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Nuclear single-particle and collective spectroscopy

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In the spirit of the present conference, one should recall that Daniel Gogny, in his seminal paper where the force that bears his name was introduced, said that one should leave room for the evaluation of the "correction ⋯due to the quasiparticle-vibrational coupling". The accuracy that one can reach through theoretical calculations of single-particle (or quasi-particle) energies has been the subject of long debates. In this talk, we will discuss recent calculations that (a) use state-of-the-art Energy Density Functionals (EDFs), (b) include pairing and tensor forces, and (c) include the coupling with collective vibrations. Results will be compared with existing data as well as with recent data from ISOLDE. We will also compare the results of similar calculations for collective states, like low-lying multipole states or giant resonances, with experimental findings. Implications for the nuclear equation of state will be also addressed. As in the case of the single-particle spectra, we aim to assess the merits and the limitations of state-of-the-art calculations based on Energy Density Functionals (EDFs), including quasiparticle-vibrational coupling. We conclude by discussing the predictive power of currently used EDFs.

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