RECON
Research and Education Cooperative Occultation Network

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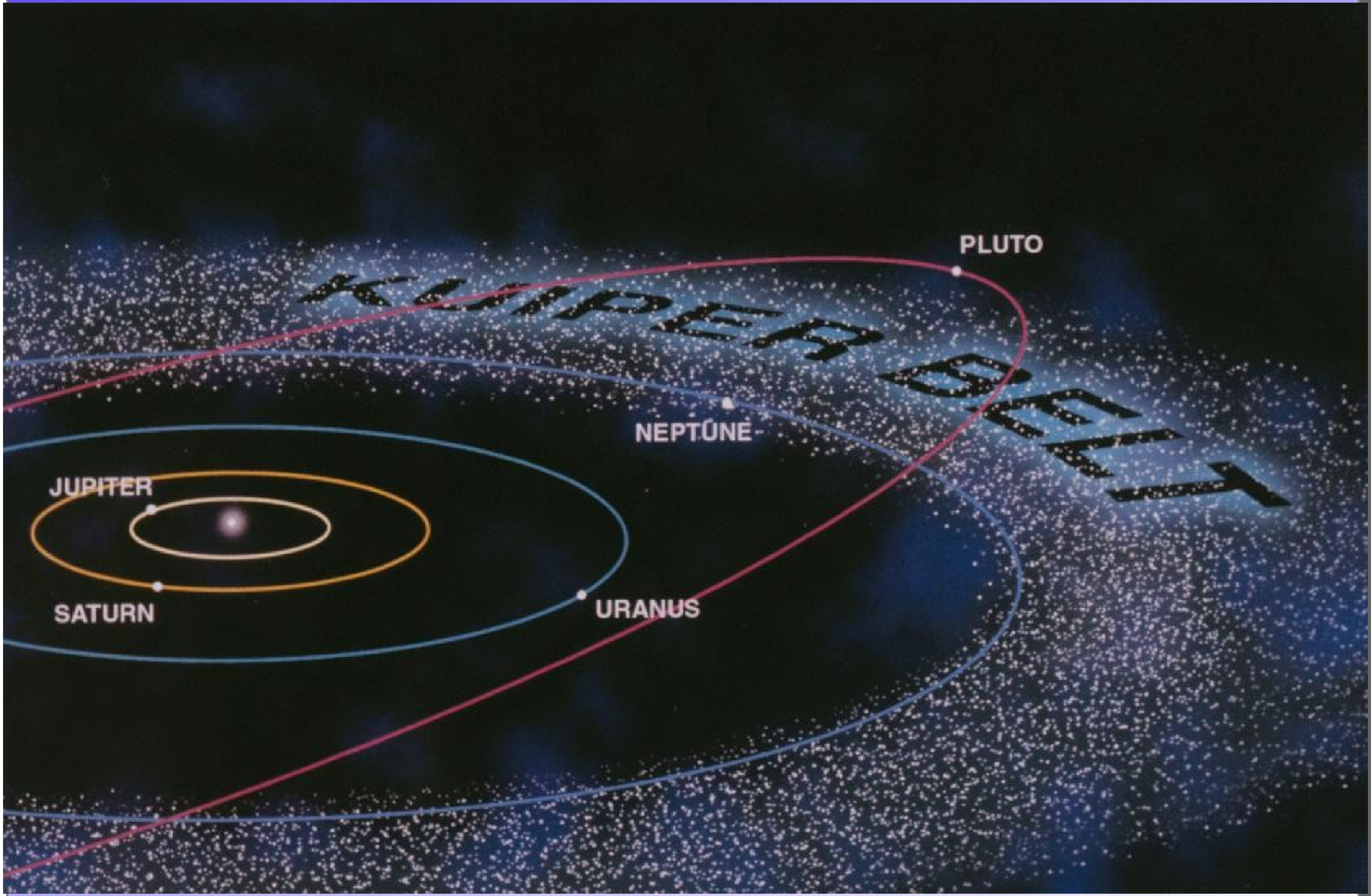
