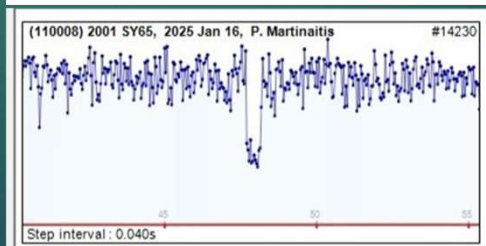
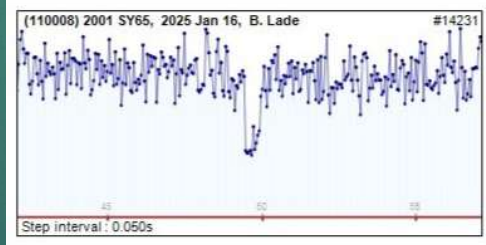
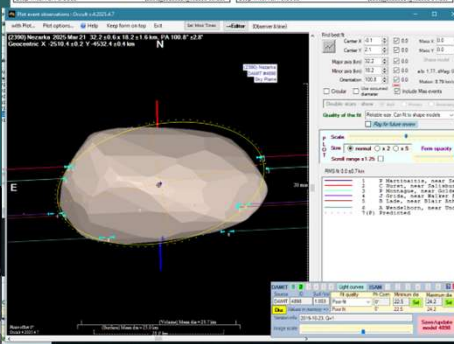
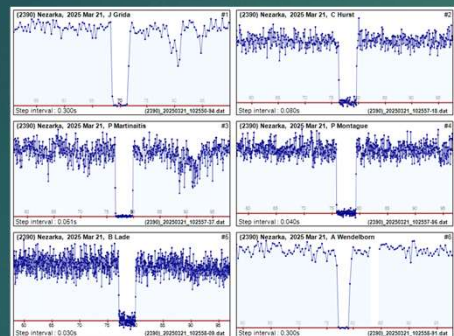
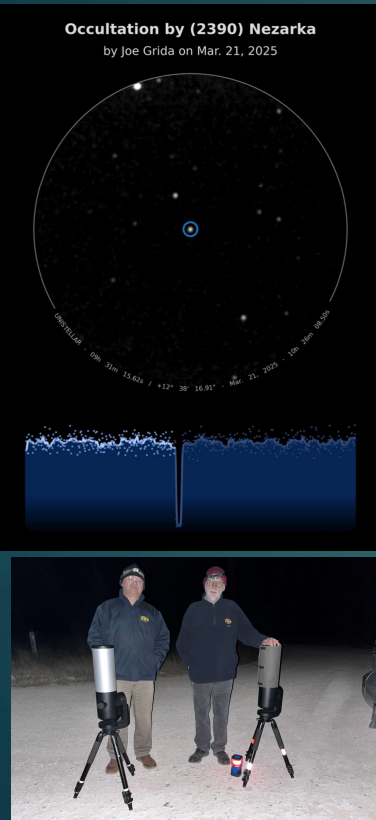


The ASSA (Adelaide) Group

Andrew Wendelborn
TTSO20 2026



Outline



- ▶ Origin and Objectives
 - ▶ Group emphasis
 - ▶ Minimal adaptation of familiar equipment
- ▶ The people and the equipment
- ▶ How we do it: basic workflows
- ▶ Some results
- ▶ Organisation and communication
- ▶ Finding events
- ▶ Other challenges...

History

- ▶ Previous occultation projects in ASSA
 - ▶ Astronomical Society of South Australia
- ▶ Pluto 2006
 - ▶ Blair Lade in the ASSA Stockport Observatory
- ▶ Chariklo 2016
 - ▶ Joe Grida; Blair Lade
- ▶ Each lead to publications
- ▶ A great inspiration for 2026!



(on location in Coonalpyn)



Who is doing these observations?

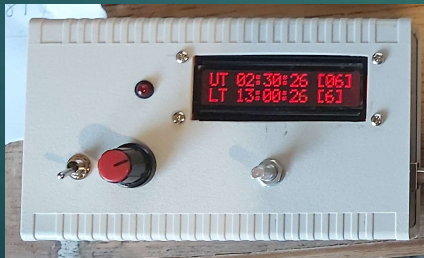
- Currently:
 - Paul Montague; Jarrod Rueff; Blair Lade; Paul Martinaitis; Colin Hurst; Joe Grida; Andrew Wendelborn and Rosemary Prentice
- A variety of equipment in use...
 - Basic requirements: telescope; camera; timing



Paul Martinaitis occultation setup



- 8" f/10 Meade SCT. (1990's model)
- EQ5Pro Mount
- Focal reducer (f3.3)
 - Brighter image and larger fov
- Mount driven with EqMod cable connected directly
 - Direct control of scope (here, with Sharpcap)
- Camera is an ASI462MM for better sensitivity
 - ASI224MC works quite well
- Sharpcap does platesolving and slews to target
- Arduino based flasher
 - variable control, clips onto tube



The screenshots show the SharpCap Pro software interface. The top window displays camera controls for the ASI462MM camera, including capture format (ADV files), output format (MONO16), and exposure settings (30.0 ms). The bottom window shows the NTP Server Monitor by Meinberg 1.03, displaying the current NTP status and a table of NTP servers.

Remote	RefId	Stratum	Type	When Poll	Reach	Delay	Offset	Jitter	
103.158.134.33	103.238.8.20	2	Unicast server	35	128	377	62.429	1.243	7.418
103.242.78.4	202.45.178.18	2	Unicast server	54	128	377	64.290	0.034	0.950
202.22.158.30	103.70.25.21	2	Unicast server	110	128	377	54.952	0.042	0.914
198.211.103.298	206.198.0.131	2	Unicast server	3	128	377	258.204	10.912	1.145
45.32.207.136	129.134.25.123	2	Unicast server	127	128	377	265.494	12.718	0.959

Paul Martinaitis setup ctd...

