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Dipole Polarizability and Neutron Skin Thickness in 68Ni

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The symmetry energy term of the nuclear equation-of-state, describing fundamental phenomena both in nuclear physics and in astrophysics, is the focus of huge theoretical and experimental efforts. The electric dipole response of nuclei as a function of the neutron-to-proton-asymmetry is driven by the symmetry energy and in particular by its density dependence. Studies of the Pygmy Dipole Resonance (PDR) in exotic nuclei have been used to constrain the symmetry energy or the neutron skin thickness. The electric dipole polarizability αD, being very sensitive to the low-lying dipole strength, is correlated to the neutron skin thickness in a robust and less model-dependent manner [1]. Recently, for the stable nucleus, 208Pb the neutron skin thickness was extracted from the measured αD [2].
Here, a first experimental determination of the electric dipole polarizability αD in an unstable nucleus, namely 68Ni, and the derivation of its neutron-skin thickness will be reported [3].
Coulomb excitation in inverse kinematics at the R3B-LAND setup at GSI allows for the investigation of the dipole strength distribution in the neutron-rich 68Ni with excitation energies spanning the pygmy (PDR) and giant dipole resonance (GDR). The results comprise the resonance parameters for the observed PDR at 9.55(17) MeV and the GDR at 17.1(2) MeV. In combination with the results from Wieland et al. [4] an unexpectedly large direct photon-decay branching ratio of 7(2)% is observed for the PDR. The measured αD of 3.40(23) fm3 is compared to relativistic RPA calculations [5] yielding a neutron-skin thickness of 0.17(2) fm for 68Ni.

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