THE HIPPARCOS VARIABLE V779 CASSIOPEIA

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1. Introduction

The star HIP 09494 (HD 12013; α_{2000} = 02h 02m 09.3s; δ_{2000} = +75° 30' 08"), spectral type A0, has been discovered as a variable star by the Hipparcos space mission (ESA, 1997). In January 1999 it has been included in the General Catalogue of Variable Stars with the name of V779 CAS. The GCVS catalogue indicates the following magnitude at Max. Hp = 6.59 and at Min. Hp = 6.65 even if satellite observations show a partial minima at magn. Hp = 7.06 with an amplitude of Hp = 0.47 magn. The star is not yet classified with certainty but it is supposed to be an EA eclipsing binary of unknown period.

In order to determine its period and confirm the status as an eclipsing binary, we decided in 2000 to place V779 CAS on the Variable Section program of the Coordinamento delle Associazioni Astrofili della Toscana (CAAT). In 2001 V779 CAS has been placed in the GEOS "prospection" program as well.

2. Observations

Fig. 1 shows the chart drawn by S. Foglia and used for the visual observations. The chart displays the field of the variable with its comparison stars indicated by the letters A, B, C, D, E which magnitude reported in tab. 1 is calculated using the Tycho catalogue data (V_T).

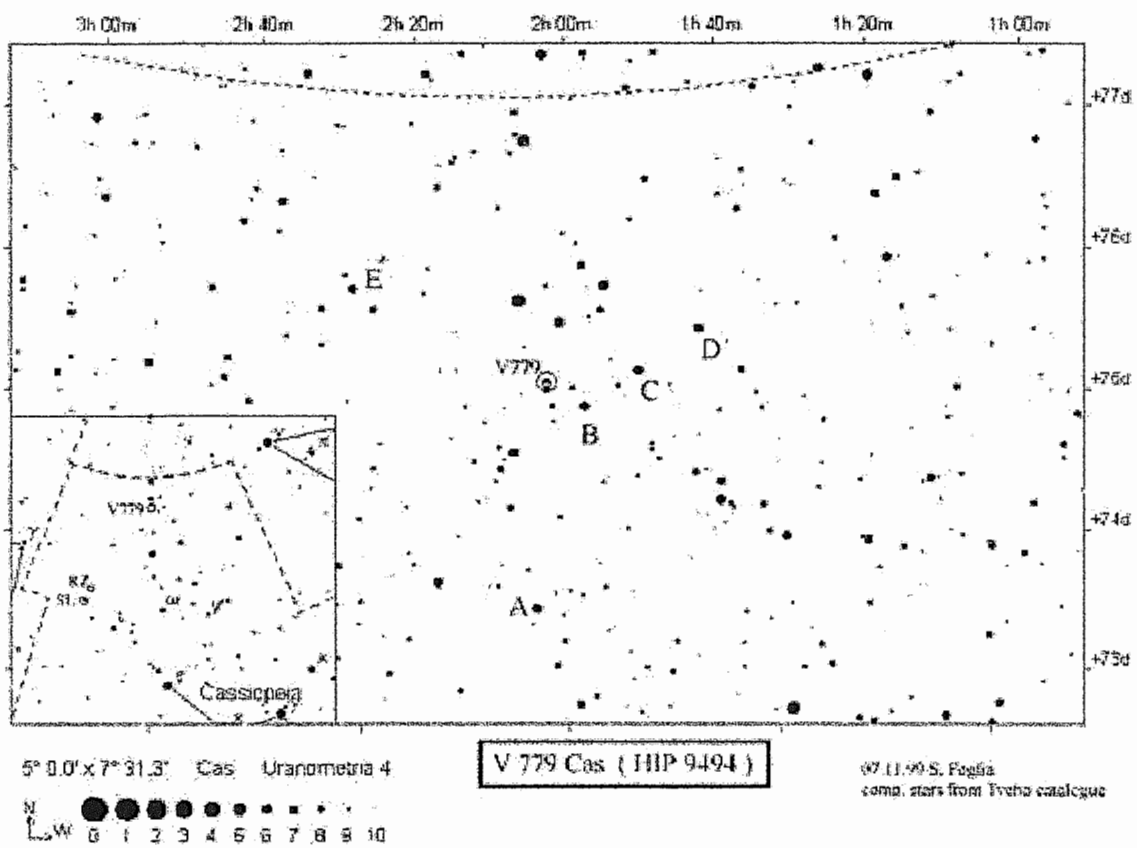

Fig. 1. V779 Cas, identification chart.

