COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS

Number 3278

Konkoly Observatory
Budapest
30 December 1988

HU ISSN 0374-0676

PHOTOMETRIC FLUCTUATIONS IN THE LIGHT CURVES OF R ARAE

The southern peculiar bright binary system R Arae (HD 149730A = HJ 4866A, $M_V \sim 6{\cdot}5$, RA = $16^h\ 35^m\ 6^s$; Dec = -56° 54' (1950)) has received more attention in recent years (Nield *et al.* (1986), Kondo *et al.* (1985), McClusky *et al.* (1983), Wolf and Kern (1983)). Nield reported some discrepancies in earlier quoted values of the period, while pointing out some definite increase of the orbital cycle since the epoch of Hertzsprung (1942). We obtained a new time of primary mid-minimum of HJD 2447386·1200. Again this minimum occurs somewhat later than Hertzsprung's period would predict and a period value of 4·42522 days best describes the interval between Nield's and our current data.

Here we wish to call attention to some clear indications of two types of small-scale optical broad-band (Johnson UBV) photometric variations which seem to persist through all phases and times of observations. These were previously discussed by Nield (1987) and are confirmed here.

In figure 1, an extensive series of measurements of a check star (HD 150745), against the comparison star (HD 147977) used in our differential photometry, is plotted with R Arae using Hertzsprung's ephemeris. This data was collected at the Black Birch outstation of Carter Observatory (New Zealand) over the period April 1986 to September 1988. Some recent improvements to the photometric equipment and its control and data acquisition system have been described by Forbes (1989).

Clearly the variations of R Arae are larger than the 'noise' in the check star and so can be confidently considered intrinsic variations of R Arae and not due to atmospheric or instrumental fluctuations. Similar results are also found in the U and B filter measurements.

Figure 2 shows R Arae in more detail, with the data from various nights plotted separately. The two types of fluctuations are ;

a) a variation throughout most nights of ~ 0·08 mag and on a timescale of order 10 hours (most clearly visible in the out of eclipse regions)

b) a fluctuation in the average magnitude level on different nights (corresponding to the same phase) of ~ 0·15mag

These variations correspond to ~ $3{\cdot}5 \times 10^{27}$ Watts and ~ $6{\cdot}6 \times 10^{27}$ Watts respectively at the source.

R Arae is thought to be an *interactive* eclipsing binary with a (~$3{\cdot}6 M_\odot$) B9 primary and an (~$1{\cdot}4 M_\odot$) F type secondary (cf. Budding (1984)). In this picture, the primary is surrounded by some accretion structure formed from material 'falling' from the secondary which is undergoing Roche Lobe OverFlow. The average period increase since Hertzsprung's Epoch would require a mass transfer rate of ~ $2 \times 10^{-7}\ M_\odot\ yr^{-1}$ (cf. Nield (1987)). An order of magnitude estimate of the power available from this infall gives ~ 3×10^{27} Watts. It is feasible, therefore, that the short timescale variations of light level might be associated with irregularities in the rate of infall, perhaps some instability of the flow or accretion structure.

