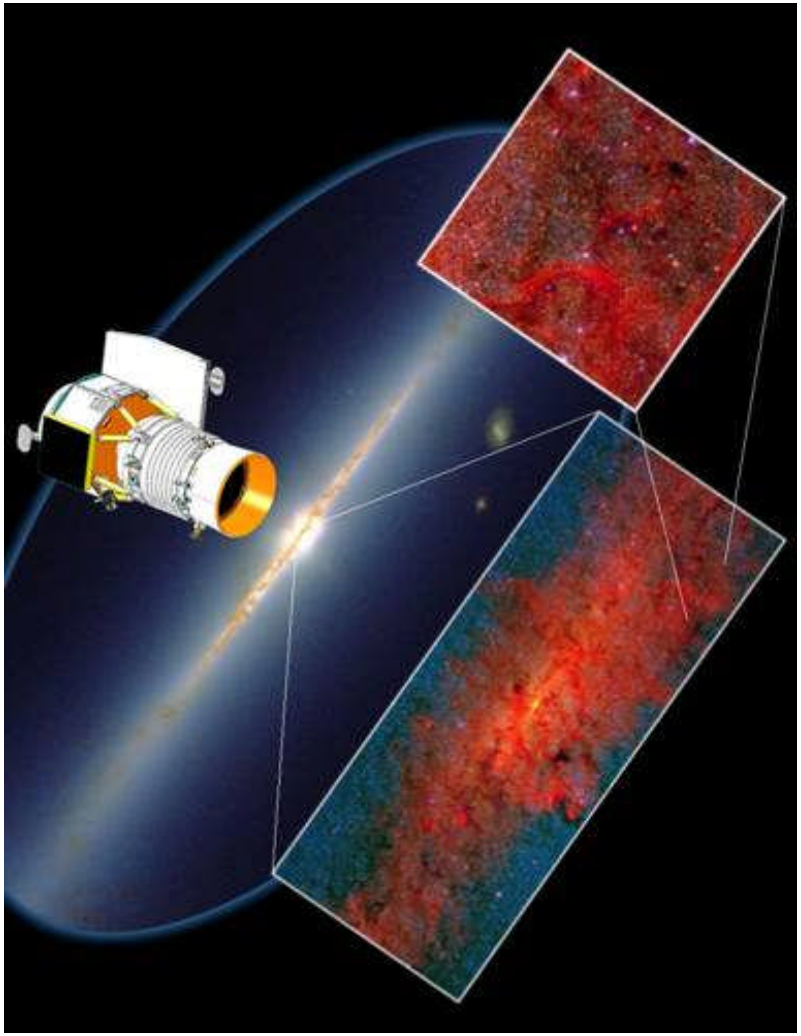
Wide Field Infrared Survey Explorer

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***



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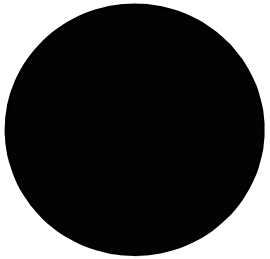
Value of IR Asteroid Data

- 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.**

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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

