

Using Sharpcap Sequencing to Automate Nightly Occultation Observations with any ASCOM GoTo Telescope

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Disclaimer!

- There are many ways to address the scheduling automated observation of a full night of occultations.
 - Many of you already do so!
 - This presentation is about sharing one approach that has worked well for me and that is straightforward to implement.

What Led Me Here

- I was impressed with multi-telescope prepointed “Mighty Mini”-type video capture observations and wanted to extend that automated capability to frame-based sCMOS imagers.
 - Particularly the QHY174-GPS running with SharpCap



How SharpCap “Sequencing” Can Help

- SharpCap is a “free” Windows application that provides for adept use of integrating cameras.
 - You need to pay the ~\$15 annual “Pro” fee to unlock the features exploited here.
- The Sequencer is a simple scripting language that includes commands such as:
 - MOUNT GOTO "19 53 49.8 -18 07 14"
 - MOUNT SOLVESYNONLY
 - SET EXPOSURE TO 1.000
 - CAPTURE 1200 LIVE FRAMES
 - AUTOFOCUS OFFSET -2400 to 2400 STEP COUNT 14 BACKLASH 0
- And most importantly for occultations
 - WAIT UNTIL LOCALTIME 08:42



SharpCap Sequence Editor

The screenshot displays the SharpCap Pro (v4.0.9.338) interface. The main window is titled "SharpCap Pro (v4.0.9.338) - D:\SharpCap Captures". The menu bar includes File, Camera, Capture, View, Tools, Sequencer, Scripting, and Help. The Sequencer menu is open, showing options: Deep Sky Sequence Planner..., Edit..., Run..., Run Current, and Run Repeat... The main toolbar contains buttons for Live View, Start Capture, Quick Capture, Live Stack, Target Name, Light Frames, FX, Zoom, and Auto. A Camera Control Panel is visible on the right.

The "SharpCap Sequence Editor - Unsaved sequence" window is the primary focus. It has a menu bar with File, Edit, and Sequence. The interface is divided into several sections:

- Available Steps:** A search box contains "capt". Below it are tabs for Camera, Processing, and Filming. A list of steps is shown, with "Capture <Frame Count> live view frames" selected. Other steps include "Capture <Frame Count> still frames (guiding required; <Require guiding active while capturing>)", "Start capturing frames", "Start capturing now and then stop when <Astronomical Event> occurs", and "Stop capturing frames".
- Sequence:** A list of steps in the sequence, currently containing "Wait until 00:00" and "Capture 10 live view frames".
- Actions:** A grid of buttons for Undo, Redo, Run, Pause, Stop, Test Step, Save Sequence, Save As..., Load Sequence, and Emergency Stop.
- Selected Step Properties:** A section for configuring the selected step, showing "Frame Count" set to 10.
- Progress:** A section with a trash icon, "Progress" label, "ETA:" label, and a progress bar.
- Scripting:** A text area at the bottom showing the sequence in script format:

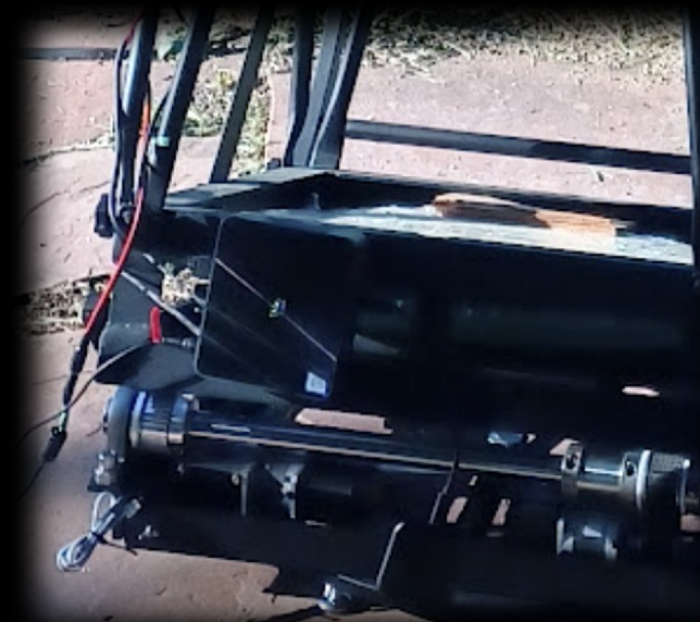
```
SEQUENCE
WAIT UNTIL LOCALTIME 00:00
CAPTURE 10 LIVE FRAMES
END OF SEQUENCE
```

Basic Recipe

- Roughly align telescope to a fiducial position and **turn on power**.
 - Skywatchers, for example, power on with due north horizon coordinates (north and level)
 - Alternatively use park position (even with a portable telescope, for example Alt =55 Az=180)
- **Slew to target**
 - The pointing will be a degree or two off. No big deal.
- **Platesolve** and sync (zeros out the initial pointing error)
- **Iterate** pointing: Slew to target, again (1-2 deg). Platesolve and Sync. Slew.
- **Autofocus**
- **Wait** until event time
- Set integration time
- **Capture** required number of frames
- **Next target...**

Required Hardware/Software Components

- All hardware should be ASCOM compatible (most every driver is)
 - GoTo Telescope mount
 - ASCOM Focuser
- Platesolving software and associated stellar databases
 - All Sky Platesolver (ASPS)
 - Astrometric STacking Program (ASTAP)
- Sharpcap compatible camera (the all are...)
- Ride along data acquisition and control computer
 - Remote desktop software



A DIY ASCOM Focuser – MyFP2 Project

- Extremely well documented
- Arduino Nano based.
- All drivers provided
- Runs NEMA-14 or NEMA-17 stepper motor
- Up to you to produce a drive train to turn your focuser knob – not hard.
- SharpCap has an autofocus routine that steps through focus positions and does a parabolic fit to the focus curve, returning to best focus at the end.



A Few Words About Platesolving

- You'll never star-align again. Your finder, if you can still find it, will collect dust.
- ASPS and ASTAP are fast (a few seconds typically, 20-30 seconds for ASPS worst case) and reliable as long as the platesolver detects enough stars
 - ASPS: 6-8 stars
 - ASTAP: 20-30 stars (but in return it's much faster – less than a second)
- I've used both at different times but have gradually defaulted to ASPS because it is robust to having a limited number of stars.
 - Aside: Platesolving makes prepointing trivial. You point to/center on the appropriate coordinate for the current time and *don't need prepoint stars*.

