



The Effect of the Initial Orbital Period on the Evolution of Massive Close Binary Systems

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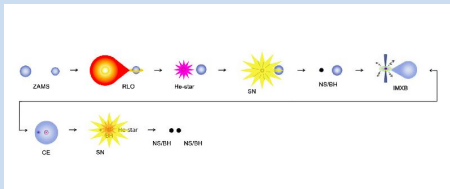


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1. Questions to answer

How does the initial orbital period affect the evolution and final properties of massive close binary systems?

How can massive close binary systems evolve into potential sources of gravitational waves (Petrović 2021, 2023), as observed by the LIGO-Virgo-KAGRA collaborations (Abbott et al. 2021)?



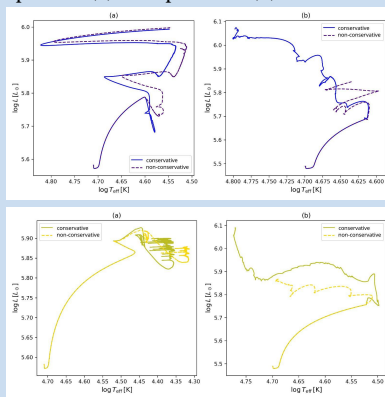
2. Model Grid

MESA

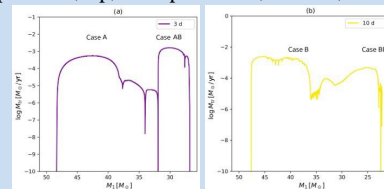
- Initial masses: $50 M_{\odot} + 45 M_{\odot}$
- Initial orbital period: 3-10 d
- **Conservative** and **non-conservative** models (accretion efficiency = 10%)
- Metallicity of the Small Magellanic Clouds (SMC): **0.0021**
- **Modules for Experiments in Stellar Astrophysics (MESA;** Paxton et al. 2011)
- Evolution of the primary and secondary stars from **zero-age main sequence (ZAMS)** to the formation of a **carbon-oxygen (CO) core** in the primary

3. Results

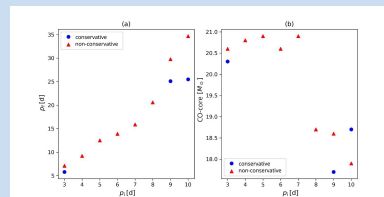
Different cases of mass transfer for non-conservative models with $p = 3$ d (a) and $p = 10$ d (b)



Evolutionary tracks of the primary (a) and secondary star (b), for systems with $p = 3$ d (top) and $p = 10$ d (bottom)



Final period and CO-core masses for conservative and non-conservative models



- Models with initial $p = 3-9$ d undergo **Case A** mass transfer, while for $p = 10$ d **Case B** occurs
- Final masses: $M_1 = 22-27 M_{\odot}$, $M_2 = 45-70 M_{\odot}$

→ system $50 M_{\odot} + 45 M_{\odot}$ can evolve into a potential source of gravitational waves

4. Conclusions

- **Conservative models:** most evolve into contact systems
- **Non-conservative models:** potential gravitational-wave sources
- Estimated **black hole masses** from primary stars: $\sim 20 M_{\odot}$ (Belczynski et al., 2008)

5. Future work

- Different mass grids
- Including rotation of both components
- Very massive stars ($M > 100 M_{\odot}$)
- Different metallicities

References

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- Belczynski K., Kalogera V., Rasio, Frederic R.A. et al., 2008, ApJS, 174, 223
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- Petrović, J. 2023, SerAJ, 206, 1