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## Natal Kicks on Compact Objects: Insights from Gaia's Precision Astrometry

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The death of massive stars can impart an impulse to the remnant black holes (BHs) and neutron stars (NSs) during supernova explosions. This impulse, also known as a natal kick (NK), can propel the compact objects to substantial space velocities. Understanding the motions perturbed by NKs not only sheds light on the underlying supernova physics but also plays a crucial role in the evolution of compact object binary which are potential gravitational wave sources. This presentation will focus on our recent investigation on systemic peculiar velocities ( $v_{\text{pec}}$ ) in an extended sample of binaries hosting NSs or BHs. Our analysis finds no clear difference in  $v_{\text{pec}}$  distributions between binaries hosting BHs and NSs. However, it uncovers a significant difference between binaries hosting low-mass (LM) and high-mass (HM) non-degenerate companions. HM binaries are constrained to  $v_{\text{pec}}$  lower than 100 km/s while LM binaries exhibit a more extensive distribution, reaching about 400 km/s. We further found a significant anti-correlation of  $v_{\text{pec}}$  with binary mass, which is consistent with our expectation that heavier binaries are more resistant to acceleration by NKs. This presentation will also present a related discussion based on an already-developed kinematic framework.

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