Influence of

Magnetic Fields

on close binary evolution

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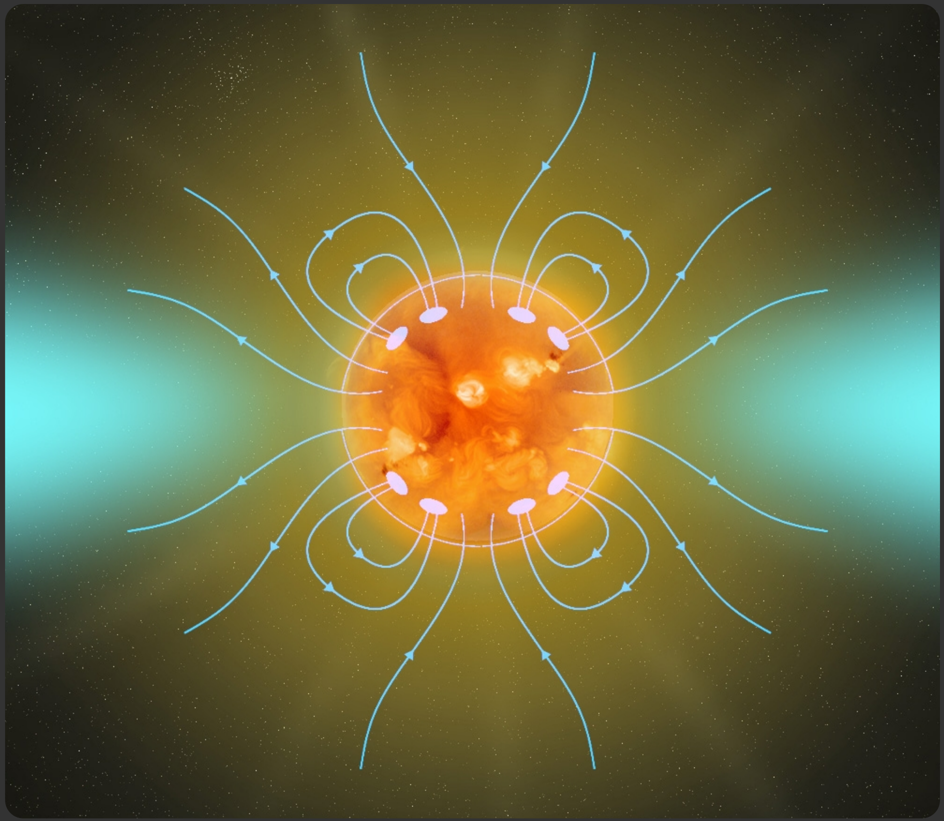
Important Driver: Magnetic Braking

We need three ingredients:



