


WISE

(Wide-field Infrared Survey Explorer)

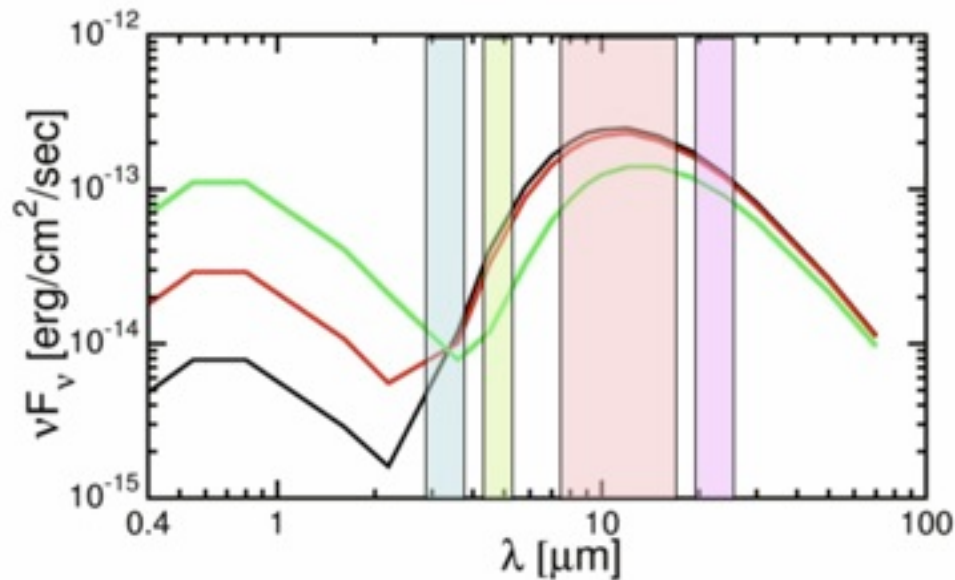
A Clear View of Dark Objects

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T. Grav (JHU), R. McMillan (UA)
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R. Walker (MIRA), E. Wright (UCLA)
and the WISE Team



C/2007 Q3 Siding Springs
WISE 4.6/12/22 microns

- WISE was designed to search for distant luminous galaxies and nearby brown dwarfs, but it is an excellent detection platform for solar system objects including:
 - Asteroids, comets, zodiacal dust bands, cometary debris trails, outer solar system bodies such as large Centaurs, Trojans and irregular satellites
- WISE will detect ~100,000 MBAs and hundreds of NEOs, 25%-50% of which should be previously unknown
- WISE bands sample thermal emission of asteroids
 - Sensitive to low albedo (dark) objects
 - Enables size determination
 - Complements visual light surveys
- WISE will also enable probes of physical properties & processes such as the Yarkovsky effect and surface thermal properties



WISE 3.4, 4.6, 12, and 22 μm bands superimposed on SEDs of MBA and NEO asteroids

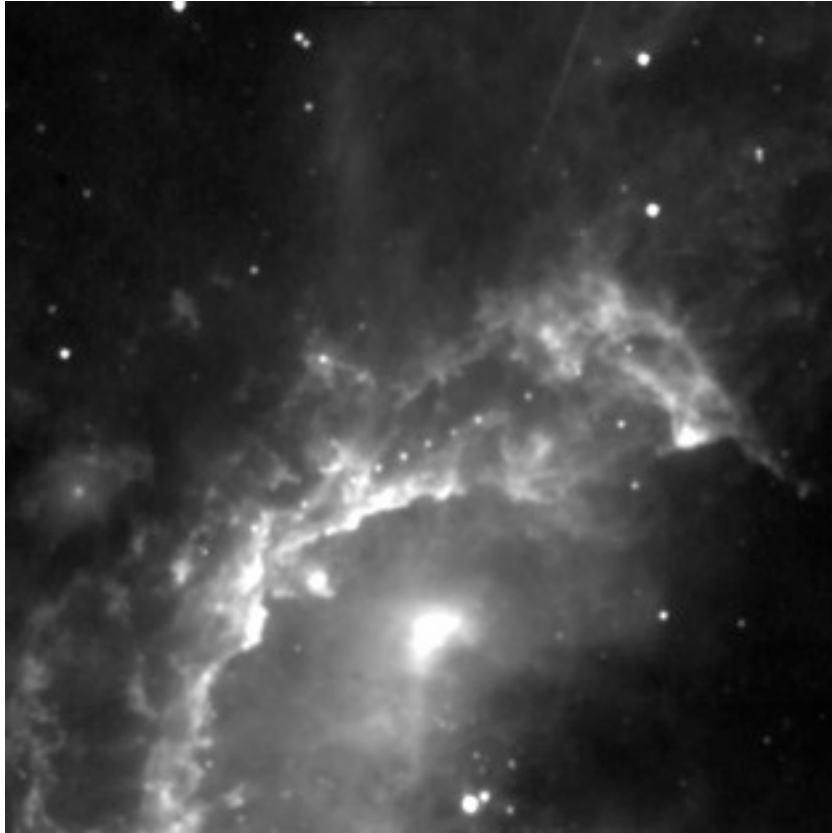


NEOWISE:



An Enhancement to WISE Data Processing

- Baseline WISE data processing predicts only known solar system objects within WISE FOV and associates with WISE source detections.
 - No provision for finding previously unknown moving objects
- NEOWISE (A. Mainzer, PI)
 - Create and release a “solar system research-friendly” archive
 - Individual epoch images and database of extracted sources
 - Interfaces to allow searching this archive for moving objects to enable search and pre-discovery following WISE mission (object name or orbit search capability)
 - Enable the discovery of new solar system objects with WISE
 - Take advantage of WISE capabilities and survey cadence
 - No changes allowed to basic WISE mission or data processing
 - Rely on additional ground-based observations for recovery/confirmation, rather than self-confirmation
 - Implementation started in February 2009 (L-10 months)!

