Measurement of the Dipole Polarizability of ^{68}Ni*

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The Equation of State (EOS) of nuclear matter is at the center of many current research axes in nuclear science, ranging from nuclear structure considerations, over heavy-ion collisions to the physics of neutron stars. When dealing with radioactive nuclei with a large proton-neutron imbalance, one component of the nuclear EOS is of particular importance: the symmetry energy. Especially its density dependence is of interest, since this parameter has been shown to correlate strongly with nuclear properties such as the neutron-skin thickness or the amount of low-lying electric dipole (E1) strength [1]. Previously, measurements of low-lying E1 strength have been used to determine the parameters of the symmetry energy [2]. It has, however, been shown that the measurement of the dipole polarizability α_D is a more robust and less model-dependent observable to extract this information [3].

In an experiment performed at the R^{3}B-LAND setup at GSI, Coulomb excitation of ^{68}Ni was measured in inverse kinematics. By measuring the invariant mass of the ^{68}Ni(γ^*,n)^{67}Ni and ^{68}Ni(γ^*,2n)^{66}Ni decay channels, the excitation energy distribution of this nucleus was reconstructed in an energy window ranging from its 1n threshold and covering the regions of low-lying E1 strength and of the IVGDR. The latter was quantitatively measured at a centroid energy of $E_m = 17.1(2)$ MeV, with a width of $\Gamma = 6.1(5)$ MeV and exhausing 98(7)% of the energy-weighted sum rule (EWSR) [4]. Low-lying E1 strength described by a Gaussian function was also observed at $E_m = 9.55(17)$ MeV, with a width of $\sigma = 0.51(13)$ MeV and 2.8(5)% of the EWSR. Based on this observed E1 strength, a polarizability of $\alpha_D = 3.40(23)$ fm^3 was measured from the 1n threshold to the upper integration limit of 28.4 MeV. Relativistic RPA calculations using the FSUGold parametrization [5] provided the correlation between the observable α_D and the neutron-skin thickness $\Delta R_{n,p}$ of ^{68}Ni, as shown in Fig. 1. The extrapolation to the measured value of α_D provides a neutron-skin thickness of 0.17(2) fm, which is in good agreement with the value obtained from the measurement of low-lying E1 strength [1]. This new method for the extraction of neutron-skin thicknesses will also be applied to more exotic systems, thus constraining the symmetry energy further.

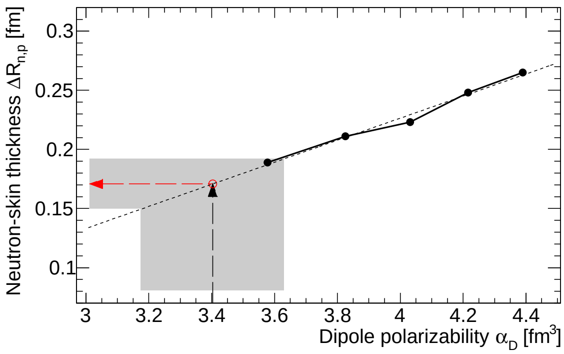

Figure 1: Correlation between the dipole polarizability α_D and the neutron-skin thickness $\Delta R_{n,p}$ of ^{68}Ni [4].

* This work was supported in part by the Helmholtz International Center for FAIR (HIC for FAIR), the Alliance Program of the Helmholtz Association (HA216/EMMI), the GSI-TU Darmstadt cooperation agreement, the Helmholtz-CAS Joint Research Group HCJRG-108, and BMBF Grants No. 06MZ222I, No. 05P12RDFN8, and No. 06MT9156.

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doi:10.15120/GR-2014-1-NUSTAR-KR-01