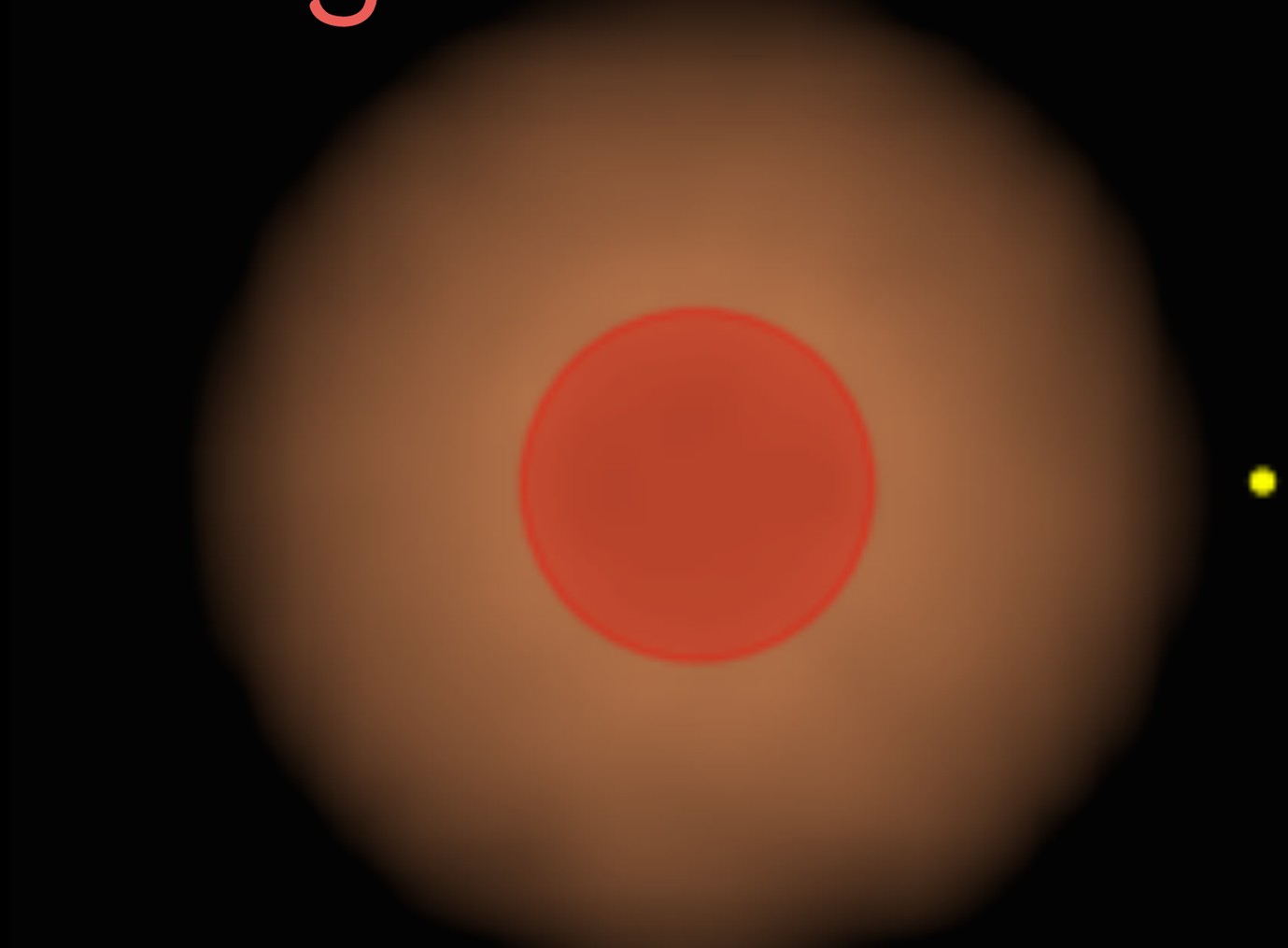
AMUSEing winds in binary stars



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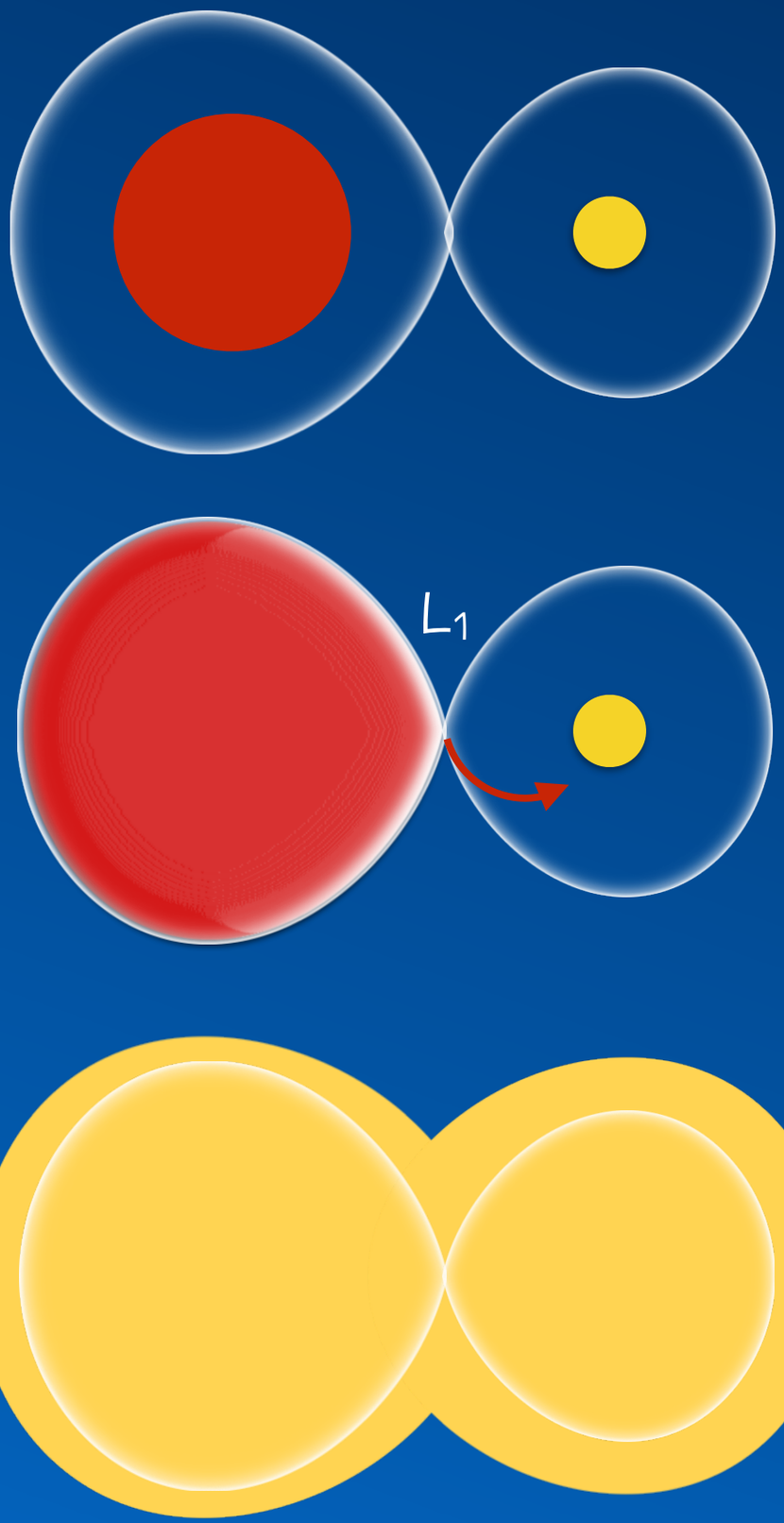
Qui Nhon, Vietnam, August 11th 2016

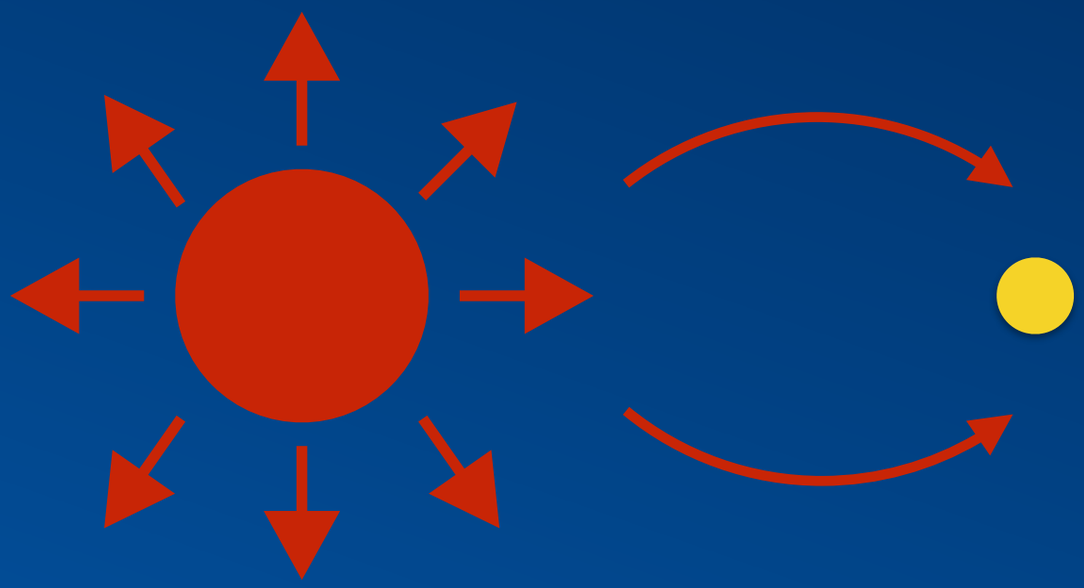
Why do we want to study wind mass transfer in binary stars?

