Nuclear Symmetry Energy and the Neutron Skin Thickness of Heavy Nuclei

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We have studied in the Skyrme Hartree-Fock model the correlations between the thickness of the neutron skin in finite nuclei and the nuclear matter symmetry energy [1]. From the most recent analysis of the isospin diffusion data in heavy-ion collisions based on an isospin- and momentum-dependent transport model with in-medium nucleon-nucleon cross sections, a value of L=88±25 MeV for the slope of the nuclear symmetry energy at saturation has been extracted, and this imposes stringent constraints on both the parameters in the Skyrme effective interactions and the neutron skin thickness of heavy nuclei. Predicted thickness of the neutron skin is S = 0.22±0.04 fm for ^{208}Pb as shown in Fig.1, where S is shown as a function of L as well as the nuclear symmetry energy $E_{sym}(\rho_0)$ and its curvature K_{sym} at saturation density ρ_0 for 21 sets of Skyrme interaction parameters. For ^{132}Sn and ^{124}Sn, their neutron skins are predicted to have thickness of 0.29±0.04 fm and 0.22±0.04 fm, respectively.

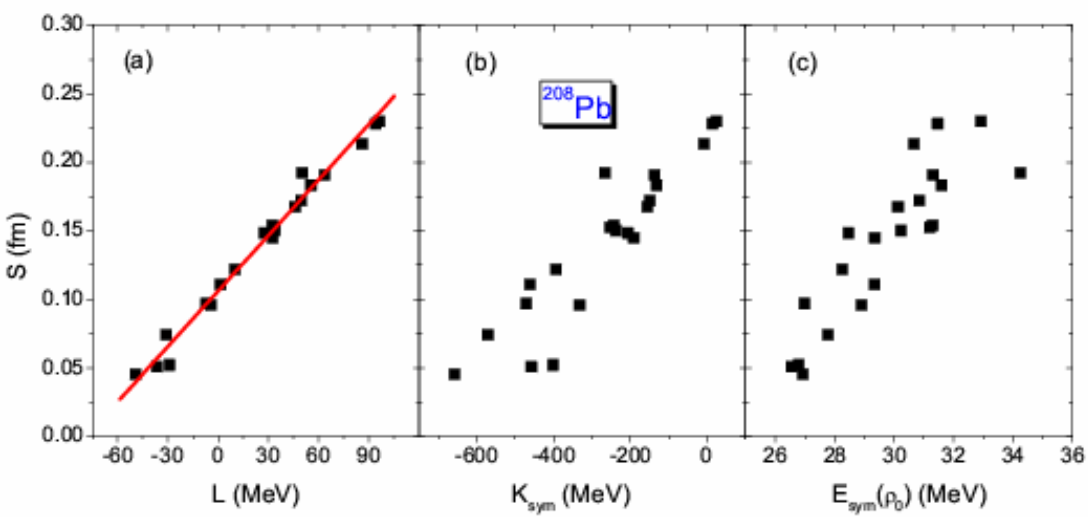

Figure 1. Neutron skin thickness S of ^{208}Pb as a function of (a) L, (b) K_{sym}, and (c) $E_{sym}(\rho_0)$ for 21 sets of Skyrme interaction parameters. The line in panel (a) represents a linear fit.

[1] L.W. Chen, C.M. Ko, and Bao-An Li, Phys. Rev. C **72**, 064309 (2005).