The Role of Deformation on the Dipole Strength Distribution of the Pygmy Dipole Resonance

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Abstract

During the last three years, our main nuclear structure activity at HIGS was to the study of low-energy dipole modes from stable nuclei below the particle emission threshold. This activity was focused on measuring the soft vibrational mode in neutron-rich nuclei which is commonly referred to as the “pygmy” dipole resonance (PDR). We determined the spin and parity of more than 1000 states in the closed neutron shell nuclei with $N = 50$ and $N = 82$ in order to unveil the nature and character of this mode of excitation. Our experimental results at HIGS verify for the first time that the PDR is indeed predominantly an E1 mode of excitation. Additionally, the fine structure of M1 dipole states have been observed for the first time in $N = 82$ nuclei. They are concentrated around 6.5 MeV and are close to the neutron separation energy. Our findings are in agreement with the QPM prediction that the character and the strength of this dipole mode is a mixture of both isoscalar and isovector excitation modes.

Our studies of the PDR at HIGS and our other collaborating facilities have, until now, focused on nuclei with spherical shells and with excess of neutrons. We propose expanding our investigation to examine this mode of excitation in nuclei that have constant deformation in their ground states in order to better understand the role that deformation plays in the fragmentation of PDR strength in the tail region of the isovector GDR.

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