The creation of the first r-process peak elements, effects of beta decay rates and nuclear masses

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The r-process is responsible for the production of about half of the heavy elements observed in the solar abundances. The site of the r-process was unknown until recent observations. The gravitational wave event GW170817, which was identified as a binary Neutron Star Merger (NSM), was followed by the detection of fast fading optical counterpart that is consistent with predictions of a kilonova/macronova, associated with r-process nucleosynthesis. In particular the observation of a bright, fast fading ultra-violet component transitioning to near infared at late times, established the production of heavy element in the aftermath of the neutron star merger.

The complicated atomic structure of lanthanides implies high opacity ejecta which would shift the wavelength of the observed light to the red. The blue color emission of the ejecta at early times indicates the presence of material with low lanthanides abundance and consequently, relatively high electron fractions. We present a study of nucleosynthesis of moderately high Y_e outflows from NSMs and we investigate the astrophysical conditions under which this could be the site for the production of the elements of the r-process abundance pattern for A $<$ 100. The effect of nuclear masses and beta decays on the abundance pattern is explored for a range of conditions consistent with simulations.