- Most stars are in binary systems. Many of them are close enough for mass flow to occur.
- The transfer of matter can occur via different mechanisms: Roche lobe overflow or wind mass transfer. This can alter the evolution of the system (e.g. change in orbital parameters, chemical pollution of the companion).

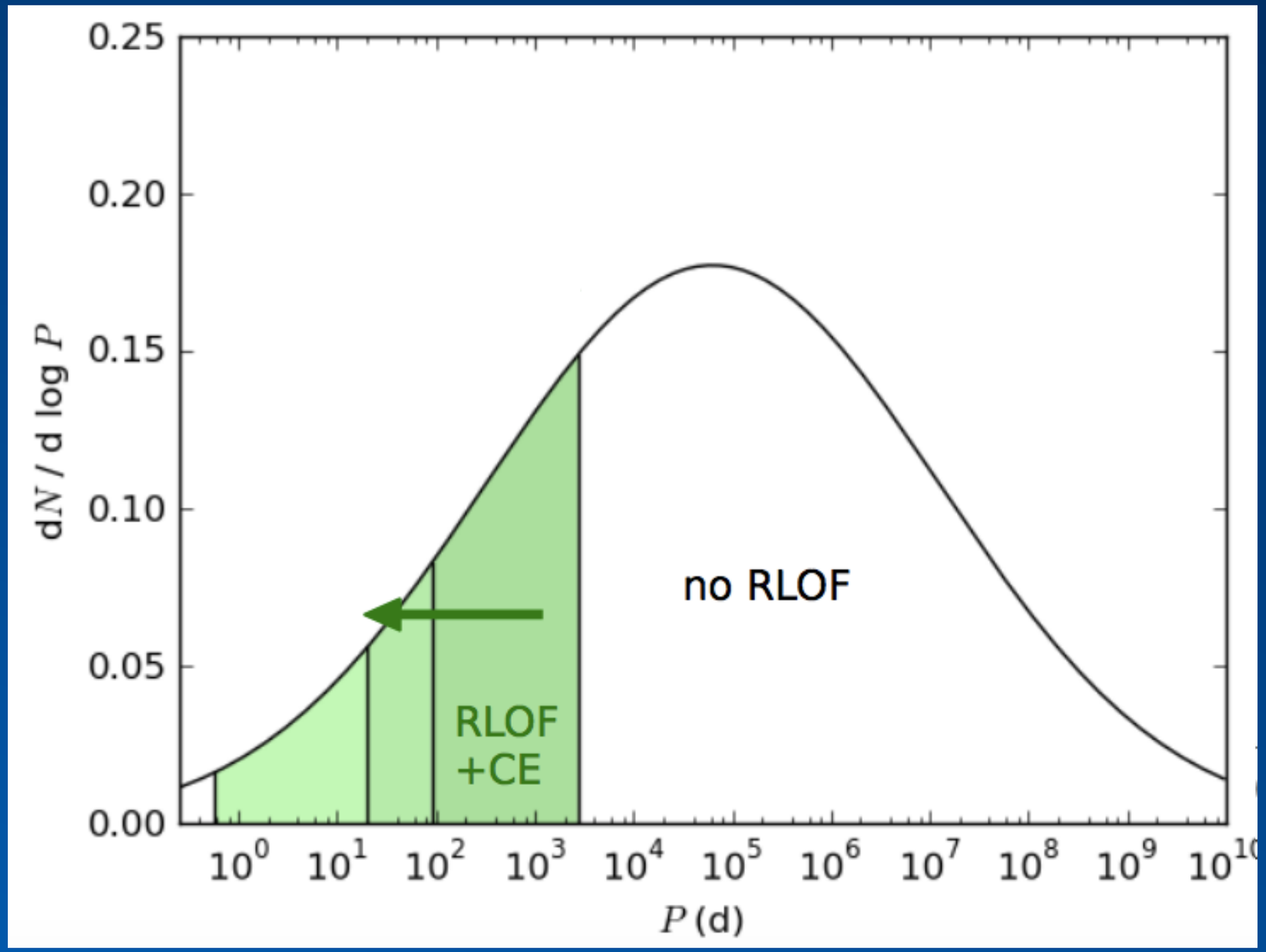
Roche Lobe Overflow



Wind mass transfer



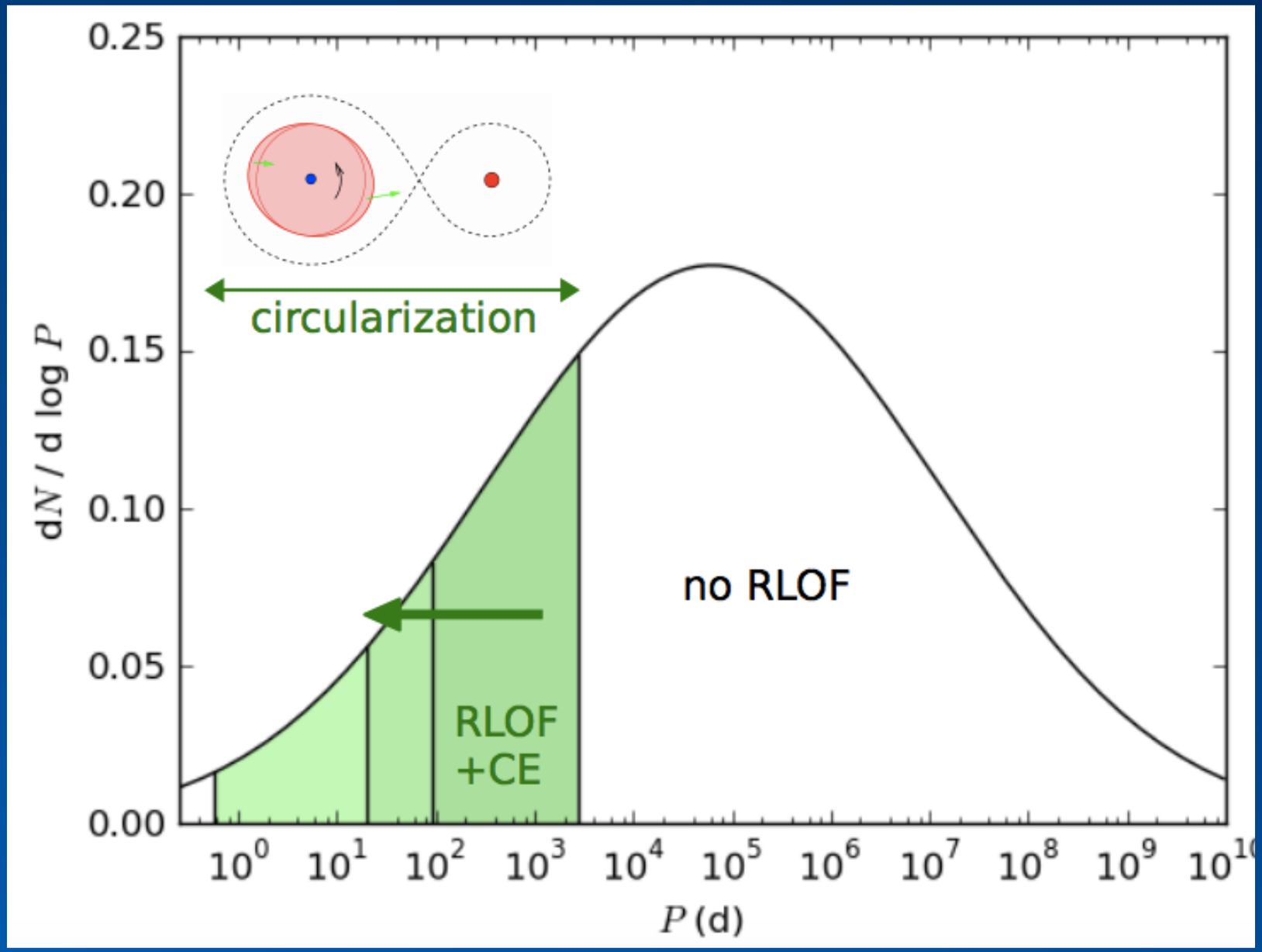
Binary period distribution



Period distribution for sun-like stars

Pols. O. Evolution of Low and Intermediate Stars, Ulaanbaatar (2014)

