Giant dipole resonance built on hot rotating nuclei produced during evaporation of light particles from the ^{88}Mo compound nucleus†

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Studying the Giant Dipole Resonance (GDR) properties at high temperature and increasing angular momentum is one of the most important tools to investigate the nuclear structure under extreme conditions. The evolution of the GDR width with angular momentum and temperature reflects the role played by quantal and thermal fluctuations in the mechanism of damping of the giant resonance. To test predictions of damping mechanisms in a more comprehensive way, the GDR studies should be based on exclusive and rather complete measurements, which include, in addition to γ-rays, the detection of the recoiling residual nuclei and emitted particles. The present article reports on an exclusive experiment performed to measure the GDR width of the ^{88}Mo nucleus, produced in the reaction ^{48}Ti + ^{40}Ca at 300 and 600 MeV bombarding energies, which correspond to the average temperatures $T = 2.1$ and 3 MeV, respectively. The data were analyzed using the statistical model Monte Carlo code *GEMINI++*. It allowed extracting the GDR parameters by fitting the high energy γ-ray spectra. The GDR strength functions and extracted GDR widths were compared with theoretical predictions based on the Lublin-Strasbourg-Drop (LSD) macroscopic model, supplemented with thermal shape fluctuations analysis (LSD+TFM)[1)], and the Phonon Damping Model (PDM)[2)]. These predictions were convoluted with the population matrices of evaporated nuclei from the statistical model. As it can be seen from the comparison (Fig. 1), the theoretical predictions by both models are in a rather good agreement with the experimental data, especially at the highest energy. A possible onset of a saturation of the GDR width was observed around T = 3 MeV.

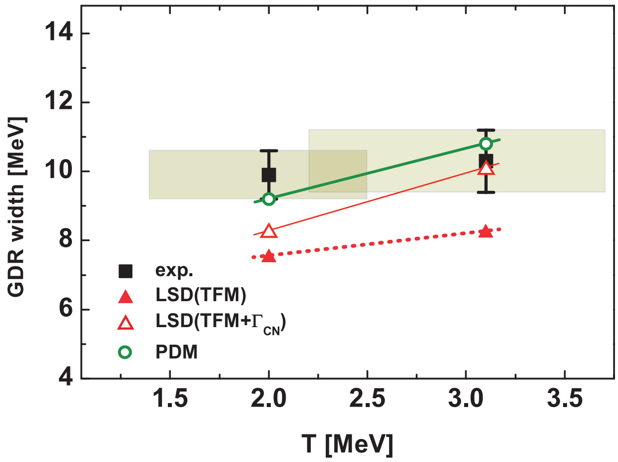

Fig. 1. Temperature dependence of the GDR width. The experimental values (full squares) are compared with the predictions of the LSD+TFM (triangles) and PDM (circles). The results of calculations based on the LSD+TFM used either GDR width at $T = 0$ equal to Γ_0=5 MeV (full triangles) or $\Gamma(T) = \Gamma_0 + \Gamma_{CN}$ (open triangles) with the T-dependent evaporation width Γ_{CN}. The experimentally extracted GDR widths are bounded in the shaded areas determined by the width of the experimental temperature distributions and the vertical error bars. The straight lines connecting the theoretical predictions are drawn to guide the eyes.

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References

1) K. Pomorski, J. Dudek, Phys. Rev. C **67** (2003) 044316. J. Dudek, K. Pomorski, N.Schunck and N. Dubray, *Eur. Phys. J. A* **20** (2004) 15.
2) N. Dinh Dang and A. Arima, Phys. Rev. Lett. **80** (1998) 4145; N. Dinh Dang, *Phys. Rev. C* **85** (2012) 064323.