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Study of the ${}^{169}{\rm Tm}(n,\gamma)$ reaction using DANCE facility at LANSCE

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The reason for studying the neutron capture reaction on the mono-isotopic element thulium is twofold. Its only stable isotope, ¹⁶⁹Tm, is often used as a neutron-flux activation monitor. The neutron capture cross-section in the relevant energy range has been measured several times \[1-4] in the past and more recently at CSNS \5. While these data show rough agreement, there are significant differences. Moreover, the uncertainties are often not quoted. These two motivate a state-of-the-art measurement and analysis of the neutron capture cross-section in the keV energy range.

The neutron capture cross-section can also be calculated via the Hauser-Feshbach approach 6, for which the key ingredients are the photon-strength-functions (PSFs) and nuclear level density (NLD). These quantities can be inferred from the γ -ray spectra of *s*-wave resonances by comparing them to the simulated spectra.

The neutron-capture reactions on the ¹⁶⁹Tm nuclei have been measured with the DANCE calorimeter \[7,8] at LANSCE \9. The background-corrected sum-energy and multi-step-cascade spectra were extracted for a number of strong isolated *s*-wave resonances. These experimental coincident γ -ray spectra are compared with their simulated counterparts using Monte-Carlo code DICEBOX \10 to obtain information about PSFs and NLD. In particular, we investigate the scissors-mode (SM) role in the *M1* PSF. Previously, SM parameters of well-deformed rare-earth nuclei were obtained by several experimental techniques, see e.g. Refs. \[11-13] and review \14. They show significant differences, especially in the strength of the mode. The shape of the low-energy tail of the giant electric-dipole resonance is uncertain too. Because of these inconsistencies, additional information on PSFs in this region is of great interest.

The neutron capture cross-section is deduced from the experimental data in the usual fashion, i.e. by subtracting backgrounds, determining the neutron flux using several flux monitors, and normalizing to the standard cross-section. The analysis steps, internal consistency of our data, preliminary results on PSFs, and neutron capture cross-sections will be presented.

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