The observation of a strong E0 component in the 2+2-2+1 transition in ^{184}Hg from the β-decay of laser-ionized thallium isotopes: a strong signature for shape coexistence.

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The mass region of neutron-deficient mercury and lead isotopes near the midshell (N=104) is well known for the phenomenon of shape coexistence. In neutron-deficient, even-even $^{180-188}$Hg isotopes an oblate ($\beta_2 \sim -0.15$) ground state band is found to coexist with an excited prolate ($\beta_2 \sim 0.25$) band at low spin and low-excitation energies. This band is built on top of a deformed excited 0^+ state, which is interpreted as resulting from proton excitations across the Z=82 closed shell. Such intruder states have been found to be a widely occurring structural feature of nuclei at and near closed shell.

The low-lying coexisting states in ^{180,182,184}Hg have been studied at ISOLDE, CERN through the β^+/EC decay of ^{180,182,184}Tl as part of a systematic α, β, and β-delayed fission study of neutron-deficient thallium isotopes. The β^+/EC decay is a very simple but still powerful tool which allows to effectively populate low-lying not-yrast states in the daughter nucleus, normally not easily accessible with other techniques, thus providing complementary information to the ones from in-beam γ-spectroscopy studies and from α−decay studies from the Pb parent nuclei.

Mass-separated Tl beams, produced at ISOLDE, CERN, in the bombardment of ^{238}U by 1.4 GeV protons and selectively laser ionized, were implanted on a carbon foil mounted on a rotating wheel. The implantation foil was surrounded by two Si detectors for α, β and electron detection while γ rays were detected with two high-resolution Ge detectors.

By means of unambiguously Si-γ and γγ coincidences, a detailed level scheme of the coexisting states has been built-up as well as a detailed description of their decay properties (γ intensities, E0 component of $2^+ \rightarrow 2^+$ transitions). The newly observed or better energy-determined 0_2^+, 2_2^+, 2_3^+ states in ^{180,182}Hg follow well the general trend of the prolate band. They confirm that the minimum of the parabolic behavior in excitation energy of the prolate band occurs in ^{182}Hg, as expected. The exceptionally large E0 component observed in the $2_1^+ \rightarrow 2_2^+$ transition in ^{184}Hg (23+/-5) confirm that the two states are strongly mixed and they have different deformation.

Isomerism is well-known in the heavier thallium isotopes and the population of low-spin states as well as high-spin states (up to 8^+ in ^{182,184}Hg) in the beta decay points to similar features in the lighter thallium isotopes.

The information gathered can be combined with the ones obtained with different techniques, such as in-beam γ and conversion-electron spectroscopy, Coulomb excitation on postaccelerated radioactive ions (recently performed at ISOLDE), lifetime measurements and laser spectroscopic studies to get a deeper knowledge of the shape-coexistence phenomenon.