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Fine Structure of the Isoscalar Giant Monopole Resonance in 58Ni, 90Zr, 120Sn and 208Pb

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Background: Over the past two decades high energy-resolution inelastic proton scattering studies were used to gain an understanding of the origin of fine structure observed in the isoscalar giant quadrupole resonance (ISGQR) and the isovector giant dipole resonance (IVGDR). Recently, the isoscalar giant monopole resonance (ISGMR) in ^{58}Ni, ^{90}Zr, ^{120}Sn and ^{208}Pb was studied at the iThemba Laboratory for Accelerator Based Sciences (iThemba LABS) by means of inelastic α-particle scattering at very forward scattering angles (including 0°). The good energy resolution of the measurement revealed significant fine structure of the ISGMR.
Objective: To extract scales by means of wavelet analysis characterizing the observed fine structure of the ISGMR in order to investigate the role of different mechanisms contributing to its decay width.
Methods: Characteristic energy scales are extracted from the fine structure using continuous wavelet transforms. The experimental energy scales are compared to different theoretical approaches performed in the framework of quasiparticle random phase approximation (QRPA) and beyond-QRPA including complex configurations using both non-relativistic and relativistic density functional theory.
Results: All models highlight the role of Landau fragmentation for the damping of the ISGMR especially in the medium-mass region. Models which include the coupling between one particle-one hole (1p-1h) and two particle-two hole (2p-2h) configurations modify the strength distributions and wavelet scales indicating the importance of the spreading width. The effect becomes more pronounced with increasing mass number.

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Email Address

a.bahini@ilabs.nrf.ac.za

Presenter if not the submitter of this abstract

Primary author: BAHINI, Armand (iThemba Laboratory for Accelerator Based Sciences (LABS))

Co-authors: Dr SEVERYUKHIN, Alexey (Bogoliubov Laboratory of Theoretical Physics, Joint Institute for Nuclear Research); Prof. LITVINOVA, Elena (Facility for Rare Isotope Beams, Michigan State University); Prof. USMAN, Iyabo (University of the Witwatersrand); Prof. CARTER, John (University of the Witwatersrand); Dr ARSENYEV, Nikolay (Bogoliubov Laboratory of Theoretical Physics, Joint Institute for Nuclear Research); Prof. VON NEUMANN-COSEL, Peter (Institut fuer Kernphysik Technische Universitaet Darmstadt); NEVELING, Retief (iThemba LABS); Prof. FEARICK, Roger (University of Cape Town)

Presenter: BAHINI, Armand (iThemba Laboratory for Accelerator Based Sciences (LABS))

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