Binary period distribution



Period distribution for sun-like stars

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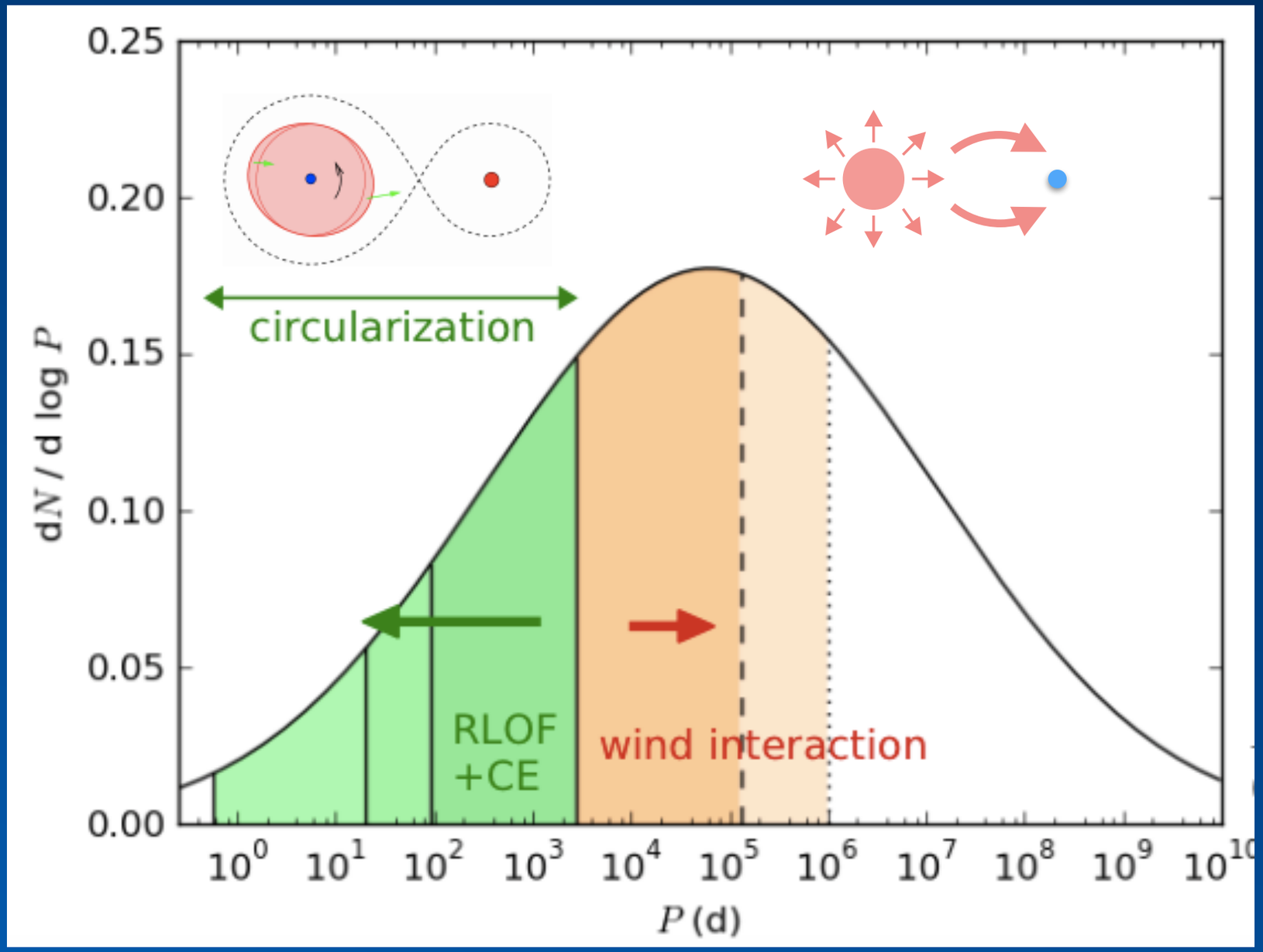
Close binary => orbit shrinks and circularizes

Binary period distribution



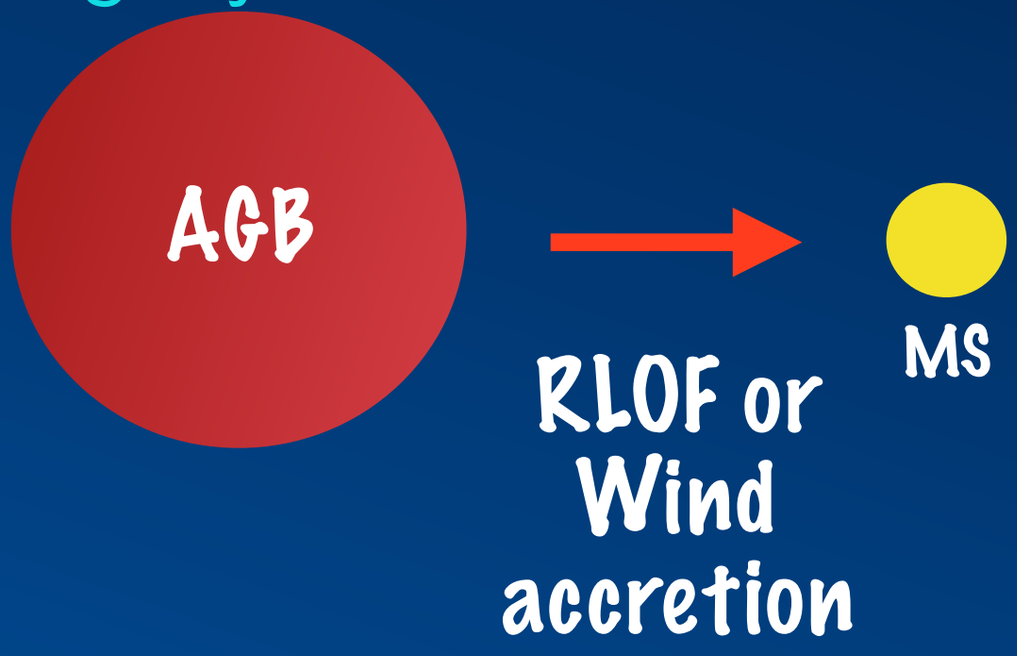
Period distribution for sun-like stars

Pols. O. Evolution of Low and Intermediate Stars, Ulaanbaatar (2014)

