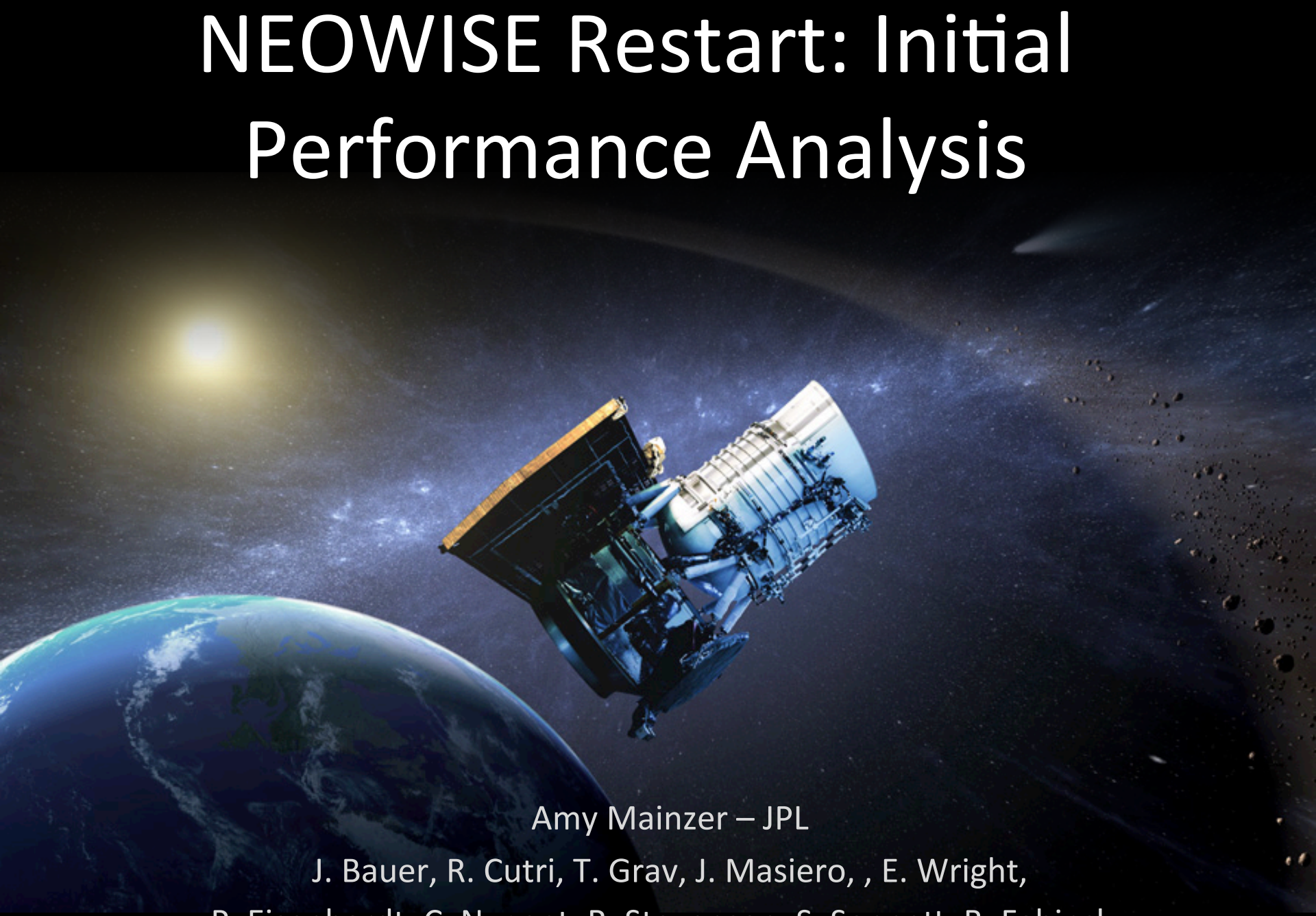
# NEOWISE Restart: Initial Performance Analysis



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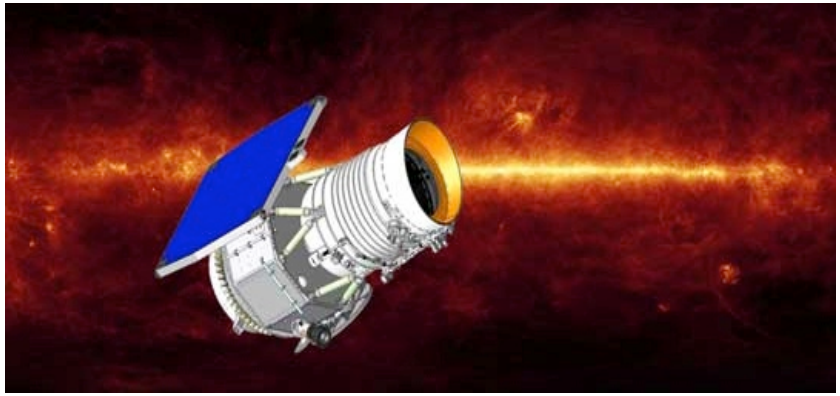
# Wide-field Infrared Survey Explorer (WISE)