1^{st}: winds

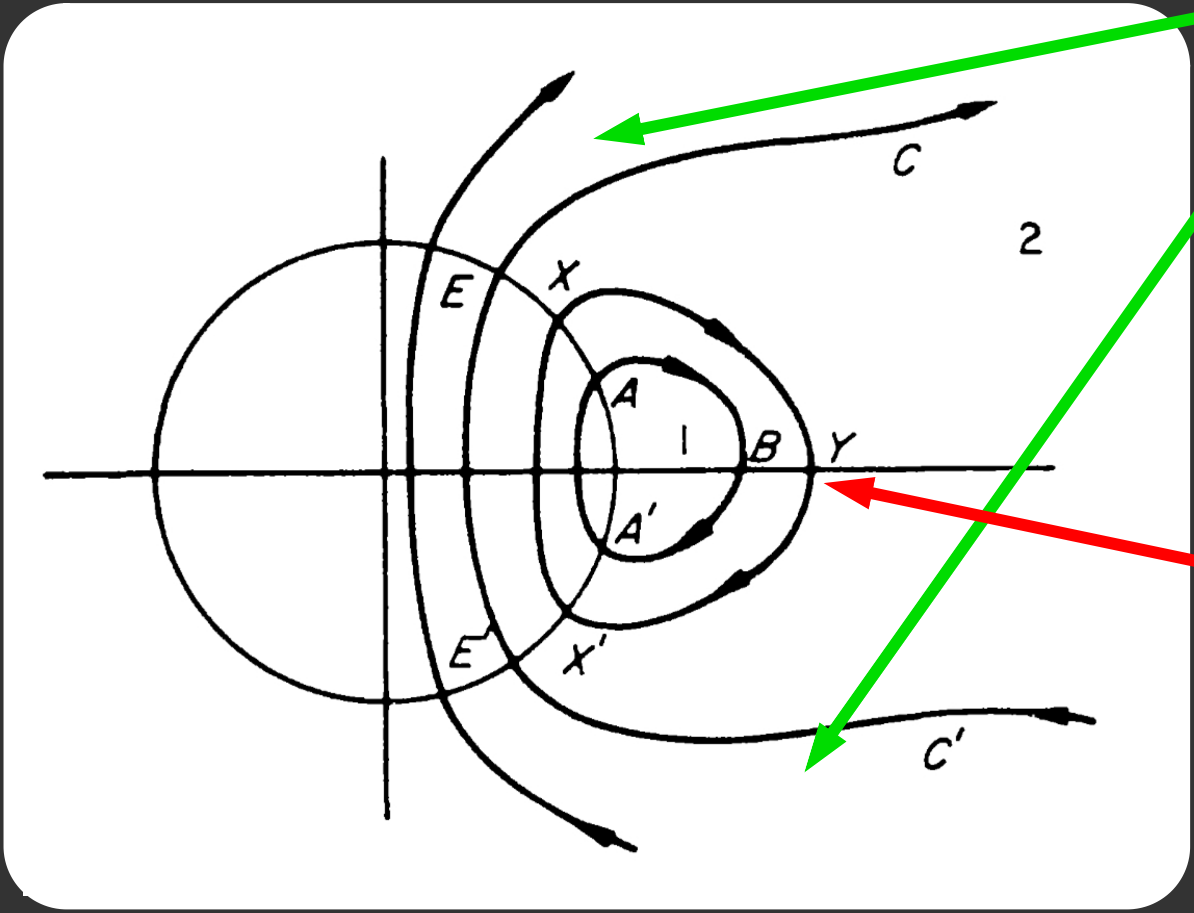
2^{nd}: rotation

3^{rd}: magnetic field

CONDITION: convective envelope

IMPORTANT DRIVER: MAGNETIC BRAKING

Standard Magnetic Braking



Mestel 1968

wind zone

open lines:

angular momentum

is carried off

dead zone

closed lines:

gas remains in the

system

Important Driver: Magnetic Braking

Orbital period changes in close binaries!

strong tides

$\rightarrow$ *synchronization*

star angular momentum loss

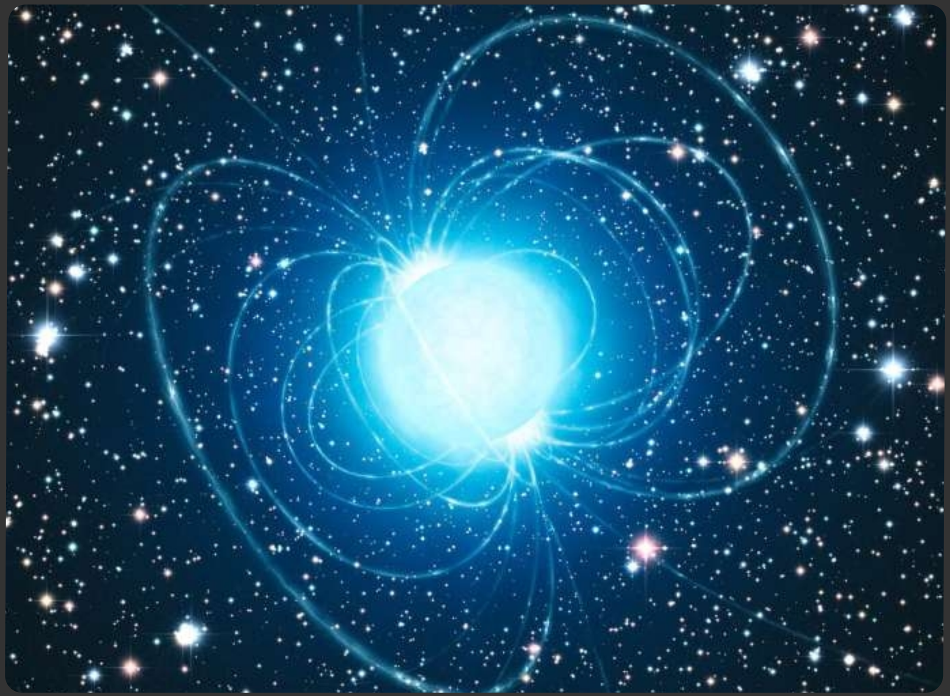
$\rightarrow$ *orbital angular momentum loss*