A Real Sequencer Script - Setup

- Define subroutines to make the main script less wordy
 - Platesolving, focus, pointing
 - Errors kick you out of the sequence unless you explicitly ignore them.
 - One pointing subroutine for each occultation, again in the name of brevity later on.

SEQUENCE

#

```
DEF SUB PLATESOLV
  IGNORE ERRORS FROM
  RETRY ERRORS UP TO 2 TIMES
  MOUNT SOLVESYNCONLY
  END RETRY ERRORS
  END IGNORE ERRORS
END SUB
```

#

```
DEF SUB POINT1
  IGNORE ERRORS FROM ONERROR RUN ""
  MOUNT GOTO "19 27 31.0 -15 24 58"
  END IGNORE ERRORS
  DELAY 10
END SUB
```

#

```
DEF SUB POINT2
  IGNORE ERRORS FROM ONERROR RUN ""
  MOUNT GOTO "18 36 06.1 -23 06 14"
  END IGNORE ERRORS
  DELAY 10
END SUB
```

....

A Real Sequencer Script – First Occultation

- Largely consists of calling the subroutines set up previously.
- “UNLOCK CONTROLS” allows you to manipulate most SharpCap controls during the step. Otherwise you are locked out.

```
#  
# Wait until 10 minutes before data recording time  
#  
MOUNT TRACKING None  
UNLOCK CONTROLS  
    WAIT UNTIL LOCALTIME 04:19  
END UNLOCK  
GOSUB TRACKSID  
#  
GOSUB POINT1  
GOSUB PLATESOLV  
#  
GOSUB AFOCUS  
#  
GOSUB POINT1  
GOSUB PLATESOLV  
# --1--  
UNLOCK CONTROLS  
    WAIT UNTIL LOCALTIME 04:29  
END UNLOCK  
# --1--  
#  
GOSUB PLATESOLV  
SET COOLER TARGET TO -15  
DELAY 1
```

A Real Sequencer Script – Occultation 1

- Largely consists of calling the subroutines set up previously.
- “UNLOCK CONTROLS” allows you to manipulate most SharpCap controls during the step. Otherwise you are locked out.
- Repeat as needed

```
GOSUB AFOCUS
#
GOSUB POINT1
GOSUB PLATESOLV
# --1--
UNLOCK CONTROLS
    WAIT UNTIL LOCALTIME 04:29
END UNLOCK
# --1--
#
GOSUB PLATESOLV
SET COOLER TARGET TO -15
DELAY 1
SET EXPOSURE TO 0.250
DELAY 3
DISPLAY STRETCH AUTO
GOSUB POINT1
UNLOCK CONTROLS
    CAPTURE 1000 LIVE FRAMES
END UNLOCK
```

A Script Will Run Any ASCOM Scope Without Modification

- You do have to change the SharpCap Hardware settings but otherwise, every configuration below works transparently.



Hubble



ZWO AM5 + C11



Skywatcher



Celestron



IOPtron AzPro

A Script Will Run Any ASCOM Scope Without Modification

- You do not have to modify anything but only if you do not otherwise



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Note there is a SharpCap Settings Screen for Platesolving

SharpCap Settings ✕

General Saving Hardware Cameras Filenames Memory

Plate Solving Polar Alignment Guiding Logging Startup Scripts

Plate solve settings

Select Plate Solving Application:

Astap

After solving from Telescope controls/Solve and Sync Menu:

Sync mount only

Focal Length of Telescope (should include barlow/reducer adjustments)

Do not use From ASCOM Mount Use mm

Always send 8 bit images to the plate solving application

Astap

Path to the Astap.exe (or Astap_cli.exe)

Detect Automatically

None found

Enter Manually

Additional Options (added to Astap command line)

Plate Solver Detection Status

```
Manually configured Astrometry      : Not configured
AstroTortilla                       : Not found
All Sky Plate Solver                 : Found at C:\Users\mfs4n\AppData\Local\Astrometry
Ansvr                                : Not found at C:\Users\mfs4n\AppData\Local\cygwin_ansvr
Cygwin/Astrometry based              : Not found at C:\cygwin
Astap (manual location)              : Found at D:\Program Files\astap\astap.exe
Astap (auto-detect)                 : Not found at c:\Program Files (x86)\Astap\Astap.exe
```

Is Scheduling 10 Occs a Night at Home Possible or Useful In Practice??

- The answer depends on your level of patience and available time.
 - With an 8” telescope I had been producing about one positive a week on average, never leaving the house – 50 positives a year.
 - Today, with a 16” aperture, it’s looking like I can double that pace.
- Most of these events don’t appear in Occult Watcher because they are not of high rank
 - But that low rank is interesting in its own right.

A Typical High Rank (OW) Event

- Uncertainty is small relative to object size.
- It's worth making a trip to the shadow and you will likely succeed.
- Great campaign target to determine a shape.

Occult Watcher, ver. 5.2.0.0 - Nederland (UTC -06:00 DST)

Synchronise now Configuration Add-ins Help

Asteroid Name	Event Date, UT	Feed	Star M...	Sub...	Pro...
My Events					
(199084) 2005 XN104	Mon 10 Jul, 07:58 UT	AZevents	15.3	1	6.6%
(8133) Takanochoei	Mon 10 Jul, 08:30 UT	AZevents	13.3	1	11.2%
(5959) Shaklan	Mon 10 Jul, 08:53 UT	NALowMag	11.9	2	27.1%
(2708) Burns	Mon 10 Jul, 10:03 UT	AZevents	13.7	1	71.9%
(94) Aurora	Sat 15 Jul, 06:43 UT	NALowMag	13.5	7	92.6%
All Events					
(192219) 2007 RO23	Mon 10 Jul, 07:58 UT	AZevents	15.5	0	4.5%
(281360) 2007 VE322	Mon 10 Jul, 08:09 UT	AZevents	14.8	0	3.2%
(101595) 1999 BJ26	Mon 10 Jul, 08:37 UT	AZevents	12.3	0	5.6%
(1663) van den Bos	Mon 10 Jul, 09:32 UT	AZevents	12.7	0	12.2%
(9066) 1993 FR34	Mon 10 Jul, 09:32 UT	AZevents	15.2	0	6.7%
(59663) 1999 JY96	Mon 10 Jul, 09:50 UT	AZevents	15.3	0	3.8%
(94) Aurora	Mon 10 Jul, 10:11 UT	NALowMag	13.5	7	92.6%

[NA Low Mag]

you center shadow 1-sigma 2 & 3-sigma limits

(94) Aurora occults UCAC4 278-151607

Event time: 06:43:07 UT Constellation: Scorpius

Position: In the shadow, 121 mi from the central line Error in time: 4 sec

There are currently 7 announced stations for this event. 1 of them is yours.

