CARBON ABUNDANCE IN MASS-EXCHANGING BINARIES

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The evolution of the carbon abundance at the surface of both components of a mass-exchanging (Algol-type) binary is examined (fig. 1). Distinction is made between case B and case AB (fig. 2) of mass transfer, in view of the different timescales involved. In the mass accreting component thermohaline mixing is adopted when matter with decreasing hydrogen abundance is deposited on the surface.

It is shown that at the surface of the loser a very low C-abundance is present, while at the surface of the gainer different regimes occur. On the average the expected C-abundance on the gainer is clearly lower than the observed solar value, but far above the value at the surface of the loser. The variation in time during the mass-exchange process is compared to the values, derived from observation of several Algol-type systems.

Theoretical models were calculated by Packet (1987) and the authors. The evolutionary codes are discussed by De Greve et al. (1985) and Prantzos et al. (1986).

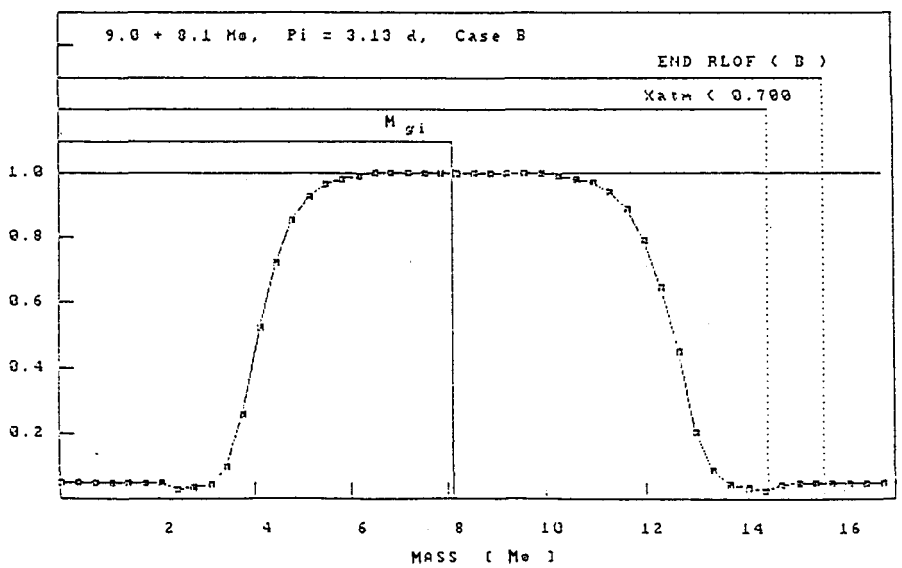

Figure 1. Carbon abundance as a function of mass for both components of a close binary system at the onset of mass transfer. The region from Mr=0 to Mr=Mgi=8.1 Mo corresponds to the originally less massive component (gainer), whereas the carbon distribution of the loser is plotted from 8.1 Mo (surface) to 17.1 Mo (center). The first occurrence of hydrogen depleted layers (Xat<0.7) and the end of the Roche Lobe Overflow are indicated.

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The observed carbon depletion of mass-losing components in Algol-type systems may be explained as the result of the conversion of C to N, while these stars were on the main sequence. Furthermore a largescale mixing of matter in mass accreting components is suggested. Indeed, the present computations show that, especially for case AB of mass transfer, large but also small underabundances of carbon may be observed at the surface of the gainer, depending on the initial parameters of the system and on the mass fraction removed from the mass-losing star.

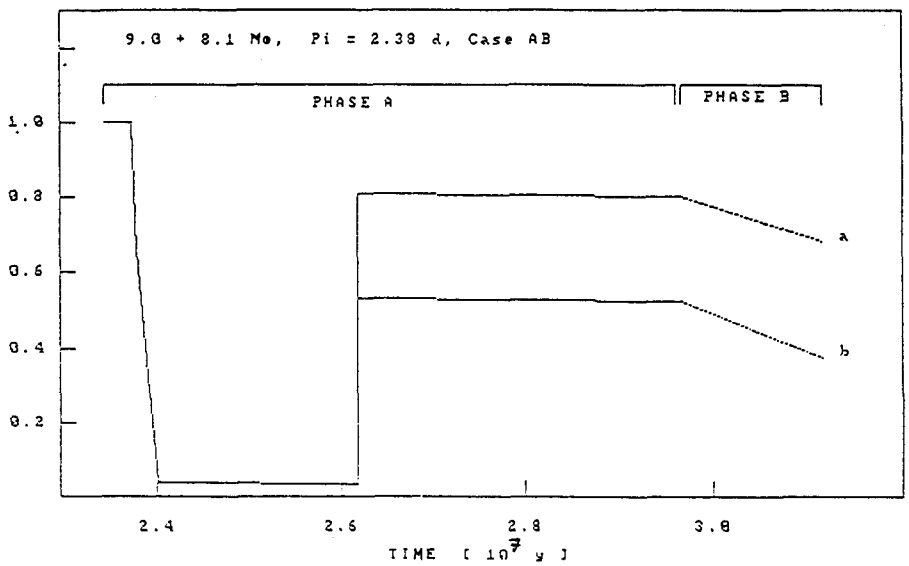

Figure 2. Carbon surface abundance of the gainer in the system 9 M⊙ + 8.1 M⊙, Pi=2.38 d, as a function of time, during a case AB of mass transfer. The line marked 'a' was obtained under the assumption that no significant conversion of C to N takes place above the convective core, during mass transfer.

References

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