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Parameter study of r-process lanthanide production and heating rates in kilonovae[1] JONAS LIPPUNER, LUKE F. ROBERTS[2], California Institute of Technology — Explosive r-process nucleosynthesis in material ejected during compact object mergers may lead to radioactively powered transients called kilonovae. The timescale and peak luminosity of these transients are sensitive to the composition of the material after nuclear burning ceases, as the composition determines the local heating rate from nuclear decays and the opacity. The presence of lanthanides in the ejecta can drastically increase the opacity. We use the new general-purpose nuclear reaction network SkyNet to run a parameter study of r-process nucleosynthesis for a range of initial electron fractions Y_e, initial entropies s, and density decay timescales τ. We find that the ejecta is lanthanide-free for $Y_e \gtrsim 0.22 - 0.3$, depending on s and τ. The heating rate is insensitive to s and τ, but certain, larger values of Y_e lead to reduced heating rates, because single nuclides dominate the heating. With a simple model we estimate the luminosity, time, and effective temperature at the peak of the light curve. Since the opacity is much lower in the lanthanide-free case, we find the luminosity peaks much earlier at ~ 1 day vs. ~ 15 days in the lanthanide-rich cases. Although there is significant variation in the heating rate with Y_e, changes in the heating rate do not mitigate the effect of the lanthanides.

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