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Studies of the Beta Decays of very neutron-deficient nuclei and a comparison with Charge Exchange reactions.

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Studies of the Tz = -1 ⟶ 0 beta decays of 42Ti, 46Cr, 50Fe and 54Ni to the self-conjugate nuclei 42Sc, 46V, 50Mn, and 54Co respectively (P.h.D Thesis,Francisco Molina- Univ. Valencia) will be presented. The nuclei of interest were produced in the fragmentation of a 58Ni beam of 680 MeV/nucleon at GSI. The ions were separated using the Fragment Recoil Separator (FRS) and implanted into a set of DSSSD detectors surrounded by the RISING CLUSTER array. The recorded number of implanted ions of the nucleus of interest was typically 3-6 x106 in total. With this large number we were able to make correlations between the Heavy Ion implants and the subsequent beta or beta-gamma decays that follow and thus to a) measure the beta-decay half-lives with one order-of-magnitude better accuracy than the values existing in the literature, b) establish decay schemes, c) determine the direct ground state to ground state feeding in the decays, d) measure the decay intensity to the 1+ states populated in the daughter and hence the absolute B(GT) values for the Gamow-Teller beta decays. The B(GT) values are of importance in terms of the comparison with the analogous Charge Exchange (CE) reactions on the mirror nuclei (Fujita et al.,PRL95(2005)212501), which populate the same levels.
One interesting observation in these experiments is that the T=0, 1+ states populated in the beta decay predominantly by M1 transitions to the T=1, 0+ g.s. No M1 gamma transitions were observed to any other T=0, 1+ excited states. This is the result of a selection rule, called a "Quasi-rule"by Warburton and Weneser (D.H. Wilkinson "Isospin in Nuclear Physics", 1969, SBN 7204 0155 0) and it is observed for the first time in the fp shell nuclei.
Encouraged by this success we have now pursued experiments at GANIL, studying the Tz=-1 58Zn and Tz=-2 56Zn beta decays. However these nuclei are more difficult to produce because they are further from stability, ie from the stable nucleus used as a beam to produce them.
The high intensity beam at RIKEN would allow us to extend these studies to higher masses and more exotic cases. This would facilitate a comparison of the beta decay and charge exchange reactions in heavier mass systems.
Amongst the cases of interest are the very neutron-deficient 63,64 and 66Se isotopes. The first two would allow us to extend our comparison with the mirror CE process on 64Zn and 63Cu. The 66Se case is of particular interest from several viewpoints, a) to study the evolution of the B(GT) strength in the fp shell, b) to study if the "Quasi-rule"for the M1 transitions persists and c) to study a possible proton-neutron condensate.
These experiments could be carried out using the fragmentation of 78Kr and could be carried out in tandem with the experiment proposed by B. Blank and collaborators, which is focussed on two proton radioactivity and is already approved.

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