
Pygmy Dipole Resonance and Dipole Polarizability in Zr Isotopes

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Recently, a bump like structure of Electric Dipole (E1) strength that emerges in the low-energy tail of the giant dipole resonance (GDR) has drawn attention as a Pygmy Dipole Resonance (PDR) in medium-heavy nuclei. The PDR is predicted to be a dipole oscillation of a neutron skin against a core nucleus. The PDR is expected to give constraints of the neutron matter equation of state (neutron EOS). From the study of ²⁰⁸Pb, the symmetry energy term of the neutron EOS is closely related to the dipole polarizability (DP) that is an inversely energy-weighted sum rule of E1 strength. The DP of ¹²⁰Sn has also been measured in order to provide a limit to the neutron EOS.

It is suggested that the valence neutrons occupying the low- ℓ orbits are important for the emergence of the PDR [1]. Since Zr isotopes have a spherical shape and a closed proton subshell, the role of such as valence neutrons can be well studied. Thus we study the PDRs in Zr isotopes. In reference [2], we reported that the PDR strength in ⁹⁰Zr over 7 – 11 MeV was $0.75 \pm 0.08 e^2\text{fm}^2$, that correspond to 2.1 ± 0.2 % of the Thomas-Reiche-Kuhn (TRK) sum rule. The strength was obtained to perform a high-resolution measurement of inelastic proton scattering off ⁹⁰Zr near 0° with using a dispersion matched beam of 295 MeV protons at the Research Center for Nuclear Physics of Osaka University. Inelastically scattered protons were measured with the Grand Raiden magnetic spectrometer at setting angles of 0°, 2.5°, and 4.5° and double differential cross sections were obtained at nine angles from 0.35° to 5.07° in the center of mass system. E1 transition strength was extracted by a multipole decomposition analysis of the angular distribution of differential cross sections using the ECIS95 distorted-wave Born approximation code with the Hartree-Fock plus random-phase approximation model and inclusion of E1 Coulomb excitation.

The project to measure the PDR strengths in Zr isotopes with using same method is in progress. In this report, we will present the PDR distributions of ⁹⁰Zr, ⁹²Zr, ⁹⁴Zr, ⁹⁶Zr and the DP in ⁹⁰Zr will be also report.

REFERENCES

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