Orbital period decreases,

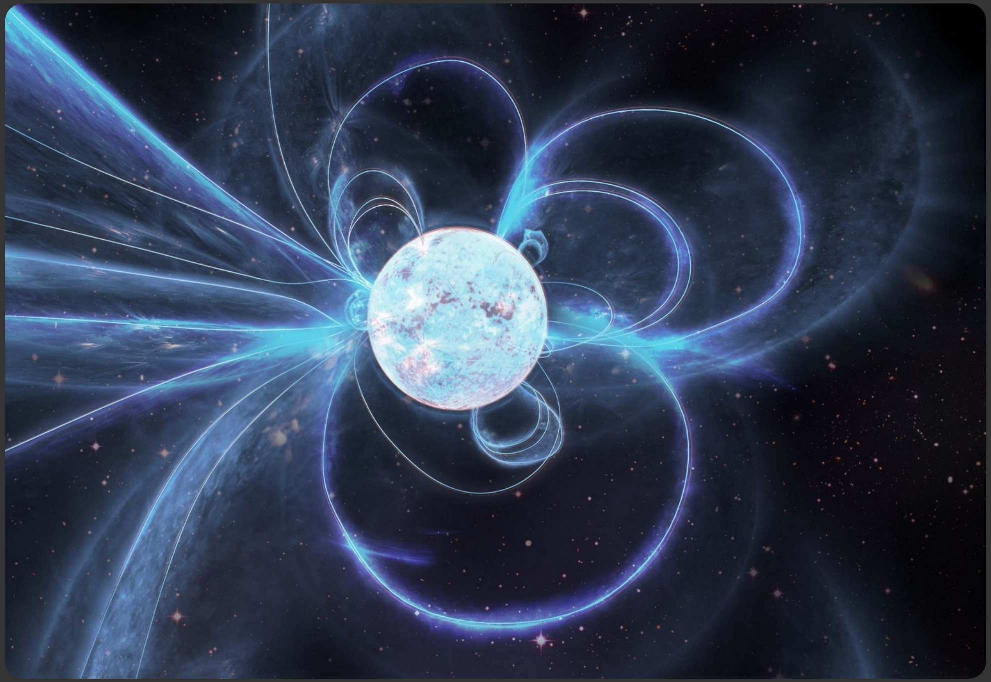
while star is spun up

Close Binaries: With Stellar Remnant

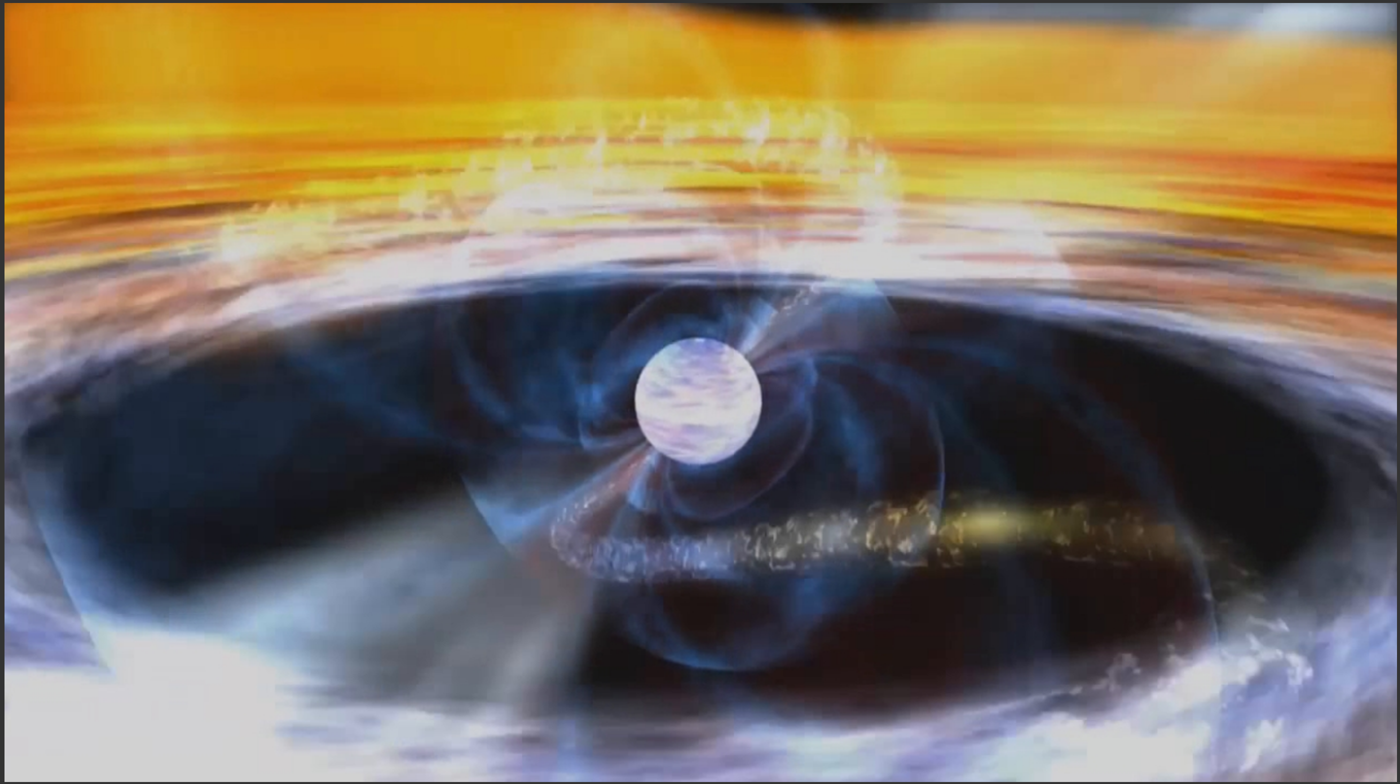
White Dwarf



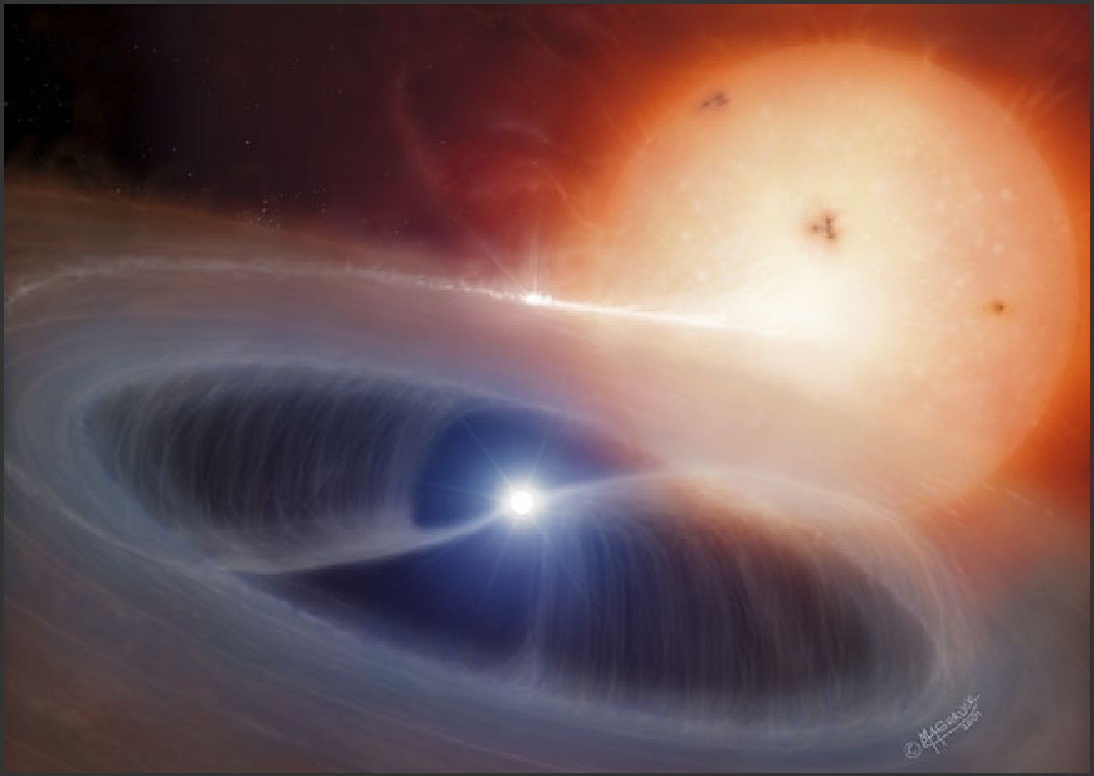
