PRELIMINARY ORBITAL ELEMENTS FOR SOME CLOSE BINARIES - PHOTOGRAPHIC SOLUTION -

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INTRODUCTION

Since 1948 for more than 25 years, at the Vatican Observatory of Castel Gandolfo (Italy), Walter J. Miller S.J. and A.A. Wachmann planned the photographic discovery and the study of faint Milky Way variables with a particular attention to the Cygnus, Cepheus and Lacerta zones.
The result was hundreds of plates (Lambda 4250 Angstrom) and hundreds of new variable stars. Moreover, in order to complete their work, Miller and Wachmann, used, for some variables, also old Harvard plates.
About the used procedures one can find further details in Ricerche Astronomiche, Vol.1, N.11 [1] and in Ricerche Astronomiche, Vol. 2, N. 7 [2].
The found new variables were named VV (Vatican Variable) and a progressive number.

MOTIVATION

The purpose of this work is the preliminary determination of the orbital elements of some close binaries and, at the same time, to recall attention to some neglected variable stars.
In fact we propose the photographic solution because we have used the only observations available for these stars, and they are the original photographic ones.
The data series (normal points) have been integrally adopted from the original papers of the discovery and the variables considered in this work are:

V906 Cyg = VV 127
NY Lyr = VV 133
HR Lac = VV 309
LU Lac = VV 374
V344 Lac = VV 462

for these five stars we were able to determinate the orbital elements while, for other variable stars, the poor quality of the data made impossible their determination, these variables are:

QU Lyr = VV 125 , V979 Cyg = VV 129 , V401 Lyr = VV 224 , V342 Lac = VV 455.

Instead, the orbital solution for the star V1256 Cyg = VV 228 will be published in the Proceedings of the "30° Conference on Variable Stars Research" ,held in 1998 at the Hvezdarna a Planetarium Mikulase Kopernika, CZ.[3]
The procedure of the work was standard for all the stars; for the determination of the orbital parameters we used the Binary Maker software [4].

STAR LIST

VV 127 = V906 Cyg is classified in the G.C.V.S. IV ed. [5] as eclipsing binary star of EW/KW type with range of variation between 14,9 - 15,7 mag ph. Secondary minimum at 15.7 mag ph. and period P = 0.365166713d. No spectrum is known and no more bibliography is available.
The non-spot model was not able to represent the features of V906 Cyg's light curve (O'Connel effect), therefore we found that the good fit of it, was reached adding one dark spot on the surface of the primary component.

The data of the best fit are:
q = 0.850 ± 0.048
f = 0.407 ± 0.098
R1 mean = 0.430 ± 0.018
R2 mean = 0.402 ± 0.017
L1 = 0.517 ± 0.041
L2 = 0.483 ± 0.041
i = 81° ± 1.1°
T2/T1 = 1.004

And the spot parameters are:
Co-Latitude = 90°
Longitude = 320°
Spot Radius = 20°
Temperature Factor = 0.5

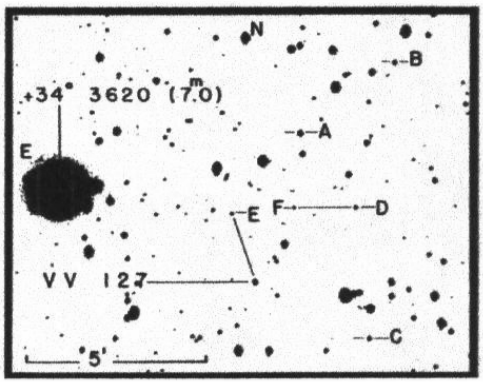
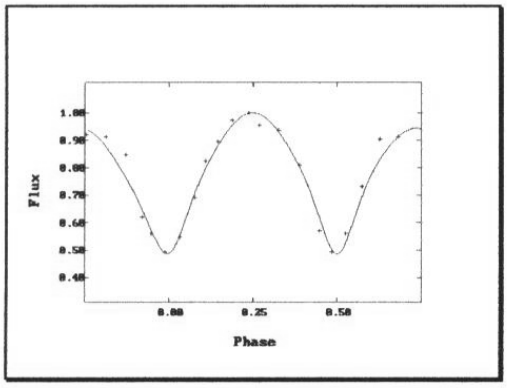


Fig. 1 – Finder chart for V906 Cyg from the original paper.



