Beta-delayed neutron emitters in the $r$process

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Beta-delayed neutron (βn)-emitters play an important, two-fold role in the stellar nucleosynthesis of heavy elements in the "rapid neutron-capture process" (r process). On one hand they lead to a detour of the material β-decaying back to stability. On the other hand, the released neutrons increase the neutron-to-seed ratio, and are recaptured during the freeze-out phase and thus influence the final solar r-abundance curve. For this reason the neutron branching ratio of very neutron-rich isotopes is a crucial input parameter in astrophysical simulations.
A large fraction of the isotopes for r-process nucleosynthesis are not yet experimentally accessible and are located in the "Terra Incognita". With the next generation of fragmentation and ISOL facilities presently being built or already in operation, one of the main motivation of all projects is the investigation of very neutron-rich isotopes at and beyond the border of presently known nuclei. However, reaching more neutron-rich isotopes means also that multiple neutron-emission becomes the dominant decay mechanism.
Since 2016 the BRIKEN project (Beta-delayed neutron measurements at RIKEN for nuclear structure, astrophysics, and applications) [**?**] focusses on the most exotic βn-emitters which can presently be produced. The setup combines the most efficient neutron detection array in the world with a state-of-the-art implantation detector and two clover detectors. Several experiments were carried out in 2017 and covered 231 βn-emitter between ^{64}Cr up to ^{151}Cs. For many of these isotopes, βn-emission branching ratios have been measured for the first time, e.g. the doubly-magic N=50 isotope ^{78}Ni, as well as about 50 new half-lives. More experiments for $A>150$ and $A<60$ will be carried out in the upcoming 2-3 years, making this experimental campaign one of the largest systematic investigation of two important nuclear physics input parameters for modelling the r-process nucleosynthesis.
The expected results from the BRIKEN campaigns will excel results from the previous six decades and will help to improve the theoretical understanding of this complex decay mechanism tremendously, especially the competition between neutron emission and de-excitation via γ-decay and emission of several neutrons. Almost all of the previously measured βn-emitters will be remeasured, and approximately 150 new βn emitters will be added to the list of 298 know βn-emitters. Also the number of measured multi-neutron emitters will be largely expanded. The inclusion of these new results in astrophysical network calculations will help to reduce the uncertainty in the calculated r-process abundances from this nuclear physics quantity.

References

[1] A. Tarifeño-Saldivia *et al.*, Journal of Instrumentation **12**(2017)P04006.