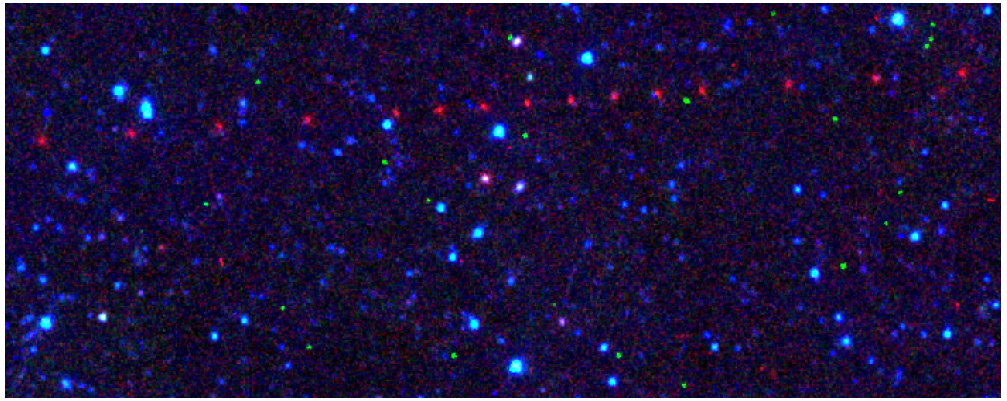
- 40 cm telescope in Sun-synchronous orbit around earth
- Four channels: 3.4, 4.6, 12 and 22 $\mu$m
- Observed over 158,000 minor planets
- > 34,000 new asteroids and comets discovered

# NEOWISE = Near-Earth Objects + WISE

**Wide-field Infrared Survey Explorer (WISE)**



**Tracklet: a moving asteroid in multiple detections**



## WISE

- Astrophysics infrared (IR) survey
- Map the whole sky with 4 IR bands
- Launched in Dec 2009; operated through Sept 2010