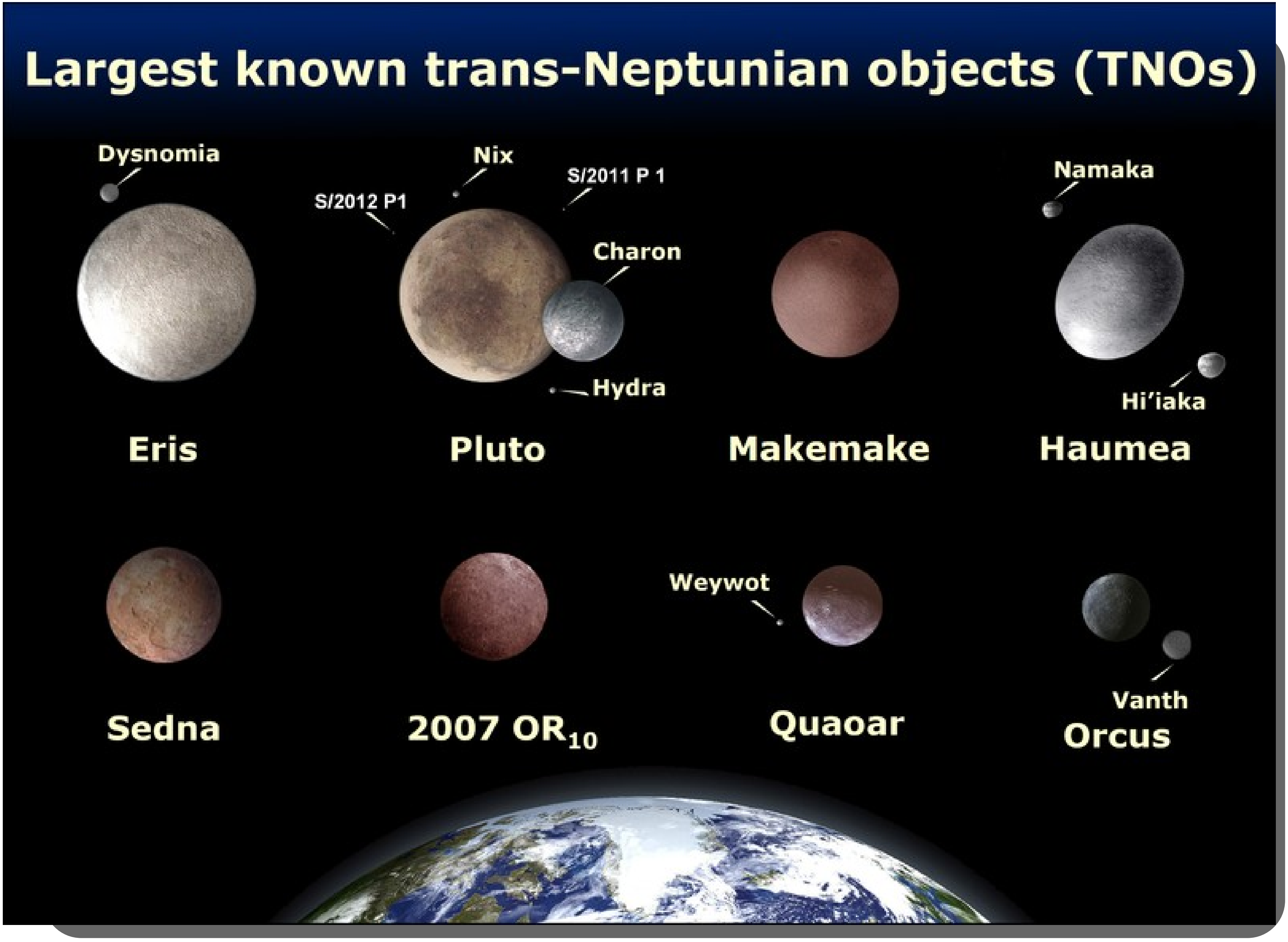
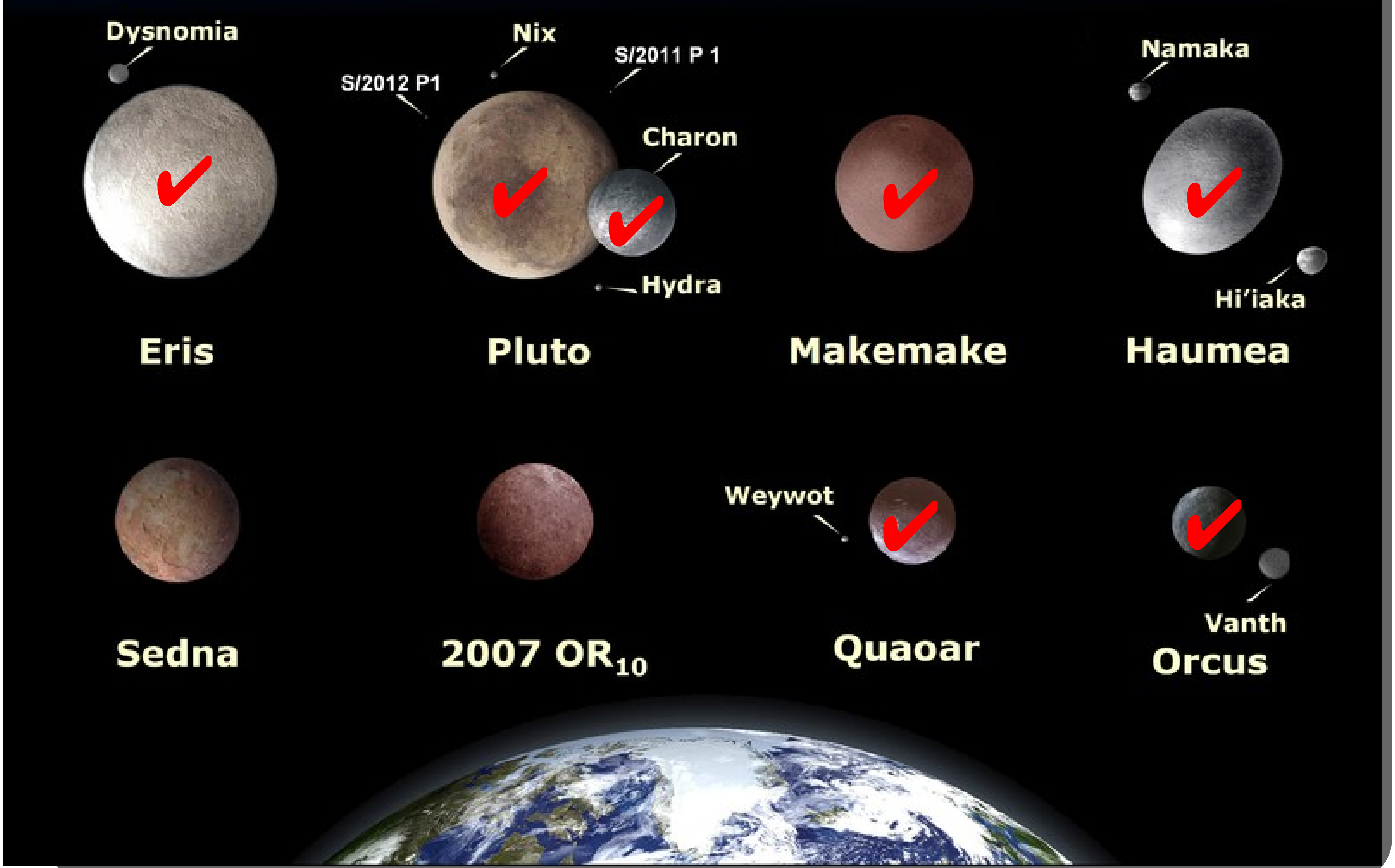
http://tnoRECON.net/