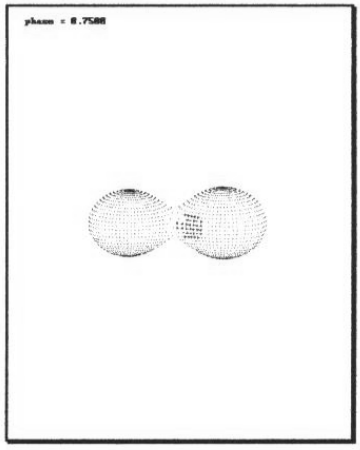


Fig.2 – (left) Output light curve from Binary Maker (example model) superimposed to the unfiltered normal points for V906 Cyg. Fig.3 (right) – Three-dimensional model of the system at phase 0,75. A spot is visible on the primary component.

VV 133 = NY Lyr was discovered by Morgenroth [10] who suggested a period of 0.22d. The star is classified in the G.C.V.S. IV ed. [5] as eclipsing binary of EW/KW type with range of variation between 12,7 - 13,2 mag ph. Secondary minimum at 13.1 mag ph. and period P = 0.44079534d. No spectrum is known and no more bibliography is available.
Some instants of minima, generally visual, can be find in literature. The non-spot model was not able to represent the features of NY Lyr's light curve (O'Connel effect), therefore we found that the good fit of it, was reached adding one dark spot on the surface of the secondary component.

The data of the best fit are:
q = 0.741 ± 0.046
f = 0.270 ± 0.094
R1 mean = 0.427 ± 0.019
R2 mean = 0.375 ± 0.017
L1 = 0.696 ± 0.040
L2 = 0.304 ± 0.040
i = 68° ± 1.1°
T2/T1 = 0.865

And the spot parameters are:
Co-Latitude = 90°
Longitude = 219°
Spot Radius = 14°
Temperature Factor = 1.5

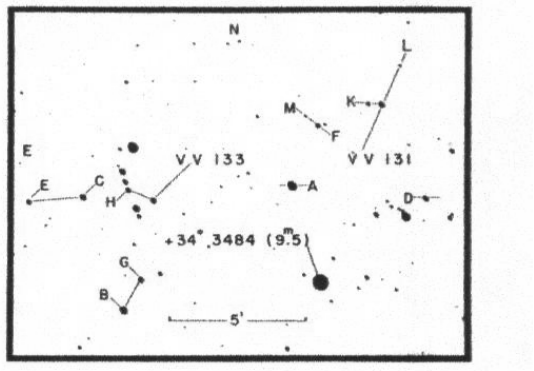
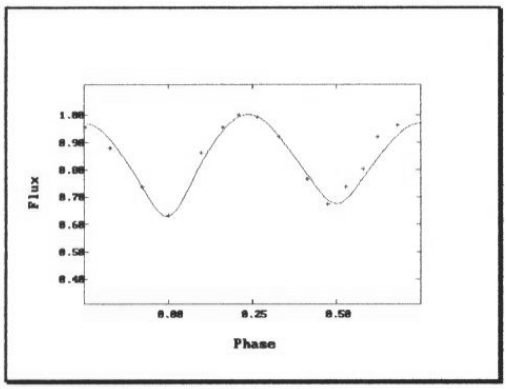


Fig. 4 – Finder chart for NY Lyr from the original paper.



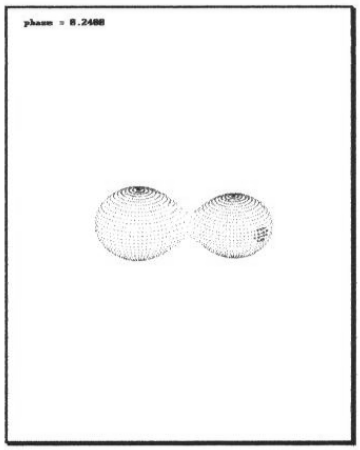


Fig.5 – (left) Output light curve from Binary Maker (example model) superimposed to the unfiltered normal points for NY Lyr. Fig.6 (right) – Three-dimensional model of the system at phase 0,24. A spot is visible on the secondary component.

