Observed Luminosity Difference between Isolated and Binary MSPs

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Not the First

We're not the first ones to measure this difference. Several authors have suggested that there may be a luminosity difference between the isolated and binary MSPs (Bailes et al 1997; Kramer et al 1998; Hobbs et al 2004). Bailes et al (1997) find that luminosities of isolated and binary MSPs are different at the 99.5% confidence level, with the isolated MSPs being intrinsically dimmer. We have confirmed their results with an updated catalog.

Scale-height difference? Yes, but it's not real.

If isolated MSPs really are less luminous than binary MSPs, you'd expect that the scale height of known binary MSPs is larger than the scale height of known solitary MSPs. This seems to be the case, as shown in Figure 1. For the pulsars listed, one finds that the standard deviation from zero for the binary MSP population is twice that of the isolated MSP population: 570 +/- 90 pc vs 280 +/- 65 pc. Figure 1 shows a histogram of z for each population. The isolated MSP population is represented in the upper half of the figure, the binary MSP population in the lower half. Also, a simple examination of the median distance of the isolated population (510 pc) compared to the median distance of the binary population (1155 pc) suggests that the isolated MSPs must be less luminous.

(You could, by the way, wonder if this scale-height difference was actually representative of the population. We suggest that it's not. If there was a real scale-height difference you'd also expect the velocities of the two populations to be different, and they're not.)

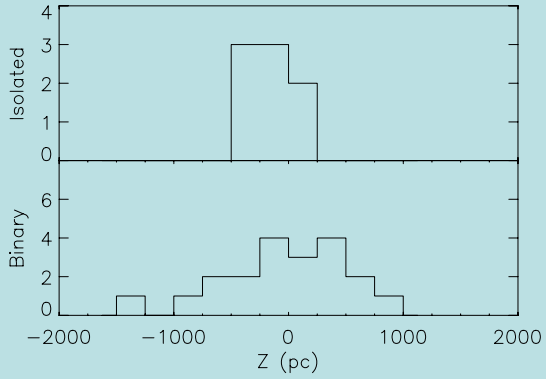

Fig 1
Histograms of height above the galactic plane for the isolated MSP population (upper) and the binary MSP population (lower).

Magnetic Field Difference? Maybe.

If there's a luminosity difference shouldn't we see a magnetic field difference? Yes, but it's not clear whether or not we do. We're limited by sample size. See Figure 2.

Implications for Formation

The most commonly invoked formation method for isolated MSPs is ablation of the companion as we see in the black widow pulsar. However, if this luminosity difference is real, it seems we must resort to a different formation mechanism for the isolated MSPs. Is it possible isolated MSPs formed via accretion induced collapse of CO white dwarf binaries (Iben et al 1987)? Is it possible that such a scenario (or some other) would lead to a lower luminosity pulsar? What other scenarios should be considered?

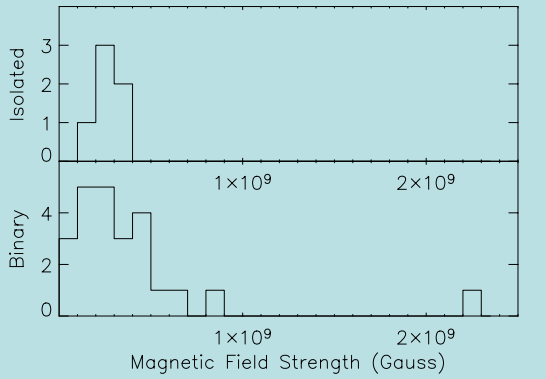

Fig 2
A histogram of isolated and binary pulsar magnetic field strength for field MSPs in which a period derivative is measured.

References

Some of the work presented on this poster has been published in the following article:

Lommen, Andrea N., Kipphorn, Richard A., Nice, David J., & Splaver, Eric M.; Stairs, Ingrid H.; Backer, Donald C. 2006, ApJ 642, 1012

Other sources:

Bailes, M., Johnston, S., Bell, J. F., Lorimer, D.~R., Stappers, B.~W., Manchester, R. N., Lyne, A. G., Nicastro, L., D'Amico, N., & Gaensler, B. M. 1997, ApJ, 481, 386

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