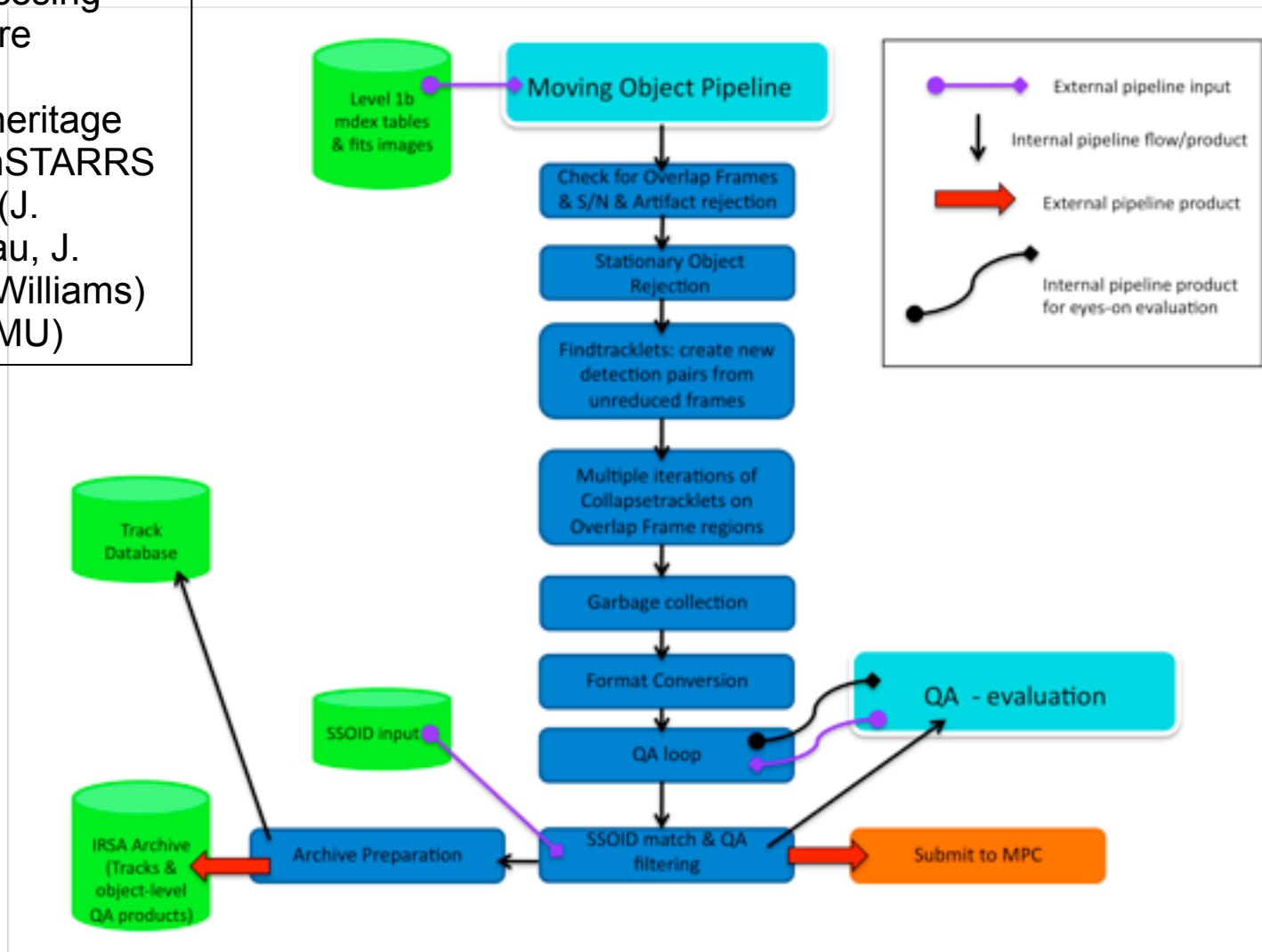


14'x14' section of a WISE W3 image covering Sh2-236 made from 11 separate exposures showing serendipitous detections of (1719) Jens 1950 DP