Max duration: 17.3 sec

Magnitude drop: 0.5 m

Combined magnitude: 12.4 m

Star magnitude: 13.6 m

Star altitude: 14° @195°

Sun altitude: -28°

Moon: (below horizon)

[Show online map with stations](#) [View details on the web](#) [Save 'Google Earth' kml file](#) [View station sorts](#)

A Typical “Stay at Home” Low Rank Event

- Large uncertainty relative to shadow size.
- No point in traveling
 - Typical probability 5-10% almost independent of location.
- A positive result improves the orbit.
 - Next time around the prediction will be more precise.

Occult Watcher, ver. 5.2.0.0 - Nederland (UTC -06:00 DST)

Synchronise now Configuration Add-ins Help

Asteroid Name	Event Date, UT	Feed	Star M...	Sub...	Pro...
(241864) 2001 TL202	Thu 20 Jul, 05:41 UT	AZevents	14.0	0	3.2%
(25999) 2001 FN94	Thu 20 Jul, 05:51 UT	AZevents	15.4	0	3.2%
(248494) 2005 UJ360	Thu 20 Jul, 06:03 UT	AZevents	14.3	0	2.0%
(46734) 1997 TL25	Thu 20 Jul, 06:07 UT	AZevents	13.5	0	5.8%
(108530) 2001 LD4	Thu 20 Jul, 06:28 UT	AZevents	15.0	0	4.0%
(91722) 1999 TW157	Thu 20 Jul, 06:40 UT	AZevents	15.4	0	1.8%
(337848) 2001 VZ95	Thu 20 Jul, 06:45 UT	AZevents	15.3	0	2.3%
(470308) 2007JH43	Thu 20 Jul, 07:06 UT	LuckyStar	16.4	0	19.3%
(126169) 2002 AR7	Thu 20 Jul, 07:27 UT	AZevents	14.0	0	4.9%
(60299) 1999 XX174	Thu 20 Jul, 07:27 UT	AZevents	15.5	0	4.0%
(506120) 2016 BM67	Thu 20 Jul, 07:32 UT	AZevents	14.4	0	0.9%
(197468) 2003 YP141	Thu 20 Jul, 07:39 UT	AZevents	13.2	0	3.2%
(71581) 2000 DG60	Thu 20 Jul, 07:54 UT	AZevents	15.5	0	5.2%
(107369) 2001 CL30	Thu 20 Jul, 07:57 UT	AZevents	15.5	0	4.7%

[Community Tags]

you center shadow 1-sigma 2 & 3-sigma limits

(71581) 2000 DG60 occults UCAC4 395-117667 Event time: 07:54:47 UT Constellation: Aquila

Position: In the 1-sigma zone, 1 mi outside the shadow path Error in time: 4 sec Star altitude: 37° @197°

There are currently no announced stations for this event. Max duration: 0.4 sec Sun altitude: -29°

Magnitude drop: 2.8 m Moon: (below horizon)

Combined magnitude: 15.8 m

Star magnitude: 15.9 m

[Show online map with stations](#) [View details on the web](#) [Save 'Google Earth' kml file](#) [View station sorts](#)

Running Personal Predictions with Occult4 is Essential

- OW shows a limited number of filtered high rank events.
- Occult4 lets you see “all” potential events with even modest probability and low rank (but those are the juicy ones).
- For the 16” I currently filter for all events brighter than 16 mag with greater than 5% probability for local observation.

The screenshot displays the Occult4 v.4.2023.6.5 software interface. The window title is "Search for occultations by Asteroids, or by Planets [including Pluto] : Occult v.4.2023.6.5". The interface is divided into several sections:

- 1. Set the date range for the search:** Start Year, month & day: 2023 7 16; End Year, month & day: 2023 7 18. Buttons for "Add 1 day =>" and "Now" are present.
- 2. Select the star catalogue for the search:** Radio buttons for Gaia (selected), Tycho2 (pre Gaia - obsolete), UCAC4, PPMXL, User star, and User catalog. A "Set user star" button is next to "User star". A list box shows "Gaia16_EDR3".
- Search filters:** Checkboxes for "Exclude if mag drop less than 0.20" and "Exclude stars fainter than mag 16.0". A "Passes within" checkbox is checked. A "Select site" dropdown is set to "600". Input fields for "km of longitude" (-105) and "Latitude" (40) are present.
- 3. Select asteroids to search, or planets [including Pluto] to search:** Radio buttons for "Asteroids & Comets" (selected) and "Planets". A "Select asteroid or Set a comet" dropdown is set to "(1) Ceres (<=> 6344 P-L (141757 asteroids)".
- 4. Set the file to save the occultation elements from the search:** Checkboxes for "Automatically save the search results" (checked) and "Do not show the search results in List & Display". A "Set the output file" button is present. The file path is "C:\Occult4\Generated Files\pass1.xml".
- 5. Do the search:** Input field for "Adjust asteroid position (in mas) by RA" (0.0) and "Dec" (0.0). A "Search" button is present. Below it, "Increase Earth miss distance by 0.1 Earth radii" and "Clear the previous results from memory" (checked) are options. "Star catalogue" is "Gaia16_EDR3" and "Orbit source" is "Asterb 2023 Jun 16".
- Search results:** A list box showing "(1) Ceres (<=> 6344 P-L" and "click Search".
- Binary asteroid ephemerides available from Miriade:** A list box with numbers 22, 31, 41, 45, 87, 93. Checkboxes for "Do not use Miriade ephemerides" and "Limit output to first (=best) orbit". Buttons for "Update list" and "Get solution details".
- Bottom section:** A grid of date ranges for occultations: 1831 Jul 02 == 1858 Nov 17, 1858 Nov 17 == 1886 Apr 04, 1886 Apr 04 == 1913 Aug 21, 1913 Aug 21 == 1941 Jan 06, 1941 Jan 06 == 1968 May 24, 1968 May 24 == 1995 Oct 10, 1995 Oct 10 == 2023 Feb 25, 2023 Feb 25 == 2050 Jul 13, 2050 Jul 13 == 2077 Nov 28. A "Re-generate all using the current DE ephemeris" button is on the right. "Current version : DE440 (1550/2650), 2077 Nov 28 == 2105 Apr 16".

