Informal discussion on Korean symmetry energy plans

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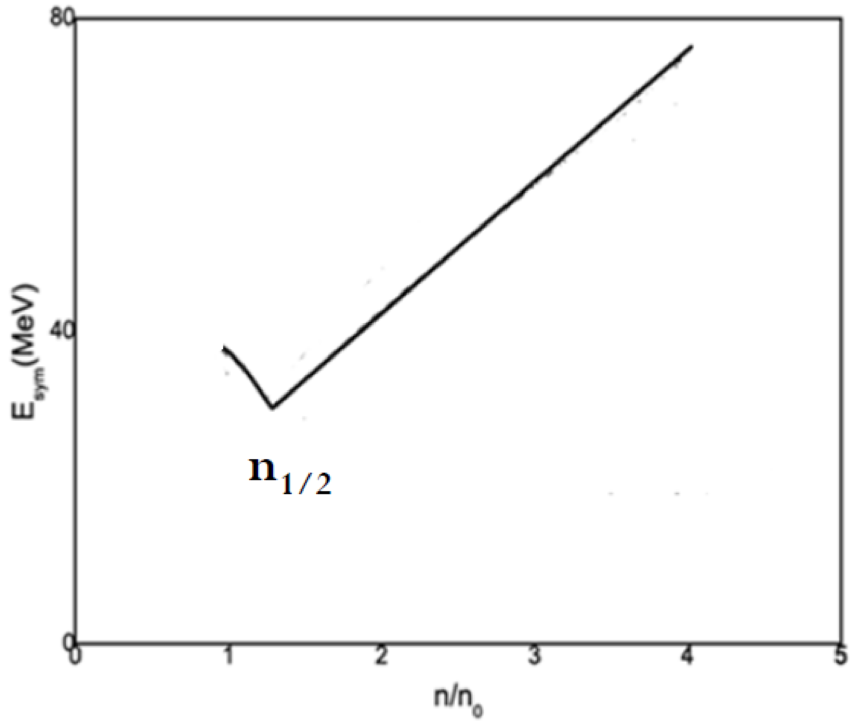
Since experimental side has been well presented, we will discuss theory activities …

E_{sym} has a cusp at $n_{1/2}$

The symmetry energy is $O(1/N_c)$ but robust in the skyrmion descriptom



Mannque Rho@NuSYM13

Nuclear Symmetry Energy from QCD sum rules

Kie Sang Jeong and Su Houng Lee, PRC 87, 015204 (2013)

We calculate the nucleon self-energies in isospin-asymmetric nuclear matter using QCD sum rules. Taking the difference of these for the neutron and proton enables us to express the potential part of the nuclear symmetry energy in terms of local operators. We find that the scalar (vector) self energy part gives a negative (positive) contribution to the nuclear symmetry energy which is consistent with the results from relativistic mean field theories. Moreover, we find that an important contribution to the negative contribution of the scalar self energy comes from the twist-4 matrix elements, whose leading density dependence can be extracted from deep inelastic scattering experiments. …

