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Arecibo Measurements of Pulsar–White Dwarf Binaries: Evidence for Heavy Neutron Stars

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Abstract. We summarize constraints on neutron star masses from ongoing timing observations of pulsar–white dwarf binaries at Arecibo. The trend is toward pulsar masses larger than the canonical value of $1.35\,\mathrm{M}_\odot$.

We have measured relativistic phenomena (orbital precession, Shapiro delay and/or orbital decay) in Arecibo pulsar timing measurements of several pulsar–white dwarf binary systems. These measurements constrain the pulsar mass, secondary star mass, and orbit inclination. This observing program has been described elsewhere (e.g., Nice et al. 2003, 2005). Here we give a snapshot of our present constraints on stellar masses and orbit inclination (Fig. 1, Table 1). These results include some work done after the conference.

The most compelling case for a high radio pulsar mass is PSR J0751+1807. Its orbital period is changing at a rate of $\dot{P}_\mathrm{b} = (6.2 \pm 0.8) \times 10^{-14}$, due to the emission of gravitational radiation. Shapiro delay is also marginally detected. The resulting pulsar mass measurement, $2.1^{+0.4}_{-0.5}\,M_\odot$ (95% confidence) is substantially higher than the canonical value of $1.35\,M_\odot$. Details will be given in Nice et al. (2005).

Table 1. Mass Measurements from Timing Analysis

Pulsar	Orb. Per. (days)	Ecc.	Pulsar Mass ($\mathrm{M}_\odot$, 95% conf.)	Companion Mass ($\mathrm{M}_\odot$, 95% conf.)
J0621+1002[1]	8.32	0.002 457	$1.7^{+0.6}_{-0.6}$	$0.97^{+0.43}_{-0.24}$
J0751+1807[2]	0.26	0.000 003	$2.1^{+0.4}_{-0.5}$	$0.19^{+0.03}_{-0.03}$
J1713+0747[3]	67.83	0.000 075	$1.3^{+0.4}_{-0.3}$	$0.28^{+0.06}_{-0.04}$
B1855+09[4]	12.33	0.000 022	$1.6^{+0.2}_{-0.2}$	$0.27^{+0.02}_{-0.03}$

References: (1) Splaver et al. 2002, (2) Nice et al. 2005, (3) Splaver et al. 2005, (4) Splaver 2004.

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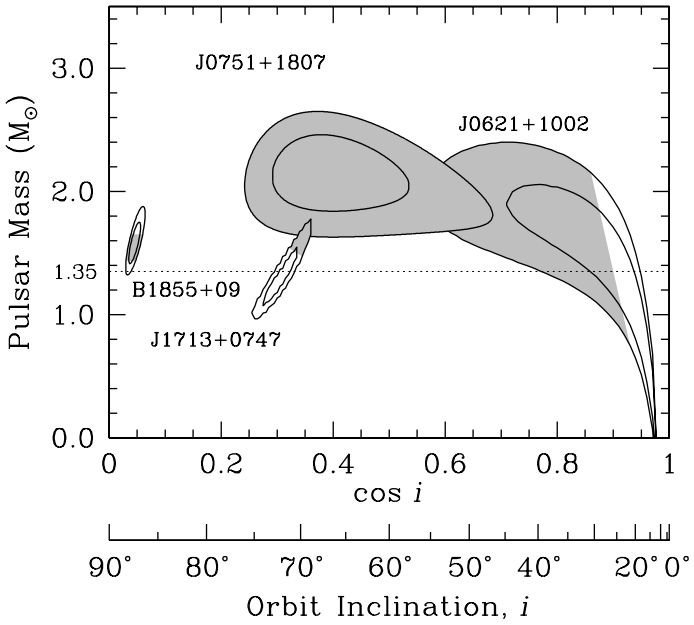

Figure 1. Constraints on pulsar masses and orbit inclinations. Contours indicate 68% and 95% confidence regions. Shaded areas denote theoretical limits from the orbital period–core mass relation (B1855+09 and J1713+0747) and from the assumption that the secondary is a white dwarf (J0621+1002).

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