Promise and Problems of Deploying Multiple Stations for Asteroidal and Outer Solar System Occultations

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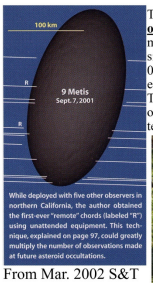
Portable Remote Stations for Asteroidal Occultations

- Too many asteroidal occultations are observed from only one station. Much more accurate information can be obtained if the event can be recorded from two or more stations. We describe and demonstrate the ability for one observer to do this here.
- Rather than just observe from home with a large telescope, observers should do that as a safe remote station, and travel with a portable scope to make another recording from an attended mobile site. If the mobile site is a friend's house or other safe location, another remote telescope might be run there, and your attended site then a 3rd station, etc.
- The station separation should be many km, so tracking times & errors with most portable telescopes are too large; pre-pointed stationary telescopes with inexpensive non-driven mounts are possible since predictions are usually good to much less that 1 min. = ¼° drift.
- Point telescope beforehand to same altitude and azimuth that the target star will have at event time and keep it fixed in that direction
- Plot line of target star's declination in the sky; Guide or C2A can be used to produce the necessary star charts, with tick marks plotted at 1-min. intervals taking into account the sidereal rate. You can usually find stars close to the pre-point line of declination that are brighter and much easier to find than the target star, but good charts will allow you to pre-point whenever you need to.
- Find a safe, hidden, but accessible place for both the attended & remote telescopes
- The separation distance is limited by travel time & set-up time at each station, and the available dark time before the occultation (but that limitation can be overcome with "paver mounts" discussed below).
- If possible, remote sites can be attended by people who only need to know how to turn on the equipment (to conserve battery power, larger station separations) and provides security, if in a populated area.

Sky-plane plot of (9) Metis occultation of double star SAO 78349 on 2001 September 7

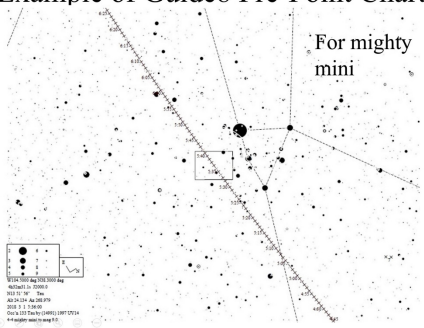


From Mar. 2002 S&T

This was **the first 2-station mobile positive observation of an asteroidal occultation,** by D. Dunham, with a remote pre-pointed station about 30 km north of his attended site. The star was known to be a close double, sep. about 0.08" with 6.5 and 6.9-mag. components, from a photoelectric lunar occultation recording at McDonald Obs., Texas, on 1973 April 9. It was the best asteroidal occultation of 2001 in the U.S.A. Dunham first used the technique for lunar grazing occultations in 1998.

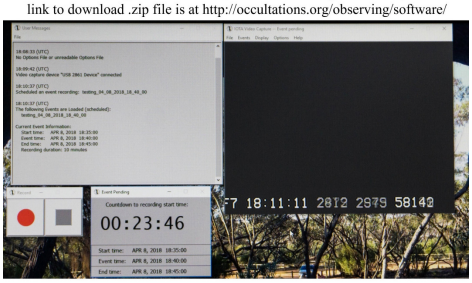
At left, equipment used at the remote site: A 50mm telephoto lens, image intensifier, video camera, and camcorder for recording

Example of Guide8 Pre-Point Chart



IOTA Video Capture

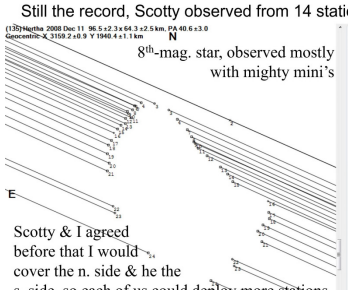
for scheduling automatic remote-station recordings with a PC; the link to download .zip file is at http://occultations.org/observing/software/



"Mighty Mini" complete portable occultation timing setup (air carryon)

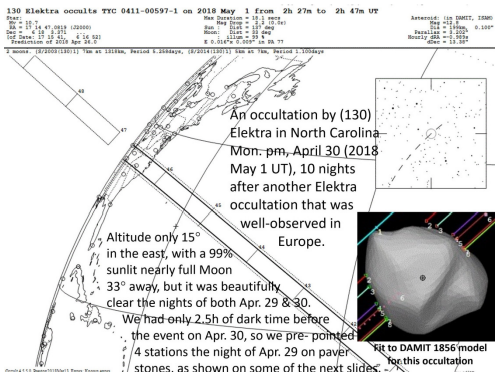
The 50mm half-binocular with cut PCV Pipe fitting that holds the Supercircuits PC164C-EX2 camera (we now have a version for the currently-available and smaller Runcam cameras sold by IOTA) can record stars well to 9th magnitude. The compact inexpensive system was designed by **Scotty Degenhardt** in 2009. Now, we prefer to use small PC's with Startech video capture devices for recording rather than the no-longer-manufactured Canon ZR camcorder shown, and adding a GPS video time inserter gives better times.