VV 309 was named HR Lac in the 58th Name List of Variable Stars [6] and is classified in the G.C.V.S. IV ed. [5] as eclipsing binary star of EW/KW type with range of variation between 13,9 - 14,4 mag ph.

Secondary minimum at 14.3 mag ph. and period P = 0.4290721d. No spectrum is known and no more bibliography is available.

The data of the best fit are:
q = 0.535 ± 0.016
f = 0.373 ± 0.032
R1 mean = 0.462 ± 0.007
R2 mean = 0.354 ± 0.005
L1 = 0.655 ± 0.013
L2 = 0.345 ±0.013
i = 68° ± 0.4°
T2/T1 = 0.984

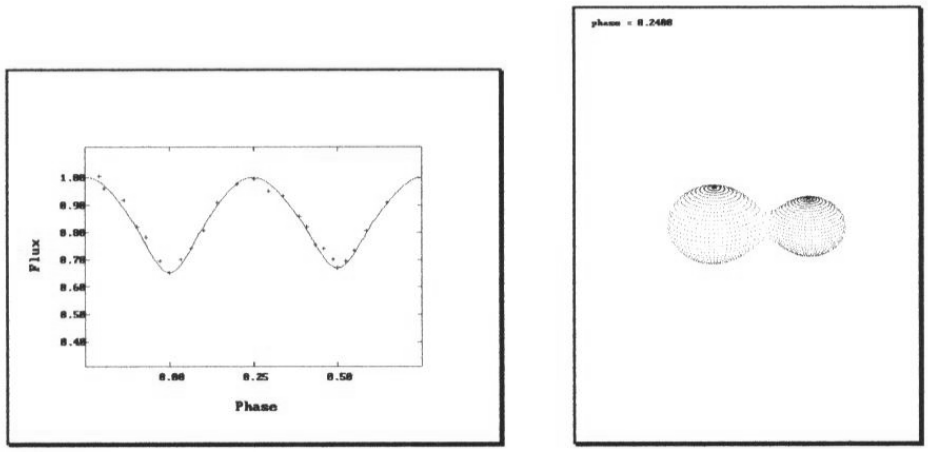


Fig.7 – (left) Output light curve from Binary Maker (example model) superimposed to the unfiltered normal points for HR Lac. Fig.8 (right) – Three-dimensional model of the system at phase 0,24.

VV 374 was named LU Lac in the 58th Name List of Variable Stars [6] and is classified in the G.C.V.S. IV ed. [5] as eclipsing binary star of EW/KW type with range of variation between 14,6 - 15,45 mag ph. Secondary minimum at 15.32 mag. pg and period P = 0.29880135d. No spectrum is known. In 1977 Locker [7] observed one minimum of light for LU Lac and, in 1981, M. Hoffmann [8] published new B photoelectric observations for LU Lac and three times of minimum light with a still small deviation from the original elements.

The data of the best fit are:
q = 0.543 ± 0.047
f = 0.590 ± 0.095
R1 mean = 0.479 ± 0.021
R2 mean = 0.377 ± 0.017
L1 = 0.635 ± 0.040
L2 = 0.365 ± 0.040
i = 83.5° ± 1.2°
T2/T1 = 0.968

