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Understanding the nuclear collective states with photons

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Our understanding of the nuclear collective behaviour is not yet complete. There are elusive collective modes, and new types of probes, such as vortex photons, have been proposed as a means to access them. Vortex photons could enable the identification of isovector modes other than the Giant Dipole Resonance (GDR) and thus provide new information on the nuclear Equation of State (EoS). In this respect, there is a clear connection between nuclear collective excitations and the status and perspectives in nuclear photonics.
In this spirit, I will start my contribution with a general introduction on what we have achieved so far by extracting information on the EoS from collective modes; I will discuss in particular the usual GDR, the dipole polarizability and other observables related to the symmetry energy. Then, I will focus on the gamma decay of giant resonances.
This decay is a severe test for theory, and I will argue that the attempt to reproduce experimental numbers for the gamma decay does indeed challenge our understanding of the excitation and dynamics of giant resonances as a whole. I will present results for the decay of various multipole excitations, either to the ground state or excited state. I will discuss how this sheds light on the isospin character of these states and, to a large extent, on their microscopic structure.

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