Asteroid Occultation Observations:

They are Fun (and Addictive)

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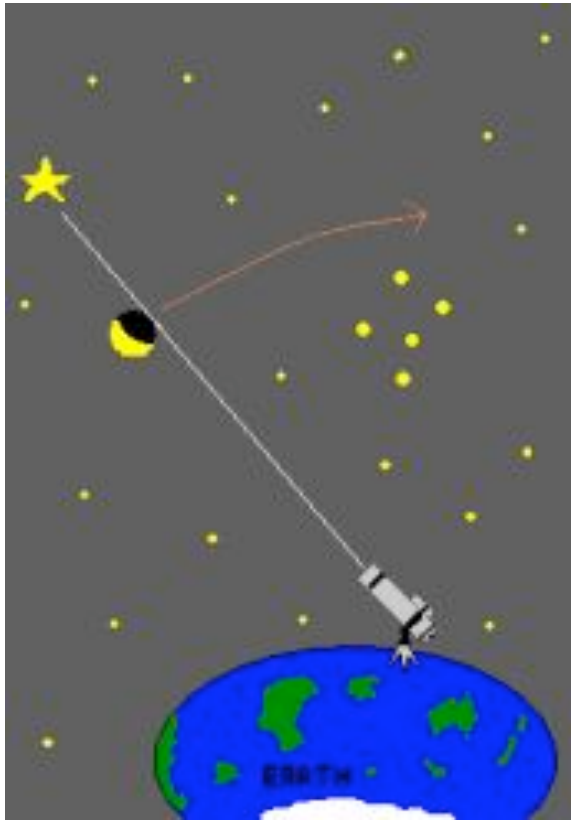


So what is an occultation?

It's all geometry, and has no physics significance..

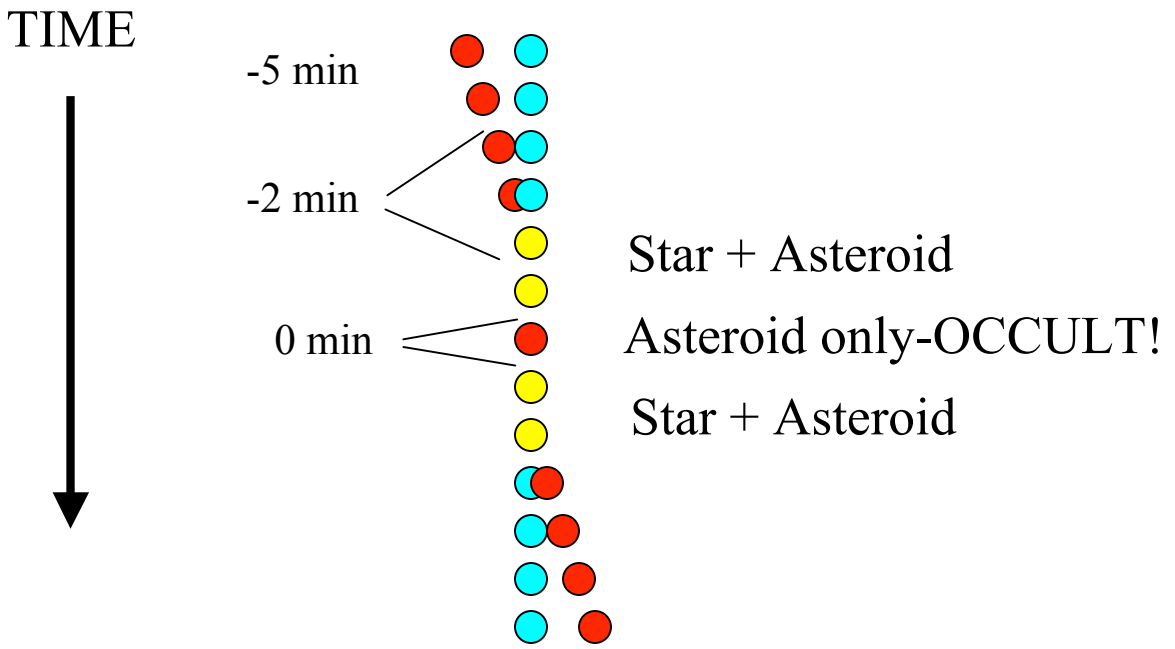
Occultation is the line-up of observer, asteroid, and star

…Asteroid passes in front of the star, blocking it from view

…Shadow (faint) of asteroid passes across the earth

What does an occultation “look” like?

Note--apparent size of asteroid or star is around 10E-2 a-s
ie., much smaller than resolution or seeing for most scopes



Occultation Observation…

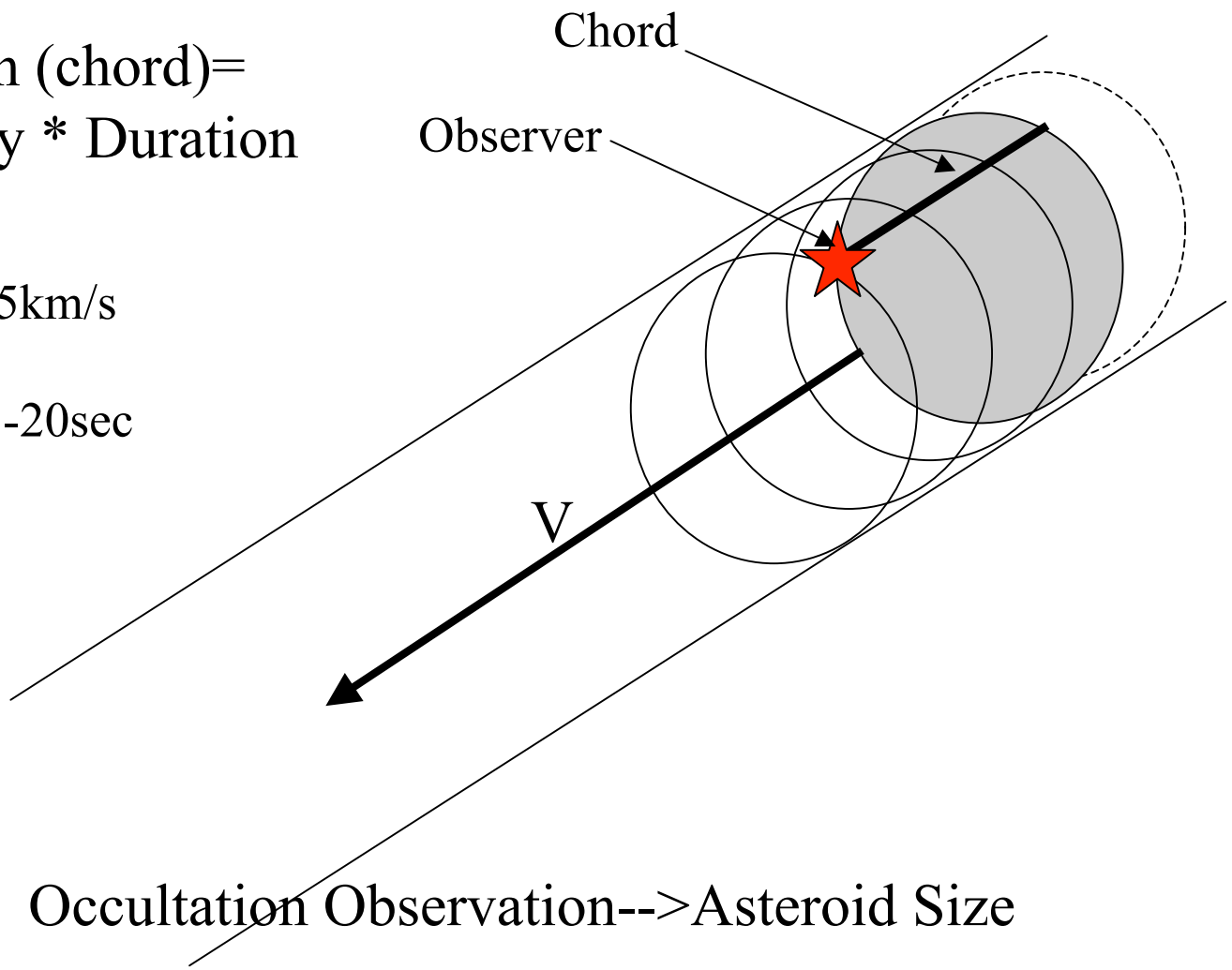
…Duration of event gives chord of asteroid

…multiple chords give size and shape (of one crossection)

Path Length (chord)=
Velocity * Duration

Velocity~15km/s

Duration~5-20sec



Occultation Observation-->Asteroid Size

Methods of determining size/shape of asteroids

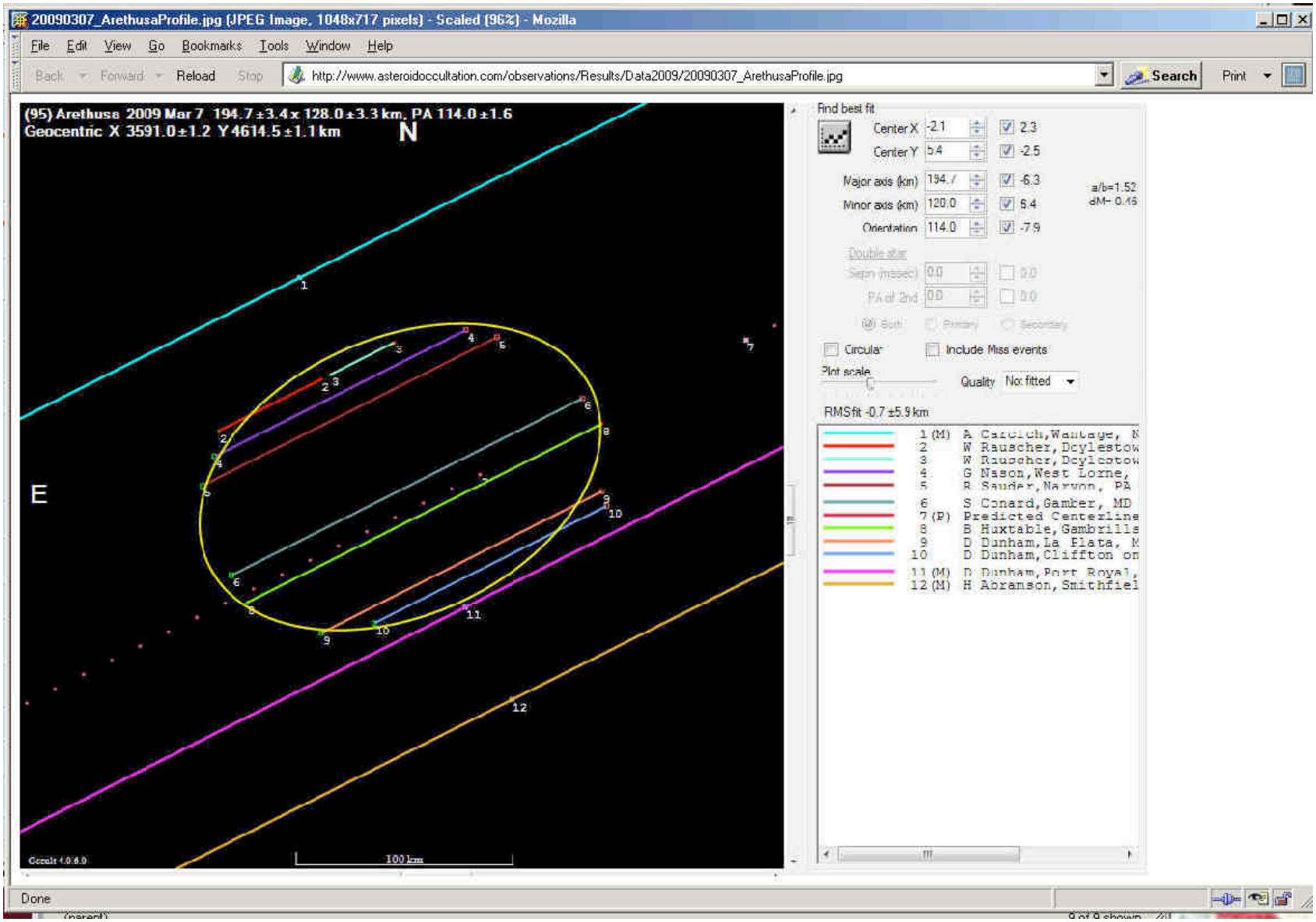
Light curves (can derive shape, but not size)

