EFFECT OF THERMAL FLUCTUATIONS IN THE PAIRING FIELD ON THE WIDTH OF GIANT DIPOLE RESONANCE

Nguyen Dinh Dang, RIKEN Nishina Center for Accelerator-Based Science, Wako city, Saitama, Japan

The effect of thermal fluctuations in the pairing field on the width of giant dipole resonance (GDR) in highly excited nuclei is demonstrated within the phonon damping model (PDM) and thermal shape fluctuation model (TSFM).

The PDM [1] represents the GDR width at a given temperature T as a sum of the quantal width and thermal width. The quantal width originates from the coupling of the GDR phonon to the particle-hole configurations, whereas the thermal width arises due to the coupling of the GDR phonon to the particle-particle, and hole-hole configurations. The latter appear owing to the distortion of the Fermi surface at finite T. However, in the open shell nuclei, the increase in the total width at low T is compensated by including temperature-dependent pairing in the PDM. Because of thermal fluctuations in finite nuclei, the pairing gap does not collapse at the critical temperature of the superfluid-to-normal phase transition, as in infinite systems, but decreases monotonically with increasing T, turning the smooth Fermi surface due to pairing at T = 0 toward the step-function, hence, reducing the effect of the coupling to particle-particle and hole-hole configurations. This compensation at low T is the reason of a GDR width that is insensitive to temperature at $T \leq 1$ MeV in open-shell heavy nuclei. The comparison of the PDM predictions for the GDR width with the experimental systematics at low $T < 1$ MeV shows that it is indeed the case [2].

The TSFM assumes that the GDR strength function can be averaged over all quadrupole shapes and orientations. This leads to the increase in the GDR width with temperature and angular momentum. Based on the success of the above-mentioned treatment of pairing within the PDM, pairing correlations have also been included for the first time in the TSFM, whose predictions for the GDR width at low T are compared with the recent experimental data [3].

At $T > 1$ MeV the effect of pairing fluctuations is negligible so that the GDR width starts to increases with temperature and angular momentum. The latter has also been recently included in the PDM, whose predictions are found in excellent agreement with the most recent experimental data for the temperature dependence of the GDR width in nuclei produced during evaporation from ^{88}Mo compound nucleus [4].

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