NUCLEAR VORTICITY IN GIANT RESONANCES: SKYRME RPA ANALYSIS

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As recently shown, the multipole vortical, toroidal, and compression modes can be analyzed on the same theoretical footing as second-order corrections to the familiar multipole electric transition operator [1]. The method follows the vorticity concept of Ravenhall and Wambach [2] and allows to establish a simple relation between the multipole vortical operator and the toroidal/compression ones. The method is implemented to the Skyrme self-consistent separable random-phase approximation (SRPA) approach known as an effective and reliable theoretical tool for investigation of electric [3] and magnetic [4] giant resonances.

First calculation for E1 vortical, toroidal, and compression strengths in ^{208}Pb have shown that the vortical and toroidal modes are dominated by the convection nuclear current in the isoscalar (T=0) channel and by magnetization nuclear current in the isovector (T=1) channel. The compression mode is fully convective in both channels.

In the present study, we continue exploration of the nuclear vorticity and related toroidal and compression modes. The difference between the Wambach's [2] and hydrodynamical prescriptions of the vorticity is scrutinized. Dependence of the results on Skyrme parameterizations and characteristics of nuclear matter is explored. Possible ways of experimental observation of the modes are discussed. Both spherical and deformed nuclei from different mass regions are covered. Effect of the nuclear deformation is analyzed.

[1] J. Kvasil, V.O. Nesterenko, W. Kleinig, P.-G. Reinhard, and P. Vesely, Phys. Rev. C **84**, 034302 (2011).

[2] D.G. Raventhall and J. Wambach, Nucl. Phys. **A475**, 468 (1987).

[3] V.O. Nesterenko, J. Kvasil, and P.-G. Reinhard, Phys. Rev. **C66**, 044307 (2002); V.O. Nesterenko, W. Kleinig, J. Kvasil, P.-G. Reinhard, and P. Vesely, Phys. Rev. **C74,** 054306 (2006); W. Kleinig, V.O. Nesterenko, J. Kvasil, P.-G. Reinhard, and P. Vesely, Phys. Rev. **C78,** 055313 (2008).

[4] P. Vesely, J. Kvasil, V.O. Nesterenko, W. Kleinig,, P.-G. Reinhard ,and V.Yu. Ponomarev, Phys. Rev. C **80,** 031302(R) (2009); V.O.Nesterenko, J.Kvasil, P.Vesely, W.Kleinig, P.- G.Reinhard, V.Yu.Ponomarev, J.Phys. G **37**, 064034 (2010).