SPACEWATCH®
Astrometry of Asteroids and Comets with the Bok 2.3-m and Mayall 4-m Telescopes.

Poster 414.17:
AAS 46th Mtg of the DPS,
2014 November

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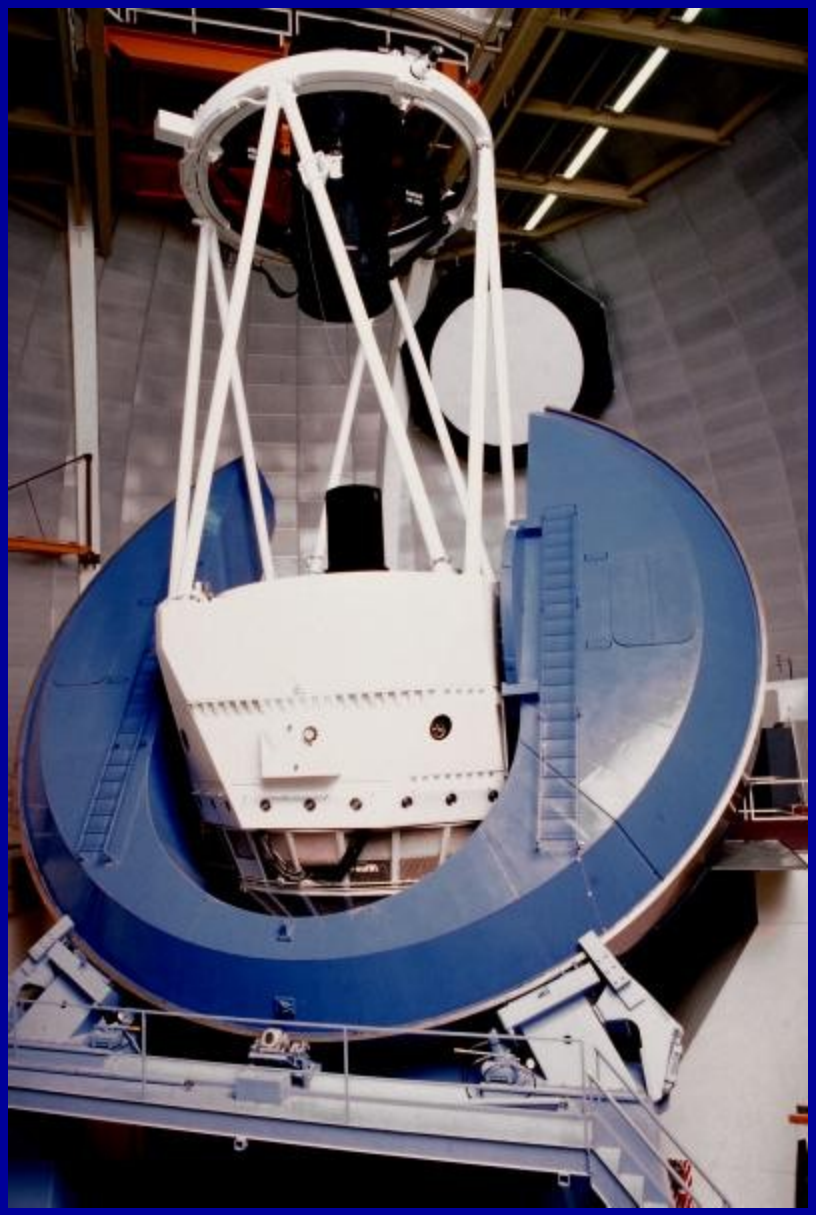
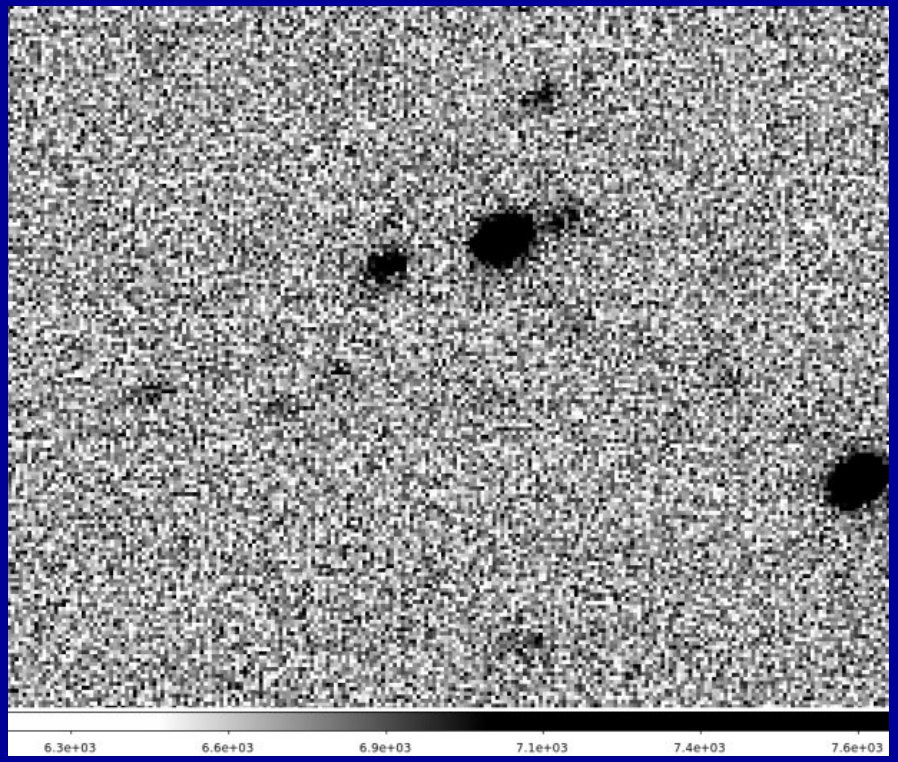