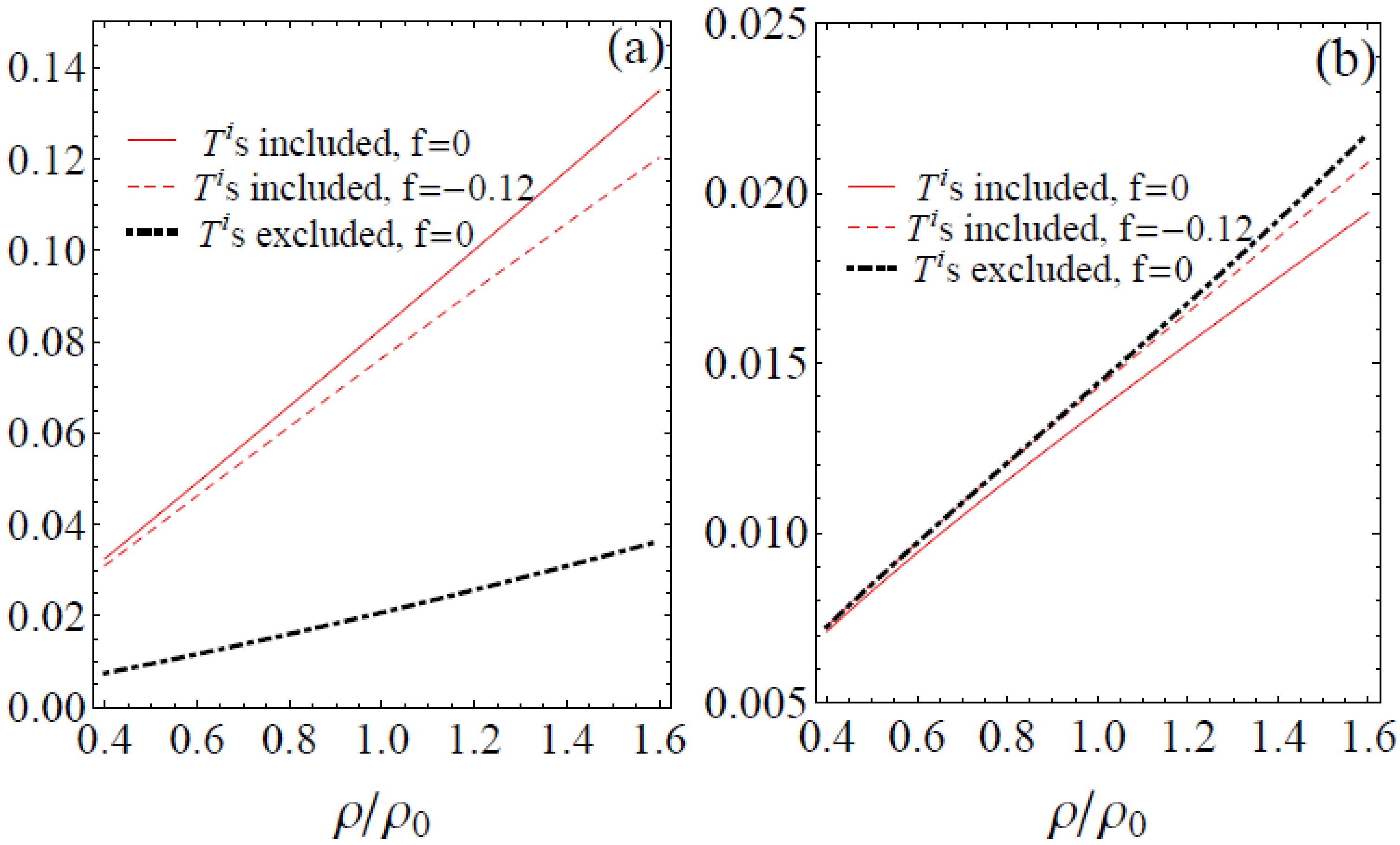


FIG. 5: (Color online) Density dependence of (a) $E^{\rm sym}_{V,\rho^2}$ and (b) $E^{\rm sym}_{K}$. The unit of the vertical axis is GeV.

Hyperon and nuclear symmetry energy in the neutron star

Chung-Yeol Ryu, Chang Ho Hyun, and Chang-Hwan Lee, PRC84, 035809 (2011)

In this work, masses and radii of neutron stars are considered to investigate the effect of nuclear symmetry energy to the astrophysical observables. A relativistic mean field model with density-dependent meson-baryon coupling constants is employed in describing the equation of state of dense nuclear matter, and the density dependencies of the symmetry energies are quoted from the recent phenomenological formulae obtained from the heavy ion data at subnuclear saturation densities. Since hyperons can take part in the -equilibrium of the dense matter inside neutron stars, we include hyperons in our estimation and their roles are discussed in combination with that of the nuclear symmetry energy. …

