Impact of the γ-Ray Strength Function to Elastic and Inelastic Photon Scattering

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Abstract

Enhancement or reduction of transition intensities in cascades relative to direct deexcitations to the ground state are governed by γ-ray strength functions and level densities. This competition in the deexcitation paths is reflected in the cross sections for inelastic and elastic photon scattering, respectively, and derived from them branching ratios for ground-state transitions. Probing this competition leads to a better understanding of the γ-ray spectra from neutron-capture experiments, which are relevant to nuclear astrophysics and development of new reactor technologies. Photon-scattering experiments provide an opportunity to study γ-ray strength functions for dipole transitions due to the low momentum transfers. The High-Intensity γ-ray Source (HIγS) at the Triangle Universities Nuclear Laboratory provides 100% linearly polarized and nearly monoenergetic photon beams of tunable energies from 1 to 100 MeV with an energy spread from 0.5 to 5%. This facility opens up the possibility to measure the cross sections for elastic and inelastic photon scattering and to study the statistical γ-ray transitions. In addition, due to the polarization of the beam, measurement of azimuthal asymmetry reveals the transition type, $E1$ or $M1$.

We will present results from photon-scattering experiments carried out at the HIγS facility on $A \approx 90 - 100$ nuclei ^{88}Sr, ^{89}Y, ^{90}Zr [1] and ^{98}Mo [2], and the heavy-mass nuclei ^{235}U [3] and ^{239}Pu. Cross section for elastic and inelastic photon scattering will be compared with results from simulations of nuclear cascades as well as results from experiments with bremsstrahlung beams performed at the ELBE accelerator and with neutron beams at DANCE.

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