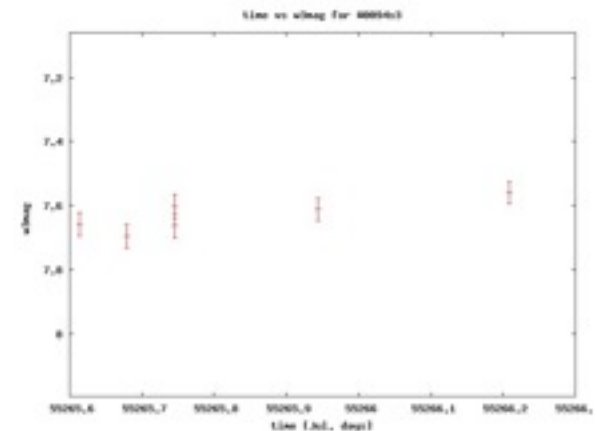
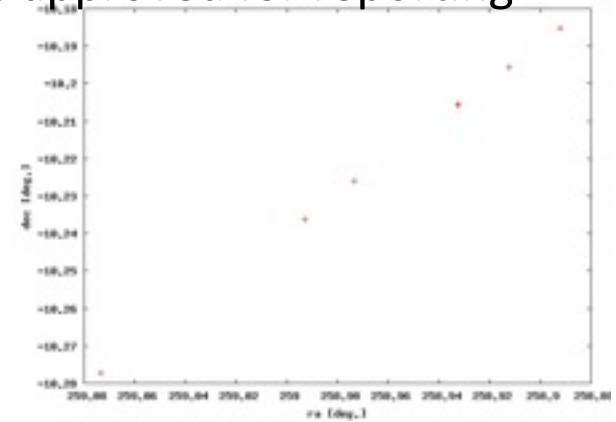
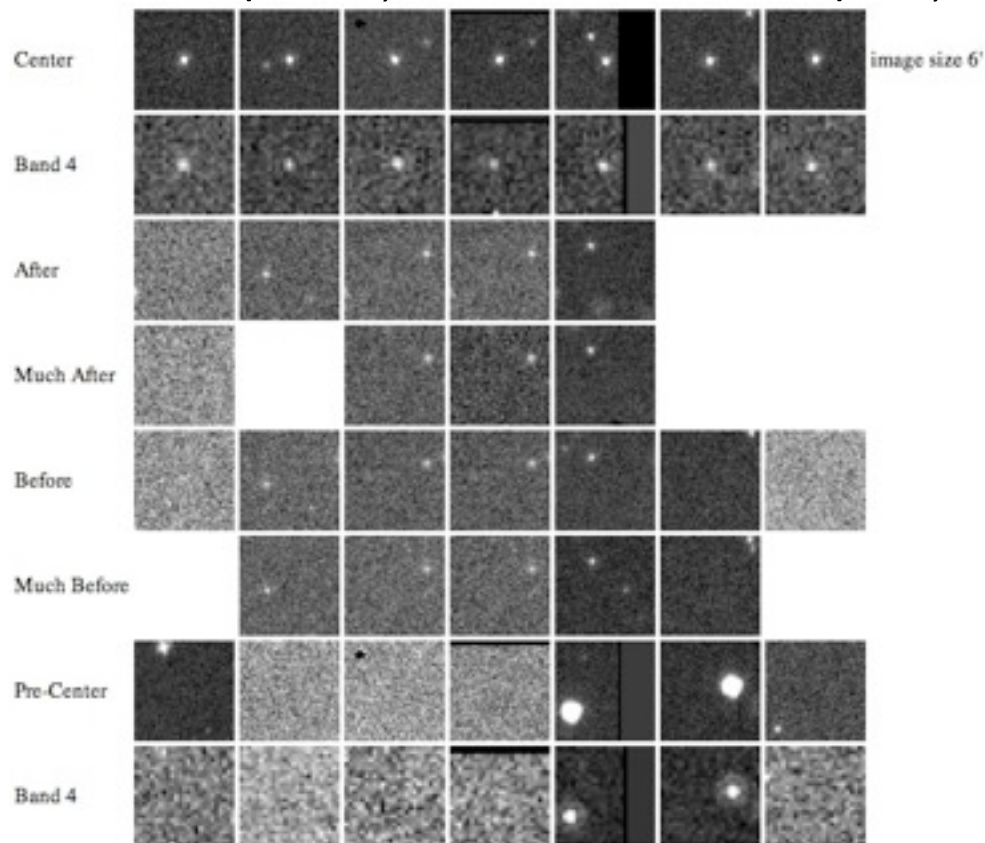
- Exploit the WISE Survey strategy to identify objects that move between exposures
- On ecliptic, WISE typically yields ~10 observations of a particular object over ~30 hours
- Identify moving object candidate detection and form position/time tracklets
- Tracklets are delivered to Minor Planet Center within 10 days of midpoint of WISE observation
- Rely on additional ground-based observations to get long term orbits, although most WISE observations are long enough to receive a designation.

Integrated into the WISE Science Data Processing System architecture

Extensive use of heritage software from PanSTARRS and LSST MOPS (J. Kubica, L. Denneau, J. Myers), MPC (G. Williams) and Auton Lab (CMU)



- Use pipeline artifact flagging to filter out most spurious extractions
- Require >4 detections to form tracklet
- 50-65% of tracklets are high reliability and automatically validated
- Lower reliability validated by visual examination, orbit parameters
- ~2 runs/week, 5000-7000 tracklets/run, ~90% approved for reporting





WMOPS Highlights

- In 41 days of surveying (MJD 55230-55271), WISE has detected 15,715 solar system objects
 - 2552 new objects (~60/day)
 - 203 known Jupiter Trojans
 - 29 comets, of which 8 are WISE discoveries
 - 82 NEOs, of which 22 are WISE discoveries

Red = NEOs

Green = comets

Blue = Centaurs

[T. Grav]

