Properties of Nuclear Matter & Finite Nuclei with Finite Range Simple Effective Interaction

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Isoscalar part of mean field

$$\mathrm{u}(k,\rho)=\lim_{Y_p\to 1/2}\frac{\mathrm{u}^{\mathrm{n}}(k,\rho,Y_p)+u^{p}(k,\rho,Y_p)}{2}$$

Isovector part of mean field

$$\mathrm{u}_{\tau}(k,\rho)=\lim_{Y_p\to 1/2}\frac{\mathrm{u}^{\mathrm{n}}(k,\rho,Y_p)-u^{p}(k,\rho,Y_p)}{2(1-2Y_p)}$$

$$k\longrightarrow \text{momentum},\quad \rho=\rho_n+\rho_p,\quad Y_p=\frac{\rho_p}{\rho},$$

$$\delta=\frac{\rho_n-\rho_p}{\rho_n+\rho_p}=1-2Y_p.$$

$$u^{n(p)}(k,\rho,Y_p)=u(k,\rho)\pm(1-2Y_p)u_{\tau}(k,\rho)$$

For the purpose, $v_d^l(r), v_d^{ul}(r), v_{ex}^l(r)$ and $v_{ex}^{ul}(r)$

ρ_n & ρ_p densities → respective Fermi-Dirac distribution functions,

$$\rho_{n,p} = \int f_T^{\,n,p}(\vec{k})\, d^3k$$

The energy density in ANM at temperature T,

$$H_T(\rho_n,\rho_p) = \frac{\hbar^2}{2m}\int [\, f_T^n(\vec{k}) + f_T^p(\vec{k})]\, k^2\, d^3k + V_T(\rho_n,\rho_p)$$

$$V_T(\rho_n,\rho_p) = \frac{1}{2}(\rho_n^2+\rho_p^2)\int v_d^l(r)\, d^3r + \rho_n\rho_p\int v_d^{ul}(r)\, d^3r$$

$$+\frac{1}{2}\iint [\, f_T^n(\vec{k})\, f_T^n(\vec{k}') + f_T^p(\vec{k})\, f_T^p(\vec{k}')\,]\, g_{ex}^l(|\vec{k}-\vec{k}'|)\, d^3k\, d^3k'$$

$$+\frac{1}{2}\iint [\, f_T^n(\vec{k})\, f_T^p(\vec{k}') + f_T^p(\vec{k})\, f_T^n(\vec{k}')\,]\, g_{ex}^{ul}(|\vec{k}-\vec{k}'|)\, d^3k\, d^3k'.$$

$$\in_T^{n,p}(k,\rho,Y_p) = \frac{\partial H_T}{\partial [f_T^{n,p}]}$$

$$\in_T^{i}(k,\rho,Y_p) = \frac{\hbar^2 k^2}{2m} + u_T^i(k,\rho,Y_p),\ i = n,p$$

$$u_T^n(k,\rho_n,\rho_p) = \left[\rho_n \int \mathrm{v_d}^{l}(\mathrm{r})\mathrm{d}^3\mathrm{r} + \rho_p \int \mathrm{v_d}^{ul}(\mathrm{r})\mathrm{d}^3\mathrm{r}\right]$$
$$+ \left[\int f_T^n(\vec{k}')g_{ex}^l(|\vec{k}-\vec{k}'|)d^3k' + \int f_T^p(\vec{k}')g_{ex}^{ul}(|\vec{k}-\vec{k}'|)d^3k'\right]$$
$$+ \quad \text{rearrangement term}$$

$$\mathrm{u_T^p}(\mathrm{k},\rho_\mathrm{n},\rho_\mathrm{p}) = \left[\rho_p \int \mathrm{v_d}^{l}(\mathrm{r})\mathrm{d}^3\mathrm{r} + \rho_n \int \mathrm{v_d}^{ul}(\mathrm{r})\mathrm{d}^3\mathrm{r}\right]$$
$$+ \left[\int f_T^p(\vec{k}')g_{ex}^l(|\vec{k}-\vec{k}'|)d^3k' + \int f_T^n(\vec{k}')g_{ex}^{ul}(|\vec{k}-\vec{k}'|)d^3k'\right]$$
$$+ \text{rearrangement term}$$

$$g_{ex}^{l,ul}(|\vec{k}-\vec{k}'|) = \int e^{i(\vec{k}-\vec{k}')\cdot\vec{r}}\, v_{ex}^{l,ul}(r)\ d^3r$$

$$In\ \ SNM\ \ at\ T=0, \qquad \rho_n=\rho_p=\rho/2, \ \ k_n=k_p=k_f=\left(\frac{3\pi^2\rho}{2}\right)^{1/3}$$

$$H(\rho)=\frac{3\hbar^2k_f^2}{10m}\rho+\frac{\rho^2}{2}\int\left(\frac{\mathrm{v_d}^{l}+\mathrm{v_d}^{ul}}{2}\right)\mathrm{d^3r}+\frac{\rho^2}{2}\int\left(\frac{3j_1(k_nr)}{(k_nr)}\right)^2\left(\frac{\mathrm{v_{ex}}^{l}+\mathrm{v_{ex}}^{ul}}{2}\right)\mathrm{d^3r}$$

$$\in(k,\rho)=\frac{\hbar^2k^2}{2m}+\ u(k,\rho)$$

$$u(k,\rho)=\rho\int\left(\frac{\mathrm{v_d}^{l}+\mathrm{v_d}^{ul}}{2}\right)\mathrm{d^3r}+\left[\rho\int j_0(kr)\frac{3j_1(k_fr)}{(k_fr)}\left(\frac{\mathrm{v_{ex}}^{l}+\mathrm{v_{ex}}^{ul}}{2}\right)\mathrm{d^3r}\right]$$

$$+\left[\frac{\rho}{2}\int\frac{\partial}{\partial\rho}\left(\frac{\mathrm{v_d}^{l}+\mathrm{v_d}^{ul}}{2}\right)\mathrm{d^3r}+\frac{\rho}{2}\int\frac{9j_1^2(k_fr)}{(k_fr)^2}\frac{\partial}{\partial\rho}\left(\frac{\mathrm{v_{ex}}^{l}+\mathrm{v_{ex}}^{ul}}{2}\right)\mathrm{d^3r}\right]$$

$$u(k,\rho)=u(k_f,\rho)+[u(k,\rho)-u(k_f,\rho)]$$

$$=e(\rho)+\rho\frac{d\,e(\rho)}{d\,\rho}-\frac{\hbar^2k_f^2}{2m}+u^{ex}(k,\rho)$$

$$u^{ex}(k,\rho)=\frac{\rho}{2}\int[\,j_0(kr)-j_0(k_fr)]\,\frac{3j_1(k_fr)}{(k_fr)}\,[v_{ex}^{l}(r)+v_{ex}^{ul}(r)]\,d^3r$$

$$\mathrm{u}_\tau(k,\rho)=2E_S(\rho)-\frac{\hbar^2k_f^2}{3m^*(k=k_f,\rho)}+u_\tau^{ex}(k,\rho)$$

$$u_\tau^{ex}(k,\rho)=\frac{\rho}{2}\int[j_0(kr)-j_0(k_fr)]\,[v_{ex}^{l}(r)-v_{ex}^{ul}(r)]\,j_0(k_fr)\,d^3r$$

$$V_{eff}(r) = t_0(1 + x_0 P_\sigma)\delta(r) + \frac{t_3}{6}(1 + x_3 P_\sigma)\left(\frac{\rho}{1 + b\rho}\right)^{\gamma}\delta(r)$$

$$+ (W + BP_\sigma - HP_\tau - MP_\sigma P_\tau) f(r)$$

$$f(r) = \frac{e^{-r/\alpha}}{r/\alpha}, Yukawa$$

$$e^{-r^2/\alpha^2}, Gaussian$$

$$e^{-r/\alpha}, \text{exponential}$$

$SEI \text{ has total } 11 - \text{numbers of Interaction parameters}$

$$b, \gamma, t_0, x_0, t_3, x_3, W, B, H, M \text{ and } \alpha$$

$$b \geq \frac{1}{\rho_0}\left[\left(\frac{mc^2}{\frac{T_{f_0}}{5} - e(\rho_0)}\right)^{\frac{1}{\gamma+1}}\right]^{-1}$$

$$T_{f_0} = \frac{\hbar^2 k_{f_0}^2}{2m}, e(\rho_0) = [H(\rho)/\rho]_{\rho=\rho_0}, k_{f_0} = \left(\frac{3\pi^2\rho_0}{2}\right)^{1/3}$$

$$\rho\int j_0(kr)\frac{3j_1(k_f r)}{(k_f r)}\left(\frac{\mathrm{v}_{\mathrm{ex}}{}^{l}+\mathrm{v}_{\mathrm{ex}}{}^{ul}}{2}\right)\mathrm{d}^3\mathrm{r}=\varepsilon_{\mathrm{ex}}\frac{\rho}{\rho_0}I(k,\rho)$$

$$I_Y(k,\rho)=\frac{3\Lambda^2(\Lambda^2+k_f^2-k^2)}{8kk_f^3}\ln\left[\frac{\Lambda^2+(k+k_f)^2}{\Lambda^2+(k-k_f)^2}\right]$$

$$+\frac{3\Lambda^2}{2k_f^2}-\frac{3\Lambda^2}{2k_f^2}\left[\tan^{-1}\left(\frac{k+k_f}{\Lambda}\right)^2-\tan^{-1}\left(\frac{k-k_f}{\Lambda}\right)^2\right]\quad(Yukawa)$$

$$I_G(k,\rho)=\frac{3\Lambda^4}{8kk_f^3}\left[e^{-\left(\frac{k+k_f}{\Lambda}\right)^2}-e^{-\left(\frac{k+k_f}{\Lambda}\right)^2}\right]+\frac{3\Lambda^3}{4k_f^3}\int_{(k-k_f)/\Lambda}^{(k+k_f)/\Lambda}e^{-t^2}dt$$

$$(Gaussian)$$

$$\varepsilon_{\mathrm{ex}}=\frac{\varepsilon_{ex}^{l}+\varepsilon_{ex}^{ul}}{2}\quad and\quad \Lambda\quad range,\ \alpha=1/\Lambda\,(Yukawa),$$

