A NEW MODEL OF AW UMa +)

G. A. Bakos
Department of Physics, University of Waterloo, Waterloo,
Ontario, N2L 3G1 Canada

T. B. Horák
Institute of the Automation Management in the Culture,
815 58 Bratislava, Czechoslovakia

J. Tremko
Astronomical Institute, Slovak Academy of Sciences,
059 60 Tatranská Lomnica, Czechoslovakia

ABSTRACT. New series of photoelectric observations have been obtained and analysed. It has been found that previous models do not fit the observations. For the analysis of the observations three new approaches were applied: the analysis of individual observational nights, the symmetrical reference light curve and the difference light curve. The model was elaborated under following assumptions: the distorsion of both components did not change, the source of the irregularities is an excretion disk and the light variations are caused by the time-dependent brightness changes of different parts of this disk. The examples of the behaviour of the system in some phases are given.

1. INTRODUCTION

The AW UMa binary system, a W UMa type star, has a period of 0.4387 days. It was discovered by Paczynski in 1964. Since then, many authors have tried to interprete its observed photometric light curves, using sophisticated methods

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and models. Their results could be summarized as follows:
a) The mass ratio is extremely low (q = 0.08).
b) The observed light curve has been explained by
- either a contact model
- or by a common envelope model.

They ignored, however, the observed irregularities of the light curve.

2. NEW OBSERVATIONS, RESULTS AND MODEL

Our observations of AW UMa were obtained at Waterloo University Observatory between 1983 and 1986 in 33 nights. The observations will be published elsewhere. To analyse them, we applied three new approaches, not taken into account by previous investigators:

a) Individual analysis

We did not put the observations into one mean light curve but we analysed each observational night separately. In this way, we were able to find the existence of two limiting types of observed light curves: shallow light curve (more frequent) and deep one.

The deep light curve has both minima deeper and the heights of both maxima is the same. The shallow light curve, having both minima shallower, has the second maximum lower, making the light curve clearly asymmetrical. Also, the shallow totality during the secondary minimum shows a presence of the slope, not seen in the deep light curve (Figs. 1 and 2).

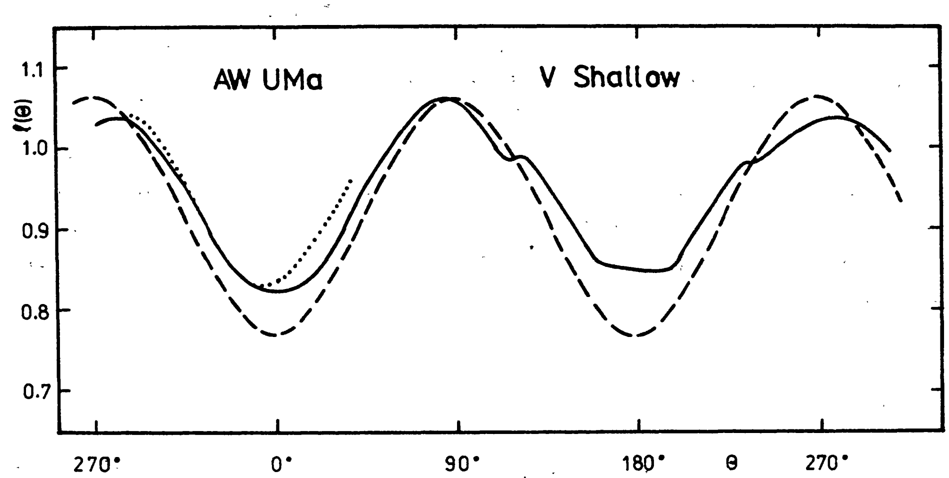

Fig. 1. Yellow shallow light curve (full line), symmetrical reference light curve (dashed line) and extraordinary yellow light curve (dotted line)

