

Nuclear symmetry energy and its components at zero and finite temperatures

***¹A.N. Antonov, ¹D.N. Kadrev, ¹M.K. Gaidarov
²P. Sarriguren, ³E. Moya de Guerra***

¹Institute for Nuclear Research and Nuclear Energy, Bulgarian Academy of Sciences, Sofia 1784, Bulgaria

²Instituto de Estructura de la Materia, CSIC, Serrano 123, E-28006 Madrid, Spain

³Departamento de Física Atomica, Molecular y Nuclear, Facultad de Ciencias Fisicas, Universidad Complutense de Madrid, E-28040 Madrid, Spain

- Calculations of the nuclear symmetry energy, its volume and surface components and their ratio at finite temperatures within the Coherent Density Fluctuation Model (CDFM)**
- Study of the temperature dependence of the symmetry energy coefficient in finite nuclei and other properties (nucleon densities, rms radii, neutron skins) within the Local Density Approximation (LDA)**

$$E(A, Z) = -BA + E_S A^{2/3} + S(T) \frac{(N - Z)^2}{A} + \text{Coulomb term} + \text{shell corrections} \quad (1)$$

$$S(T) = \frac{S^V(T)}{1 + \frac{S^S(T)}{S^V(T)} A^{-1/3}} = \frac{S^V(T)}{1 + A^{-1/3} / \kappa(T)}, \quad \kappa(T) \equiv \frac{S^V(T)}{S^S(T)} \quad (2)$$

$$S^V(T) = S(T) \left(1 + \frac{1}{\kappa(T) A^{1/3}} \right), \quad S^S(T) = \frac{S(T)}{\kappa(T)} \left(1 + \frac{1}{\kappa(T) A^{1/3}} \right) \quad (3)$$

In the CDFM the nuclear symmetry energy $S(T)$ and an approximate expression for the ratio $\kappa(T)$ can be written:

$$S(T) = \int_0^\infty dx |\mathcal{F}(x, T)|^2 S[\rho(x, T)] \quad (4)$$

$$\kappa(T) = \frac{3}{R\rho_0} \int_0^\infty dx |\mathcal{F}(x, T)|^2 x \rho_0(x) \left\{ \frac{S(\rho_0)}{S[\rho(x, T)]} - 1 \right\} \quad (5)$$

Temperature dependent symmetry energy coefficient within the LDA:

$$e_{sym}(A, T) = \frac{1}{I^2 A} \int \rho(r) e_{sym}[\rho(r), T] \delta^2(r) d^3r \quad (6)$$

