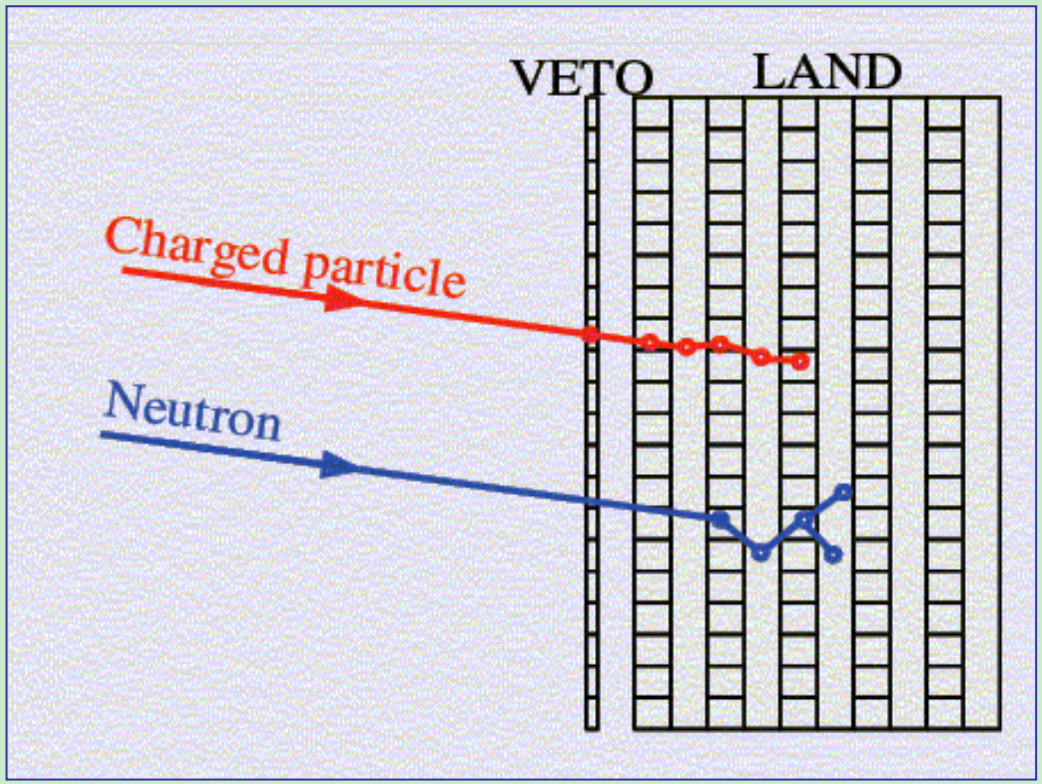
Can LAND be used to measure differential proton/neutron flow ?

