Giant resonance properties & the nuclear equation of state

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Duration : 2h

Giant resonance, which are high frequency collective excitation modes of the nucleus, involve a large number of nucleons. As such they are linked to the nuclear equation of state [1]. In particular the compression modes are related to the nuclear incompressibility [2] and despite significant progress in our understanding, one cannot converge towards a value that is more accurate than the 10%–20% level. The measurement of compression modes in exotic nuclei could, therefore, significantly improve our understanding of nuclear matter incompressibility and in particular its evolution away from the stability.

This type of measurement is a particularly challenging task and has been mainly limited to the isovector (protons and neutrons out of phase) giant and pygmy dipole resonance in neutron-rich radioactive isotopes [3, 4]. More recently experiments have been possible for the compression modes, thanks to the development on efficient new apparatus like active targets [5–7].

The lectures will be organized as follows :

1. Introduction on the evolution of the nuclear equation of state away from stability.
2. Giant resonances classification and main characteristics, description of the suitable probes to measure them and their limitations.
3. Standard experimental approach and new development.
4. Results on compression modes and implication for the nuclear equation of state.

References

[1] M. N. Harakeh and A. van der Woude, *Giant Resonances: Fundamental High-Frequency Modes of Nuclear Excitation* (Oxford University Press, 2001).

[2] U. Garg and G. Colò, Progress in Particle and Nuclear Physics **101**, 55 (2018), ISSN 0146-6410, URL https://www.sciencedirect.com/science/article/pii/S0146641018300322.

[3] D. Savran, T. Aumann, and A. Zilges, Progress in Particle and Nuclear Physics **70**, 210 (2013), ISSN 0146-6410, URL http://www.sciencedirect.com/science/article/pii/S0146641013000057.

[4] J. Gibelin, Ph. d. thesis, Université Paris Sud - Paris XI (2005), URL https://tel.archives-ouvertes.fr/tel-00011600.

[5] M. Vandebrouck, Ph.D. thesis, Université Paris Sud - Paris XI (2013), URL http://tel.archives-ouvertes.fr/tel-00872712.

[6] S. Bagchi, Ph.D. thesis, University of Groningen (2015), URL https://hal.archives-ouvertes.fr/tel-01253585/file/Thesis_Soumya.pdf.

[7] J. Gibelin, Acta Physica Polonica B **48**, 359 (2017), URL https://doi.org/10.5506/aphyspolb.48.359.