- Timing
 - NTP used to get computer clock close to UT
 - GPS Flasher calibrates for acquisition delay and timebase error
 - Can use a low cost usb flasher
 - Built an Arduino based flasher with variable LED control
 - Clip to tube and set appropriate level
 - Long/Lat readout and UT/local time
 - Indicator lights for confirmation of sync to GPS and leap second acquisition
 - Can video time on unit + light flashing + computer clock for secondary timing

Alt Az setup: Evolution mount

- Current state of experimentation...
 - Celestron Evolution Mount
 - Initially C6 tube, at native focal length (no reducer)
 - Next steps: f3.3 reducer and C8 tube
 - Mount driven with cable connected through handset
 - Direct control of scope (CPWI and Sharpcap)
 - Camera: ASI662MM (known for excellent sensitivity)
- Initial experiments use standard Celestron alignment procedures
 - such as two-star alignment
- Slewing using CPWI
- This shows promise
 - next steps will introduce Sharpcap
- Handheld or Arduino based flasher, in the usual way



Workflow for astrophotography equipment

Occultation Walkthrough (updated)

Capture

- NINA and ASTAP
- SharpCap: Occultation Profile for capture
- Adjust gain / exposure if required (avoid multiples of 50 ms).
- Use **Tools** → **Pixel Value Readout** to check for saturation
- Open a command prompt and run `n1pq -pn`, confirm **reach = 377**
- Activate GPS flashers at least **10 minutes** prior to the event.
- **Capture** → **Start Capture** (using the profile's default values).
- At least **1 minute** prior to the event, perform ~10 GPS flashes

Light Curve – first run (for GPS timing)

GPS Time Correction (spreadsheet)

Light Curve – second run (time-corrected, without GPS flashes)

This is the light curve you'll feed into AOTA.

Extract D/R Times with AOTA and Build Submission Pack

Prepare the Asteroid Occultation Report Form (xls)

Build the submission pack (files to include)

Email submission

The screenshot displays the Occultation Workspace application. The top bar shows the profile 'Cudlee Creek Observatory' and the OWC URL. Below this, a 'Cases' list shows the selected case: '20260307 - (296484) 2009 HW103 - UCAC4 487'. The main panel is divided into several sections:

- Case Summary:** Displays target information: (296484) 2009 HW103 / UCAC4 487-015234, times in UTC and Local, workspace path, and workflow status (Missing artifacts: 8 | Missing review fields: 8).
- Uncorrected Tangra [Pending]:** Shows a message that the first Tangra run with GPS pulses is captured and attached. It lists 'Tangra uncorrected CSV' and 'Tangra uncorrected screenshot' as missing files with 'Open' and 'Browse...' buttons.
- GPS delay [Pending]:** Shows a message that the GPS delay workbook has been updated and confirmed. It lists 'GPS delay workbook' as ready with a file path and 'Open' and 'Browse...' buttons. A checkbox for 'GPS workbook has been reviewed and saved' is present.
- Corrected Tangra [Pending]:** Shows a message that the second Tangra run around the event is attached. It lists 'Tangra time-corrected CSV', 'Time-corrected Jc', and 'Tangra corrected screenshot' as missing files with 'Open' and 'Browse...' buttons.
- AOTA [Pending]:** Shows a message that the AOTA report and screenshots are attached and parsed. It lists 'AOTA report', 'AOTA Tab 5 screenshot', and 'AOTA Tab 6 screenshot' as missing files with 'Open' and 'Browse...' buttons.

At the bottom, there are buttons for 'Open Case Folder' and 'Delete Case'.

Under development by Jarrod Rueff

Occultation

Global Triggers

Sequence Start Area

⌚ Wait for Time Source Time Time 20 : 0 : 0 | Day Rollover Time 07:23:57

🚫 Unpark Scope !

UCAC4 487-015234

Target

Name	UCAC4 487-015234		
RA	5 h	54 m	58.0 s
Dec	7 d	22 m	26.7 s
Rotation	240 °		

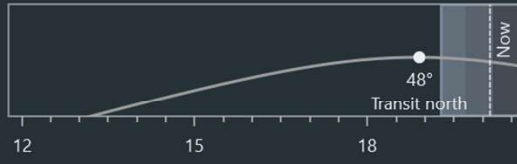
▶ 📷 Exposure Info L - 10:14:13 | LPF - 0:01:00 | L-eXt - 10:20:00

