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Lifetime measurements in the N=126 region with the reversed plunger configuration

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A novel technique has been developed to measure lifetimes of heavy neutron-rich nuclei, namely 'the reversed plunger'. In heavy neutron-rich nuclei, information on the lifetimes of low-lying excited states is scarce since these nuclei are difficult to populate. Among different reaction mechanisms, multi-nucleon transfer reactions have shown to be the perfect tool to explore such regions. Therefore, profiting from the kinematics of such reactions and the plunger device in the reversed configuration, lifetimes of excited nuclear states of the order of picoseconds can be measured.
This technique was employed for the first time at Laboratori Nazionali di Legnaro to measure lifetimes of low-lying excited states of nuclei with a mass of around 190, where shape transitions from prolate to oblate are expected to occur along different isotopic chains while approaching the N=126 shell closure.
A beam of ^{136}Xe with the energy of 1134~MeV passed through a degrader foil of ^{93}Nb with a thickness of 3.2~mg/cm^2 and impinged into a ^{198}Pt target 1.4~mg/cm^2 thick. Beam-like fragments entered the PRISMA spectrometer where they were identified in mass, atomic number, and velocity, while the target-like fragments (the heavy nuclei of interest) traveled towards the degrader foil where they were stopped. Gamma rays were measured with the AGATA tracking array composed of 33 segmented HPGe detectors. Among the nuclei populated in this experiment is ^{198}Pt, for which the lifetimes of the low-lying excited states are known, and can be used as a benchmark to validate the use of the proposed technique.
This work reports the lifetimes of the 2^+_1, 2^+_2 and the 4^+ states of ^{198}Pt measured with the reversed plunger configuration, employing the standard analysis procedures: the Decay Curve Method and the Differential Decay Curve Method. The agreement of our results with the literature data demonstrates the capability of this technique to further investigate the nuclear structure of heavy neutron-rich nuclei.

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