CONSTRAINTS TO POSSIBLE PROGENITOR SYSTEMS OF PSR 1831-00

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Abstract. Numerical computations were carried out to simulate the evolution of the recently discovered radio pulsar binary PSR 1831-00 with a very low mass function (P_{orb} = 1.81 days, Dewey et al. 1986). These show that the minimum value of the initial mass of the progenitor of the mass-losing secondary is about 1 $M_{\odot}$. All computed systems with a final period equal to the observed one, and an initial progenitor mass of 1 $M_{\odot}$ have an age of the order of the Hubble time ($\sim 1.3 \times 10^{10}$ years). For a 1.5 $M_{\odot}$ progenitor of the mass-losing secondary we find that the final (= presently observed) orbital period sets strong constraints to the possible initial system configuration: the binary period should have been such that the 1.5 $M_{\odot}$ star was just at the onset of the over-all contraction phase (P_{orb} = 0.74 days, X_c = 0.05) when it began to fill its Roche-lobe, and the initial mass of the compact mass-accreting star must have been < 0.85 $M_{\odot}$. (This star was then presumably a white dwarf, which later collapsed due to the accretion). For example, the final period and remnant secondary mass for a system with an initial configuration of 1.5 + 0.8 $M_{\odot}$ are 1.83 days and 0.20 $M_{\odot}$, respectively.

If one would start out from a more evolved initial state of the 1.5 $M_{\odot}$ secondary than the end of the overall-contraction phase, the maximum initial mass of the compact object will become drastically smaller and the final remnant mass of the secondary becomes larger than 0.20 $M_{\odot}$ in all cases.

Calculations for a 2.0 $M_{\odot}$ progenitor of the secondary suggest that if such a progenitor can produce the present system, the initial mass of the accreting primary was at maximum 1.30 $M_{\odot}$.

All the calculations were performed with the inclusion of magnetic braking in so far as the extent of the convective envelope allowed this (see Pylyser & Savonije 1986, in preparation). The effects of the explosion effects due to the accretion induced collapse of the white dwarf were not taken into account.

Reference

Dewey, R.J., Maguire, C.M., Rawley, L.A. Stokes, G.H., Taylor, S.H., 1986, preprint.

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