⚡ Triggers

📄 Loop Conditions

📋 Instructions

📏 Cool Camera Slew and Centre



The eVscope and Citizen Science



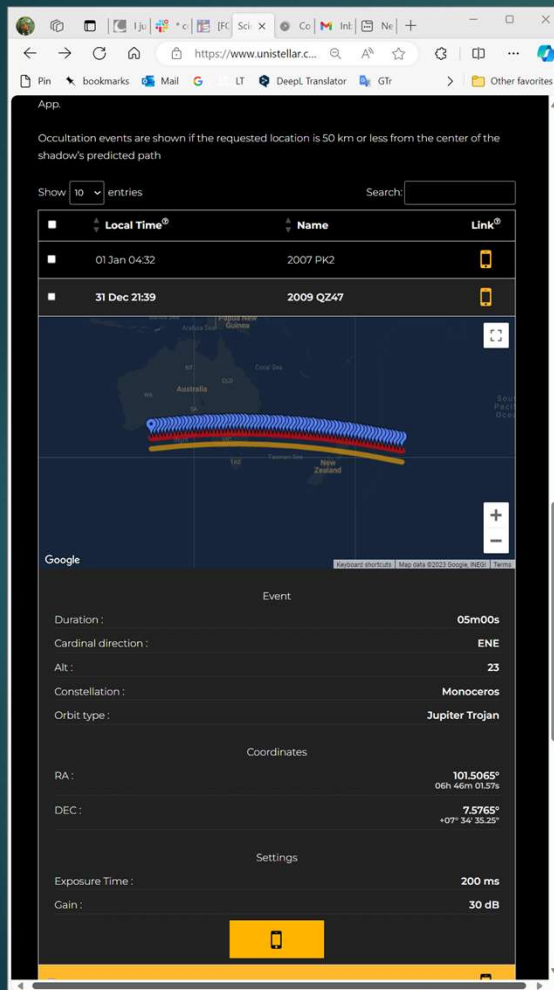
Unistellar Citizen Science

- **eVscopes**
 - Control with phone app
 - Autonomous field detection
 - Real time stacking
 - Aperture: 114 mm
- **Network > 10,000 eVscopes**
- **Science Campaigns:**
 - Transients
 - Exoplanets
 - Occultations
 - Comets
 - Planetary Defense

Evscope 1/ eQuinox
37' x 28' FOV
1.72 "/pix
Sony IMX224

Evscope 2/ eQuinox 2
47' x 34' FOV
1.33 "/pix
Sony IMX347

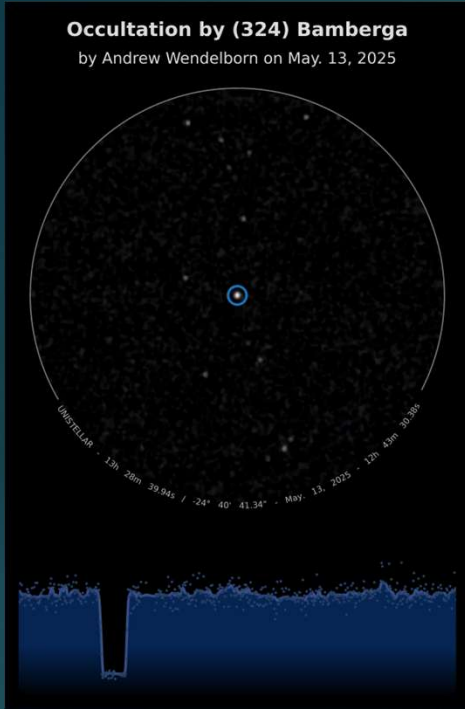
Unistellar eVscope workflow



- Finding a candidate asteroid occultation
 - SETI team publishes lists covering broad areas
 - Each entry has a map
 - Red line predicts best points to observe occultation
- Scope controlled via a **deeplink** such as
 - [unistellar://science/occultation?ra=88.74177015&dec=7.3740266&et=200&g=30&d=240&t=1772890320&scitag=o2603072009Hw1034](https://www.unistellar.com/science/occultation?ra=88.74177015&dec=7.3740266&et=200&g=30&d=240&t=1772890320&scitag=o2603072009Hw1034)
 - Send a deeplink and press **record** just before the event!
- I often generate deeplinks from OWC listings
 - Our eVscopes can then participate in all appropriate group events

