Asteroids & Remote Planets Section (Occultations)

Double star unexpectedly detected during occultation by asteroid – a first from the UK

These results are a very dramatic demonstration of the effectiveness of the occultation method at measuring the intrinsic properties of a double star or occulting body. – R. Miles, Director

Many asteroids are predicted to occult stars each year, but only a tiny fraction of these events are visible from any one location on Earth. One such event involved the main-belt asteroid (212) Medea, which was predicted to occult the magnitude 10.3 star TYC 1857-01108-1,[1] in Taurus, on the evening of 2021 Nov 23 (See the 2021 BAA *Handbook*, page 56).

Philip Denyer was observing from Hornchurch, London that evening using a *Celestron* C9.25 Schmidt–Cassegrain telescope equipped with a WAT-910HX integrating video camera, when an unusual event was about to unfold. Phil was making a routine observation in the hope of seeing an occultation, which occurs when the light from the star is obstructed by the passage of the asteroid body blocking it for a few seconds. However, it turned out that the star 'blinked' not once but twice.

In his initial communication to the Asteroids & Remote Planets Section (ARPS), Phil wrote:

> *'I obtained a positive result of (212) Medea on November 23rd. I saw on the monitor a dip two seconds before the predicted time for my location. However I did not notice a second dip on the monitor until the light curve was produced using* Tangra *software. [In Table 1] are my times and event details as extracted by visual inspection of the light curve [see Figure 2]. A quick look at the light curve shows the magnitude drop on second D ['disappearance'] appears to be about half the level of the first D.'*

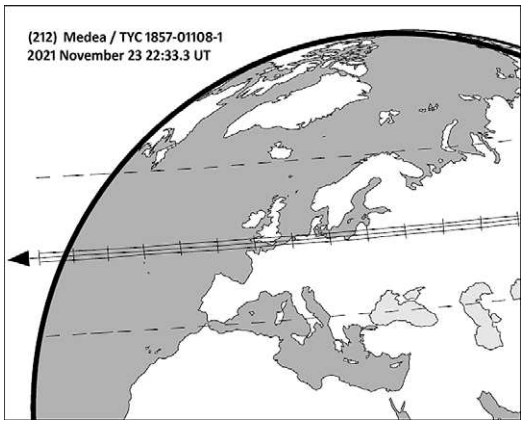


Figure 1. The predicted shadow path for (212) Medea. (*E. Goffin*)

Obtaining a light curve

The ARPS Occultations group recommends the use of video or CMOS cameras to record potentially occulted stars over an interval of a few minutes. The digital recording (in AVI or SER format) should be time-stamped *via* a dedicated GPS receiver or a computer clock carefully synchronised to Universal Time.[2] Event timings can be displayed in *Tangra* and several stars can be selected for comparison purposes.

The recording of this observation involved the use of a WAT-910HX video camera together with a GPSBOXSPRITE3 time-inserter, a USB video digitiser and *VirtualDub* video-capture software.

What does the light curve reveal?

Note that the first D–R event did not totally extinguish the star as would normally be expected: some light remained. Then, the second D–R event exhibited a drop in intensity amounting to about half that of the first step-change in brightness.

The rapidly fluctuating light levels are caused by turbulent seeing conditions in our atmosphere and changes in transparency. Given the short exposure time used, the observed fluctuations are similar to the appearance of stars 'twinkling'. The effect can be smoothed out to a degree by placing the star slightly out of focus.

The observation by Phil is a very clear-cut and dramatic demonstration of each component of the double star passing along separate chords, traversing behind the solid body of the asteroid. Sadly, no other observer has sent in a report of this occultation, either positive or negative. ►

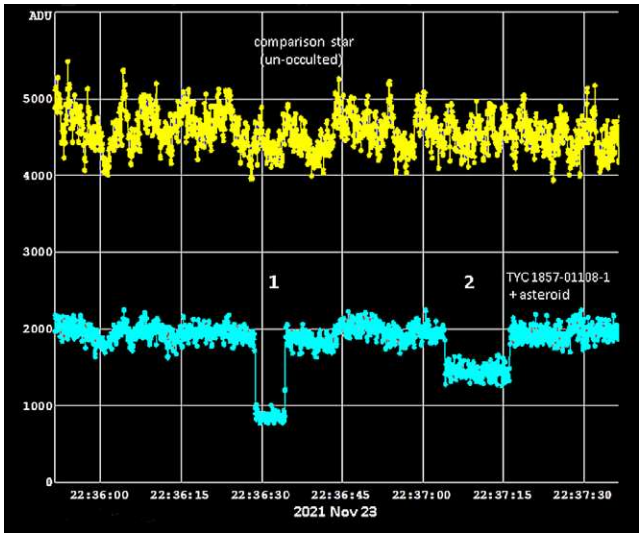


Figure 2. Light curve obtained by the observer using *Tangra* (author: Hristo Pavlov). The yellow trace is the measured intensity of a brighter star used to simultaneously monitor the seeing conditions and transparency. The blue trace is the intensity of the occulted star + asteroid *vs.* time. (*P. Denyer*)

