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Topological vector currents and neutron star kicks JAMES CHARBONNEAU, UBC — We propose that the asymmetry required to create neutron star kicks with large magnitudes, $v > 800km/s$, is carried by non-dissipating currents that travel along the superconducting vortices in the neutron star. These currents, called topological vector currents, appear specifically in systems with non-zero magnetic flux and an asymmetry in the number of left and right-handed fermions. A satisfying explanation for large kicks does not yet exist. Two candidates are hydrodynamic instabilities and asymmetric neutrino flux. With hydrodynamic kicks an asymmetric mass distribution triggers an asymmetric explosion during formation but it is not clear that enough momentum is produced. Neutrino kicks involve neutrino transport caused by the magnetic field and the weak interaction, but the required momentum is generated at temperatures high enough that detailed balance washes out the asymmetry. Kicks from topological currents are powered by the electron chemical potential, not the temperature, so are not washed out and the momentum carried by these currents appears to be capable of generating the large velocities observed in some neutron stars.

James Charbonneau
UBC

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