$$\alpha=2/\Lambda\,(Gaussian)$$

two parameters in the momentum dependent part of mean field

$$u(k_{300},\rho_0)\approx 0$$

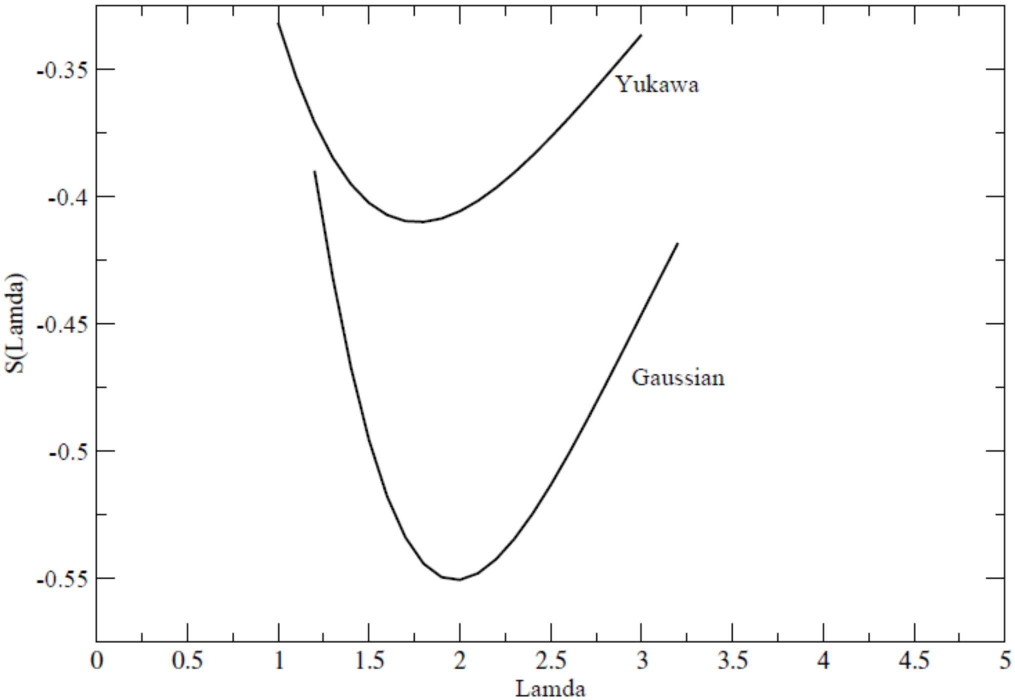
$$= e(\rho_0) - T_{f_0} + \varepsilon_{\text{ex}} S(\lambda), \qquad \Lambda = \lambda k_{f_0}$$

$$S(\lambda) = [I(k_{300},\rho_0) - I(k_{f_0},\rho_0)] = \frac{T_{f_0} - e(\rho_0)}{\varepsilon_{\text{ex}}},$$

$$\varepsilon_{\text{ex}} = \frac{\varepsilon_{ex}^{l} + \varepsilon_{ex}^{ul}}{2}$$

and Λ - determined simultaneously using an optimisation procedure

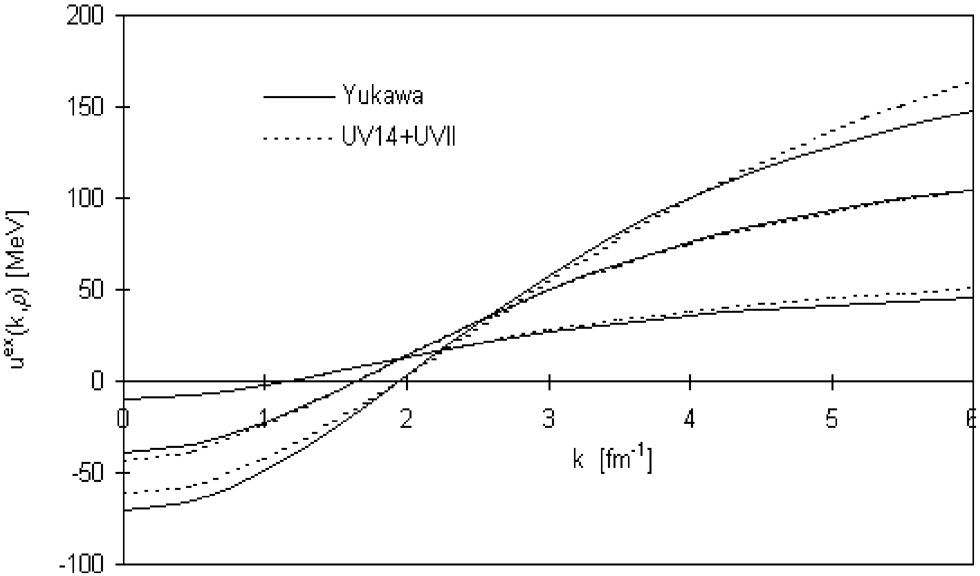
$$e(\rho_0) = -16\,MeV, \quad T_{f_0} = 37\,MeV\,(\rho_0 = 0.161\,fm^{-3})$$



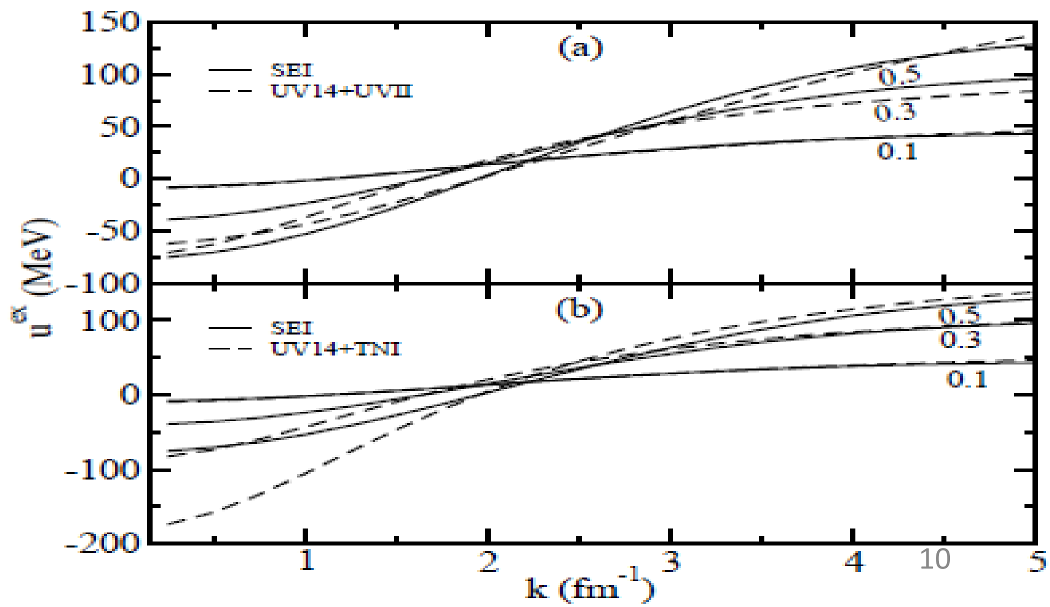
PARAMETER	YUKAWA	GAUSSIAN
ε_{ex} (Mev)	-129.247	-96.2443
α (fm)	0.42316	0.75766

J.Phys. G: Nucl. Part. 24 (1998) 2073

$$u^{ex}(k,\rho) = \frac{\rho}{2}\int [\, j_0(kr) - j_0(k_f r)\,] \; \frac{3 j_1(k_f r)}{(k_f r)} \; [v_{ex}^{l}(r) + v_{ex}^{ul}(r)]\, d^3 r$$



R.Wiringa PRC 38 2967(1988)



$$\frac{m^*}{m}(k,\rho)=\left[\frac{m}{\hbar^2 k}\frac{\partial \in (k,\rho)}{\partial k}\right]^{-1}$$

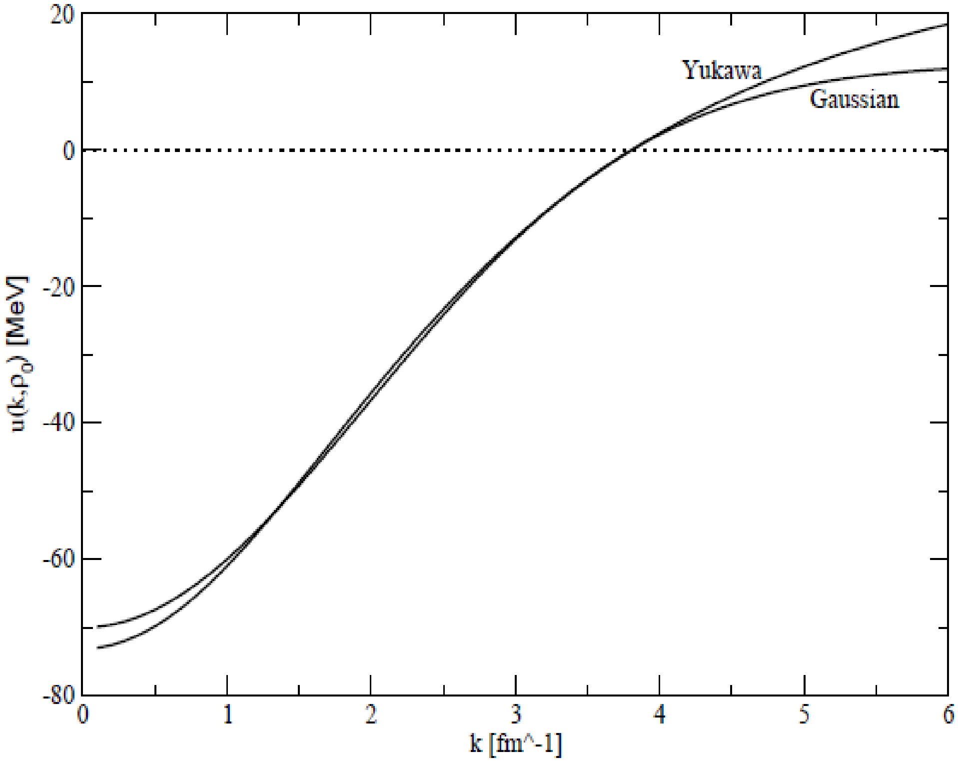
$$=\left[1-\frac{m}{\hbar^2}\rho\int\frac{j_1(kr)}{kr}\frac{3j_1(k_f r)}{k_f r}v_{ex}(r)r^2 d^3r\right]^{-1}$$

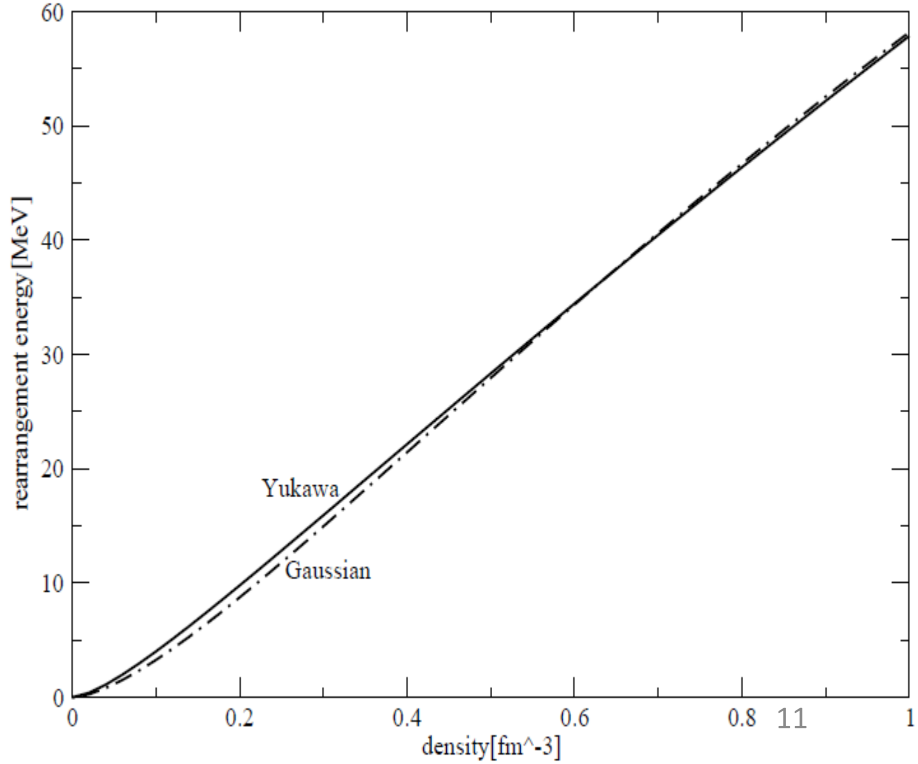
$$u(k,\rho_0)=e(\rho_0)-T_{f_0}+\varepsilon_{ex}[I(k,\rho_0)-I(k_{f_0},\rho_0)]$$

$$u_R(\rho)=\frac{\hbar^2 k_f^2}{10m}-e(\rho)+\rho\frac{\partial e(\rho)}{\partial\rho}-u_R^{ex}(\rho)$$

$$u_R^{ex}(\rho)=\rho\int\left[j_0(k_f r)-\frac{3j_1(k_f r)}{k_f r}\right]\frac{3j_1(k_f r)}{k_f r}v_{ex}(r)d^3r$$

