

# A New Double Star Detected During an Occultation by the Asteroid 4004 List'ev

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**Abstract:** An occultation of the star UCAC4 250-090193 by a small asteroid found this star to be a previously unknown double star.

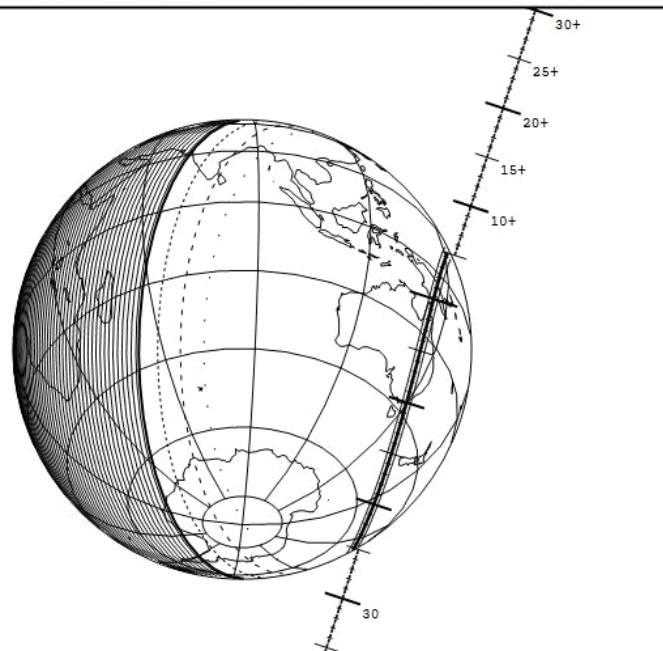
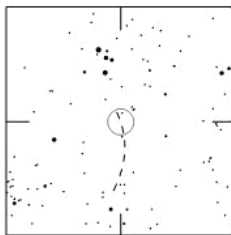
## Circumstances

On August 3, 2019 the path of an occultation of the star UCAC4 250-090193 by the asteroid (4004) List'ev was predicted to pass near the author's observatory near Canberra, Australia. The star's BCRS coordinates are

16h 19m 32.16s,  $-40^{\circ} 3' 30.4''$ . The predicted path is shown in Figure 1.

The asteroid is relatively small for occultation events. It has three diameter measurements from the NEOWISE project, with diameters of 24.7,  $19.7 \pm 5.0$ ,

<b>4004 List'ev occults UCAC4 250-090193 on 2019 Aug 3 from 13h 35m to 14h 5m UT</b>		
Star:	Max Duration = 4.8 secs	Asteroid:
Mag V = 13.3; B = 14.8; R = 12.5	Mag Drop = 4.0 (4.4r)	Mag = 17.3
RA = 16 19 32.1619 (BCRS)	Sun : Dist = 117°	Dia = 23km, 0.013"
Dec = -40 3 30.413	Moon: Dist = 86°	Parallax = 3.570"
[of Date: 16 20 52, -40 6 18]	: illum = 9 %	Hourly dRA = 0.262s
Prediction of 2019 Jul 31.0	E 0.057"x 0.057" in PA 90	dDec = 9.14"



Occult 46122.

Figure 1. Predicted occultation path

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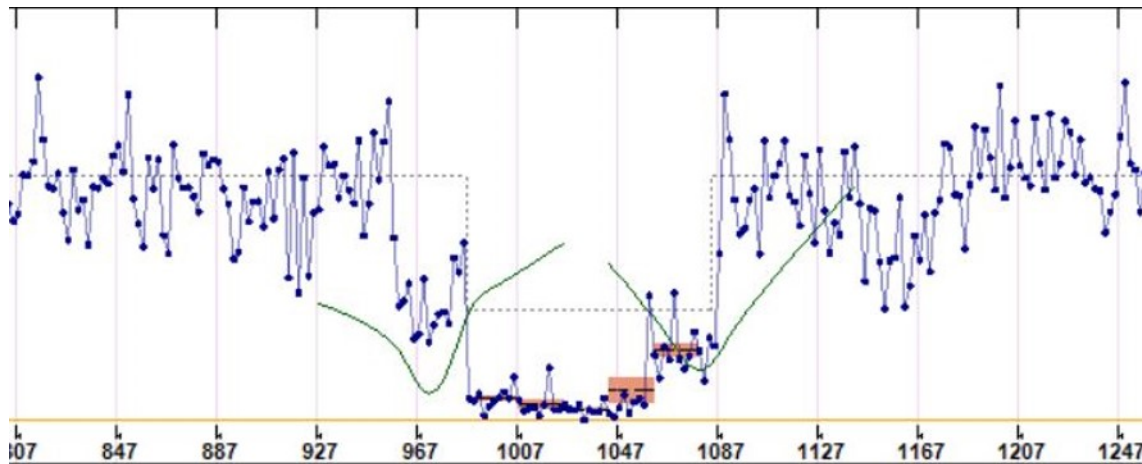