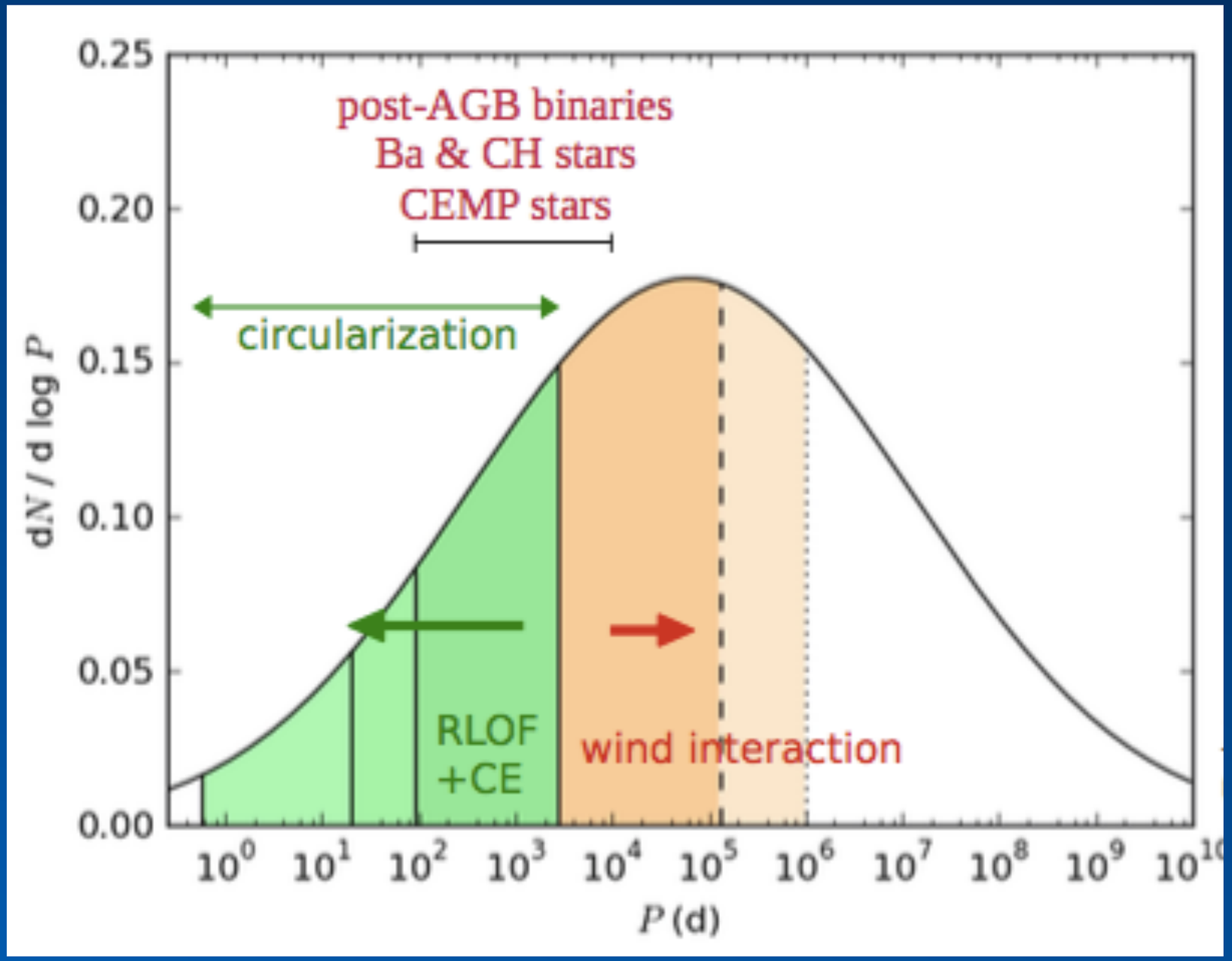
Close binary => orbit shrinks and circularizes

Wide binary => orbit widens

Progeny of AGB stars in binaries



Binary period distribution



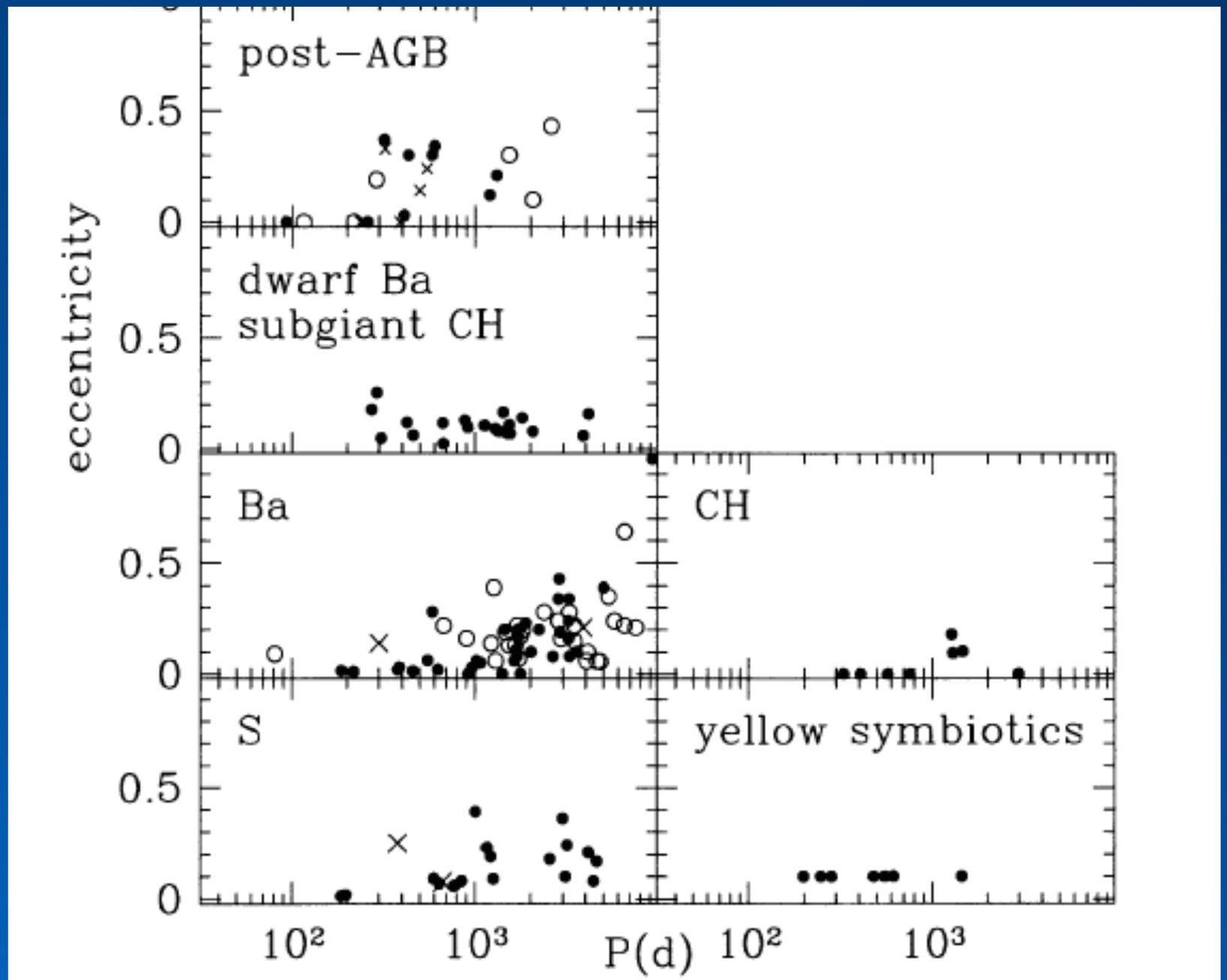
Period distribution for sun-like stars

Pols. O. Evolution of Low and Intermediate Stars, Ulaanbaatar (2014)

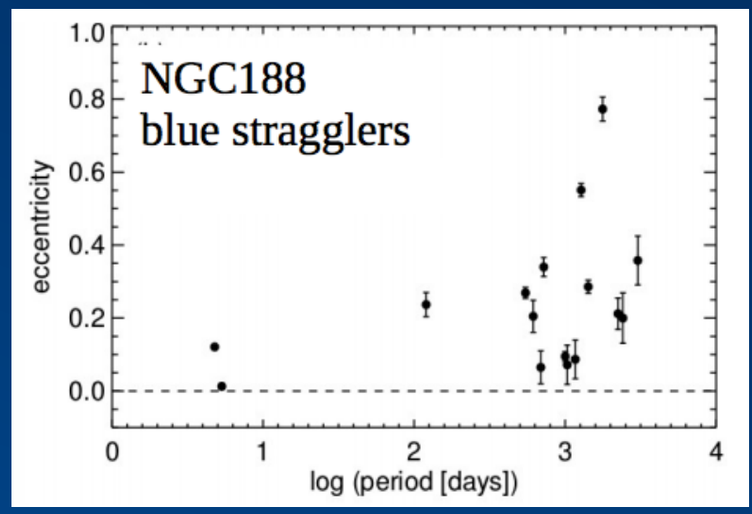
Close binary => orbit shrinks and circularizes

Wide binary => orbit widens

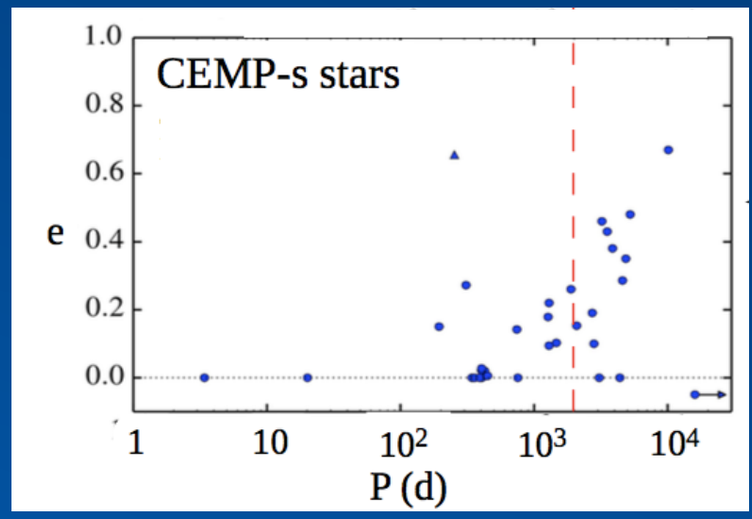
but.. What happens with the progeny of AGBs which are in binary systems?



