

## Level density and unusual low energy enhancement of $\gamma$ -strength in iron isotopes.

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The level densities and  $\gamma$ -strength functions have been obtained for  $^{56,57}\text{Fe}$  isotopes using different experiments and methods. The first experiment has been performed at the Oslo cyclotron laboratory using the  $^{57}\text{Fe}(^3\text{He},\alpha\gamma)^{56}\text{Fe}$  and  $^{57}\text{Fe}(^3\text{He},^3\text{He}'\gamma)^{56}\text{Fe}$  reactions. The level density and  $\gamma$ -strength function have been obtained by using the sequential extraction technique [1]. The striking result of these experiments was an unusual enhancement of the  $\gamma$ -strength function below  $\sim 3$  MeV of  $\gamma$ -energy [2]. This result contradicts the existing models and requires new theoretical developments as well as experimental confirmation. The main assumption of the Oslo method is the Axel Brink hypothesis [3], according to which the  $\gamma$ -strength function depends only on the energy of the  $\gamma$ -transition and not on the excitation energy of the initial and final states. This assumption allows the level density and  $\gamma$ -strength function to be simultaneously extracted from the  $\gamma$ -matrix in the Oslo-type experiment. Although it is believed that estimated possible violations of this assumption do not introduce large errors in the final results, an independent experimental confirmation is needed.

The level density for the  $^{56}\text{Fe}$  nucleus has been independently obtained from the neutron evaporation spectrum of  $^{55}\text{Mn}(d,n)^{56}\text{Fe}$  measured at the Edwards accelerator of Ohio University with 7-MeV deuterons. The evaporation spectra from backward angles have been used to extract the level density, which in turn has been compared with that obtained from the Oslo type experiment. Good agreement has been found thereby increasing the reliability of obtained results for both the level density and  $\gamma$ -strength function for iron isotopes as well as for the Oslo method in general. It also indicates that the neutron evaporation spectrum taken from backward angles does not contain noticeable direct reaction contributions that would lead to a distortion of the obtained level density function.

The  $\gamma$ -strength functions have been extracted from the  $\gamma$ -matrix of the Oslo experiment but now with new a level density obtained from the neutron evaporation spectrum. This allows one to build the  $\gamma$ -strength functions at different excitation energies of initial states and investigate the Axel-Brink hypothesis that is very important from both a fundamental point of view and from the point of view of its application to the Oslo method. The results and perspectives are discussed.

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3. P.Axel, Phys. Rev. 126, 671 (1962)