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First study of the PDR via neutron inelastic scattering at GANIL-SPIRAL2/NFS

The pygmy dipole resonance (PDR) refers to a low-lying strength in the dipole response of nuclei, located around the neutron separation energy [1] and associated with neutron excess in nuclei. As of today, the available experimental data do not provide an accurate picture of the fine structure of the PDR. These open questions on its structure and its potential implications on neutron capture-rates in the r-process [2] or as a tool to constrain the symmetry energy in the nuclear equation of state [3] convey a clear need for more experimental data to pin down its nature and refine theoretical models.

In experimental studies of the PDR via inelastic scattering, the so-called “multi-messenger investigation” [4] of the PDR shows a clear advantage to extract complementary information on its nature, depending on the probe used. The experiment I will present fits into this context and offers, for the first time, a study of the PDR using a neutron probe.

The experiment dedicated to the study of the PDR in the ^{140}Ce nucleus via neutron inelastic scattering ($n, n'\gamma$) took place in 2022 at the Neutrons For Science facility at GANIL-SPIRAL2 [5]. The ~ 30 MeV quasi-monoenergetic neutron beams available at the facility, which are unique in terms of intensity, made this study possible. The PARIS [6] and the MONSTER [7] arrays were used for the γ and scattered neutron detection respectively. The detection setup offers very good timing characteristics and a high γ -ray efficiency in the PDR region.

The talk will first present the results for the elastic and inelastic scattering reactions on ^{12}C target used as a benchmark. The presentation will then focus on the results of the study with the ^{140}Ce target, with the extraction of the PDR strength. Finally, conclusions on the interest of the neutron probe and perspectives will be discussed.

References

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