Running Personal Predictions with Occult4 is Essential

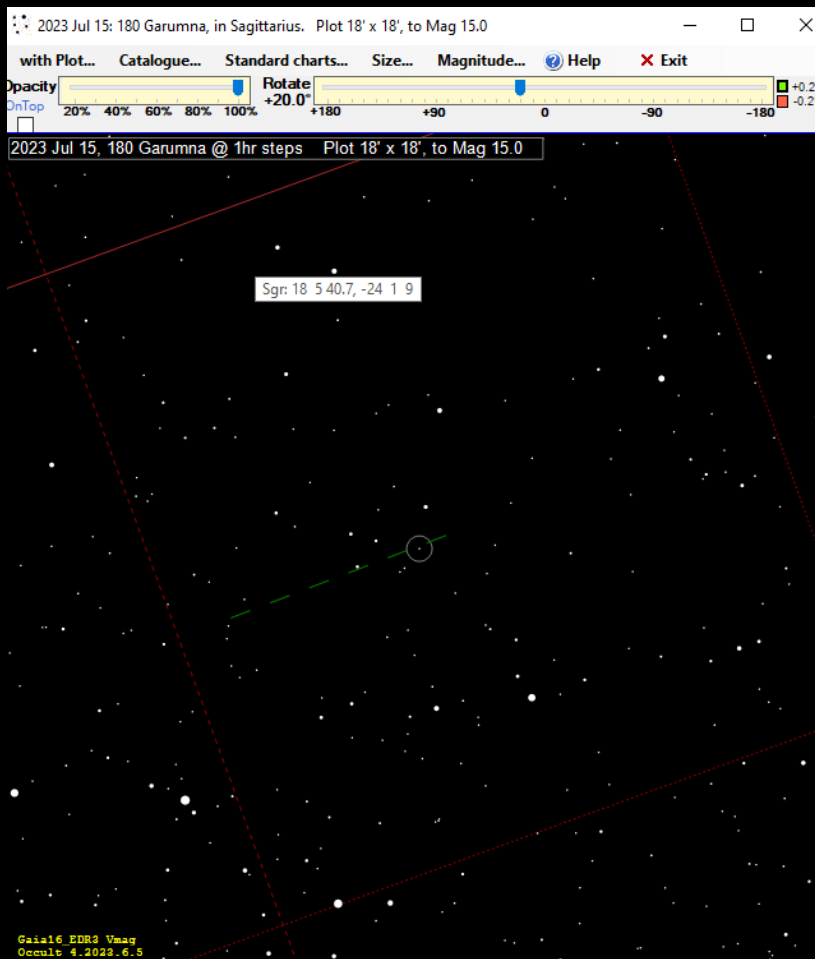
- Occult4 steps:

- Cast a wide net with default downloaded elements.
 - 3 km object size limit searches 150,000 objects
- Download Horizons elements from pass1 events and run a second pass for final (accurate predictions).
- Yields about 25 potential events per night with >5% probability at or better than the limit of my 16" system.

The screenshot shows the Occult4 v.4.2023.6.5 interface. The window title is "Search for occultations by Asteroids, or by Planets [including Pluto] : Occult v.4.2023.6.5". The interface is divided into several sections:

- 1. Set the date range for the search:** Start Year, month & day: 2023 7 16; End Year, month & day: 2023 7 18. Buttons for "Add 1 day =>" and "Now" are present.
- 2. Select the star catalogue for the search:** "Gaia" is selected. Other options include Tycho2, UCAC4, PPMXL, User star, and User catalog. A search box shows "Gaia16_EDR3".
- Search filters:** "Exclude if mag drop less than 0.20" and "Exclude stars fainter than mag 16.0" are checked. "Passes within" is checked. "Select site" is set to 600 km of longitude -105 and Latitude 40.
- 3. Select asteroids to search, or planets [including Pluto] to search:** "Asteroids & Comets" is selected. "Select asteroid or Set a comet" is set to "(1) Ceres <=> 6344 P-L (141757 asteroids)".
- 4. Set the file to save the occultation elements from the search:** "Automatically save the search results" is checked. The output file is "C:\Occult4\Generated Files\pass1.xml".
- 5. Do the search:** "Adjust asteroid position (in mas) by RA 0.0 Dec 0.0" is set. "Increase Earth miss distance by 0.1 Earth radii" is checked. "Clear the previous results from memory" is checked. "Star catalogue" is "Gaia16_EDR3" and "Orbit source" is "Asterb 2023 Jun 16". A "Search" button is present.
- Search results:** "To search for (1) Ceres <=> 6344 P-L click Search".
- Binary asteroid ephemerides available from Miniad:** A list of dates from 1831 Jul 02 to 1993 Aug 21. "Do not use Miniad ephemerides" and "Limit output to first (=best) orbit" are checked. "Update list" and "Get solution details" buttons are present.
- Bottom section:** "Note: Search must be within the interval covered by the depressed buttons. Press buttons as needed." A grid of date ranges is shown, and a "Re-generate all using the current DE ephemeris" button is present.

