Low-energy part of the spectrum in the internal Compton effect

K.Ilakovac, M.Jurčević, and Z.Krečak, Institute "Rudjer Bošković", Zagreb

Measurements[1] of the electron-photon double decay in ^{137}Ba and ^{113}In indicate that this process proceeds mainly via electronic intermediate states. This conculsion is obtained from the comparison of the experimental differential transition probabilities with the theoretical values calculated for various mechanisms. Best agreement is obtained by the theory of the internal Compton effect of Spruch and Goertzel[2]. In this theory,due to the application of the Born approximation, a diverging (proportional to 1/E) differential transition probability was obtained at low photon energies. This divergence cannot be real, since otherwise the integrated transition probability would be infinite, and the isomeric state would decay instantly. A deviation from the 1/E distribution was observed in the decay of ^{137}Ba. In the decay of ^{113}In, which was studied more recently using a Ge (Li) detector for detection of photons, the deviation was not observed. In both measurements the spectra of photons above the X-ray lines were measured. The aim of the present investigation was to measure the differential transition probability of the Kγ decay in ^{113}In below X-ray lines of 24 and 27 keV. Triple coinicidences of electrons, photons, and X rays were recorded in a three-dimensional analyzer system. A Canberra Low-Energy Photon Detector of a resolution of less than 1 keV at 122 keV and a volume of 8 cm^3, was used to detect photons. A point was obtained at an average photon energy of 17.6 keV, for which the differential transition probability was determined at $(15.8 \pm 3.7)\cdot 10^{-3}$ $(mc^2.sr)^{-1}$ per K conversion electron. This value is larger than the theoretical value derived from the Spruch-Goertzel theory of $8.7\cdot 10^{-3}$ $(mc^2.sr)^{-1}$ per K conversion electron. It seems that the Kγγ process yields an increase in the low-energy part of the photon spectrum.

References

1. A.Ljubičić, B. Hrastnik, K. Ilakovac, M. Jurčević, and I. Basar, Phys. Rev. C3 (1971) 824; M. Jurčević, K. Ilakovac, and Z. Krečak, to be published.
2. L. Spruch and G. Goertzel, Phys. Rev. 93 (1954) 642.