HDE 341703 – A new eclipsing binary star in Hercules

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The suspected variable star HDE 341703 (= TASV 1809+23) has been found to be an eclipsing binary with a period of 8.4678 days.

Introduction

The variability of HDE 341703, an 11th-magnitude star in the constellation of Hercules, was first noticed by Mike Collins of Sandy in Bedfordshire, who found it half a magnitude fainter than normal on two nova-patrol photographs exposed on the night of 1989 June 4/5. The discovery was announced in *The Astronomer*[1] where the star was also given the suspected variable star designation TASV 1809+23.

Collins' photographs showed the star to have been faint on only one night out of the six nights on which photographs had been taken. This strongly suggested that the star was an eclipsing binary as most other types of variable star are most often found either near the middle of their ranges or else towards their faint ends. However, to confirm that it was an eclipsing binary, it was first necessary to identify the period of the star's variations, if indeed they were periodic.

Observations

With this in mind, the writer started to make visual estimates of the brightness of HDE 341703 using a 200mm reflector. The comparison stars that he used are shown in Figure 1.

The variability was confirmed quite soon. On the first three observing nights, 1989 August 12, 17 and 18, the star appeared more or less constant at 10.7 mag, but on August 19 it was seen to fade from 10.9 mag at 08.35 GMAT to 11.4 mag at 13:25. By 08.09 on the following evening it was back again to 10.7 mag.

The writer continued to make observations of HDE 341703 at every opportunity and by 1989 November 27 he had made 155 estimates on 45 nights. The star had been seen faint on three further occasions: 1989 August 28, September 5 and September 22.

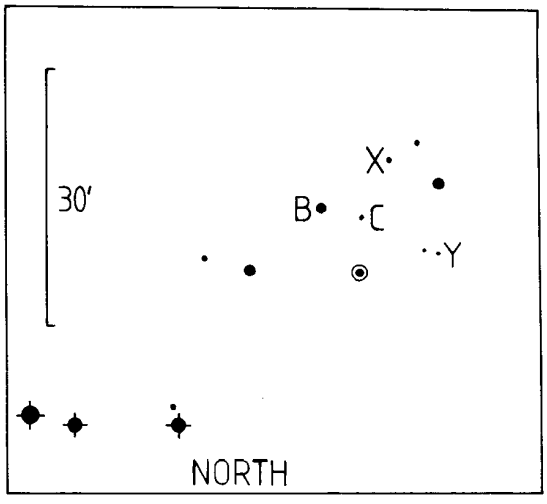

Figure 1. Field chart for HDE 341703 (1950.0 18h 09m 28s, +23° 54.5'). The following comparison star magnitudes are based on visual estimates and, hence, are only approximate: B = 10.4; X = 11.0; C = 11.2; Y = 11.6.

Identification of the period

So, including the fade recorded by Collins, by the end of 1989 five approximate heliocentric times of minimum were available for use in identifying the period. These were:

JD 2447682.5
758.6
767.3
775.5
792.3

The successive intervals between these times are 76.1, 8.7, 8.2 and 16.8 days which suggests a cycle of about 8.5 days. This approximate value was then made more precise by comparing observations covering the two well-observed fades seen on August 19 and September 5. These can be superimposed by either adding 16.906 ± 0.030 days to the times of the former or by subtracting the same value from the times of the latter. As the 16.906 days corresponds to two of the approximately 8.5-day cycles, the more precise value was found to be 8.453 ± 0.015 days.

A preliminary light-curve was then constructed by phase-folding all of the 1989 observations on the 8.453-day cycle. This light-curve confirmed, firstly, that this value for the cycle was the true period and not a whole-number multiple of it and, secondly, that the star was a fairly typical eclipsing binary showing both primary and secondary eclipses. A preliminary report announcing this was published in *The Astronomer*.[2]

Refinement of the period

It was clear to the writer that the above value for the period would not be accurate enough to provide reliable predictions for times of eclipse more than a few months ahead. So, the following year, he made a further 23 observations of HDE 341703 on 7 nights between 1990 July 28 and November 3. These showed that eclipses were then occurring nearly one day later then predicted by the 8.453-day period.

A new value for the period was determined by comparing observations of two fades on 1989 August 19 and 1990 October 8. These were separated by 414.920 ± 0.030 days which corresponds to 49 cycles so the period must be 8.4678 ± 0.0006 days.

Discussion

Figure 2 shows the result of using the 8.4678-day period to plot all of the available observations against phase. The light-curve is clearly that of an eclipsing binary. At maximum the star is more or less constant at $10^m.7$ and so it most probably belongs to the Algol-type subclass. The duration of primary eclipse, expressed as a fraction of the period, is about 0.15. Although neither primary nor secondary eclipse are completely covered by the observations, it is clear that primary eclipse must be at least $0^m.7$ deep and secondary, at least $0^m.15$ deep.

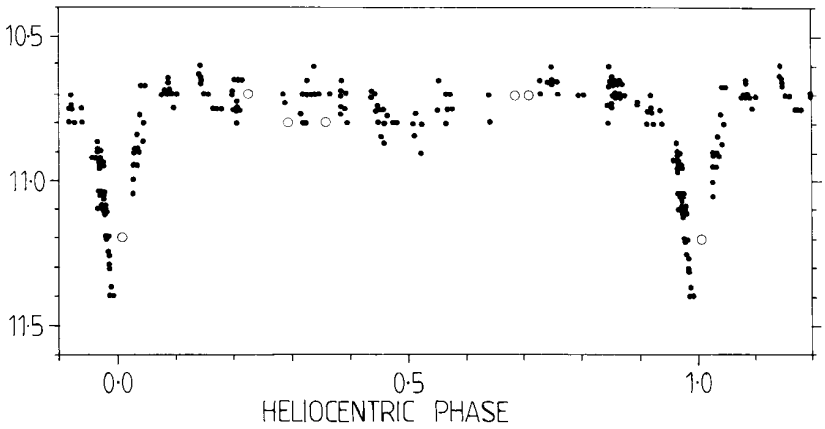

Figure 2. All of the available observations of HDE 341703 from 1989 and 1990 phase-folded on the 8.4678-day period. Zero phase corresponds to JD 2447758.67. The black dots are visual magnitudes determined by the writer. The open circles are approximately-photovisual magnitudes determined by Collins. The latter have each been adjusted by the addition of $0^m.2$ to correct for a systematic difference between them and the visual magnitudes. This difference probably results from the different spectral responses of the writer's eye and Collins' photographic film.

More observations of HDE 341703 are needed to further refine the period and to determine the depths of the eclipses. For the next few years, eclipses can be predicted by the elements:

$$\text{Min I} = \text{JD Hel. } 2447758.67 + 8.4678 \times E$$
$$(\pm 0.01)\ (\pm 0.0006)$$

The figures in parentheses are estimated errors.

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References

1 Collins, M., *The Astronomer*, **26**, No 303, 51 (1989).
2 Brelstaff, T., *The Astronomer*, **26**, No 310, 216–17 (1990).

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