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Spectroscopy of Neutron-Deficient Nuclei Near the Z=82 Shell Closure *

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Abstract

Nuclear structure studies of proton-rich Au, Hg, Tl and Pb nuclei are important in order to elucidate their shape evolution with neutron number from well-studied deformed minima at mid-shell to the near spherical ground states observed for nuclei at the proton drip line. In addition, detailed knowledge of level and decay properties of those nuclei are also relevant for better understanding of rare decay modes in this region, such as electron-capture delayed fission.

Over the last several years, we have performed a number of experiments using Gammasphere and the Argonne Fragment Mass Analyzer (FMA) aimed at measuring properties of proton-rich nuclei in this region. In these studies, the use of the FMA is essential in order to differentiate evaporation residues from the large fission background which dominates the reaction cross-section. In addition, we have found that using symmetric fusion reactions at bombarding energies near the Coulomb barrier is beneficial in performing these studies. By keeping the bombarding energy low, fission is minimized and the reaction products are concentrated in only a few channels.

New results have recently been obtained using the ^{89}Y+^{92}Mo reaction in studies of ^{179}Tl and ^{180}Tl via the 2n and 1n channel, respectively. While α decays from the ground and isomeric states were observed in ^{179}Tl, no α-decaying isomer was identified in ^{180}Tl, in contrast to the daughter nuclide ^{176}Au. The corresponding decay properties were established from spatial and time-correlated $recoil{-}\alpha{-}\gamma$ coincidences. The new results allowed quantum numbers and configurations to be assigned, thus enabling the removal of ambiguities from earlier studies. For the first time, excited structures associated with the α-decaying states in ^{179,180}Tl were identified. The implications of the new results on the structure evolution in the region and on properties of daughter (Au) and granddaughter (Ir) nuclides will be discussed.

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