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What can we say about the dipole photon strength in ^{57}Fe compound from the $(n_{\rm th}, \gamma)$ data?

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Decay properties of nuclear states in the domain of high nuclear level density (NLD) are usually described within the statistical model of the nucleus using the NLD and photon strength functions (PSFs). In some nuclei with mass $A \sim 30 - 100$, the NLD might still be insufficiently low even near the neutron separation energy S_n. Despite this, the statistical model is used to describe the decay of these nuclei.

In the mentioned mass range, information on PSFs for γ-ray energies well below S_n comes mainly from charged-particle-induced reactions, analyzed using the Oslo method \1. Data analyzed with this method show that the PSFs should significantly decrease with E_γ for E_γ $lesssim 3$ MeV. This feature is known as a low-energy enhancement (LEE) and was, for the first time, reported in Fe nuclei \2. This result was supported by two-step γ cascade data following thermal neutron capture measured at Budapest \2. However, these data can easily be contaminated by soft bremsstrahlung induced by extremely intense primary transitions \3 that may mimic the effect of LEE.

In practice, the LEE has been reported only from a limited number of techniques other than the Oslo method. Any independent experimental confirmation of LEE is thus desired, especially as data from radiative thermal neutron capture in Mo isotopes – where the LEE was also reported from Oslo data – seem inconsistent with any strong enhancement \[4-6].

An almost complete decay scheme of ^{57}Fe was recently published from radiative capture of thermal neutrons on ^{56}Fe \7. In this contribution, we present tests of the compatibility of these experimental data with several PSFs and NLD models. The main limitations of analysis come from expected fluctuations of individual transition intensities – believed to follow the Porter-Thomas distribution (PTD) around an E_γ-dependent expectation value \8. The PTD predicts many transitions with low intensities, which may escape detection, and a threshold for observation of transitions thus has to be considered in any analysis within the statistical model. Several different observables from $^{56}{\rm Fe}(n,\gamma)$ reaction can be checked against predictions from simulations. Particular interest is paid to primary transitions that are relevant for the radiative cross section.

In addition, a new detailed analysis of two-step γ cascade spectra from $^{56}{\rm Fe}(n,\gamma\gamma)$, re-measured at Nuclear Physics Institute at Řež, has also been made. A comparison of the results from this experiment will be presented, too.

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