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NEOWISE Team

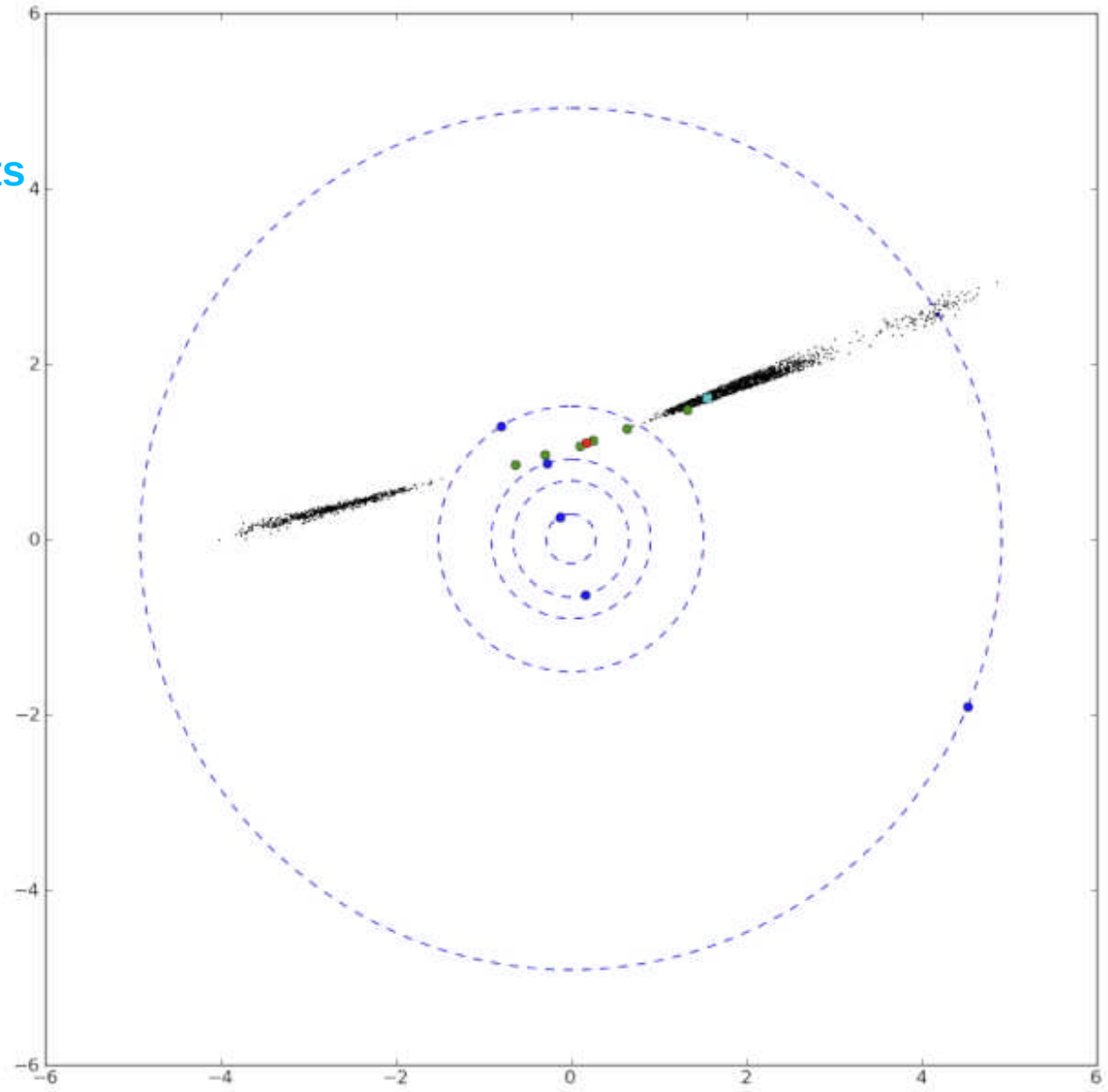
- A. Mainzer (PI)
- James Bauer (JPL)
- Roc Cutri (IPAC)
- John Dailey (IPAC)
- Tommy Grav (Johns Hopkins)
- Robert Jedicke (University of Hawaii)
- Bob McMillan (University of Arizona)
- Joe Masiero (JPL/NASA Postdoctoral Fellow)
- Dave Tholen (University of Hawaii)
- Russ Walker (MIRA)
- Students!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

