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The investigation in non-statistical mechanisms of photonuclear emission of charged particles on molybdenum

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It is generally accepted that photonuclear reactions caused by photons occur in two stages in region of giant dipole resonance (GDR): the excitation of the nucleus as a system and its decay according to statistical laws. Neutron emission is the most well studied decay channel. Its output has a much greater magnitude than other reactions: (γ, 2n), (γ, p), etc. In addition, the direct registration of reaction products doesn't allow to attribute nucleons to specific channel reliably if thresholds of several reactions are exceeded. Thus, the photonuclear reactions with the emission of charged particles are studied poorly. However, they point out the domination of non-statistical decay mechanisms in GDR region. For example, the collective model overestimates the yields of reactions with the neutron emission and significantly underestimates the reactions with the proton emission in nuclei with A > 90. The isospin splitting of GDR effect is the reason for this.
We've investigated the photonuclear reactions on molybdenum isotopes for bremsstrahlung with 20, 40 and 55 MeV in this research. (γ, p), (γ, pn), (γ, p2n), (γ, α) and (γ, αn) are studied. 20 MeV bremsstrahlung allows to distinguish the dominant reaction. 40 and 55 MeV bremsstrahlung enable to follow cross sections changes. The values calculated in Talys1.95 are much smaller than the observed ones. We've tested method of isospin splitting consideration for (γ, p)-reactions and it has provided us with the values which are close to experiments.
The statistical model also gives a strong yield underestimation for the reactions with the emission of α-particles, for which the Coulomb barrier is essential in its framework. The observed yield can be explained by the contribution of semi-direct reactions occurring on time scales of 10-21 s when the barrier does not have enough time to form and inhibit (γ, α). Our results shows the connections between yields and nuclear shell completeness. If the residual nucleus has the magic number of neutrons (N = 50 in our case) then yield is much higher for such a reaction.

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The speaker is a student or young scientist

Yes

Section

1. Experimental and theoretical studies of nuclear reactions

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