NON-CONSERVATIVE EVOLUTIONARY SCENARIO FOR 100 ALGOLS

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ABSTRACT

We have examined the observational data of 100 Algols in order to check the validity of several simple models of non-conservative mass transfer. Strong evidence of mass and angular momentum loss has been found at least in about 20% of our Algols. Case B mass exchange is favoured for low-mass Algols, while case A predominates, though not so widely as expected, in Algols of higher total mass.

INTRODUCTION

It is now generally recognized that non conservative approaches, in which mass and angular momentum loss from binary systems is taken into account, can improve the agreement between theory and observations for Algols.

We wish to clarify that, in this paper, by Algols we mean: the semi-detached (sd) systems whose less massive members filling their Roche lobes are apparently more evolved; the systems with undersize subgiant components (sd-d systems) regarded as post-main sequence mass-exchange cooler remnants; and the early-type contact systems having recently undergone or undergoing mass transfer between the components. The Algols we consider are : TW And, XZ And, RX Aqr, KO Aql, QY Aql, RW Ara, SX Aur, IM Aur, IU Aur, LY Aur, SU Boo, Y Cam, SZ Cam, S Cnc, RZ Cnc, R CMa, CV Car, RZ Cas, SX Cas, TV Cas, TW Cas, U Cep, RS Cep, XX Cep, XY Cep, U CrB, RW CrB, SW Cyg, UZ Cyg, VW Cyg, WW Cyg, ZZ Cyg, KU Cyg, MR Cyg, V548 Cyg, V729 Cyg, W Del, Z Dra, TW Dra, AI Dra, S Equ, AS Eri, RW Gem, RX Gem, RY Gem, Al Gem, X Gru, u Her, UX Her, AD Her, V338 Her, RX Hya, TT Hya, Y Leo, T LMi, δ Lib, β Lyr, TT Lyr, RW Mon, TU Mon, AR Mon,

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RV Oph,UU Oph, ON Ori, AQ Peg, AT Peg AW Peg, OI Peg, β Per, RT Per, RW Per, RY Per, ST Per, DM Per, IZ Per, δ Pic, Y Psc, V Pup, XZ Pup, U Sge, RS Sgr, XZ Sgr, V356 Sgr, V505 Sgr, μ^1 Sco, V453 Sco, RY Sct, RZ Sct, λ Tau, RW Tau, X Tri, TX UMa, VV UMa, W UMi, S Vel, DL Vir, Z Vul, RS Vul, BE Vul, V78 ω Cen.

Available observational data(taken from the literature) regarding our Algols tend to indicate that the larger the total mass of a system, the shorter its orbital period, the higher its mass ratio, and the less prominent the oversized properties of its secondary (less massive) component are. Moreover, a discrete fraction ($\sim$15%) of primaries appear to have radii significantly larger than main sequence values.

The amount of mass and angular momentum loss from binary systems is poorly known. Estimates have been provided by Svechnikov's (1969) and Popov's (1970) surveys of statistical observational data of detached and semidetached systems and by Guseinov and Novruzova's (1974) study.

DISCUSSION AND CONCLUSIONS

Extending previous works generally based on the conservative assumption only, we have tried to infer some information on the evolutionary status of each binary by estimating its initial (i.e. prior-to-mass-exchange) values of orbital period and total mass, computed according to the conservative assumption and various non-conservative approaches (Tutukov and Yungelson, 1971; Plavec et al., 1973; Drobyshevski and Reznikov, 1974; Djakov and Reznikov, 1979; Vanbeveren et al., 1979).

We considered the implications of various assumptions(present in the above-mentioned approaches) concerning mass and angular momentum loss from binary systems. So we can suggest the following basic conclusions:
(i) Conservative calculations of mass exchange are not able to account for the evolutionary status of about 20% of our Algols (especially for those with low total masses an low mass ratios).
(ii) A relatively large amount of angular momentum loss (being the ratio between the specific angular momentum of the lost matter and that of the original system equal to 2.5÷3.0) is required for obtaining,for the low-mass Algols, initial periods not forbidden by evolutionary constraints whenever a plausible fraction (40% 80%) of mass loss is adopted.
(iii) Drobyshevski and Reznikov's (1974) approach, as well as Djakov and Reznikov's (1979), seem able to explain the low mass binaries, whilst Plavec et al.'s (1973) approach appears to be more suitable for systems of higher mass.
(iv) Practically all Algols with relatively low ($\lesssim 7M_\odot$) total mass can be regarded as case B remnants.

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(v) As regards systems of higher total mass (roughly $\gtrsim 7M_{\odot}$), case A predominates, though not by much.
(vi) Our results undoubtedly indicate a strong deficit of systems originated from case A.

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