Measurement of gamma-ray line production cross sections from residual nuclei produced in natCa (p, x) nuclear reactions. Comparison of the results to theoretical predictions.

Gamma-ray energy spectra from the de-excitation of residual nuclei produced in irradiations of a calcium target with proton beams of energies, Ep = 30, 42, 54 and 66 MeV, have been recorded using the iThemba LABS AFRODITE array equipped with 8 Compton-suppressed HPGe clover detectors. The areas of characteristic peaks for de-excitation gamma-ray lines from low-lying states of several nuclei - 40Ca (line at 3737 keV), 39Ca (2796 keV line), 39K (2522 and 2814 keV lines), 38K (328 keV line), 38Ar (2167 keV line) and 37Ar (1410 and 1611 keV lines) - have been extracted from which integrated line production cross sections have been determined via Legendre-polynomial fits to the angular distribution experimental data. The obtained results were then compared to TALYS code calculations in order to estimate the contributions of different reaction mechanisms. Following calculations using the TALYS code default input parameters, fair agreements between theory and experiment are observed for the lines at E$\square$ = 328 keV and 1611 keV, while large discrepancies ranging from 25 % up to 100 % are found for the other lines. Significant improvements are achieved following our TALYS calculations performed with using in the latter code modified Optical Model Potential (OMP) parameters and applying the Level Density (LD) model.

Preliminary cross-section experimental results are presented here, together with data available in the literature measured for 40Ca at proton energies, Ep = 66, 80, 95, 110 and 125 MeV, compared to theory via TALYS code calculations.

Keywords: Nuclear reactions, γ-ray production cross sections, TALYS code calculations, optical model potential.

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