Jorissen (2003)



Mathieu+Geller (2014)



Jorissen+ (2015)
Hansen+ 2016

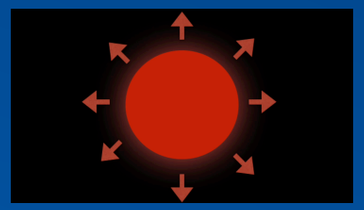
Aim

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.

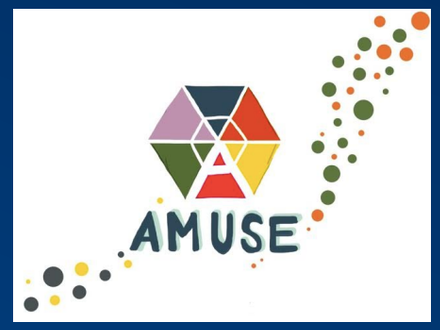
Ingredients & tools

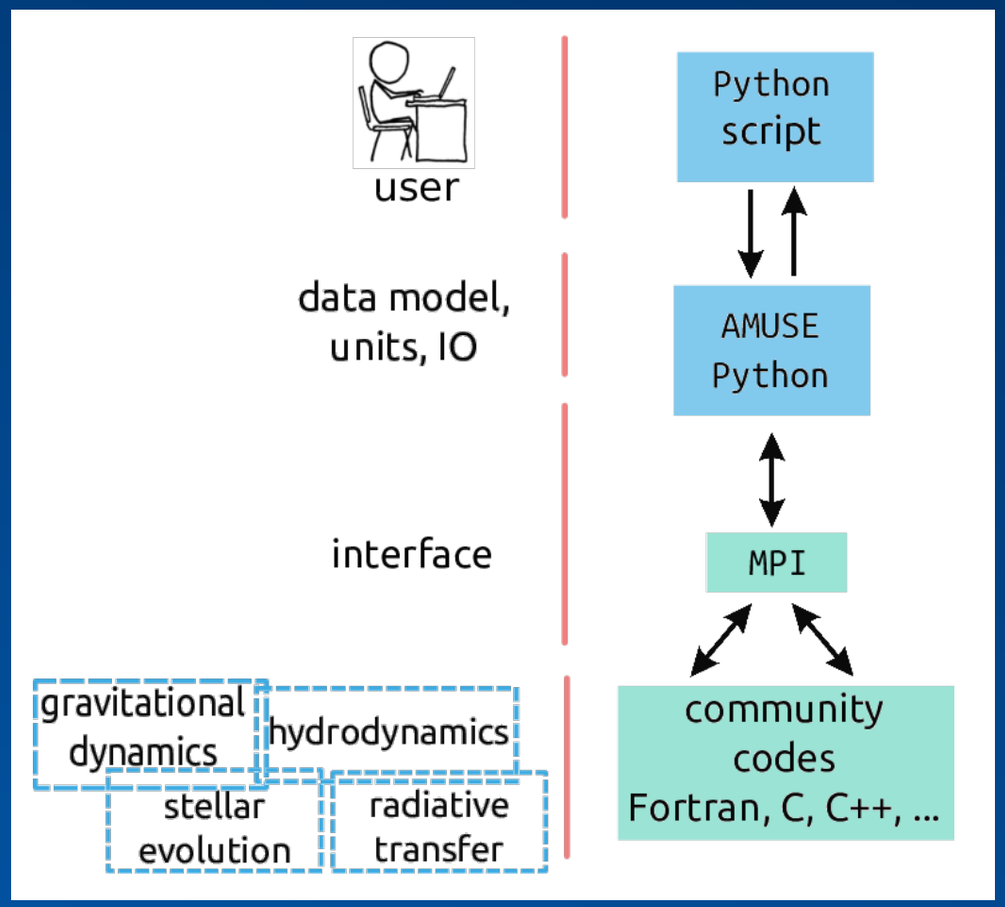
* a) Primary star = AGB star:

Mass loss rate 10^{-7}-10^{-5} MSun/yr
Slow winds ~ 5-30 km/s
no Bondi Hoyle accretion



b) Secondary star = Low mass main sequence star.