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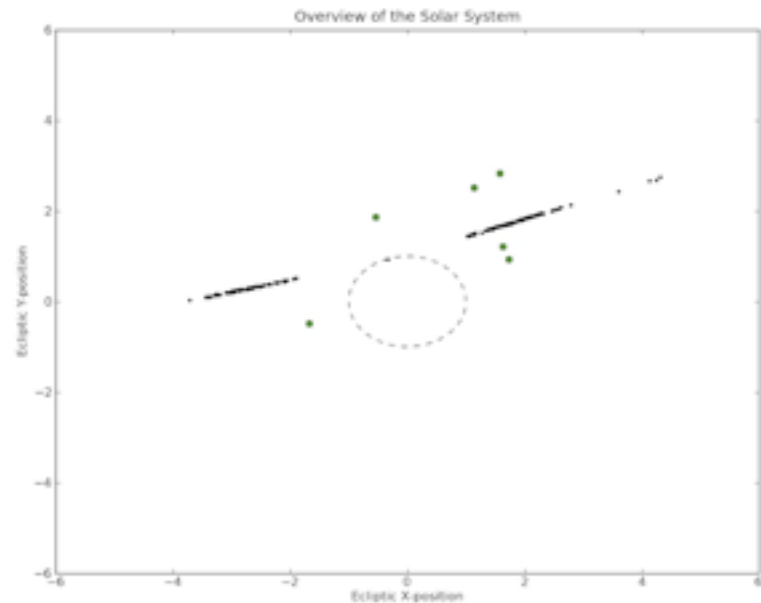
objects

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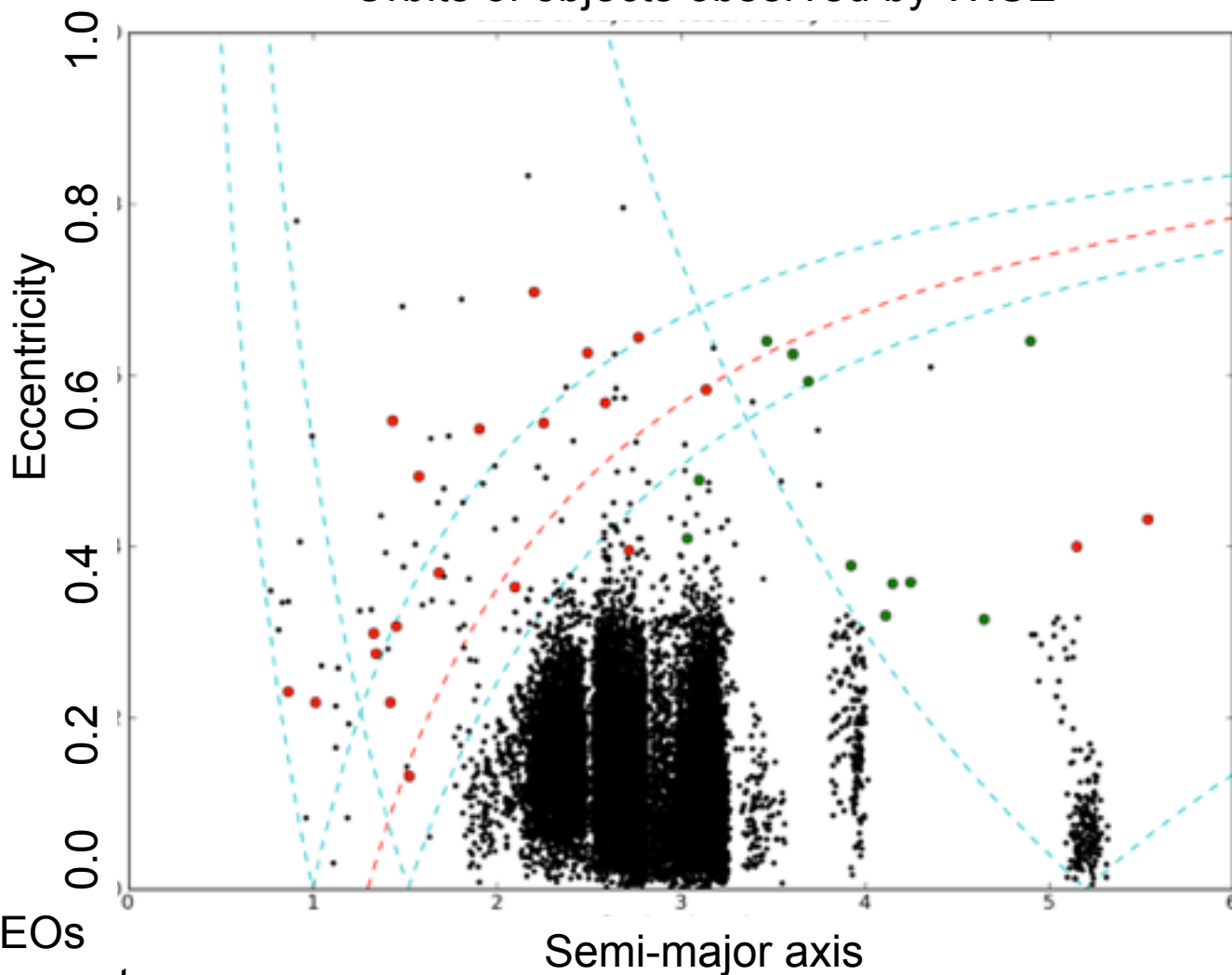
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[T. Grav]