Properties	Yukawa	Gaussian
$\frac{m^*}{m}(k=k_{f_0},\rho_0)$	0.686	0.709
$\frac{m^*}{m}(k=0,\rho_0)$	0.609	0.660
u $(k=\infty,\rho_0)$ MeV	35.89	12.68
u $(k=0,\rho_0)$ MeV	-73.11	-70.05
$u_R(\rho_0)$ MeV	15.93	16.91





$b, \gamma, \varepsilon_0^{l}, \varepsilon_0^{ul}, \varepsilon_\gamma^{l}, \varepsilon_\gamma^{ul}, \varepsilon_{ex}^{l}, \varepsilon_{ex}^{ul}$ and $\alpha - 09$ *parameters of ANM*

$$\varepsilon_0^{l} = \rho_0 \left[\frac{t_0}{2}(1 - x_0) + (W + B/2 - H - M/2) \int f(r) d^3 r \right]$$

$$\varepsilon_0^{ul} = \rho_0 \left[\frac{t_0}{2}(2 + x_0) + (W + B/2) \int f(r) d^3 r \right]$$

$$\varepsilon_\gamma^{l} = \frac{t_3}{12} \rho_0^{\gamma+1} (1 - x_3)$$

$$\varepsilon_\gamma^{l} = \frac{t_3}{12} \rho_0^{\gamma+1} (2 + x_3)$$

$$\varepsilon_{ex}^{l} = \rho_0 (M - W/2 + H/2 - B) \int f(r) d^3 r$$

$$\varepsilon_{ex}^{ul} = \rho_0 (M + H/2) \int f(r) d^3 r$$

$$\int f(r) d^3 r = 4\pi\alpha^3 (Yukawa)$$
$$= \pi^{3/2} \alpha^3 (Gaussian)$$

$$H_T(\rho) = \frac{\hbar^2}{2m}\int f_T(\vec{k})\, k^2\, d^3k + \frac{\varepsilon_0}{2}\frac{\rho^2}{\rho_0} + \frac{\varepsilon_\gamma}{2\rho_0^{\gamma+1}}\frac{\rho^{\gamma+2}}{(1+b\rho)^\gamma}$$

$$+ \frac{\varepsilon_{ex}}{2\rho_0}\iint [\, f_T(\vec{k}) f_T(\vec{k}')\, g_{ex}(|\vec{k}-\vec{k}'|)\, d^3k\; d^3k'$$

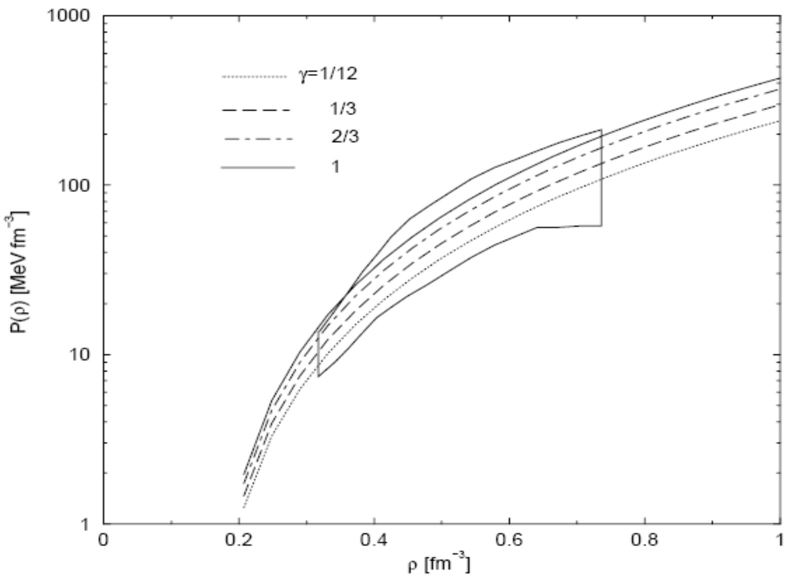
$$\varepsilon_{ex} = \frac{(\varepsilon_{ex}^{l} + \varepsilon_{ex}^{ul})}{2} \qquad \varepsilon_\gamma = \frac{(\varepsilon_\gamma^{l} + \varepsilon_\gamma^{ul})}{2} \qquad \varepsilon_0 = \frac{(\varepsilon_0^{l} + \varepsilon_0^{ul})}{2}$$

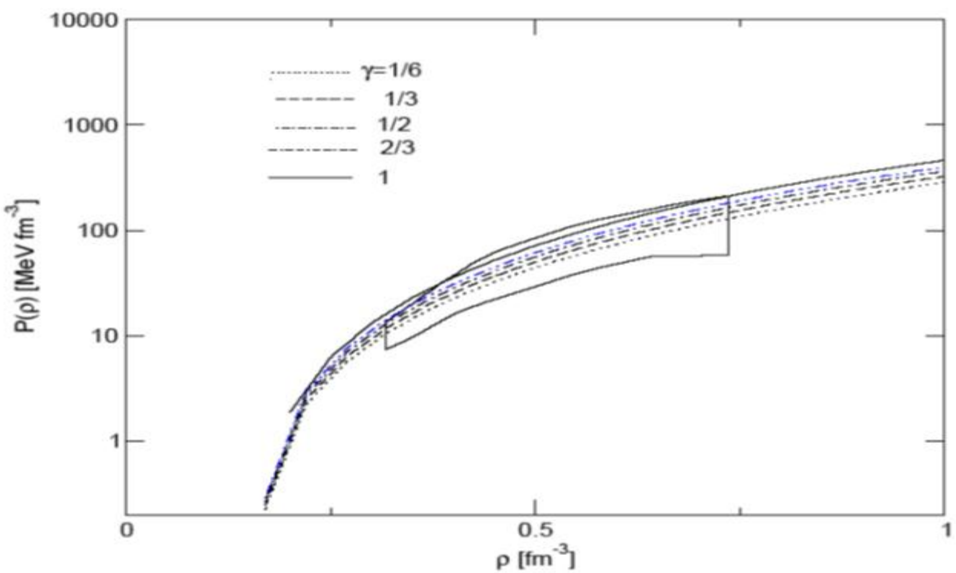
$\gamma, b, \alpha, \varepsilon_{ex}, \varepsilon_\gamma$ *and* ε_0 *– 06 parameters of SNM*

ε_0 *and* $\varepsilon_\gamma \rightarrow$ *Saturation properties*

$\gamma \rightarrow$ *determines the stiffness of EOS*

$$b \geq \left[\left(\frac{mc^2}{\frac{T_{f0}}{5} - e(\rho_0)}\right)^{\frac{1}{\gamma+1}}\right]^{-1}$$





Danielewicz P et al., Science 298 (2002) 1592

$$(\varepsilon_0^l + \varepsilon_0^{ul}) \quad (\varepsilon_\gamma^l + \varepsilon_\gamma^{ul}) \quad (\varepsilon_{ex}^l + \varepsilon_{ex}^{ul})$$

into two specific channels for interactions between like (l) and unlike (ul) nucleons.

$$(\varepsilon_{ex}^l + \varepsilon_{ex}^{ul}) = 2\varepsilon_{ex}, \textit{The splitting can be arbitrary subject to this condition}$$

The sign of ($\varepsilon_{ex}^l - \varepsilon_{ex}^{ul}$) ⇨ splitting of n and p effective masses.

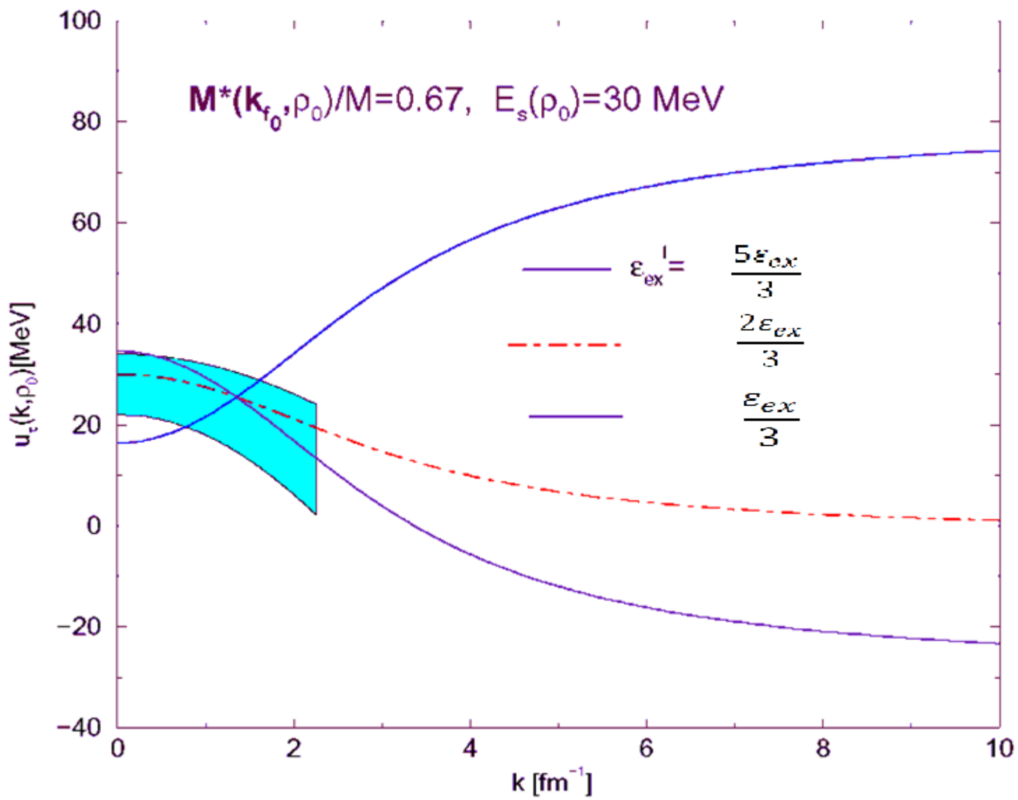
$$u_\tau(k,\rho) = 2E_s(\rho) - \frac{\hbar^2 k_f^2}{3m}\left\{\left(\frac{m^*(k,\rho)}{m}\right)\right\}_{k=k_f}^{-1} + u_\tau^{ex}(k,\rho)$$