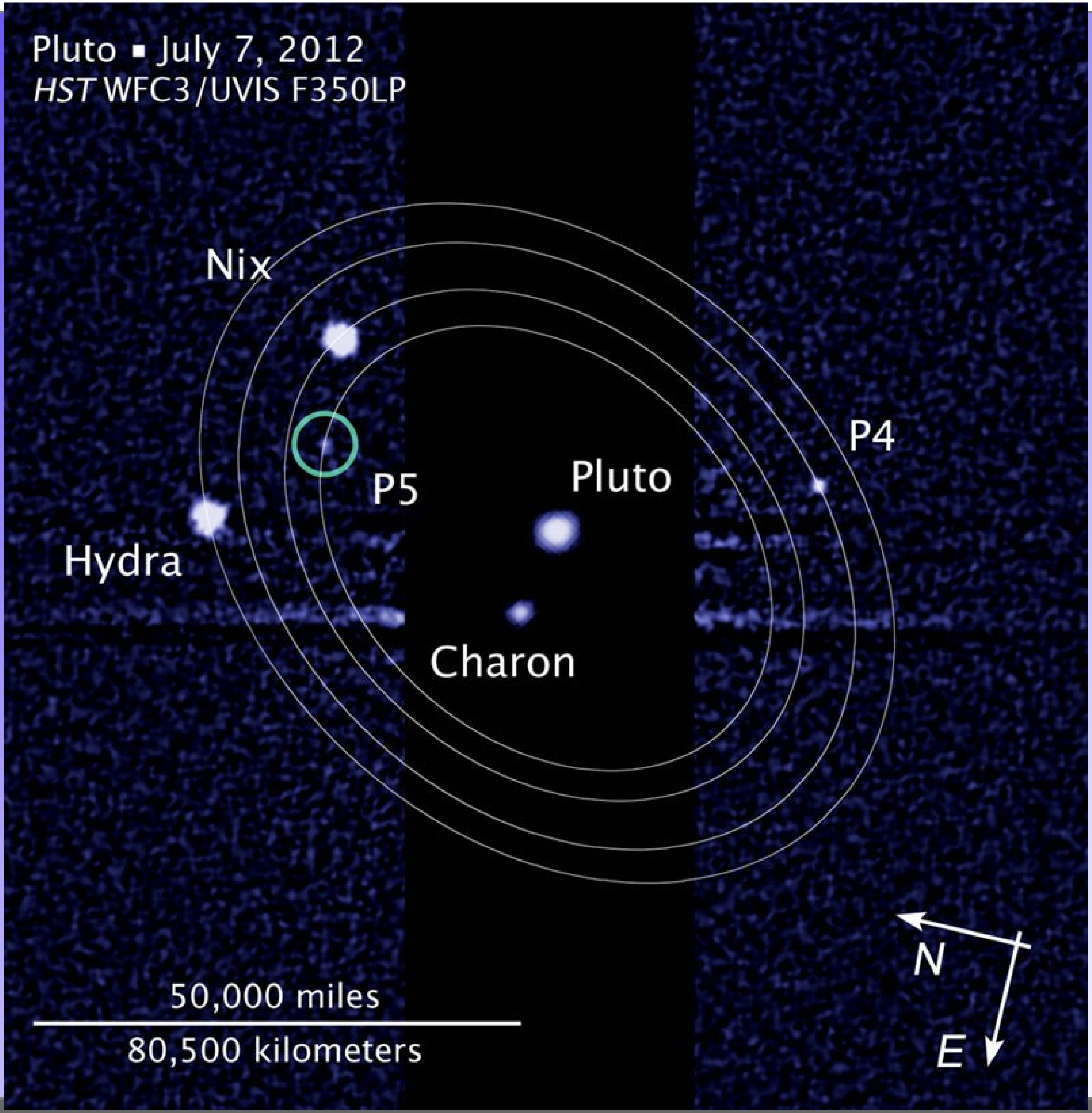


PLUTO
KUIPER BELT
NEPTUNE
JUPITER
SATURN
URANUS

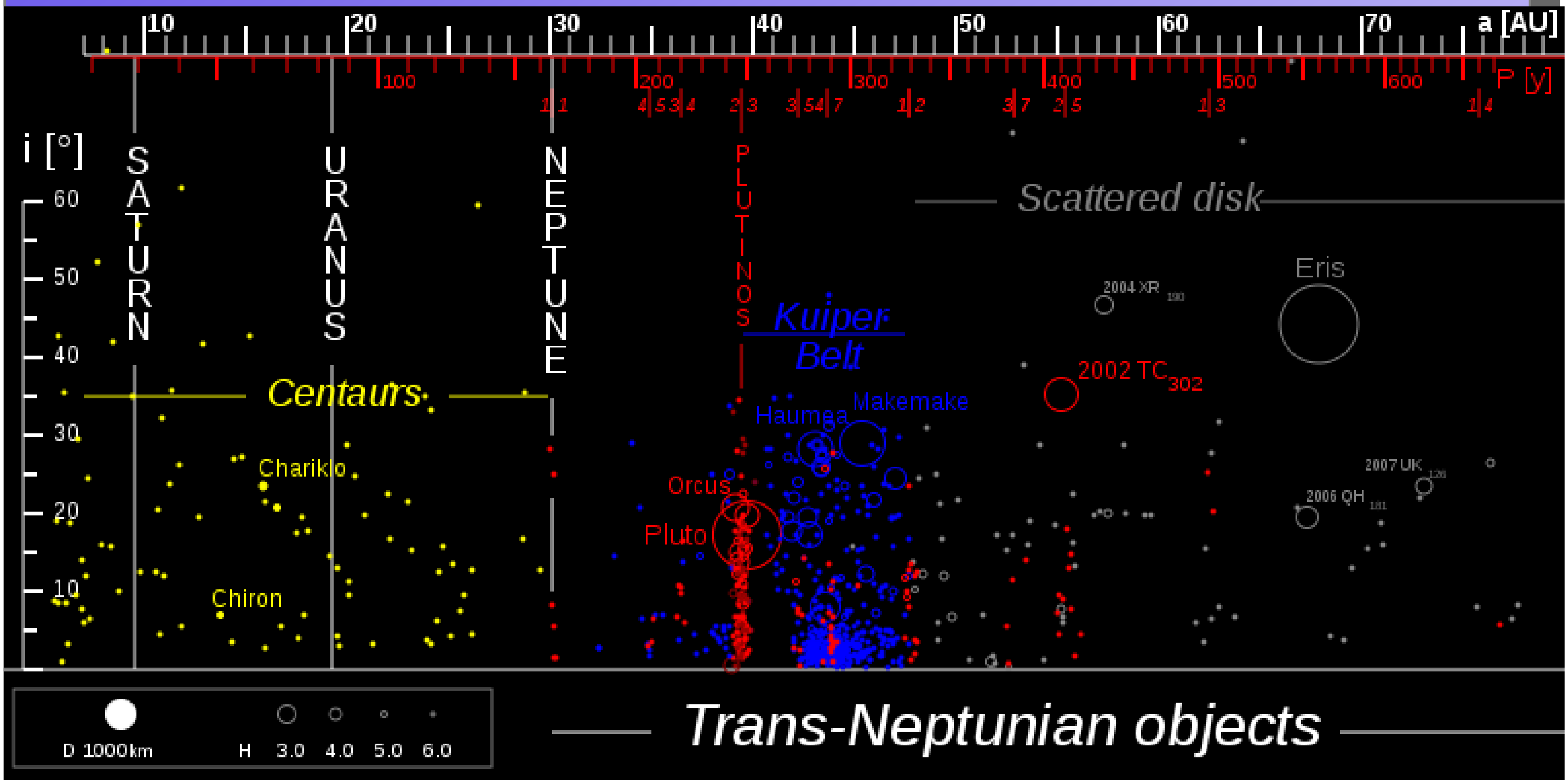

Largest known trans-Neptunian objects (TNOs)
Dysnomia
Nix
S/2011 P 1
S/2012 P1
Charon
Hydra
Namaka
Hi'iaka
Eris
Pluto
Makemake
Haumea
Weywot
Vanth
Sedna
2007 OR10
Quaoar
Orcus

Largest known trans-Neptunian objects (TNOs)





Pluto ▪ July 7, 2012
HST WFC3/UVIS F350LP
Nix
P5
Pluto
P4
Hydra
Charon
N
E
50,000 miles
80,500 kilometers


10
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4:5
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SATURN
URANUS
NEPTUNE
PLUTINOS
Kuiper Belt
Scattered disk
Eris
2004 XR
2002 TC302
Centaurs
Makemake
Haumea
Chariklo
Orcus
Pluto
Chiron
2007 UK
2006 QH
D 1000km
H 3.0 4.0 5.0 6.0
Trans-Neptunian objects

Full Network

- Notional sites targeted
- Good spacing in most locations
- Red curve shows track from a 100 km object
- Gray curve shows track from a 500 km object

Pilot Project Network

- 10 sites (North to South)
  - Tulelake, CA
  - Alturas, CA
  - Burney, CA
  - Susanville, CA
  - Quincy, CA
  - Reno, NV
  - Yerington, NV
  - Hawthorne, NV
  - Bishop, CA
  - Tonopah, NV

Community Observation Teams

- Take responsibility for 11-inch telescope and camera over duration of project
- Send one representative to 4-5 day weekend training session, Reno – March, 2013
- Participate in coordinated observations
  - 4 observations between April-September 2013
  - 6 observations between October 2013 – August 2014
- Download and transfer data files from observations to SwRI for analysis
- Discuss, inform, and/or involve additional members of their community in this citizen science research effort