Quick Aside: Best Finder Charts I Have Ever Used



Tonight's (Jul 16 UT) Raw List from Occult4

Event Summary for Longitude -105.4454°, Latitude 39.9872° - sorted by Date

Date	U.T.	Diameter	Durn	Star	Mag-Drop	Elon	Star	Rely	Planet	Alt	Proba-	R.A. (J2000)	Dec.
Jul 16	3 37.1	13 0.008	1.09s	15.0	3.3	3.7+	UCAC4 292-184550	0.90	10444 de Hevesy	11 150	11%	18 29 2.321	-31 41 54.77
Jul 16	3 43.7	7.9 0.007	0.79s	15.8	1.2	1.7+	UCAC4 445-086250	1.00	4767 Sutoku	36 129	16%	18 53 19.804	- 1 6 19.65
Jul 16	4 26.2	6.2 0.004	0.51s	15.9	3.6	3.7	UCAC4 381-065645	1.10	21696 Ermalmquis	21 229	7%	13 49 29.283	-13 56 56.88
Jul 16	4 52.0	8.5 0.006	0.66s	15.7	1.5	1.7	UCAC4 424-060430	1.00	6898 Saint-Mary	31 230	20%	14 41 12.826	- 5 18 27.33
Jul 16	4 57.8	3.41 0.004	0.44s	14.7	3.7	4.2+	UCAC4 313-244252	1.20	118631 2000 HB48	19 157	5%	19 9 58.363	-27 35 8.35
Jul 16	5 8.3	3.81 0.004	0.46s	14.9	3.6	3.9	UCAC4 383-116063	0.85	206668 2003 YE85	35 163	6%	18 35 32.136	-13 28 36.84
Jul 16	5 8.2	3.71 0.005	0.53s	15.2	2.3	2.5+	UCAC4 327-155258	1.10	18773 Bredehoft	24 168	8%	18 30 6.989	-24 42 58.56
Jul 16	5 21.1	4.7 0.003	0.34s	14.5	6.2	5.8	UCAC4 390-059321	1.15	41684 2000 UL15	11 243	9%	13 38 14.406	-12 9 26.82
Jul 16	5 27.0	8.8 0.007	0.81s	13.8	4.1	4.3	UCAC4 278-213583	1.00	13775 Thebault	14 167	7%	19 0 23.396	-34 31 5.00
Jul 16	5 33.5	3.61 0.003	0.61s	15.4	3.4	3.9	UCAC4 347-093316	1.00	20420 Marashwhit	28 193	6%	17 16 55.396	-20 37 34.29
Jul 16	5 49.2	18 0.012	1.56s	15.8	0.7	0.8+	UCAC4 367-123735	2.70	2802 Weisell	33 178	19%	18 27 4.057	-16 44 42.08
Jul 16	5 55.5	8.4 0.005	0.82s	13.5	5.6	6.3	UCAC4 275-150018	s 1.60	83451 2001 SR60	15 186	6%	18 1 16.643	-35 0 6.59
Jul 16	5 55.1	3.51 0.004	0.42s	14.5	4.2	4.3	UCAC4 454-120392	1.00	15121 2000 EN14	7 95	7%	23 52 9.990	0 47 50.69
Jul 16	6 14.6	19 0.014	1.67s	15.0	1.9	2.0	UCAC4 374-175175	0.90	4808 Ballaero	26 142	36%	21 4 58.129	-15 12 20.09
Jul 16	6 33.3	3.91 0.005	0.58s	14.8	1.9	2.4+	UCAC4 310-208220	0.90	52839 1998 RZ55	21 190	13%	18 22 0.391	-28 2 56.41
Jul 16	6 35.6	6.2 0.006	0.70s	15.9	0.6	0.49+	UCAC4 279-185107	0.85	31487 Parthchopr	15 189	9%	18 23 47.982	-34 16 51.26
Jul 16	6 36.3	8.3 0.004	0.57s	13.5	5.5	5.8+	UCAC4 336-186099	2.50	47108 1999 CM37	27 180	8%	19 9 16.365	-22 51 59.84
Jul 16	6 53.0	8.3 0.005	0.74s	15.9	3.5	4.1	UCAC4 356-109172	1.00	74400 Streaky	26 208	8%	17 40 34.873	-18 54 16.09
Jul 16	6 59.9	8.0 0.006	0.88s	14.6	0.9	0.8+	G180042.3-272011	s 0.95	25261 1998 VX5	20 202	8%	18 0 42.259	-27 20 10.69
Jul 16	7 6.8	8.0 0.006	0.85s	15.6	0.30	0.11+	UCAC4 314-126147	1.15	25261 1998 VX5	19 203	9%	18 0 42.035	-27 20 10.65
Jul 16	6 50.4	4.8 0.007	1.29s	15.5	2.6	3.2	UCAC4 327-102480	1.25	77981 2002 JK24	20 209	6%	17 24 20.026	-24 40 17.84
Jul 16	7 31.4	4.7 0.006	0.54s	15.5	1.4	1.7	UCAC4 304-252072	0.95	25546 1999 XL164	20 194	13%	19 4 3.327	-29 13 56.94
Jul 16	8 12.7	10 0.008	1.49s	13.2	4.8	5.8	UCAC4 345-103661	s 0.80	4108 Rakos	15 225	16%	17 34 51.728	-21 5 46.51
Jul 16	8 18.3	4.4 0.003	0.42s	15.3	4.7	5.3+	UCAC4 287-136437	0.95	146543 2001 SC277	7 216	7%	17 55 31.941	-32 47 46.80
Jul 16	8 27.8	10 0.008	1.24s	12.8	5.1	6.0+	UCAC4 296-167073	s 0.80	14077 Volfango	9 216	14%	18 11 11.099	-30 50 2.98
Jul 16	8 45.4	13 0.007	0.84s	15.4	3.7	3.8	UCAC4 567-000122	0.95	109582 2001 QL275	52 103	5%	0 3 42.527	23 18 45.82
Jul 16	9 4.5	6.2 0.004	0.70s	15.4	4.5	4.9	UCAC4 366-089969	1.00	69967 1998 VS49	9 239	6%	17 28 13.815	-16 52 5.72
Jul 16	8 52.2	7.9 0.004	1.56s	14.0	5.9	6.0	UCAC4 461-059518	0.90	104540 2000 GF57	11 264	6%	16 14 57.448	2 10 6.11
Jul 16	9 36.8	82 0.107	7.3s	12.8	0.33	0.33	UCAC4 549-127153	0.90	914 Palisana	61 233	50%	20 33 7.475	19 44 39.75
Jul 16	9 30.1	3.91 0.004	0.42s	15.6	1.9	2.2	UCAC4 347-165280	1.10	19596 Spegorlars	16 224	6%	18 59 55.905	-20 38 9.65

