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THE MINIMUM MASS RATIO FOR CONTACT CLOSE BINARY SYSTEMS OF W URSAE MAJORIS-TYPE

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Abstract. The main research topic of this dissertation are extreme mass ratio contact close binary systems, $q \lesssim 0.1$, of W Ursae Majoris (W UMa) type. These close binaries (CBs) represent an interesting class of objects in which "normal", approximately one solar mass main-sequence star is in contact with a significantly less massive companion, $M_2 \sim 0.1 M_\odot$. Earlier theoretical investigations of these systems found that there is a minimum mass ratio $q_{\rm min} = M_2/M_1 = 0.085 - 0.095$ (obtained for $n = 3$ polytrope – fully radiative primary) above which these CBs are stable and could be observed. If the mass ratio is lower than $q_{\rm min}$, or, equivalently, if orbital angular momentum is only about three times larger than the spin angular momentum of a massive primary, a tidal instability develops (Darwin's instability) forcing eventually the stars to merge into a single, rapidly rotating object (such as FK Com-type stars or blue stragglers). However, there appear to be some W UMa-type CBs with empirically obtained values for the mass ratio below the theoretical limit for stability. The aim of this dissertation is to try to resolve the discrepancy between theory and observations by considering rotating polytropes. By including in theory the effects of higher central condensation due to rotation we were able to reduce qmin to the new theoretical value $q_{\rm min} = 0.070 - 0.074$, for the overcontact degree $f = 0 - 1$, which is more consistent with the observed population. Other candidate systems for stellar mergers such as AM CVn-type stars have also been discussed in the dissertation.

References

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