The Solar System as Seen by WISE

Orbits of objects observed by WISE



Red = NEOs

Green = comets

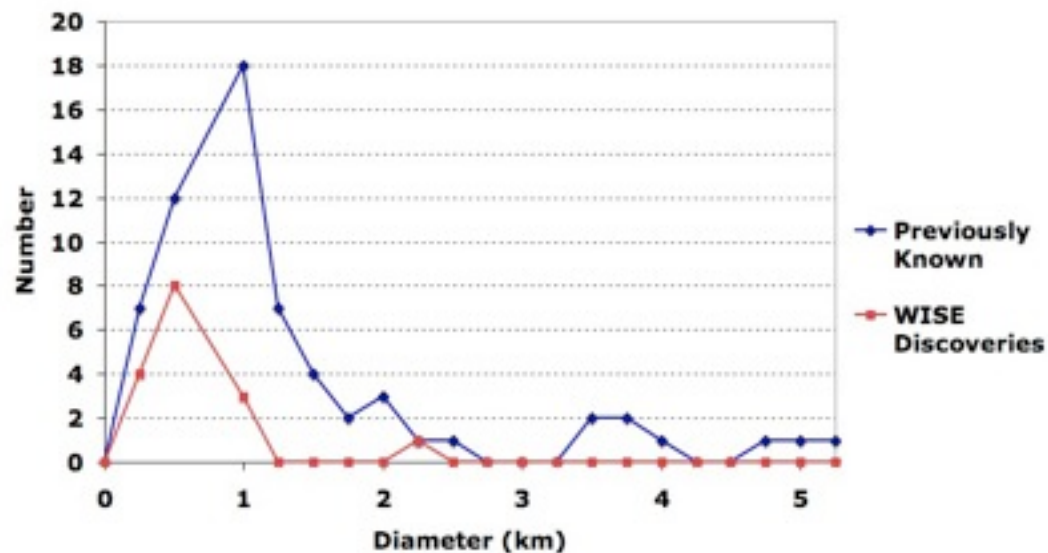
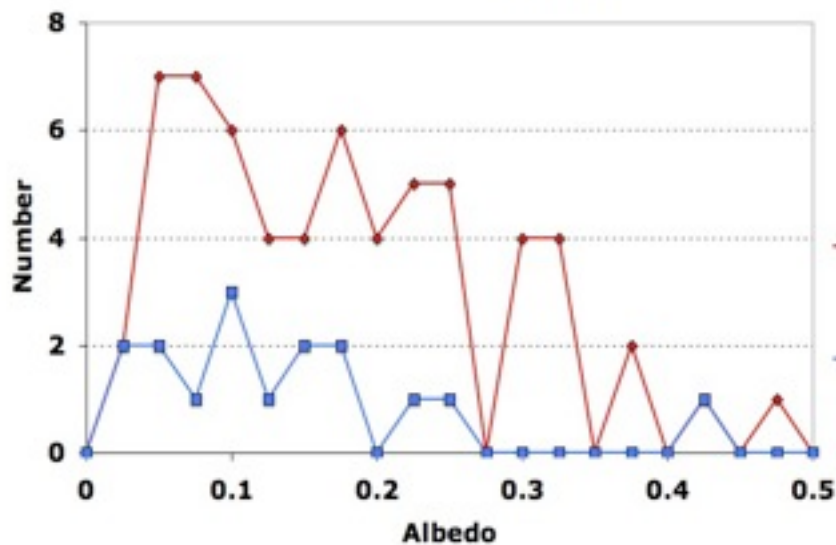
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[T. Grav]

Near-Earth Objects (NEOs)

• Size-frequency and albedo distributions

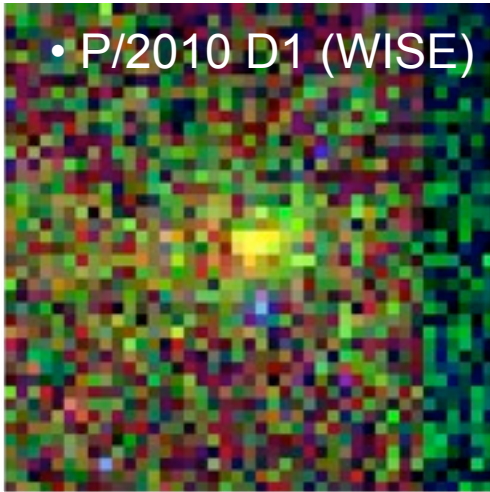
- 82 objects so far; 22 new w/ optical data
- No efforts made to debias yet! ****PRELIMINARY****
- Of new WISE discoveries, 55% have albedo < 10%
- Of previously known NEOs, 29% have albedo < 10%
- First retrograde found! 2010 DG56: $i=160^\circ$
- Many NEOs at high inclinations
- Many targets are bright to WISE but faint optically: $V=22.91$