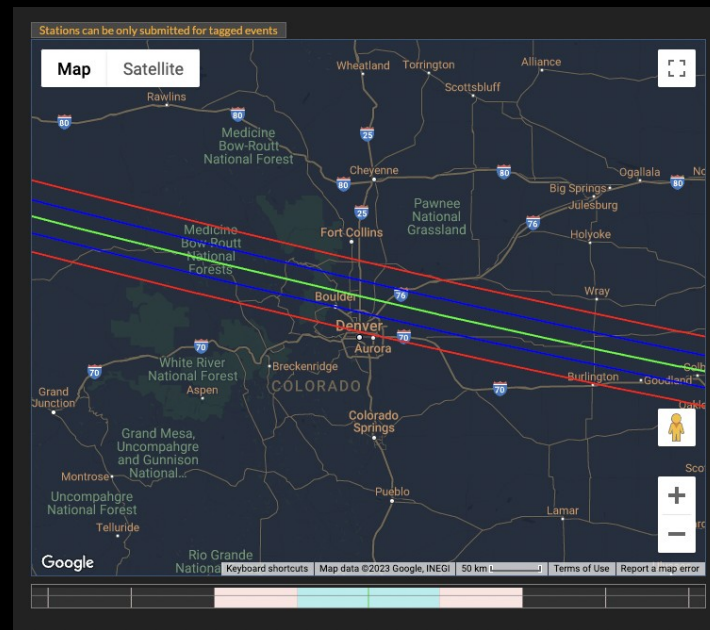
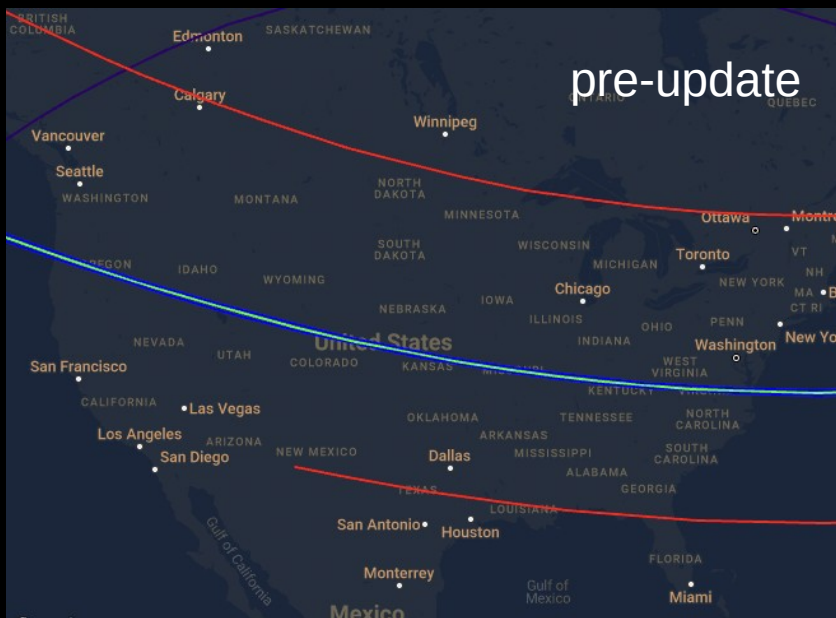
Tonight's (Jul 16 UT) Raw List from Occult4

Event Summary for Longitude -105.4454°, Latitude 39.9872° - sorted by Date

Date	U.T.	Diameter	Durn	Star	Mag-Drop	Elon	Star	Rely	Planet	Alt	Proba-	R.A. (J2000)	Dec.
Jul 16	3 37.1	13 0.008	1.09s	15.0	3.3	3.7+	UCAC4 292-184550	0.90	10444 de Hevesy	11 150	11%	18 29 2.321	-31 41 54.77
Jul 16	3 43.7	7.9 0.007	0.79s	15.8	1.2	1.7+	UCAC4 445-086250	1.00	4767 Sutoku	36 129	16%	18 53 19.804	- 1 6 19.65
Jul 16	4 26.2	6.2 0.004	0.51s	15.9	3.6	3.7	UCAC4 381-065645	1.10	21696 Ermalmquis	21 229	7%	13 49 29.283	-13 56 56.88
Jul 16	4 52.0	8.5 0.006	0.66s	15.7	1.5	1.7	UCAC4 424-060430	1.00	6898 Saint-Mary	31 230	20%	14 41 12.826	- 5 18 27.33
Jul 16	4 57.8	3.41 0.004	0.44s	14.7	3.7	4.2+	UCAC4 313-244252	1.20	118631 2000 HB48	19 157	5%	19 9 58.363	-27 35 8.35
Jul 16	5 8.3	3.81 0.004	0.46s	14.9	3.6	3.9	UCAC4 383-116063	0.85	206668 2003 YE85	35 163	6%	18 35 32.136	-13 28 36.84
Jul 16	5 8.2	3.71 0.005	0.53s	15.2	2.3	2.5+	UCAC4 327-155258	1.10	18773 Bredehoft	24 168	8%	18 30 6.989	-24 42 58.56
Jul 16	5 21.1	4.7 0.003	0.34s	14.5	6.2	5.8	UCAC4 390-059321	1.15	41684 2000 UL15	11 243	9%	13 38 14.406	-12 9 26.82
Jul 16	5 27.0	8.8 0.007	0.81s	13.8	4.1	4.3	UCAC4 278-213583	1.00	13775 Thebault	14 167	7%	19 0 23.396	-34 31 5.00
Jul 16	5 33.5	3.61 0.003	0.61s	15.4	3.4	3.9	UCAC4 347-093316	1.00	20420 Marashwhit	28 193	6%	17 16 55.396	-20 37 34.29
Jul 16	5 49.2	18 0.012	1.56s	15.8	0.7	0.8+	UCAC4 367-123735	2.70	2802 Weisell	33 178	19%	18 27 4.057	-16 44 42.08
Jul 16	5 55.5	8.4 0.005	0.82s	13.5	5.6	6.3	UCAC4 275-150018	s 1.60	83451 2001 SR60	15 186	6%	18 1 16.643	-35 0 6.59
Jul 16	5 55.1	3.51 0.004	0.42s	14.5	4.2	4.3	UCAC4 454-120392	1.00	15121 2000 EN14	7 95	7%	23 52 9.990	0 47 50.69
Jul 16	6 14.6	19 0.01	1.67s	15.0	1.9	2.0	UCAC4 374-175175	0.90	4808 Ballaero	26 142	36%	21 4 58.129	-15 12 20.09
Jul 16	6 33.3	3.91 0.005	0.58s	14.8	1.9	2.4+	UCAC4 310-208220	0.90	52839 1998 RZ55	21 190	13%	18 22 0.391	-28 2 56.41
Jul 16	6 35.6	6.2 0.006	0.70s	15.9	0.6	0.49+	UCAC4 279-185107	0.85	31487 Parthchopr	15 189	9%	18 23 47.982	-34 16 51.26
Jul 16	6 36.3	8.3 0.004	0.57s	13.5	5.5	5.8+	UCAC4 336-186099	2.50	47108 1999 CM37	27 180	8%	19 9 16.365	-22 51 59.84
Jul 16	6 53.0	8.3 0.005	0.74s	15.9	3.5	4.1	UCAC4 356-109172	1.00	74400 Streaky	26 208	8%	17 40 34.873	-18 54 16.09
Jul 16	6 59.9	8.0 0.006	0.88s	14.6	0.9	0.8+	G180042.3-272011	s 0.95	25261 1998 VX5	20 202	8%	18 0 42.259	-27 20 10.69
Jul 16	7 6.8	8.0 0.006	0.85s	15.6	0.30	0.11+	UCAC4 314-126147	1.15	25261 1998 VX5	19 203	9%	18 0 42.035	-27 20 10.65
Jul 16	6 50.4	4.8 0.007	1.29s	15.5	2.6	3.2	UCAC4 327-102480	1.25	77981 2002 JK24	20 209	6%	17 24 20.026	-24 40 17.84
Jul 16	7 31.4	4.7 0.006	0.54s	15.5	1.4	1.7	UCAC4 304-252072	0.95	25546 1999 XL164	20 194	13%	19 4 3.327	-29 13 56.94
Jul 16	8 12.7	10 0.008	1.49s	13.2	4.8	5.8	UCAC4 345-103661	s 0.80	4108 Rakos	15 225	16%	17 34 51.728	-21 5 46.51
Jul 16	8 18.3	4.4 0.003	0.42s	15.3	4.7	5.3+	UCAC4 287-136437	0.95	146543 2001 SC277	7 216	7%	17 55 31.941	-32 47 46.80
Jul 16	8 27.8	10 0.008	1.24s	12.8	5.1	6.0+	UCAC4 296-167073	s 0.80	14077 Volfango	9 216	14%	18 11 11.099	-30 50 2.98
Jul 16	8 45.4	13 0.007	0.84s	15.4	3.7	3.8	UCAC4 567-000122	0.95	109582 2001 QL275	52 103	5%	0 3 42.527	23 18 45.82
Jul 16	9 4.5	6.2 0.004	0.70s	15.4	4.5	4.9	UCAC4 366-089969	1.00	69967 1998 VS49	9 239	6%	17 28 13.815	-16 52 5.72
Jul 16	8 52.2	7.9 0.004	1.56s	14.0	5.9	6.0	UCAC4 461-059518	0.90	104540 2000 GF57	11 264	6%	16 14 57.448	2 10 6.11
Jul 16	9 36.8	82 0.107	7.3s	12.8	0.33	0.33	UCAC4 549-127153	0.90	914 Palisana	61 233	50%	20 33 7.475	19 44 39.75
Jul 16	9 30.1	3.91 0.004	0.42s	15.6	1.9	2.2	UCAC4 347-165280	1.10	19596 Spegorlars	16 224	6%	18 59 55.905	-20 38 9.65