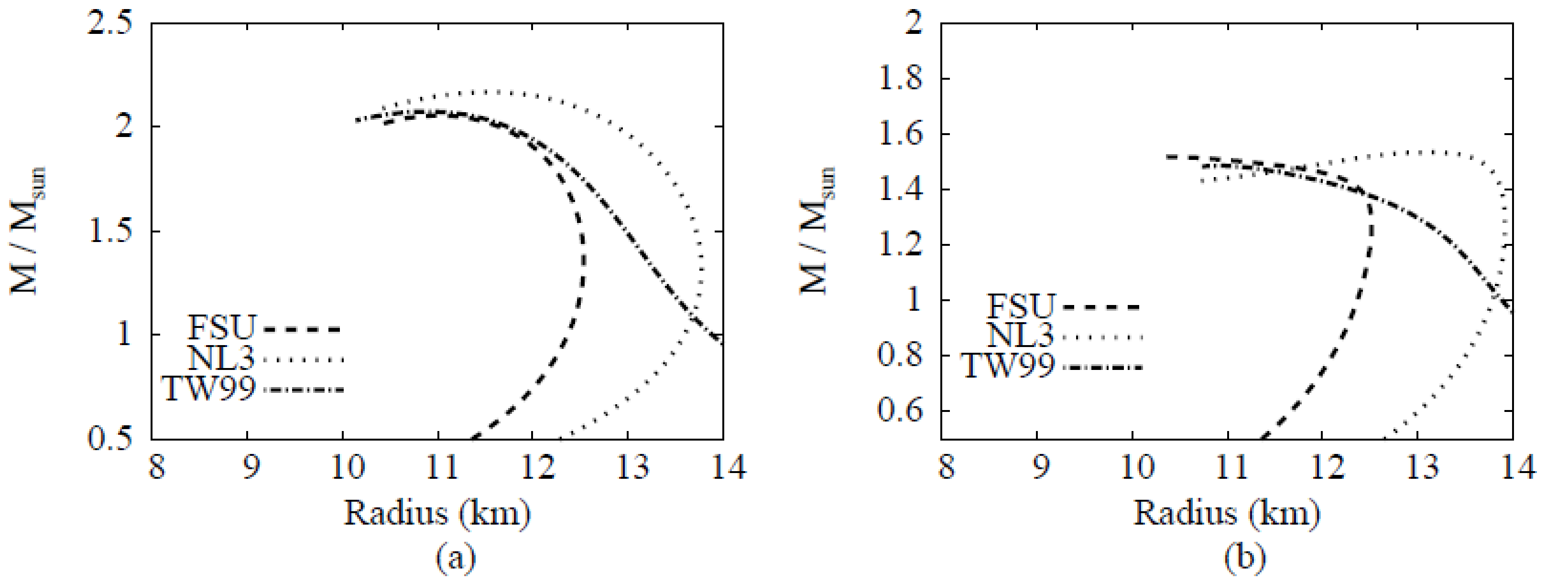


FIG. 5: The relation between mass and radius for np (left pannel) and npH (right pannel).

Symmetry and Surface Symmetry Energies in Finite Nuclei

S.J. Lee and A.Z. Mekjian, PRC82, 064319 (2010)

A study of properties of the symmetry energy of nuclei is presented based on density functional theory. Calculations for finite nuclei are given so that the study includes isospin dependent surface symmetry considerations as well as isospin independent surface effects. Calculations are done at both zero and non-zero temperature. It is shown that the surface symmetry energy term is the most sensitive to the temperature while the bulk energy term is the least sensitive. It is also shown that the temperature dependence terms are insensitive to the force used and even more insensitive to the existence of neutron skin. ...