Table 1. Occultation timings, by Philip Denyer

The first D (predicted time 22:36:31 UT; offset error 2s; max. duration 13.7s; mag. drop 2.1) was followed by a gap of 29.72 seconds and then the second D:

	Disapp. (UT)	*Reapp. (UT)*	*Duration (s)*
First D	22.36.28.899	22:36:34.579	5.68
Second D	22:37:04.299	22.37.16.339	12.04

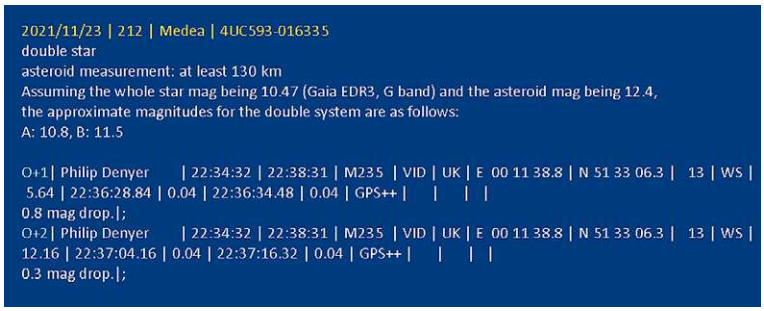


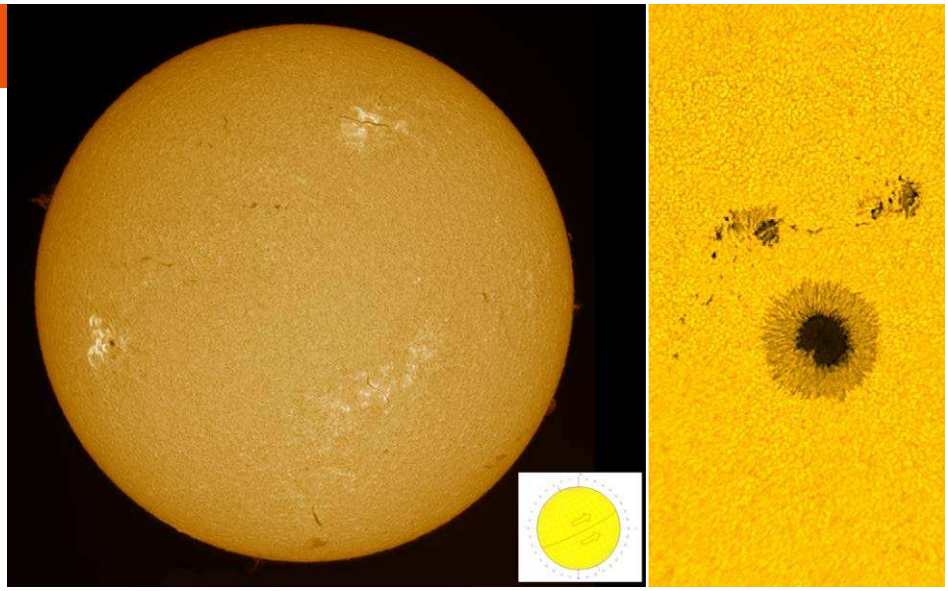
Figure 3. Euraster.net report for the double-star occultation observed by Phil Denyer. (*E. Frappa*)

Solar Section

Lyn Smith
Director

2021 October

Although activity fell compared to the preceding month, it was still relatively high, with the Relative sunspot number (*R*) being the second-highest recorded by the Section since 2017 September. The Quality number also fell, but nevertheless remained at a comparatively high level. Twelve sunspot groups were recorded, with groups being observed on all days of the month except Oct 17, when most observers recorded a blank disc.



Left: **The Sun in H-alpha on 2021 Oct 6 at 09:15 UT, imaged from Preston, Lancashire.** *(Stuart Green)*
Right: **Active Region 2882 on 2021 Oct 9.** *(Brian Halls)*

AR2877 S21°/328° remained on the disc from the previous month but was approaching the SW limb on Oct 1, type Dao. The group then rotated around the limb.