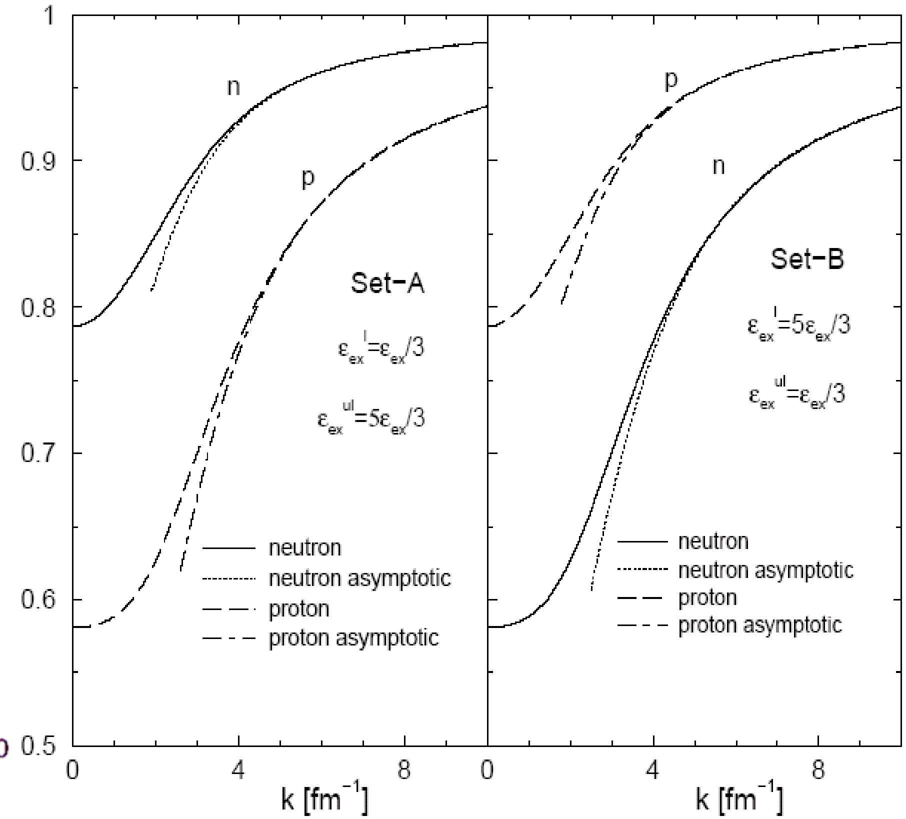
$$u_\tau^{ex}(k,\rho) = \frac{(\varepsilon_{ex}^l - \varepsilon_{ex}^{ul})}{\rho_0 \int f(r)\, d^3r} \int [j_0(kr) - j_0(k_f r)]\, j_0(k_f r)\, f(r)\, d^3r$$

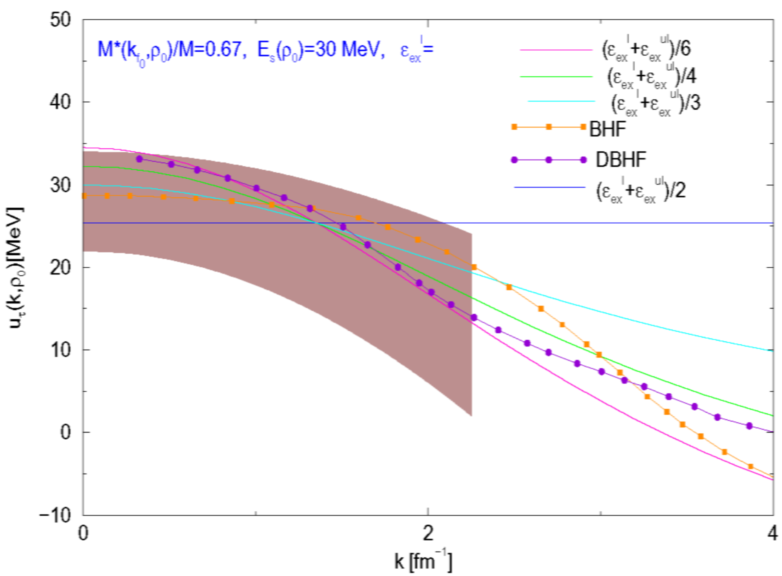
$$\left[\frac{m^*}{m}(k,\rho,Y_p)\right]_{n,p} = \left[1 + \frac{m}{\hbar^2 k}\frac{\partial u^{n,p}(k,\rho,Y_p)}{\partial k}\right]^{-1}$$

$$\varepsilon_{ex} < \varepsilon_{ex}^l \le 0 \; (m_n^* > m_p^*)$$

$$2\varepsilon_{ex} \le \varepsilon_{ex}^l < \varepsilon_{ex} \; (m_p^* > m_n^*)$$



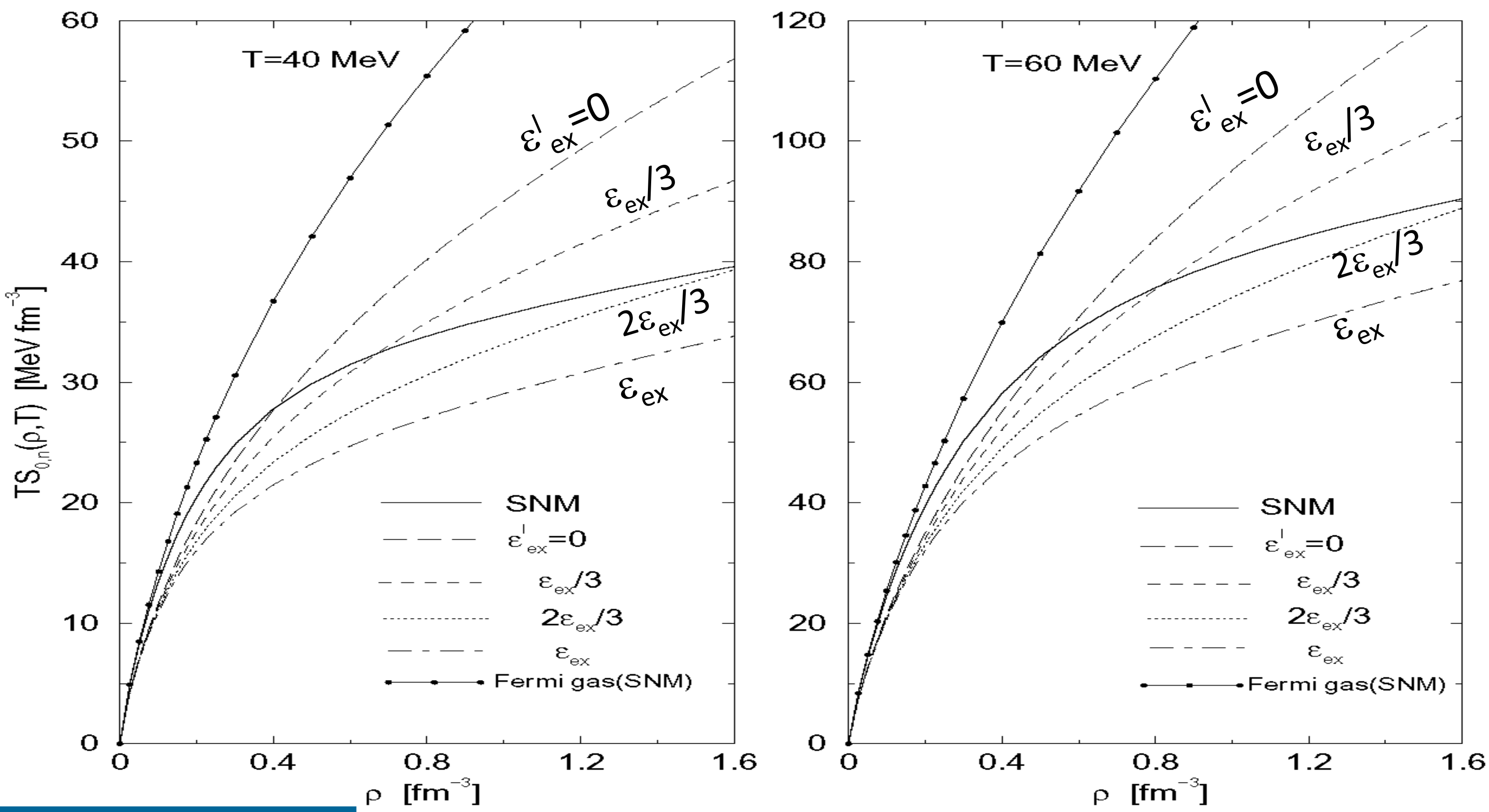




Hodgson P E, 1994 The Nucleon Optical Model (Singapore: World Scientific, p613

Entropy Density

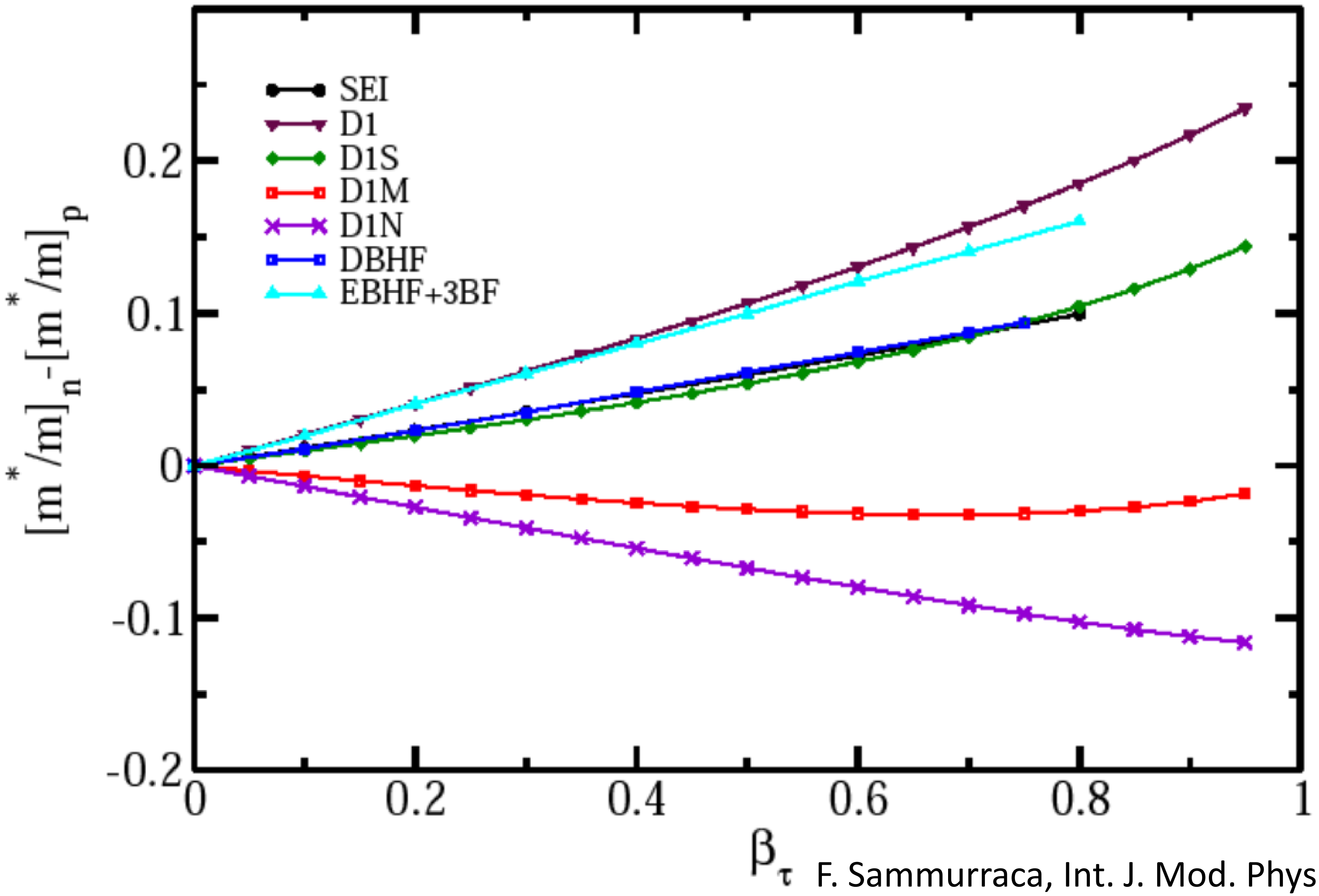
$$S^{0,n}(\rho,T) = -\frac{\xi}{(2\pi)^3}\int\left[n_T^{0,n}(k)\ln n_T^{0,n}(k) + \left(1-n_T^{0,n}(k)\right)\ln\left(1-n_T^{0,n}(k)\right)\right]d^3k,$$



$$\varepsilon_{ex}^{l} = 2\varepsilon_{ex}/3$$

Behera et al. JPG 38 (2011) 115104

$$\left[\frac{m^*}{m}(k,\rho_0,\beta_\tau)\right]_n - \left[\frac{m^*}{m}(k,\rho_0,\beta_\tau)\right]_p, \beta_\tau = \frac{\rho_n - \rho_p}{\rho_n + \rho_p}$$