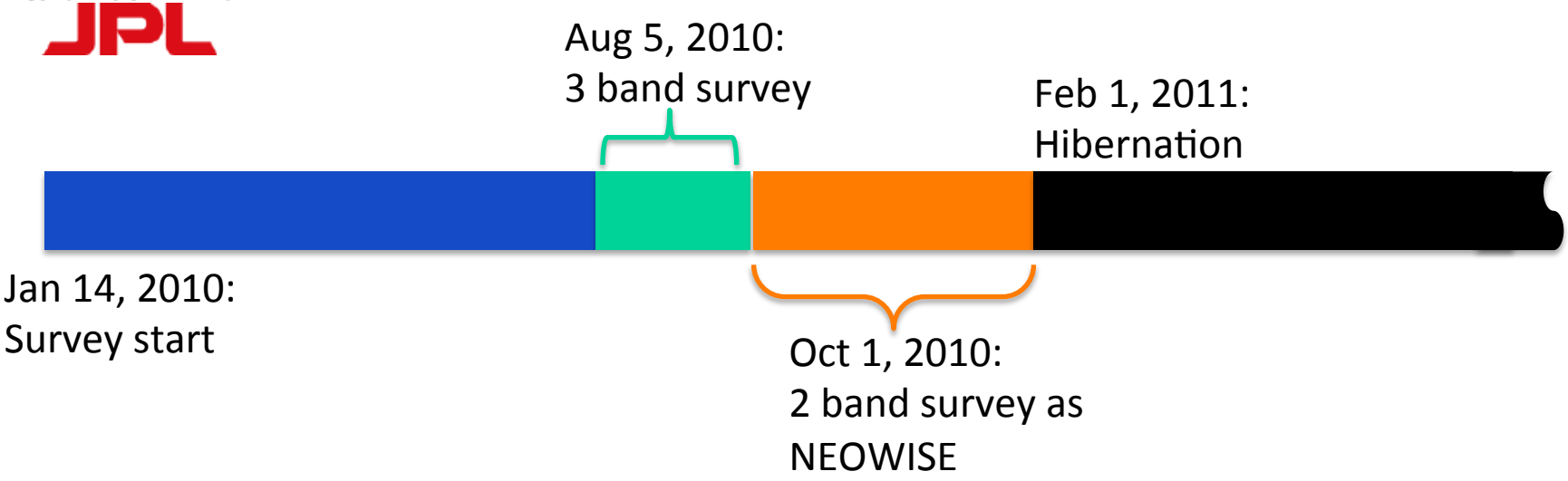
## NEOWISE

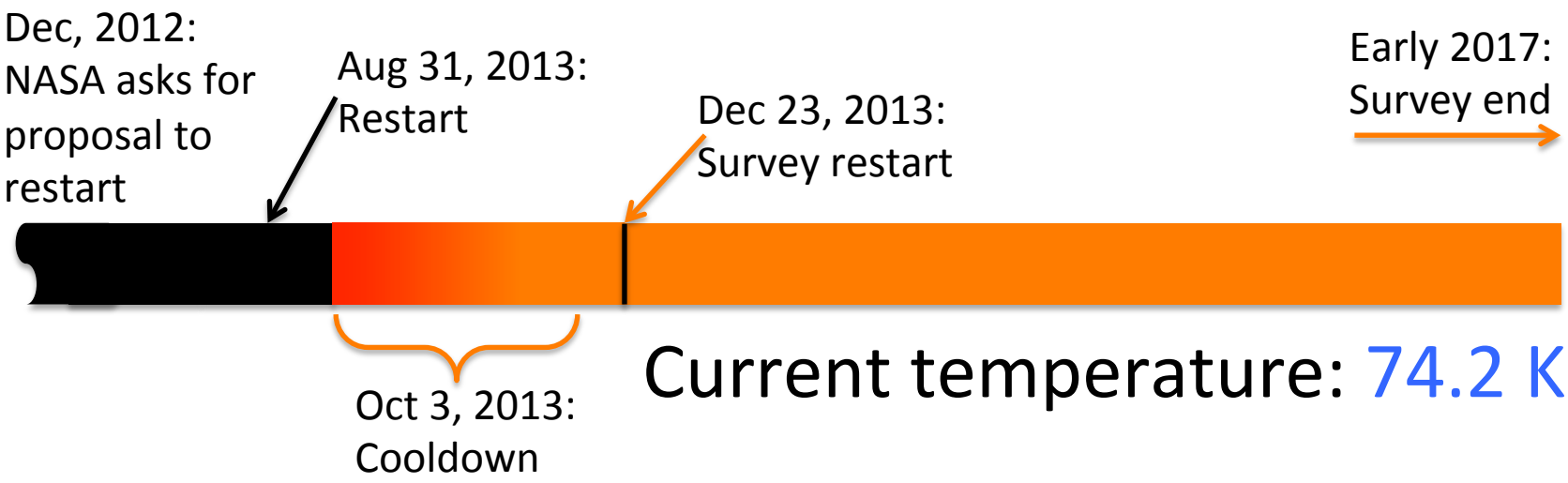
- Planetary mission, no hardware development
- Developed enhanced WISE Moving Object Processing System (WMOPS)
- Processed WISE data to detect and characterize (size, albedo) asteroids
- All data released

# NEOWISE Reactivation Expected Science Return

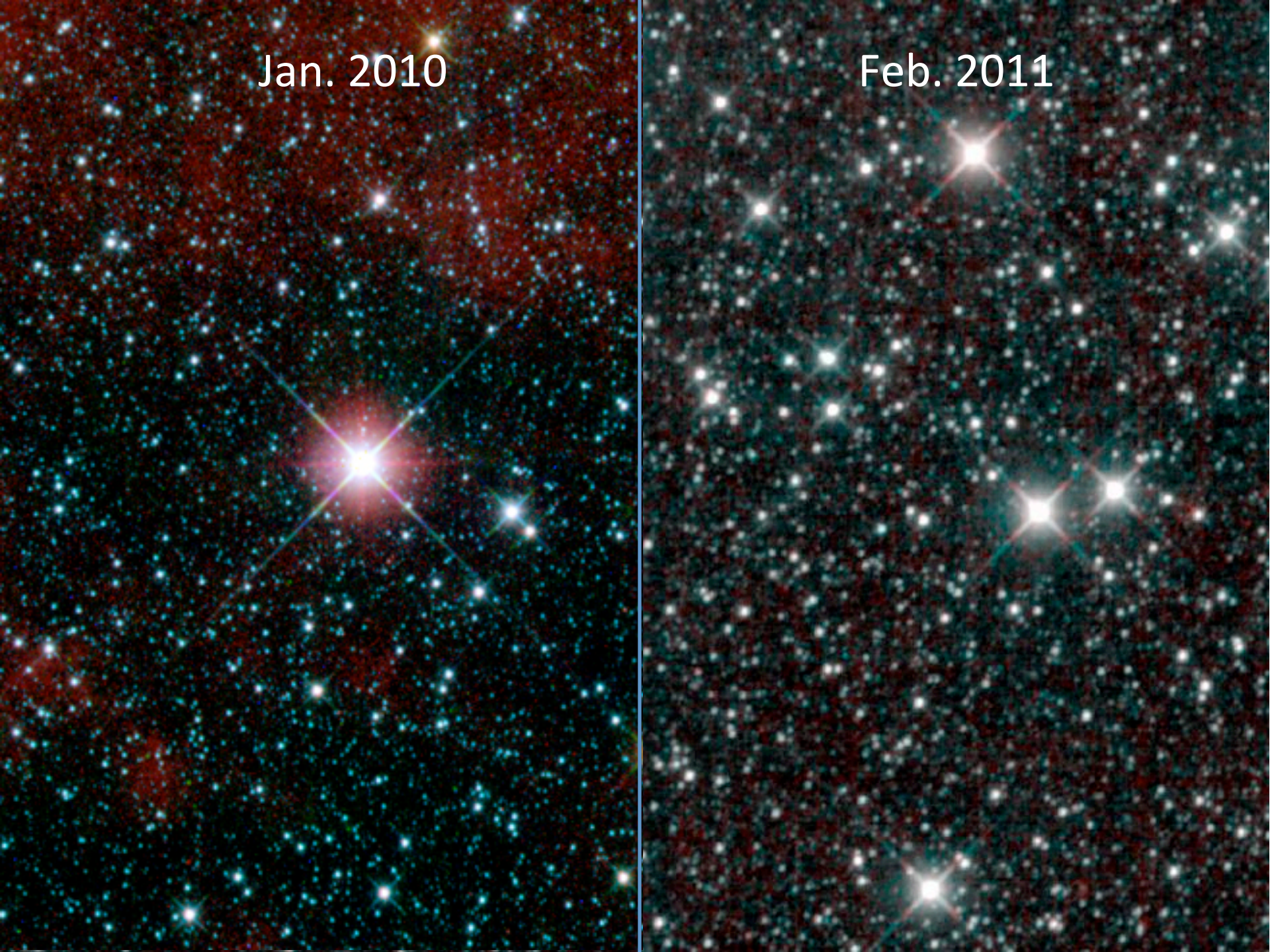
- Only ~1000-2000 NEOs have any sort of physical properties measured beyond H & orbit out of 10,500+ known to date
- Detect & characterize ~2000 near-Earth objects (NEOs) over 3 year survey
  - Derive diameters to ±25%, albedos to ±50%
  - Tens of thousands of Main Belt asteroids + comets
- Discover ~150 new NEOs (25% potentially hazardous)
- Set additional constraints on subpopulations of NEOs, including Earth Trojans and potentially hazardous asteroids
- Data delivery policies same as prime mission

