Radio Frequency Studies of the Pulsar Binary PSR J1614−2318

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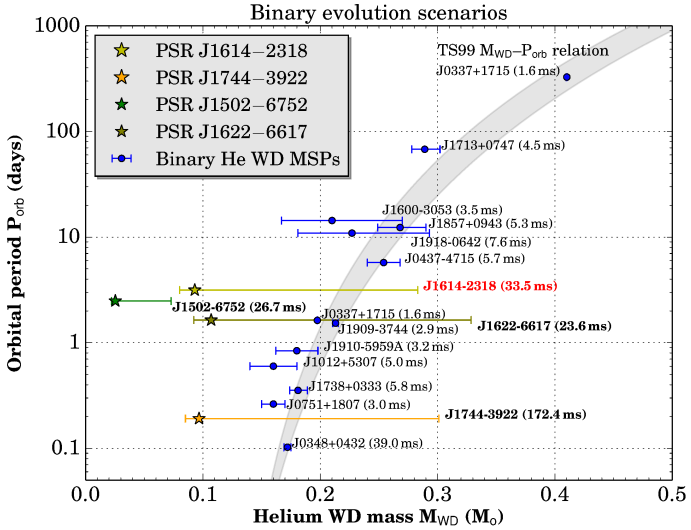

Figure 1: PSR J1614−2318 (labelled in red) is among other three pulsar binaries (non-blue colors) whose orbits must be close to face-on to agree with theoretical expectations (grey region) on the binary orbital period $P_{\rm orb}$ versus companion mass $M_{\rm wd}$ plane. Other binaries with measured Shapiro delays (blue color) all agree with the theoretical curve.

PSR J1614−2318, a radio pulsar binary unexpectedly discovered during the Parkes survey of unidentified EGRET γ-ray sources in 2002 [1, 2], has a number of unique features. Along with a significant (nearly 100%) pulse duty cycle at low frequencies, the binary possesses a very low-mass companion ($M_{\rm c,min} \sim 0.08 M_\odot$) but spins way slower ($P_{\rm spin} = 33.5\,$ms) than what standard evolutionary models predict [3]. Moreover, binary orbital period and companion mass ratio agrees with the theory only at low orbital inclinations (see Fig. 1). We outline 13 years of multi-frequency and radio timing observations of PSR J1614−2318. An optical non-detection of the companion down to the 25th magnitude suggests it is likely a white dwarf, whereas an unmeasured Shapiro delay again signifies the orbit is not close to edge-on. We provide an updated timing solution with multi-wavelength radio profiles, discuss potential multi-component profile distribution as well as possible formation scenarios for such a binary system. Our results suggest an interplay between an aligned rotation, inefficient accretion, and a possibly high-mass neutron star.

References

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