

Exploiting pulsar distances and velocities from VLBA astrometry

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Precision astrometry campaigns with the Very Long Baseline Array yield model-independent distances and velocities to neutron stars. We report on new parallaxes and proper motions that we have measured with a recently-concluded VLBA astrometry campaign. These results are being exploited, for example, to locate neutron star birth sites, establish reference frame ties, model the Galactic electron density distribution, and to constrain the astrophysics of supernova explosions. Specifically, PSR B1508+55 has a transverse velocity of $1100 \pm 100 \text{ km s}^{-1}$, the highest velocity directly measured for a neutron star. Binary disruption alone is insufficient to impart the required birth velocity. Not only is a natal kick indicated, but the extreme velocity challenges current simulations of supernova core collapse.