Beta-delayed neutrons with VANDLE

R. Grzywacz
Dept. of Physics and Astronomy, University of Tennessee, Knoxville, TN 37996, USA
Physics Division, Oak Ridge National Laboratory, Oak Ridge, TN 37830, USA

Beta-delayed neutron emission (βn) is a significant or even dominant decay channel for the majority of very neutron-rich nuclei. New developments in experimental techniques enabled studies of beta-delayed neutron emission as a part of a larger scope of research on beta-decay strength distribution. Because they directly probe relevant physics on the microscopic level, energy-resolved measurements of the beta-decay strength distribution constitute a better test of nuclear models than traditionally used gross properties like half-lives and neutron branching ratios. We have constructed and used a new detector system called the Versatile Array of Neutron Detectors at Low Energy (VANDLE) [1]. One of the purposes of VANDLE was to study the very neutron-rich fission fragments produced at present-day facilities. Vastly improved isotope production and separation techniques have made fission fragments in the rapid-neutron capture (r-) process path available for spectroscopic studies [2]. In its first experimental campaign at the Holifield Radioactive Ion Beam Facility neutron energy spectra in key regions of the nuclear chart were measured: near the shell closures at 78Ni and 132Sn, and for the deformed nuclei near 100Rb. Many of the studied nuclei lie directly on proposed r-process paths. Of the almost thirty βn-emitters studied, only a few relatively long-lived isotopes were previously investigated. In several cases, unexpectedly intense and concentrated, resonant-like, high-energy neutron structures were observed. Furthermore, models suggest these resonances are driven by nuclear structure effects. I will present a how the VANDLE experimental results can be interpreted with the shell model calculation and how our the results contribute to the debate on the nuclear pandemonium [3,4].

*This research was sponsored in part by the National Nuclear Security Administration under the Stewardship Science Academic Alliances program through DOE Cooperative Agreement No. DE-FG52-08NA28552

[1] C. Matei et al., Proceedings of Science, NIC X, 138 (2008)
[2] M Madurga et al., Phys. Rev. Lett. 109, 112501 (2012).
[3] J. Hardy et al. Nucl. Phys. A 305, 15 - 28 (1978).
[4] K.L. Kratz et al.Phys. Rev. Lett. 33, 859(1974).