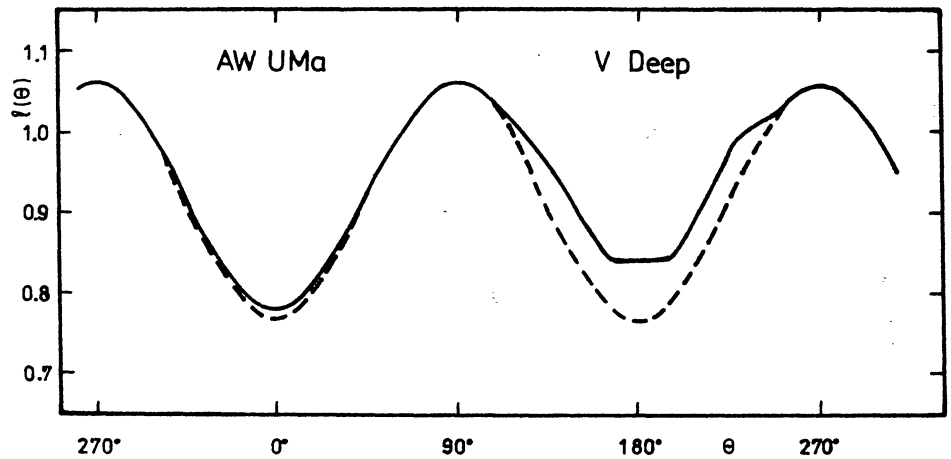

Fig. 2. Yellow deep light curve (full line) and symmetrical reference light curve (dashed line).

b) Symmetrical reference light curve

To investigate those two limiting cases and the intermediate light curves, we constructed a symmetrical reference curve to depict the symmetry and the asymmetry effects (dashed line on the Fig. 1 and 2). In this way, we were able to classify each night of observations as deep, shallow or intermediate. However, in two nights we classified the observations as extraordinary (dotted line on the Fig. 1).

c) Difference light curve

We feel that such a rapid time-dependent variation of the l. c. could be not explained by the common envelope and/or contact binary models of previous authors. To find a resonable explanation of observed variations we calculated a difference light curve shallow-deep between these two limiting cases (Fig. 3).

In this way we were able to identify the phases at which the changes of the light curve were the greatest. This kowledge helped us in the search of the source of the light curve distortion.

We made following assumptions:

a) The distorsion of both components did not change during the observed period of time.
b) The source of observed irregularities is an excretion disk around the primary component and the binary can be reasonably represented by a three component model (see paper of P. Kvačkay at this Symposium).
c) The light variations are caused by time-dependent brightness changes of different parts of this disk.

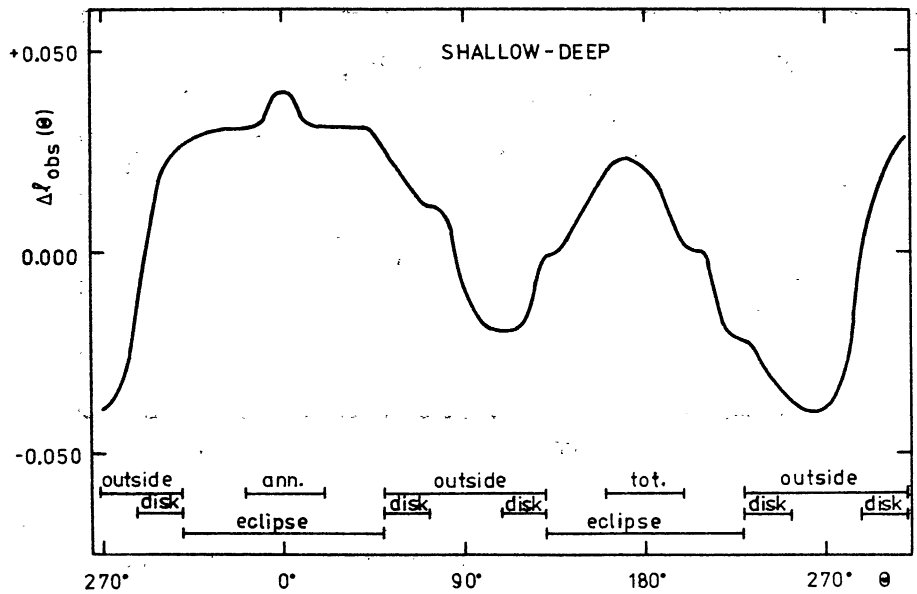

Fig. 3. Difference light curve: shallow-deep.

Some features of the model are demonstrated on Fig. 4 and 5.