Neutron Star



Close Binaries: With Neutron Stars

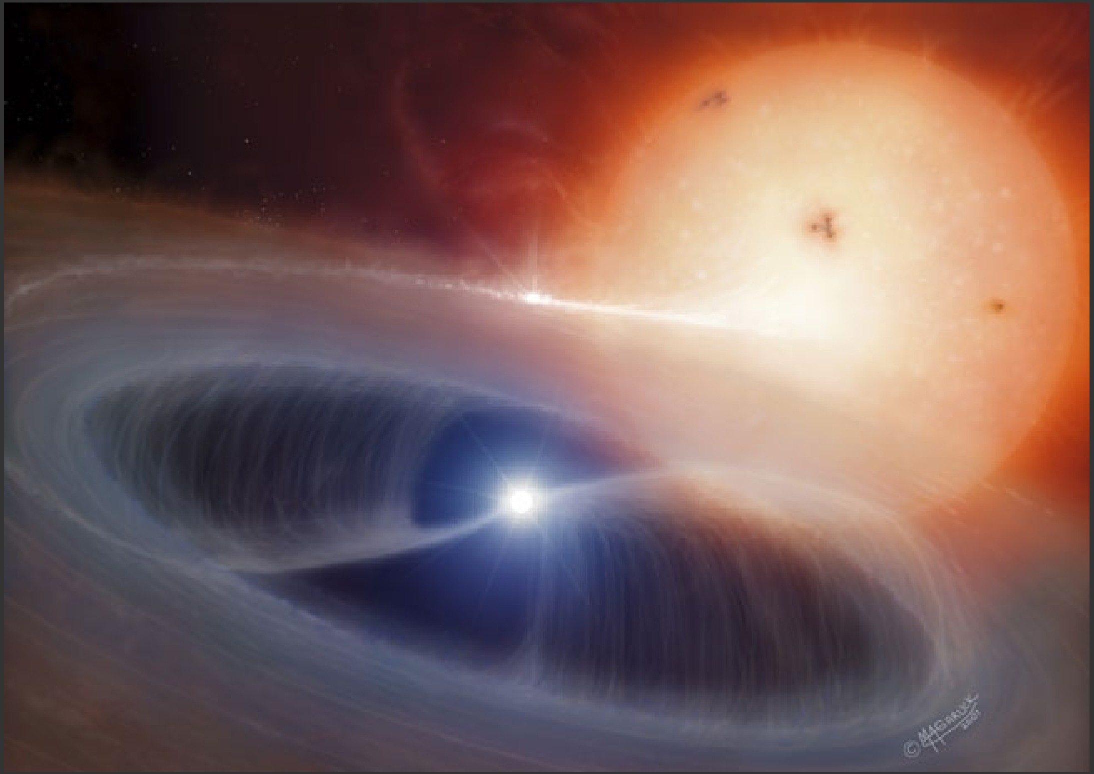


Close Binaries: With White Dwarfs



Close Binaries: With White Dwarfs

Is this always the case?