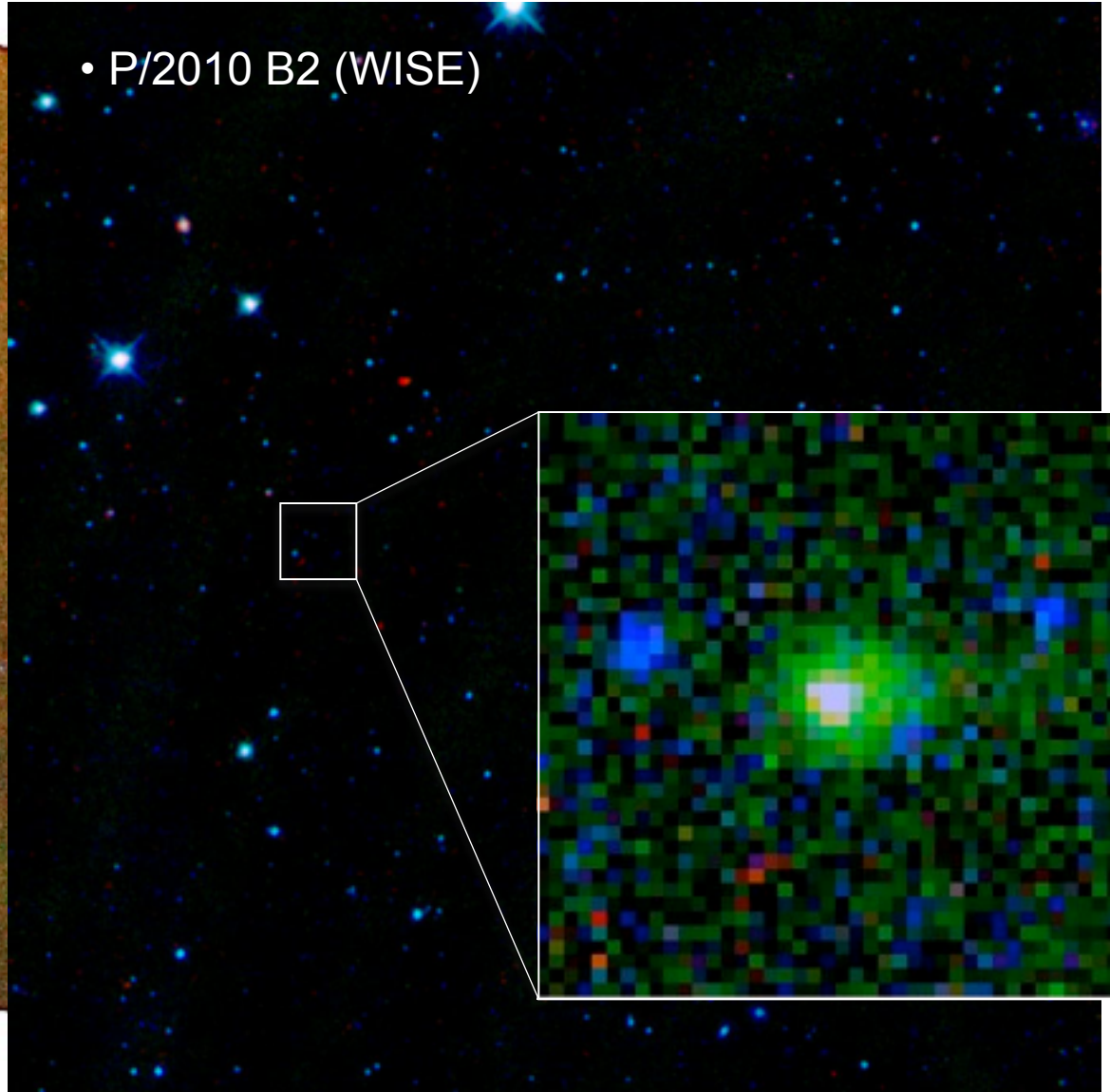
Comets Discovered by WISE

7 new and 1 reclassified asteroid

• P/2010 D1 (WISE)



• P/2010 B2 (WISE)





Summary



- WMOPS demonstrating that moving object detection works!
- WISE is detecting large numbers of MBAs, NEOs, comets and other solar system objects
- Ongoing delivery of astrometric data to MPSC
 - New objects on the NEO Confirmation Page daily
 - Other observations published in MPC Daily Orbit Updates (DOUs)
 - Check MPC confirmation page for latest objects of interest
- Follow-up observations from professional and amateur observers around the world
- WISE data release schedule

