THE EVOLUTION OF MASSIVE CLOSE BINARIES WITH MASS LOSS AND OVERSHOOTING. AN APPLICATION TO V729 CYG (=BD+40 4220).

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The evolution of massive close binaries is altered if the effects of mass loss through a stellar wind and overshooting from the convective core are taken into account. The occurrence of mass transfer as well as the extent ofthe mass transfer itself differs from the classical case (Doom and De Greve 1983, Doom 1984). The main-sequence widening due to the enlargement of the convective core results in an enhancement of the frequency of case A of mass transfer. It occurs for initial periods much longer than in the classical case. A cosiderable number of early-type systems will therefore undergo this type of mass transfer (Sybesma, 1985b). Systems with primary masses larger than 35 $M_\odot$ will most likely not undergo mass transfer at all as these stars do not form red supergiants if overshooting is coupled to the effects of mass loss through stellar wind. These systems will only be able to undergo case A of mass transfer, and then only for initial periods below 2-3 days.
Simultaneous evolutionary calculations resulting in case A of mass transfer for systems with an initial primary mass of 20 $M_\odot$ have been presented in 2 previous papers; Sybesma 1985a and Sybesma 1985c.
Calculations for the more massive systems undergoing case A of mass transfer have been performed for two different primary masses: 80 and 40 $M_\odot$, with an initial mass ratio of 0.5. Both the systems form a contact system soon after the start of mass transfer. The evolution of these systems differs considerably (see table 1.). The length of the mass transfer stage is determined by the surface hydrogen abundence. If it becomes less than 0.7 when the central hydrogen abundance is low enough the star evolves to the left in the HRD and detaches from the critical lobe. In the more massive system this happens as the gainer (which has become so massive as to pass the loser in evolutionary speed) is turning into a WR star (beginning of core helium burning). In the less massive system it happens very quickly after mass transfer has started. In this case the mass ratio is not reversed by the mass transfer.
A more extensive study of the mass transfer in such very massive systems, including different masses and mass ratios, is underway. It will be reported on in a paper to be submitted for publication in Astronomy and Astrophysics

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	X_c	X_a	M_1/M_o	M_2/M_o	P	X_c	X_a	M_1/M_o	M_2/M_o	P
initial	.7	.7	40	20	2	.7	.7	80	40	1.5
start RLOF	.4	.7	37	19.5	2.3	.65	.7	71	39.7	1.5
end RLOF	.4	.66	32	24.3	1.8	.2	.63	30	61	3.2
start WR(*)	0	.14	24*	22.9	2.6	.2	.63	30	61*	3.2
end WR(*)	0	0	9*	22.6	5.7	.15	.61	29	49*	4.2

Table 1. parameters in the evolution of very massive close binaries undergoing case A of mass transfer.

The Evolutionary status of V729 Cyg

Recent observations of the spectroscopic binary V729 Cyg have cast doubts on its classification as an Of +Of binary. Vreux, 1985, has studied the H profiles and proposed a model consisting of a WR component (the lower mass, most evolved component) accreting mass from the more massive Of companion.
The system has been spectroscopically studied by Bohannon and Conti, 1976, and Massey and Conti, 1977, and found to consist of a 47 M_o primary and a more evolved 15 M_o secondary both classed as Of stars.
In order to test the models from a theoretical evolutionary standpoint the system has been compared to evolutionary tracks for single stars. (taken from Pylyser et.al., 1985). If the secondary is an Of star it must still have hydrogen at the surface. Hence the H exhausted core at the end of core H burning must be smaller than 15 M_o. This means that the initial mass of the current secondary must have been no larger than 25 M_o (comparison to the tracks). The total current mass however is 62 M_o so that the current secondary, which is the more evolved, must have an initial mass of at least 31 M_o. This is of course a contradiction and therefore we conclude that the 15 M_o component is indeed a He star, and that V729 Cyg is a post mass transfer binary with a WR component accreting in the wind of the more massive Of star .

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