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Electromagnetic transition rates in the nucleus $^{136}_{58}$Ce

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Abstract

The properties of the nuclei from the N = 80 isotonic chain allow a consistent test of shell model predictions for proton numbers above the Z = 50 shell closure. The systematic, which is available for the B(E2) values in the barium isotopes follows a smooth curve, while for the cerium isotopes in ^{138}Ce [1] we have an anomalous behaviour compared to the neighbouring isotonic and isotopic chains.The systematic of the $B(E2; 6^+_1 \rightarrow 4^+_1)$ values for the cerium and barium isotopes, indicates that the E2 transition to the $I^\pi = 4^+_1$ level is more strongly hindered than the corresponding $B(E2)$ value for the N = 82, magic nucleus ^{140}Ce.

A similar situation has been reported for the ^{136}Ba [2], where $B(E2; 6^+_1 \rightarrow 4^+_1) < B(E2; 6^+_1 \rightarrow 4^+_2)$. To interpret of this result, the authors assume that the $I^\pi = 6^+_1$ and $I^\pi = 4^+_2$ states have similar congurations dominated by $\pi(g_{7/2})^2$ and $\nu(h_{11/2})^{-2}$ excitations [2].

One possible way to further investigate this anomalous behaviour was to measure the lifetime (or find the $B(E2)$ value) of the 6^+ state in ^{136}Ce. This paper presents the preliminary results of such a measurement. Using the reaction ^{128}Te(^{12}C,4nγ) at a beam energy of 60 MeV and the fast-timing γ -ray coincidence method with a mixed $LaBr_3$(Ce)-HPGe NuBall array the lifetimes of $I^\pi = 6^+_1$ state of ^{136}Ce has been mesured for the first time. The obtained results as well as experimental aspects relevant for further studies are discussed.

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