Radar (nearby only)

Multi-telescope interferometry (new)

Space probe fly-by (expensive, rare)

Stellar-asteroid occultation observation


20090307_ArethusaProfile.jpg (JPEG Image, 1048x717 pixels) - Scaled (96%) - Mozilla
File Edit View Go Bookmarks Tools Window Help
Back Forward Reload Stop
http://www.asteroidoccultation.com/observations/Results/Data2009/20090307_ArethusaProfile.jpg
Search
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(95) Arethusa 2009 Mar 7 194.7±3.4x 128.0±3.3 km, PA 114.0±1.6
Geocentric X 3591.0±1.2 Y4614.5±1.1 km
N
E
100 km
Find best fit
Center X -2.1
Center Y 5.4
Major axis (km) 194.7
Minor axis (km) 120.0
Orientation 114.0
a/b=1.52
dM= 0.45
Circular
Include Miss events
Plot scale
Quality Not fitted
RMS fit -0.7 ±5.9 km
1 (M) A Carolich,Wantage, N
2 W Rauscher,Doylestow
3 W Rauscher,Doylestow
4 G Nason,West Lorne,
5 R Sauder,Narvon, PA
6 S Conard,Gamber, MD
7 (P) Predicted Centerline
8 B Huxtable,Gambrills
9 D Dunham,La Plata, M
10 D Dunham,Cliffton on
11 (M) D Dunham,Port Royal,
12 (M) H Abramson,Smithfiel
Done

Occultation observation requirements..

Predict location and time of occultation
- location/path to within tens of miles
- timing to tens of seconds

Must be able to observe dimming
- dimming usually >25-50%
- fast (<0.1 sec)

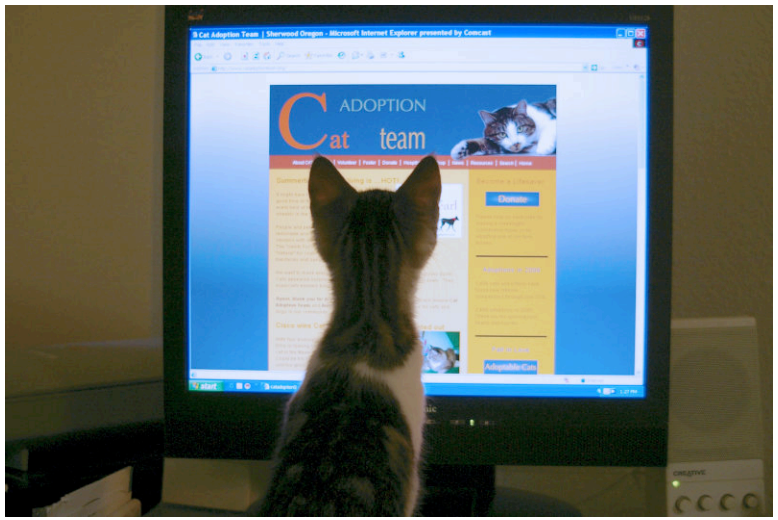
Must be able to measure duration (UTC even better)
- events last 30 sec
- may be in error or have additional events

Where to find occultation predictions:

Prediction web sites

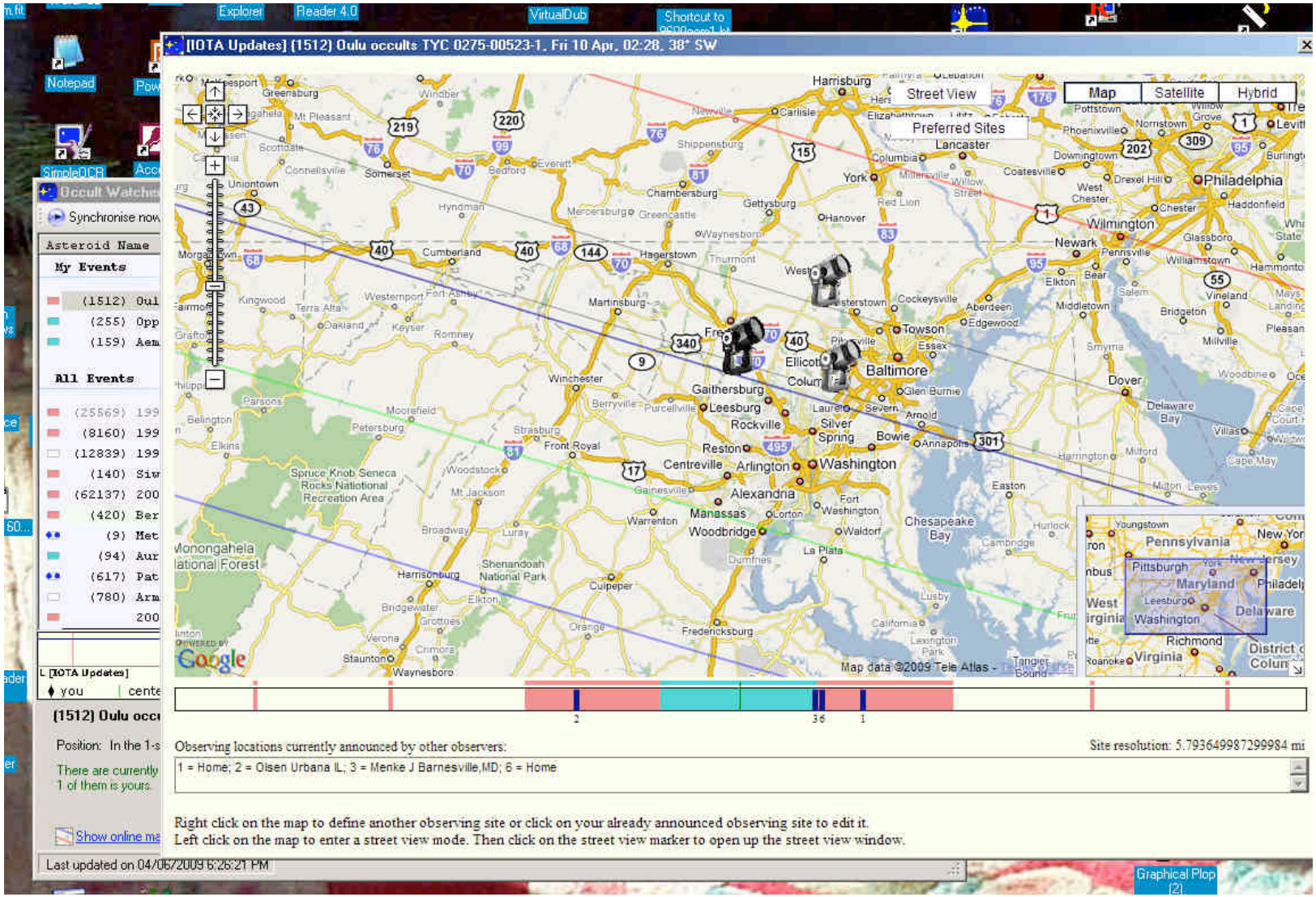
Newsletters (e.g., Dunham, Breit)

Sky & Telescope listings

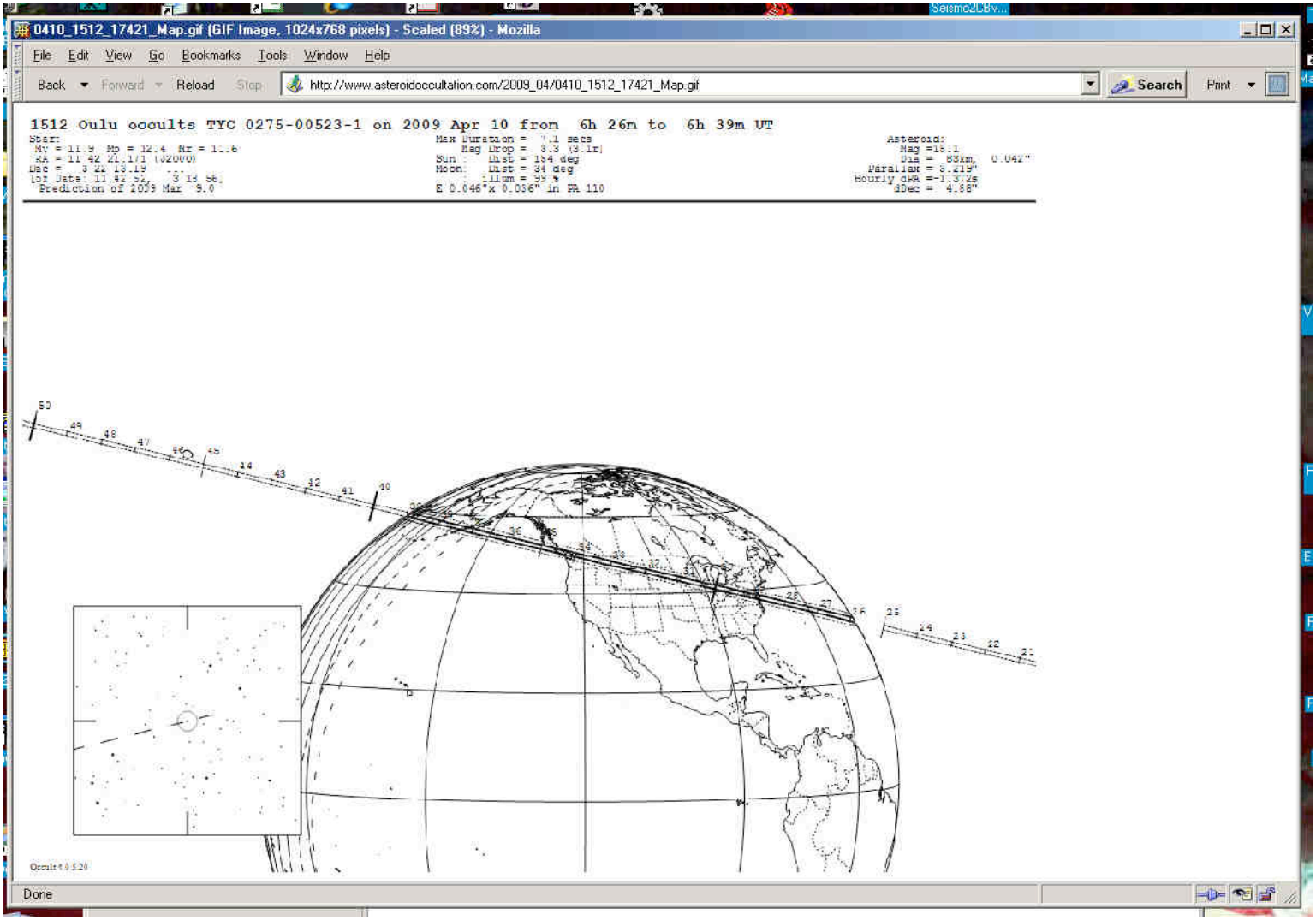


Use OccultWatcher (Freeware), tailors time and place,
and helps map where on the path to observe

