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Search for cluster radioactivity from barium isotopes

Cluster radioactivity can be understood as a phenomenon between alpha decay and fission, a kind of very asymmetric fission. This radioactivity has been observed for the first time in the 1980s in the decay of ^{223}Ra [1]. Since then cluster emission in more than 20 heavy nuclei has been experimentally evidenced [2]. However, all these cases have daughter nuclei in the close vicinity of doubly-magic ^{208}Pb . With a daughter nucleus in the direct vicinity of a doubly-magic nucleus, the Q value for cluster emission is increased and the cluster decay probability increases compared to alpha decay.

A new region of cluster radioactivity was proposed above doubly-magic ^{100}Sn . The isotopes ^{112}Ba and ^{114}Ba are, according to theoretical predictions, the best candidates to search for cluster radioactivity in this new region of the chart of nuclei by the emission of ^{12}C clusters. However, even in this favourable case, the branching ratio of cluster radioactivity is as small as 10^{-4} to 10^{-7} per decay. Therefore, the first step in the search for cluster radioactivity in the ^{100}Sn region is to measure precisely the triple alpha decay energies. For the decay of ^{114}Ba , these alpha energies have already been measured with precisions between 10 and 40 keV. However, more precision is needed to improve the predicting power of models. For ^{112}Ba , no experimental information exists. After the successful measurement of these alpha decay energies, searches for cluster radioactivity can be sought of. During these experiments, the masses of ^{112}Ba and ^{114}Ba will be measured.

[1] H.J. Rose, G.A. Jones, *Nature* 307 (1984) 245

[2] B. Blank et al., *Handbook of Nuclear Physics* by I. Tanihata, H. Toki, T. Kajino (Eds.), Springer, 2023

Author: BLANK, Bertram (LP2i Bordeaux)