Star	Designation	Magnitude (V_T)	Spectral type
A	HIP 9586	6.18	A5
B	HIP 9147	6.62	G5
C	HIP 8690	6.94	F5
D	HIP 8145	7.26	F0
E	HIP 11252	7.62	A0

Tab. 1. Comparison stars used for visual estimate.

The star was visually monitored from November 1999 to February 2003 (between JD 2451490 and JD 2452690) by three observers who gathered 603 estimates: M. Checcucci (419), S. Foglia (100) and S. Leonini (84) using their binoculars 20x80, 20x80 and 11x80. Moreover, in the night of JD 2452652, G. Galli collected 55 CCD measurements of unfiltered differential photometry using a 0.13-m refractor telescope (F/6.4) equipped with a SBIG ST7-E ABG camera.
PPM 4879 (SAO 4551, $V_T = 8^m.83$, B-V = 0.856, spectrum K5) was chosen as comparison star and PPM 4861 (SAO 4537, $V_T = 8^m.93$, B-V = 0.402, spectrum F2) as a check star, both shoot in the same frame of V779 CAS. All CCD exposures were dark-subtracted and flat-fielded before differential photometry was performed using AIP4Win software (Berry & Burnell, 2000). No correction for differential atmospheric extinction was applied due to the proximity of the comparison star to the variable.

3. Determination of the minima and period research

During the observing campaign, between JD 2452150 and JD 2452262, M. Checcucci was able to observe three minima of the star that have been then analysed with a software used for periodicity searching for a data set called PDM (Stellingwerf, 1978). The research performed between a resolution of 0.1 and 50 days, shows different probable periods, the most reliable of which is 6.3561155 days, also confirmed by following observations.

Among the total of the observations it was possible to obtain eight time of primary minima using different methods, depending on the nature of the data set, denominated AVALON, IPPNET, TARANIS, TINTAGEL and SOP5 (Gaspani, 1995, 1996, 1995, 1995, 1994) all dedicated to the search for the extremum in a set of data using artificial neural networks algorithms and stochastic optimization programs.

At the times of minimum, expressed in heliocentric time and resulting from the most precise extreme algorithm, it has been assigned weight 1 for visual observations and weight 3 for CCD measurements. In order to compute the best ephemeris of the star, a linear regression was applied:

$$\textbf{Min. I} = \textbf{HJD } 2452144.042799 + 6^d.3533975 \times E \qquad (1)$$
$$\pm\, 0.005493 \quad \pm\, 0.0001657$$

(error range at 95% of confidence)

Tab. 2 shows the minima collected, the error, the number of the cycles, the O-C between the time observed and the time calculated on the basis of the ephemeris, the name of the observer and the research method.

The O-C standard deviation is equal to $\sigma = 0.0071^d$ and we can note that no minimum is over $\pm 3\,\sigma$, limit usually used in statistics for the random errors.

HJD 2400000 +	Error (JD)	Cycle	O-C	Observer	Method
52150.3859833	± 0.0000013	1	- 0.0102	Checcucci	visual
52201.2315500	± 0.0045608	9	+0.0082	Checcucci	visual
52220.2860101	± 0.0007620	12	+0.0024	Checcucci	visual
52544.3069262	± 0.0019326	63	+0.0001	Checcucci	visual
52652.3064778	± 0.0008088	80	- 0.0081	Leonini	visual
52652.3139475	± 0.0015481	80	- 0.0007	Checcucci	visual
52652.3206689	± 0.0010704	80	+0.0061	Galli	CCD, no filter
52690.4250692	± 0.0007432	86	- 0.0099	Leonini	visual

Tab. 2. V779 Cas, times of primary minimum.