F. Sammurraca, Int. J. Mod. Phys. E 19 (2010) 1259

$$\left(\varepsilon_{\gamma}^{l} + \varepsilon_{\gamma}^{ul}\right)$$

$$\left(\varepsilon_{0}^{l} + \varepsilon_{0}^{ul}\right)$$

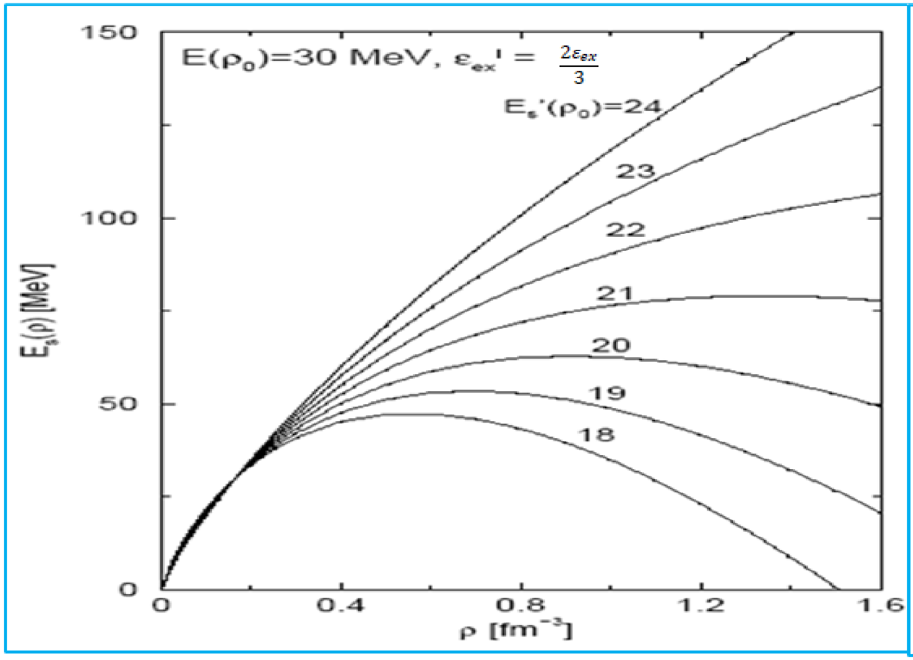
$$E_S(\rho_0, T=0)$$

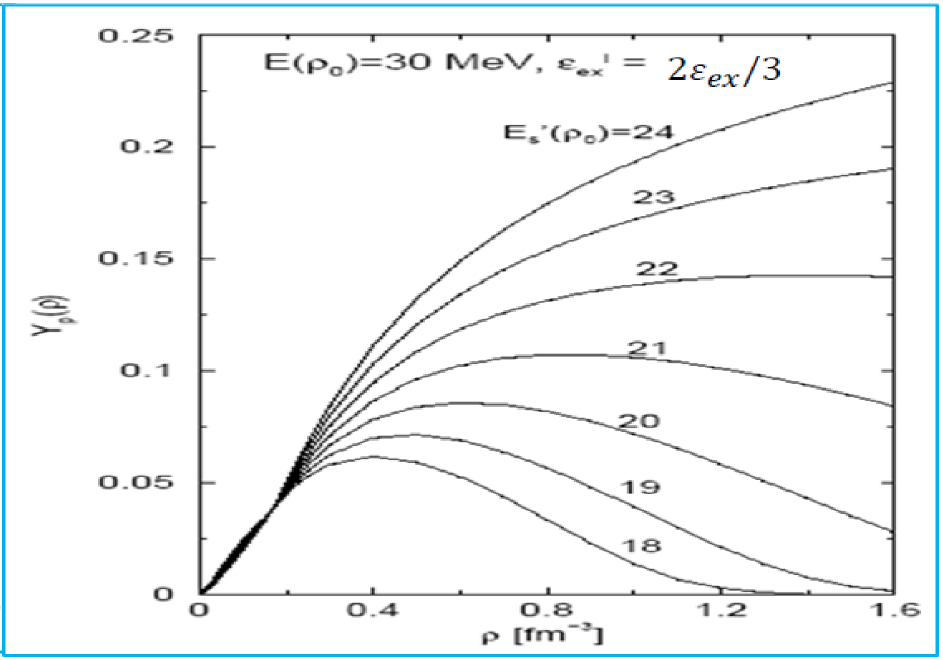
$$E_s'(\rho_0, T=0) = \rho \left.\frac{dE_s(\rho, T=0)}{d\rho}\right|_{\rho=\rho_0}$$

$beta-stable \quad n+p+e+\mu \ \ matter\,(NSM)$

$$\mu_n(\rho, Y_p) - \mu_p(\rho, Y_p) = \mu_e(\rho, Y_e) = \mu_\mu(\rho, Y_\mu)$$

