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■ [title] ■

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ABSTRACT

■ [TBD] ■ ■ [Christian, make an ORCiD account and add the number in squared bracket to your author. Decide now if you want to publish as C. Burt or C. A. Burt (you should then stick with it for the rest of your career)] ■

1. MASS TRANSFER BETWEEN [**VERY MASSIVE STARS ~~BINARY BLACK HOLE PROGENITORS~~**]

Binary stars with a sufficiently small [**orbital separation ~~radius~~**] undergo a mass transfer phase in which one donor star transfers mass to an accretor star. For massive stars ($> 30 M_\odot$), this occurs in two cases [**this is not correct, to most people a 3Msun star is massive and could also have case C**]. Case A mass transfer occurs while the donor star is in the main sequence[**, while c**]ase B mass transfer occurs while the donor star is burning helium in its core [**Kippenhahn & Weigert (1967)**]. In both cases, the radius of the [**which star?**] star expands, eventually overflowing its Roche Lobe, allowing for the surface to become gravitationally bound to the accretor [**logical order: maybe first describe the radius expansion, then the filling of the Roche lobe, then introduce case A/B**]. The accretor gains the mass lost by the donor until the masses are equal [**no, typically until m2=1.1*(m2 before RLOF), see Packet (1981)**], or the mass gainer cannot accrete due to increased rotational velocity caused by angular momentum conservation. The [**increase in total mass of the accretor, typically a main sequence star during RLOF, causes by the virial theorem an increase in its central temperature and thus in the extent of core-convection resulting in access to more nuclear fuel and ~~accreted mass has been observed to~~ elongation of the lifespan of the star (Neo et al. 1977 but see also Braun & Langer 1995) and potentially modifying its internal structure and future evolution (Renzo et al. 2023; ?; Wagg et al. 2024; Landri et al. 2024; Nathaniel et al. 2024, e.g.,).**]

[**slow down a bit and reorder: first state that typically case B is the most common, because stars expand most post-main sequence in the Herzsprung gap (van den Heuvel 1969) then say something like "however the more massive the star, the greater radial expansion on the main sequence" (e.g., Brott et al. 2011) resulting in a change in the ratio of number of systems going through case A vs. case B with initial donor mass (de Mink et al. 2008). Please rephrase the paragraph below**]

[**probably already from the "introduction" we need to say why we care, why would readers care? binary interactions are crucial to the formation of GW sources, and in particular for BBH stable mass transfer may dominate ??**]

The relative proportion of case A mass transfer in comparison to case B mass transfer increases with mass of the donor star. This is expected, as larger stars see greater rates of radial expansion during the main sequence. This has a significant side effect for stars with ($\gtrsim 75 M_\odot$), case A mass transfer occurs in all possible mass transfer processes. For stars of lesser mass, the thermal expansion of the star at the end of the main sequence expands the star beyond its maximum radius during the main sequence. However, for stars in this mass range, the radius expands drastically during the main sequence, such that the maximum radius during the main sequence and helium core burning phase are similar.

[**maybe here you need to explain a bit what we do in this research note before jumping in the results!**] **■ [Describe the models you run (which input physics, which code) with and without overshooting, and the pols+98 models (just reference)] ■**

[**here you want to make sure to not confuse the readers, so the paragraph above should be phrased as the typical expectation, however, stellar physics uncertainties matter**] Convective [**boundary mixing~~overshooting~~**] has a strong effect on stellar radius Brott et al. (2011); Johnston et al. (2024), which determines Roche lobe overflow. [**There-**

fore ~~Ergo~~], different overshooting models have a great effect on the nature of mass transfer. The model in the [panel] that limits case B for stars with mass ($\gtrsim 75 M_{\odot}$) includes exponential overshooting with constants []. In contrast, the model in the [panel] shows no overshooting and consequently models a star that is much more compact. As a result, a system with no overshooting would allow for case B mass transfer to be observed in all mass ranges

[Can you put some bullet points for what you think should go after this? Some ideas: explain why we plot also Pols+98 models and connect to GWs should be the aim here]

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Figure 1. ■ [TBD] ■