Another Aside: 4808 Ballaero Tonight

- Prior to requesting an update at Occult Watcher Cloud this event was Rank **2** with huge uncertainty.
- Following a request for update at OWC the Rank is now **86** and the uncertainty is tight as suggested by the Occult4 prediction.



Tonight's (Jul 16 UT) Raw List from Occult4

Event Summary for Longitude -105.4454°, Latitude 39.9872° - sorted by Date

Date	U.T.	Diameter	Durn	Star	Mag-Drop	Elon	Star	Rely	Planet	Alt	Proba-	R.A. (J2000)	Dec.
Jul 16	3 37.1	13 0.008	1.09s	15.0	3.3	3.7+	UCAC4 292-184550	0.90	10444 de Hevesy	11 150	11%	18 29 2.321	-31 41 54.77
Jul 16	3 43.7	7.9 0.007	0.79s	15.8	1.2	1.7+	UCAC4 445-086250	1.00	4767 Sutoku	36 129	16%	18 53 19.804	- 1 6 19.65
Jul 16	4 26.2	6.2 0.004	0.51s	15.9	3.6	3.7	UCAC4 381-065645	1.10	21696 Ermalmquis	21 229	7%	13 49 29.283	-13 56 56.88
Jul 16	4 52.0	8.5 0.006	0.66s	15.7	1.5	1.7	UCAC4 424-060430	1.00	6898 Saint-Mary	31 230	20%	14 41 12.826	- 5 18 27.33
Jul 16	4 57.8	3.41 0.004	0.44s	14.7	3.7	4.2+	UCAC4 313-244252	1.20	118631 2000 HB48	19 157	5%	19 9 58.363	-27 35 8.35
Jul 16	5 8.3	3.81 0.004	0.46s	14.9	3.6	3.9	UCAC4 383-116063	0.85	206668 2003 YE85	35 163	6%	18 35 32.136	-13 28 36.84
Jul 16	5 8.2	3.71 0.005	0.53s	15.2	2.3	2.5+	UCAC4 327-155258	1.10	18773 Bredehoft	24 168	8%	18 30 6.989	-24 42 58.56
Jul 16	5 21.1	4.7 0.003	0.34s	14.5	6.2	5.8	UCAC4 390-059321	1.15	41684 2000 UL15	11 243	9%	13 38 14.406	-12 9 26.82
Jul 16	5 27.0	8.8 0.007	0.81s	13.8	4.1	4.3	UCAC4 278-213583	1.00	13775 Thebault	14 167	7%	19 0 23.396	-34 31 5.00
Jul 16	5 33.5	3.61 0.003	0.61s	15.4	3.4	3.9	UCAC4 347-093316	1.00	20420 Marashwhit	28 193	6%	17 16 55.396	-20 37 34.29
Jul 16	5 49.2	18 0.012	1.56s	15.8	0.7	0.8+	UCAC4 367-123735	2.70	2802 Weisell	33 178	19%	18 27 4.057	-16 44 42.08
Jul 16	5 55.5	8.4 0.005	0.82s	13.5	5.6	6.3	UCAC4 275-150018	s 1.60	83451 2001 SR60	15 186	6%	18 1 16.643	-35 0 6.59
Jul 16	5 55.1	3.51 0.004	0.42s	14.5	4.2	4.3	UCAC4 454-120392	1.00	15121 2000 EN14	7 95	7%	23 52 9.990	0 47 50.69
Jul 16	6 14.6	19 0.014	1.67s	15.0	1.9	2.0	UCAC4 374-175175	0.90	4808 Ballaero	26 142	36%	21 4 58.129	-15 12 20.09
Jul 16	6 33.3	3.91 0.005	0.58s	14.8	1.9	2.4+	UCAC4 310-208220	0.90	52839 1998 RZ55	21 190	13%	18 22 0.391	-28 2 56.41
Jul 16	6 35.6	6.2 0.006	0.70s	15.9	0.6	0.49+	UCAC4 279-185107	0.85	31487 Parthchopr	15 189	9%	18 23 47.982	-34 16 51.26
Jul 16	6 36.3	8.3 0.004	0.57s	13.5	5.5	5.8+	UCAC4 336-186099	2.50	47108 1999 CM37	27 180	8%	19 9 16.365	-22 51 59.84
Jul 16	6 53.0	8.3 0.005	0.74s	15.9	3.5	4.1	UCAC4 356-109172	1.00	74400 Streaky	26 208	8%	17 40 34.873	-18 54 16.09
Jul 16	6 59.9	8.0 0.006	0.88s	14.6	0.9	0.8+	G180042.3-272011	s 0.95	25261 1998 VX5	20 202	8%	18 0 42.259	-27 20 10.69
Jul 16	7 6.8	8.0 0.006	0.85s	15.6	0.30	0.11+	UCAC4 314-126147	1.15	25261 1998 VX5	19 203	9%	18 0 42.035	-27 20 10.65
Jul 16	6 50.4	4.8 0.007	1.29s	15.5	2.6	3.2	UCAC4 327-102480	1.25	77981 2002 JK24	20 209	6%	17 24 20.026	-24 40 17.84
