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Nuclear muon capture, a perfect probe of neutrinoless double beta decay

The ordinary muon capture (OMC) is a process where a nucleus captures a negative muon from the lowest atomic orbital, the 1s orbital. Modern muon facilities in Japan and Switzerland produce these muons and shoot them at target atoms, some of which capture the muon and thus enable the OMC. The OMC resembles the electron capture (EC), except the mass of the captured muon is some 200 times the mass of an electron, thus introducing momentum exchanges in the range of 100 MeV, in the ballpark of the momentum exchanges involved in the neutrinoless double beta decay (NDBD). In NDBD-minus decaying nuclei the OMC on the NDBD daughter populates the states of the intermediate nucleus of the NDBD, like in the case of 136-Xe NDBD the capture on 136-Ba populates the states of 136-Cs. Since in both processes, NDBD and OMC, the momentum exchange is similar, both processes populate intermediate/final states of high excitation energies and high angular momentum. This is how the OMC probes effectively the wave functions of all the intermediate states relevant for the NDBD. Furthermore, the rates of both processes depend on the value of the weak axial coupling, $g_{\rm A}$, and the induced pseudoscalar coupling, $g_{\rm P}$, the effective values of which are not well known in the nuclei that double beta decay. In particular the NDBD rate is highly sensitive to the value of $g_{\rm A}$. This dependence of the OMC on weak couplings adds to its importance as a probe of the NDBD. In my talk I review what is known about the effective values of $g_{\rm A}$ in medium-heavy and heavy nuclei and highlight the recent advances in calculating the rates of the OMC, relevant for the NDBD candidates.

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