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Fine structure of the Isovector Giant Dipole Resonance from light to heavy-mass nuclei and 1⁻ level densities using (p,p') scattering at zero degrees

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Abstract content
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A survey of the fine structure phenomenon of the Isovector Giant Dipole Resonance (IVGDR) was carried out, using proton inelastic scattering for an incident energy of 200 MeV separated sector using the cyclotron at iThemba LABS and the K600 magnetic spectrometer at zero degrees for a wide target-mass range of closed and near-closed shell nuclei: ²⁷Al, ⁴⁰Ca, ⁵⁶Fe, ⁵⁸Ni and ²⁰⁸Pb. A background subtraction procedure which eliminates the contributions due to the Isoscalar Giant Quadrupole Resonance (ISGQR), Isovector Giant Quadrupole Resonance (IVGQR), quasi-free scattering and the phenomenological background effects was implemented before the experimental cross-section data were converted into equivalent photo-absorption cross-sections. The obtained equivalent photo-absorption cross-sections were then compared with photo-nuclear data available in the literature. Characteristic energy scales from both the experimental data and state-of-art QPM calculations of the IVGDR were extracted using the wavelet analysis technique. In addition, experimental level densities of J^{&pi} = 1⁻ states were extracted using the fluctuation analysis method. The method utilises the autocorrelation function which is a key tool in obtaining a measure of the cross-section fluctuations with respect to a stationary mean value. It also makes use of the Discrete Wavelet Transform (DWT) analysis which is crucial in removing the remaining physical background from other multipoles excited and any remaining instrumental background. The experimentally extracted level densities were then compared with different theoretical parameterisations of the Hartree Fock-Bogoliubov (HFB), Hartree Fock-Bardeen-Cooper-Schrieffer (HF-BCS) and Back shifted Fermi Gas model (BSFG). Capabilities and limitations of the recently commissioned zero-degree facility of the K600 magnetic spectrometer will be discussed.

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Main supervisor (name and email)
and his / her institution

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