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Velocity monitoring of sequence-E red giants

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Abstract.
We are currently monitoring radial velocities of LMC red giants from sequences D and E of Wood et al. (1999). The spectra are being obtained with the FLAMES/GIRAFFE instrument on the VLT. Here, some preliminary velocity curves for several sequence E stars are presented. These stars appear to be Roche lobe filling red giants in binary systems. Preliminary light curve modelling suggests very low masses for the red giants, which may be post-common envelope objects.

Key words. Stars: binaries: close – Stars: late-type – Stars: variable

1. Introduction

Variable red giants lie on a number of distinct period-luminosity relations (e.g. Wood et al. 1999, Soszyński et al. 2004). One of these sequences, labelled sequence-E by Wood et al. (1999), consists of low or intermediate-mass stars predominantly on the first ascent of the giant branch (Fig. 1). It is thought that these stars are close binaries.

2. Velocity variations

Fig. 3 shows light and preliminary velocity curves for three of twelve sequence-E stars whose velocities are being monitored using FLAMES/GIRAFFE on the VLT. Velocity variations are clearly evident, with maximum and minimum velocities at times of maximum light, as expected for close binary systems.

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3. Light curve modelling

The light curves of two sequence-E stars have been modelled using the Wilson-Devinney code (Wilson 1990 and references therein). An example is shown in Fig. 2. The preliminary results of modelling of the light curves alone (i.e. velocity was not modelled) gives red giant masses of 0.278 and 0.488 $M_\odot$ for 77.7672.98 and 77.7673.79, respectively, with companion masses about 20% of the red giant masses. The derived red giant masses are similar to the core masses of these stars, which can be obtained from their luminosities. Thus these stars appear to have very small envelope masses. Such low masses can only result from a process (common envelope evolution) where the red giants have lost mass and the mass has been lost from the binary system.

This suggests that the immediate outcome of a common envelope event is a low envelope mass red giant rather than a white dwarf, as is

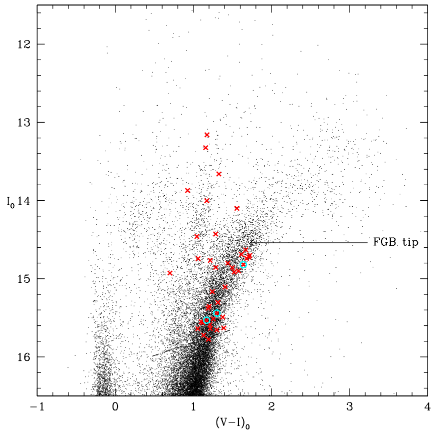

Fig. 1. The HR diagram for variable and non-variable LMC stars in the field of Wood et al. (1999). The sequence-E variables are shown as crosses. Velocity curves are given in Fig. 3 for the three circled objects. Only stars above the dashed line were examined for variability.

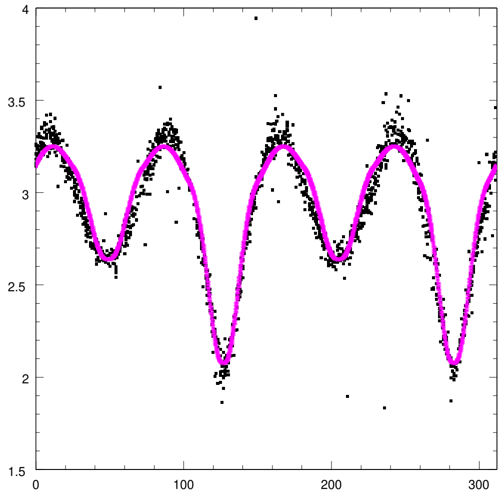

Fig. 2. A model (continuous line) for the light curve of MACHO 77.7672.98 (points). The vertical axis is luminosty (arbitray units) and the horizontal axis is time in days.

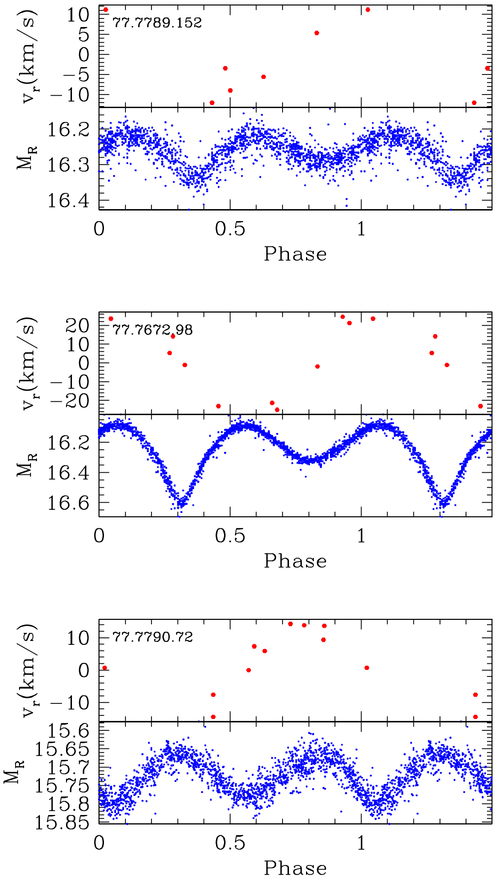

Fig. 3. Light (MACHO red) and preliminary radial velocity curves for three sequence-E stars. The velocity zero point is the mean velocity.

usually postulated (see Webbink 1988). An essential requirement for common envelope evolution is that the red giant expands more than the orbit upon losing mass. However, these stars with their very low envelope mass are almost certainly in the stage where they contract rather than expand upon losing mass. The common envelope merger process will be stopped when this situation is reached.

References

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