Ni isotopic chain

⁷⁸Ni

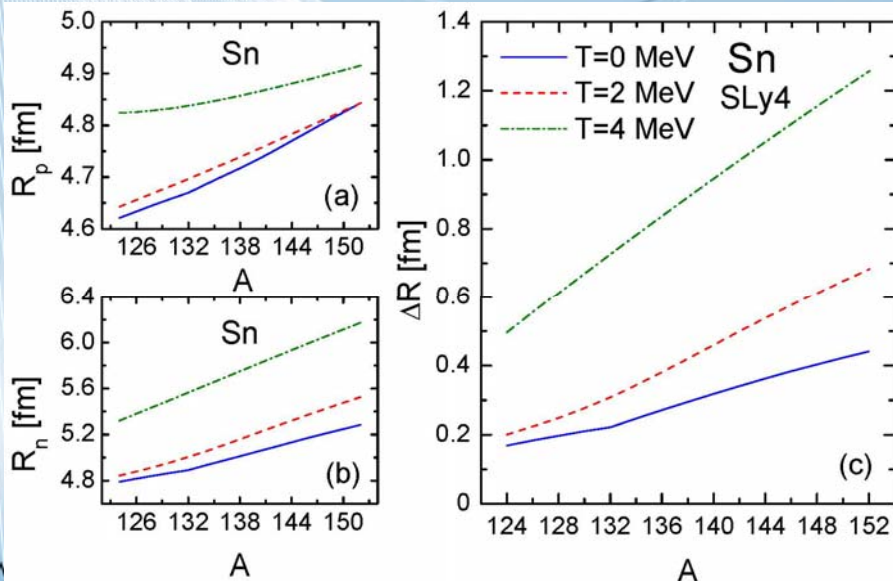
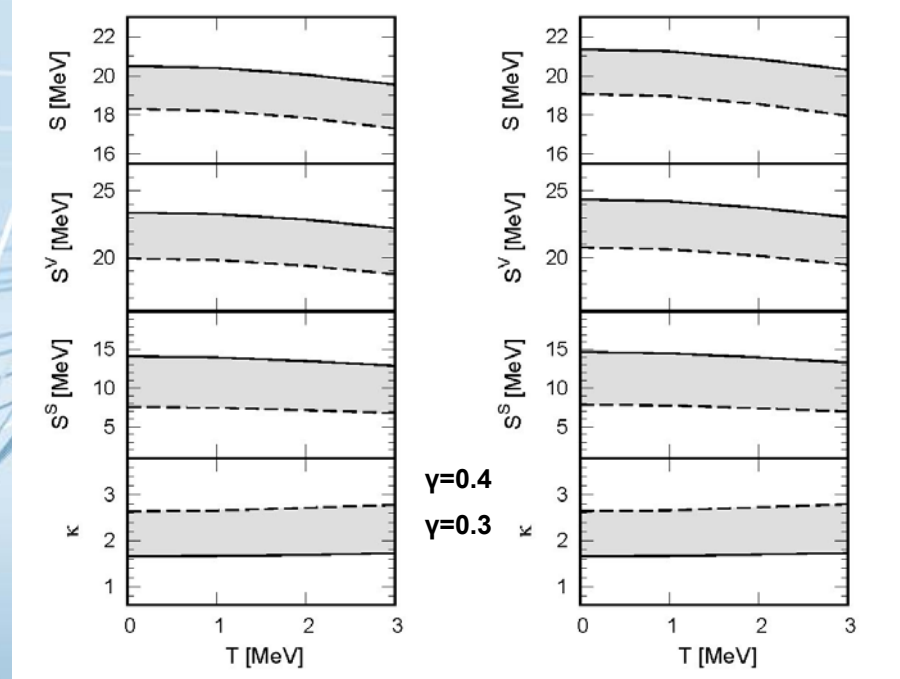
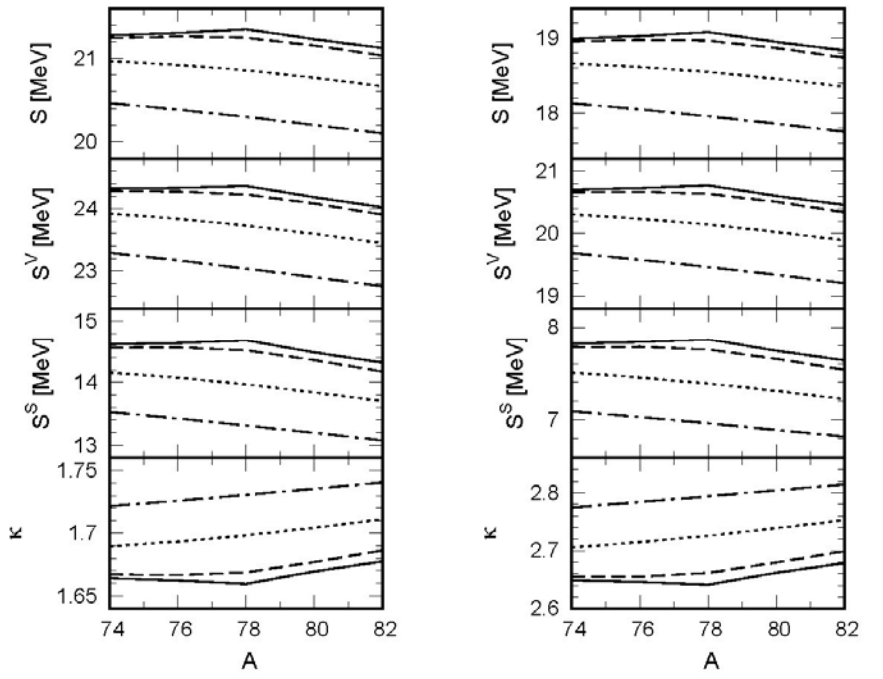
$\gamma=0.3$

SLy4

$\gamma=0.4$

SkM*

SLy4



$$S[\rho(x,T)] = S^V(T) [\rho(x,T)/\rho_0]^\gamma$$

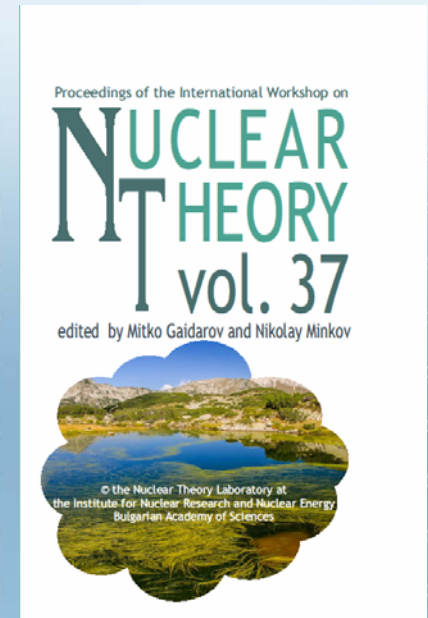
- Phys. Rev. C 94, 014319 (2016)
- Phys. Rev. C 95, 024314 (2017)
- Phys. Rev. C 98, 054315 (2018)

38th International Workshop on Nuclear Theory

23-29 June 2019

Hotel Lion, Borovetz Resort, Rila Mountains, Bulgaria

- nuclear structure and reactions
- symmetries and dynamics
- collective and intrinsic motions of nuclei
- exotic nuclei
- few-body and many-fermion systems
- nuclear astrophysics and related topics



<http://ntl.inrne.bas.bg/workshop/2019/>