Occultation by (324) Bamberga

by Andrew Wendelborn on May. 13, 2025



Results from SETI processing

SETI INSTITUTE UNISTELLAR

Asteroid Occultation **Positive Detection**

ASTEROID (324) BAMBERGA

On the night of May 13th to 14th, 2025

Prediction

Timing (UTC)
12:43:55.67

Maximum Duration
16.0 s

Object type
Main-Belt

Citizen Scientist

Name
Andrew Wendelborn

Location
Australia



Observations

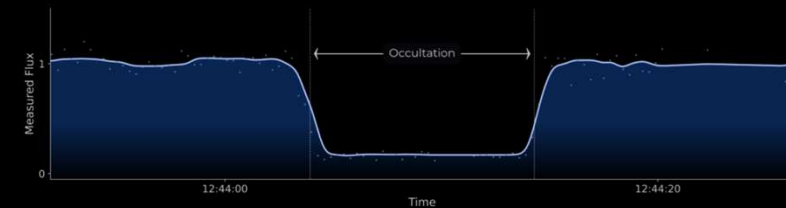
Disappearance (UTC)
12:44:03.84

Reappearance (UTC)
12:44:14.35

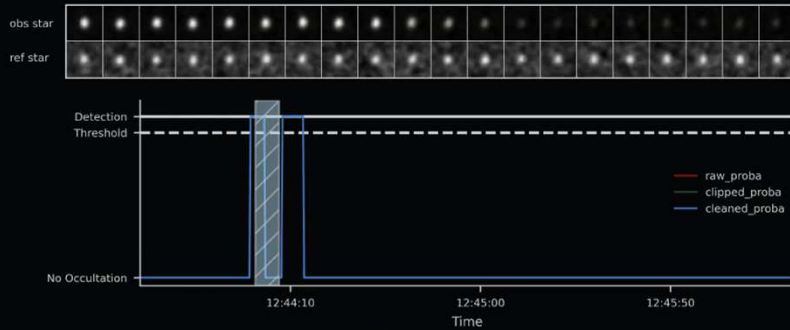
Duration
10.51 s

Magnitude Drop
0.84 mag

Light Curve

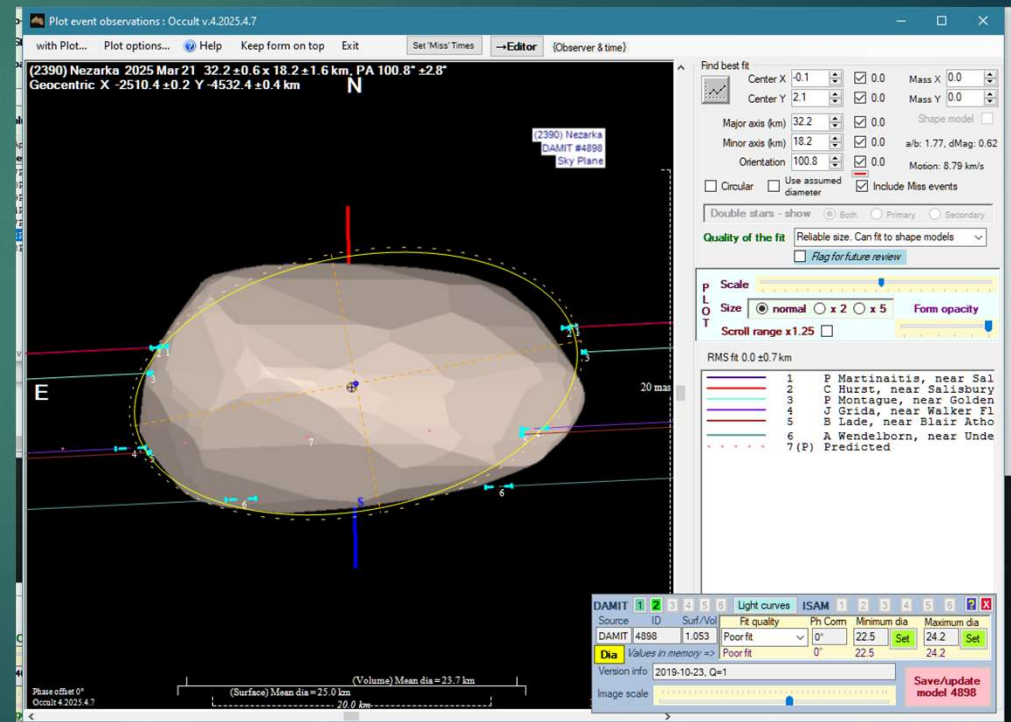
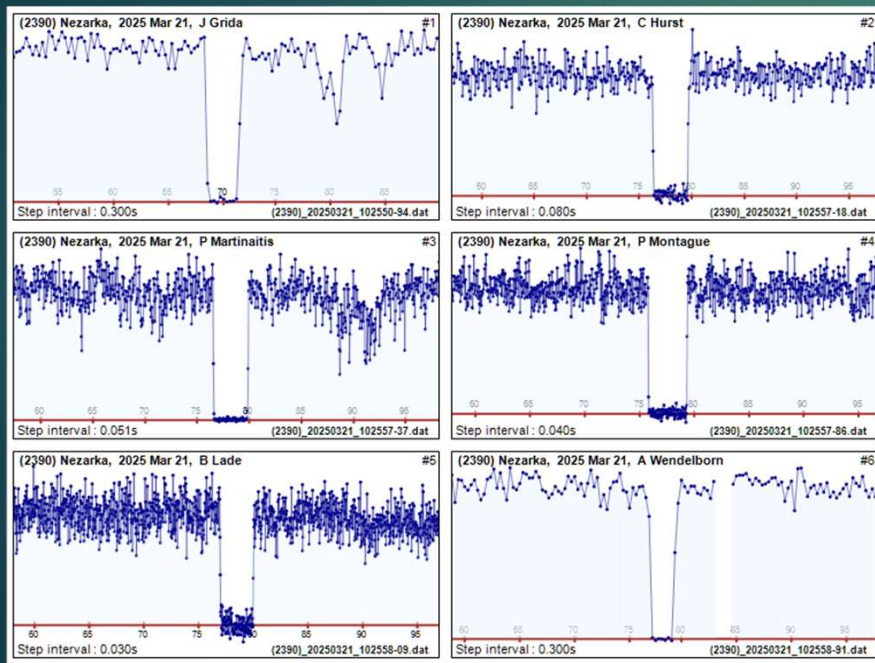


eVent: Bamberga, date: May, 13, 2025, sn: uvu, result: Positive
time in [12:44:00.6, 12:44:06.9]



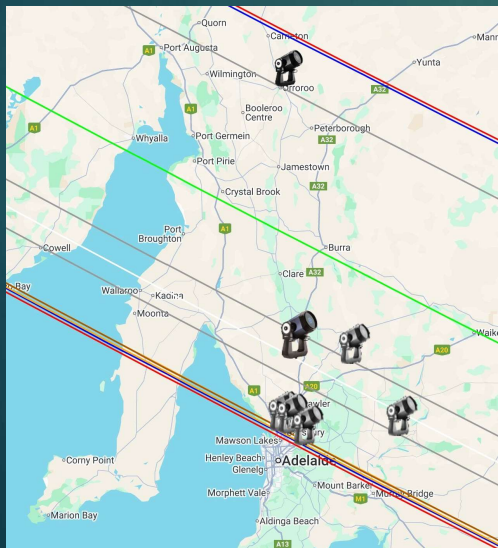
ASSA group: some results

- (2390) Nezarka 23km diameter
- Six ASSA observers; six lightcurves; six chords
- Existing shape model: our obs will give a better fit