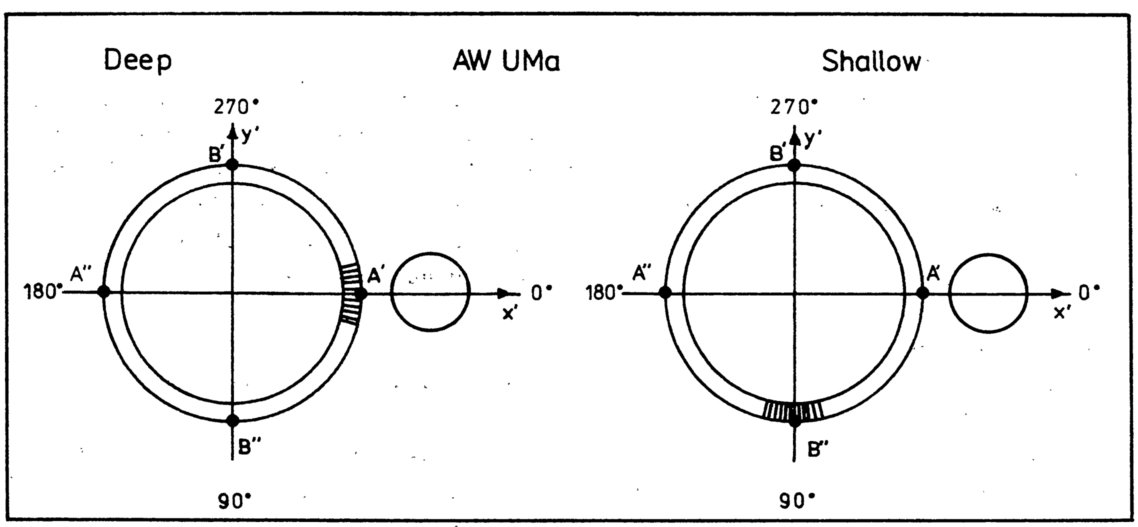

Fig. 4. The position of the bright area producing deep and shallow light curve.

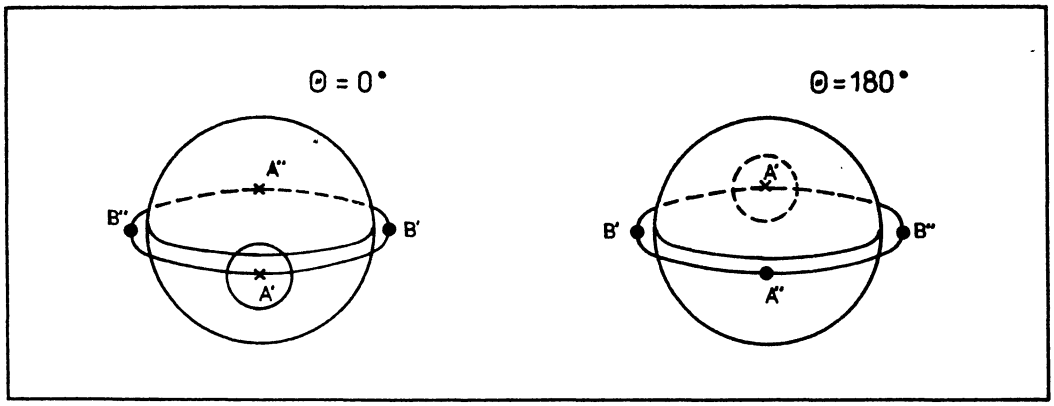

Fig. 5. Mutual position of stars and bright area during primary and secondary minimum.

a) Primary minimum

In Shallow, the bright part of the disk around area B" is visible. In Deep the secondary component eclipses the bright part of the disk around area A', making the depth of the primary minimum deeper.

b) Secondary minimum

In Shallow, the bright area B" is visible. In Deep, the brightness increase around area A' is not visible, making the depth of the secondary minimum deeper.

c) Heights of maxima

At the first maximum we see in Shallow area B", as well as in Deep area A', so the maxima area equal. At the second maximum we do not see the Deep area A', so the Shallow second maximum is lower.

Our new model of AW UMa can qualitatively explain the observed rapid time-dependent variations of observed photometric light curve. The time scale of these variations is few days. The impression is, that such a model could explain a missing link in the evolution path of binary stars - an existence of a more massive looser and very low-mass gainer.