CHARGE-EXCHANGE REACTIONS, GT TRANSITIONS AND THE THINGS BEYOND FOR THE DOUBLE BETA DECAY

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The (^{3}He,*t*) reaction as a probe for the Gamow-Teller (GT) excitations was developed at the RCNP facility in Osaka (JP), where measurements with an unprecedented high resolution of 30 keV at incident energies of 420 MeV are now readily possible. Because GT transition are directly connected to the 2υββ decay, the high resolution allows a detailed insight into the excitations of the intermediate odd-odd nuclei of ββ decay and the properties of the 2υββ "decay paths", which are generally described by the nuclear matrix elements. As will be shown, some rather unexpected features are being unveiled. The ββ decay nuclei ^{76}Ge, ^{82}Se, ^{96}Zr, ^{100}Mo, and ^{136}Xe will be highlighted, where one observes that the strong fragmentation of the GT strength seen in ^{76}Ge at low excitation energies is gradually shifted to the region of the giant GT resonance as one increases the mass to ^{100}Mo. Further, ^{100}Mo features the largest 2υββ decay matrix element and ^{136}Xe the smallest of all relevant ββ decay nuclei, and some explanation will be given. It will also be argued that the intrinsic deformation of the ground-state wave functions of the mother and grand-daughter nucleus has a pronounced effect on the observed GT distribution and the 2υββ decay matrix elements.

In the end, I will describe efforts how to get information about the matrix elements for the neutrinoless ββ decay, either from charge-exchange reactions and/or from measuring weak decay properties of the intermediate odd-odd nuclei. In this context, the low-energy strength of 2^{-} states in charge-exchange reactions will be reported and compared with shell-model predictions. Here ^{136}Xe stands out again, in particular against ^{96}Zr and ^{100}Mo. Following this, an outlook will be given of what will be ahead, where I shortly describe an upcoming experiment on ^{96}Zr, which will provide direct input to theoretical models aimed at predicting the matrix elements for the neutrinoless decay