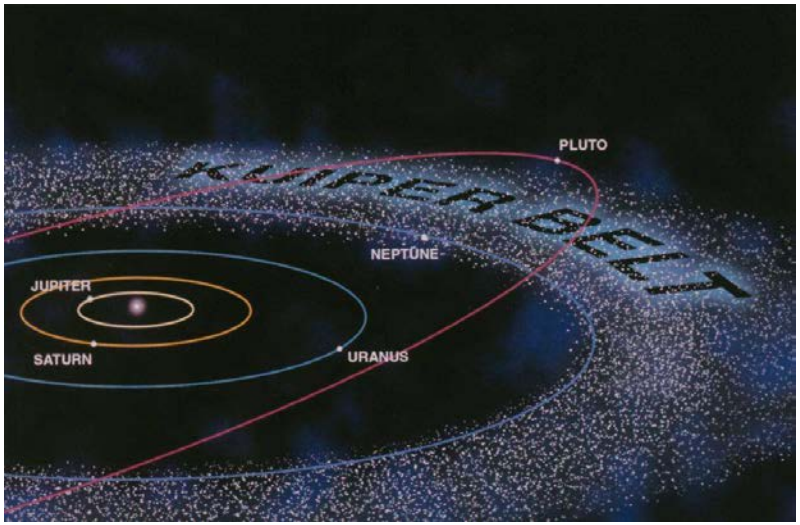
RECON: Research and Education Collaborative Occultation Network

This material is based upon work supported by the NSF under Grant Nos. 1212159 and 1413072.

Goal: Measure TNOs

- Recently discovered objects orbiting beyond Neptune called Trans-Neptunian Objects (TNOs) provide key clues into the formation and history of the Solar System.
- Determination of TNO sizes and characteristics is needed to understand the composition, density, formation, and history of these ancient objects.



Credit: NASA

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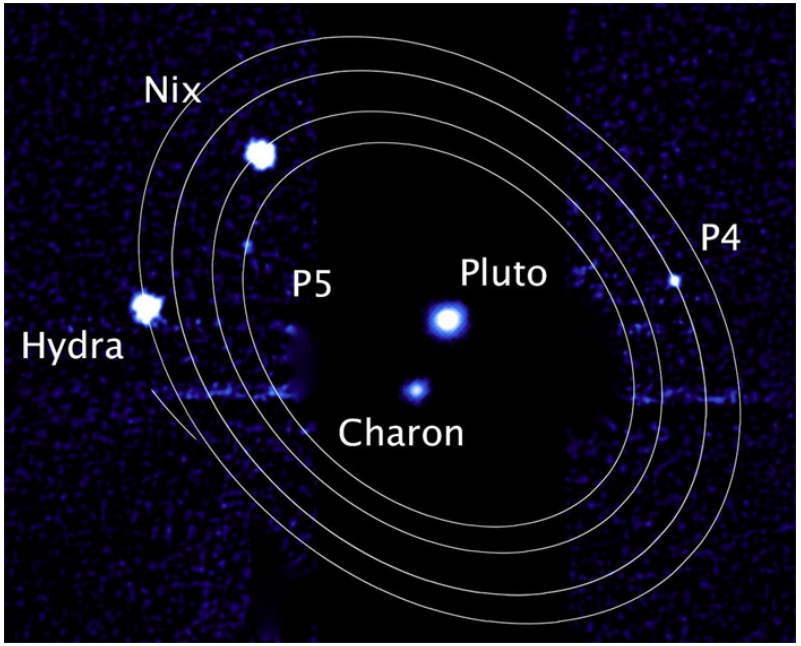
Goal: Measure TNO Sizes

- Perhaps the most famous TNO is the dwarf planet Pluto. Discovered in 1930, we now know this Kuiper Belt Object (KBO) has at least five satellites.
- Since 1992, over a thousand additional KBOs have been discovered. Estimates place the number of KBOs larger than 100 km in diameter at over 100,000.



