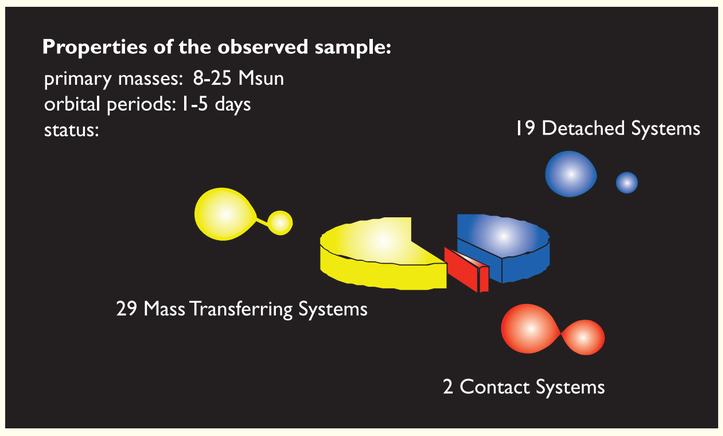
Testing Binary Evolution Models

Introduction

The majority of OB stars are binaries, often with very short orbital periods in which mass can be transferred from one star to the other, completely altering the evolution of both stars.

One of the main uncertainties in binary evolution models is the **efficiency of mass transfer**: Can it be described as a conservative process or is a significant amount of mass and angular momentum lost from the system?

We address this question by comparing observed binaries (§1) to test our models (§2) by fitting evolution tracks (§3) and searching for correlations between the efficiency of mass transfer and the binary parameters (§4).

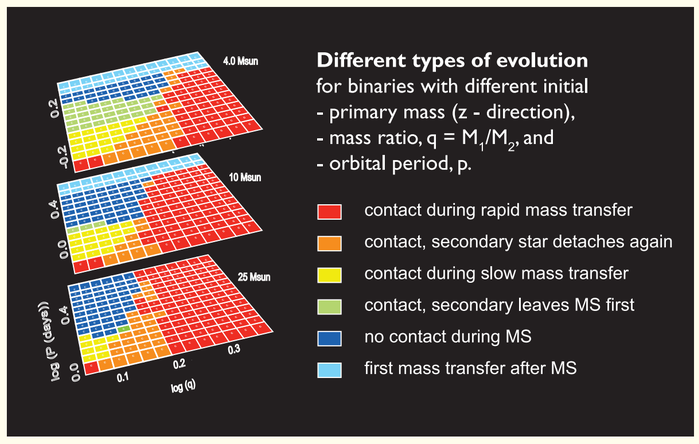


§1 Observations

Hilditch et al. 2005

Recently the masses, radii and temperatures for 50 close massive binaries in the Small Magellanic Cloud were determined. This sample is the **largest single set** of stellar parameters for massive stars in any galaxy.

More than half of the systems is currently undergoing mass transfer. This sample is therefore potentially very suitable to test models of interacting binaries.



Eggleton 1971, De Mink & Pols (in prep.)

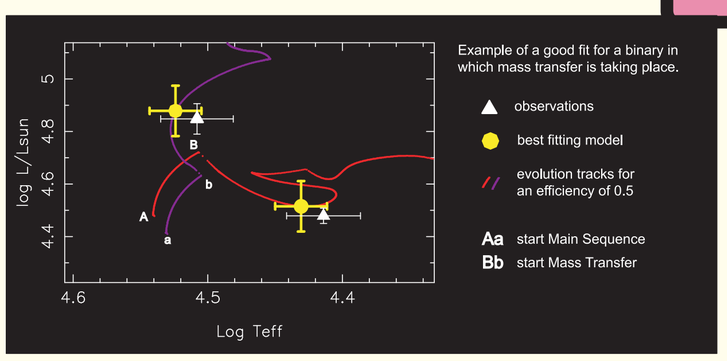
§2 Models

No detailed binary evolution models are available against which the observed systems can be tested. We present over **17,000 binary evolution tracks** at the metallicity of the Small Magellanic Cloud for different masses, mass ratios, orbital periods, for conservative and three types of nonconservative mass transfer. Above an impression of the different binary evolution tracks in our model grid.

Conclusion

- In general we find good agreement between observations and models although the observed temperature ratio is often bigger than our models predict (§3).
- Initially closer systems prefer more conservative models than initially wider systems, the correlation is however weak (§4).
- Our models (§2) will soon become available to the astronomical community.

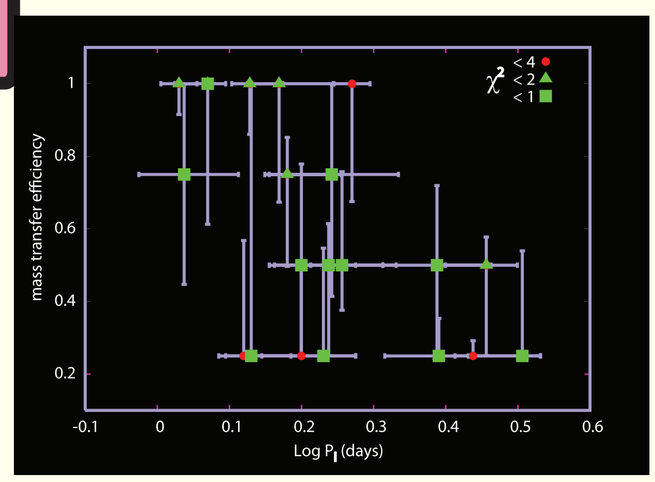
De Mink & Pols (in prep.)



§3 Fitting evolution tracks

Comparing the observed binary systems to our models with a chi-squared test we find acceptable fits for about 80% of the detached systems and for 70% of the mass transferring systems. An example is given above.

A common discrepancy between the observations and our models is the effective temperature ratio: the observed systems have extremer temperature ratios than our models predict.



§4 Efficiency of mass transfer

A weak correlation was found between the best fitting mass transfer efficiency and the initial orbital period P_i: initially closer binaries prefer more conservative models than wider systems.

This trend, significant or not, can be understood in the following way. In close binaries tidal forces prevent the accreting star from spinning up to critical rotation. In wider binaries tidal interaction is less effective, which enables the accreting star to loose a significant fraction of the transferred mass in its equatorial plane.

No significant correlations were found with other fit parameters.

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