PERIODS OF UNEVOLVED LATE-TYPE CLOSE BINARIES: EVIDENCE OF MAGNETIC ACTIVITY.

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ABSTRACT

Our study of the period distribution of about 200 FGKM-type unevolved close binaries has revealed a strong deficit of short-period systems. This finding may be connected with the occurrence of a very efficient mechanism of orbital angular momentum loss via magnetic braking by stellar wind, in the earliest evolutionary phases.

INTRODUCTION

Reliable clues to early evolutionary processes in close binaries may come from the distribution of the orbital periods of close binaries, provided that, of the binaries catalogued, one considers only the systems substantially unevolved. Through a survey of the literature we have gathered together the available data on the periods and primary spectral types of 79 FGKM-type eclipsing binaries for which there is sufficient information (i.e., basically, lightcurve analyses must be available) to regard these binaries as unevolved (we have in essence considered nearly main sequence detached systems). Furthemore, we have selected 120 non-eclipsing spectroscopic binaries (with periods < 1000 days), which have a high enough orbital eccentricity e ($e \geq 0.1$) or estimated mass ratio q close enough to unity ($0.7 \leq q \leq 1.3$) to be regarded as probably unevolved.

RESULTS AND DISCUSSION

A period-spectrum plot of our 79 unevolved eclipsing binaries shows a strong deficiency of short-period eclipsing pairs (with periods $\lesssim 1$

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day). Besides, the lower envelope to the observed periods considerably departs from the lower theoretical limits corresponding to ZAMS contact binaries with members of equal mass. Interestingly enough, this gap, which cannot be attributed to observational selection effects, markedly increases as we go from the G to the M spectral type. A similar behaviour is shown by the period-spectrum diagram of our 120 unevolved spectroscopic binaries, although in this case the real existence of the gap is not well established, since severe observational limitations act against the detection of short-period non-eclipsing spectroscopic pairs.

A reasonable explanation of our findings is that a very efficient mechanism of angular momentum loss via magnetic braking by stellar wind occurs in the earliest evolutionary phases of late-type binaries, the youngest of which are known often to display strong magnetic activity. Thus, regardless of whether the late-type contact pairs form in the pre-main sequence evolutionary phase or in later phases - this latter view seems to be favoured by preliminary theoretical calculations of close binary formation (Popova et al., 1982) - , late-type detached binaries of small enough initial separations are probably rapidly drawn into contact by magnetic braking, which is probably more efficient for systems of small mass and separation. Hence, the resulting systems are observed as contact pairs (W UMa stars) and, therefore, are excluded from our binary sample.

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