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# Electromagnetic dipole transitions in nuclei at finite temperature

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Describing the properties of highly excited nuclei or atomic nuclei at finite temperatures remains one of the most challenging tasks for both nuclear theory and experiment. Understanding the response of nuclei, particularly electromagnetic dipole transitions, under extreme conditions is not only crucial for nuclear physics but also essential for modelling astrophysical phenomena such as stellar and galactic evolution [1].
To describe temperature effects in electromagnetic transitions, we developed a self-consistent finite temperature relativistic quasiparticle random phase approximation (FT-RQRPA) based on relativistic energy density functional with point coupling interaction [2-3]. We studied the electric dipole (E1) and magnetic dipole (M1) transitions at temperatures ranging from T=0 to 2 MeV for the calcium and tin isotopic chains. Our study revealed that the E1 and M1 responses exhibit significant dependence on temperature. The E1 strength experiences slight modifications within the considered temperature range, while new low-energy peaks emerge in the low-energy region due to thermal unblocking. The M1 strength also undergo significant shifts towards lower energies due to the decrease in spin-orbit splitting energies and the weakening of the residual interaction with increasing temperature. At high temperatures, we observed an intriguing phenomenon in 40,60Ca nuclei: the emergence of M1 excitations. These excitations, which are typically forbidden at zero temperature due to fully occupied (or fully vacant) spin-orbit partner states, became apparent under these conditions. These findings could play a crucial role in modelling gamma strength functions and their applications in astrophysically relevant nuclear reaction studies.

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