

ADDITIONAL OBSERVATIONS OF (617) PATROCLUS-MENOETIUS MUTUAL EVENTS

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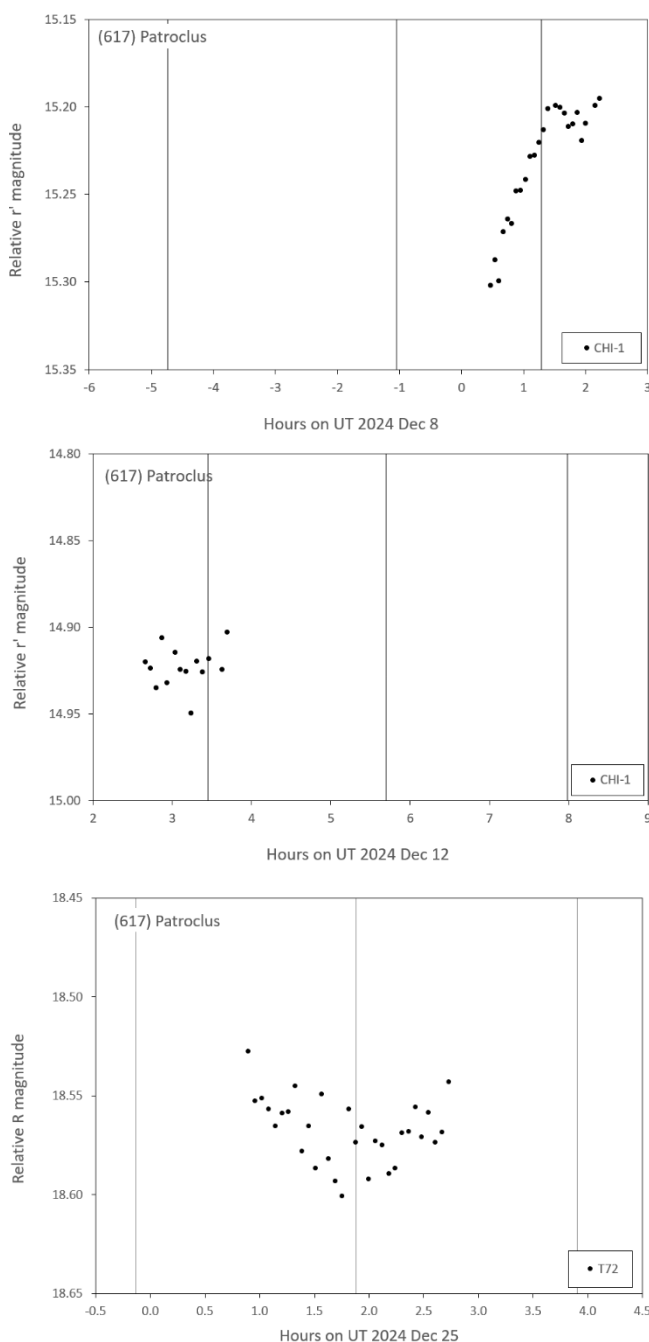
We present lightcurves of mutual events of the L5 binary trojan (617) Patroclus and its companion Menoetius on three nights in Dec 2024.

The binary trojan asteroid pair (617) Patroclus and its slightly smaller satellite Menoetius are the principal targets of study of NASA's Lucy Mission when it arrives at Jupiter's L₅ swarm in 2033. Both the spacecraft trajectory and the pointing of its instruments must be precisely programmed in advance, which requires an accurate dynamical model of the binary system. In response to an observing call (Binzel, 2024) we observed several mutual events of the Patroclus-Menoetius binary near their opposition (Wilkin et al., 2024). Although the observing geometry near opposition was more favorable for long observing sessions, the mutual events predicted by Brozović et al. (2024) continued until mid-January 2025, and the later, partial events may provide tight constraints on the binary's geometry despite the less favorable viewing geometry late in the season.

Observational planning used predicted start, maximum, and end times made available by Brozović et al. (2024), and we have reproduced their predictions in Table I for the three nights on which we obtained usable images. Telescopes and cameras are described in Table II. The telescopes CHI-1 and T72 are operated by Telescope.Live and iTelescope.net, respectively. Filters and telescopes used for individual nights are given in the lightcurve figures. All images were processed for bias, dark, and flat field corrections. We extracted photometric measurements from the images using *AstroImageJ* (Collins et al., 2017). The predicted ingress, maximum depth, and egress times are indicated in the lightcurve figures by vertical lines. No light travel time corrections were applied.

On Dec 8 we captured the egress of the event that began on Dec 7. The Dec 12 observation ended at about the predicted ingress time, and appears to be pre-ingress baseline only. Finally, our Dec 25 observation apparently captured the maximum occultation for the event that began on Dec 24. All three of the events were inferior, when the disk or shadow of Menoetius is partially contained within the visible disk of Patroclus. Further analysis of our results will be done in combination with additional observations contributed by

other observers to obtain updated solutions for the physical parameters of the Patroclus-Menoetius system.



