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Approaching the pygmy dipole resonance in Sn isotopes with the Oslo method

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The pygmy dipole resonance (PDR) is a feature commonly appearing in the low-lying electric dipole response of nuclei on top of the tail of the giant dipole resonance (GDR). Despite the ongoing debates regarding its origin, its emergence is commonly associated with the presence of the neutron excess and might potentially affect the neutron-capture rates and, thus, abundances of elements produced in heavy-element nucleosyntehsis [1]. A systematic investigation of the evolution of the PDR in different isotopic chains with different theoretical approaches and experimental methods is therefore required for both general nuclear structure studies and large-scale astrophysical calculations.

This work presents a systematic study of the evolution of the low-lying electric dipole strength in eleven Sn isotopes, $^{111-113,116-122,124}$Sn, using the dipole γ-ray strength functions (GSF) below the neutron separation energy extracted from particle-γ coincidence data with the Oslo method [2]. These GSFs were compared with the strengths from relativistic Coulomb excitation in forward-angle inelastic proton scattering below the neutron threshold [3], where they were found to be in excellent agreement within the uncertainties. The Coulomb excitation data cover a wide energy range of both the PDR and the GDR and provide the dipole magnetic part of the response. Together with the Oslo data, they were used to extract the low-lying electric dipole strength in all eleven Sn isotopes. It appears to exhaust $\approx 2\%$ of the classical Thomas-Reiche-Kuhn (TRK) sum rule and to be nearly constant throughout the whole chain of stable Sn isotopes. This is in contradiction with the majority of theoretical approaches (e.g., relativistic quasiparticle random-phase and time-blocking approximations), which predict a steady increase in the PDR strength with neutron number. Moreover, a presumably isovector component of the PDR was extracted for $^{118-122,124}$Sn. Its strength was found to increase almost linearly with neutron number, reaching up to $\approx 0.5\%$ of the TRK sum rule in ^{124}Sn.

The nuclear level densities of Sn isotopes, also extracted with the Oslo method, were employed together with the corresponding GSFs as inputs for calculations of neutron-capture cross sections and rates within the Hauser-Feshbach approach with the reaction code TALYS. The obtained cross sections and rates are in excellent agreement with other experimental data and evaluations from the KADoNiS, JINA REACLIB, and BRUSLIB libraries. Even though the low-lying electric dipole strength in Sn isotopes is limited to $\approx 2\%$ of the TRK sum rule, it contributes up to 20% of the estimated total cross sections. Moreover, the new experimentally constrained rates of the ^{121,123}Sn$(n,\gamma)^{122,124}$Sn reactions were found to affect the production of ^{121,123}Sb in the i-process simulations and limit the available theoretical uncertainties considerably.

[1] S. Goriely, Phys. Lett. B 436, 10-18 (1998).
[2] A. C. Larsen, et al., Phys. Rev. C 83, 034315 (2011).
[3] S. Bassauer, et al., Phys. Rev. C 102, 034327 (2020).

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