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Electric Dipole Response of ²⁰⁸Pb: PDR, Neutron Skin, and Symmetry Energy

ponses of atomic nuclei to an external field. Most of the E1 strength is carried by a giant dipole resonance (GDR), which is described as a dipole oscillation between protons and neutrons. Recently a sizable E1 strength concentration has been found in several nuclei at the region of neutron separation energy below GDR, which is called low-lying dipole strength or a pygmy dipole resonance (PDR). The nature of the PDR is not known well but might be explained as a dipole oscillation of neutron skin against an isospin-saturated core. The properties of the PDR may shed light on the formation of neutron skins, symmetry energy and equilibrium properties of neutron stars. In addition, recent studies on energy density functionals using Skyrme forces suggest dipole polarizability, which is an inversely energy-weighted sum-rule of the E1 strength, as an alternative observable to constrain both neutron skin and symmetry energy. Thus complete determination of the E1 response is quite important.

A case of special interest is the doubly magic nucleus 208Pb. We have performed a high-resolution proton inelastic scattering measurement from ²⁰⁸Pb at very forward angles including zero-degrees. The data were taken at the Research Center for Nuclear Physics (RCNP), Osaka University, employing a polarized proton beam at 295 MeV. Differential cross sections were measured at 0-6 degrees and polarization transfer coefficients at 0-2.5 degrees. The measured excitation energy region is 5-22 MeV, which completely covers the GDR and PDR strengths.

We have obtained an accurate E1 strength distribution including the PDR region. The dipole polarizability has been determined up to 130 MeV by combining our data and existing data. The measured dipole polarizability and the E1 strength distribution are compared with theoretical models to discuss the neutron skin thickness and the symmetry energy of the nuclear equation of state.

In the workshop, I will explain the overview of the experimental methods and will discuss the results on behalf of the RCNP-E282 collaboration.

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