DNP12-2012-020223

Abstract for an Invited Paper
for the DNP12 Meeting of
the American Physical Society

Beta Decay Half-lives and Delayed Neutron Emission of r-process Neutron-Rich nuclei in the vicinity of 78Ni

M. MADURGA, Department of Physics, University of Tennessee at Knoxville

The region of neutron rich isotopes at and beyond the N=50 shell closure in the vicinity of ^{78}Ni has recently attracted major interest from experimental and theoretical nuclear physics community [1-4]. Moreover, as many nuclei in the region are predicted precursors of r-process nucleosynthesis, their most basic nuclear properties such as mass and beta decay half-life are required parameters in abundance calculations. The availability of hight purity and high quality radioactive beams of nuclei in this region at the Holifield Radioactive Ion Beam Facility has spurred a systematic campaign to study their properties through beta decay. Four new half-lives of ^{82,83}Zn, ^{85}Ga and ^{86}Ge were measured for the first time. The resulting values differ from the predictions of the Finite Range Droplet Model used in r-process abundance calculations. We presented a new model based on Density Functional Theory that correctly reproduced the new half-lives. The revised analysis of the rapid neutron capture process in low entropy environments with our new set of measured and calculated half-lives shows a significant redistribution of predicted isobaric abundances strengthening the yield of A $>$ 140 nuclei. Continuing our effort to systematically understand decay properties in the region of beta-delayed neutron emission, 30 nuclei in the region were studied using the neutron energy Time-of-Flight detector VANDLE. Due to the shell structure in the region, most of the decay strength is expected to concentrate in states above neutron separation energy, in the so-called Pigmy Giant resonance. Precise knowledge of the position and strength of the resonance may help fine tune and develop existing models, with the aim of increasing their reliability beyond what can be experimentally measured. The data resulting from the experimental campaign at Holifield are still being analyzed. In a few species strong shell effects have already been identified and they will be presented. In particular, the decay of ^{84}Ga shows that more than half of the neutron strength concentrates in a single neutron transition at 2 MeV, suggesting the population of the Pigmy resonance.

[1] P. Hosmer et al., Phys. Rev. Lett. 94, 112501 (2005).
[2] T. Otsuka, T. Suzuki, R. Fujimoto, H. Grawe, and Y. Akaishi, Phys. Rev. Lett. 95, 232502 (2005).
[3] B. Cheal et al., Phys. Rev. Lett. 103, 142501 (2009).
[4] S. Padgett et al., Phys. Rev. C 82, 064314 (2010).