

THE TECHNIQUE FOR DISTINGUISHING BETWEEN RESONANT AND
NON-RESONANT EXCITATION OF NUCLEI BY GAMMA-RAYS

M. Krčmar, A. Ljubičić, K. Pisk and B.A. Logan
Ruđer Bošković Institute, Zagreb, Yugoslavia
Department of Physics, University of Ottawa, Ottawa, Canada

We have studied the photoactivation of ^{115}In and ^{111}Cd isomeric levels, using ^{60}Co sources. In contrast to earlier investigations, we have considered the possibility of nonresonant processes, and have developed a technique which allows us to distinguish between activation via the resonance fluorescence, and by non-resonant processes involving the 1172 and 1332 keV ^{60}Co photons. Our technique involves lead pieces interposed between the source and the sample (indium or cadmium) during the photoactivation exposures. The relative values of the resonant and non-resonant photon fluxes depend on the tail of low energy photons emerging from the source and the scattering and absorption in the lead and the sample. In the photoactivation exposures the relative number of resonant excitation increases as the thickness of lead increases, and by using several different thickness it is possible to distinguish between the resonant and non-resonant contributions. The effects of the lead and the sample on the photon energy distribution were investigated using a smaller ^{60}Co source which emits full-energy photons only. The photon beam emerging from ~ 30 cm long collimator was expected to have an appreciable low energy tail. This was not measured directly but a parameter k , which represented the fraction of photons with less than the full energy that emerged from the source, was a variable in a χ^2 comparison between the experimental photoactivation data and the theoretical predictions.

We have found that non-resonant processes are the dominant modes of activation. This suggests that in many experimental investigations involving continuous photon distributions unconsidered non-resonant contributions could have been important and could result in an overestimate of the ground state transition width.