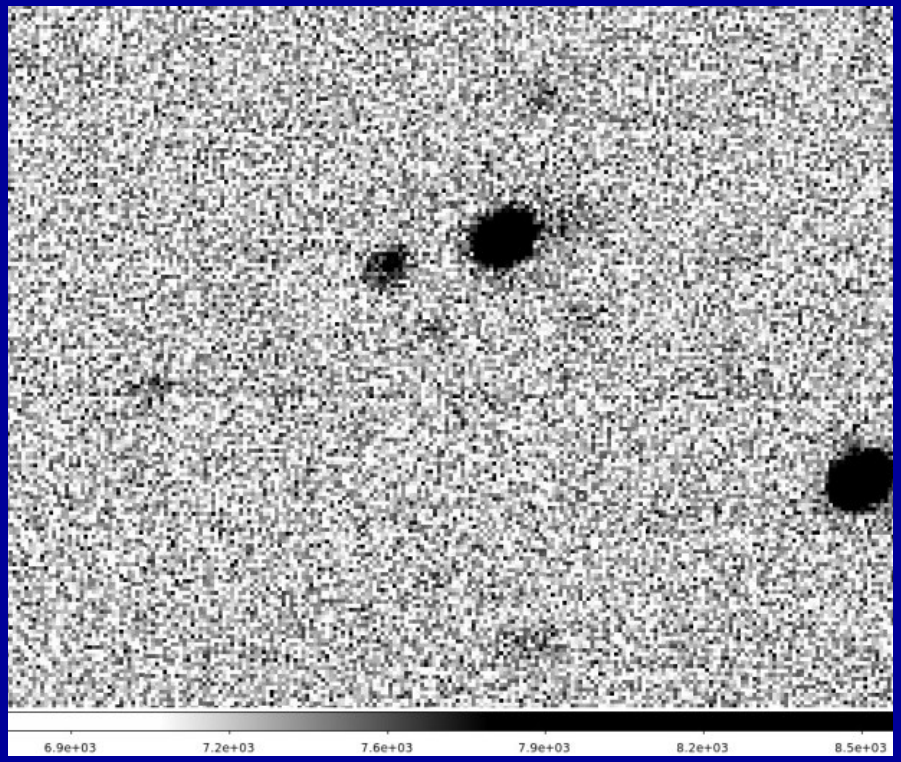
Photo of 4-m Mayall Telescope:
NOAO/AURA/NSF

Why we get time on bigger telescopes

- Improve knowledge of the **orbits and magnitudes** of high priority classes of Near Earth Objects (NEOs) and other small bodies in need of recovery that cannot be reached with the Spacewatch 1.8-m telescope.

2012 HG31 (APO) on 2014 Jan 10, R=24.2





2.3-meter Bok Telescope of Steward Observatory on Kitt Peak

90Prime mosaic camera:

FOV ~1 deg^2

0.45"/pixel.

V mag limit ≈ 24.