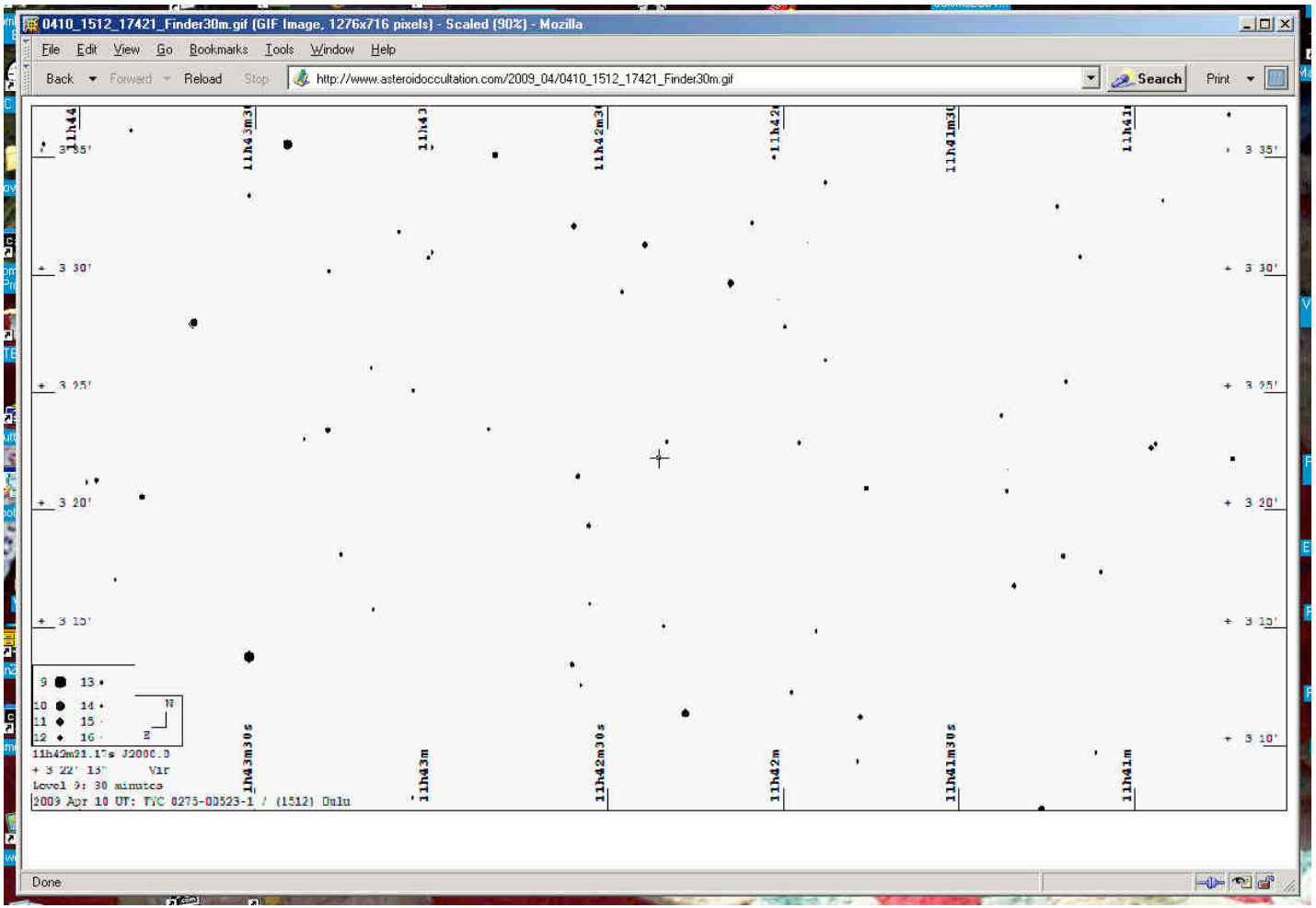
OccultWatcher Main Window



Occult Watcher Mapping functions



Steve Preston Site--Occultation Path map



Steve Preston Site-Star Map

So, measuring a 12mag star should be easy, right?

Pushing the envelope on moon, alt & az, twilight, etc means star may be hard to find

Portable setups increase difficulty of acquiring and tracking target

Little time for practice--occultations only 0-4x per month

No second tries--mess up one step and you've lost the opportunity

Absolute deadline for preparation--it happens when it happens

And timing a 30 sec event should be easy, right?

Aha, but with <0.1 sec resolution, too?……

Objects are often faint 12-13 mag, hard to get good S/N

Scintillation effects strong at under one second speed

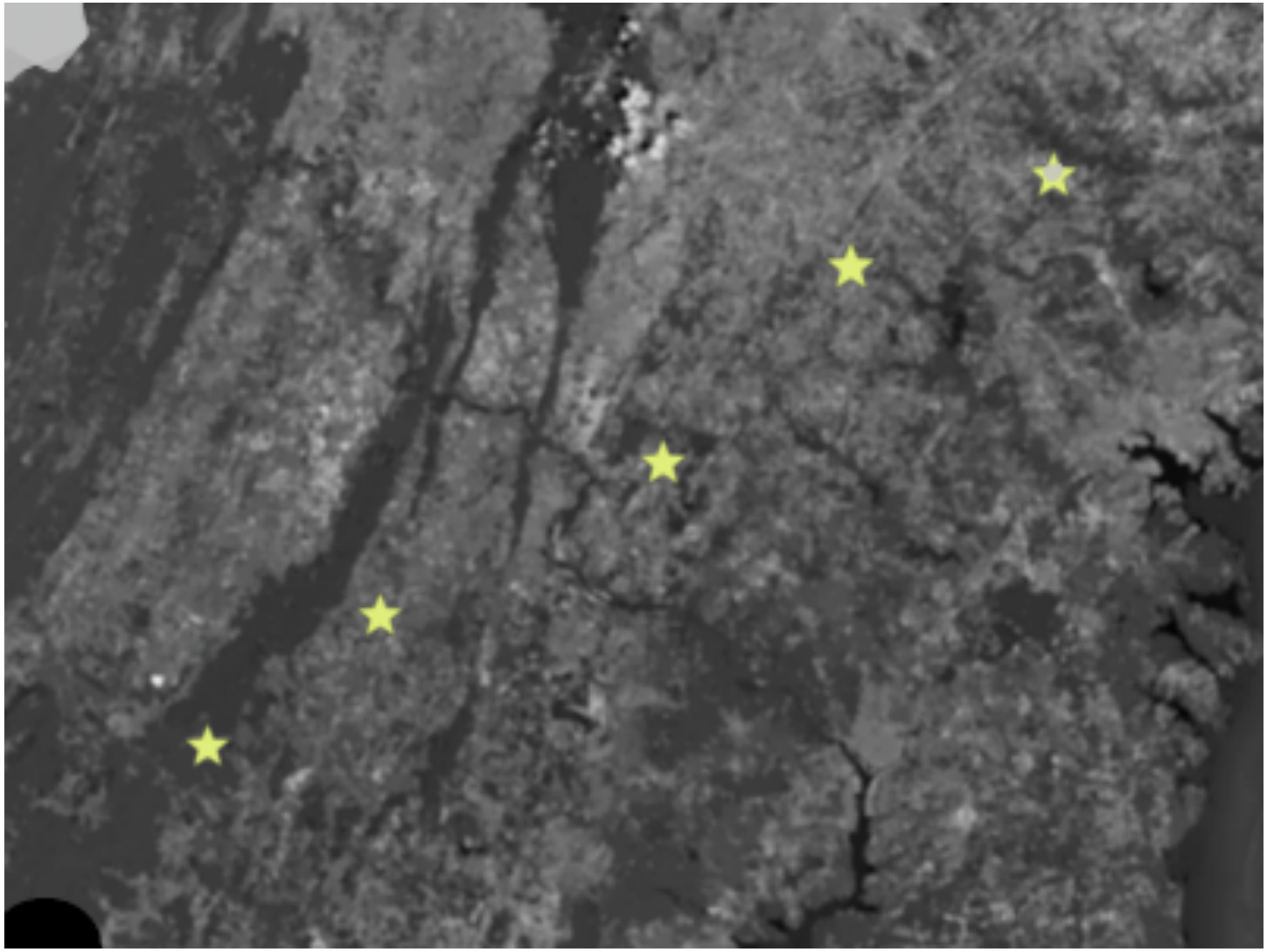
Difficult to get/use accurate UTC time to <1 sec

Windows computer programs cannot do <1 sec UTC

Want automatic, permanent recording of time and event

And then there is Mother nature..

