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Neutron Star Mergers and Kilonovae: r-Process and Gravitational Waves

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Neutron star mergers are the prime example for multi-messenger events with the potential to address many open questions with regards to nucleosynthesis of heavy elements and the properties of high-density matter. This concerns for instance the composition of the outflows and to which extent they resemble the solar abundance pattern. Also, the existence of non-nucleonic degrees of freedom in the cores of neutron stars is yet unclear and may be elucidated by detections of gravitational waves and kilonovae. We will present some recent developments combining the insights from the kilonova emission and the gravitational radiation of GW170817. For instance, a thorough analysis suggests that the merger remnant in GW170817 was not very long-lived and that relatively little amounts of helium were produced in the outflow from this event. The early black-hole formation places an upper bound on the maximum mass of neutron stars and on the radii of neutron stars.

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