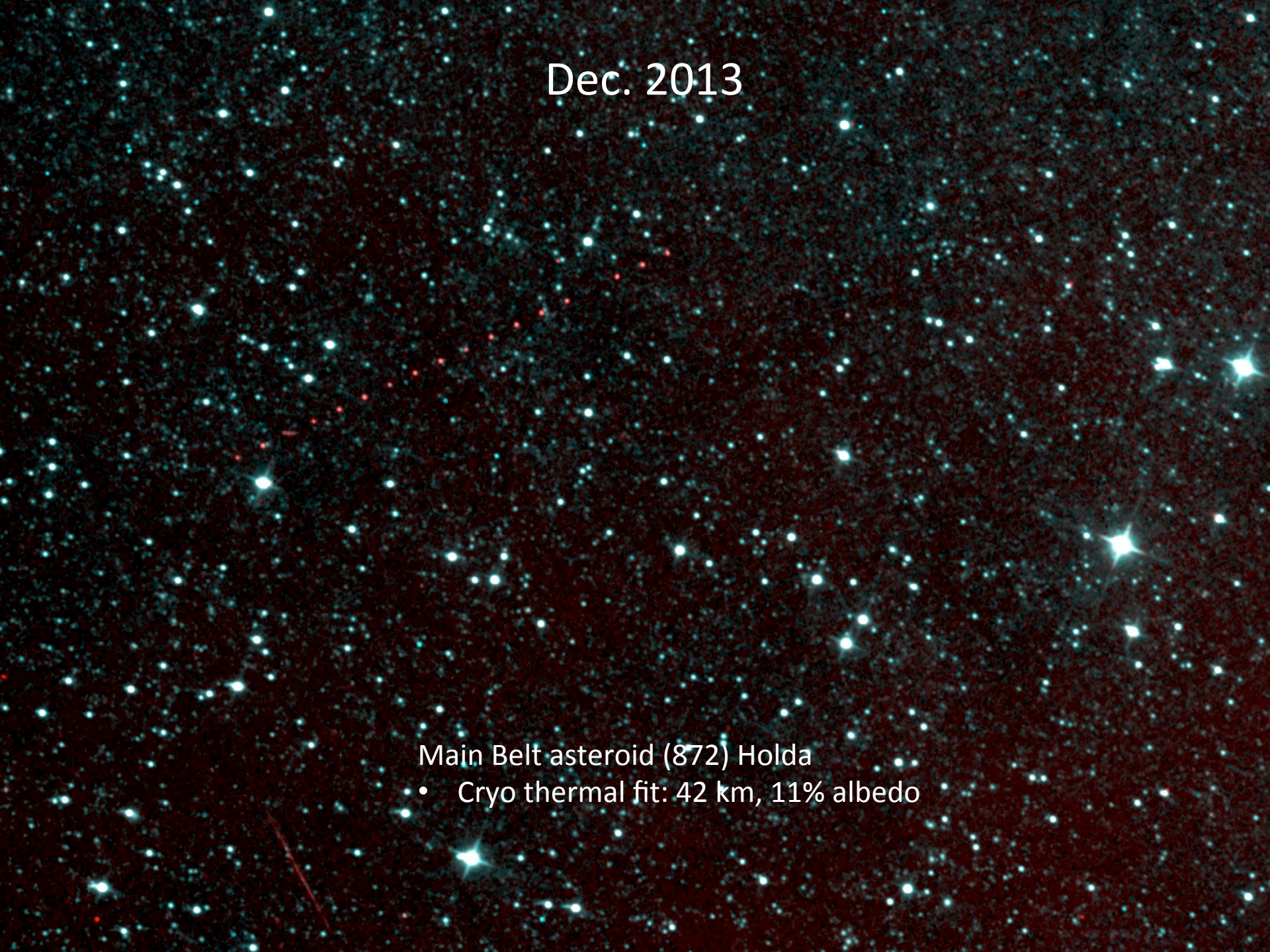
# Timeline



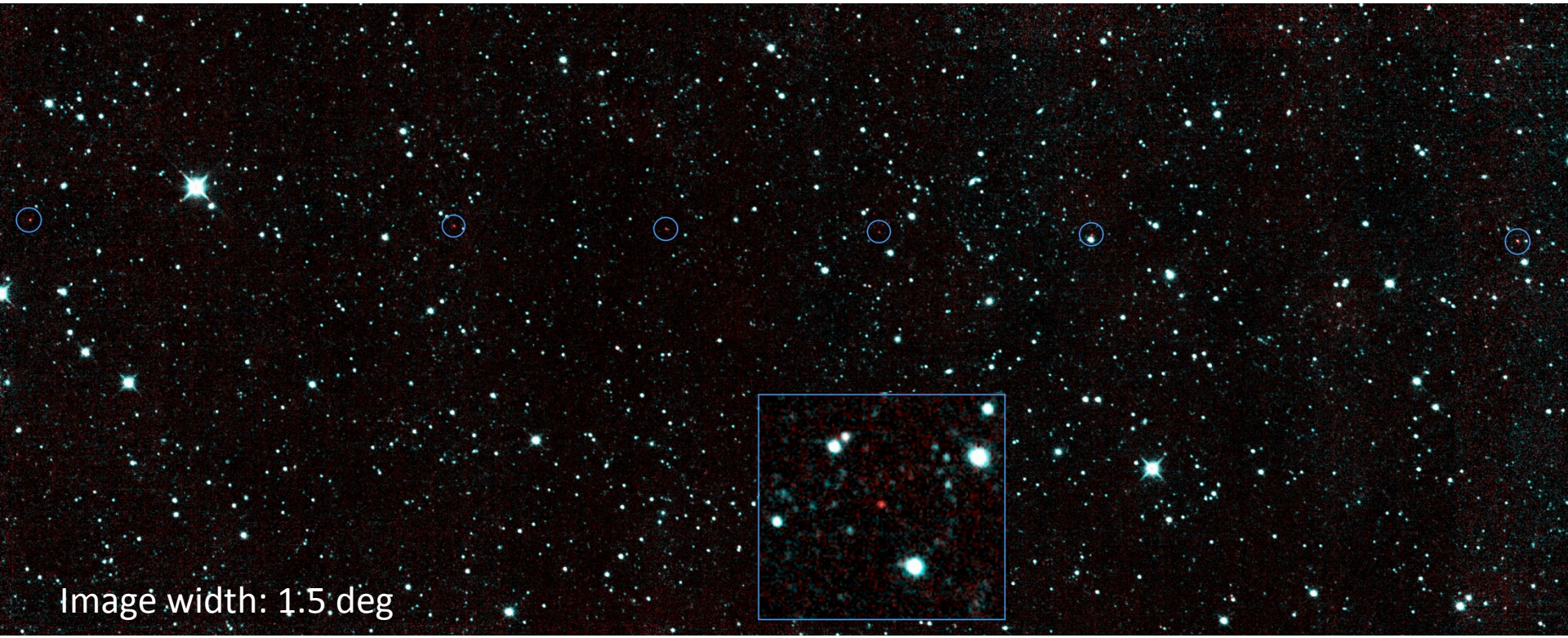




Current temperature: 74.2 K


Jan. 2010
Feb. 2011


Dec. 2013
Main Belt asteroid (872) Holda
• Cryo thermal fit: 42 km, 11% albedo

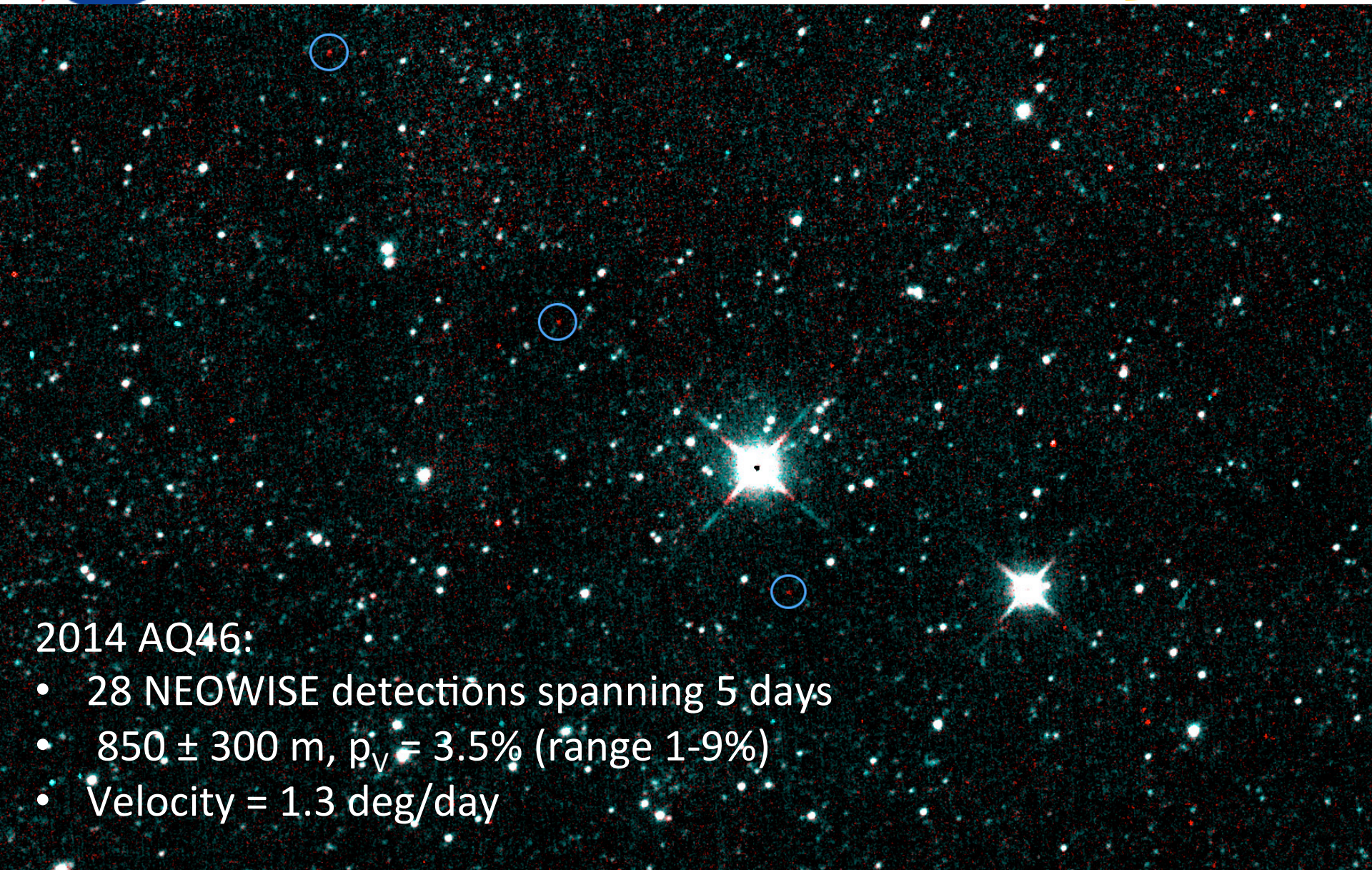
# First New NEO




- 2013 YP139
- Prelim thermal fit: 650±230 m, $p_V$=1-3%