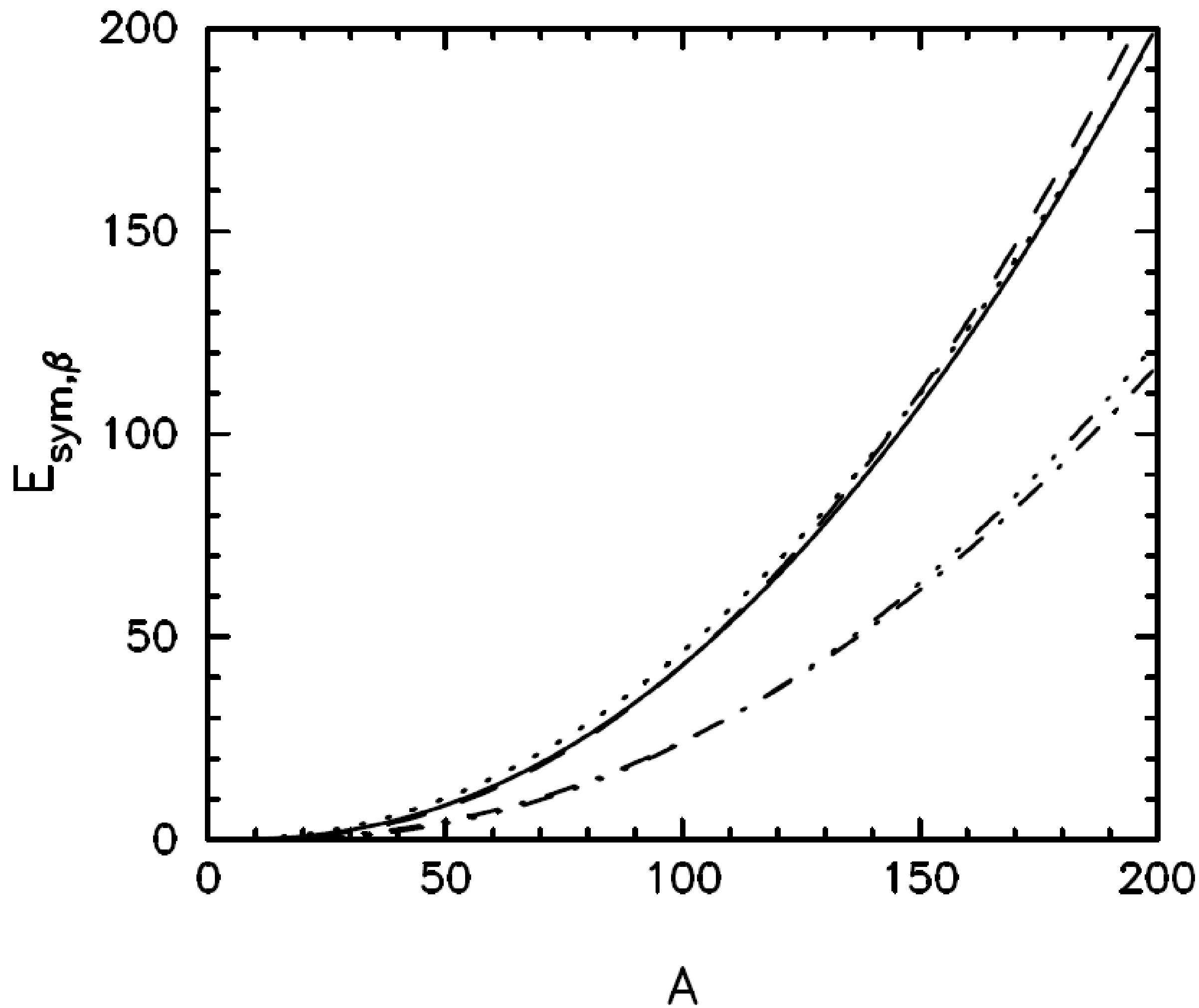
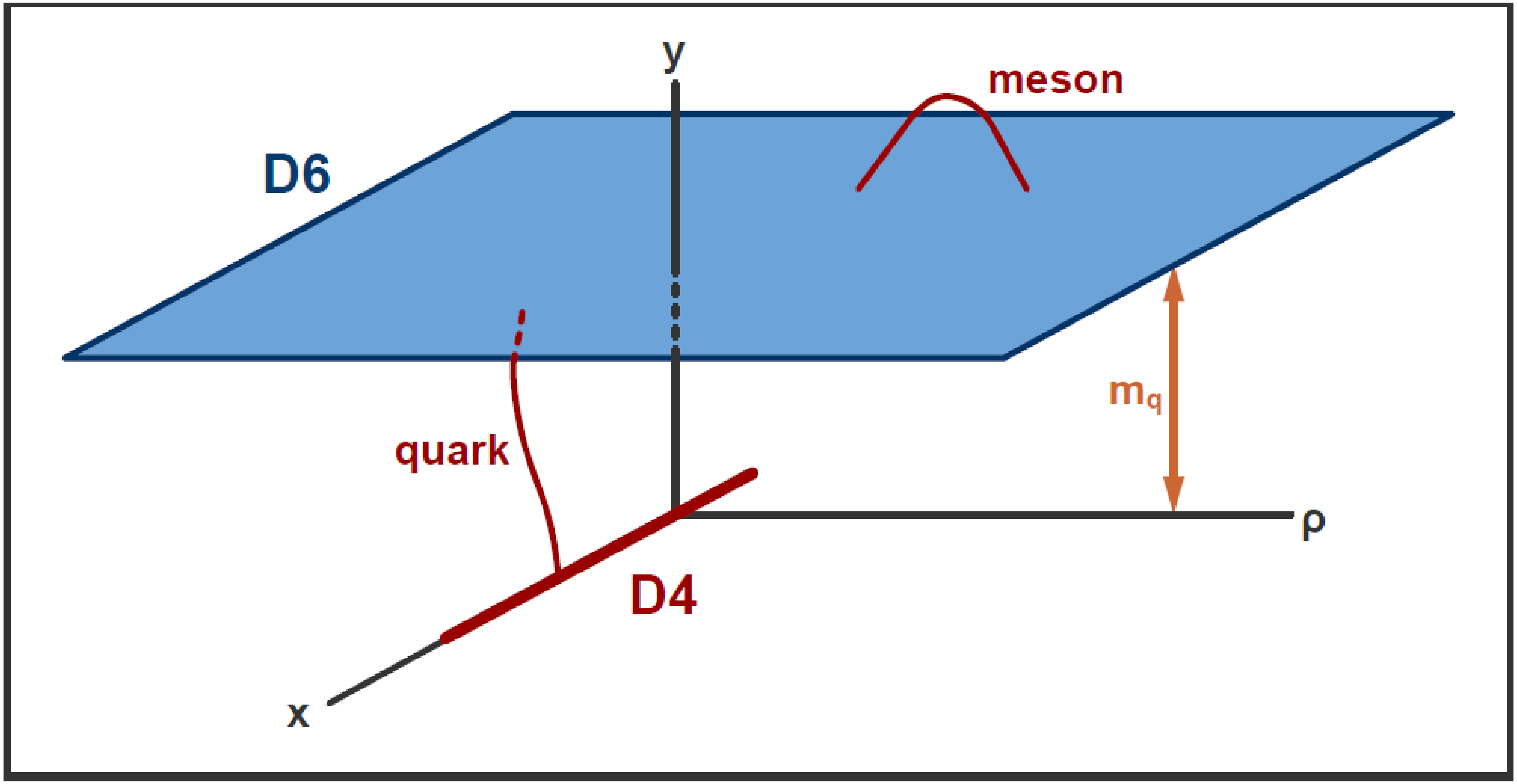