Credit: NASA; ESA; M. Showalter, SETI Institute

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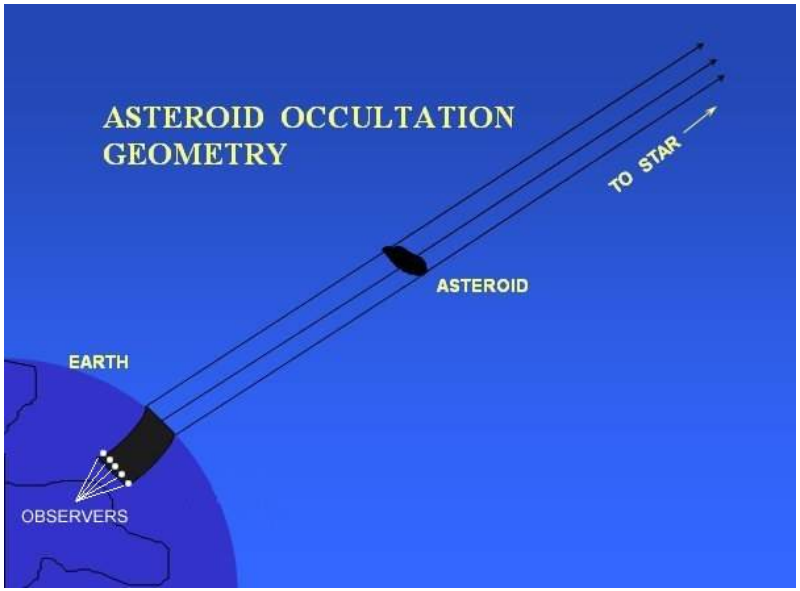
Method: Occultation Events

- When a Solar System object such as an asteroid or TNO passes in front of a star, it casts a shadow on on Earth's surface.
- This type of astronomical event is called an occultation because the star is "hidden" by the passing object.



Credit: IOTA

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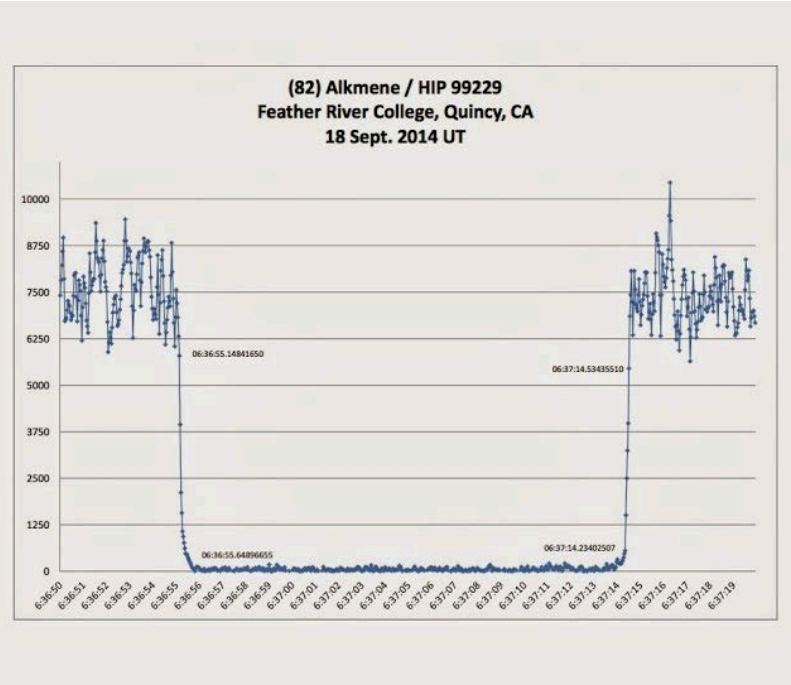
Method: Occultation Timing

- During an occultation, the star will dim as the Solar System object passes in front of it.
- Shown here is a light curve from data collected by a RECON telescope site in Quincy, California