$$Y_p(\rho) = Y_e(\rho) + Y_\mu(\rho)$$

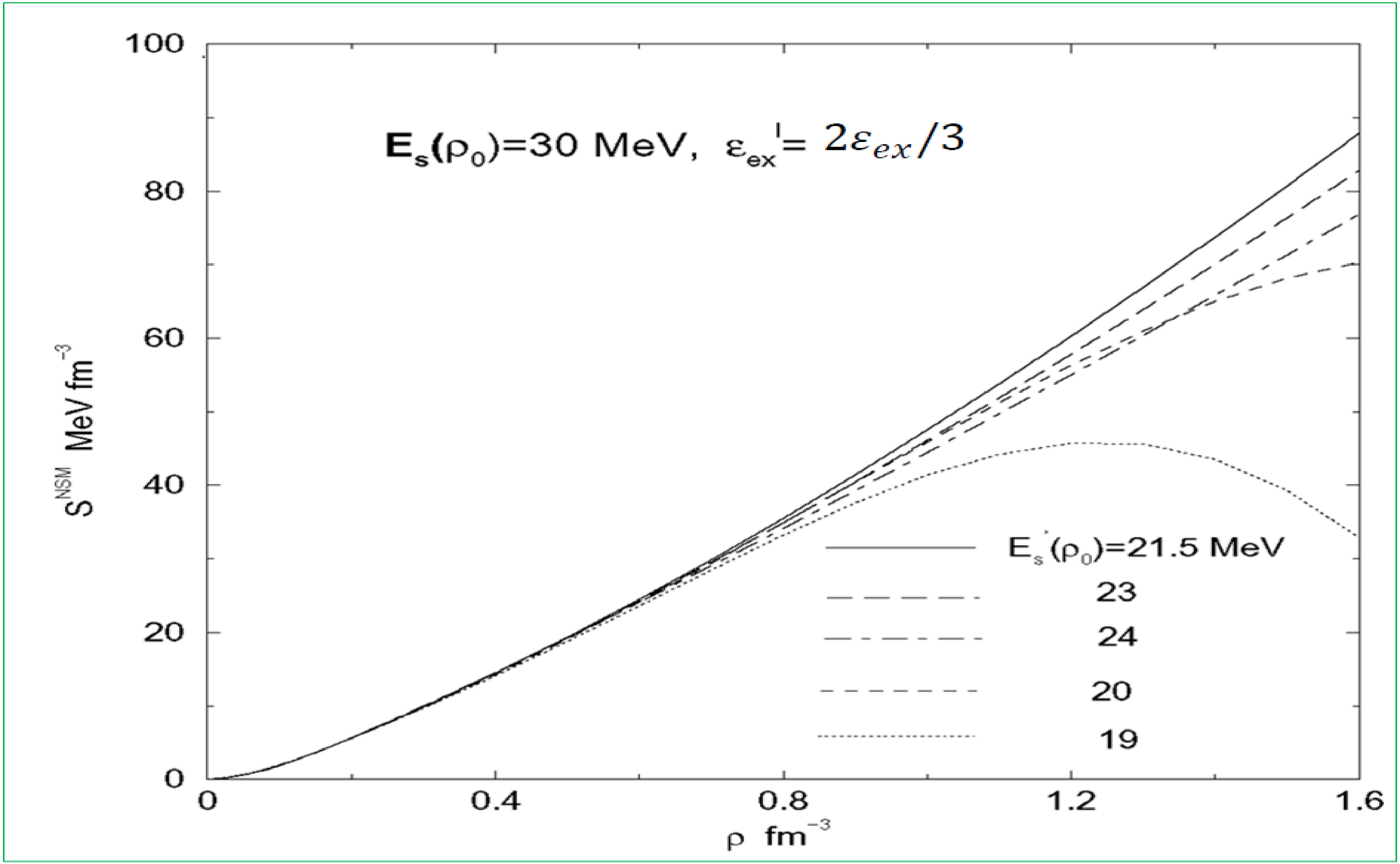


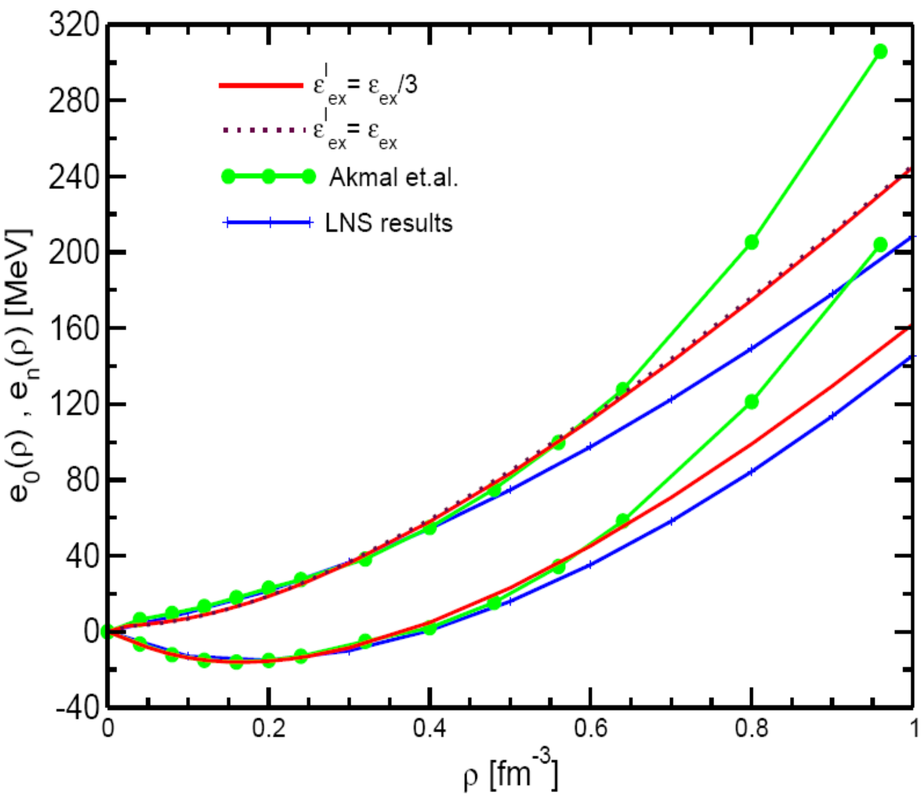


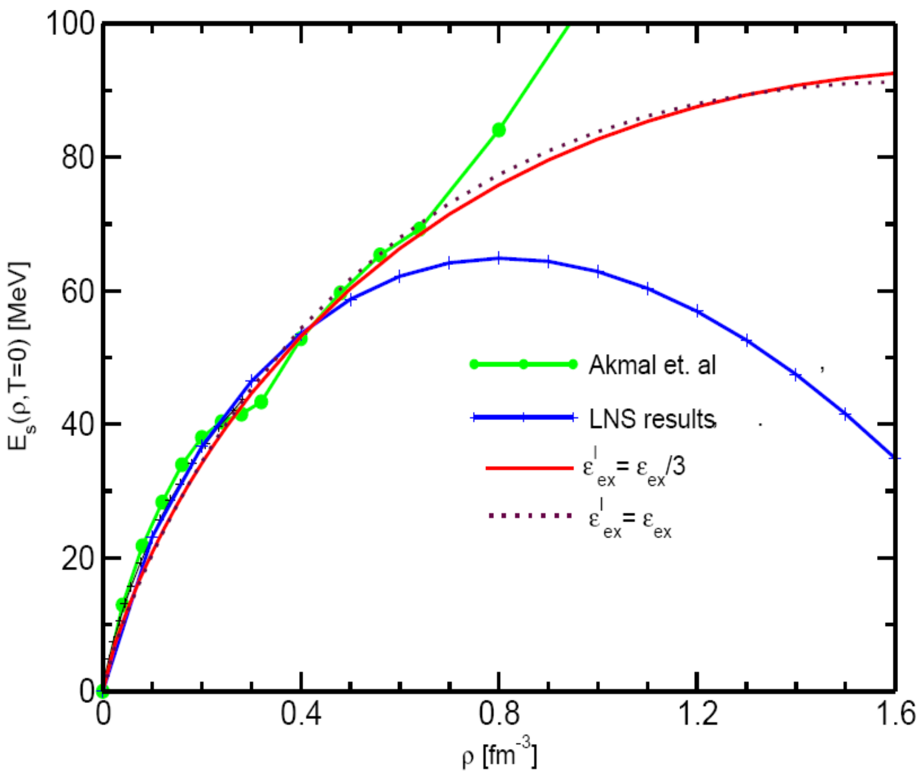
$$H^{NSM}(\rho, Y_p) = H^N(\rho, Y_p) + H^e(\rho, Y_e) + H^\mu(\rho, Y_\mu)$$

$$P^{NSM}(\rho, Y_p) = P^N(\rho, Y_p) + P^e(\rho, Y_e) + P^\mu(\rho, Y_\mu)$$

$$S^{NSM}(\rho, Y_p) = \left[H^N(\rho, Y_p) - H(\rho, Y_p = 1/2)\right]$$
$$= \left[\left(1 - 2Y_p(\rho)\right)^2 \rho E_S(\rho)\right]_{NSM}$$







Behera et al., JPG 36 (2009) 125105

Same density dependence of the EOS in ANM for widely varying momentum dependence of the mean field and vice versa; Therefore, the simple effective interaction can be used in the transport model analysis of the flow data.

- 09-parameters of ANM → three standard values $e(\rho_0)$, ρ_0 and $E_s(\rho_0)$ for a given γ.
- Out of 11-interaction parameters, two parameters open. We have taken

$$t_0 \quad \text{and} \quad x_0$$

as the open parameters.

- We further constrain one more parameter, namely, x_0

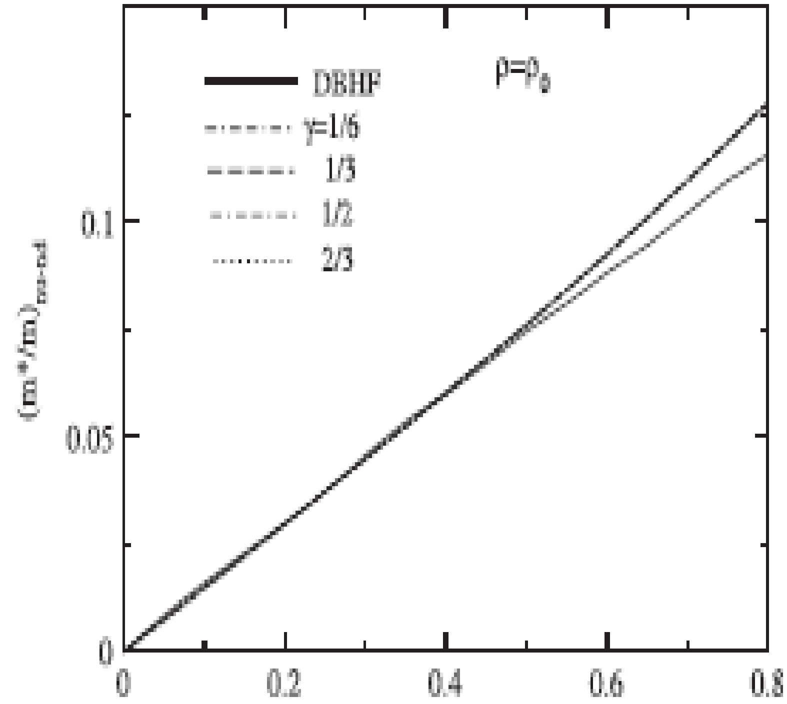
from spin polarization property in NM.

Spin polarized Neutron Matter

$$\varepsilon_{ex}^{l} = \frac{(\varepsilon_{ex}^{l,l} + \varepsilon_{ex}^{l,ul})}{2}, \quad \varepsilon_{\gamma}^{l} = \frac{(\varepsilon_{\gamma}^{l,l} + \varepsilon_{\gamma}^{l,ul})}{2}, \quad \varepsilon_{0}^{l} = \frac{(\varepsilon_{0}^{l,l} + \varepsilon_{0}^{l,ul})}{2}$$

$$\left[\frac{m^*}{m}(k,\rho_{nu},\rho_{nd})\right]_{nu,nd} = \left[1+\frac{m}{\hbar^2 k}\frac{\partial u^{nu,nd}(k,\rho_{nu},\rho_{nd})}{\partial k}\right]^{-1}$$

$$\left[\frac{m^*}{m}(k,\rho,\beta_\sigma)\right]_{nu} - \left[\frac{m^*}{m}(k,\rho,\beta_\sigma)\right]_{nd}, \beta_\sigma = \frac{\rho_{nu}-\rho_{nd}}{\rho_{nu}+\rho_{pd}}$$



$$(\varepsilon_{ex}^{l,l} + \varepsilon_{ex}^{l,ul}) = 2\varepsilon_{ex}^{l}$$

$$\varepsilon_{ex}^{l,l} = \frac{1}{3}\varepsilon_{ex}^{l}$$

agreement with DBHF prediction

(F Sammarruca and P G Krastev PRC 75(2007)034315)

$$\varepsilon_{ex}^{l,l} = -\rho_0 V_0^{TO}\int f(r)d^3r$$

$$x_0 = 1 - \frac{2}{t_0\rho_0}\left(\varepsilon_0^{l} - \varepsilon_{ex}^{l} + \frac{3}{2}\varepsilon_{ex}^{l,l}\right)$$

Only one parameter t_0 kept open which shall be determined from finite nucleus.

FINITE NUCLEI

The many-body Hamiltonian with an effective interaction

$$\mathcal{H} = \mathcal{T} + \sum_{i \neq j} v_{i,j}^{NN} + \sum_{i \neq j} v_{i,j}^{coul},$$

Kinetic Energy

Finite range + spin-orbit

Coulomb Interaction

Again,

$$v_{i,j}^{NN} = v_{i,j}^{c} + v_{i,j}^{SO}.$$

Simple effective Interaction

Spin-orbit Interaction

$$\mathcal{H}_0 = \frac{\hbar^2}{2m}(\tau_n + \tau_p) + \mathcal{H}_d^{Nucl} + \mathcal{H}_{exch}^{Nucl} + \mathcal{H}^{SO}(\mathbf{r}) + \mathcal{H}_d^{Coul}(\mathbf{r}) + \mathcal{H}_{exch}^{Coul}(\mathbf{r}).$$

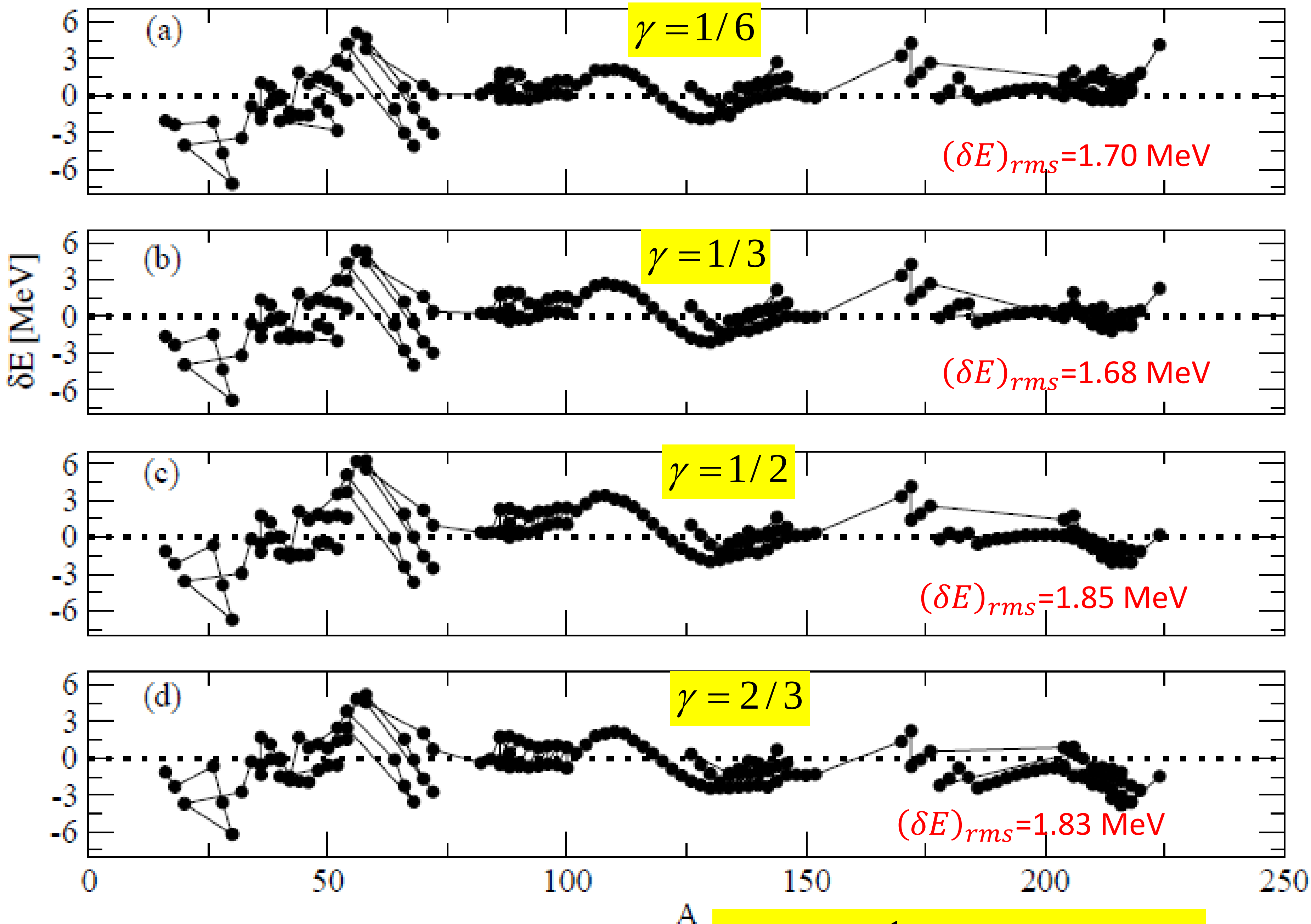
- The total nuclear direct and exchange energy density coming from SEI. The non-local exchange part is made local by using semi-classical ħ-expansion of density matrix upto 2nd order. (X.Viñas et. al. PRC 67 (2003) 014324)