always ready to help out…



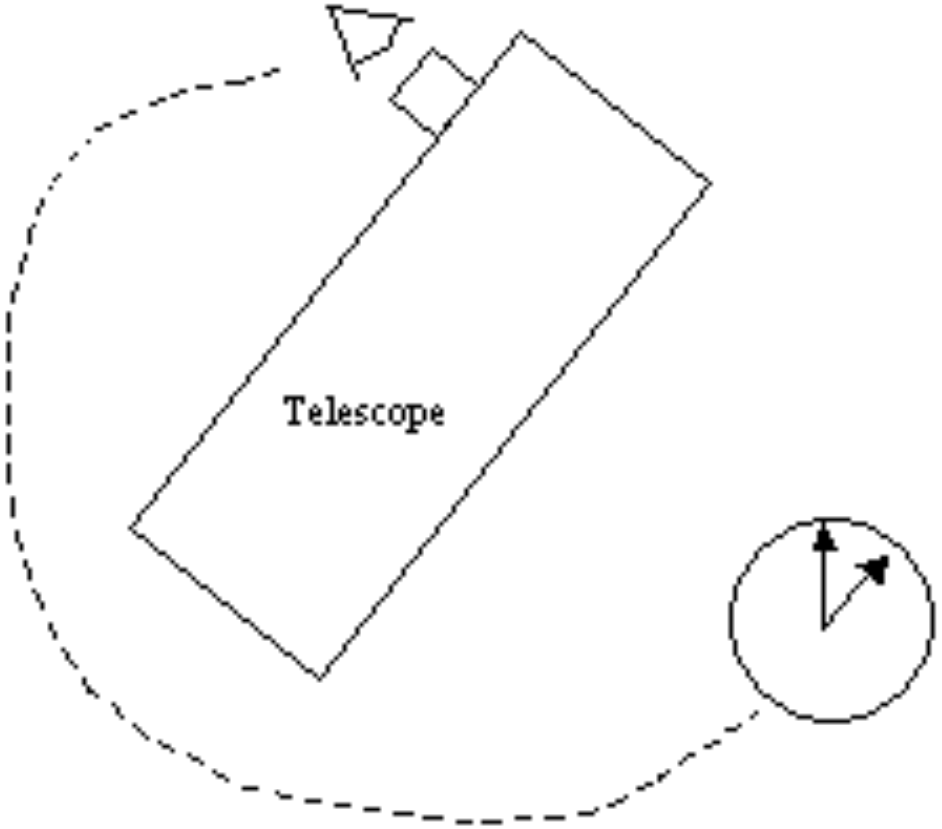
Methods of Observation

Detector Type	**Telescope**	**Mounting**	**Timing**
Visual (eye)	Small	GoTo	Radio
CCD Camera*	Big	Non-GoTo	WWV
Video Camera		Non-Tracking	Stopwatch
Photometer			GPS

