DISCHARGE OF METASTABLE NUCLEI DURING NEGATIVE MUON CAPTURE

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A negative μ meson captures by a metastable nucleus may accelerate the discharge of the latter by many orders of magnitude (c.f.[1,2]). For a certain relation between the energy range of the nuclear and mesonic levels the discharge may be followed by the ejection of a meson, which may then participate in the discharge of the other nuclei. In this paper we present a consistent QED theory for phenomenon of discharge of a nucleus with emission of γ quantum and further meson conversion, which initiates this discharge. Traditional process of the μ meson capture are in details studied earlier and here is not considered. Within an energy QED approach (c.f.[1,2]) with QED scattering matrix, a decay probability is presented as an imaginary part of the energy shift. The intensities of satellites are linked with imaginary part of the "nucleolus core+ proton +meson" system. For radiative decays it is manifested as effect of the retarding in interaction and self-action. Three channels should be taken into account: 1). Radiative purely nuclear 2^j -poled transition (probability P_1; this value can be calculated on the basis of known traditional formula); 2). Non-radiative decay, when a proton transits into the ground state and a meson leaves the nuclei with energy $E = \Delta E^{p}_{N_1 J_1} - E^{i}_{\mu}$, where $\Delta E^{p}_{N_1 J_1}$ is an energy of nuclear transition, E^{i}_{μ}- is an energy of bond for meson in the *1s* state (probability P_2); 3). A transition of proton into the ground state with excitement of meson and emission of the γ-quantum with energy $h\omega = \Delta E^{p}_{N_1 J_1} - \Delta E^{\mu}_{nl}$ (probability P_3). Within the QED perturbation theory [1-3,], a full probability is divided into the sum of the partial contributions, connected with decay into definite final states of system. These contributions are equal to the corresponding transitions probabilities (P_i). For example, under condition $\Delta E^{p}_{N_1 J_1} > E^{i}_{\mu}$ a probability definition reduces to QED calculation of probability of the autoionization decay of the two-particle system. The corresponding QED expression is derived. There are also discussed the key moments of calculational procedure on the basis of our nuclear numerical code [3-5]. For a sample with a sufficiently high density of metastable nuclei and a sufficiently intense meson beam above considered process can result in a sharp increase of γ radioactivity of the sample and may be used as the basis of operation of a high power source of monochromatic γ radiation.

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