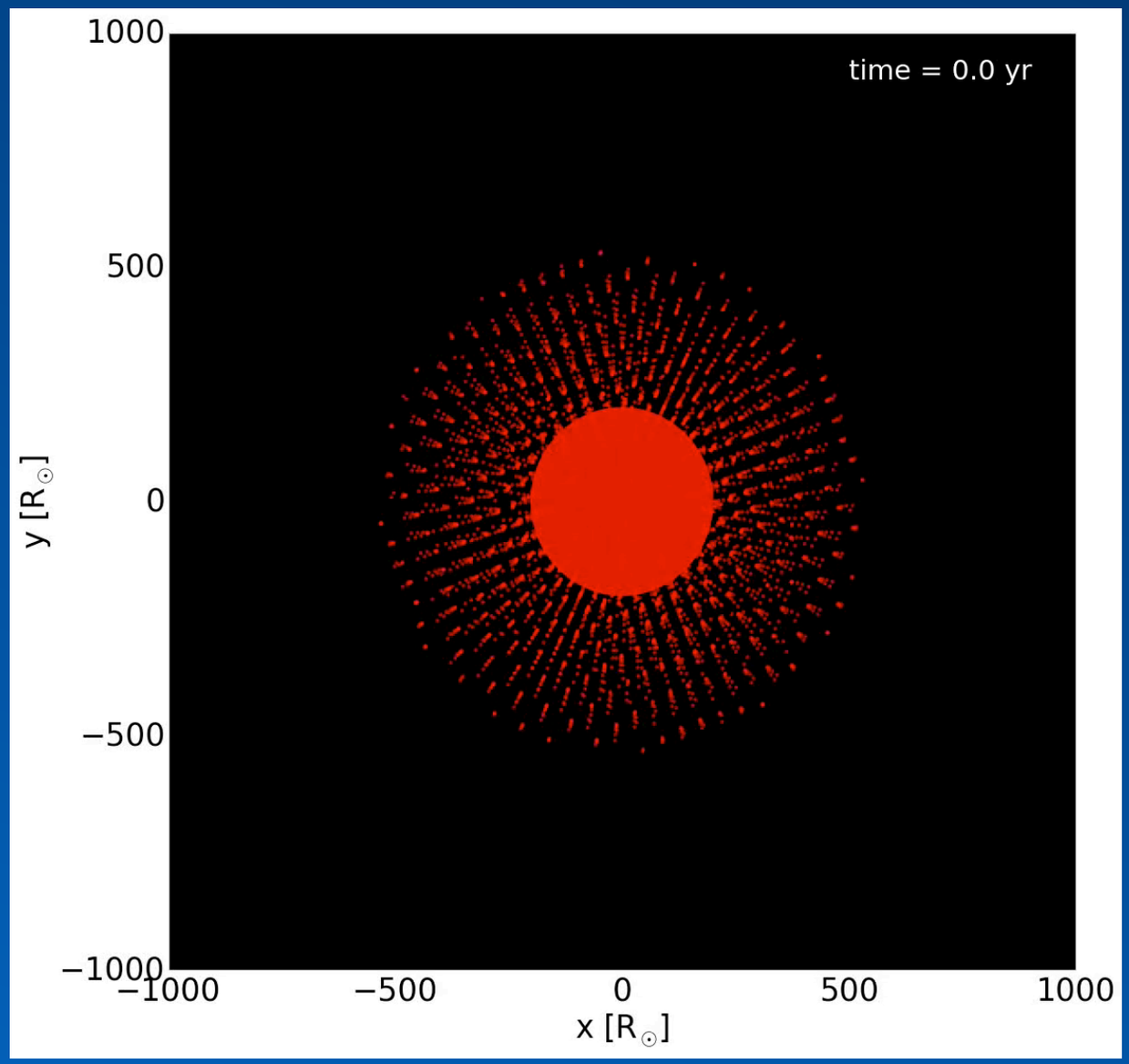


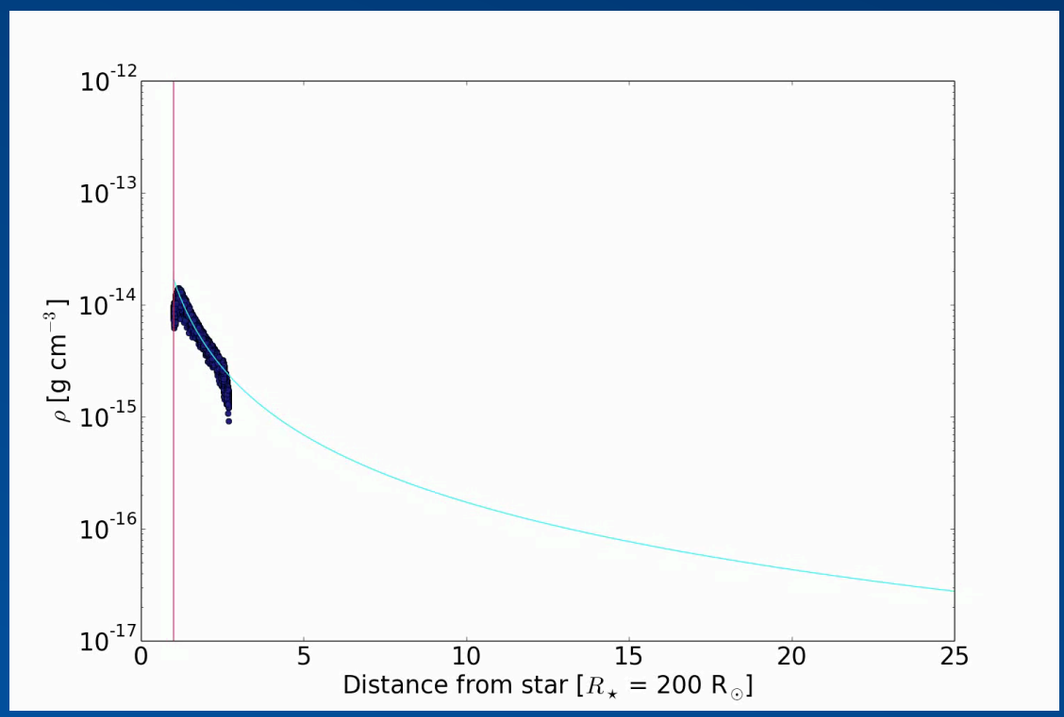


Portegies-Zwart+(2013); Pelupessy+(2013); van Elteren+(2014)

AGB with stellar_wind.py

van der Helm, Saladino + (in prep),
L ü tzgendorf + (2016)

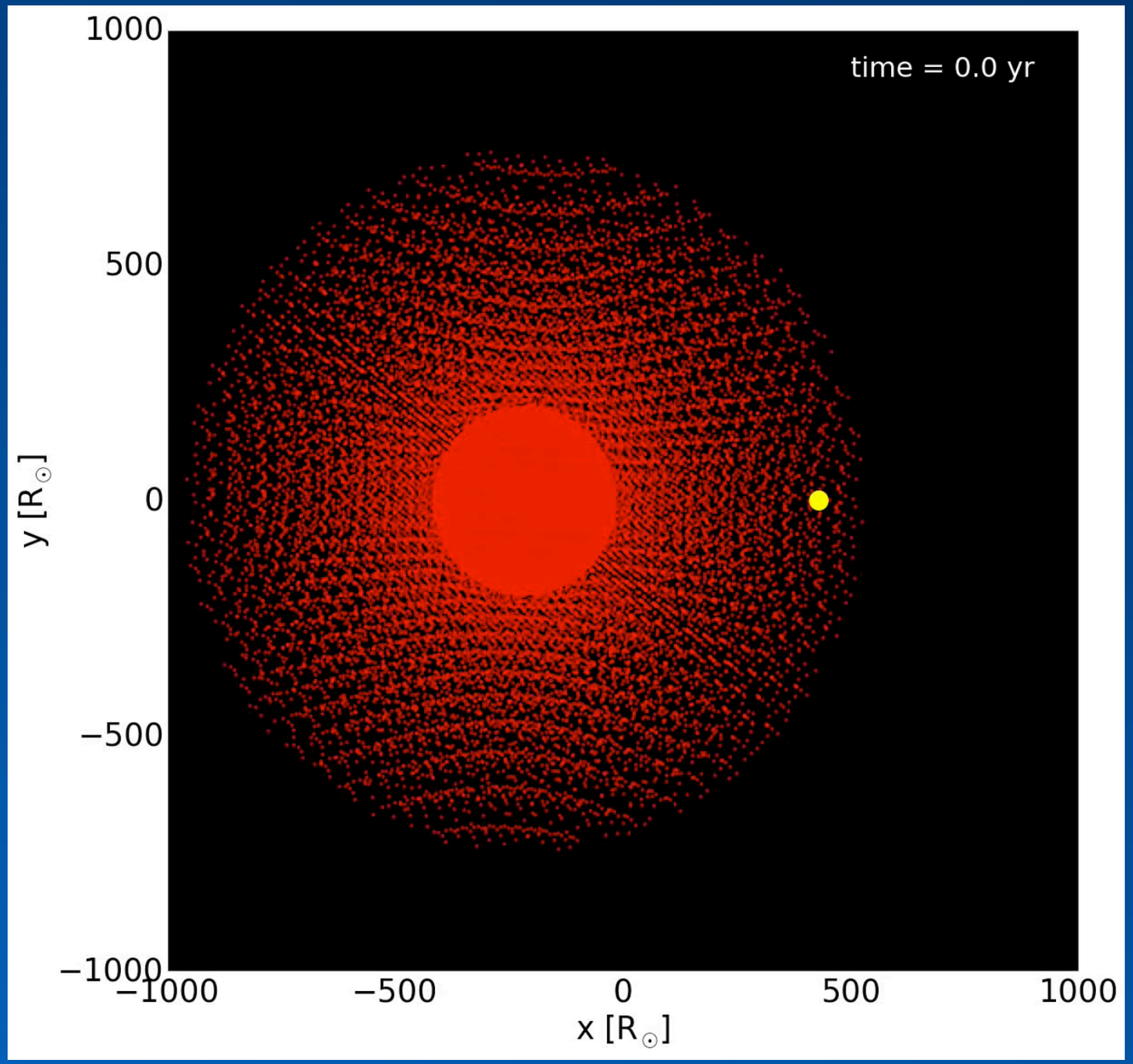




Mass loss rate = 10^{-6} MSun/yr and wind with constant velocity = 15 km/s

Movie in: http://www.astro.ru.nl/~misaladino/movies.html

Binary system



Following Theuns+ (1993)