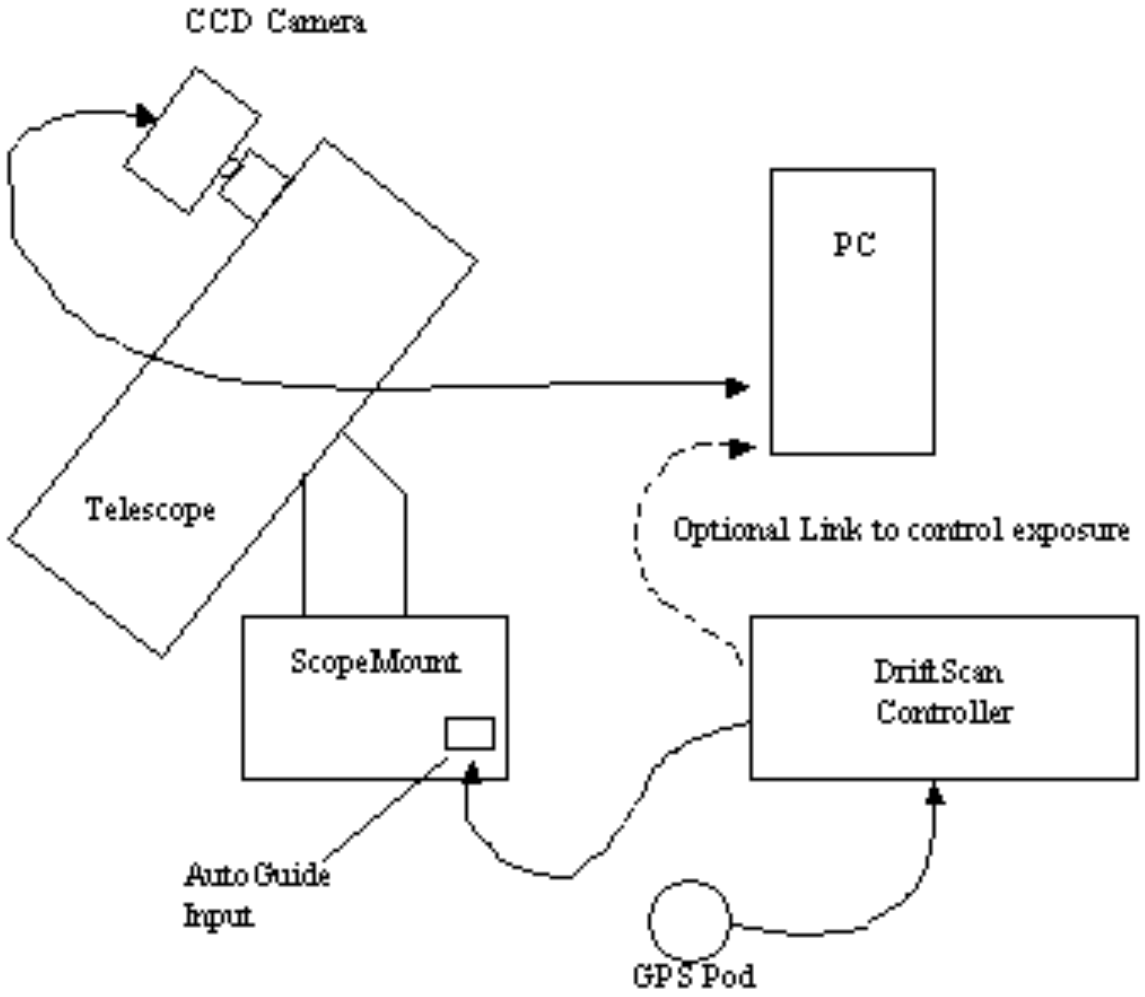
= most common

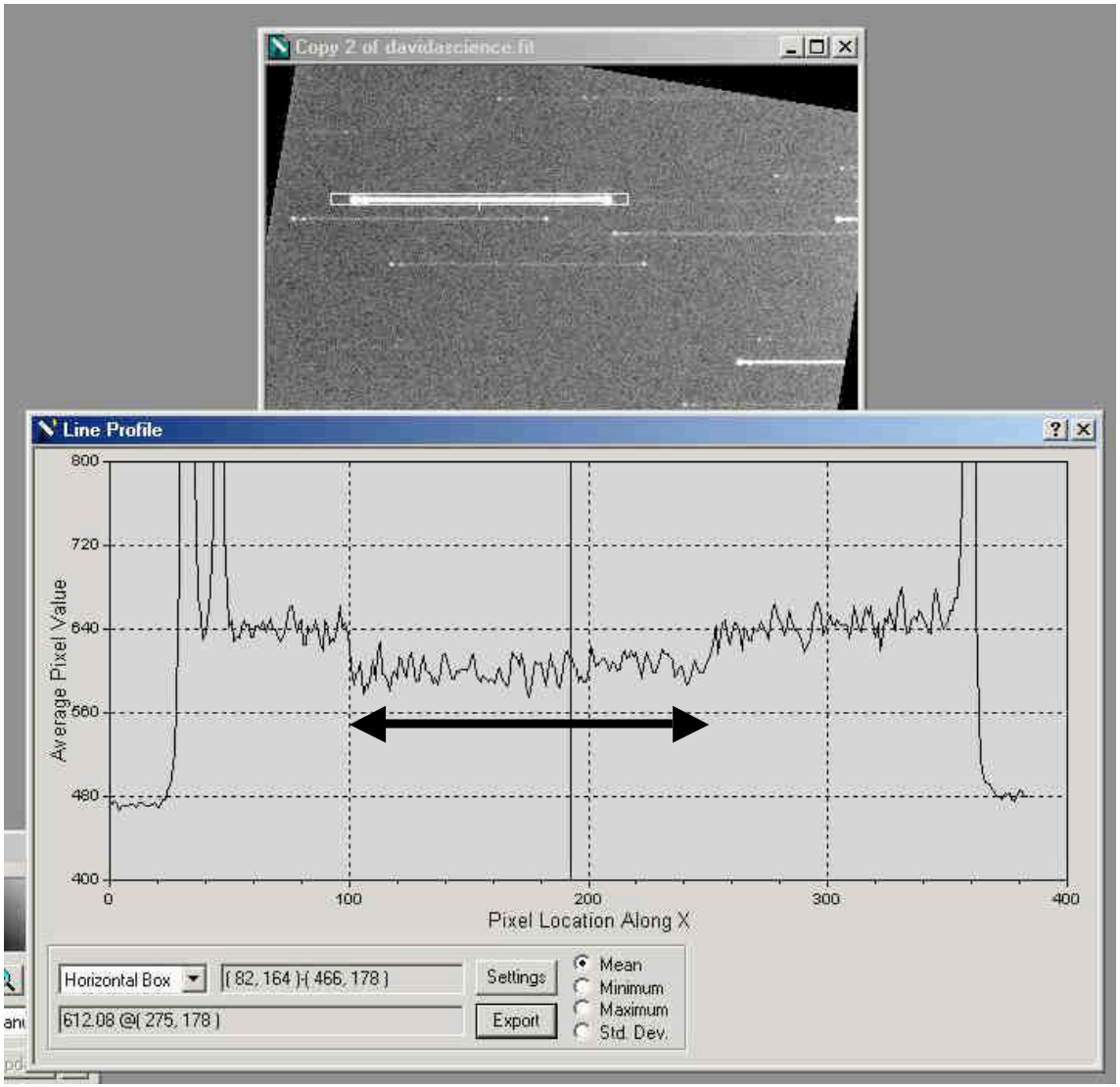
* Drift Scan

Visual Occultation Setup



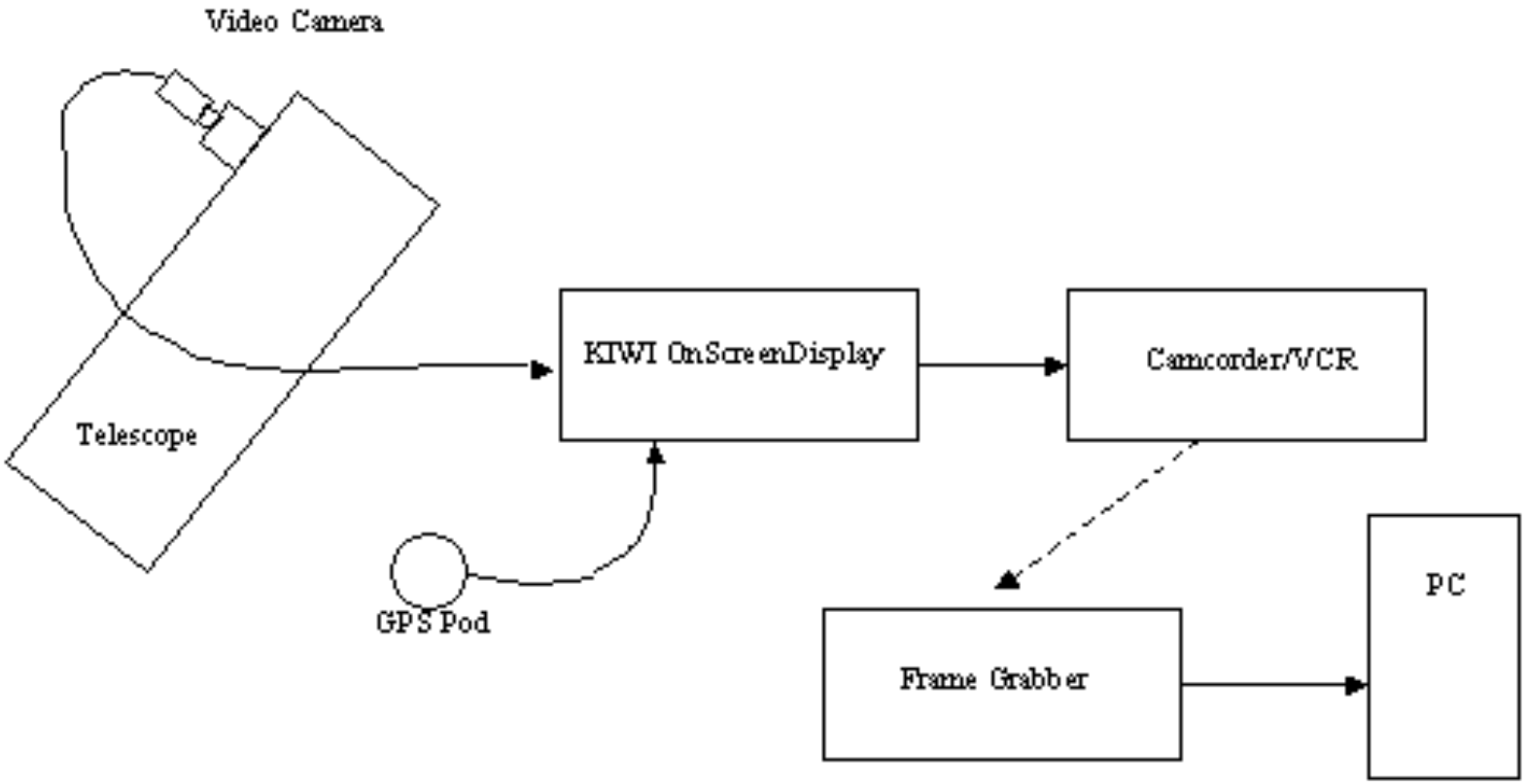
CCD DriftScan/GPS Occultation Setup





Davida Drift Scan Result

Video/GPS Occultation Setup



Video Characteristics:

60 fields/sec-30frames/sec

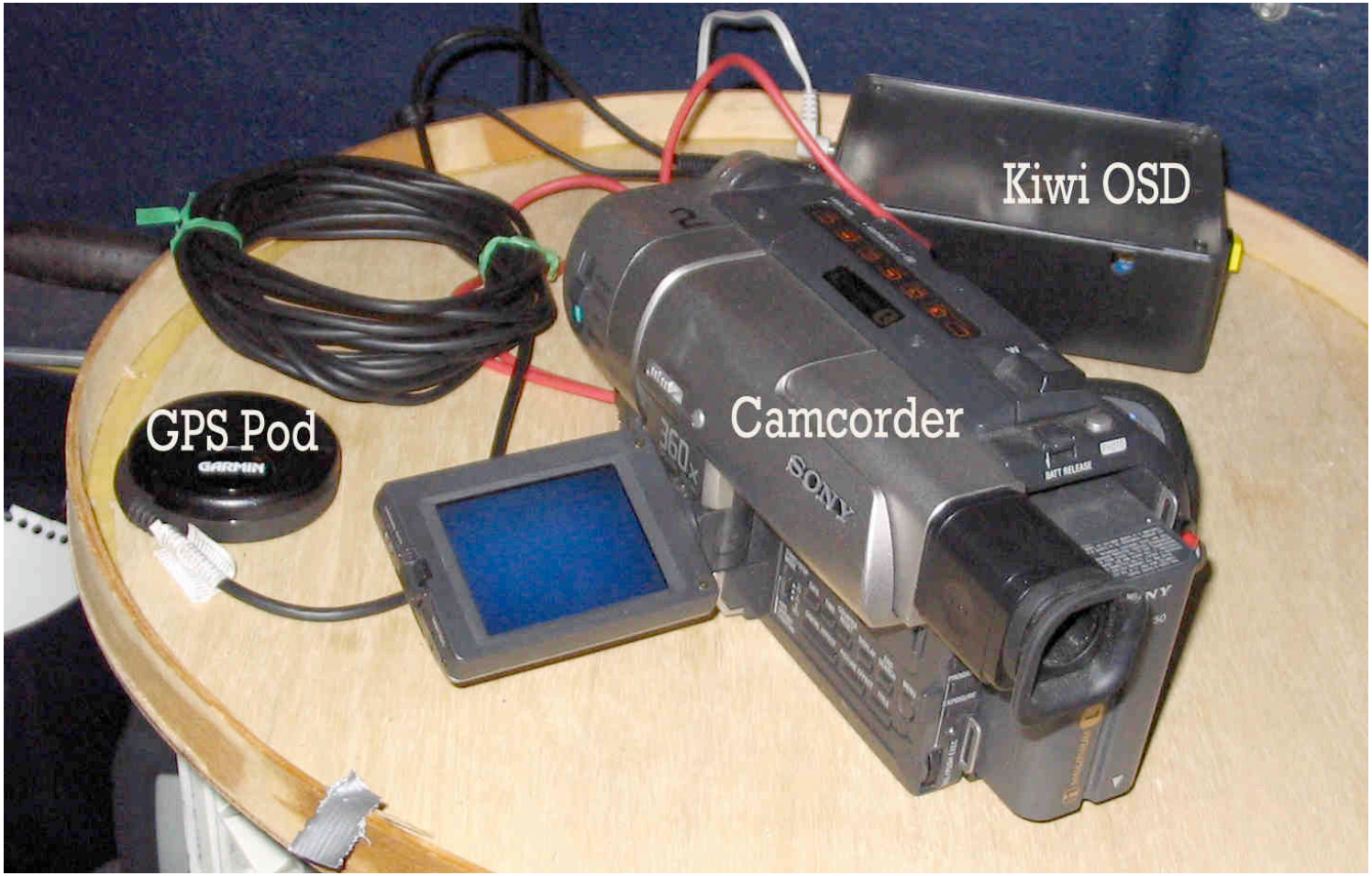
small board cameras through integrating cameras (x128=2 sec)

no cooling (short exposures)

