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Symmetry energy and neutron pressure of finite nuclei using the relativistic mean-field formalism

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ABSTRACT

In this theoretical study, we establish a correlation between the neutron skin thickness and the nuclear symmetry energy for the even-even isotones for magic neutron N = 20, 40, 82, 126, 172 (expected) within self-consistent relativistic mean-field formalism for non-linear NL3* and density-dependent DD-ME2 parameter sets [1-3]. The local density approximation is used to formulate the symmetry energy, and its co-efficient, namely, neutron pressure of finite nuclei over the isotonic chains [4]. We find a few moderate signatures of pick and/or depth over the isotonic chains at and/or near the proton magic for symmetry energy and neutron pressure, which is a manifestation of the persistence of shell/sub-shell closure. Furthermore, we show the symmetry energy as a function of neutron-proton asymmetry, which results in similar behavior as persisted in the mass-dependence curve. The obtained results are of considerable importance since due to shell closure over the isotonic chain, will act as awaiting point in nucleosynthesis of the *r*-process. These results are also further strengthened the experimental investigations for the existence of magicity in the drip-line region of the nuclear chart [1].

Reference:

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•G. Lalazissis, S. Karatzikos, R. Fossion, D. P. Arteaga, A. Afanasjev and P. Ring, Physics Letters B **671**, 36 (2009).
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•B. K. Agrawal, J. N. De, and S. K. Samaddar, Phys. Rev. Lett. **109**, 262501 (2012).

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Though what imperative

Motivations/Objective:

1. **The transition from asymmetric nuclear matter (ANM) to finite nuclei is a natural way to constraint the nuclear symmetry energy.**

2. **The surface properties of the finite nucleus strongly co-related with the symmetry energy and its co-efficients.**

3. **Conversely, the precise determination of surface symmetry energy is important to the deformability of the neutron rich system of light nuclei.**

4. **Further, the ANM observables for finite nuclei near drip-line of the nuclear chart are crucial for determining the magicity and also some related phenomena.**

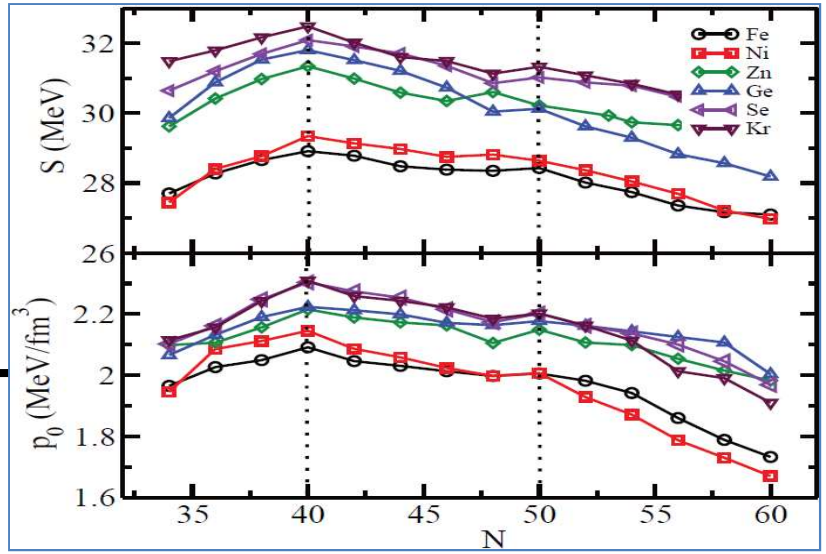
HOW TO PROCEED

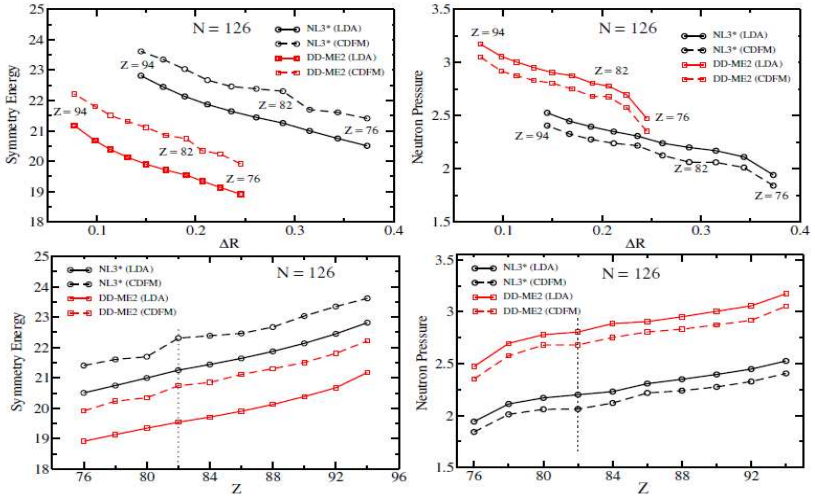
Connecting symmetry energy of finite nuclei and infinite nuclear matter

$$s = \int_0^\infty dx\,|\mathcal{F}(x)|^2 S^{\rm NM}(x),$$
$$p_0 = \int_0^\infty dx\,|\mathcal{F}(x)|^2 p_0^{\rm NM}(x),$$
$$\Delta K = \int_0^\infty dx\,|\mathcal{F}(x)|^2 \Delta K^{\rm NM}(x).$$

Thanks for your kind attentions and welcome for discussions

The symmetry energy and neutron pressure over the isotopic chain.





The symmetry energy and pressure denity over the isotonic chain from CDFM and LDA.