Close Binaries: With White Dwarfs

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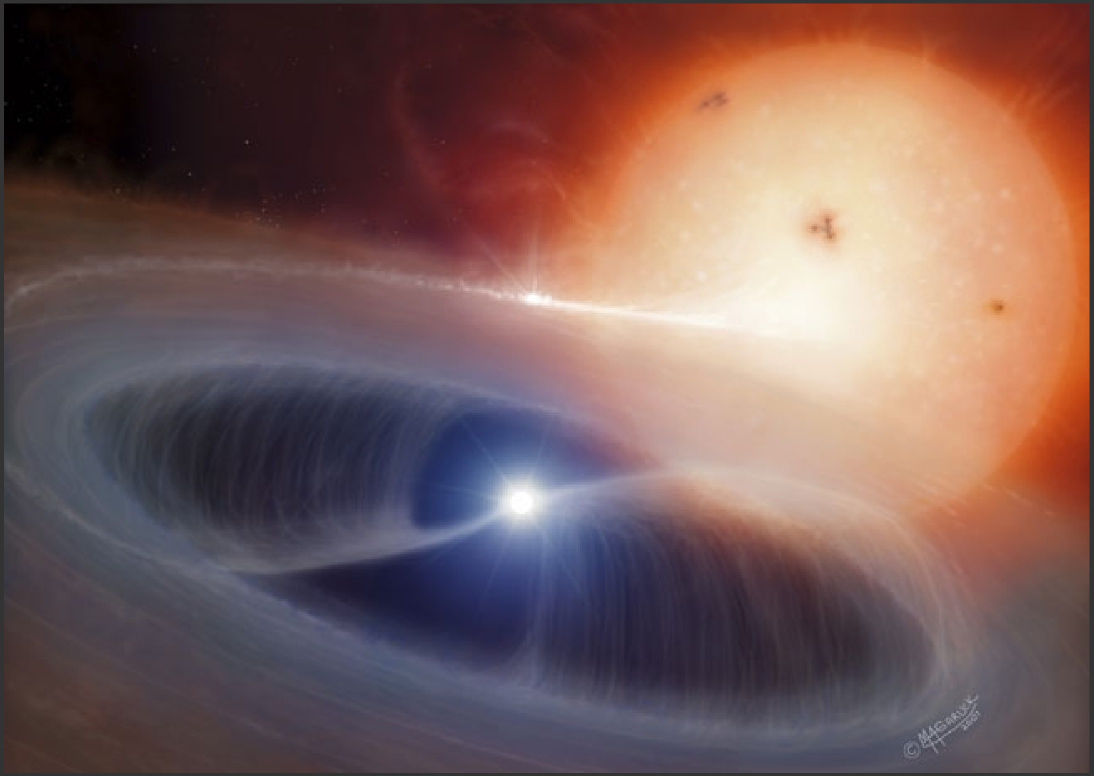
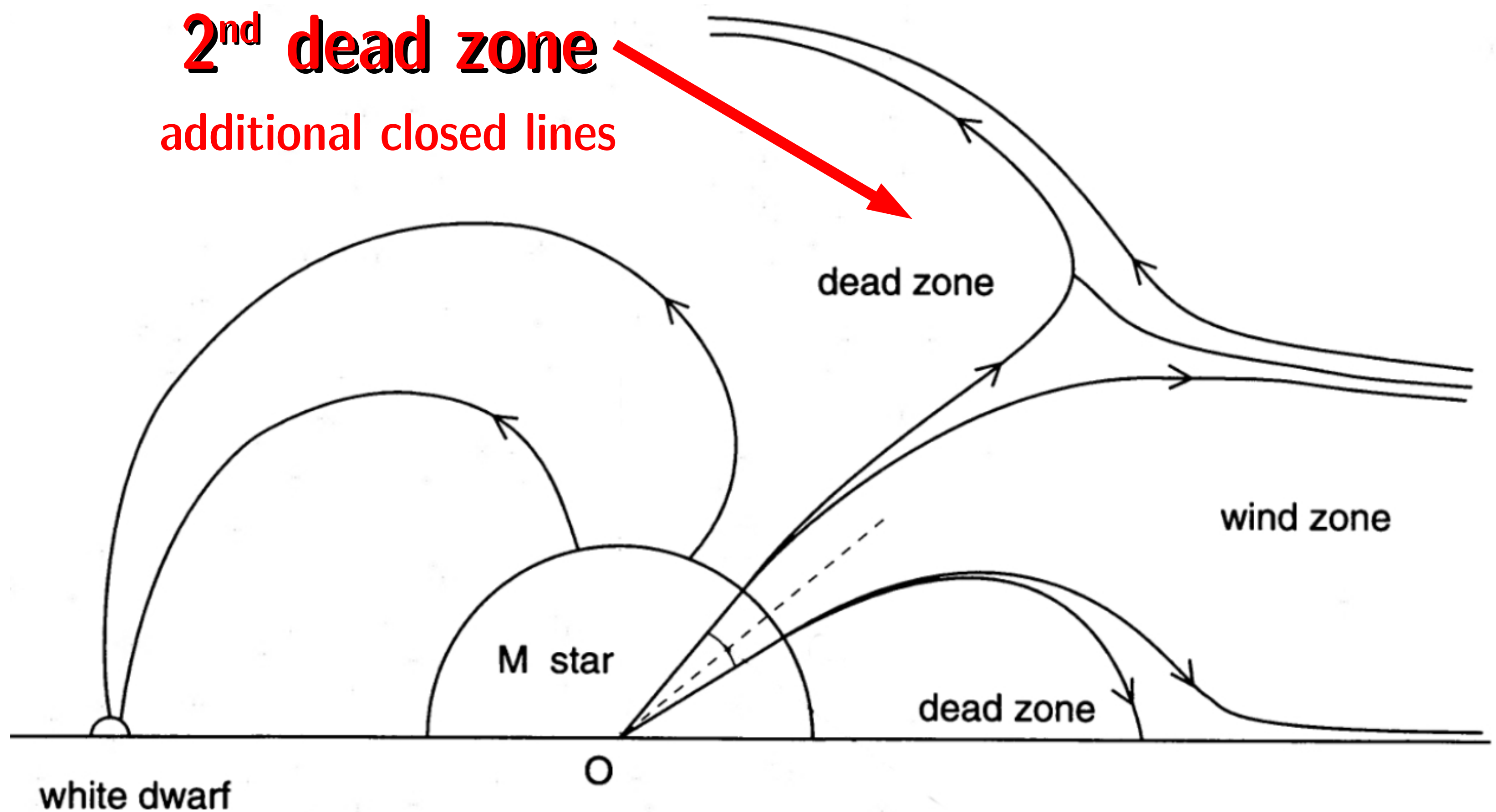


Close Binaries: With White Dwarfs

Everything changes if magnetic moment is sufficiently strong!



