AMUSEing winds in binary stars

Martha Irene Saladino[1], Onno Pols[1], Edwin van der Helm[2]

[1]Dept. of Astrophysics/IMAPP, Radboud University Nijmegen.

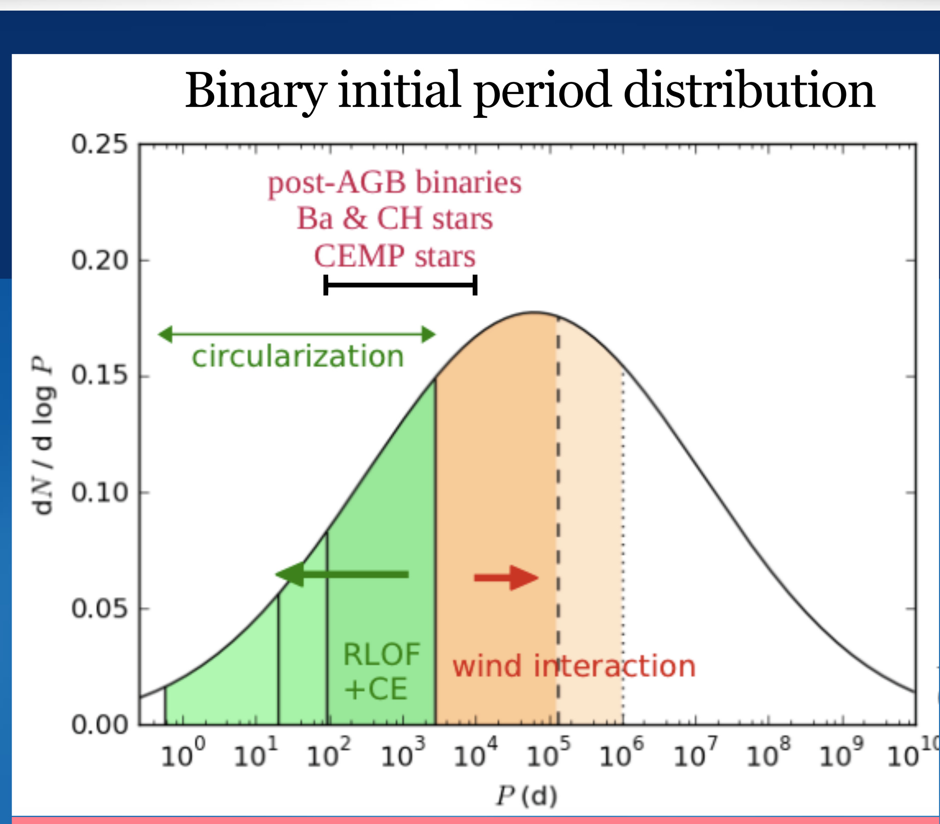
[2]Leiden Observatory, Leiden University.

m.saladino@astro.ru.nl

www.astro.ru.nl/~misaladino

CONTEXT

In binary systems of low mass, mass transfer is likely to occur while one of the stars is in the AGB phase. Observations have shown that many post-mass-transfer binaries have periods of 1-10 yr, where binary evolution models predict a gap.