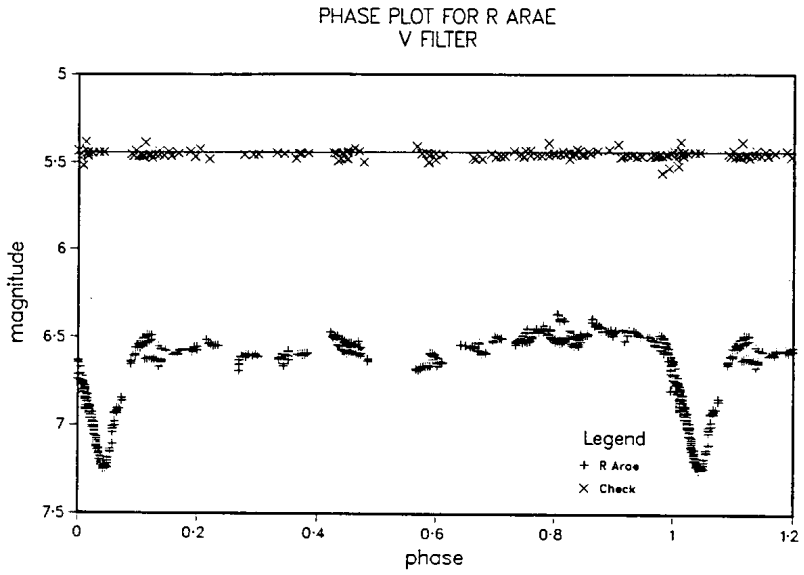

Figure 1

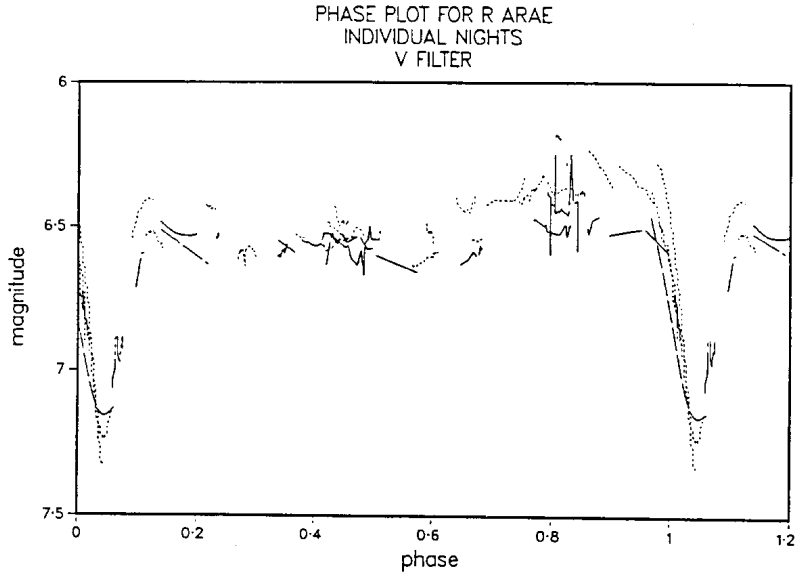

Figure 2

The larger scale variation (night to night) cannot however be explained by a RLOF effect. A point to be kept in mind concerning this is the presence of the visual companion (HD 149730B), only 3·6 arc secs away. All photometry hitherto has included this companion but efforts to measure it's relative contribution have been rather error prone. Nield gave an estimate of 30% ± 10%, though a rather lower figure (16%) is quoted in the General Catalogue of Variable Stars (Kholopov (1985)), see also Jeffers *et al.* (1963). The question arises as to whether this companion might be the source of this ~ 0.15 mag variation. Clearly the proportional effects would have to be large and seem to rule out the possibility of any α^2 CVn type variability. No binarity of the companion has been reported, nor does the variability clearly indicate such.

Hence the undoubted peculiarities of R Arae remain rather mysterious and we can only urge further observational attention to help resolve some of these problems.

MURRAY FORBES

Victoria University of Wellington
New Zealand

EDWIN BUDDING and JOHN PRIESTLEY

Carter Observatory, Wellington
New Zealand

References:

Budding, E., 1984, CDS Bulletin, 27, 91
Forbes, M.C., 1989, M.Sc. Thesis, Victoria University of Wellington (unpublished)
Hertzsprung, E., 1942, Bull. Astr. Inst. Netherlands, 9, 277
Jeffers, H.M., van dan Bos, W.H. and Greeby, F.M., 1963, Index Catalogue of Visual Double Stars 1961.0, Part 2, University of California, Publications of the Lick Observatory, 21, 804
Kholopov, P.N., 1985, General Catalogue of Variable Stars, "Nauka", Moscow
Kondo, Y., McCluskey, G.E., and Parsons, S.B., 1985, The Astrophysical Journal 295, 580
McCluskey, G.E. and Kondo, Y., 1983, The Astrophysical Journal, 266, 755
Nield, K.M., Priestley, J., and Budding, E., 1986, Information Bulletin on Variable Stars, No. 2941
Nield, K.M., 1987, M.Sc. Thesis, University of Waikato (unpublished)
Wolf, G.W., and Kern, J.T., 1983, The Astrophysical Journal Supplement Series 52, 429