New NEOs

Known NEOs

New Comets

Known Comets



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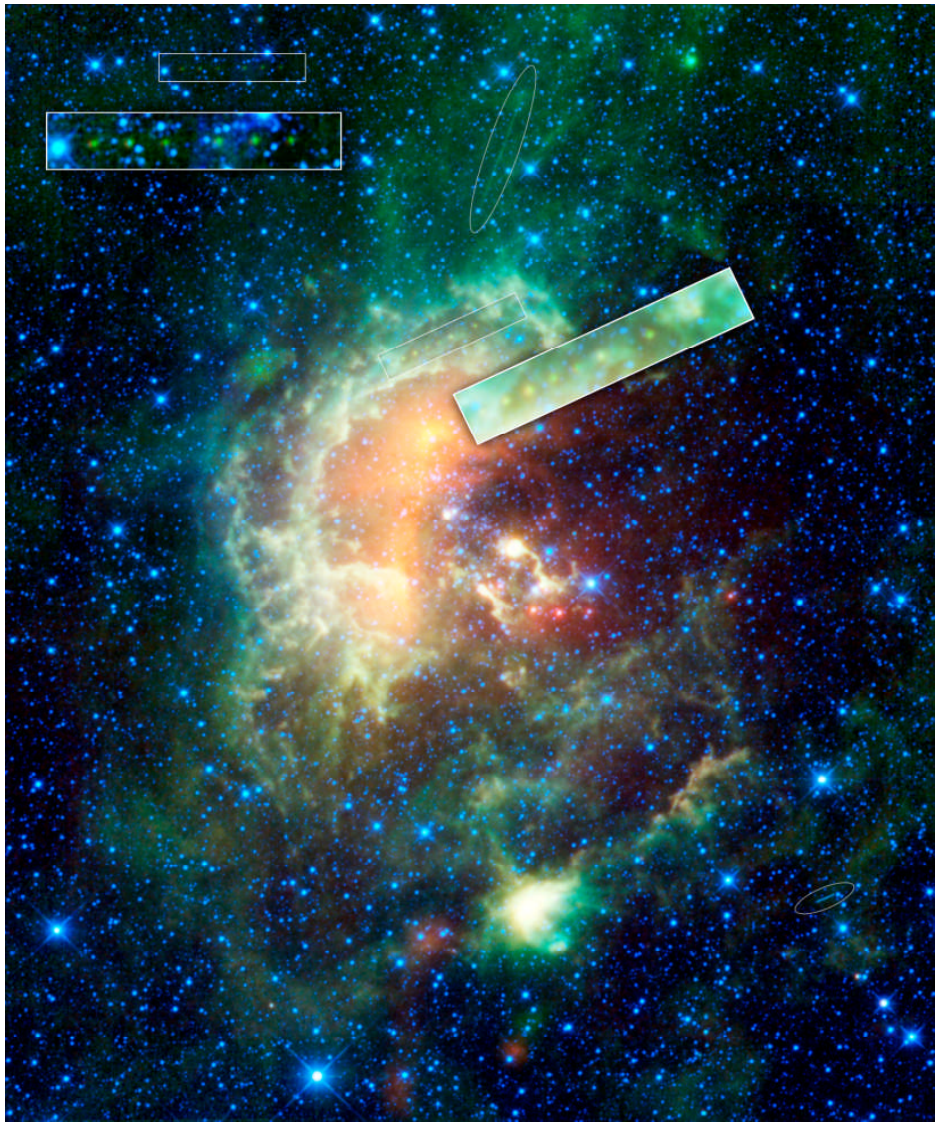
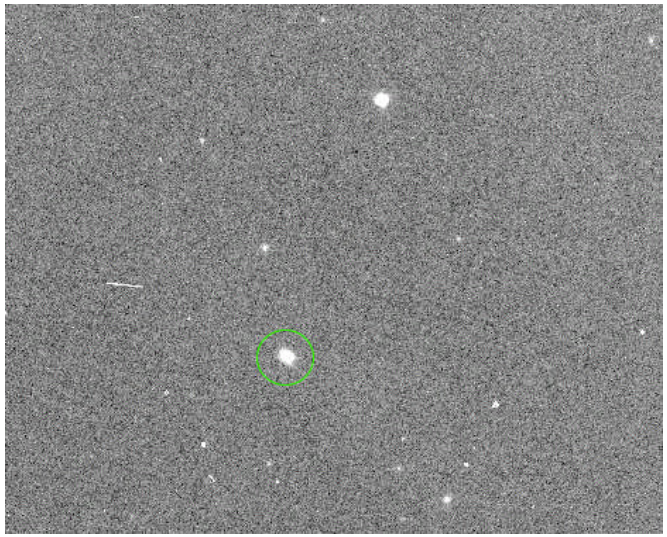
NEOWISE Results to Date

- **>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~17

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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~150-470 m, but thermal fits to NEOWISE data give
  - D=900 m with pV = 1.5%
- 2010 KH (NEOWISE discovery)
  - H=20.1 implies D~190-590 m, but thermal fits give
  - D=1 km, pV=2%
- 2006 JT6
  - H=19.3 implies D~270-840 m, but thermal fits give
  - D=2.2 km, pV=1%

Summary

- 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