Investigation of shape coexistence in ^{172}Pt via lifetime measurements

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Neutron-deficient nuclei in the $A = 180$ region are known to exhibit strong signs for shape coexistence. The ground-state configuration in the nuclei $^{178-186}$Pt around neutron midshell ($N = 104$) is proposed to be a prolate intruder configuration based on energy systematics and α hindrance factors (compare fig. 57 in [1]) similar to the $\pi(2p2h)$ intruder configuration in the neighboring Hg isotopes. For Pt isotopes with $N \leq 98$ a drastic change towards a less deformed normal-order configuration is foreseen for the ground state. The level schemes of these nuclei show a backbending in the Yrast band around the 6^+ or 8^+ state. This could be caused by a crossing of the intruder and normal-order configuration making an investigation of these states very interesting.

A sensitive probe for the investigation of shape coexistence are transition strengths. In the extremely neutron-deficient ^{172}Pt only transition strengths for the $2_1^+ \to 0_1^+$ and $4_1^+ \to 2_1^+$ transitions are known [2] giving a ratio of $B_{4/2} \equiv B(E2; 4_1^+ \to 2_1^+)/B(E2; 2_1^+ \to 0_1^+) = 0.55(19)$. The magnitudes of the measured $B(E2)$ values indicate that the excitations have a collective nature, as is expected in this region. However, collective models only allow $B_{4/2}$ ratios in the range of 1.43 (rotor) $\leq B4/2 \leq$ 2.0 (vibrator). Similar observations were made in neighboring nuclei: $B_{4/2}(^{168}\text{Os}) = 0.34(18)$ [3], $B_{4/2}(^{170}\text{Os}) = 0.38(11)$ [4], $B_{4/2}(^{166}\text{W}) = 0.33(5)$ [5]. Such values could potentially be explained by configuration mixing. But, as metioned above, from the level scheme of ^{172}Pt the mixing is expected to start rather at higher-lying states.

To clarify this picture, lifetimes of the Yrast states in ^{172}Pt up to the 8_1^+ state were measured using the recoil distance Doppler-shift (RDDS) method. These lifetimes and the resulting transition strengths give important new insights into the nuclear structure in ^{172}Pt with respect to shape coexistence and configuration mixing. The experiment was performed at Argonne National Laboratory using the integrated Cologne Argonne plunger setup (ICAPS) in conjunction with the Gammasphere spectrometer and the Argonne gas-filled analyzer (AGFA).

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