Introduction to the β-Spectrum Module*

B.C. Rasco[1]
[1] *Oak Ridge National Laboratory, Oak Ridge, TN, USA*

Studies of β decay have been and continue to be an extremely fruitful area of physics research. From the first prediction of an exotic particle (the neutrino) to understanding fundamental interactions and in applied physics such as nuclear reactor design and safety along with uses in medical physics, weak interaction physics continues to challenge researchers. Of particular interest are β-energy spectra and their deviation from an allowed shape, which can be characterized by a β-shape function. The β-shape functions derived from β-energy spectra give insight into many disparate areas of physics, such as nuclear structure [1, 2], precision reactor antineutrino physics [3, 4, 5], precision reactor decay heat [6], and there is even some possibility of identifying exotic physics beyond the standard model [5, 6]. Though many β decays have been studied for over 90 years, measuring β-energy spectra is challenging. There are many prior experimental challenges, such as backscatter off of detector faces and Bremsstrahlung, as well the recognition that most β decays have many different β transitions that can not be separated. Working with the Oak Ridge National Laboratory Physics Division Scintillator Laboratory, a novel β-energy detector, the β-Spectrum Module (βSM), has been designed to measure β-energy spectra of complex β decays. The novel βSM detector is designed to discriminate between β and γ interactions. Preliminary results of extracted ground-state to ground-state β-shape functions, including description of the shape-function extraction technique, will be presented.

[1] L. Hayen et al., Physical Review C 99 (2019) 031301(R).
[2] A. Glick-Magid and D. Gazit, Journal of Physics G 49 (2022) 105105.
[3] A. Hayes, et al., Physical Review Letters 112 (2014) 202501.
[4] B.C. Rasco, et al., Physical Review Letters 117 (2016) 092501.
[5] A. Fijałkowska, et al., Physical Review Letters 119 (2017) 052503.
[6] Oscar Naviliat-Cuncic and Martin Gonzalez-Alonso, Annalen der Physik 525 (2013) 600-619.
[7] A. Glick-Magid, et al., Physics Letters B 767 (2017) 285-288.

*Work funded under Nuclear Data FOA-2440 and the DOE Office of Science DE-AC05-00OR22725