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Lifetime measurements of excited states of ^{210}Pb and ^{200}Pt applying the two-neutron transfer reaction

The r-process path of cosmic nucleosynthesis is expected to proceed partly along the $N = 126$ neutron shell closure where it contributes to the third r-process peak [1]. Improved microscopic understanding of cosmic nucleosynthesis calls for more precise and complete data on neutron-rich nuclei in the mass region around the doubly-closed shell nucleus ^{208}Pb that serve to constrain microscopic nuclear models [2]. In particular, the $B(E2)\downarrow$ values of yrast transitions of ^{210}Pb partially show discrepancies with shell model calculations. However, so far the uncertainty of the $B(E2; 2_1^+ \rightarrow 0_1^+)$ value [3] was too large to conclusively compare the experimental and theoretical results. Therefore, ^{210}Pb was studied in an experiment at the 10 MV FN-tandem accelerator at the University of Cologne.
Furthermore, the region of the nuclear chart, where the W, Os, Pt and Hg isotopes are located, exhibits phase transitions between oblate, prolate and spherical shapes [4, 5]. The $R_{4/2}$ ratio of the energies of the 2_1^+ and 4_1^+ states indicates a transition from γ-softness towards sphericity for the Pt isotopic chain when approaching the neutron-shell closure at $N = 126$. ^{200}Pt could sit at the shape-phase transitional point and was investigated at the 9 MV tandem accelerator at the IFIN-HH in Bucharest-Măgurele. Besides the $R_{4/2}$ ratio, the $B_{4/2}$ ratio of the $B(E2)\downarrow$ values of the $4_1^+ \rightarrow 2_1^+$ and $2_1^+ \rightarrow 0_1^+$ transitions serves as a complementary indicator for nuclear structure. However, no $B(E2)\downarrow$ values of ^{200}Pt are known to date.
The $B(E2)\downarrow$ value is inversely proportional to the lifetime of the de-exciting state. Therefore, we performed lifetime measurements applying the recoil-distance Doppler-shift [6] method to obtain the lifetime of the 2_1^+ state of ^{210}Pb and the lifetimes of the 4_1^+ and 2_1^+ states of ^{200}Pt.
The significantly more precise $B(E2; 2_1^+ \rightarrow 0_1^+)$ value of ^{210}Pb enhances the comparability to shell model calculations, underlining the theoretical discrepancy to the experimental result of the $B(E2; 4_1^+ \rightarrow 2_1^+)$ value.
The first measured $B(E2)\downarrow$ values for ^{200}Pt allow the calculation of the $B_{4/2}$ ratio, which shows good agreement with the theoretical limit of a spherical nucleus, indicating the structural evolution within the Pt isotopic chain.

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