Jul 16	7 31.4	4.7 0.006	0.54s	15.5	1.4	1.7	UCAC4 304-252072	0.95	25546 1999 XL164	20 194	13%	19 4 3.327	-29 13 56.94
Jul 16	8 12.7	10 0.008	1.49s	13.2	4.8	5.8	UCAC4 345-103661	s 0.80	4108 Rakos	15 225	16%	17 34 51.728	-21 5 46.51
Jul 16	8 18.3	4.4 0.003	0.42s	15.3	4.7	5.3+	UCAC4 287-136437	0.95	146543 2001 SC277	7 216	7%	17 55 31.941	-32 47 46.80
Jul 16	8 27.8	10 0.008	1.24s	12.8	5.1	6.0+	UCAC4 296-167073	s 0.80	14077 Volfango	9 216	14%	18 11 11.099	-30 50 2.98
Jul 16	8 45.4	13 0.007	0.84s	15.4	3.7	3.8	UCAC4 567-000122	0.95	109582 2001 QL275	52 103	5%	0 3 42.527	23 18 45.82
Jul 16	9 4.5	6.2 0.004	0.70s	15.4	4.5	4.9	UCAC4 366-089969	1.00	69967 1998 VS49	9 239	6%	17 28 13.815	-16 52 5.72
Jul 16	8 52.2	7.9 0.004	1.56s	14.0	5.9	6.0	UCAC4 461-059518	0.90	104540 2000 GF57	11 264	6%	16 14 57.448	2 10 6.11
Jul 16	9 36.8	82 0.107	7.3s	12.8	0.33	0.33	UCAC4 549-127153	0.90	914 Palisana	61 233	50%	20 33 7.475	19 44 39.75
Jul 16	9 30.1	3.91 0.004	0.42s	15.6	1.9	2.2	UCAC4 347-165280	1.10	19596 Spegorlars	16 224	6%	18 59 55.905	-20 38 9.65

Last Night's (Jul 15 UT) Selected List – Ten Events, All Observed

2023 Jul 15	4	31.0	12	0.009	1.03s	15.0	1.5	1.7	173	UCAC4 373-171209	0.95	9711	Zeletava	25	140	0.0	17%	150	6	19	27	31.0	-15	24	58.81
2023 Jul 15	4	44.9	6.6	0.005	0.70s	14.0	4.8	5.3	166	UCAC4 335-177058	1.25	73622	3418 T-3	24	159	0.0	6%	165	6	18	36	06.1	-23	06	14.22
2023 Jul 15	4	55.0	25	0.016	2.2s	14.8	0.8	1.2	159	UCAC4 330-126165	1.10	180	Garumna	25	169	0.0	26%	172	6	18	05	35.6	-24	08	21.16
2023 Jul 15	5	4.6	9.7	0.006	0.69s	13.1	5.0	5.1	167	UCAC4 356-161667	0.85	15243	1989 TU1	29	160	0.0	28%	161	6	18	44	39.1	-18	56	19.84
2023 Jul 15	5	13.7	12	0.009	0.98s	15.9	1.8	2.3†	164	UCAC4 329-155593	1.35	25467	1999 XV32	25	168	0.0	23%	167	6	18	30	21.9	-24	12	11.29
2023 Jul 15	5	42.5	4.0	0.003	0.35s	14.5	4.7	4.8	164	UCAC4 419-135018	1.00	46060	2001 DL88	37	145	0.0	5%	139	6	20	00	55.3	-06	22	01.91
2023 Jul 15	6	18.6	6.6	0.004	0.56s	15.3	4.8	5.0	136	UCAC4 490-068931	0.90	162971	2001 QU256	53	215	0.0	5%	145	6	17	26	19.2	07	55	52.12
2023 Jul 15	6	43.1	186	0.104	15.7s	13.6	0.36	0.5†	154	UCAC4 278-151607	6.10	94	Aurora	14	196	0.0	90%	172	6	17	56	53.8	-34	30	07.86
2023 Jul 15	6	53.5	7.1	0.005	0.70s	13.3	5.1	5.3	154	UCAC4 340-108576	0.85	45635	2000 EY11	24	205	0.0	7%	175	6	17	43	35.4	-22	10	28.51
2023 Jul 15	8	0.3	22	0.013	1.64s	15.1	2.0	2.6	161	UCAC4 408-086141	0.85	24388	2000 AB175	36	213	0.0	17%	156	6	18	42	20.6	-08	33	55.50

- Typically 6 to 12 events survive selection for a given night
- Star is dead center in every automated observation (very rarely platesolve will fail)
- Autofocus still needs work. Worst case it returns to the previous focus after failing a parabolic fit.
 - Windshake, tracking glitches will confuse the algorithm.

Contact Info – Queries Always Welcome

- Questions about
 - SharpCap sequencing
 - Mount interfacing
 - MyFP2 focuser
 - I had a bunch of boards made and can mail you one.
 - Etc...

mfs4n@virginia.edu