- The Spin-orbit interaction taken similar to Skyrme and Gogny interaction.

t_0 → ^{40}Ca

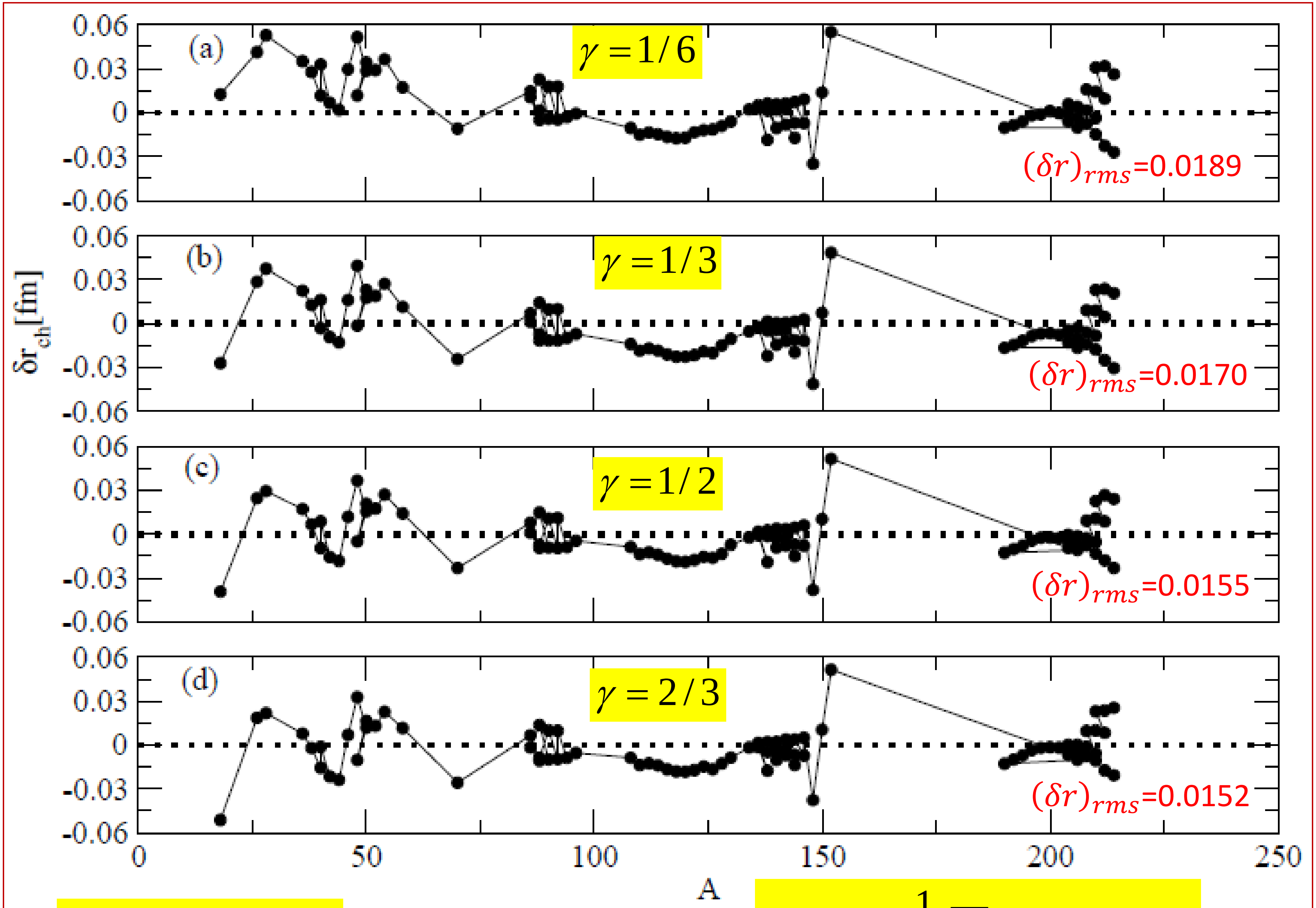
W_0(strength parameter of Spin-orbit interaction) → ^{208}Pb

