Observing Trans-Neptunian Objects with Portable Telescopes

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Observing Basics

- Reflected light observations require 4-m class telescopes (or better)
  - Typical size – D=100km
  - Apparent brightness – R~23.5
- Occultations
  - Measure size as object passes in front of star
  - Telescope size depends on brightness of star
    - 11-in (28cm) can reach R~13
  - Timing measurement, not photometry

Occultations – Figures of Merit

- Size measured by (event duration / velocity)
  - D=100km, v=20km/sec, t=5 sec
  - $\sigma_D \leq 10\%$ implies $\Delta t \leq 0.5$ sec

- Size constrains albedo
  - Apparent brightness known
  - $\sigma_D \leq 10\%$ implies $\sigma_A \leq 3\%$

- Currently ~500 candidate TNOs
  - R~13 mag limit implies ~2-4 events per year from a single "location"

Occultations – Strategy 1

- RECON – Coordinated fixed stations
  - Joint project with John Keller, CalPoly
  - 40 stations, community hosted
  - IOTA contributions as desired
  - No travel, let shadow come to the network
  - Baseline system – ~$4k/station
    - Celestron 11
    - Watec 902H
    - GPS video overlay
    - Digital DVR

RECON

- 40 stations

- Mean spacing ~50 km

- Community/school based

- Citizen scientists

- John Keller – Educational coordination

- Marc Buie – Scientific coordination

- 1-2 events per year

- 2 sites see event

Occultations – Strategy 2

- Go to shadow – portable telescopes
    - Feasible only for best orbits and largest objects
    - Intensive prediction effort needed for each event
- 1-m class portables
    - Limiting mag drops to R~16 (compared to 11in)
    - 40x increase in candidates
    - Comparable to RECON for large TNOs
    - Can fill in gaps between large fixed telescopes

Instrumentation

- High quantum efficiency cameras always good
- Fast readout – goal is zero deadtime
    - Video or frame-transfer best
- Time-tagged images (≤1ms) required
- Lower cost = more stations = better results
- Photometry (≥12bits/pixel)
    - Needed for atmospheric detection/study
    - Not necessary for size on airless bodies