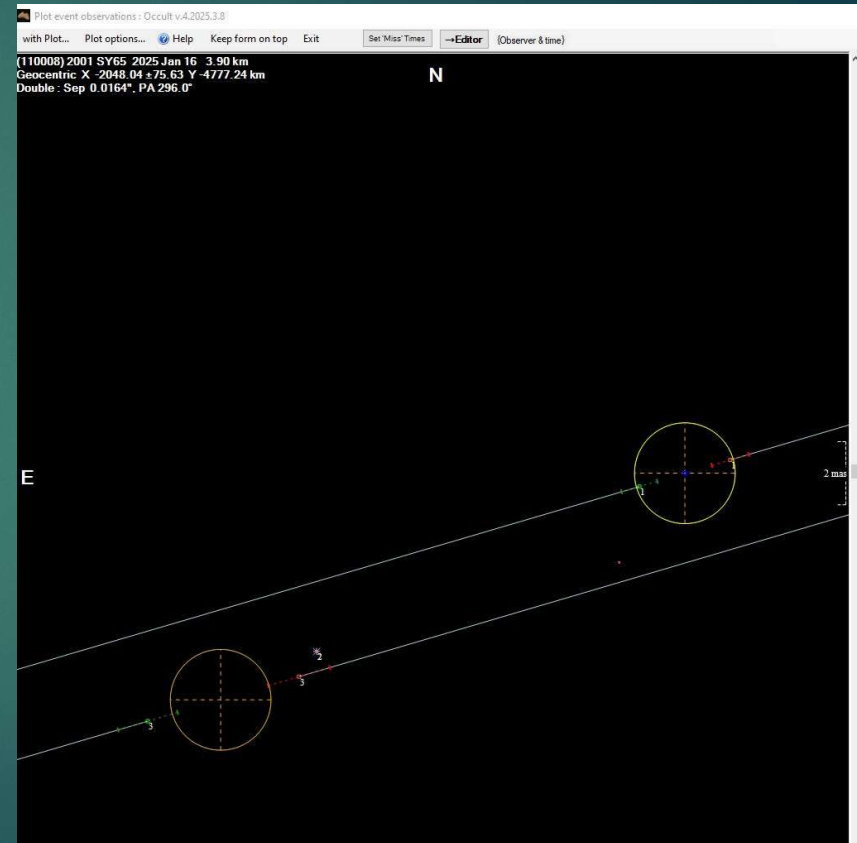
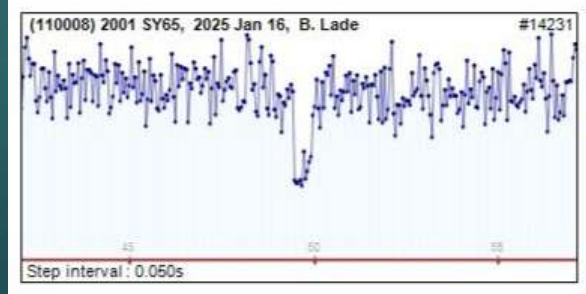
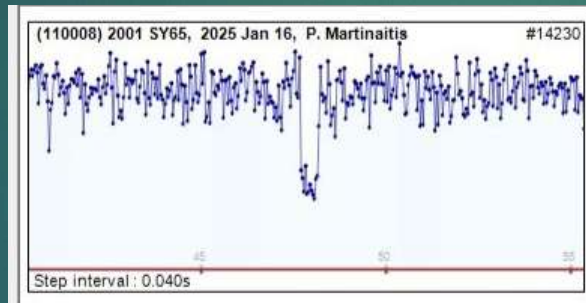
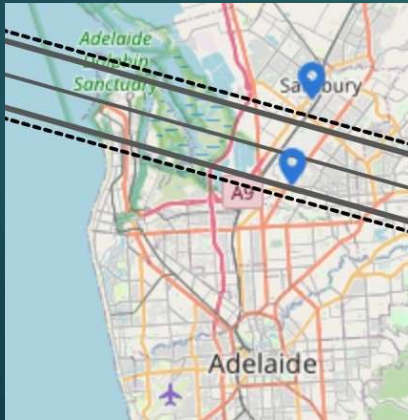
Sometimes the unexpected happens...

- 230km diameter: a big one directly over Adelaide!
- Some travelled to improve spread across path: Orroroo; Stockport; Dutton; Walker Flat
- The lightcurves look strange: why do they have steps? We didn't expect that!
 - Not one but two light sources, so two superimposed shadows
- **A double star!!**



Another occultation ... Duplicity doubled

- Asteroid 2.5 km diameter directly over Adelaide
- Two observers: one just outside predicted path
- The lightcurves are *shallower* than expected
 - But combined they give 100% drop
 - Two light sources, two *separate* shadows
- **Once again, a double star!**



Group organisation and communication

- Definitely nonhierarchical!
- Discord for suggesting events; discussing results; guidance...
 - Structured using channels
- Shared repository for reports; helpful documents; workflow documentation...



Discord usage example



The screenshot shows a Discord server interface for 'ASSA COMA - Occultations'. The left sidebar lists various channels including 'Events', 'Server Boosts', 'Text channels', and 'Voice channels'. The main chat area shows a conversation between Paul Mo and Paul Martinaitis discussing a new feature in the Occult Watcher desktop app. Paul Mo's message includes a code block for a command: `<Observer Initials="PSM-B" Id="montagoo@gmail.com" Lat="-32.354" Lng="138.793" Alt="450" />`. Paul Martinaitis responds with a similar command: `<Observer Initials="PNM-Home" Id="kosh@vorlon.au" Lat="-34.762" Lng="138.636" Alt="10" />`. The chat also shows a list of online and offline users, including NGC6231 (Andrew W), AstroColin, Blair, Jarrod Rueff, Joe Grida, Michael Camilleri, Paul Martinaitis, and Paul Mo.

