

Pulsar distances and velocities from VLBA astrometry

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ABSTRACT: Precision astrometry campaigns with the Very Long Baseline Array yield model-independent distances and velocities to neutron stars which address fundamental astrophysical questions. These include, for example, locating neutron star birth sites, establish reference frame ties, model the Galactic electron density distribution, and constraining the astrophysics of supernova explosions. We report on new parallaxes and proper motions that we have measured with a recently-concluded VLBA astrometry campaign in which we have doubled the total number of neutron star parallaxes. Specifically, we present PSR B1508+55, which 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.