NEUTRON-SKIN THICKNESS AND SYMMETRY-ENERGY CONSTRAINTS FROM THE STUDY OF THE ANTI-ANALOG GIANT DIPOLE RESONANCE

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There is a renewed interest in measuring the thickness of the neutron skin [1-4], because it constrains the symmetry-energy term of the nuclear equation of state (EoS). The precise knowledge of the symmetry energy is essential not only for describing the structure of neutron-rich nuclei, but also for describing the properties of the neutron-rich matter in nuclear astrophysics.

The symmetry energy determines to a large extent, through the EoS, the proton fraction of neutron stars [5], the neutron skin in heavy nuclei [6] and enters as input in the analysis of heavy-ion reactions [7, 8]. Furnstahl [6] demonstrated that in heavy nuclei an almost linear empirical correlation exists between the neutron-skin thickness and theoretical predictions for the symmetry energy of the EoS in terms of various mean-field approaches. This observation has contributed to a revival of an accurate determination of the neutron-skin thickness in neutron-rich nuclei [9]. In this work, we suggest a new method for measuring the neutron-skin thickness with unprecedented accuracy.

Recently, we have shown that the energy difference between the anti-analog giant dipole resonance (AGDR) and the isobaric analog state (IAS) is very sensitively related to the corresponding neutron-skin thickness [10]. The energy of the charge-exchange anti-analogue giant dipole resonance (AGDR) has been calculated using the state-of-the-art fully self-consistent relativistic proton–neutron quasiparticle random-phase approximation based on the relativistic Hartree–Bogoliubov model. It is shown that the AGDR centroid energy is very sensitively related to the corresponding neutron-skin thickness [10].

The experimentally determined energy of the AGDR in different isotopes has been used to calculate the neutron-skin thickness and also the symmetry energy at saturation as well as the slope of the symmetry energy [10,11]. The results will be compared with the available experimental data.

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