Li, Wu & Wickramasinghe 1994

Close Binaries: With White Dwarfs

Everything changes if magnetic moment is sufficiently strong!

Can we confirm this?

Close Binaries: With White Dwarfs

Everything changes if magnetic moment is sufficiently strong!

Can we confirm this?

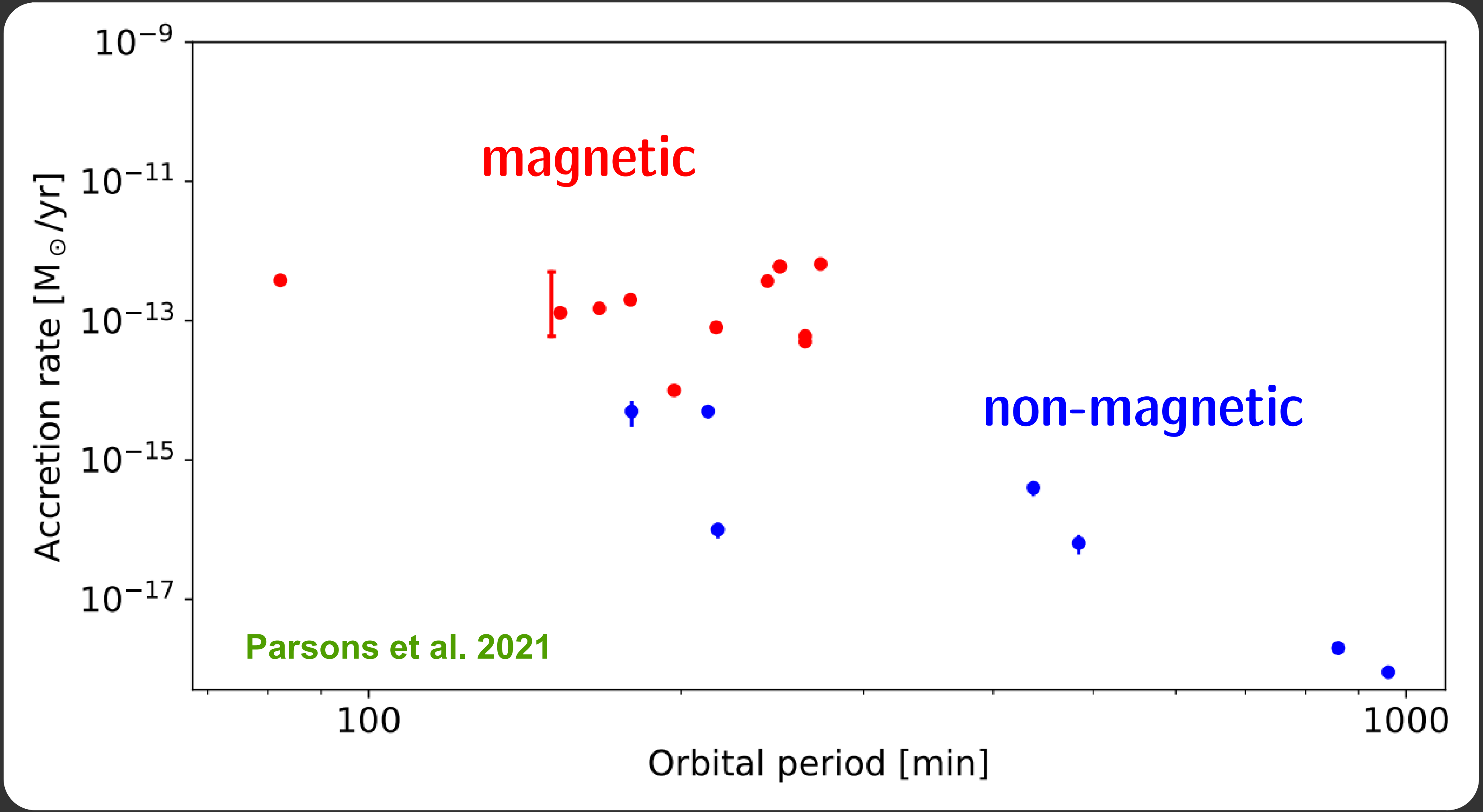
