THE THEORY OF CONTROLLING THE SPONTANEOUS GAMMA-DECAY OF EXCITED AND RADIOACTIVE NUCLEI

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The paper discusses the theory of controlling gamma-radioactivity of nuclear sources and targets. For the first time we have created the theory of influence on the probability of spontaneous radiation and life-time of gamma-radioactive nuclei [1]. We have considered the general system which included the excited nucleus, the system of this nucleus electrons, the system of zero-energy (in vacuum state) electromagnetic modes and the system of N resonant or non-resonant atoms (screen) situated at the distance $L \gg \lambda_{eg}$ from the excited nucleus. The phenomenon of spontaneous nucleus decay controlling is a result of interaction of the excited nucleus with zero-energy electromagnetic modes, interaction of these modes with the atoms of screen, interaction of the excited nucleus with electrons system.

It is shown for the first time that the decay parameters greatly depend on the sign and magnitude of the radiation shift (radiation correction) of the resonance level position (nuclear analog of the Lamb shift for atom electrons.) This shift is determined by processes of nucleus interaction with all zero-energy electromagnetic field modes (the lowest by energy or ground). It was shown that the resonant screen effect in all cases appears to be more significant than for the nonresonant one. It is shown for the first time that the most influence on the nucleus spontaneous decay process will be realized in the case when the modes of the electromagnetic field in the zero-energy state, which interact with the nucleus, occur to be mutually synchronized. For this case the radiative life-time may be increased by many orders of magnitude.

The methods of the gamma-decay optimization (e.g. change by several orders of spontaneous radiative life-time) is also discussed

1. Vysotskii V.I. // *Physical Review* C, v.58 (1998) 337.