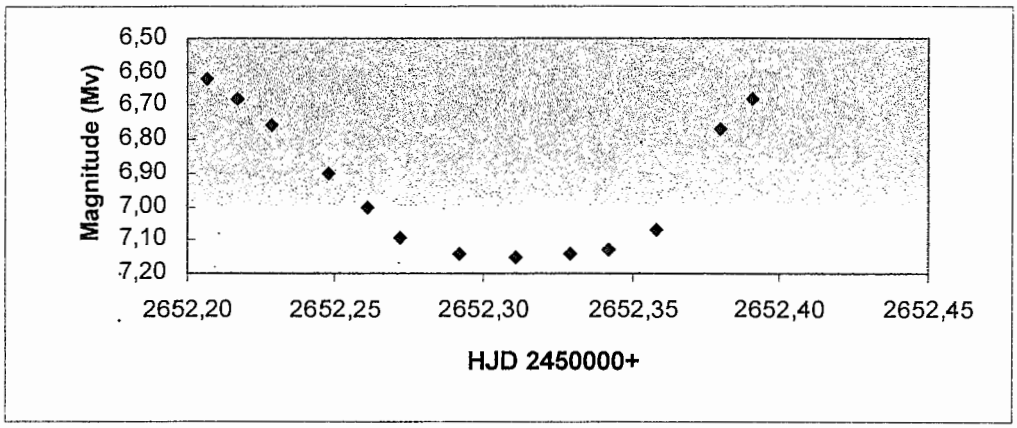

Fig. 2. V779 Cas, visual light curve of an eclipse (M. Checcucci).

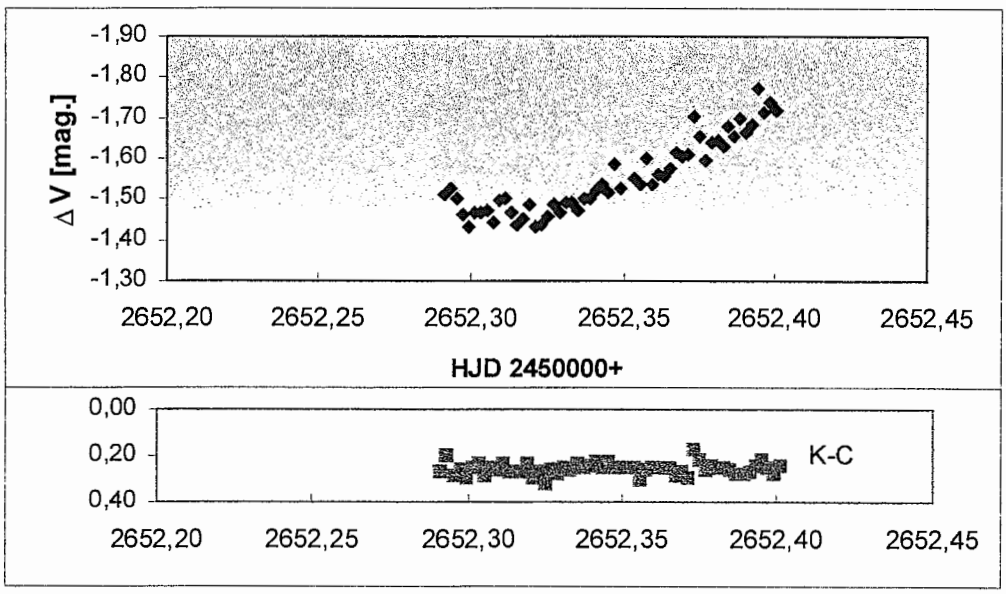

Fig. 3. V779 Cas, unfiltered CCD light curve (G. Galli). Lower panel shows the difference in magnitude between the check (K) and the comparison (C) star.

4. Conclusions

The light curves analysis suggests that V779 CAS is an eclipsing star of the Algol type with medium period; the classification supposed by the GCVS is therefore correct.

The orbital period given by the ephemeris (1) is well compatible with the photometric data of the only minimum, even if incomplete, observed by the Hipparcos satellite on JD 2448027.

The duration of the eclipse is about 0.18 period fraction (4.5 hours); the amplitude observed is 0.53 magn. but photoelectric or multicolour CCD measurements will have to confirm this result.

5. Acknowledgements

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6. References

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