- 6 detections in 0.4 days
- Velocity 3.2 deg/day

- Discovered Dec. 29, 2013, 6 days after survey start
- Follow-up: Spacewatch + Peter Birtwhistle (UK)

# Second New NEO



2014 AQ46:

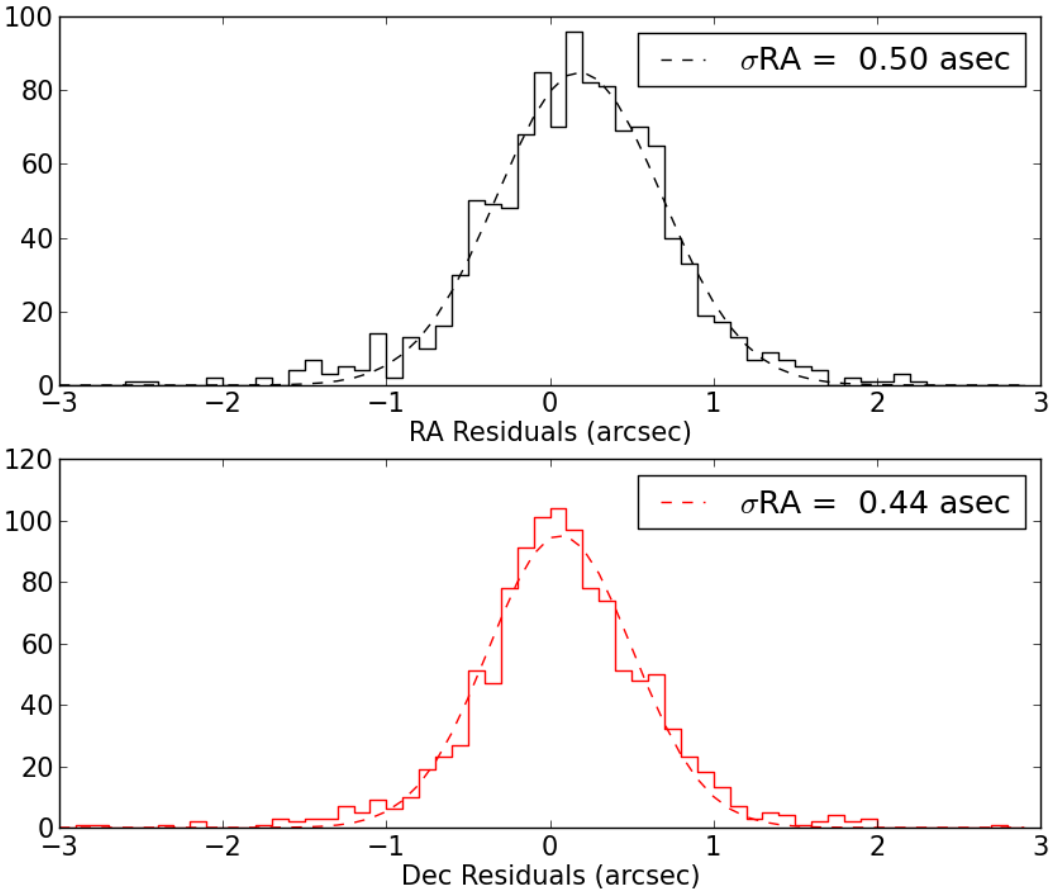
- 28 NEOWISE detections spanning 5 days
- 850 ± 300 m, $p_V$ = 3.5% (range 1-9%)
- Velocity = 1.3 deg/day