→ Wind Accretion

→ Orbital Period Distribution

→ Mass Transfer Rate

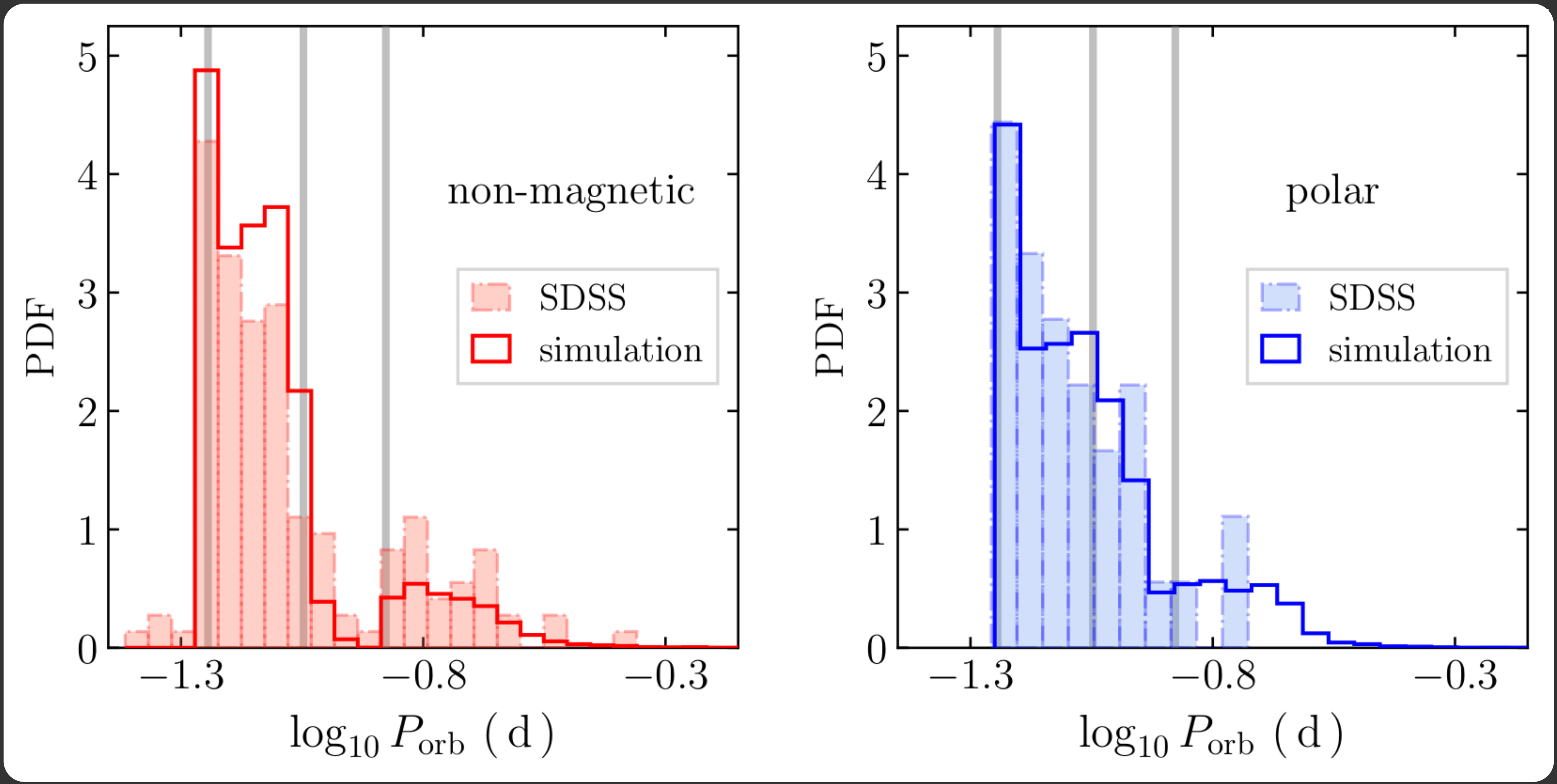
Close Binaries: With White Dwarfs

Wind Accretion in detached binaries



Close Binaries: With White Dwarfs

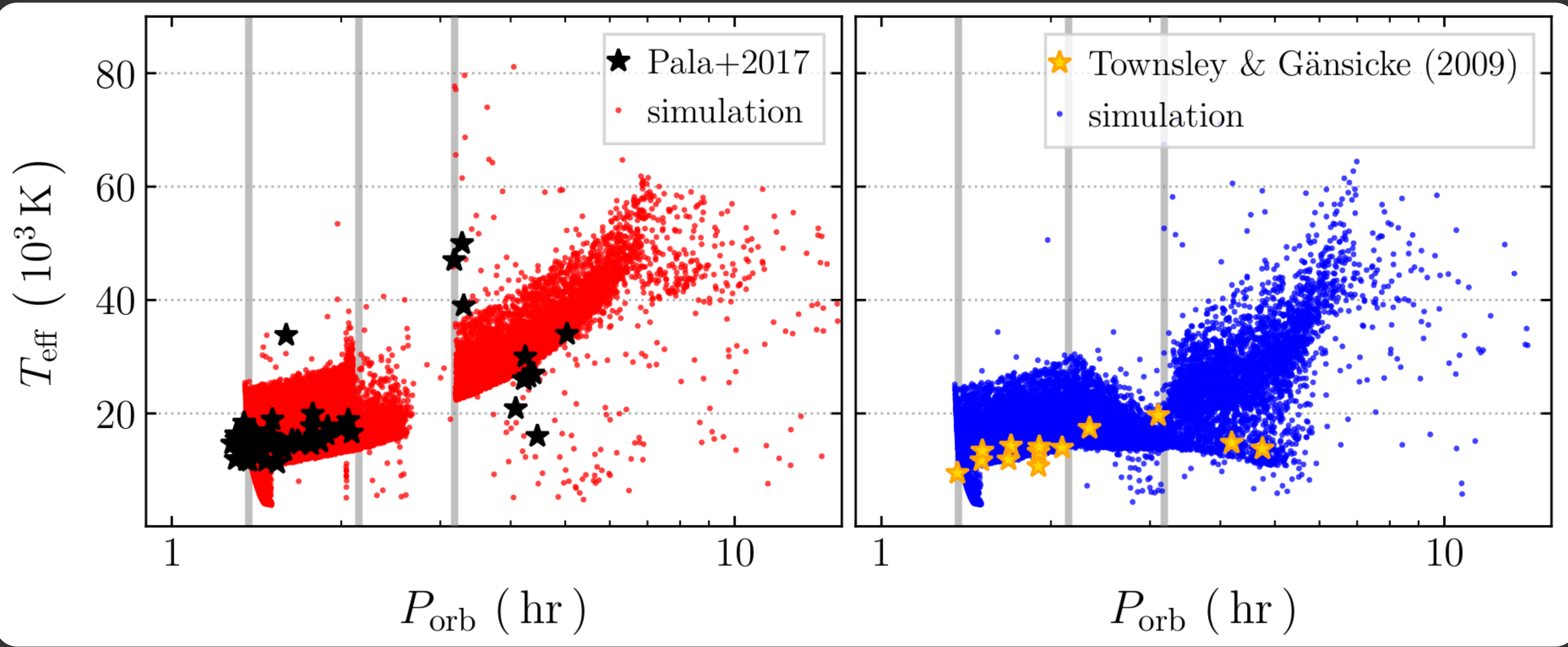
Orbital period distribution of semi-detached binaries



