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Beta decay to continuum states

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As one moves towards the driplines, an increasing fraction of beta decays will feed particle unbound states. An overview of the many physics consequences this has can be found in a recent review [1]. This contribution will focus on the mechanism behind beta-delayed particle emission, more specifically on whether decays proceed through resonances in a daughter nucleus or go directly into the continuum.

Halo nuclei, see [2] and references therein, constitute an extreme limit of nuclear structure and the two-neutron halo nuclei ^{6}He and ^{11}Li appear both to have beta-delayed deutron emission taking place directly into the continuum. For ^{11}Li this process is strong when measured in terms of beta-strength (the small energy window makes the branching ratio of order 10^{-4}), whereas cancellation effects reduces the strength for ^{6}He. The "two neutron to deuteron" overlap enters in the description of the process, and a much cleaner case would therefore be the beta-delayed proton decay of a single-neutron halo nucleus. Estimates of this process for ^{11}Be indicates that this will be a very rare process [3] due to the very low energy available; the maximum strength will only give a branching ratio of a few times 10^{-8}. Experiments at ISOLDE/CERN (the IS374 [3] and IS541 [4] collaborations) have looked for the ^{11}Be(βp)^{10}Be decay and results from them will be presented.

Two more general related subjects will be covered briefly as well. First, the standard definitions of beta strength in beta-delayed particle processes will be critically examined. There is currently an unfortunate dependency of the definition on the assumed reaction mechanism. I shall argue that a very simple experiment-based definition is conceptually superior to those employed e.g. in R-matrix analyses.

Finally, the decay mechanism question will be discussed in general with an emphasis on how resonant structures in the continuum may enter in the theoretical description.

[1] M. Pfützner, M. Karny, L.V. Grigorenko and K. Riisager, Rev. Mod. Phys. 84, 567 (2012);

[2] K. Riisager, Physica Scripta T, in press (2013); arXiv:1208.6415;

[3] M.J.G. Borge et al., submitted to J. Phys. G (2013); arXiv:1211.2133;

[4] The IS541/ISOLDE collaboration, to be published.