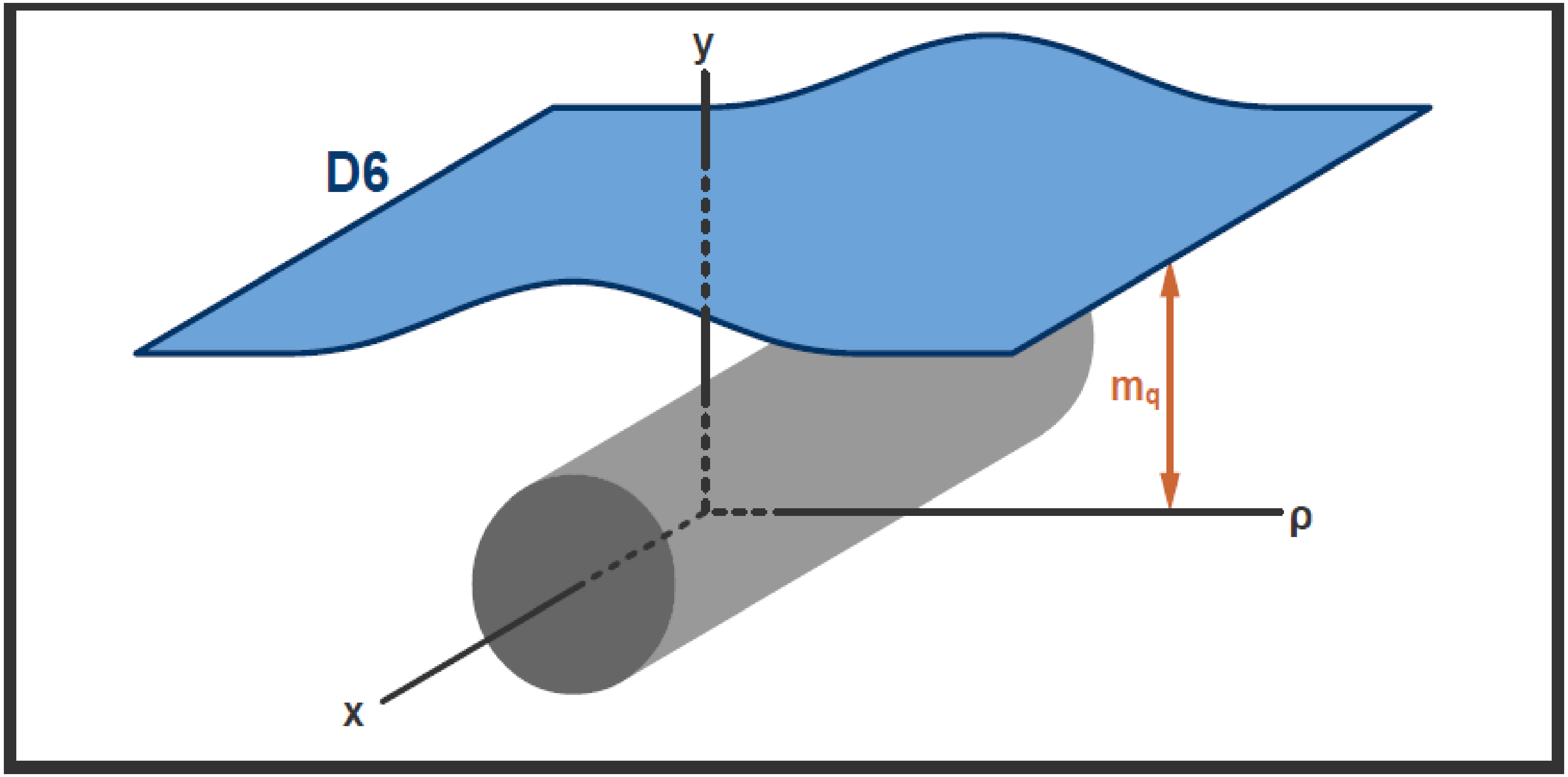