The screenshot shows a Discord channel welcome message for '#20260320-2003-uj127!'. The message is titled 'Welcome to #20260320-2003-uj127!' and includes a link to the event page: <https://cloud.occultwatcher.net/event/1904-267832-88050-648927-U022493>. The message describes the event as a low rank event where any detection will improve astrometry. It mentions that Dave Gault has registered in the Blue Mountains at 20km south of centre line. The message also notes that all locations have potential and are north of centre, and that Mount Barker is close to path centre. The message concludes with 'I'll attempt it from the public night at Hawthorndene which is 7 km from the path centre. I have registered a station on OWC.'

Group repository example

OneDrive Explorer window showing the 'Occultation_Reports' folder. The folder contains 15 items, including a spreadsheet and several subfolders.

Name	Date modified
RASNZ_AstReportForm_V4.1.2.F.xls	3/12/2025 12:37 PM
20260307 (296484) 2009 HW103	12/03/2026 10:39 AM
20260306 2696 Magion	12/03/2026 10:33 AM
20260201 142784 2002 UZ13	11/03/2026 6:03 PM
20260216 (236006) 2005 GQ31	10/03/2026 6:12 PM
20260125 29107 1981 EO25	10/03/2026 5:39 PM
20260216 Nephele	10/03/2026 5:38 PM
20260104 203334 2001 TC226	12/01/2026 11:34 AM
20260107 10080 Macevans	8/01/2026 5:35 PM
20251208 10907 Savalle	10/12/2025 8:31 PM
20251127 2887 Krinov	1/12/2025 5:54 AM
20250513 324 Bamberga	24/11/2025 5:06 PM
20240701 31 Euphrosyne	3/10/2025 6:15 PM
20250718 163 Erigone	3/10/2025 6:15 PM
20250731 419 Aurelia	3/10/2025 6:15 PM

15 items | 1 item selected | Available when online

OneDrive Explorer window showing the contents of the '20251127 2887 Krinov' folder. The folder contains 5 items, including subfolders and files.

- Andrew Wendelborn
- Jarroed Rueff
- Paul Martinaitis
- GPS Flash Timing Delay Calculator Feb 2025 - For Tangra.xlsx
- GPS Flash Timing.pdf

5 items | 1 item selected | Available when online

OneDrive Explorer window showing the contents of the 'Jarroed Rueff' folder. The folder contains 10 items, including spreadsheets, reports, screenshots, and CSV files.

- 20251127_2887_Krinov_UCAC4_479_002869+Rueff.xlsx
- 20251127_2887_Krinov_UCAC4_479_002869+Rueff_AOTA_Report.txt
- 20251127_2887_Krinov_UCAC4_479_002869+Rueff_AOTA_Tab5_Screenshot.png
- 20251127_2887_Krinov_UCAC4_479_002869+Rueff_AOTA_Tab6_Screenshot.png
- 20251127_2887_Krinov_UCAC4_479_002869+Rueff_CameraSettings.txt
- 20251127_2887_Krinov_UCAC4_479_002869+Rueff_GPS Flash Timing Delay Calculator.xlsx
- 20251127_2887_Krinov_UCAC4_479_002869+Rueff_Tangra_LC_Screenshot.png
- 20251127_2887_Krinov_UCAC4_479_002869+Rueff_Tangra_Time_Corrected_LC_Screenshot.png
- 20251127_2887_Krinov_UCAC4_479_002869+Rueff_TimeCorrected_LightCurve.lc
- 20251127_2887_Krinov_UCAC4_479_002869+Rueff_TimeCorrected_LightCurveCSV.csv

10 items



Issues and Challenges

- Searching for, and choosing, events
- Classifying events as "interesting"?
- Testing and validation
- Improving and automating workflows
 - using Michael's scripts (and other methods)
- Many learning curves!!
- Setting up larger scopes
 - 20" at Stockport Observatory
 - 30" at Swan Reach Observatory

Conclusion

- Occultations are accessible to a wide range of potential observers
- Scientifically valuable to observe
- Rewarding group effort
- Always another interesting aspect to pursue

- THANKS
 - Michael Camilleri; Steve Kerr; Dave Gault; Dave Herald
 - The creators of excellent occultation software
 - Our helpful group members
 - And the community in general