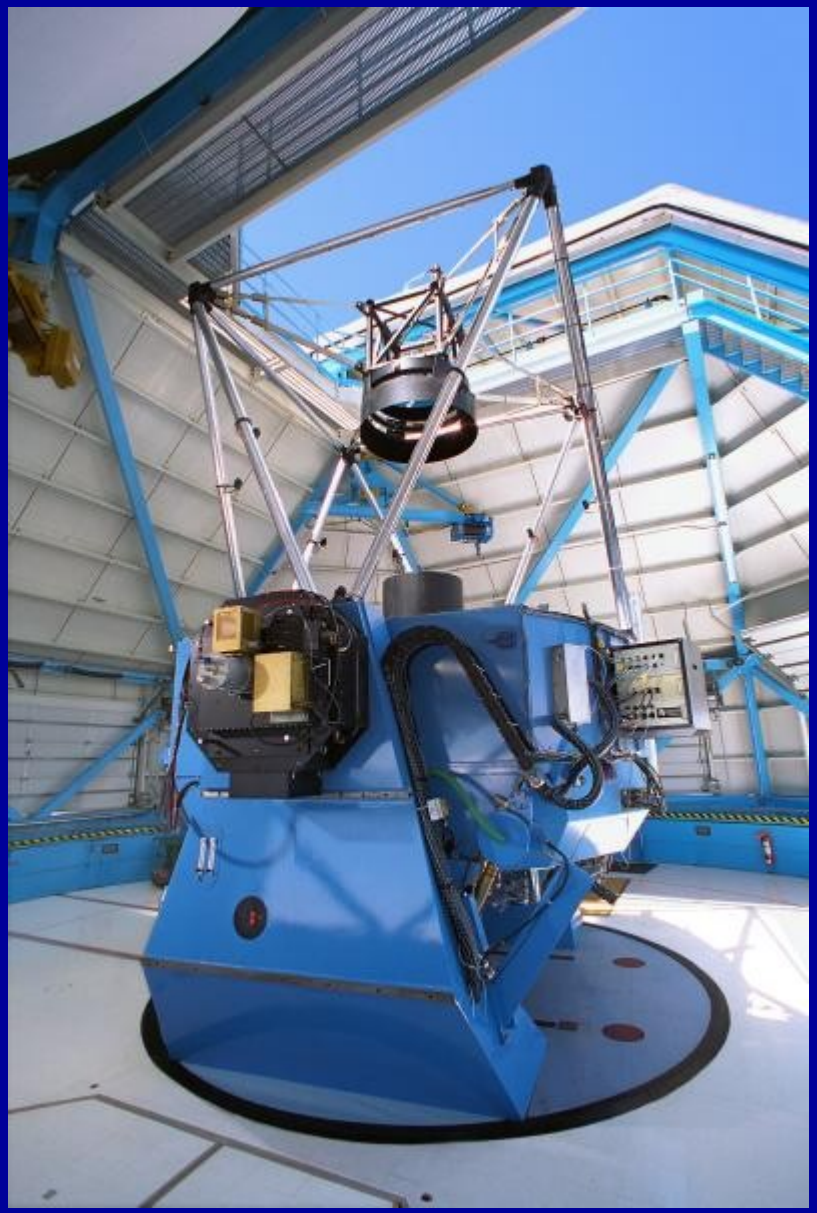
~ 24 nights per year.

~3 objects per hour.

Photo 2007 by Marc Murison, USNOFS.

3.5-m telescope of Wisconsin-Indiana-NOAO (WIYN) on Kitt Peak, Az.

Used in 2010 to recover selected faint NEOs discovered by the Near-Earth Object Wide-field Infrared Survey (NEOWISE) spacecraft mission.



Targets

- NEOs with **virtual impact** solutions.
- Future targets of **radar**.
- Orbits & albedos suggesting **cometary** activity.
- Potential destinations for spacecraft (**NHATS** list).
- Returning NEOs w/ diameters determined by **NEOWISE**.
- Faint Potentially Hazardous Asteroids (**PHAs**).

Capabilities

- Faintest V mag observed so far = **24.4**.

- Smallest elongation angle observed = **46 deg**.

Output, 2010-2014

- The MPC has accepted from us:

- 1316 lines of astrometry on
  - **207** different NEOs.
  - including **84** different PHAs.
  - **343** observations of PHAs with V>=22.

Calendar Arc Extensions

- Average calendar span extension on large PHAs (with H<=17.75) is **184 days**, which is 2x longer than the next most effective observing station.
- Extend span of calendar coverage on PHAs an average of **3.8x**.
- For 38 of the 72 PHAs we **added another observed opposition.**

Reducing Uncertainties

- Analysis of our astrometry by MPC (G. Williams 2014 private communication).
- We've been reducing uncertainties of orbital elements an average of a **factor of 6**.

- Reducing the uncertainty of time of perihelion passage T an average of a **factor of 19**.

PHA Orbital Element Improvement

- Table 1. Effects of observations by Spacewatch COD ^695, 2010 Jun - 2014 May on Uncertainties of PHA Orbital Elements . Analysis by MPC.

- f(parameter) = uncertainty before / uncertainty after.

	% Span	f(T)	f(Peri)	f(e)	f(Node)	f(Incl)	f(q)
Minima	0.00	0.91	0.90	0.91	0.81	0.83	0.83
Maxima	4027.27	596.29	11.14	43.57	40.96	17.40	13.44
Averages	**384.66**	**19.29**	**2.38**	**6.89**	**2.95**	**3.37**	**3.57**

Acknowledgements

- NASA’s NEO Observation Program.
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- JPL’s NEO Office.
- Kitt Peak National & Steward Observatories.
- The U. S. Naval Academy.