# Performance

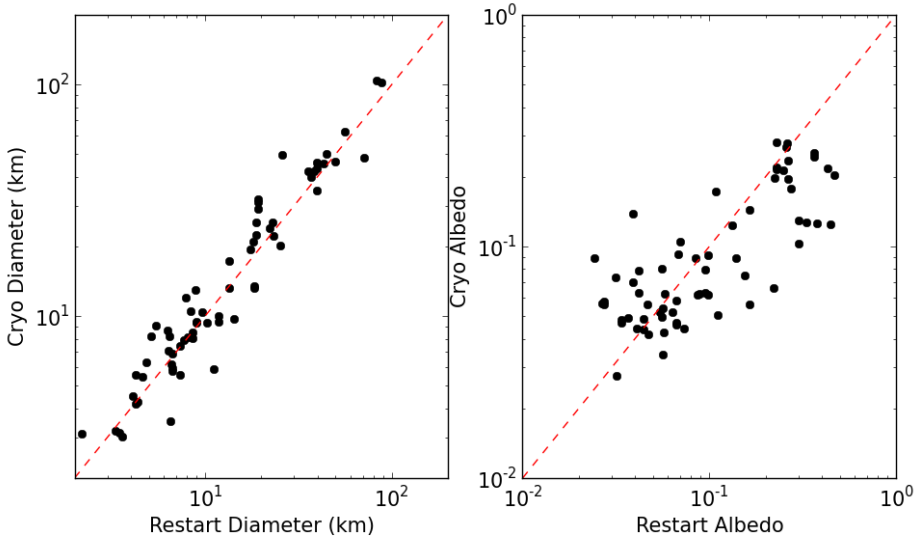
- Routine processing of data using moving object processing software has begun
- Regular deliveries to Minor Planet Center (MPC) being made
- Pipeline running at SNR=5
- Running 2-3x per week
- Currently detecting ~1 NEO/day out of ~35 minor planets/day in single-frame images (no stacking)
  - Consistent w/ predicted performance so far
  - Stats based on 13.5 days of data

# Astrometry

- Residuals for 1066 observations of 108 objects returned from MPC: 0.67 arcsec = same as during prime mission

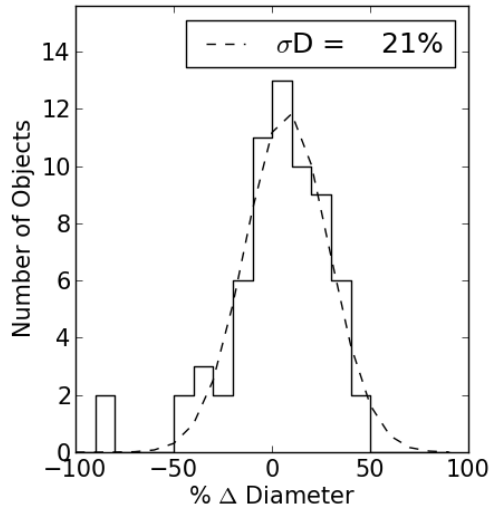


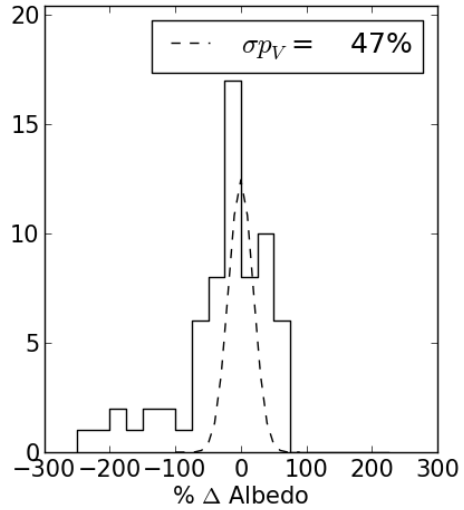
# Preliminary Thermal Fits: Cryo vs. Restart