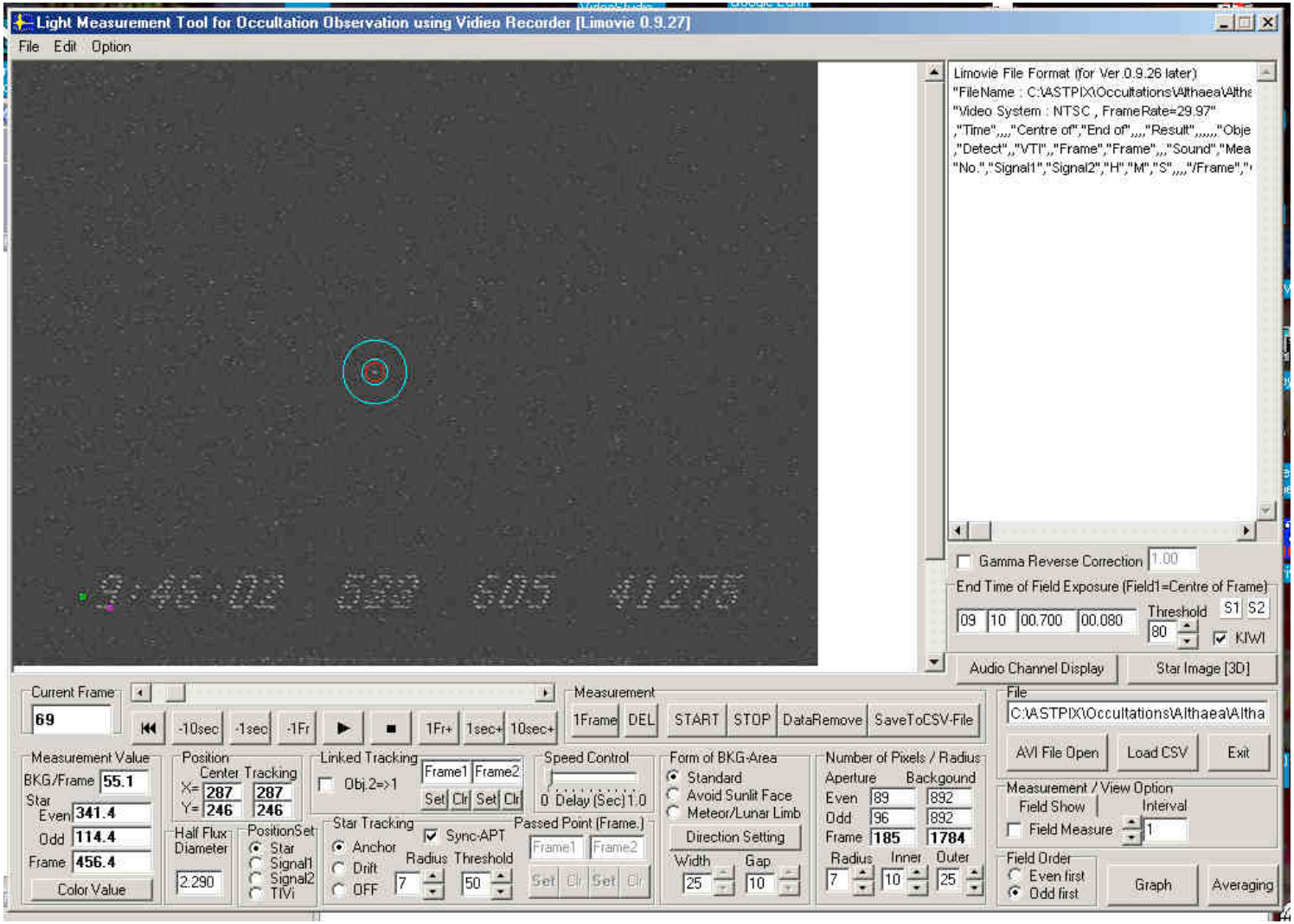
most are autoexposure, a few are manual

$25-1000

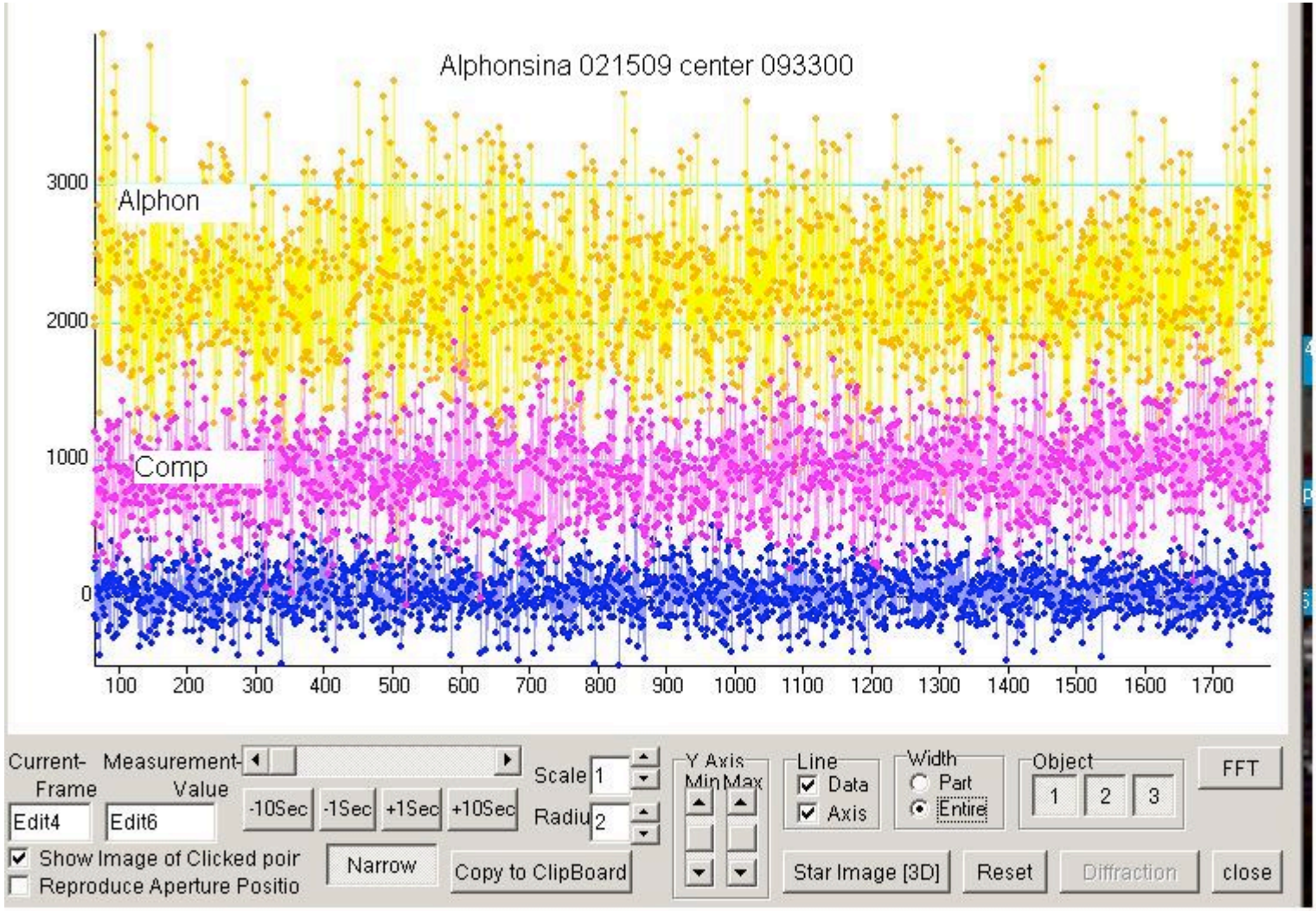
most are analog, convert to 8bit with frame grabber



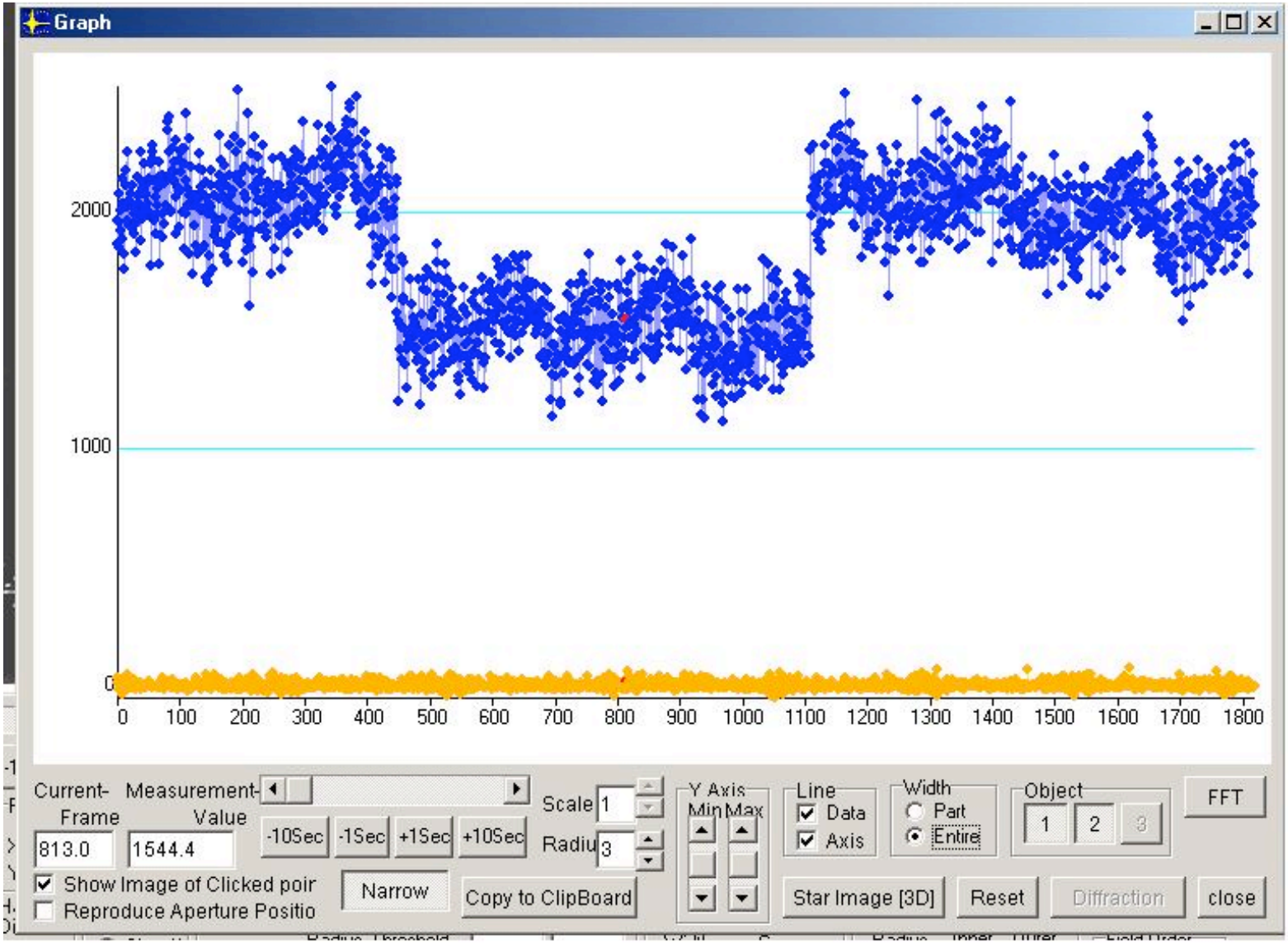
Video/GPS Setup using Camcorder



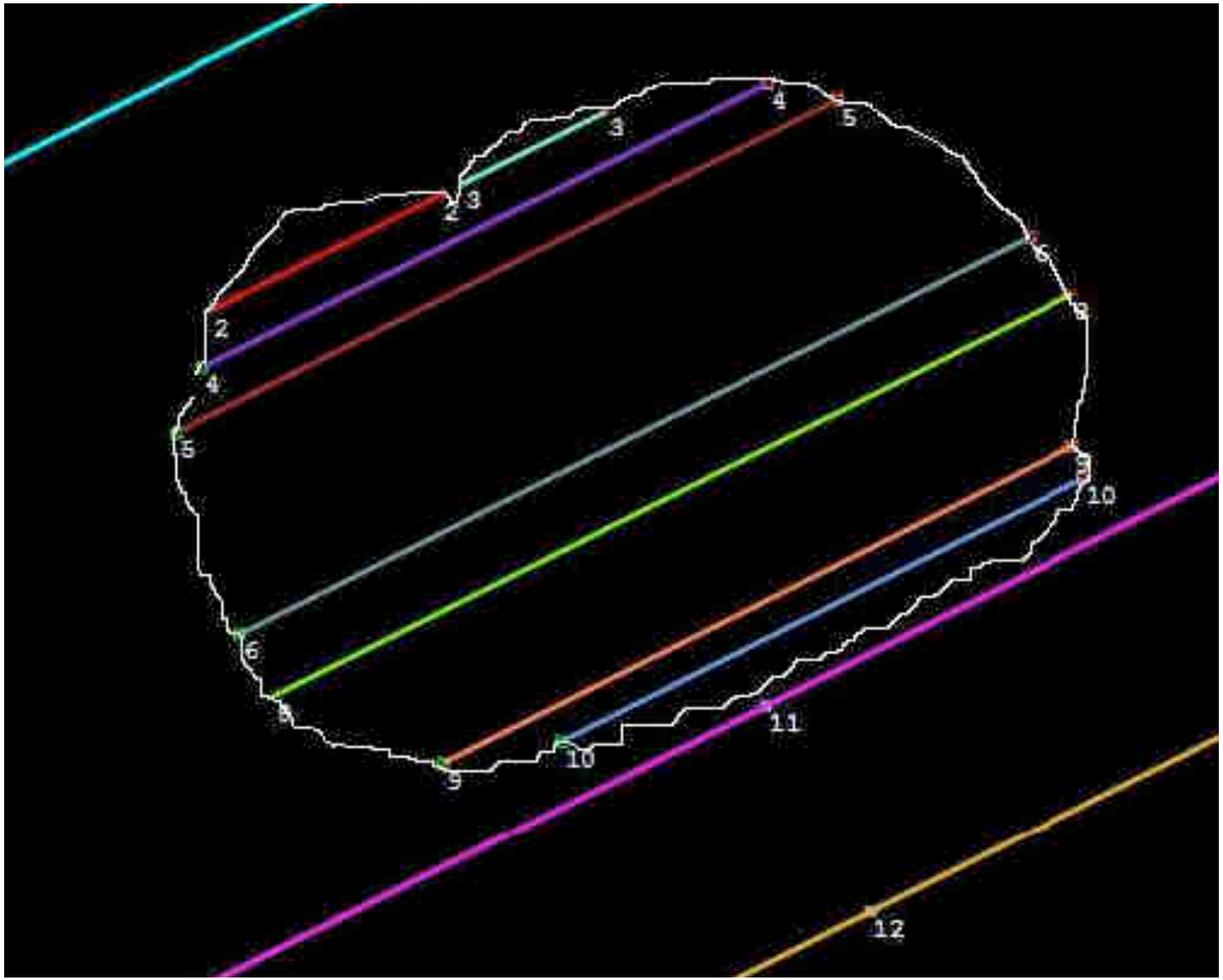
LiMovie Main Window



LiMovie Graph Function-miss (4AM)



LiMovie Graph Function-Davida Positive



Arethusa Hypothetical Shape

The MightyMini and its variations

Scotty Degenhardt is a leading developer and user

Small Scope (2-3 inch) on tripod (no mount)

Video Camera with KIWI for gps timing

Recorder (camcorder, DVD, etc.)

Advantages..

