OBSERVATION OF THE COMPETITIVE DOUBLE-GAMMA DECAY

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The double-gamma decay is a rare electromagnetic process, where instead of a single photon two gamma-rays are emitted, each with a continuous energy spectrum. The sum energy of the two photons equals the transition energy. This process has so far only been observed for the decay of the first excited states of 16O, 40Ca and 90Zr [1,2], where the spin of the excited and the ground state is zero, and thus the single photon decay---the main experimental obstacle to observe the double-photon decay---is strictly forbidden and cascading decays cannot occur due to the absence of any intermediate states. In these cases branching ratios for double-gamma decay are of the order of 10^-4, with the main competing decay channel being internal pair production.

We have recently succeeded to measure the double-gamma decay of the 662 keV 11/2- isomer of 137Ba populated in the beta-decay of the well know spectroscopy standard 137Cs. In this case the double-gamma decay competes with the allowed single photon decay: a situation we call the competitive double gamma decay. The branching ratio of double- to single-gamma decay was measured to be 2.05(37) 10^-6 [3]. Characteristic of the decay is a very pronounced angular correlation, which is not symmetric about 90 degree. The angular correlation and the energy distribution of the individual photons are characteristic of the contributing multipolarities and we conclude that the decay is dominated by (virtual) M2E2-transitions with a contribution of E3M1.

The observed branching ratio, as well as the energy distribution and the angular correlation, can be well described within the quasiparticle phonon model (QPM).

The observation of the competitive double-gamma decay process opens the door to a further study of this decay mode and the off-diagonal transition polarizabilities and susceptibilities that govern this rare process.

REFERENCES

[1] J. Schirmer et al., PRL 53, 1897 (1984)
[2] J. Kramp et al., NPA 474, 412 (1987)
[3] C. Walz, Dissertation, TU Darmstadt (2014)