Credit: Charley Arrowsmith, Feather River College

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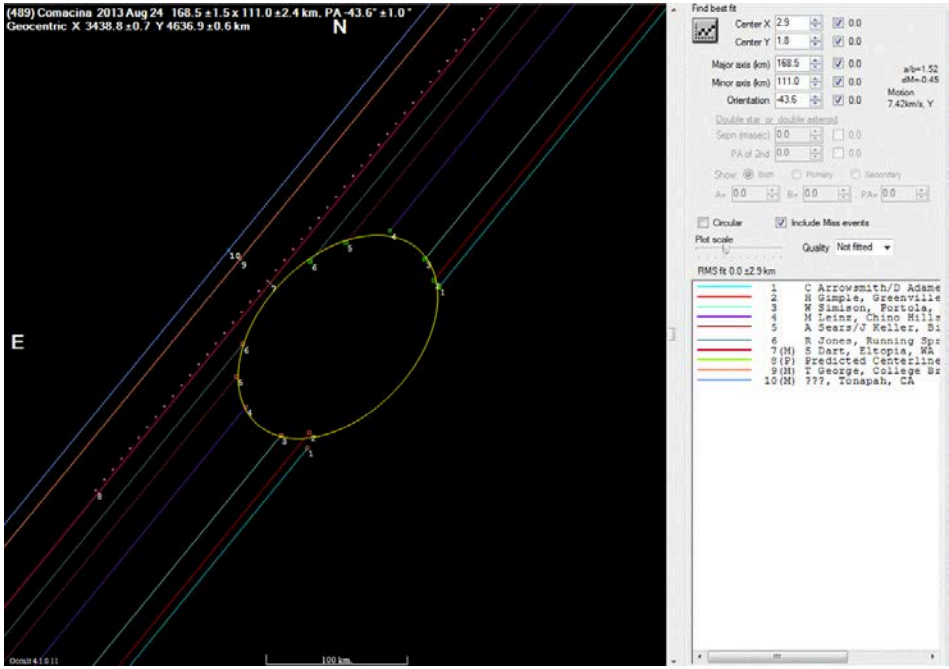
Method: Occultation Chords

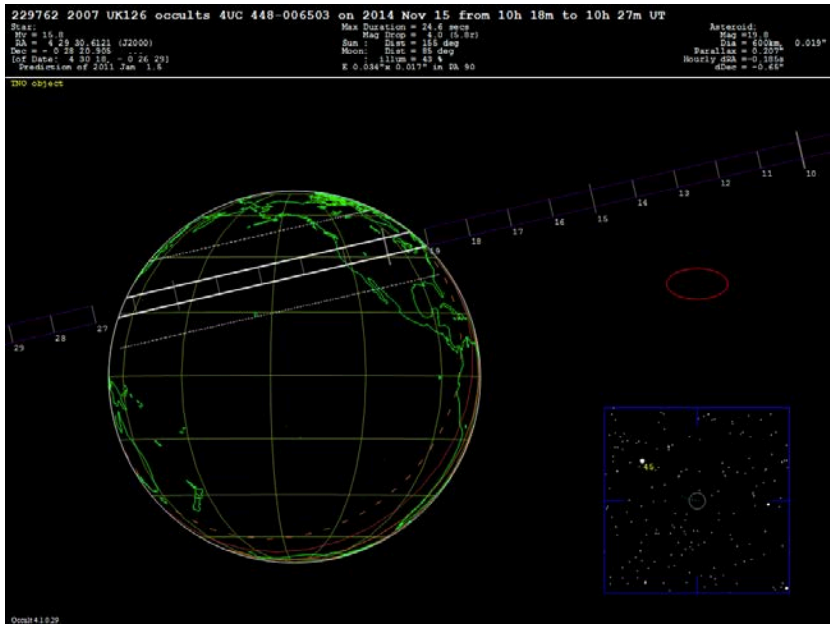
- The size and shape of the object can be determined by measuring the location and duration of the event using a network of telescopes.



