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Kilonova emission from realistic neutron star merger simulations

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The detection of GW170817 and its electromagnetic counterpart AT2017gfo confirmed the expectation that a kilonova would accompany the merging of binary neutron stars, and subsequently there has been much interest in simulating kilonova emission to better understand the observations of AT2017gfo, including confirming that these are the primary production site of r-process material. The majority of models considered when predicting kilonova emission have been 1D, or even idealised toy models. Few simulations have been based on realistic merger simulations, and fewer have carried out full 3D simulations of the merger and subsequent kilonova emission. We present 3D radiative transfer simulations based on the dynamical ejecta from 3D smoothed-particle hydrodynamics neutron star merger simulations, including a sophisticated neutrino treatment. Nucleosynthesis calculations following the SPH trajectories provide the energy released due to radioactive decays of r-process material. We discuss the predicted light curves in different lines of sight, as well as the influence of the assumptions we make on the light curve evolution. This includes our assumption of opacities based on the electron fraction of the material, which is predominantly responsible for the distribution of r-process elements synthesised. We find that the light curves do not show a strong viewing angle dependence, despite the asymmetrical ejecta.

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