BEs of 161 - and Radii of 86- spherical nuclei: A=16 to A=224



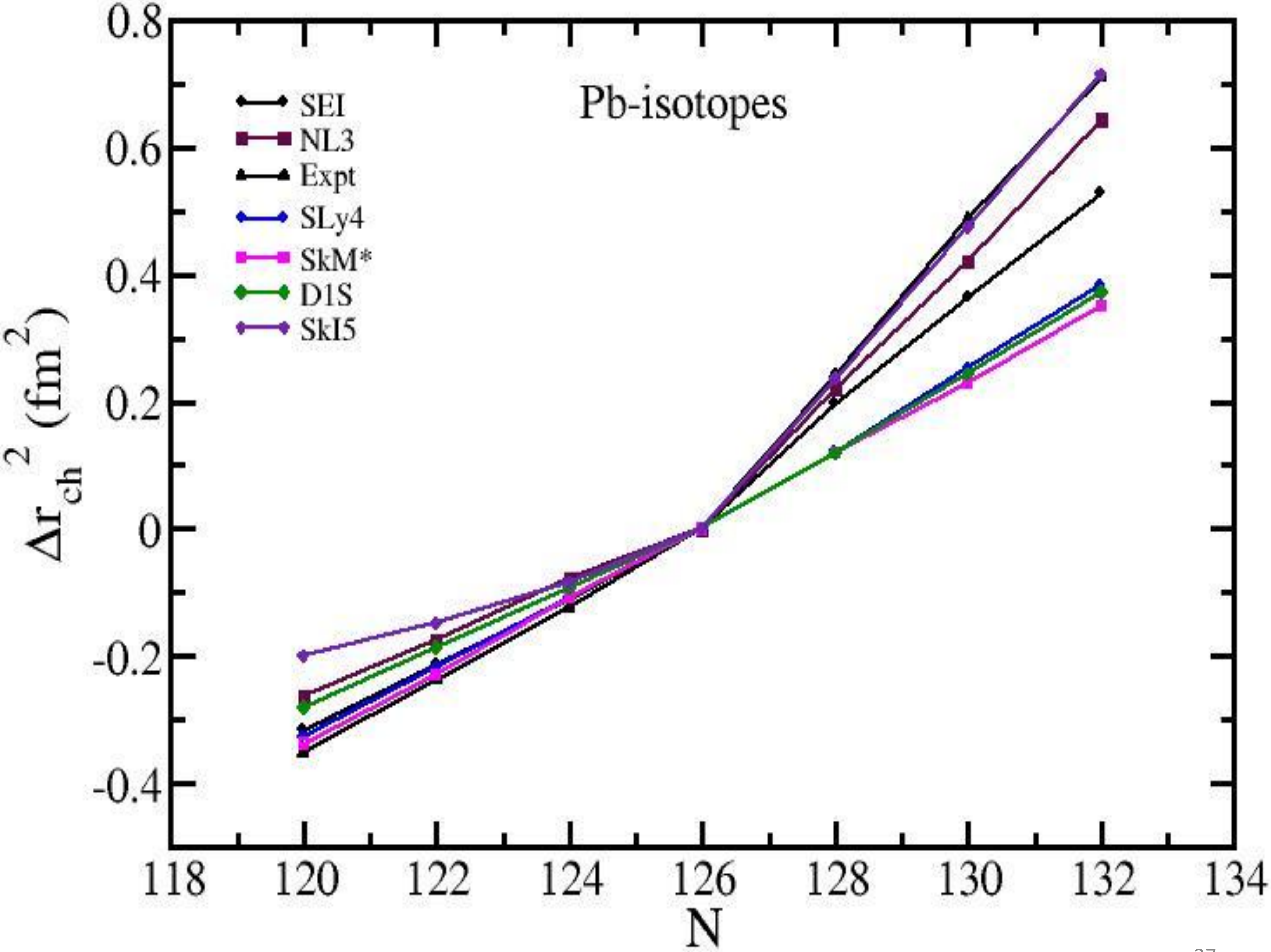
$$\delta E = (E_{calc} - E_{expt})$$

$$(\delta E)^2_{rms} = \frac{1}{N}\sum (E_{calc} - E_{expt})^2$$

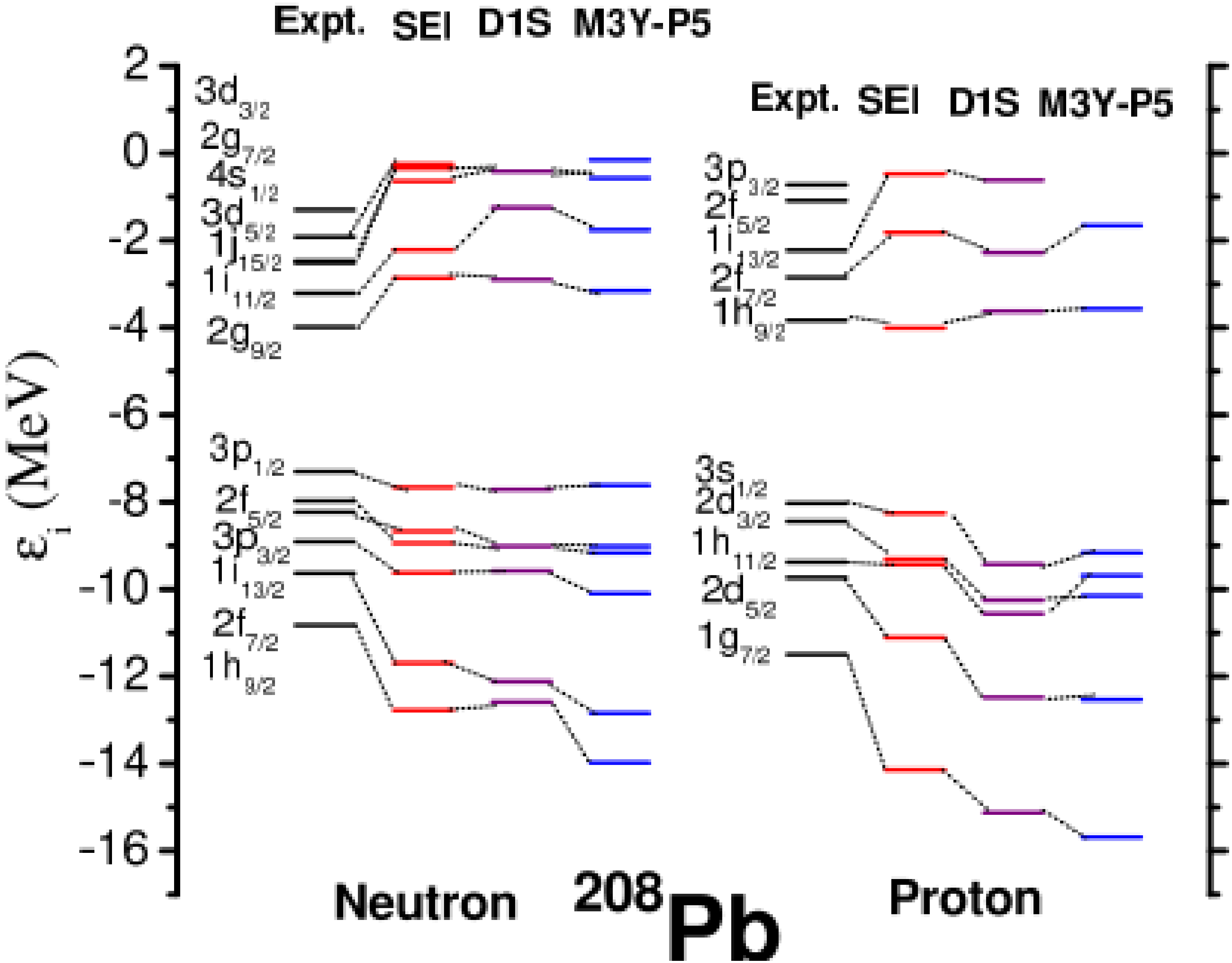


$$\delta r_{ch} = (r_{calc} - r_{\text{expt}})$$

$$(\delta r)^2_{rms} = \frac{1}{N}\sum (r_{calc} - r_{\text{expt}})^2$$



Pb-isotopes
SEI
NL3
Expt
SLy4
SkM*
D1S
SkI5
Δr_{ch}^2 (fm^2)
N
0.8
0.6
0.4
0.2
0
-0.2
-0.4
118
120
122
124
126
128
130
132
134



Behera et. al., J.Phys G (2013) 095105; (2015) 045103

HFB results with SEI for 579 even-even nuclei, deformed and spherical, over the nuclear chart

γ=1/3

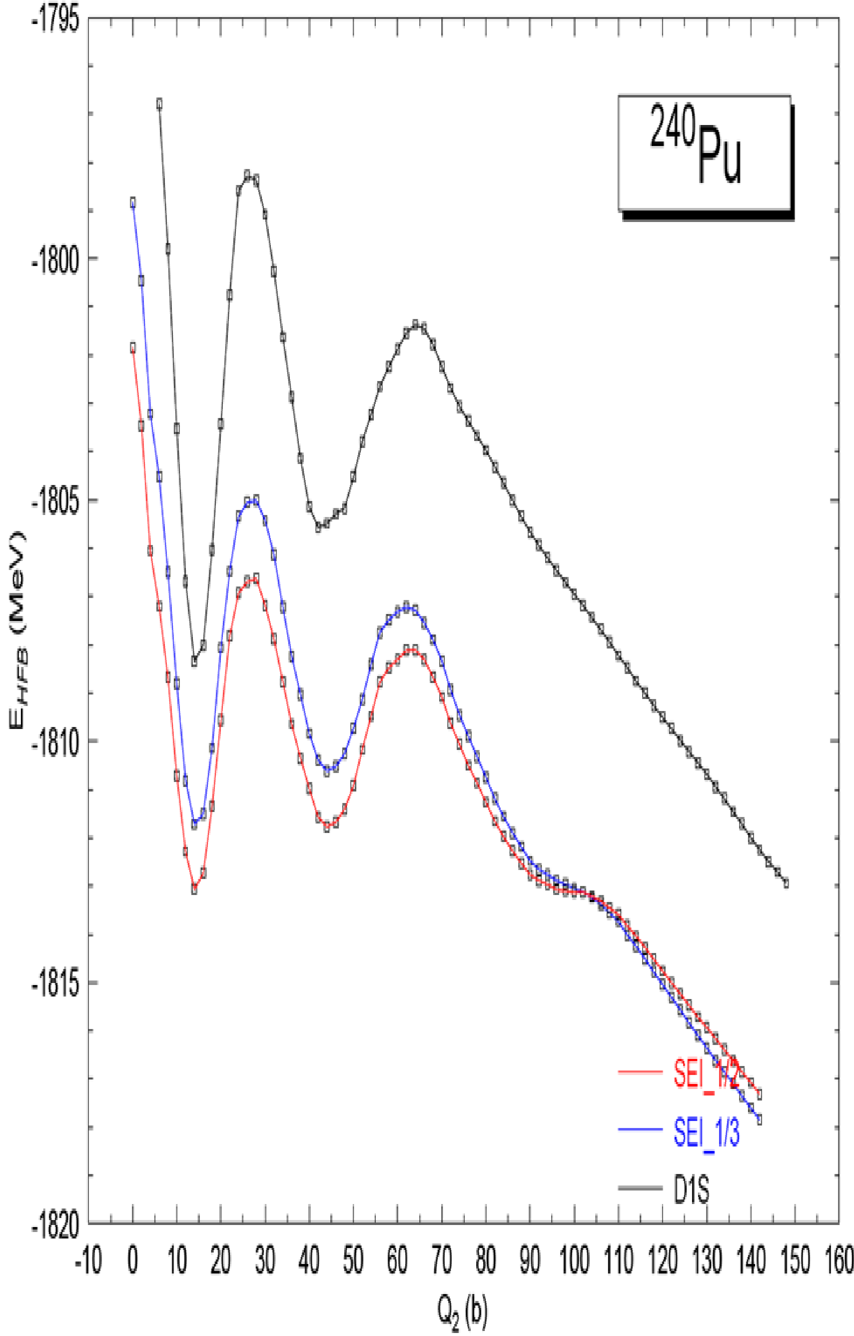
t_0=201, W_0=115 ΔE_{rms}=1.873(HFB)

t_0=214, W_0=115 ΔE_{rms}=1.788 (EROT)

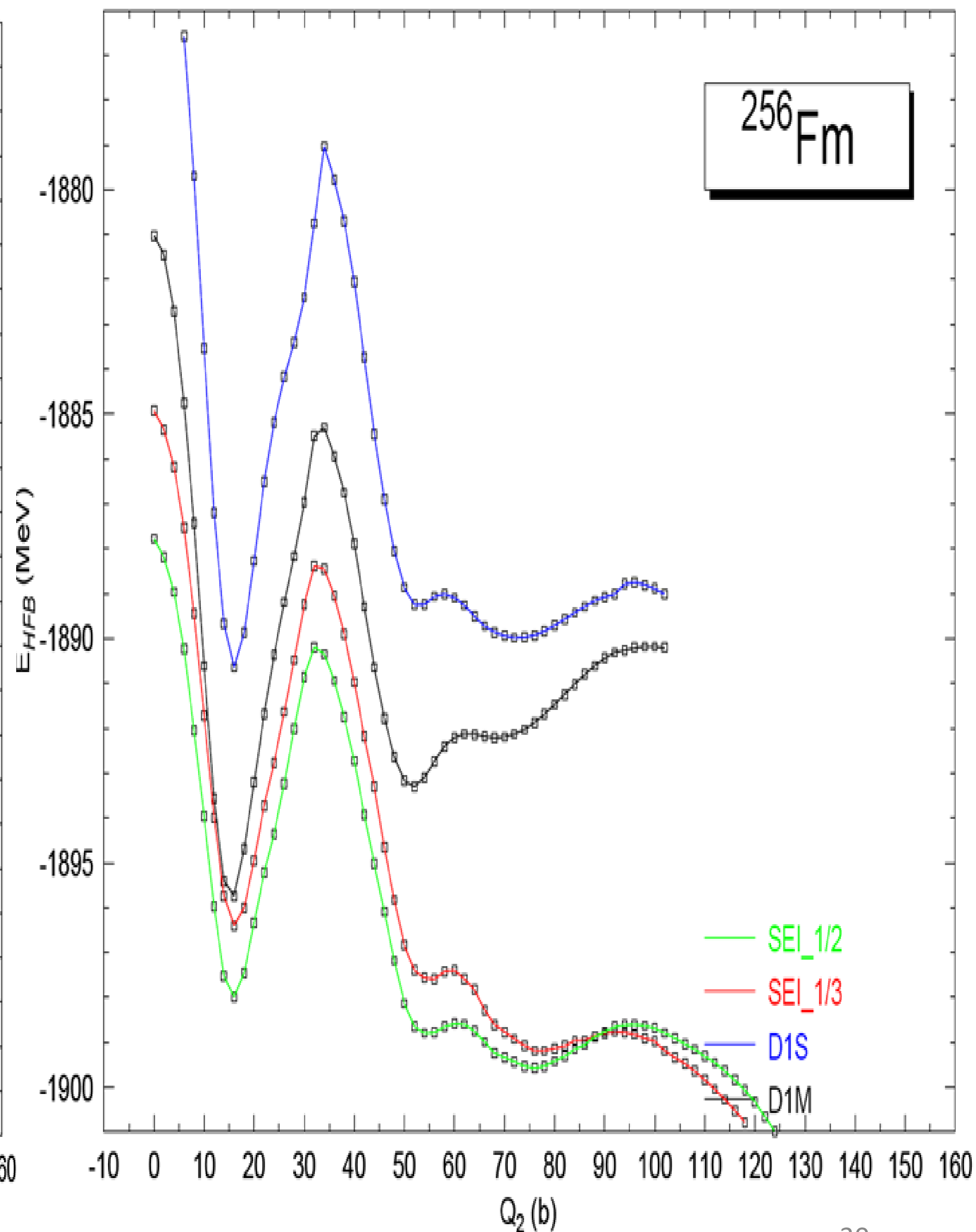
γ =1/2

t_0=438, W_0=112 ΔE_{rms}=1.958 (HFB)

t_0=450, W_0=115 ΔE_{rms}=1.843 (EROT)



240Pu
E HFB (MeV)
-1795
-1800
-1805
-1810
-1815
-1820
-10
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
Q2 (b)
SEI_1/2
SEI_1/3
D1S



256Fm
E HFB (MeV)
-1880
-1885
-1890
-1895
-1900
-10
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
Q2 (b)
SEI_1/2
SEI_1/3
D1S
D1M

CONCLUSION:

- By adjusting the parameters of SEI from considerations of momentum dependence of the mean fields in NM, the interaction could predict the finite nuclei properties similar in quality as that of any other conventional interaction.

- The procedure of parameter fixation provide the flexibility of systematically varying the momentum dependent properties, where the EOSs remains the same and vice-versa.

- The preliminary results of HFB with SEI shows that it is also competent to account for the deformation properties in finite nuclei similar in quality as any other successful effective interaction.

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THANK YOU