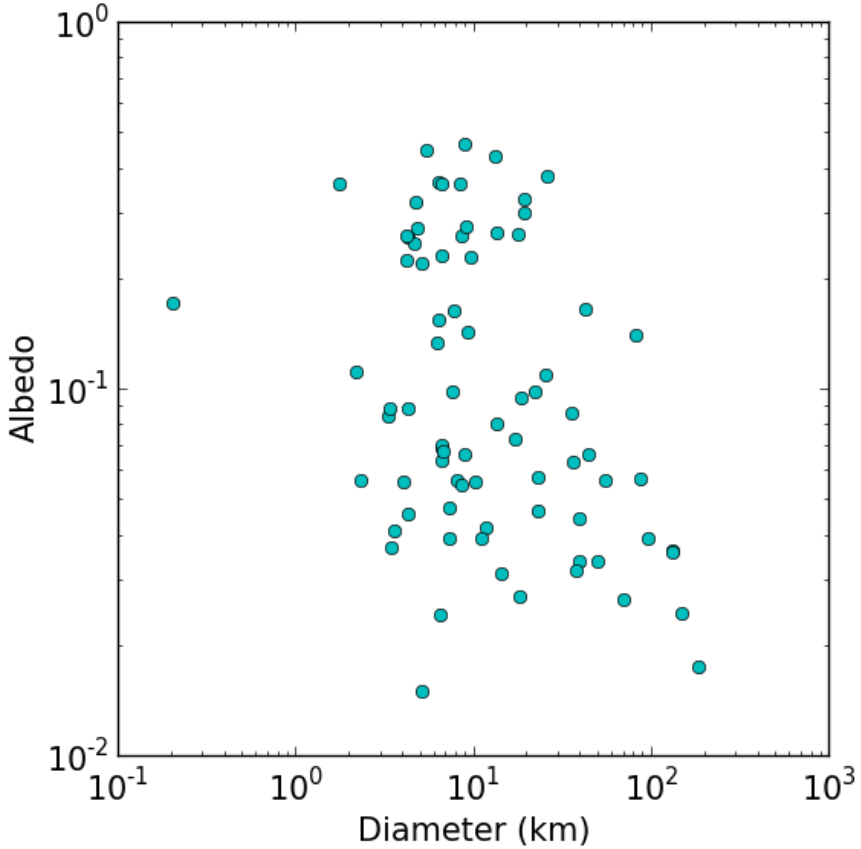







- Very preliminary! Parameters not optimized, small sample (66 Main Belt asteroids).

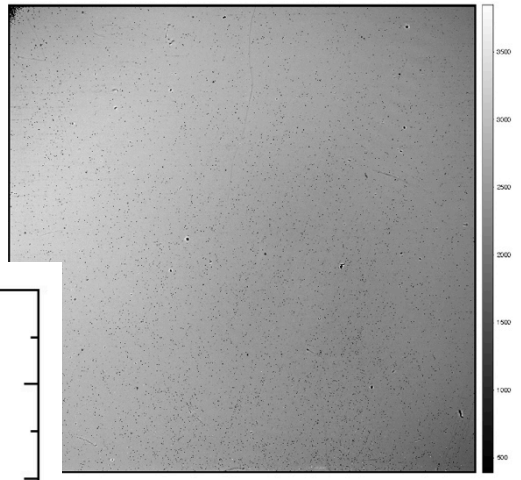


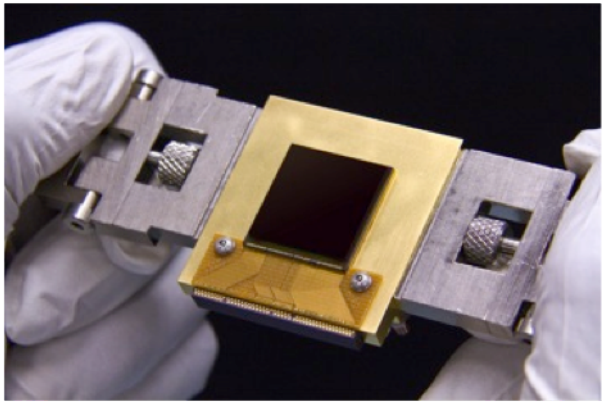
# Follow-up Badly Needed

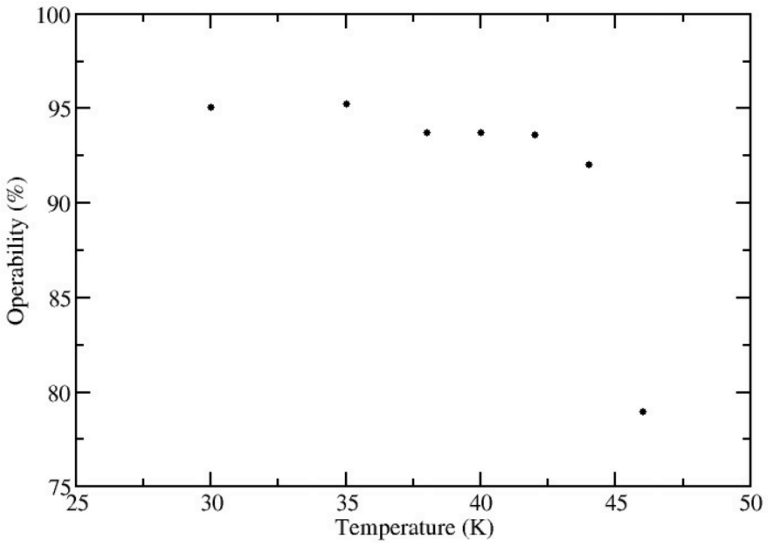
- NEOWISE observatsions span 1-2 days
  - Not enough to secure orbit
  - Will lose most objects w/o follow-up
- Need visible + IR to get albedo
- Losing objects hurts science badly when trying to extrapolate sample -> larger population
- Southern hemisphere telescopes especially sparse
- Candidate NEOs will appear on the Minor Planet Center NEO confirmation page

# Near-Earth Object Camera: NEOCam

- Discovery mission proposed 2005, 2010
- Technology development awarded 2010
- Mission optimized for NEO discovery & characterization








- New 10 μm HgCdTe arrays produced capable of operating @40 K
- Radiation-sensitive substrates successfully removed

# NEOCam Radiation Testing

- Detector development continuing – radiation testing conducted Nov, 2013
- Detected irradiated with 64 MeV protons & total dose of 7.5 kRad (7 yr dose)
- Device irradiated showed no significant degradation in dark current: operability dropped from 96% to 94%
- More testing planned to evaluate single-event effects

# Conclusions

- Spacecraft healthy so far
- Survey operations begun Dec. 23, 2013; science data processing begun
- Follow-up observations needed
- Will return ~double the number of NEO physical properties known, + tens of thousands of Main Belt asteroids