The measurement of cross sections of inelastic and transfer reactions with gamma-particle coincidence

J.R.B. Oliveira, V. Zagatto, D. Pereira, P.R.P. Allegro, L.C. Chamon, E.W. Cybulska, R. Linares, N.H. Medina, R.V. Ribas, E.S. Rossi Jr, W.A. Seale, C.P. Silva
Instituto de Física da USP, Brazil

D.L. Toufen
Instituto Federal de Educação, Ciência e Tecnologia, Guarulhos, São Paulo, Brazil

M.A.G. Silveira
Centro Universitário da FEI, São Bernardo do Campo, Brazil

G.S. Zahn, F. A. Genezini
Instituto de Pesquisas Energéticas e Nucleares, São Paulo, Brazil

L. Gasques
Centro de Física Nuclear da Universidade de Lisboa, Lisboa, Portugal

J. Lubian, J.M.B. Shorto
Instituto de Física da Universidade Federal Fluminense, Niterói, RJ, Brazil

The reaction cross sections of inelastic excitation and transfer to excited states can be measured by gamma-particle coincidences. Special care has to be taken, however, with the particle-gamma angular correlations, which can be affected by the de-alignment caused by hyperfine interaction when the gamma decay occurs in vacuum. This is further complicated when rather thick targets are used (in order to obtain large statistics) causing the recoil velocity distribution to become broad. We describe a series of tests in order to understand and control these effects and obtain reliable values for the cross sections. The measurements were made at the Pelletron accelerator laboratory of the University of São Paulo with the Saci-Perere spectrometer [1], which consists of 4 GeHP Compton suppressed gamma detectors and a 4π charged particle ancillary system with 11 $\Delta E - E$ plastic phoswich scintillators. A set of collimators was introduced for the reduction of the angular aperture of the plastic scintillators and to avoid excessive count rates due to elastically scattered beam particles [2]. The passive photomultiplier bases were replaced by active bases, allowing for a very stable operation. The ^{18}O + ^{110}Pd reaction was measured (among others) in the beam energy range from 46-60 MeV. Up to eleven different angles of the scattered particle were measured for each run, in the interval from 30 to 140 degrees relative to the beam direction. The targets consisted of 0.84 mg/cm^2 isotopically enriched ^{110}Pd with a 1.5 mg/cm^2 Au backing. In order to test the corrections due to the vacuum de-alignment, some measurements have been made with the target turned around (the beam entering through the Au layer). Extensive Coulomb excitation calculations (code GOSIA [3]) were performed and compared with the data at low energies and scattering angles. In addition, calculations were performed with a new model based on the São Paulo potential, specifically developed for the inclusion of dissipative processes such as deep-inelastic collisions (DIC) [4,5]. We discuss the comparison between the results.
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References

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