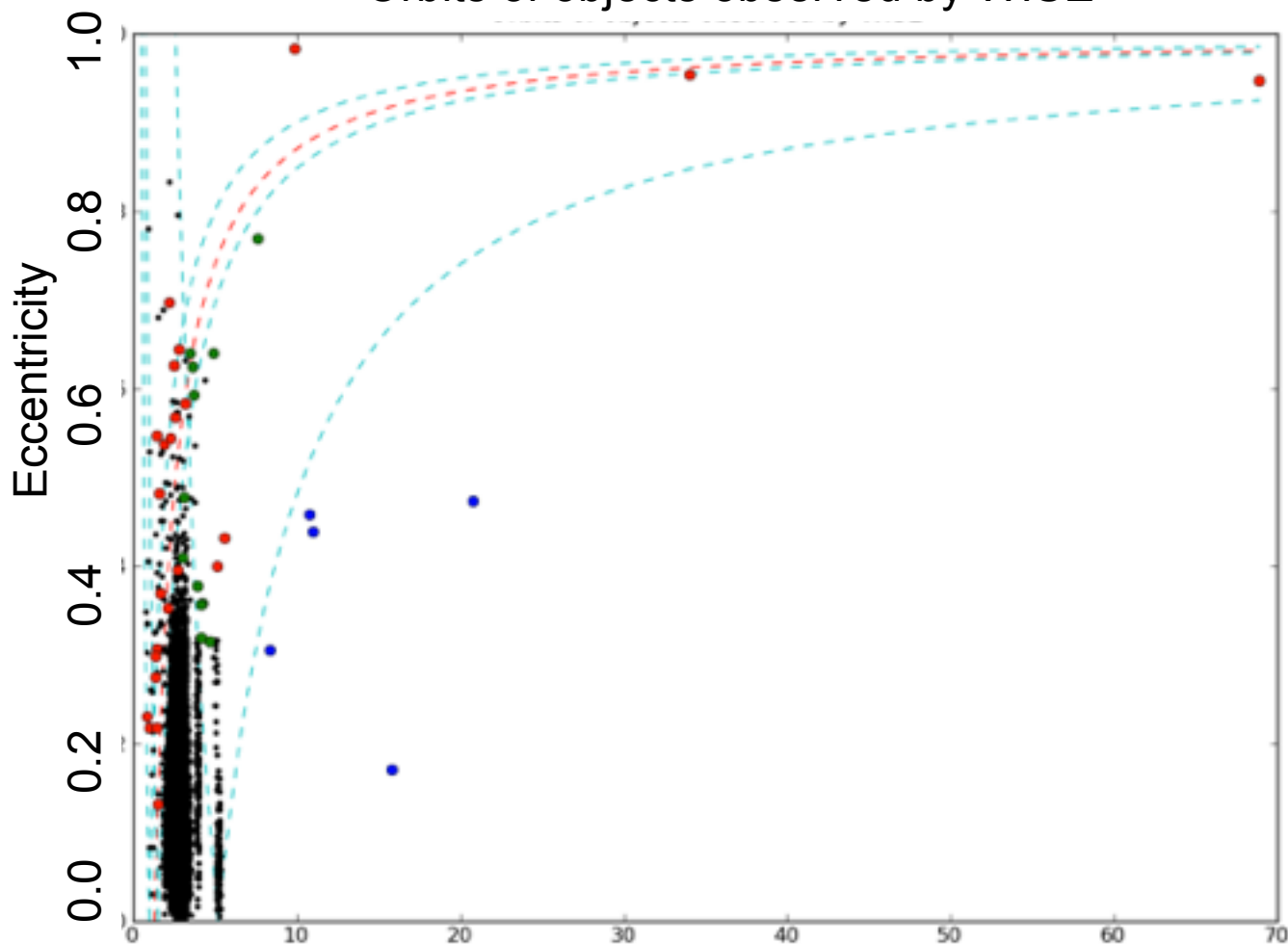
<http://wise.astro.ucla.edu>



Backup Slides

The Solar System as Seen by WISE

Orbits of objects observed by WISE



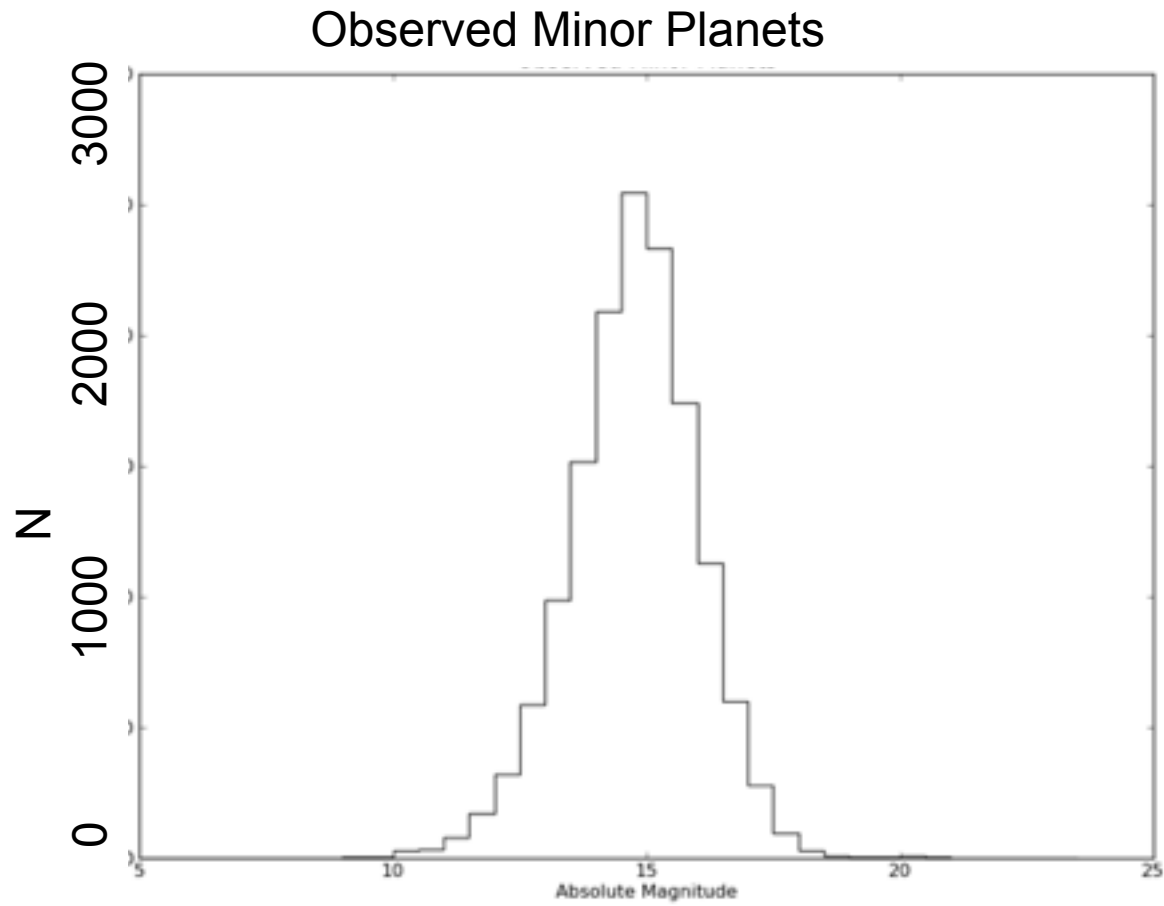
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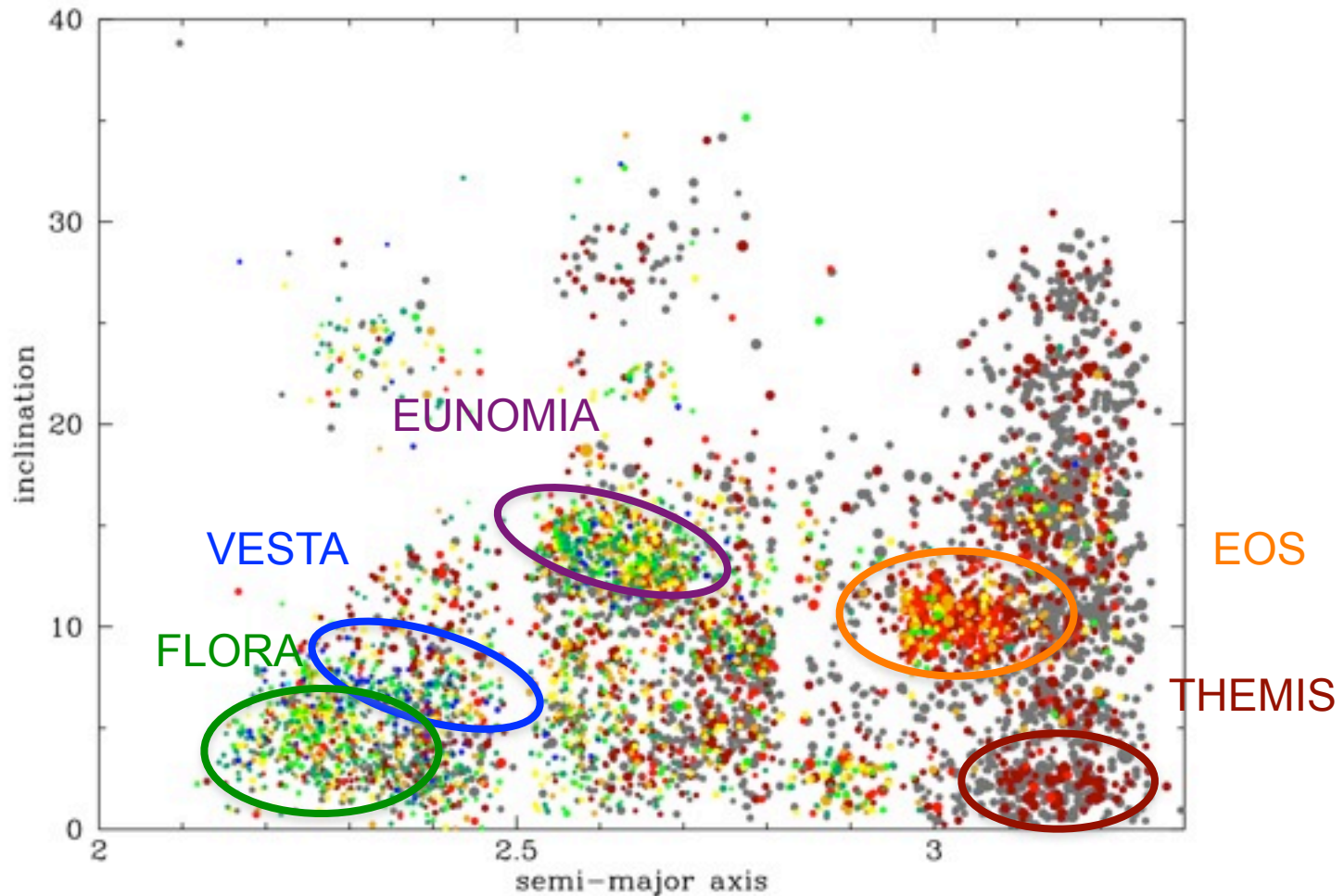
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Semi-major axis

[T. Grav]



MBA Diameters and Albedos



PRELIMINARY albedo and diameters for known MBAs detected by WISE so far. Dot size proportional to diameter. Color encodes albedo - grey is darkest, Increasing through red, green, blue. (Masiero et al. 2010)