Description of Magnetic Giant Resonances with Skyrme Forces

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Despite a great success of the time-dependent Skyrme Hartree-Fock (TDSHF) approach in exploration of nuclear dynamics, it is still poorly applied to magnetic excitations, in particular to spin-flip M1 and scissors M1 giant resonances (GR). At the same time the spin-flip M1 GR can be an important source of knowledge on spin correlations in the Skyrme functional. The resonance strongly depends on the spin-orbit splitting and so can serve as a robust test of the spin-orbit interaction. Besides, the spin-flip M1 GR is closely related to the Gamow-Teller (GT) resonance and its satisfactory treatment is relevant for the description of GT mode as well. The scissors M1 resonance is also of a great importance as a useful source of information on the nuclear deformation and orbital magnetism.

Our recent studies have shown that TDSHF has serious troubles in description of the spin-flip M1 giant resonance [1,2]. The results for different Skyrme parameterizations are contradictory and poorly agree with the experiment. In particular, it is quite difficult to describe simultaneously the one-peak gross structure of M1 strength in doubly magic nuclei and two-peak structure in heavy deformed nuclei. The reason of this mismatch could lie in an unsatisfactory treatment of spin correlations and spin-orbit interaction.

We review the present status of the problem and possible ways of its solution [1,2]. In particular, we inspect i) the interplay of the collective shift and spin-orbit splitting, ii) the isovector M1 response versus isospin-mixed responses, and iii) the role of tensor and isovector spin-orbit interaction. The analysis is done within the self-consistent separable Skyrme-RPA (SRPA) method which, being proved as a reliable theoretical tool for investigation of electric giant resonances [3], was recently specified for the magnetic excitations [1,2]. The exploration involves 8 Skyrme forces and various (light/heavy, spherical/deformed) nuclei. The results for the orbital scissors M1 mode are also presented [4]. General perspectives of TDSHF description of magnetic modes are discussed with the emphasis to the role of the tensor interaction.

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