Start Date (UTC)	Start	Event Max	Stop	Events	Observation coverage
2024 12 07	19:16	22:57	25:17	PE, PO	Egress
2024 12 12	03:27	05:42	07:59	PO	Pre-Ingress Baseline
2024 12 24	23:52	25:53	27:54	PO	Maximum depth, In-transit-only

Table I. Mutual Events Season 2024. The first column indicates inferior (I) or superior (S) event and sequence number. Columns 3-5 give the predictions of Brozović et al. (2024). In column 6, possible events include: PO--Partial Occultation, PE--Partial Eclipse.

Name	Site	Telescope	Camera	Array	Filter	FOV (')	Scale ("/pix)
CHI-1	Rio Hurtado, Chile	0.61-m f/6.8	QHY 600M Pro	9576×6382×3.8μm	r'	31×21	0.395
T72	Rio Hurtado, Chile	0.50-m f/6.8	FLI ML16200	4500×3600 ×6μm	R	27×22	0.359

Table II. Telescopes and Cameras. Filters: R: Cousins R; r': Sloan r'.

Acknowledgements

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References

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TWO MUTUAL EVENTS OBSERVED FOR PATROCLUS-MENOETIUS BINARY SYSTEM

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Two mutual events were observed for 617 Patroclus-Menoetius synchronous binary system in 2024 October in order to contribute to refine the physical parameters of the system, in view of the NASA’s Lucy fly-by mission, expected in year 2033.

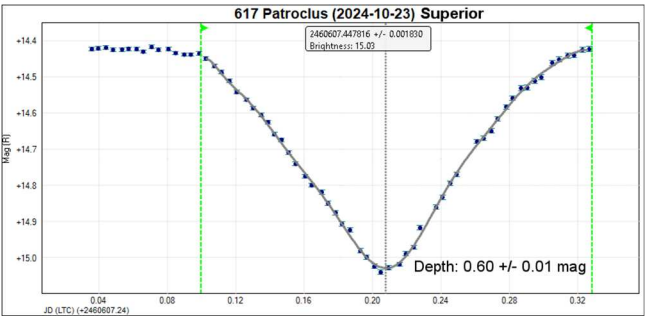
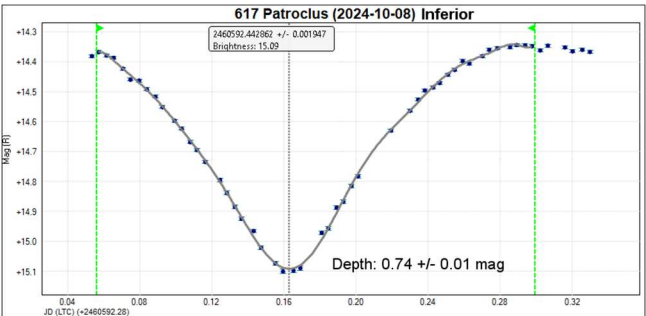
To respond to the “Call for Observations” by Binzel (2024), CCD observations of the Trojan binary asteroid 617 Patroclus-Menoetius were carried out in 2024 October 8 and 23 at the Schiaparelli Southern Observatory (Hakos Farm, Namibia, MPC code M21). We used a 0.36-m f/8.8 Ritchey-Chretien telescope, CCD Finger Lakes ProLine KAF16803 (bin 3×3), 300 second exposure time, clear filter.

Photometric data reduction was performed with *MPO Canopus* (Warner, 2023). All data were converted to R band, using solar colored field star from CMC15 catalogue. These data are being archived to the asteroid lightcurve data base (LCDB). Time of the minima at the mid-eclipse were measured with Peranso (Paunzen and Vanmunster 2016) applying the correction for light time and using the “Lightcurve Workbench” function with a polynomial fit of order 15. The magnitude depth of the minima events were evaluated as the difference from the flat portion of the lightcurve and the fit minimum.

#	Time of Minimum JD (LTC) Date (UTC)	Depth Mag	Event Type
1	2460592.4429 ± 0.0019 2024-10-08 22:38	0.74 ± 0.01	Inferior
2	2460607.4478 ± 0.0018 2024-10-23 22:45	0.60 ± 0.01	Superior

Table 1. Measured time (LTC) of minima at the mid-eclipse for the observed mutual events.

We found the time of minima at the mid-eclipse for two mutual events, as reported on Table 1. The drop of the secondary eclipse, 0.60 ± 0.01 , gives a lower limit on the secondary-to-primary mean diameter ratio D_s/D_p of 0.86 ± 0.02 .



References

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