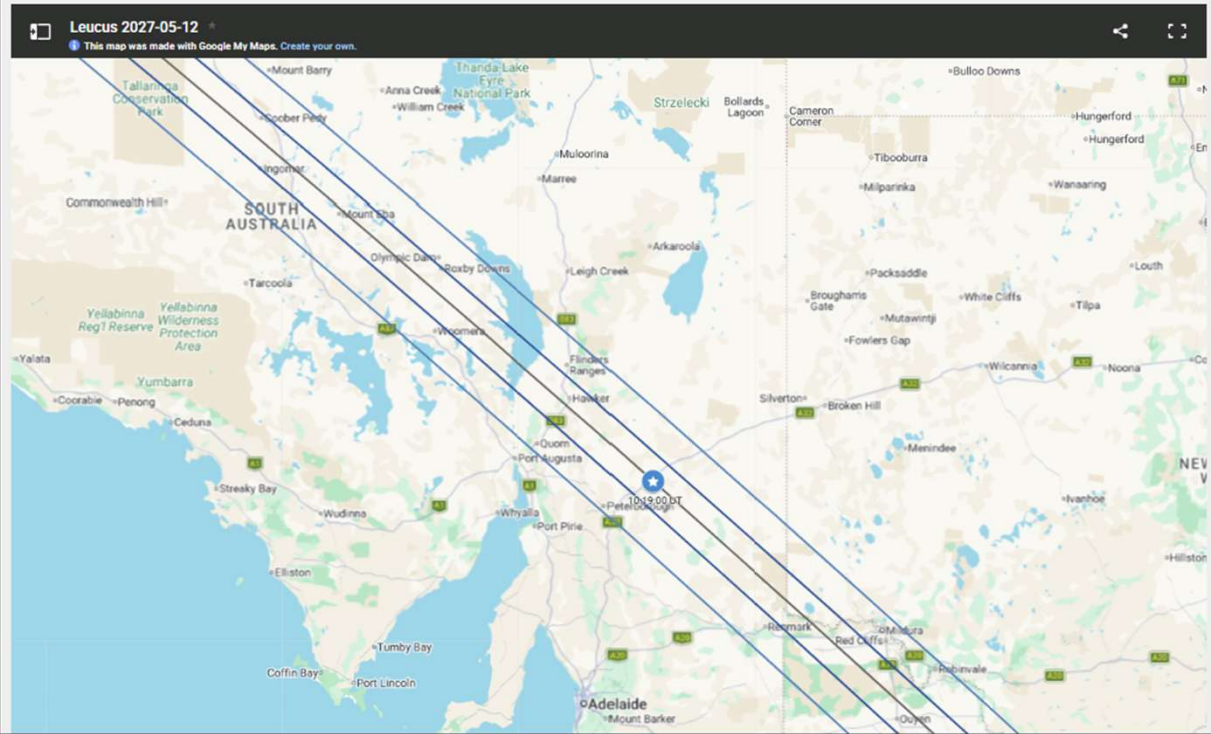
Home Mission ▾ Encounters ▾ Occultations News ▾ Learn More ▾

Leucus Occultation 2027-05-12 ($G^* = 9.7$)

The interactive map below shows our current prediction for the occultation by (11351) Leucus on 2027 May 12 UT. The prediction is based on a Gaia eDR3 position for the star, corrected for parallax and proper motion, and the v20230508164723 orbit estimate for Leucus, which is derived from leucus_20220214a.bsp. This ephemeris has a 1-sigma crosstrack uncertainty of 10.0 km and a 1-sigma downtrack uncertainty of 0.1 sec for this event (these are placeholder values).

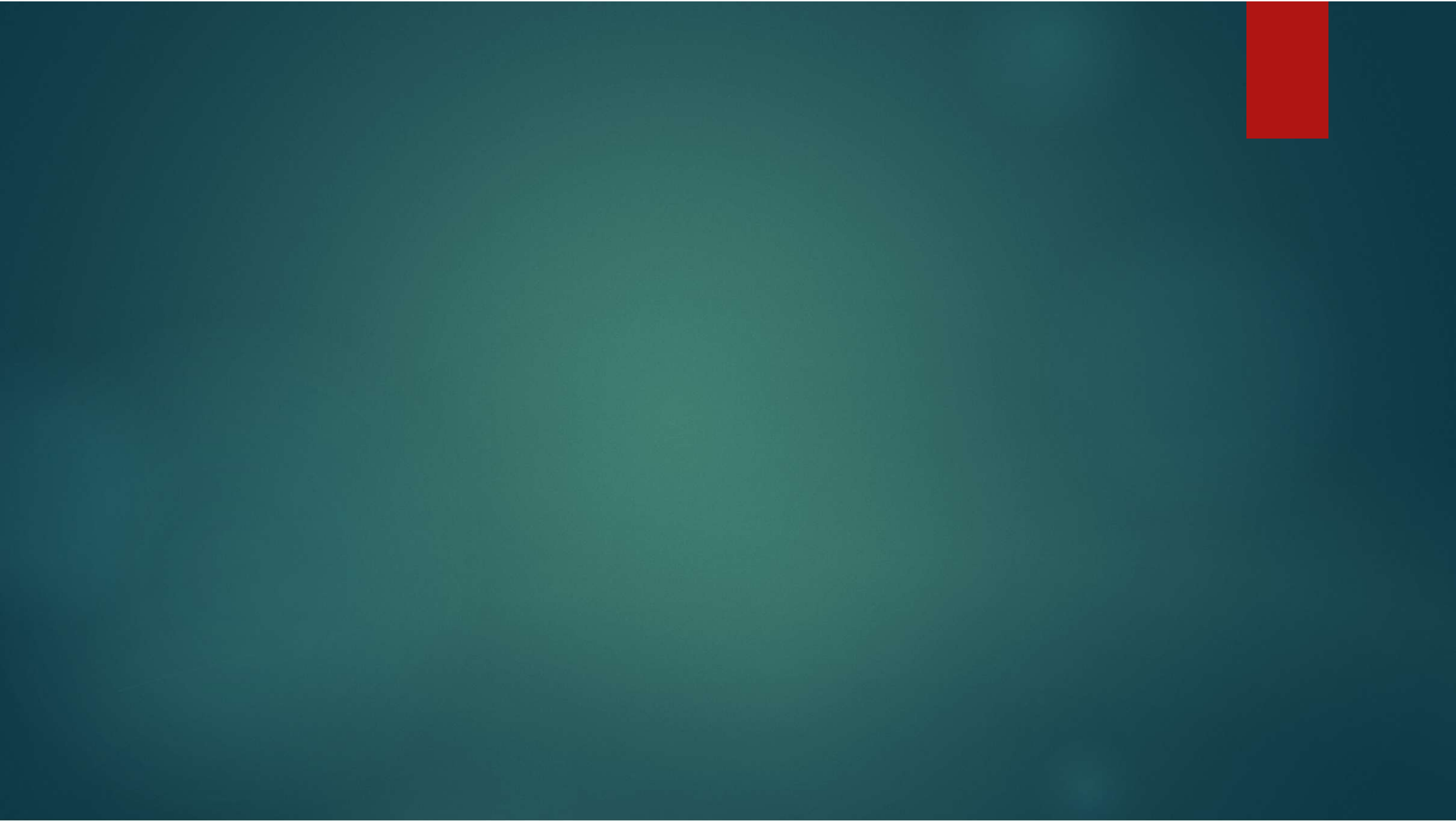
The geocentric mid-time of the event is 10:16:19.1 UT. The J2000 star position is RA 14:20:53.7 (14.3482407), Dec -21:19:31 (-21.325389), and its magnitude is 9.87. Leucus is moving at 17.3 km/s with respect to the star and its diameter is estimated to be 41.0 km, so central chords are expected to last 2.4 seconds.