- Wide field of view (1-2 deg)
- Can do Pre-Pointing, then no drive
- Reasonably sensitive (10-11mag)
- Very Portable (a few pounds)
- Low power (easy battery supply)
- Fast Setup
- Cheap-can do multiple stations (~$200)

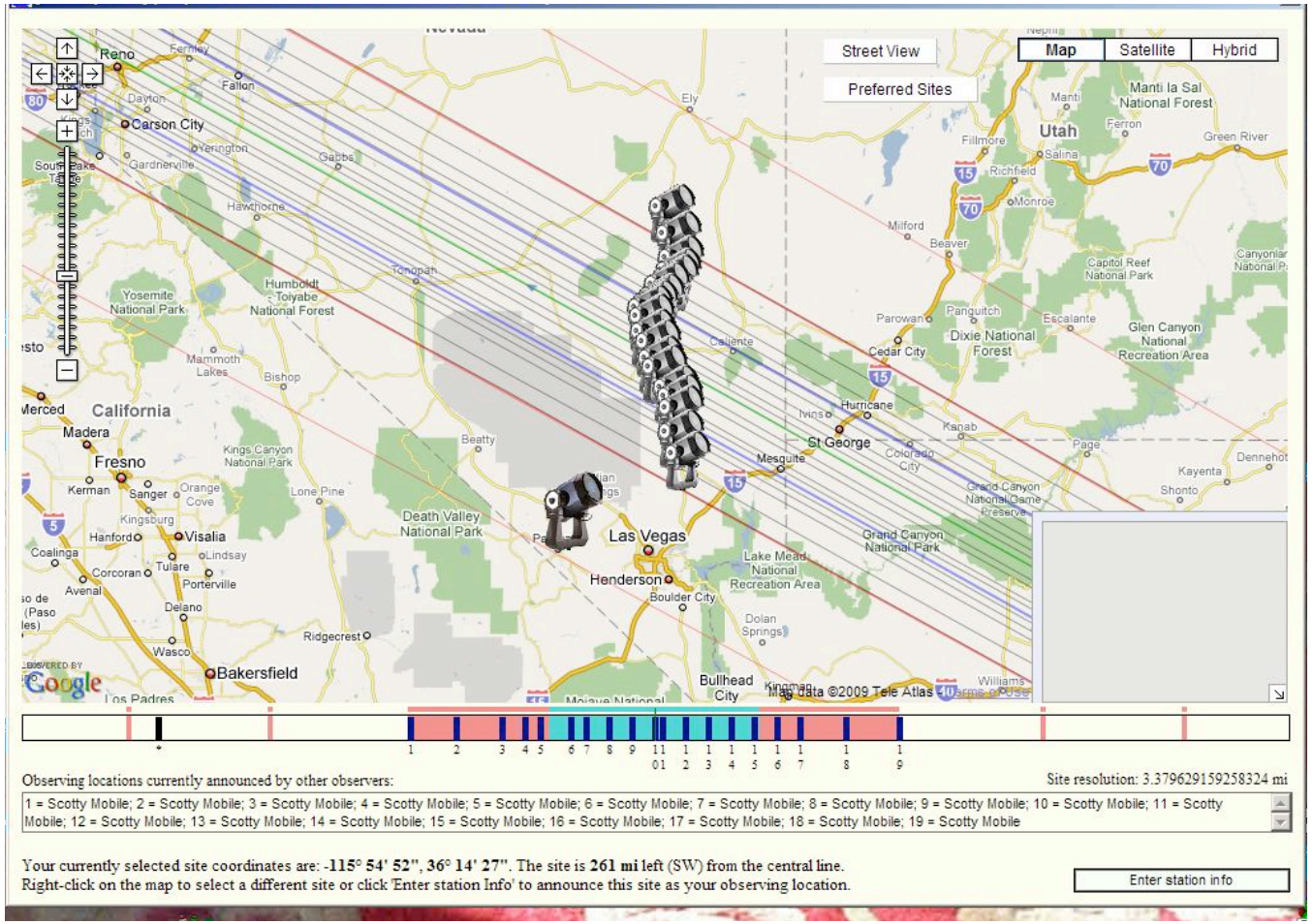
Complete portable occultation timing setup (air carryon)

- Mighty Mini optics (half of a Tasco Essentials 10x50 binocular)
- PC164CEX-2 video camera
- MX-350 miniature tripod (collapses to 12")
- Canon ZR camcorder (digital VCR)
- 9 AA NiMH battery pack
- Prime focus adapter for lunar occultations
- Total weight: under 10 lbs
- Limiting magnitude = 10.2
- FOV = 3.2 x 2.4 degrees (using Owl FR)

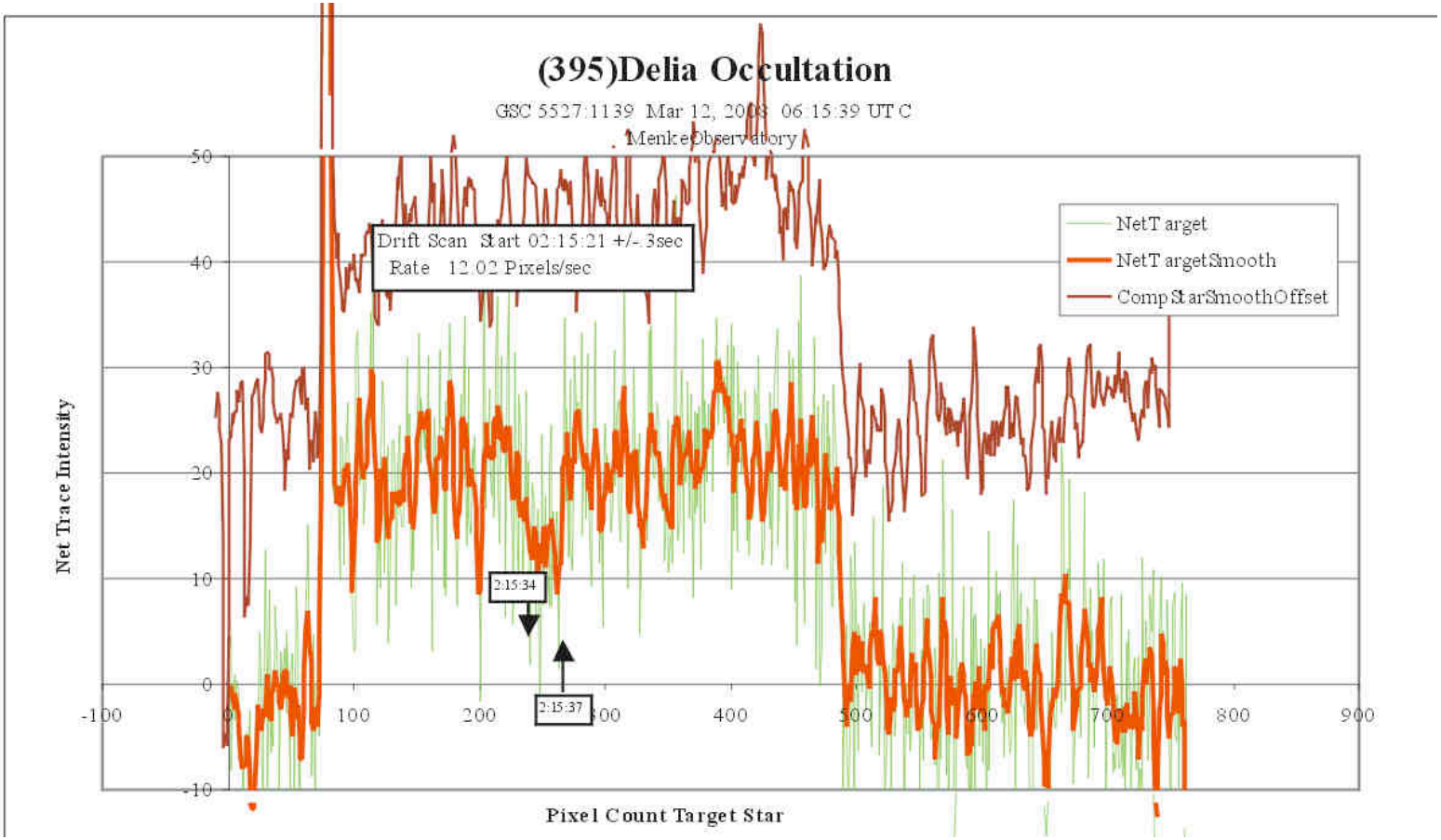
- System designed by Scott Degenhardt

Scotty Degenhardt MightyMini Portable Station

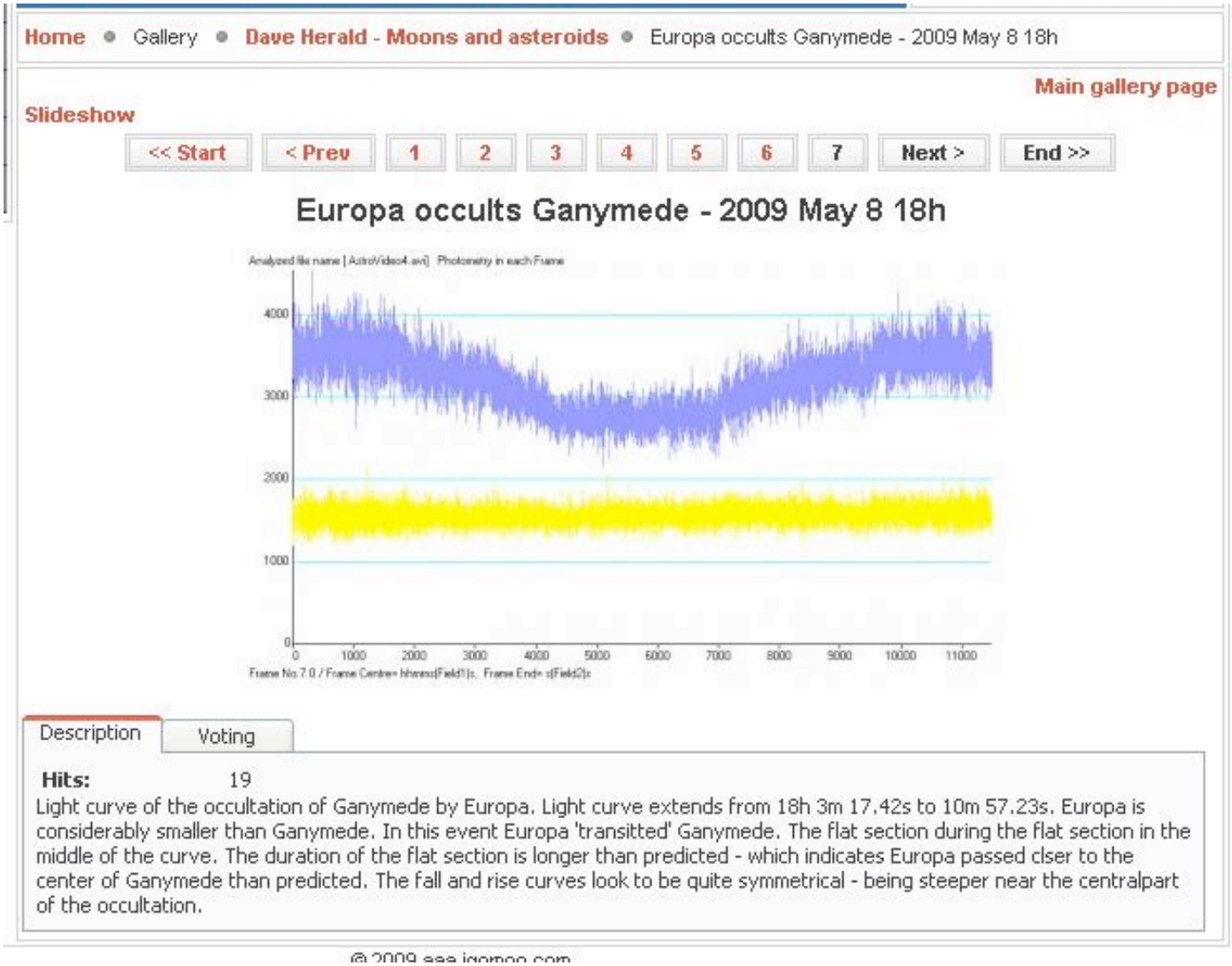
Scotty with Six Stations Ready-to-go!



