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Description of the $M1$ resonance in ^{208}Pb within the self-consistent phonon-coupling model

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The theoretical description of nuclear magnetic excitations within self-consistent models is hampered by the fact that the parameters of the underlying energy-density functionals (EDF) are determined without accounting for magnetic properties which leaves the EDF's spin parameters uncertain. In a recent paper 1 we have explored low-lying M1 excitations in ^{208}Pb within a self-consistent random-phase approximation (RPA) based on a Skyrme EDF. By re-tuning the spin parameters we managed to reproduce the experimental key quantities: energy and the strength of the 1^+_1 state as well as mean energy and summed strength of the M1 resonance in 208Pb in the interval 6.6-8.1 MeV.
However, the observed fragmentation of the M1 resonance and its total width are not described within the RPA. Here we have to go beyond RPA by proceeding to the self-consistent time blocking approximation (TBA) which includes particle-phonon coupling and which we use actually in its renormalized version [2]. The Skyrme EDF with the basis parametrization SKXm [3] was used both in the RPA and in the TBA. The spin-related EDF parameters x_W, W_0, g and g' were refitted as explained in 1. The theoretical and "experimental" strength functions were obtained by folding the discrete spectra with a Lorentzian of half-width Δ = 20 keV. The results are shown in the figure. The TBA, in contrast to the RPA, reproduces the experimental splitting of the M1 resonance into two components separated by the dip near 7.4 MeV. But the total width of the resonance is still underestimated and the detailed fragmentation structure of the experimental curve is not quantitatively reproduced.

1. V. Tselyaev et al. // Phys. Rev. C 2019. V.99. P.064329.
2. V. Tselyaev et al. // Phys. Rev. C 2018. V.97. P.044308.
3. B. A. Brown // Phys. Rev. C 1998. V. 58. P.220.

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