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Fine structure of the Isoscalar Giant Quadrupole Resonance using proton inelastic scattering at 200 MeV in spherical to highly deformed neodymium isotopes

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Abstract :

Proton inelastic scattering measurements have been performed at iThemba Laboratory for Accelerator Based Sciences, using the state-of-the-art K600 Magnetic Spectrometer. This is one of the only two facilities in the world with a unique capability of high energy-resolution measurements at medium energies. The 200 MeV proton beams were delivered by the Separated Sector Cyclotron (SSC). As a result, fine structure has been observed in the region of the Isoscalar Giant Quadrupole Resonance (ISGQR) in five stable even-even neodymium (from spherical to highly deformed) target nuclei, namely, ^{142}Nd, ^{144}Nd, ^{146}Nd, ^{148}Nd and ^{150}Nd. Nuclei with mass number $A \approx 150$ and neutron number $N \approx 90$ are particularly of special interest since they occupy that region of the nuclide chart wherein the onset of permanent prolate deformation occurs. The stable even-even neodymium ($Z = 60$) isotopes have been chosen in the present study in order to investigate the influence of the onset of deformation on the excitation energy spectra in the ISGQR region ($9 \leq E_x \leq 15$ MeV), since they extend from the semi-magic $N = 82$ nucleus (^{142}Nd) to the permanently deformed $N = 90$ (^{150}Nd) nucleus. In order to enhance the ISGQR in the excitation energy spectra measured, a Discrete Wavelet Transform (DWT) background subtraction was carried out. A comparison of the resonance widths extracted shows a systematic broadening of the ISGQR, moving from spherical to highly deformed nuclei as has already been observed for the Isovector Giant Dipole Resonance (IVGDR) excited by &gamma-capture.; Energy scales were extracted for the resonance region using the Continuous Wavelet Transform (CWT) technique. Another important further step which has been conducted is the extraction of 2^+ nuclear level densities from the fine structure in the region of the ISGQR. Experimental details, data extraction and analysis techniques, together with preliminary results will be presented.

Award :

No

Level :

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Paper :

No

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