Studying after effects by gamma-gamma and electron-gamma perturbed angular correlations

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Using electron-gamma perturbed angular correlations (PAC) experiments working side-by-side with gamma-gamma PAC on the same isomeric transitions, besides structural properties, additional information can be unambiguously obtained by following the electronic recombination at the atomic shells and the neighbor atoms after the emission of the conversion electron from the probe nuclei K, L, or M atomic shells. Such experiments can be envisaged, as well, to clear out gamma-gamma PAC experiments where the probing state is fed by electron capture decay. There, one K, L, M orbital electron is absorbed by a proton creating a hole when the atomic number changes from Z to Z-1. This causes a severe electronic rearrangement of the atomic shells accompanied by the emission of x-rays and Auger electrons. The atom is left in a highly ionized state and the recombination time – fast or slow – depending on the availability and mobility of host electrons determines if a transient effect is observed within the lifetime of the nuclear state used for PAC. This is the so called “after effect”, that if properly understood, can further contribute to learn about the interaction of the impurity probe with the host, eventually observing ionized states and determining electron mobility [1]. Illustrating this problematic we present and discuss in this work the study of TiO_2 doping [2] using different PAC isotopes (^{111}In/^{111}Cd, ^{181}Hf/^{181}Ta, ^{111m}Cd/^{111}Cd, ^{117}Cd/^{117}In).

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[2] J. Schell, CERN-THESIS-2015-229, São Paulo University, Brazil (2015).