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β-delayed neutron spectroscopy at the ISOLDE Decay Station

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The investigation of isotopes far from stability provides a substantial test of our understanding of the forces involved in organizing nuclear matter. Ground state properties, such as its mass or spin parity, and beta-decay properties, like the half-life or the neutron branching ratio are the typical observables that must be correctly reproduced to trust a nuclear theory calculation. In particular, trustworthy calculations of beta-decay half-lives and neutron branching ratios of exotic nuclei are invaluable inputs for models of stellar nucleosynthesis.

The recent availability of exotic nuclei beyond the N=(50,82) magic numbers has spurred a rush of experimental measurements that aim to disentangle their decay properties. These two regions are of special interest for beta-decay measurements as the decay is complicated by the fact that valence neutrons and protons occupy different major harmonic shells. Under these conditions the normally inert nucleons in the core are allowed to play a role due to the small overlap of the valence neutrons with low energy states in the daughter. Raising the difficulty for its experimental investigation, the large energy gap at N=50 implies the allowed decay of core neutrons occurs to neutron unbound states.

A systematic investigation of this so-called core decay in N>50,82 nuclei have been performed at ORNL and ISOLDE using different experimental setups including the neutron Time-of-Flight array VANDLE (Versatile Array for Neutron Detection at Low Energies). From the observed decay strength distribution we identified the large neutron branching ratios observed in Ga isotopes as arising from the decay strength associated to 0f5/2 neutrons. However the valence space in ^{84}Ga (Z_v=3,N_v=3) resulted in a very fragmented decay strength.

Here we present the results of the 2015 VANDLE campaign at ISOLDE. We measured the beta delayed neutron emission of ^{132}Cd. Thanks to the small valence space in ^{132}In, (Z_v=-1,N_v=-1), beta decay is expected to populate quasi-single particle states, and be dominated by the beta transition of the $g_{7/2}$—>$g_{9/2}$. This allowed us to have a unique insight to the nuclear structure of states making ^{132}Sn.

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