AR2880 N32°/244° also survived on the disc from the previous month, midway across the NE quadrant. The group was bipolar and type Dac, consisting of a penumbral leader and two smaller followers, with an area of around 310 millionths. It crossed the central meridian (CM) during Oct 3/4 and during its passage, several pores were noted between the leader and follower sunspots. The group was last reported on Oct 6, type Axx, in the NW quadrant and approaching the limb.

AR2882 N18°/158° appeared over the NE limb on Oct 4, type Hsx; it was a single penumbral sunspot. This group showed little development as it crossed the disc, but on Oct 6 several pores were noted following the main sunspot, which had an area of 330 millionths. By Oct 9, the trailing sunspots were now located to the north of the main sunspot and it developed into a type-Dko group on Oct 10 & 11, with the total area measuring 360 millionths on Oct 11. By Oct 12, the fringe sunspots had started to fade and rotate to proceed the main sunspot. On Oct 13, only one faint sunspot was seen preceding the main element. The group was last seen on Oct 16, close to the NW limb.

AR2883 N27°/203° was a faint Axx sunspot that formed in the NW quadrant on Oct 10 and was still present on Oct 11, nearing the limb.

AR2884 S20°/170° was another faint Axx-type sunspot that formed in the SW quadrant on Oct 10 and was still present on Oct 11, but faded thereafter.

AR2885 N15°/171° appeared on the disc on Oct 14, close to the NW limb and west of the approaching AR2882.

AR2886 S18°/335° rounded the SE limb on Oct 18. This was another sunspot that showed little development as it crossed the disc, being type Hax for most of its passage and having a maximum area of 180 millionths on Oct 20. The group crossed the CM on Oct 25 and was last seen near the SW limb on Oct 29.

AR2887 S26°/277° appeared over the SE limb on Oct 22 and proved to be the largest and most active group of the month. Although initially a single penumbral sunspot of type Hsx, the group was fully on the disc the following day and comprised of two penumbral sunspots in a roughly east–west alignment, with two smaller penumbral sunspots to the south. A pore was also seen to the north-west of the following penumbral sunspot. Faculae were noted with the group from Oct 22 to Oct 25. On the latter date it was seen to comprise of three penumbral sunspots spread out in latitude, together with many pores. The penumbral areas of both the main leader and follower spots were highly asymmetric, and the group had an area of 520 millionths. Although it reduced in size over subsequent days, it remained a complex Dac group, with changes visible each day. The biggest change occurred between Oct 28 & 30, when there was a reduction in the number of sunspots within the group. It was clearly fading on Oct 31.

AR2888 S15°/253° appeared over the SE limb on Oct 25 as a faint Axx-type group that soon faded on the disc.

AR2889 S25°/248° was preceded by faculae on Oct 25 before the faint sunspot appeared on Oct 26. This developed into a collection of small pores later that day, type Bxo. The group remained Bxo on Oct 27 but faded again the following day, dissolving on the disc.

AR2890 S19°/317° formed on the disc on Oct 26 in the SW quadrant, to the east of AR2886. The group was type Cro but it reduced to type Bxo on Oct 27; it was still evident on Oct 28 but faded from view thereafter.

AR2891 N18°/211° appeared over the NE limb on Oct 27, type Cao, with a penumbral

Asteroids & Remote Planets Section (Occultations): Cont'd

▶ *Reporting*

An extract of a preliminary report on the Euraster website maintained by Eric Frappa is shown in Figure 3 (see previous page).[3] Eric helped with the analysis and he details the magnitude of the stellar components as A: 10.8 and B: 11.5, obtained using the *Python* program *PyOTE*.[4]

Given the motion of the asteroid at the time amounted to 0.47arcsec/min in position angle 265°, we suggest an approximate separation of 0.3 arcseconds between components A and B of the double. Surprisingly, the apparent double star is not included in the *Washington Double Star Catalogue* and could represent a new detection. Further investigation is suggested.

Phil Denyer, Tim Haymes & Richard Miles
Asteroids & Remote Planets Section

1 Prediction: **bit.ly/34ZQt7l**. The star is also known as UCAC4 593-016335.
2 Haymes T., 'Observing asteroid occultations with digital cameras': **britastro.org/node/16423**
3 Euraster: **bit.ly/3qzxMja**
4 *PyOTE* is an occultation timing extraction utility, written by Bob Anderson of the International Occultation Timing Association (IOTA).