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

D. M. Rossi[1,2,3], *P. Adrich*[2], *F. Aksouh*[4], *H. Alvarez-Pol*[5], *T. Aumann*[2,6], *J. Benlliure*[5], *M. Böhmer*[7], *K. Boretzky*[2], *E. Casarejos*[8], *M. Chartier*[9], *A. Chatillon*[10], *D. Cortina-Gil*[5], *U. Datta Pramanik*[11], *H. Emling*[2], *O. Ershova*[12], *B. Fernandez-Dominguez*[5,9], *H. Geissel*[2], *M. Gorska*[2], *M. Heil*[2], *H. T. Johansson*[13], *A. Junghans*[14], *A. Kelic-Heil*[2], *O. Kiselev*[2,3], *A. Klimkiewicz*[2,15], *J. V. Kratz*[3], *R. Krücken*[7], *N. Kurz*[2], *M. Labiche*[16,17], *T. Le Bleis*[2,7], *R. Lemmon*[17], *Yu. A. Litvinov*[2], *K. Mahata*[2,18], *P. Maierbeck*[7], *A. Movsesyan*[6], *T. Nilsson*[13], *C. Nociforo*[2], *R. Palit*[19], *S. Paschalis*[6,9], *R. Plag*[2,12], *R. Reifarth*[12], *D. Savran*[20], *H. Scheit*[6], *H. Simon*[2], *K. Sümmerer*[2], *A. Wagner*[14], *W. Waluś*[15], *H. Weick*[2], and *M. Winkler*[2]

[1]NSCL/MSU, USA; [2]GSI Darmstadt, Germany; [3]University of Mainz, Germany; [4]King Saud University, Saudi Arabia; [5]University of Santiago de Compostela, Spain; [6]Technische Universität Darmstadt, Germany; [7]Technische Universität München, Germany; [8]University of Vigo, Spain; [9]University of Liverpool, United Kingdom; [10]CEA Bruyères-le-Châtel, France; [11]SINP Kolkata, India; [12]Goethe University Frankfurt, Germany; [13]Chalmers University of Technology, Göteborg, Sweden; [14]Helmholtz-Zentrum Dresden-Rossendorf, Germany; [15]Jagiellonian University of Krakow, Poland; [16]University of the West of Scotland, Paisley, United Kingdom; [17]STFC Daresbury Laboratory, United Kingdom; [18]BARC Mumbai, India; [19]TIFR Mumbai, India; [20]Extreme Matter Institute/GSI Darmstadt, Germany

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.

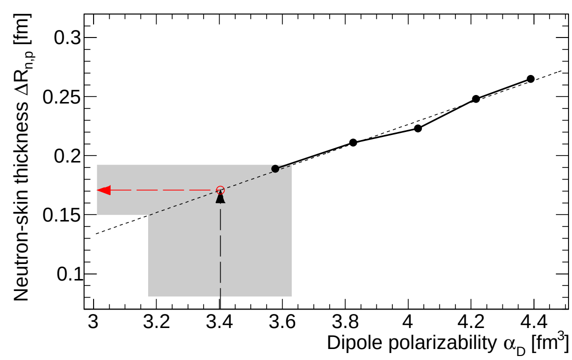

Figure 1: Correlation between the dipole polarizability α_D and the neutron-skin thickness $\Delta R_{n,p}$ of ^{68}Ni [4].

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