Static electric quadrupole moments for the 11^- and 12^+ isomers in ^{192}Pb

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The neutron-deficient Pb nuclei offer one of the best illustration of the phenomenon of shape coexistence. Spherical states associated with the Z=82 shell closure are coexisting at low excitation energies with deformed states involving proton particle-hole intruder excitations across the closed shell. The observation of low-lying 0^+ states is one of the essential experimental fingerprints [1]. The occurence of intruder states is explained [2] by the combined effect of (i) the monopole and quadrupole interaction acting in the valence space of many-particle many-hole proton excitation across the Z=82 closed shell and of (ii) a very large open neutron shell.

High-spin isomers involving a broken pair two-proton configurations are of particular interest since the measurement of their static moments could provide direct information on the underlying structure and deformation. States with $I^\pi = 11^-$ have been observed from ^{188}Pb to ^{196}Pb [1], and have been interpreted as a two-proton $\pi(h_{9/2}i_{13/2})_{11^-}$ configuration. They are coexisting with $I^\pi = 12^+$ isomers involving a $\nu i^2_{13/2}$ neutron configuration characteristic of sphericity.

In the present work we have investigated the quadrupole moments of the 11^- and and 12^+ isomers in ^{192}Pb, with the aim to evidence the shape coexistence and to provide a measure of the deformation associated to the two-proton intruder excitation. The isomer lifetimes, $\tau(11^-)$=1.09(3) μs and $\tau(12^+)$=1.59(7) μs [3], are well suited for applying the time-differential perturbed angular distribution (TDPAD) method. The quadrupole interaction has been studied in the electric field gradient of the polycrystalline lattice of metallic Bi. The states have been populated and aligned in the ^{168}Er(^{28}Si,4n) reaction using a ^{28}Si beam of 143 MeV delivered by the Legnaro National Laboratory XTU Tandem accelerator. The beam has been pulsed, with a pulse width of 2 ns at a repetition period of 3.2 μs. The target consisted of 0.7 mg/cm^2 ^{168}Er foil on which a 5 mg/cm^2 metallic Bi layer has been evaporated, followed by a 50 mg/cm^2 thick Pb foil to stop the beam. Planar and large-volume Ge detectors have been used for detecting the γ-rays.

The data analysis is in progress. Sample experimental TDPAD spectra are shown in Fig. 1 together with the least-squares fits. Preliminary values of $|Q(12^+)| = 0.27(5)$ eb and $|Q(11^-)| = 2.5(4)$ eb have been derived. The small quadrupole moment of the 12^+ two-quasineutron state fits very well into the systematics of measured moments for quasi-neutron states in light Pb [4]. The higher value derived for the quadrupole moment of the 11^- state indicates an increased collectivity associated with the proton intruder excitation. Assuming for this state a strongly coupled $K^\pi=11^-$ oblate configuration, a quadrupole deformation β_2=–0.11(2) is deduced from the experimental static quadrupole moment.

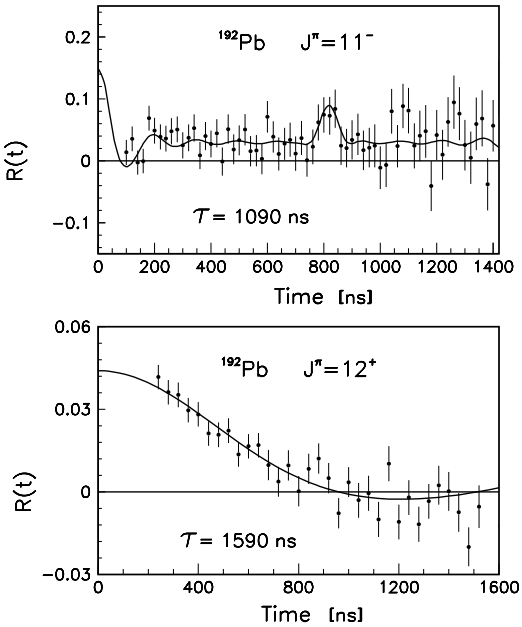

FIG. 1. TDPAD spectra showing the quadrupole interaction of the 11^- and 12^+ isomeric states in ^{192}Pb implanted in the polycrystalline lattice of metallic Bi.

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