Benefits

- Community receives 11-inch reflector telescope and video camera system useful for:
  - coordinated observation efforts related to project
  - other educational activities in the community
- Team representative will receive funding to participate in a hands-on training in Reno in March, 2013
- Communities will play an essential role in making new discoveries related to this NSF funded project
- Astronomers Buie and Keller will visit target communities to provide support and public outreach
- Each community team receives $700 to facilitate their involvement

Mentors

- The organization of RECON calls for regional mentors
  - Pilot project will have one such mentor, complete network will have four or five mentors
- Mentors provide help in the region providing a local contact and support
- Compensation provided and will participate in workshop

Observations

- Expected TNO rate of 4-6 events per year
    - limiting magnitude of 13
    - Slowest rate 1-2 Hz (16 or 32 frames integration)
- Use main-belt asteroids during pilot project to ensure some positive results
- Predictions and observations to be coordinated with Occult Watcher

Opportunities for IOTA

- All TNO events will be very uncertain (10x worse than main-belt, at best)
- Not practical for mighty-mini or other types of portable deployments
- Low-cost and low-effort efforts work best
- 11-inch will likely be a minimum aperture
- Observe from your backyard or other easy to support location

Project Schedule

- Oct. 2012 – site visits
- Nov.-Dec. 2012 – team selection
- Nov. 2012 – Jan. 2012 – hardware procurement
- Mar. 2013 – participant workshop
- Apr. 2013 – Network functional
- Nov. 2013 – NSF proposal due
- Aug. 2014 – End of pilot project
- Sep. 2014 – Start implementation of full network?

Todd Hunt
Scott Darrington
Joanna Kuzia

Yerington, Nevada

Hawthorne, Nevada

Kathy Trujillo
Melissa Cardenas

Hawthorne, Nevada

Tonopah, Nevada

Ted Sauvagean
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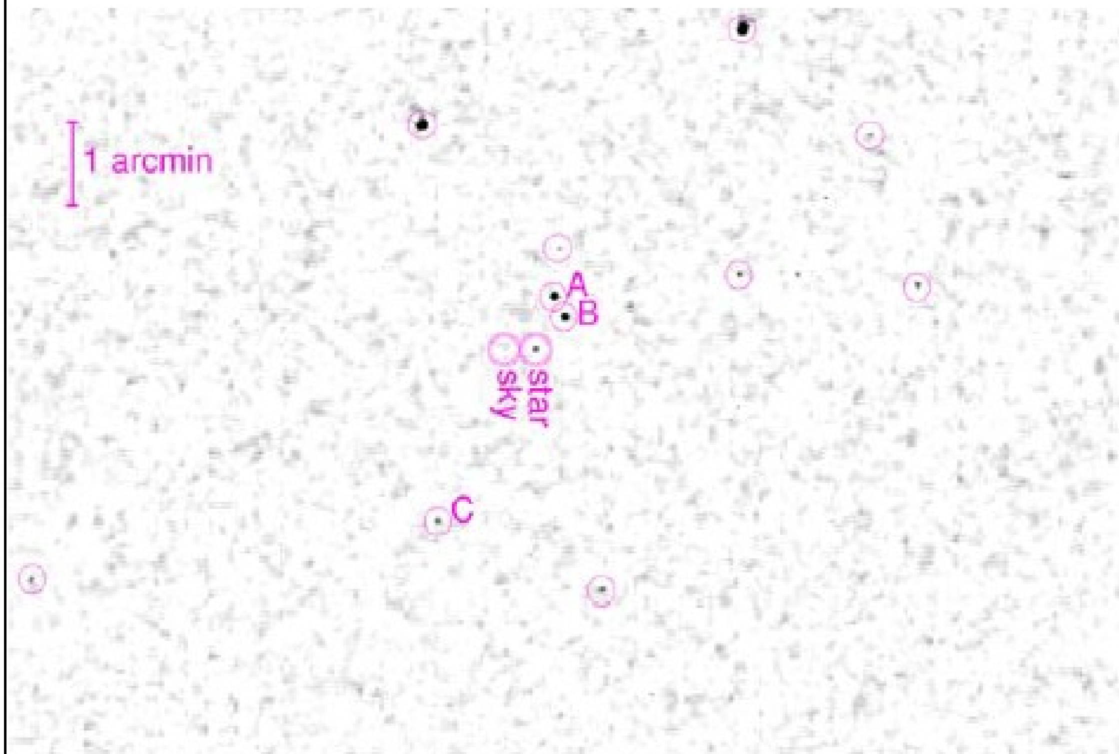

