Beta-decay spectroscopy towards the r-process path

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The study of the structure of neutron-rich Pb isotopes is fundamental to trace the evolution of single-particle levels and the residual proton-neutron interaction beyond the doubly magic nucleus ^{208}Pb. In addition the study of the β decay of neutron-rich nuclei with N$>$126 is of primary importance to understand the stellar nucleosynthesis: in this region the r-process path lies far away from accessible nuclei, therefore nuclear models have to extrapolate extensively to predict nucleosynthesis production rates. Currently two main prescriptions are used: the first includes first-forbidden transitions as a perturbation of the allowed Gamow-Teller decays [1], while the second treats the two contributions on the same level [2]. As a result, the predictions of lifetimes and production rates can vary orders of magnitude.

In this contribution we present results from an experiment focused on the investigation of neutron-rich Pb-Tl-Bi isotopes, carried out within the *Stopped beam Campaign* of the RISING collaboration at GSI. The nuclei of interest were produced by fragmentation of a relativistic U beam impinging on a thick Be target. The residues were identified in the Fragment Separator and finally stopped in the RISING active stopper [3], consisting of 9 DSSSDs which measured position and time of both implanted ions and β electrons. The γ-ray transitions of the daughter nuclei were registered using the RISING Ge array [4], placed in packed geometry around the active stopper.

β-decay half-lives of ^{211,212,213}Tl and ^{218,219}Bi are measured for the first time , as well as the de-excitation of their daughter nuclei ^{211,212,213}Pb and ^{218,219}Po. By comparing the newly measured half-lives to nuclear models built to describe the r-process the importance of first-forbidden transitions is confirmed. These results are well accounted for by the model in ref. [1], at variance from close-lying N$<$126 nuclei which are instead overestimated by this approach [5].

This information is complemented by the study of β-delayed γ spectra giving for the first time an insight on the structure of these nuclei.

[1] P. Möller et al., Phys. Rev. C 67 (2003) 055802;
[2] I.N. Borzov, Phys. Rev C 67 (2003) 025802;
[3] R. Kumar et al., Nucl. Instr. Meth. A 598 (2009) 754;
[4] S. Pietri et al., Nucl. Instr. Meth B 261 (2007) 1079;
[5] G. Benzoni et al.,Phys. Lett. B 715 (2012) 293.