Contribution ID: **59** Type: **Oral**

Nuclear response at zero and finite temperature

Recent developments of the relativistic nuclear field theory on the proton-neutron response and on the finite-temperature formalism will be presented. The general non-perturbative framework, which advances the nuclear response theory beyond the one-loop approximation, is formulated in terms of a closed system of non-linear equations for the two-body Green's functions. This provides a direct link to ab initio theories and allows for an assessment of accuracy of the approach.

The response theory is extended for the case of finite temperature. For this purpose, the time blocking approximation to the time-dependent part of the in-medium nucleon-nucleon interaction amplitude is adopted for the thermal (imaginary-time) Green's function formalism. The method is implemented self-consistently in the framework of Quantum Hadrodynamics and designed to connect the high-energy scale of heavy mesons and the low-energy domain of nuclear medium polarization effects in a parameter-free way. In this framework, we investigate the temperature dependence of dipole spectra in the even-even medium-heavy nuclei with a special focus on the giant dipole resonance's width problem and on the low-energy dipole strength distribution. Its behavior, together with the temperature dependence of the Gamow-Teller resonances, are studied for their potential impact on the r-process nucleosynthesis.

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Track Classification: Invited Talk