Primary: 3 MSun, 200 RSun

Secondary: 1.5 MSun

Separation: 3 AU

Eccentricity: 0

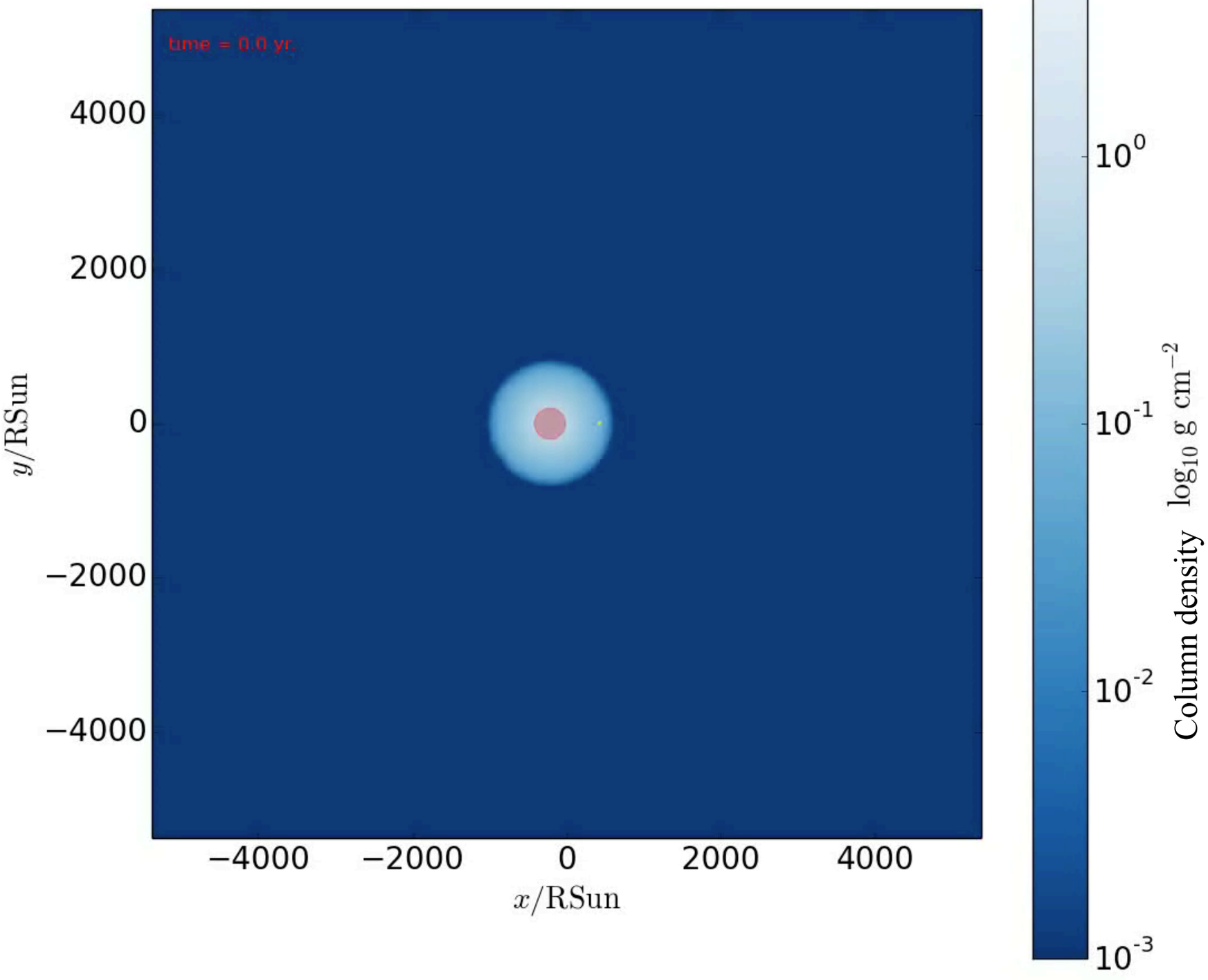
Mass loss rate: 10^{-6} MSun/yr

Velocity: constant 15 kms/s

Includes cooling due to H radiation

(Spitzer 1998, Palla et. al, 1983)

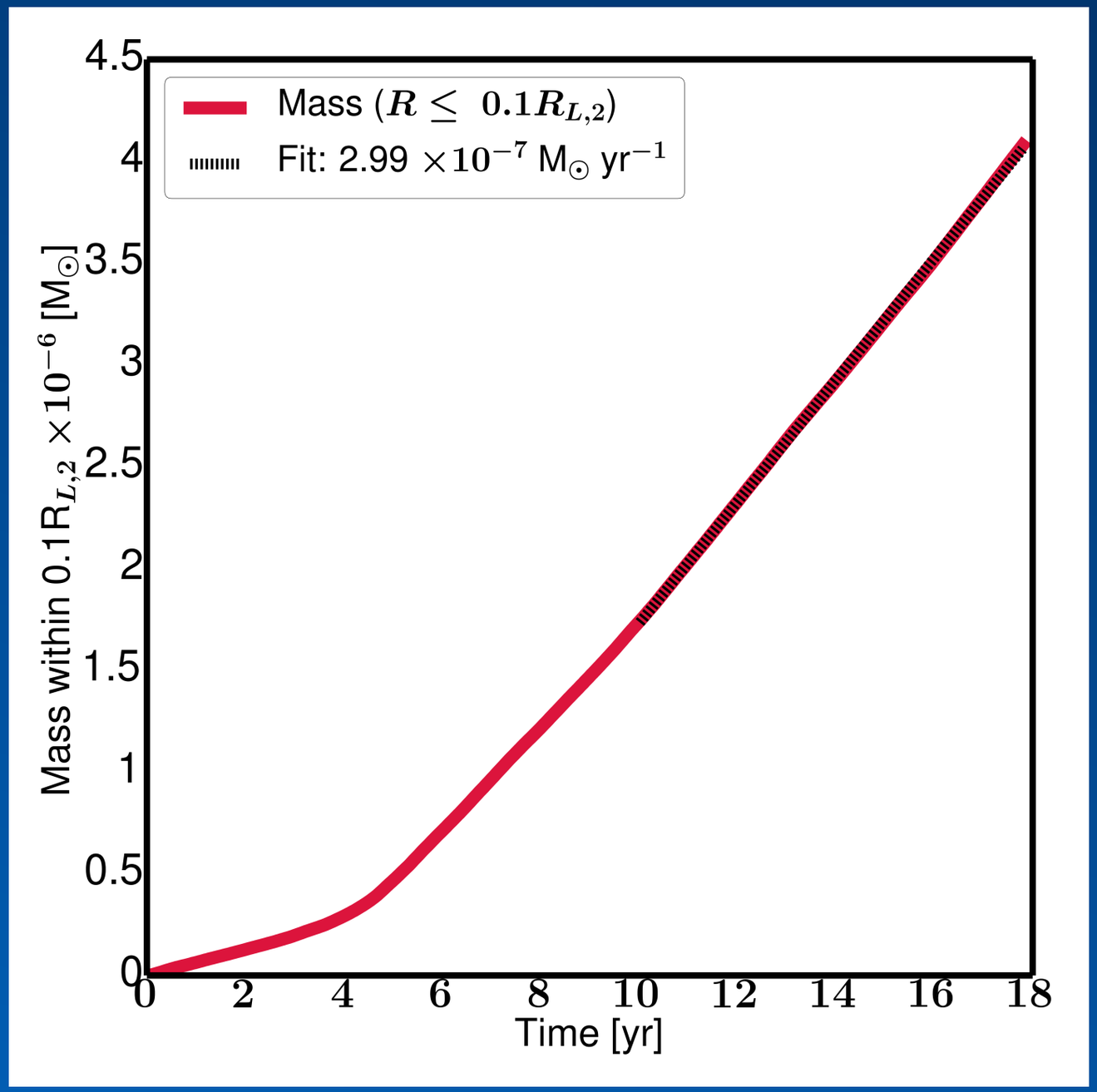
Movie in: http://www.astro.ru.nl/~misaladino/movies.html