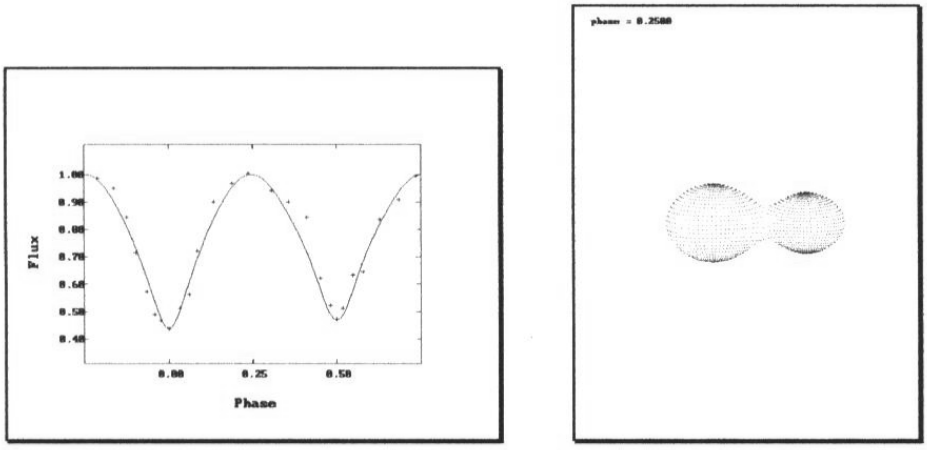


Fig.9 – (left) Output light curve from Binary Maker (example model) superimposed to the unfiltered normal points for LU Lac. Fig.10 (right) – Three-dimensional model of the system at phase 0,25.

VV 462 was named V344 Lac in the 60th Name List of Variable Stars [9] and is classified in the G.C.V.S. IV ed. [5] as eclipsing binary star of EW/KW type with range of variation between 12,2 - 13,0 mag ph. Secondary minimum at 13.30 mag ph. and period P = 0.39222768d. Spectrum A3:. For this star there are in bibliography many instants of minima, generally visual, and two photoelectrical ones. The non-spot model was not able to represent the features of V344 Lac's light curve (O'Connel effect), therefore we found that the good fit of it, was reached adding one dark spot on the surface of the secondary component.

The data of the best fit are:
q = 0.755 ± 0.044
f = 0.700 ± 0.090
R1 mean = 0.471 ± 0.018
R2 mean = 0.426 ± 0.016
L1 = 0.566 ± 0.039
L2 = 0.434 ± 0.039
i = 75° ± 1°
T2/T1 = 0.985

And the spot parameters are:
Co-Latitude = 90°
Longitude = 310°
Spot Radius = 22°
Temperature Factor = 0.5

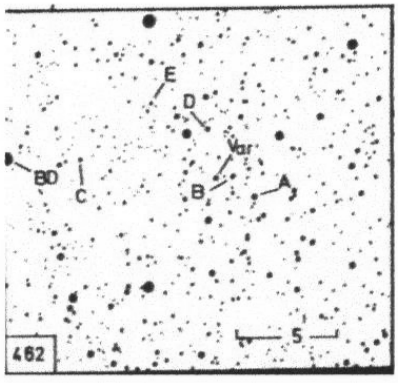
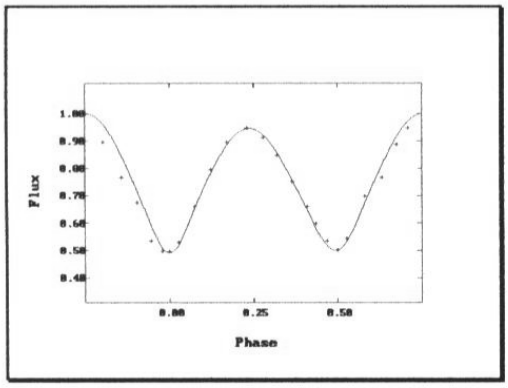


Fig. 11 – Finder chart for V344 Lac from the original paper.



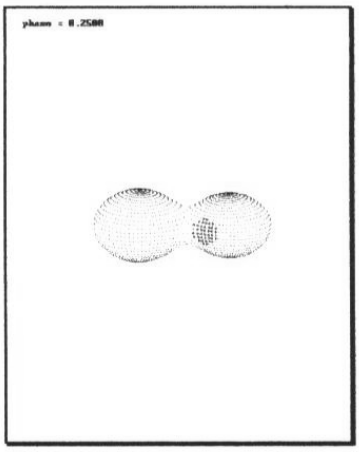


Fig.12 – (left) Output light curve from Binary Maker (example model) superimposed to the unfiltered normal points for V344 Lac. Fig.13 (right) – Three-dimensional model of the system at phase 0,25. A spot is visible on the secondary component.

CONCLUSION

In the present paper we propose the first and preliminary model for some neglected variables by using the original photographic observations. Moreover, with the modern technologies, in particular the CCD cameras, it is possible to re-observe these neglected variable stars in order to improve the validity of the elements.

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