Conference on Quantum-Many-Body Correlations in memory of Peter Schuck (QMBC 2023)

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Thermal phase transitions and giant resonances in atomic nuclei with chiral effective interactions

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Ab initio approaches to the nuclear many-body problem have seen their reach considerably extended over the last decade. However, collective excitations have seldom been addressed in that context, due to the prohibitive cost of solving the corresponding equations of motion.

We adapt a novel method originally proposed in the framework of the nuclear energy density functional method, and derive its extension to non-zero temperatures.
We thus obtain the first fully self-consistent ab initio study of multipolar responses of atomic nuclei using two- and three-body chiral interactions, at zero and finite temperature.

The method is applied to the mid-mass nucleus ^{56}Fe, which is challenging for ab initio interactions due to its mid-mass, deformed and superfluid character. After reproducing the temperature-induced shape transition at the mean-field level, we analyse the evolution of the isovector dipole strength function within a temperature range $k_B T \in [0; 4]$ MeV. A strong dependence is observed, characterised by a downwards shift of the resonance centroid when the system is heated up.

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