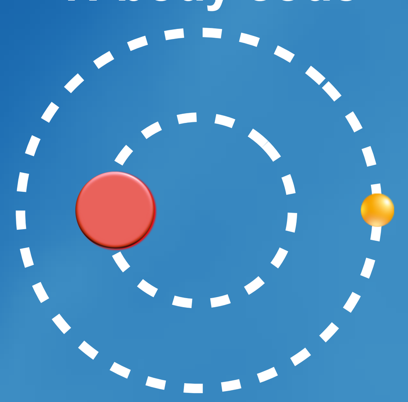


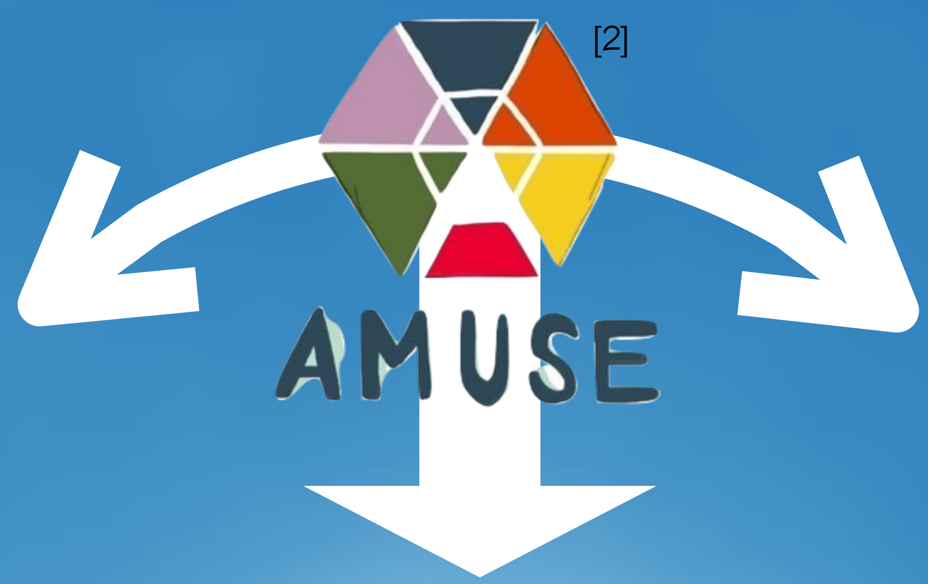
Green: close binaries; mass transfer occurs via Roche lobe overflow. Orange: wide binaries; mass transfer occurs via wind accretion. Arrows indicate the expected direction of orbital evolution, predicting a gap in the range 1-10 yr [1].

AIM

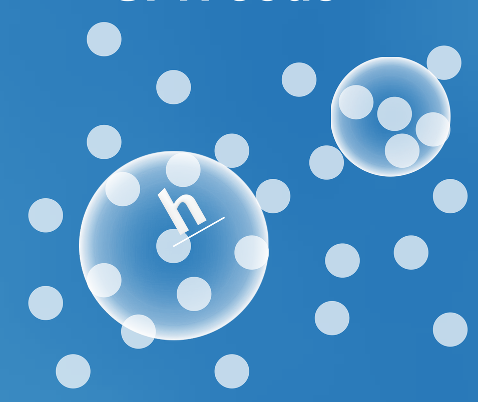
We investigate wind mass transfer in low mass binaries to see how the mass accreted by the companion star depends on the initial orbital parameters of the system and how it affects the evolution of the orbit.