Figure 2. Recorded light curve

and  $16.5 \pm 4.0$  km. The reduction process assumed a nominal diameter of 23 km, which equates to an angular diameter of 13.0 mas. Its rate of motion in the sky was 2.6 mas/second.

The recorded light curve is shown in Figure 2.

The light curve shows intermediate steps at both the start and end of the occultation. The light drop from the intermediate step to the bottom level at the start is considerably greater than the corresponding rise at the end. This indicates the sequence of occultation events was B-A-B-A.

Measurements of the durations of the occultation events showed that component B was occulted for  $4.04 \text{ secs} \pm 0.05 \text{ sec}$ , while component A was occulted for  $4.02 \pm 0.07 \text{ sec}$ .

Assuming the asteroid is circular (a big assumption for a small asteroid!) there are four solutions for the Separation and Position Angle. They are:

Soln	Sep (mas)	P.A.
#1	$3.2 \pm 0.4$	$194.7^\circ \pm 11.3^\circ$
#2	$7.2 \pm 0.6$	$131.6^\circ \pm 3.4^\circ$
#3	$3.2 \pm 0.4$	$196.2^\circ \pm 11.4^\circ$
#4	$7.2 \pm 0.6$	$259.3^\circ \pm 3.4^\circ$

Figures 3 to 6 are plots for each of these solutions against the circular outline of the asteroid.

**Magnitudes**

There is some concern about the degree of linearity in the light curve. For that reason it is appropriate to compare the change in light levels from the minimum level to the intermediate levels at the start and end. This provides light changes for the A component at the start, and the B component at the end. Taking the change in light level at the end being 10 units, the change at the beginning is about 15 units. Taking these changes as being the light contributions of each component, we get a total light total light of 25 units. Using the standard mathematical relationships for magnitudes of systems, this leads to the conclusion that the A component is 0.5 mags fainter than the total magnitude, while the B component is 1.0 mags fainter.

The star is UCAC4 250-090193 = Gaia DR2 5993965549837237248. The Gaia G magnitude is 13.25. From this I conclude that the G (or V) magnitudes of the two components are 13.7 and 14.2.

**Spatial Separation**

Gaia gives the parallax of this star as 0.9852 mas.

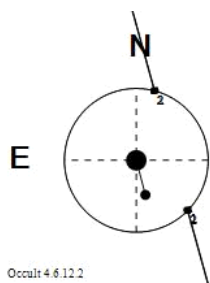


Figure 3

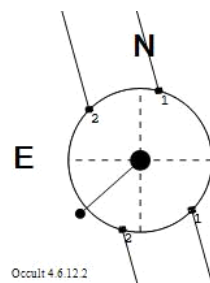


Figure 4

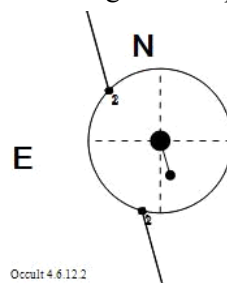


Figure 5

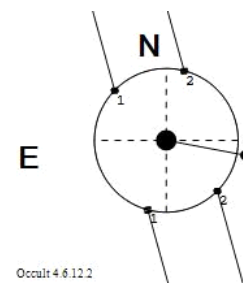


Figure 6

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Name	RA+Dec	Mags	PA	Sep	Date	N	Note
xxxxxxx	161932-4004	13.7 14.2	195	0.0032	2019.592	1	Soln 1
xxxxxxx	161932-4004	13.7 14.2	132	0.0072	2019.592	1	Soln 2
xxxxxxx	161932-4004	13.7 14.2	259	0.0072	2019.592	1	Soln 3

*Table 1. Three possible solutions for the double star*

Accordingly the measured separations of 7.2mas and 3.2mas correspond to projected separations at the distance of the star of 7.3 AU and 3.3 AU.

#### Summary

The 13th magnitude star UCAC4 250-090193 is a close double star with a projected component separation of either 3 or 7 AU. Solutions 1 and 3 are essentially redundant, leaving the three possible solutions shown in Table 1.

