Neutron star physics from super-fine astrometry

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Abstract

Astrometric measurements can address several core ideas in neutron star physics. One key topic is the formation processes in these systems, which can be addressed both via their mass distributions and their natal kick velocity distributions. Astrometric wobble measurements can provide the hard-to-measure inclination angles for a subset of X-ray binaries and detached millisecond pulsar binaries, which, due to the (sinˆ3 i) dependence in the conversion from radial velocity curves to masses, often dominates uncertainties. Proper motions and parallaxes together provide core information on kicks, which becomes more powerful when combined with knowledge of the position angle of the binary orbits, but which are nontheless very valuable even for shorter period binaries where astrometric wobble is not measurable. Together, these can provide crucial information about how supernovae explode. Another key topic is to understand the equation of state of neutron stars, which can be achieved in part by understanding the extremes of the neutron star mass distribution, and in part by adding precise distance estimates to X-ray pulse timing. Finally, in combination with polarization measurements, orbital position angles these can be used to understand magnetic field misalignments in neutron star binaries.

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