Credit: IOTA

Why So Many Telescopes?

- Uncertainties in object orbits and star positions make accurate predictions of shadow paths for TNOs very challenging.
- Shown here is the predicted shadow path for a known TNO (solid lines), but there is a 68% probability that the shadow will fall anywhere within the dashed lines.



Credit: RIO Team

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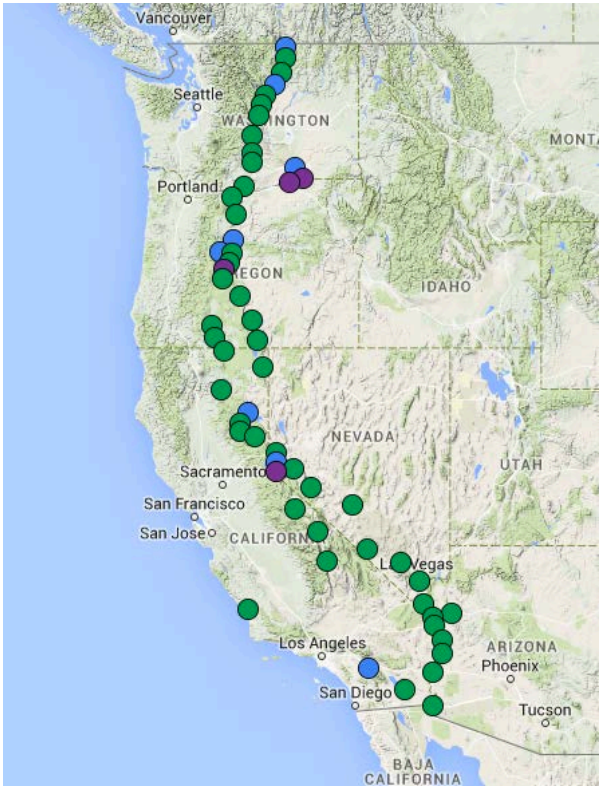
Pilot RECON Network

- The National Science Foundation (NSF) has provided funding to create an extensive telescope network of communities stretching across the western United States.
- Green sites have received both a telescope and camera system; blue sites have received camera systems but are providing own telescopes; purple site is providing own telescope and camera system.



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RECON Teams

- RECON has recruited over 200 educators and amateur astronomers/community members to lead this exciting research effort.
- The project has provided telescopes and equipment to 52 telescope sites coordinated by over 60 communities.

RECON Equipment

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RECON is Citizen Science

- Citizen science provides opportunity for students, teachers, and community members to collaborate in authentic research.
- Next Generation Science Standards for K-12 students include scientific and engineering practices inherent in citizen science research efforts.

RECON Project Benefits

- Students, teachers, and community members conduct authentic research with professional astronomers to measure currently undetermined characteristics of our Solar System.
- RECON telescopes and cameras provided to each community are available for public star parties, education, and research.
- Project scientists Marc Buie (Boulder) and John Keller (San Luis Obispo) will provide public talks during planned community visits.
- RECON is connecting participants both within local communities and across the entire network.

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Ways to Get Involved

- Visit the RECON website — www.tnorecon.net
- RECON Communities
  - Join a local RECON team and help during occultation events
  - Participate in local RECON star parties and astronomy activities
- Amateur astronomers outside RECON communities
  - Join RECON campaigns — www.tnorecon.net/observation-campaigns/
  - Timing Association (IOTA) – www.occultations.org

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Ways to Get Involved

- Stay current and connected to RECON activities:
  - RECON Blog and Website: Visit www.tnorecon.net
  - Facebook: Like us at TNO RECON
  - Twitter: Follow us @tno_recon

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"This is cutting edge real science! This isn't like in my classroom where we repeat others' work over and over getting the same results. People will be repeating our work someday!"

"The telescope is awesome! I can't wait to take it out and show my students the night sky. We are no longer just learning science . . . we are DOING science."

- Quotes from RECON Workshop Participants

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