THE SOLAR-TYPE ECLIPSING BINARY SYSTEM AI PHOENICIS

E.F. Milone and B.J. Hrivnak
Rothney Astrophysical Observatory, The Univ. of Calgary

INTRODUCTION

AI Phe was discovered to be variable and identified as an EA binary by Strohmeier (1972). Reipurth (1978) subsequently carried out uvby photometry, determined the period (24.5923 d), and noted the lengthy totality of primary minimum and the displacement of the secondary minimum. Imbert (1978) obtained radial velocity curves and determined spectroscopic orbital elements. Imbert also gives a spectroscopic classification of G2V for the primary (hotter) component and approximately G5 for the secondary. AI Phe thus appeared to offer a unique opportunity to study the limb darkening of a non-interacting solar-type star. As an extension of a solar UV limb darkening study (Kjeldseth Moe and Milone 1978), ten IUE spectra were obtained on Aug. 12 in 2 successive shifts (cf Milone et al 1981). In conjunction with this, ground-based 5-colour photometry and spectroscopy were carried out at CTIO and at UTLCO.

PRESENT WORK

UBVRI photometry was carried out in September 1981 by Hrivnak at CTIO, and over the season, by I. Sheldon at Las Campanas. Figure 1 displays the differential V light curve relative to comparison star HD 6236. Standardization to the Johnson system permitted the determination of magnitude and colours of the two components, since the secondary is seen alone at primary minimum.

Star	V	U - V	B - V	V - R	V - I
S	9.326	1.35	0.85	0.70	1.15
P	9.335	0.47	0.49	0.47	0.70

Spectra taken in eclipse beginning at phase $0^{P}.0048$ reveal a composite spectral type of about G5. From this phase where the primary contributed 24% of the B light to the last exposure, at $0^{P}.009$, when the contributions were equal, the strength of the Balmer lines increased to suggest a composite spectral type no later than early G. Spectra at maximum, where the primary contributes just 58% (in B), appear still

P. B. Byrne and M. Rodonò (eds.), Activity in Red-Dwarf Stars, 407–408.

earlier, but later than ~G0.

We conclude that colours and spectra are consistent with a system containing an F6-7 main sequence primary and a mid-G, probably subgiant, secondary, although the latter's colours are somewhat peculiar. The colour problem created difficulties in modelling the system. Analysis initiated with the Wilson-Devinney code (modified by Wilson to treat orbital eccentricity) failed to give satisfactory fits to the primary minimum in all wavelengths. However, we have obtained a provisional set of elements.

$q = 1.044$ (Imbert), $i = 89°.2$, $e = .14$, $\omega = 115°$

	Primary	Secondary
T	6400 (assumed)	4960
M (θ)	1.10 (Imbert)	1.15 (Imbert)
r/a	0.030	0.055
R(θ)	1.4	2.6
ρ(θ)	0.39	0.15

L_p = 0.65 (U), 0.58 (B), 0.51 (V), 0.44 (R), 0.40 (I)

Each component is well within its Roche Lobe. The results suggest that the secondary star is slightly evolved off the main sequence, a result consistent with its slightly higher mass (Imbert 1978). A fuller discussion will appear in the Astronomical/Astrophysical Journal.

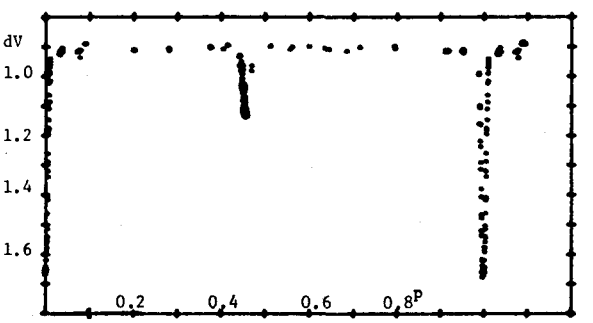

Figure 1 – Light curve of AI Phe from a single season by Hrivnak and Shelton. Note the displaced secondary.

REFERENCES

Imbert, M. 1979, Astron. Astrophys. Suppl. 36, 453.
Kjeldseth Moe, O. and Milone, E.F. 1978, Astrophys. J. 225, 301.
Milone, E.F., Hrivnak, B.J., Clark, T.A., Kjeldseth Moe, O., Blades, J.C. and Shelton, I. 1981, Info. Bull. Var. Stars 2060.
Reipurth, B. 1978, Info. Bull. Var. Stars 1419.
Strohmeier, W. 1972, Info. Bull. Var. Stars 665.

https://doi.org/10.1017/S0252921100096391 Published online by Cambridge University Press