N-body code





SPH code



AGB star

$M = 3\ \mathrm{M_\odot}$

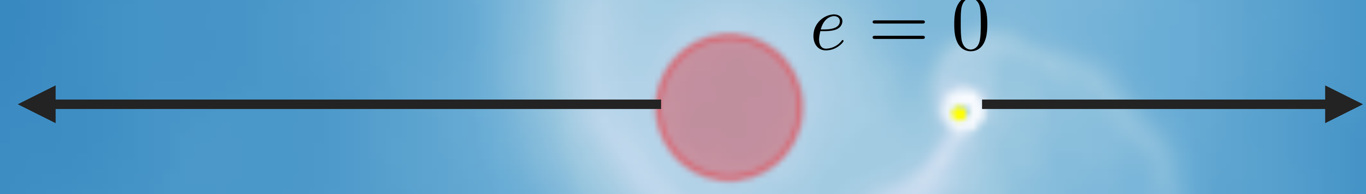
$R = 200\ \mathrm{R_\odot}$

$\dot{M}_1 = 10^{-6}\ \mathrm{M_\odot/yr}$

$v_{wind} = 15\ \mathrm{km/s}$

$a = 3\ \mathrm{AU}$

$e = 0$



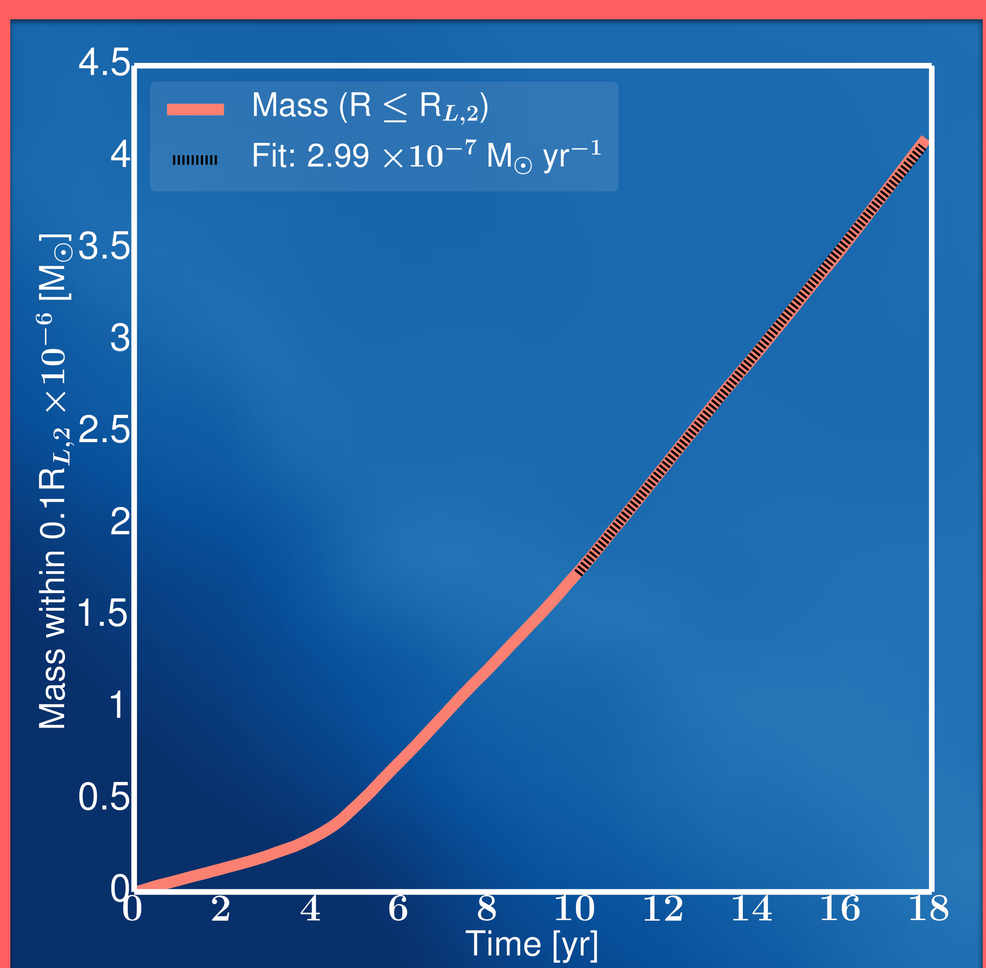
Low mass companion

$M = 1.5\ \mathrm{M_\odot}$

$R = 1\ \mathrm{R_\odot}$

PRELIMINARY RESULTS

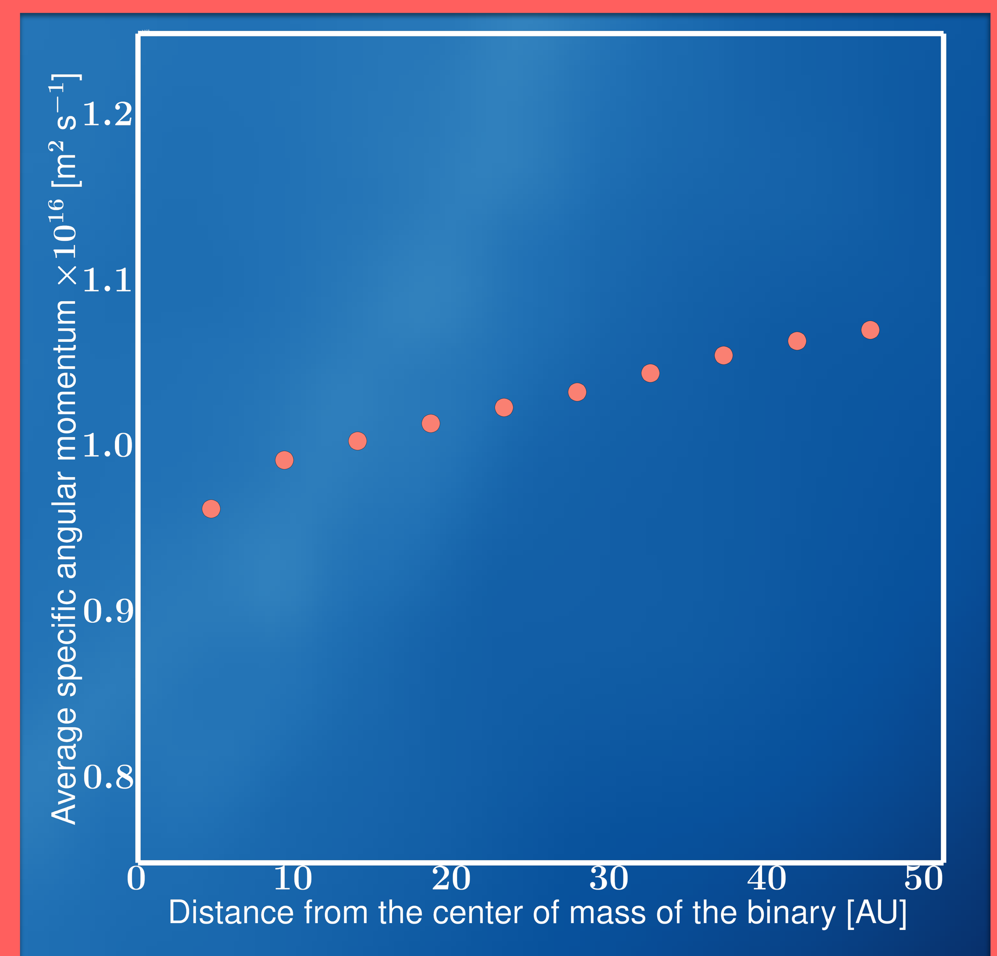
Fraction of mass accreted



Mass accumulated onto the companion star within 0.1 $R_{L,2}$ as function of time. This gives an upper limit for the mass accretion rate of about 0.3$\dot{M}_1$. Note that the fit is performed after 4 orbital periods: once the system has reached a steady state.

An accretion disk forms around the companion star of a size of 0.3 $R_{L,2}$

Fraction of angular momentum loss



Average specific angular momentum of escaping particles as a function of radius. It was computed beyond certain distances from the center of mass of the binary at time t = t_{end}. Its value is ~ 3 times the average specific orbital angular momentum.

FUTURE WORK

- Determine the change of orbital parameters due to angular momentum loss.
- Determine mass accretion and angular momentum loss rates for different wind velocities, orbital separations and mass ratios, as well as for eccentric orbits.
- Study the effect of rotation of the donor star on the system evolution

The image in the background shows the line-of-sight column density projected onto the orbital plane. We observe an accretion disk around the secondary star due to gas funneling through the inner Lagrangian point. The spiral structure is formed due to the Coriolis force and collision of the accretion wake with gas coming from the primary.

References:

[1] Pols. O. (This conference; Tuesday July 26th, 17:40-18:00)

[2] Portegies Zwart S., et. al (2013), Computer Physics Communications, 183, 456; van der Helm, E. + (in prep)

Movie of the simulation