Belloni et al. 2020

Close Binaries: With White Dwarfs

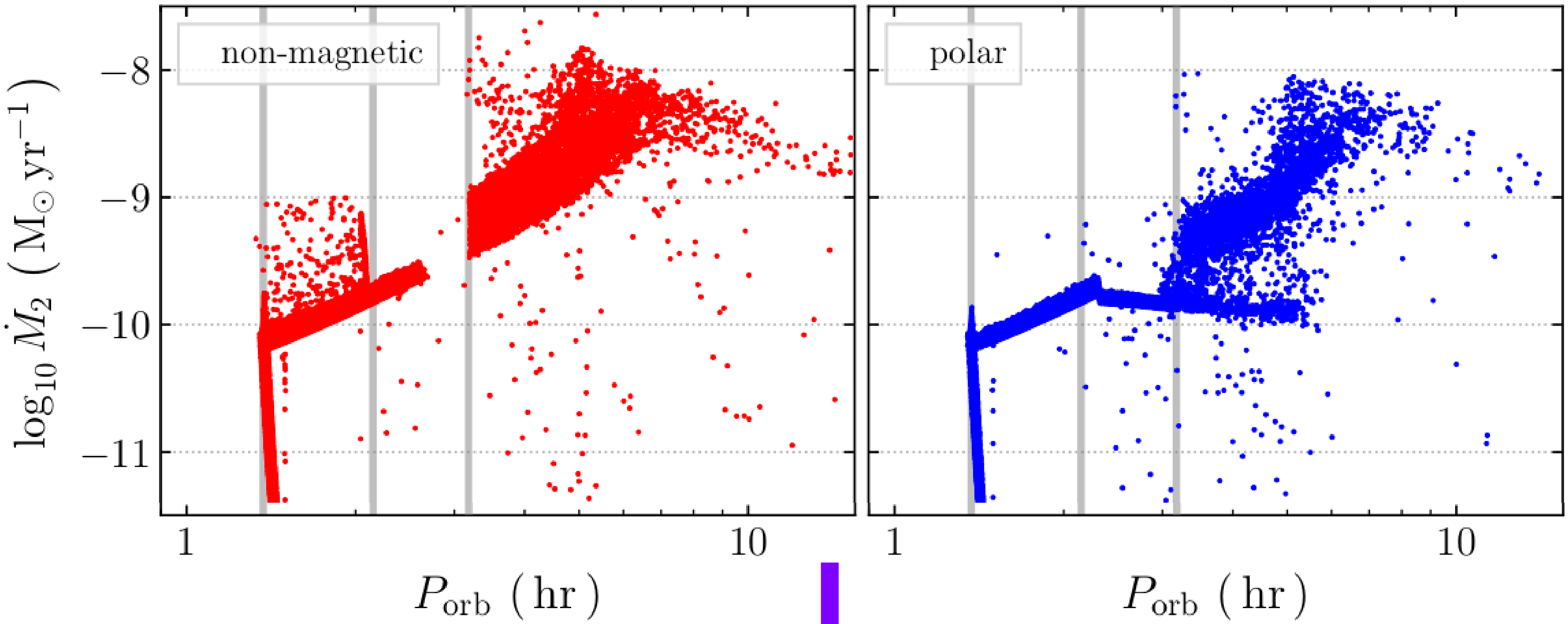
"Mass transfer rate" of semi-detached binaries



Belloni et al. 2020

CONCLUSION

Magnetic fields play a major role in most close binaries!



compressional heating

$$\frac{T_{\rm eff}}{\rm K} = 1.7 \times 10^4 \left(\frac{\langle \dot{M}_2 \rangle}{10^{-10}\, M_\odot\, {\rm yr}^{-1}} \right)^{0.25} \left(\frac{M_{\rm WD}}{0.9\, M_\odot} \right)$$

Townsley & Gänsicke 2009