FIG. 1: The total symmetry energy $E_{sym}(T) = S_V(T)I^2A + S_S(T)I^2A^{2/3}$ in MeV versus mass number A along the line of stability. The upper curves are the interaction SLy4 (the solid curve for $T = 0$ and the dashed curve for $T = 3$ MeV) and the lower curves are SKM($m^* = m$) (the dash-dotted curve for $T = 0$ and the dash-dot-dot-dotted curve for $T = 3$ MeV). The dotted curve is a pure volume term symmetry energy with $S_V = 24$ MeV and $S_S = 0$ MeV. The $E_{sym,\beta}$ is in MeV.

Symmetry Energy from Holography?

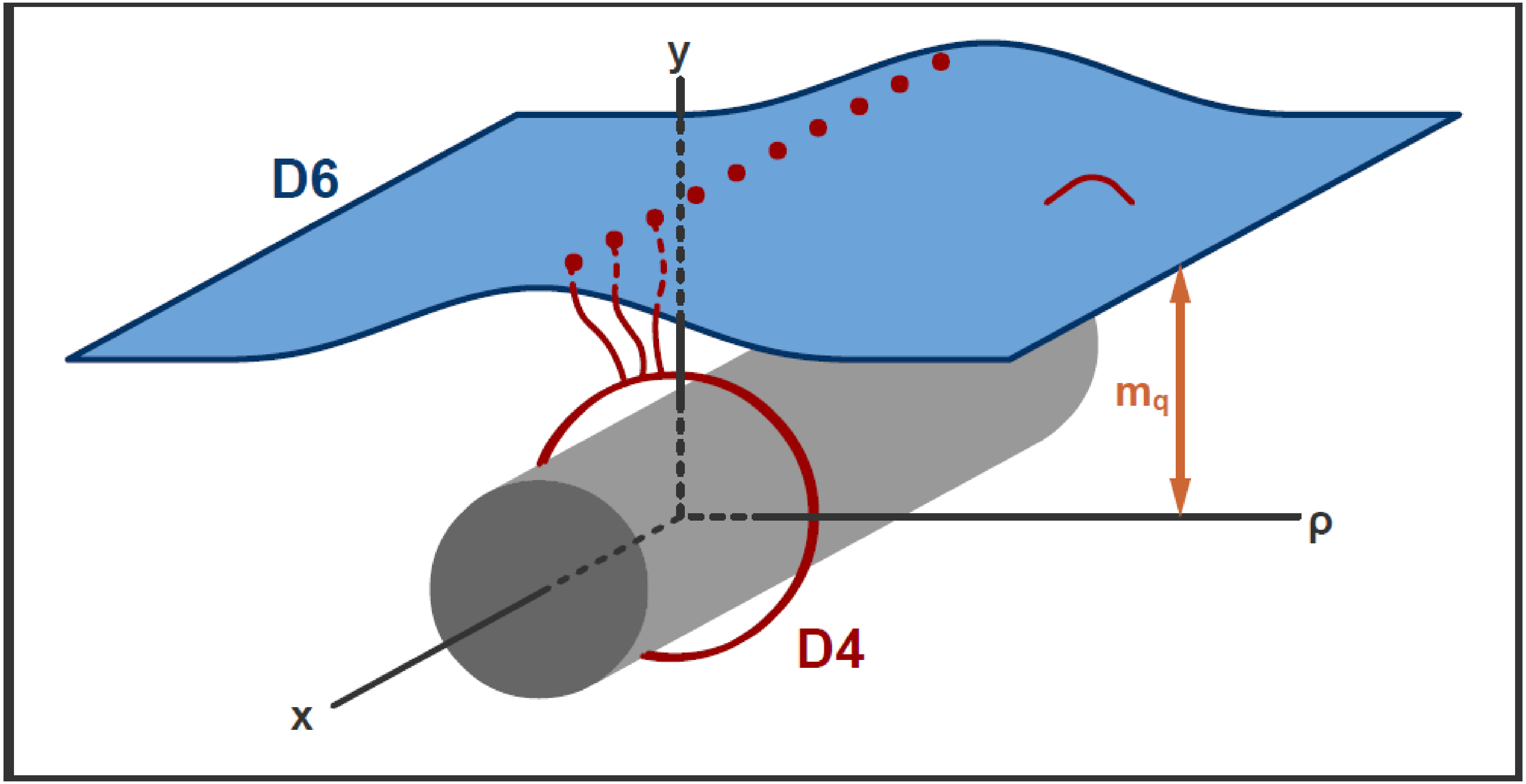




$$ds^2 = \left(\frac{U}{R}\right)^{3/2}\left(dt^2 + d\vec{x}^2 + f(U)dx_4^2\right) + \left(\frac{R}{U}\right)^{3/2}\left(\frac{U}{\xi}\right)^2\left(d\rho^2 + \rho^2 d\Omega_2^2 + dy^2 + y^2 d\phi^2\right),$$

