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Apsidal Precession in Double White Dwarfs Binaries

FRANCESCA VALSECCHI, WILL FARR, BART WILLEMS, CHRISTOPHER DELOYE, VASSILIKI KALOGERA — Galactic double white dwarfs (DWD) in close orbits are guaranteed gravitational wave (GW) sources for the Laser Interferometer Space Antenna (LISA) detector, with more than 10^4 binaries expected to be detected over the mission's lifetime. Although the majority of them are expected to be circular, dynamical interactions in globular clusters can lead to a sub-population of detectable eccentric DWDs. Here we investigate the potential for probing white dwarf (WD) interiors through apsidal precession in eccentric binaries. For the first time, we analyze the tidal, rotational, and general relativistic (GR) contributions to this process using detailed WD models. We find that apsidal motion can lead to a detectable shift in the emitted GW signal; the effect is stronger for binaries with hot (young) WDs, and weaker for cool (old) WDs. Apsidal motion in cool DWDs is dominated by tides at orbital frequencies above $\sim 10^{-3}$ Hz (10^{-4} Hz for hot WDs). Therefore, only accounting for GR would inevitably lead to a bias in the mass measurements of these GW sources. Furthermore, we find that tidally-induced apsidal precession can be used as a unique probe of WD interiors.

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