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Comparing Radiative Transfer Methods for Kilonovae

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The electromagnetic signals from the kilonova AT2017gfo provide an opportunity to study an astrophysical site of the r-process which produced about half of all nuclei heavier than iron. In order to be able to connect kilonova light curve and spectral properties to the ejecta dynamics it is important to address the role of the individual simplifying assumptions commonly used in theoretical modelling. Fully self-consistent radiative transfer Monte Carlo simulations are nowadays possible. However, due to computational limitations and the need to cover a large parameter space it is important to develop fast and accurate modelling pipelines.

We compare two different methods for simulating kilonova light curves based on two-dimensional simulations of the ejecta dynamics: Monte Carlo radiative transfer (ARTIS code) and a two-moment scheme adopting the M1 approximation (ALCAR code). By this, we are able to benchmark the computationally cheap ALCAR code against the more expensive ARTIS code. Furthermore, we benchmark commonly used approximations for the thermalization of radiative decay products against fully microscopic and local description of the energy deposition.

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