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Nuclear weak-interaction processes in stars

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Nuclear weak-interaction processes play an important role in nucleosynthesis processes and late-stages of the evolution of stars. These processes are often modified due to the temperature and density conditions of the environment allowing for the appearance of novel decay channels normally not found under laboratory conditions. At the moderate conditions at which the s-process operates in AGB stars atoms are partially ionized making necessary to consider both atomic and nuclear corrections to the processes. An important example is 205Tl that decays by bound-beta decay to 205Pb under stellar conditions. The evolution of the core of AGB stars is again determined by weak processes that lead phases with URCA cycles and double electron capture processes. Typically in all these cases weak processes are determined by only a few nuclear transitions whose strength should be determined experimentally whenever possible.

Weak processes are also fundamental to determine the collapse and explosion of massive stars. Electron capture processes operating in nuclei determine the collapse dynamics. However, differently to low and intermediate mass stars, they operate in a broad range of nuclei excited to rather high temperatures making an experimental determination challenging. As the density increases neutrino matter interactions become more and more important being fundamental to determine the supernova explosion.

Neutrino-nucleus reactions are also important for the nucleosynthesis of heavy nuclei. I will introduce a new nucleosynthesis process, the νr-process, that operates in ejecta subject to very strong neutrino fluxes producing p-nuclei starting from neutron-rich nuclei. It may solve a long standing problem related to the production of 92Mo and the presence of long-lived 92Nb in the early solar system.

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