Still the record, Scotty observed from 14 stations in Oklahoma



8th-mag. star, observed mostly with mighty mini's

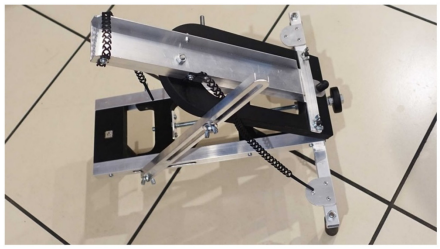
Scotty & I agreed before that I would cover the n. side & he the s. side, so each of us could deploy more stations across a shorter distance. This time, the path shifted s. so he hit the jackpot. 3 LA region fixed observers expected no event, but ended up defining the southern part of Hertha.



2018 May 1 Elektra Station 2 – Roanoke Rapids, NC

80mm "midi" refractor with IOTA Runcam camera and a stick iView miniPC to record. An IOTA-VTI provides accurate time. This "paver-mount" station was pre-pointed on the 30cm square paver stone shown the night before the occultation, removed from the paver stone, then returned to it the afternoon before the occ'n night. The system can record stars to mag. 11.0. This station was in middle of an old street, mostly torn up & with large concrete blocks to placed to prevent vehicle access. More about the 2018 May 1st Elektra occultation, and our multiple paver-mount effort for it, is in Journal of Occultation Astronomy, 2019 issue #1, pp. 3-8.

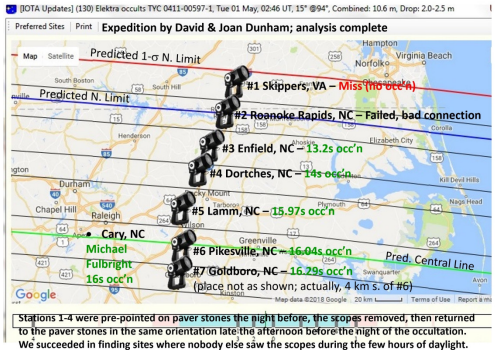
This shows the paver mount, designed and built by John Broughton, in more detail, without the 80mm telescope. The bottom is held with a screw through a single hole, the top is in one of two ranges, for coarse altitude adjustment. Fine adjustment is made by turning the knob on the back end. Three wooden "feet" can be added to elevate the mount above the ground if it is not used on a paver stone. For use on a paver stone, all screws can be tightened, then the mount (with the scope) lifted off of, and later returned to, the paver stone, to preserve the pointing to a few tenths of a degree.



2018 May 1 Elektra Station 3 – Enfield, NC

120mm "maxi" refractor. It used a paver mount similar to that for the 80mm scope and, like Sta. 1, 2, and 4, it was pre-pointed the night before. Here, it is returned to the paver stone the afternoon before the event. The 120mm scope can record stars well to mag. 12.0.

Occultation of 10.7-mag. star by (130) Elektra, 2018 May 1



Stations 1-4 were pre-pointed on paver stones the night before, the scopes removed, then returned to the paver stones in the same orientation late the afternoon before the night of the occultation. We succeeded in finding sites where nobody else saw the scopes during the few hours of daylight.

Mighty Mini Training at Sabadell, Spain, in 2010.

Many systems can easily be transported, and others trained to use them.

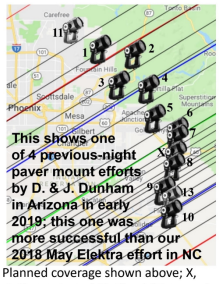
Components of John Broughton's 25cm "Suitcase Telescope" that can record stars to mag. 13.0 well, and to at least 14.0 with integration.

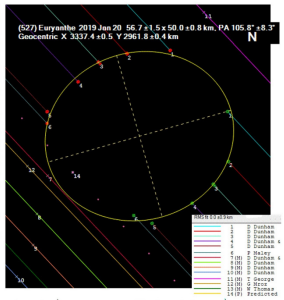
John's "Suitcase Scope" designs since 2016 use an alt-alt design, like the paver mounts, that allows easy pointing near the zenith, but are a little larger than the alt-az version shown here.

A 10-inch "suitcase" telescope; a larger version could record many TNO & Centaur events

The telescope total weight is 30 pounds and fills about 60% of a standard suitcase; towels and bubble wrap protect the equipment in the suitcase. We haven't tried, but a 16-inch version that could still have a large-enough FOV should be possible. It used a "mighty mini" with 3° FOV as a video finder. This was like those used at Sta. 6 & 7 for the 2018 May 1st Elektra occ'n (same night pre-pointing). A 16-in. version could record to 16th mag. and thus, could record some TNO & Centaur events if the time prediction is good enough.

Occ'n of 10.4-mag. star by (527) Euryanthe near Phoenix, AZ; paver mounts solve the problem of events in early evening that have short usable dark times from sunset to the event





Planned coverage shown above; X, station not used. To the right, a good elliptical fit. Positive sta. 1-5 were pre-pointed on paver stones the night before.