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Ab initio description of monopole resonances

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Giant monopole resonances, and in particular the nuclear breathing mode, play a central role in constraining the incompressibility of nuclear matter - an essential parameter in the nuclear equation of state. Traditionally, these modes have been studied within the Random Phase Approximation (RPA) using phenomenological Energy Density Functionals (EDF), establishing a well-known framework for exploring collective excitations.

However, a comprehensive, systematic treatment of monopole resonances within the ab initio paradigm remains largely unexplored. Ab initio many-body methods, despite their remarkable progress over the past two decades, still face challenges in addressing excited-state phenomena.

In this talk, I will present systematic ab initio predictions of (giant) monopole resonances across light- and mid-mass nuclei, including both closed- and open-shell systems. Using the Projected Generator Coordinate Method (PGCM) and the In-Medium Similarity Renormalization Group (IMSRG), we explore key aspects of the monopole response, highlighting novel insights into the structure and dynamics of nuclear matter from first principles.

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