Multiple Scotty Observing Sites Scheduled for May 20, 2009 (547) Praxedis Near Las Vegas

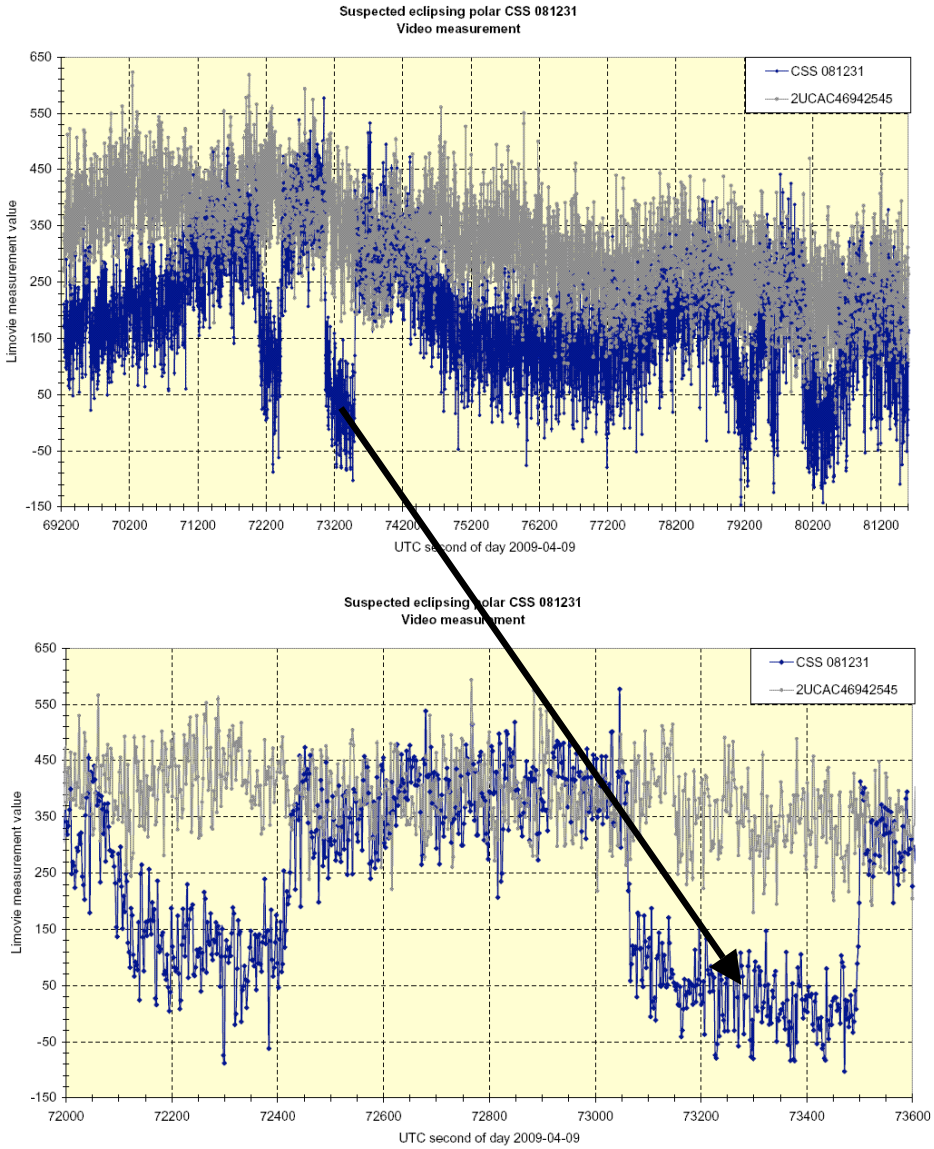


LiMovie-False Positive

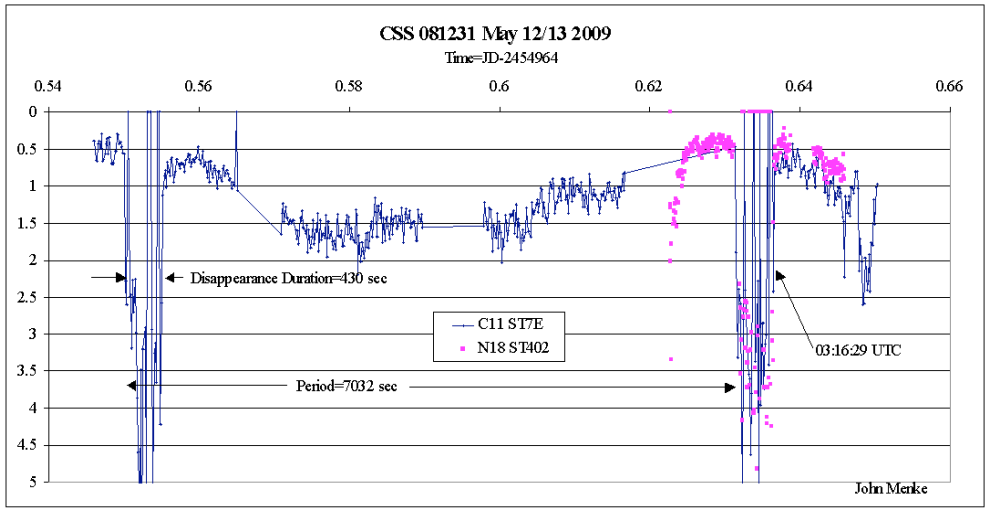


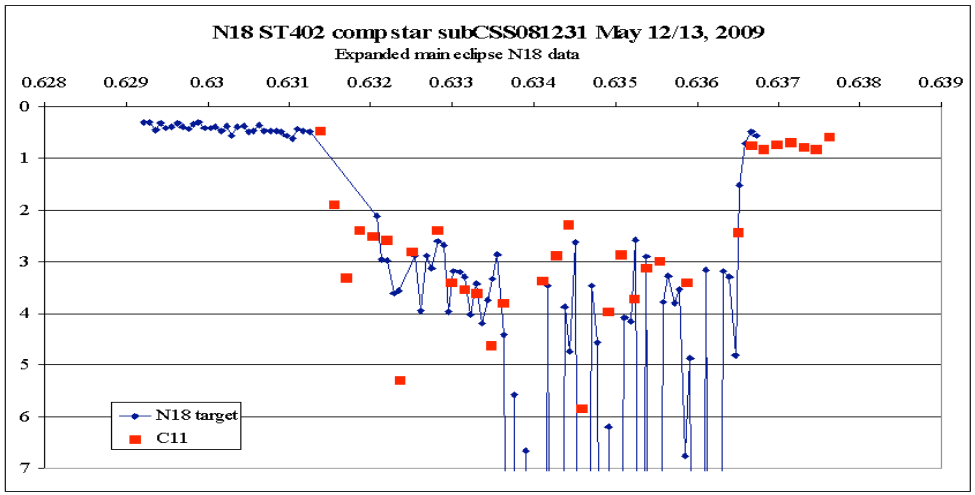
David Herald Video (LiMovie) of Europa/Ganymede Event

Note: 14" Meade, polar mounted, and a Watec 120N+ video camera.



CSS 081231 Apr 9, 2009 Gerhard Dangl--2 sec integration video





CSS 081231 May 12/13,2009 Menke C11/ST7 and N18/ST402

Occultation Madness…

Immediate observation results…”the rush”

Great break from routine work

Helps the old adrenaline flow

New skills, applicable to additional observing

Exciting new field, lots of energy and enthusiasm

A chance to use an observing system getting .01 a-s resolution!

Gratification--got a Positive!

One morning, observing an occultation….

So I am up at 4 AM.. Half hour to event time.. Half hour is shorter than my usual 60 minutes of tracking, but the scope is permanently mounted, and was 'Prewired" last night.. A Simple Synch on Spica and a GOTO to the target within 30' of a mag 5 star.. How hard could that be?? Well to start with, I have been using my ST80 and it's 1.98 x 1.48 degree FOV extensively and using the 12" scope and it's 24 x 17 arc minute FOV is no longer 'common'. And of course, 4:34:15 comes and goes and I would have missed the event by about 2 minutes because I broke my own rule and didn't allow enough time. One small detail..Event time is 5:34:15.. Just like it says on my chart.. Hell!.. I can do this! So I switch cameras to the integrating camera. Focus all the way in.. Nothing.. All the way out.. Nothing.. Heavy dew is everywhere, raining off the trees in my forest, so I check the corrector and.. lets just say it's wet.. So I am into the house, forgetting I have my knit 'Robber Mask' on with the two eye and one mouth holes.. Flashlight in hand, I trek into the bedroom to steal Wifey's hair dryer.. Next thing I know I have Wifey's Tasmanian Devil.. err.. Yorkshire Terrier ripping into various appendages with a vengeance because some hooded masked man with a flashlight is in the bedroom. Crash!.. Down I go.. On my back, wedged between the bed and the wall, 7 pound set of teeth on my chest.. "Honey! Where's the OFF switch!" "Don't hurt my dog!.. He's 'LITTLE' "!, she says.. Yeah.. A 'LITTLE' vicious SOB.. After stopping the blood flow, I dry the corrector, locate the target and all is well.. Integrating 32 fields.. Let's try less.. Worked my way down to real-time and could see it, but I went to 4 fields.. Good time resolution, high SNR.. About 1m 15 seconds to go, all the stars disappear, so I jump to the strategically placed hair dryer and whip out the flashlight to see how much dew needs to go away... the corrector is perfectly dry.. The target had set behind the ridge. And only a few short hours after I posted the Occultationist Humor - "Blew the Event".. So this event has been renamed.. This is No Longer, the Astarte Event.. It is now known as "The Great Metcalfia Warm-up" ! Derek http://www.poyntsource.com/New/index.htm