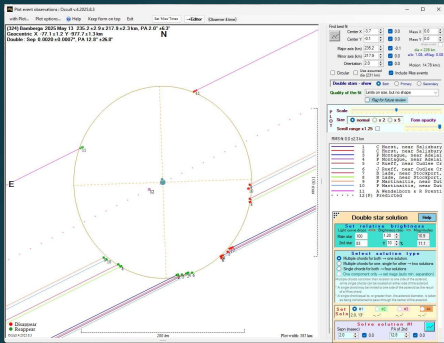
Of-date coordinates for the target star on event night are RA 14:22:26.1 (14.3739167), Dec -21:26:58 (-21.449444).



<https://lucy.swri.edu/occ/predictions/20270512Leucus/>

NASA's Lucy spacecraft visiting Trojans
 Call for occultations to back it up
 Flinders Ranges May 2027
 Who will be there?





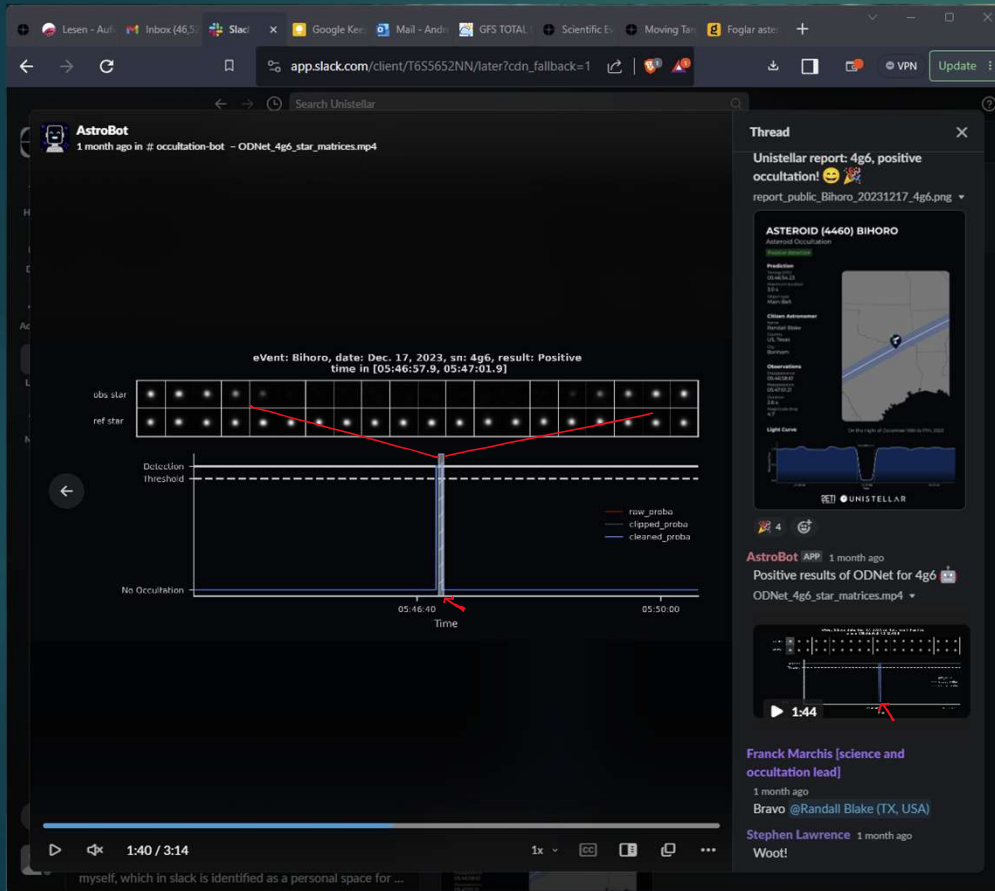
Camera:

- Most modern cmos cameras will do a reasonable job. (Start by just using what you have already got). I started with a ASI224mc (popular for colour planetary imaging). Now use a monochrome **asi462MM** which is much more sensitive.
- Aim for a fov of at least 0.5 degrees – helps platesolving to work. With a fov of (32' x 18'), the finders are rarely used. Mount is switched on in home position and then Sharpcap's platesolver used to slew to target coordinates and then correct position.

Software:

- Sharpcap
- Eqmod (<https://eq-mod.sourceforge.net/>)
 - Replaces hand controller and allows mount to be directly controlled by laptop.
 - Alternative is to use hand controller and serial cable – will still work with SharpCap as long as the scope has an ASCOM driver.
- Meinberg NTP
- Tangra
- Occult

eVscope detection: overall results



- Three sets
 - Observation video
 - Location and light curve
 - Another video
 - Reference star of observed star
 - Clearly shows extinction of observed star
 - My annotations in red