GRAVITATIONAL WAVES

Something for nothing

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Ever since 70 observatories around the world (and in space) detected electromagnetic waves following the merger of two neutron stars in the gravitational wave (GW) event GW170817, the astronomy community has been waiting for another merger event involving a neutron star. A coalescence of a binary neutron star (BNS) system or a neutron star and a black hole (NSBH) would produce a kilonova that emits at almost all observable wavelengths. But of the multiple GW detections since GW170817, no electromagnetic counterparts have been convincingly detected, despite prompt searches after each GW trigger. Michael Coughlin and co-workers analyse the data from the non-kilonova detections to establish constraints on the ejecta mass and properties of the source objects.

Specifically, Coughlin et al. apply three different kilonova models (two Gaussian process regressions and one semi-analytic model) to follow up on five events predicted to have a non-zero remnant mass. For each model they determine the ejecta mass constraints for various values of one key quantity: the lanthanide fraction (1), the temperature (2) and the opacities (3). These three parameters control the kilonova brightness and colour. The authors found the tightest constraints for S190425z, a BNS merger candidate, with a total mass of $2.5\text{--}2.9 M_{\odot}$ depending of the stiffness of the equation of state; for S190426c, a candidate NSBH merger, the non-detection of a kilonova rules out large aligned black hole spins with low-mass stars. Improvements to these constraints will require deeper observations, at the expense of sky coverage.

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