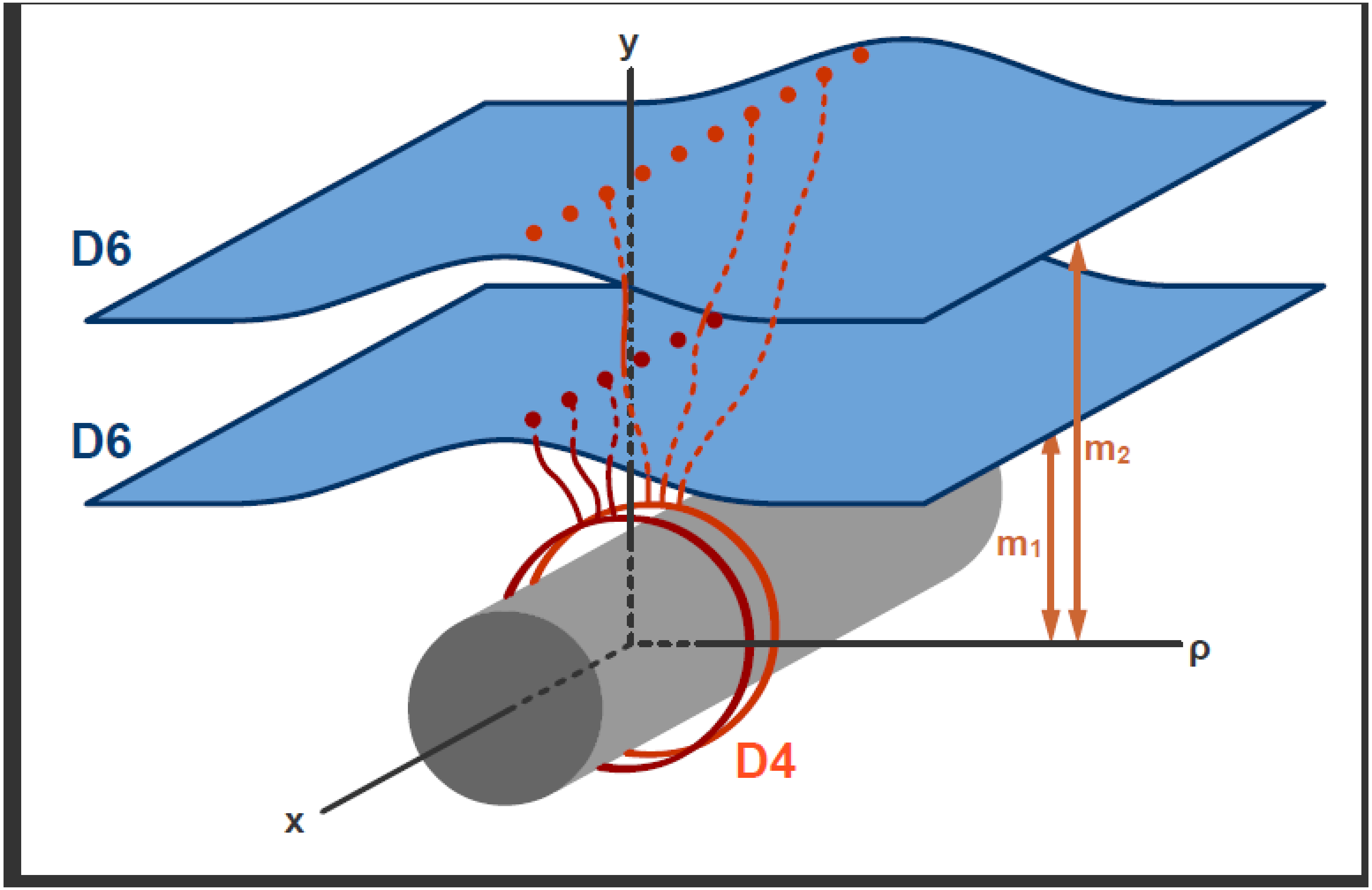
$$S_{D6} = \int dt\mathcal{L}_{D6} = -\mu_6 \int e^{-\phi}\sqrt{\det(g + 2\pi\alpha' F)}$$

$$= -\tau_6 \int dt d\rho \rho^2 \omega_+^{4/3}\sqrt{\omega_+^{4/3}(1+\dot{y}^2) - \tilde{F}^2}$$