Movie in: http://www.astro.ru.nl/~misaladino/movies.html

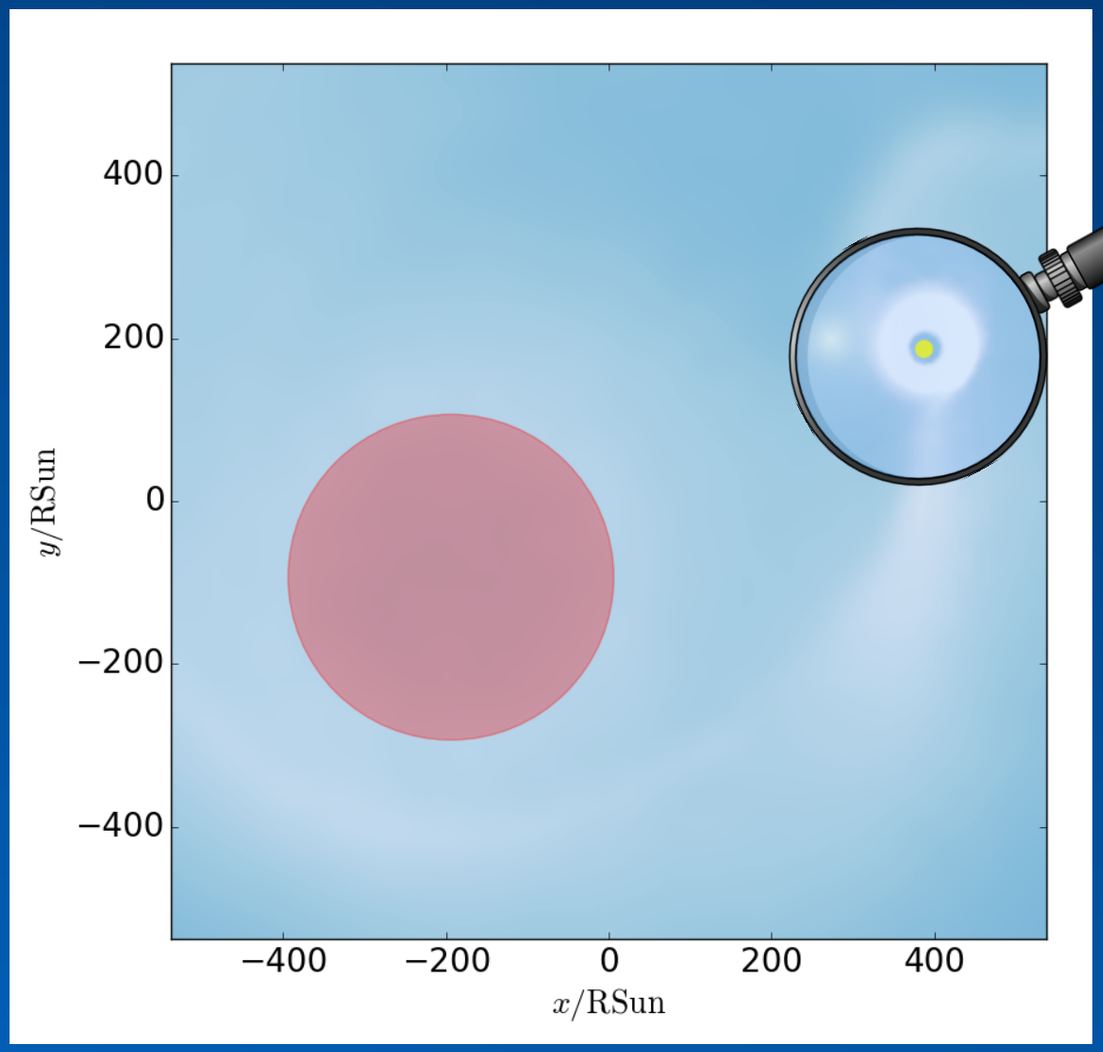
Preliminary results

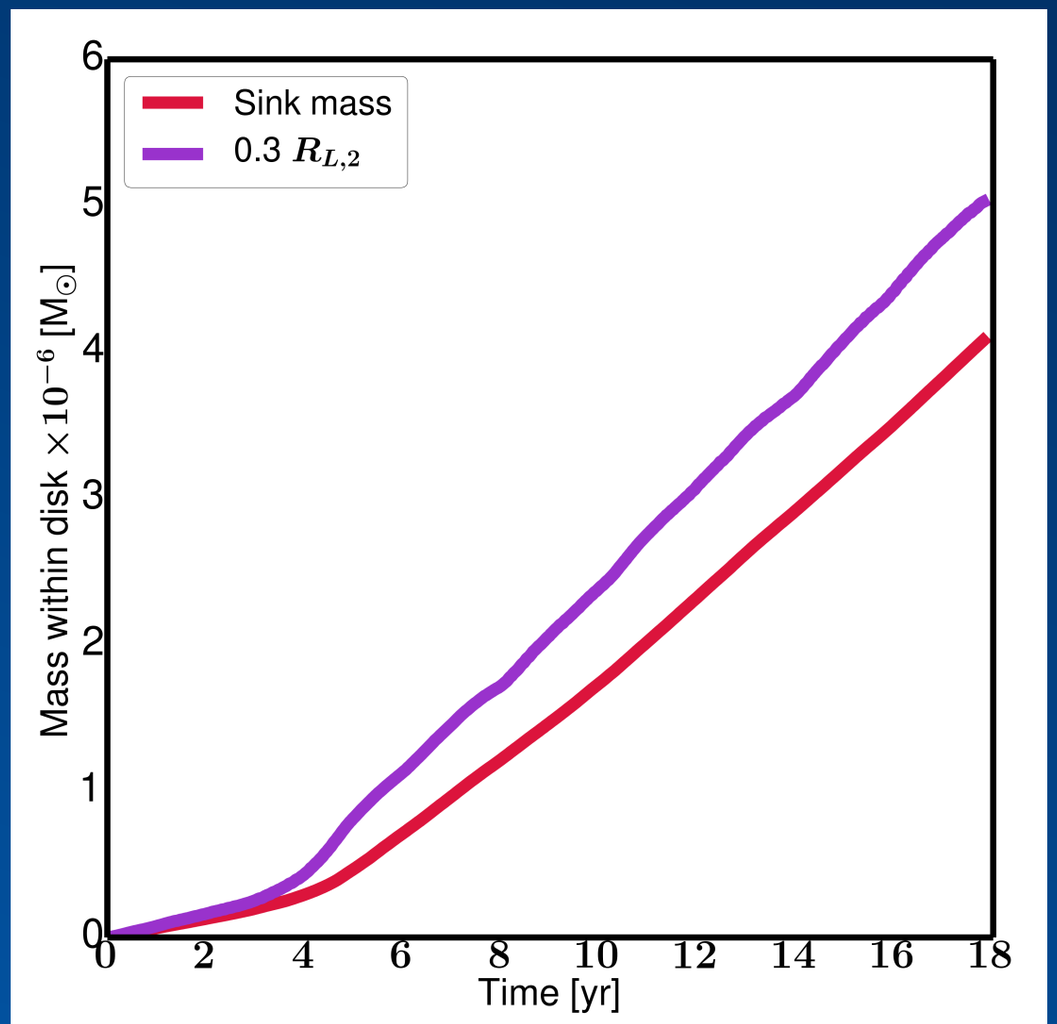
Mass accreted onto companion



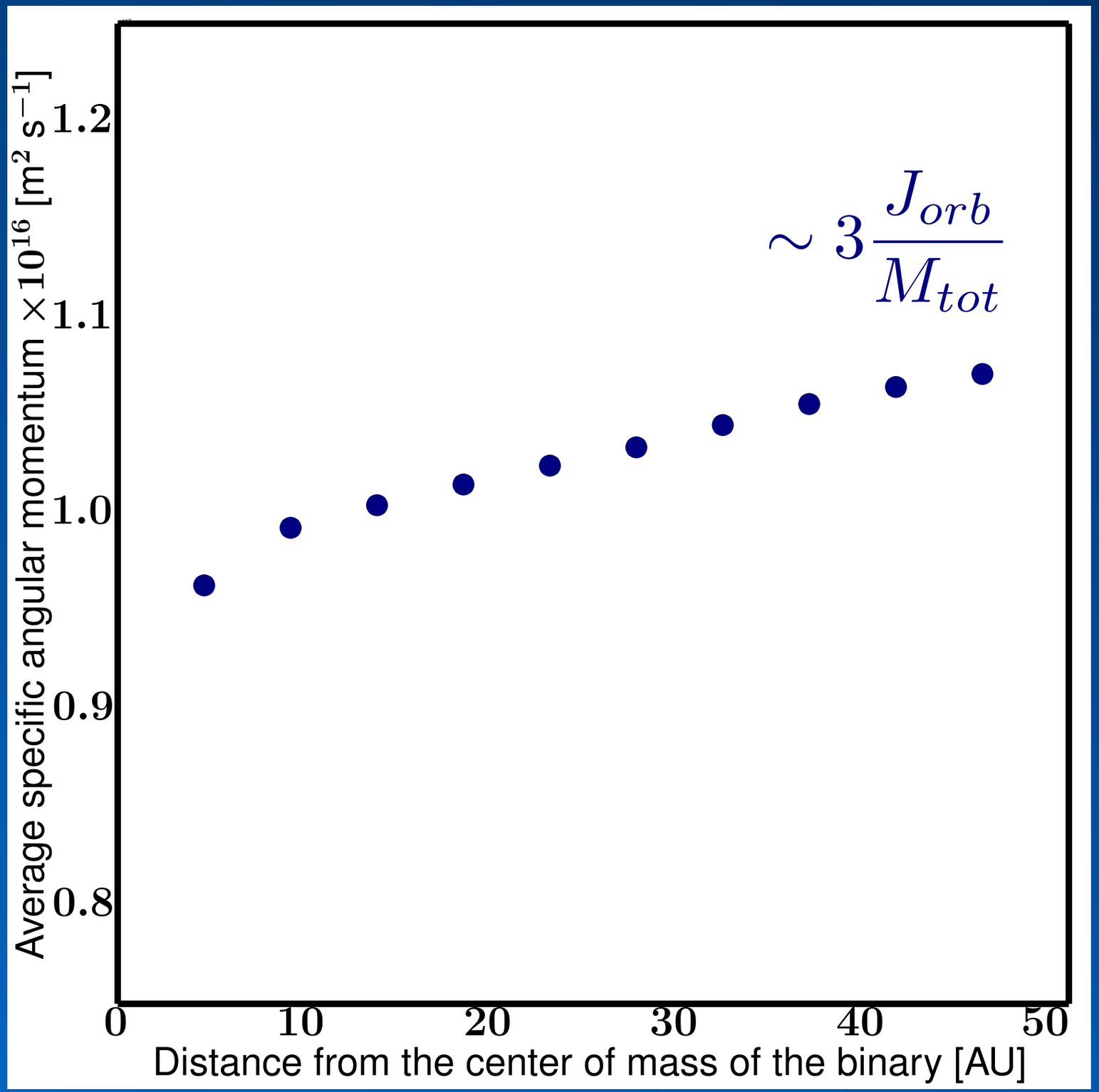
Note: is an upper limit

Size and mass of accretion disk





Specific angular momentum loss



Orbit shrinks

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.