Figure 4: Sample video image of a candidate occultation star. The labeled star was identified from the USNOB star catalog to have a geocentric appulse of 0.9 arcsec with (66652) Borasisi at 2009/10/12 05:18:20 UT. The catalog (red) magnitude is 12.0. For comparison, stars A and B are 10.9 mag. The astrometric uncertainty for this object at the time of the appulse was 0.6 arcsec and its most recent astrometric measurement was taken on 2004/05/29. Locations marked with a double-circle are used to extract the simulated lightcurve shown in Fig. 5. All other circled locations show positions of all the other sources in the field, some of which are clearly fainter than the star of interest.

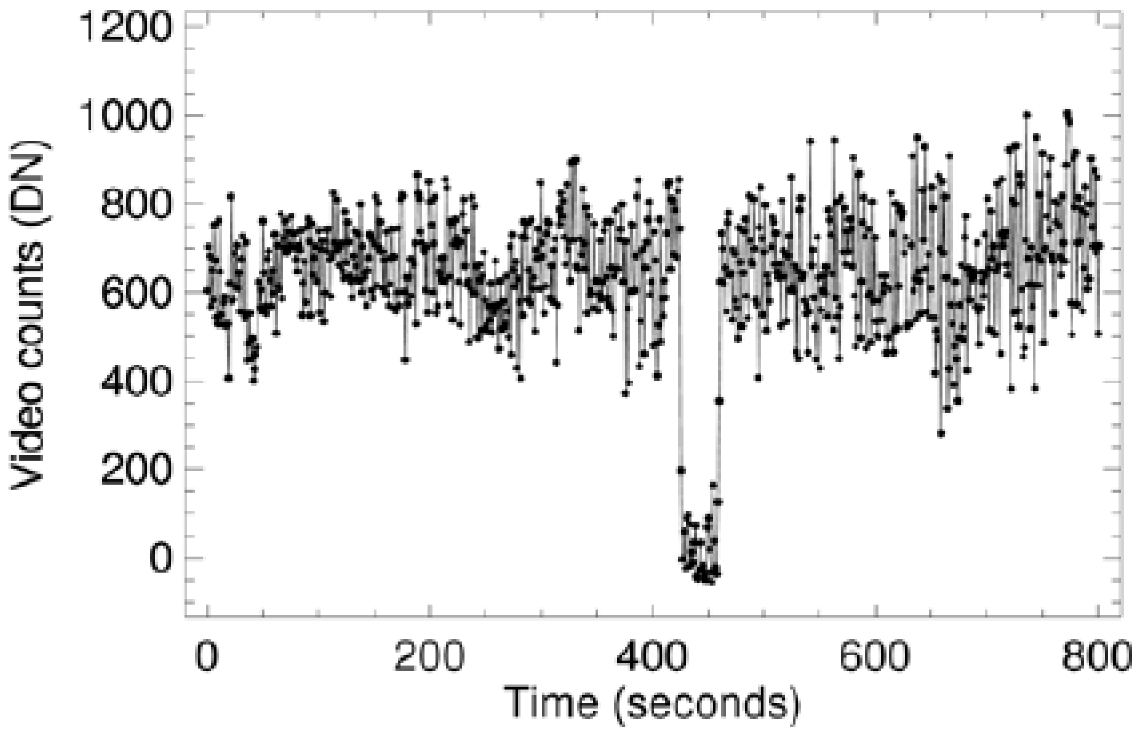

Figure 5: Simulated occultation lightcurve. Data shown are extracted from a 800-sec run on the star shown in Fig. 4. The “flux” extracted from the sky aperture is inserted to show what the data would look like for a real occultation. The duration simulated here is 34.2 seconds. The flux is extracted with synthetic aperture photometry using a 2.5-pixel radius object aperture and a sky-subtraction annulus with inner and outer radii of 5 and 25 pixels. No attempt was made to correct for flat fielding, fixed bias patterns, or atmospheric effects (skies were photometric at the time).