V2331 Cygni is an Algol Variable With Deep Eclipses

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Abstract We report the discovery that V2331 Cygni is not an L star but an eclipsing variable with deep minima, and present a determination of the elements of the star: Epoch = HJD 2456184.296 ±0.001 and Period = 1.3886 ± 0.0001 days.

1. Discovery

V2331 Cygni (R.A. $21^h\ 11^m\ 13.60^s$ Dec. +34° 19' 14.3") was discovered to be a variable star by Dahlmark during a systematic photographic search for new variables (Dahlmark 2001). The star, originally named LD391, was determined by Dahlmark to be a slow irregular variable, and it was classified type L when it entered the *General Catalogue of Variable Stars* (GCVS; Samus *et al.* 2013) as V2331 Cyg (Samus *et al.* 2007–2012; Kazarovets *et al.* 2003). Since then, few observers appear to have been interested in the object.

The star is close to the Mira star V2330 Cyg, which is on a program organized by SAAF/V (the variable star section of the Swedish Amateur Astronomy Association) to study fifty underobserved Miras. During the monitoring of V2330 Cyg, sudden dips in the brightness of nearby V2331 Cyg were noted on August 21 and September 4, 2012. Incompatible with the normal behavior of an L star, could these two dips be indications of V2331 Cyg being of another type?

A period of intense observations of V2331 Cyg followed, the results of which are given in this paper.

2. Observations and elements

When it became apparent that this star was an eclipsing variable and the first preliminary elements of its variations were determined, it became possible to do time-series observations around the predicted time of minimum. Three such time-series observations were made during the autumn and winter of 2012. In addition, five time-series and seventy-three individual observations were made at phases outside of primary eclipse, in order to give a picture of the full light curve. Thus, a small secondary minimum was uncovered. All in all, 1,157 observations were made. The methods used were B-, V-, and R-filtered CCD observations, on local as well as remote telescopes, and DSLR observations reduced to V. The observations are available for downloading from the SAAF/V database at http://var.astronet.se/obsar_export.php?exporttype=csv&search_fd1=v2331+cyg%25 (comma-separated file format).

The mean BVR magnitudes of the system outside of eclipse were found, by analysis of observations at phases 0.1–0.4 and 0.6–0.9, to be as shown in Table 1.

The depth of the primary minimum, in V, is 2.5 magnitudes and the secondary minimum is 0.15. The duration of the eclipse is 0.15 of the period. The V observations were analysed using PERANSO (Vanmunster 2005, methods: Lafler-Kinman and Dworetsky) and the elements for the light variations determined are:

Epoch: HJD 2456184.296 ± 0.001

Period: 1.3886 ± 0.0001 d

3. Acknowledgements

It is a pleasure to acknowledge the support of the AAVSO charts and sequences team in providing sequences of comparison stars for the program of observing fifty neglected Mira stars. This research has made use of the SIMBAD database,operated at CDS, Strasbourg, France. Remote observations were performed using the Bradford Robotic Telescope, the iTelescope network, and the Sierra Stars Observatory.

References

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Vanmunster, T. 2005, PERANSO period analysis software (www.peranso.com).

Table 1. Mean magnitudes of V2331 Cyg outside of eclipse.

Color	*Magnitude*	*Standard Error*
V	13.422	±0.002
B	13.857	±0.006
R	13.177	±0.003
B–V	0.435	—
V–R	0.245	—

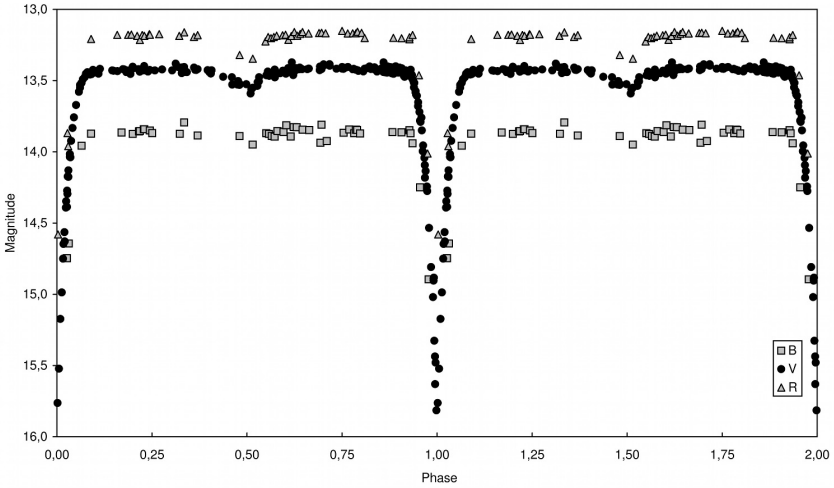

Figure 1. V2331 Cyg light curve folded according to the elements given in the text. Time-series observations during minima are here represented as averages of every fifth observation.