Influence of higher-order terms on approximation of nuclear symmetry energy

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We investigated accuracy of the approximation of symmetry energy.

$$a_t(\rho) = \frac{1}{2}\frac{\partial^2 \mathcal{E}(\rho,\eta_t}{\partial \eta_t^2}|_{\eta_t=0}$$

$$\tilde{a}_t(\rho) = \mathcal{E}(\rho, \eta_t = 1) - \mathcal{E}(\rho, \eta_t = 0)$$

We evaluated the relative error

$$\Delta_t(\rho) = \{\tilde{a}_t(\rho) - a_t(\rho)\}/a_t(\rho)$$

analytically and numerically.

System

spin degenerated homogeneous nuclear matter

Interaction

effective interactions based on HF theory

(Skyrme, Gogny, and M3Y)

As analytical approach ...

$$a_t = \sum_i a_i$$

$$= a_K + a_d + a_c + a_{pO} + a_{pX} \quad \text{(e.g. Skyrme)}$$

$$\Delta_i = \{\tilde{a}_i - a_i\}/a_i \quad \rightarrow \text{ analytically evaluated}$$

$$\Delta_t = \sum_i \Delta_i a_i / a_t$$

As results, for example,

$$\Delta_t = \{0.057 a_K - 0.021 a_{pO} - 0.1 a_{pX}\}/a_t$$