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Exotic nuclei in supernova evolution and r-process nucleosynthesis

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.Exotic nuclei play an important role in many astrophysical environments, in particular the collase of massive stars and r-proccess nucleosynthesis. During the collapse, the composition of the core is dominated by intermediate mass neutron-rich nuclei. Due to the high temperatures and densities, electrons can be captured on nuclei removing the major source of pressure support and accelerating the collapse. Particularly important are electron capture rates around the N=40 and N=50 and regions where there is experimental evidence of large correlations across the shell closures. A proper account of these correlations together with finite temperature effects is fundamental to determine the relevant electron capture rates.

Compact binary mergers are currently considered the best candidate for the main r-process site. These events are expected to produce gravitational waves, likely to be observed by the LIGO collaboration, and eject large amounts of neutron-rich material where the r process operates. I will discuss the important role of nuclear physics to determine the r-process yields from compact binary mergers. In addition to neutron captures and beta decay, fission rates and yields of superheavy neutron-rich nuclei are fundamental to understand the r-process dynamics and nucleosynthesis. Mergers constitute also ideal candidates to directly observe the r-process via an electromagnetic transient due to the radioactive decay of r-process material. This type of event, known as kilonova, may have already been observed associated with the gamma-ray burst GRB 130603B.

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