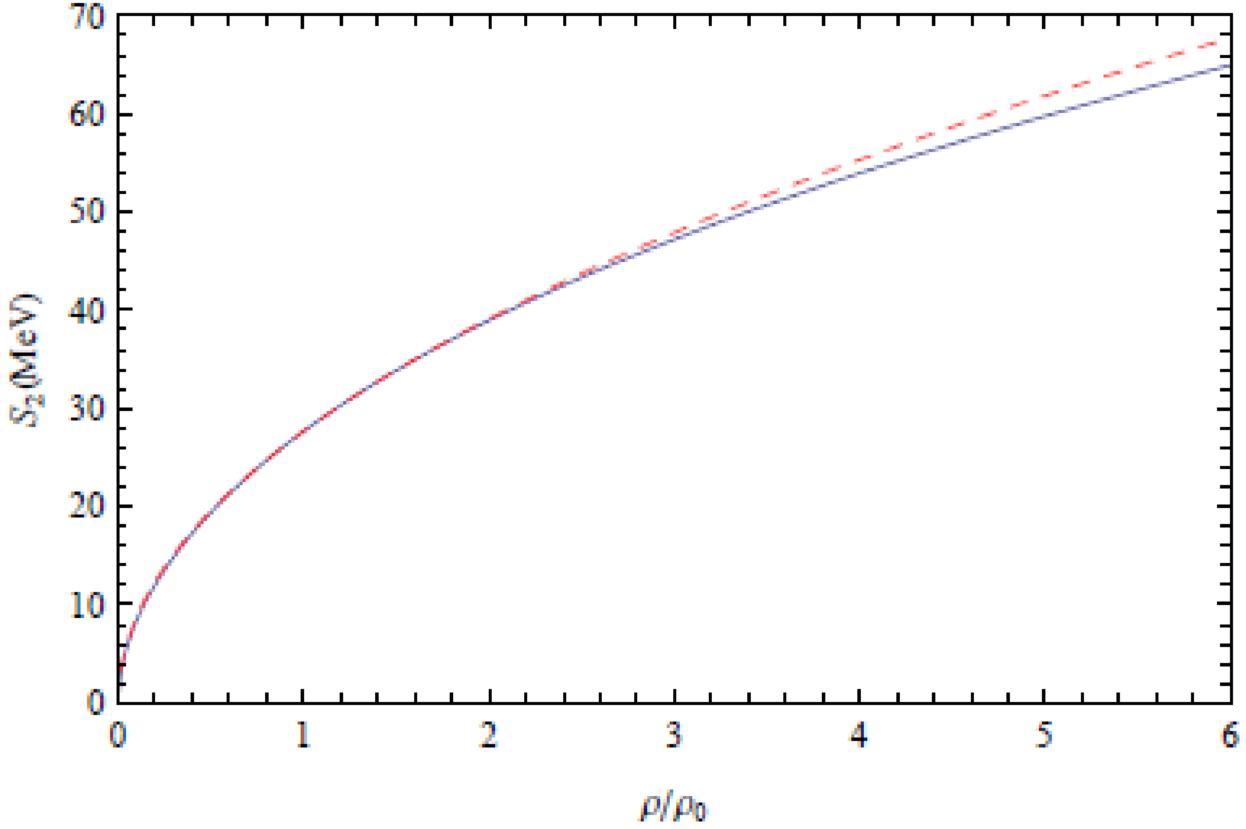


In holographic QCD, a compact D4 brane wrapping on the 4-sphere S^4 transverse to $\mathbb{R}^{1,3}$ is introduced as a baryon

- Dense D4/D6/D6 (N_f =2)



$$E_{tot} = \frac{Q}{N_C}\mathcal{H}_{D4} + \mathcal{H}_{D6}(Q_1) + \mathcal{H}_{D6}(Q_2)$$
$$= \tau_6 \left[\frac{\tilde{Q}}{4} E_4 + E_6(\tilde{Q}_1) + E_6(\tilde{Q}_2) \right],$$



Y. Kim, Y. Seo, I. J. Shin, and S.-J. Sin, JHEP 1106:011,2011

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Theory at RISP

- Nuclear structures /reactions
- Nuclear transport
- Chiral EFT
- …

- (Nuclear) astrophysics
- Dense matter
- Particle (hadron) physics
- …