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Detectability of nuclear reactions in neutron star mergers through gravitational waves

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The impact of nuclear reactions on observed signals from neutron star mergers is uncertain. We make a first attempt at quantifying that uncertainty by studying two cases that, intuitively, are the most extreme. In one case we assume that the reactions happen instantaneously (on timescales much faster than can be resolved in simulations). In the other we assume reactions do not happen (or occur on timescales much slower than the orbital, or simulation, timescale). We find that the resulting differences in the gravitational wave signal are small, but are potentially detectable by next generation observatories. These differences will impact on parameter recovery efforts driven by matching to templates extracted from numerical relativity simulations. Failure to take the effects discussed here into account may lead to systematic errors of unknown size being introduced into equation of state parameters inferred from gravitation wave signals.

Presenter: HAMMOND, Peter (University of Southampton)

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