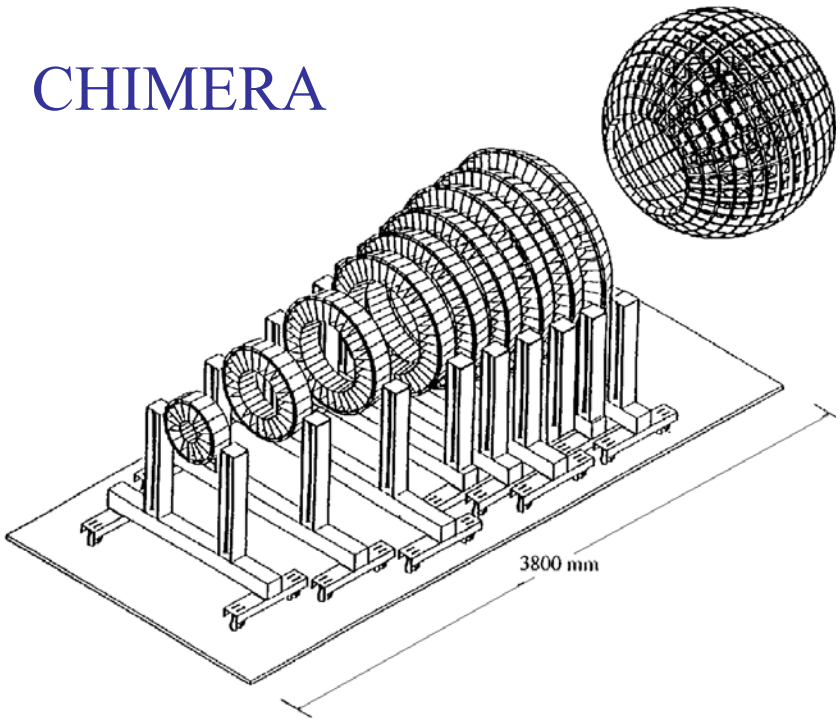


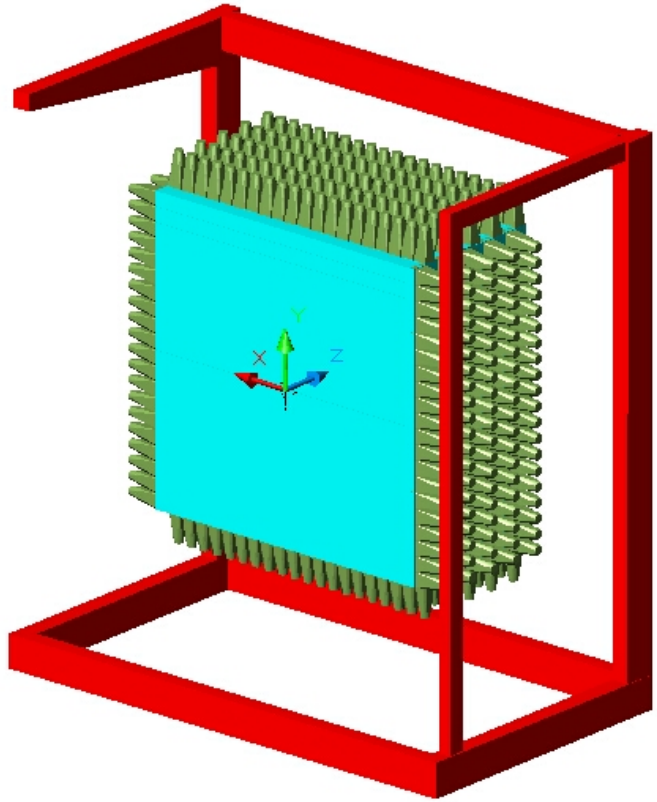
J. Brzychczyk,
P. Pawlowski

neutron and proton detection

Can LAND be used to measure differential proton/neutron flow ?

CHIMERA

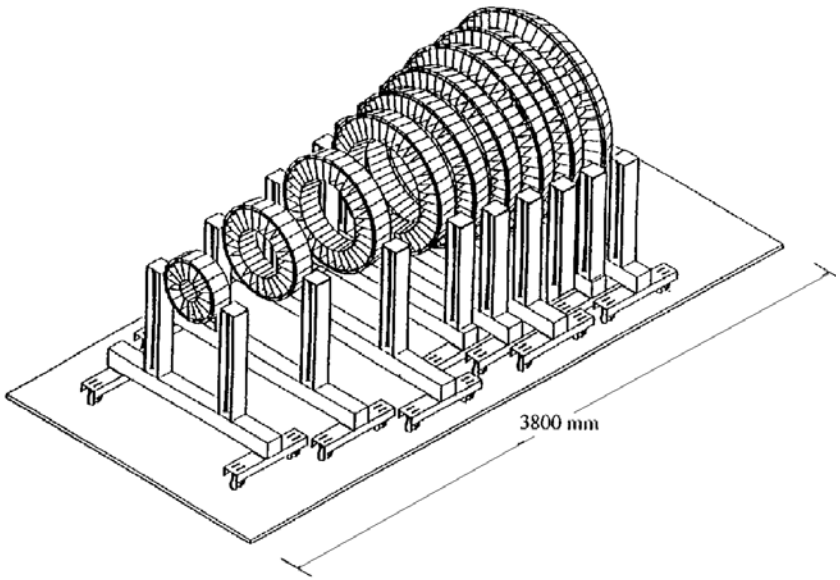


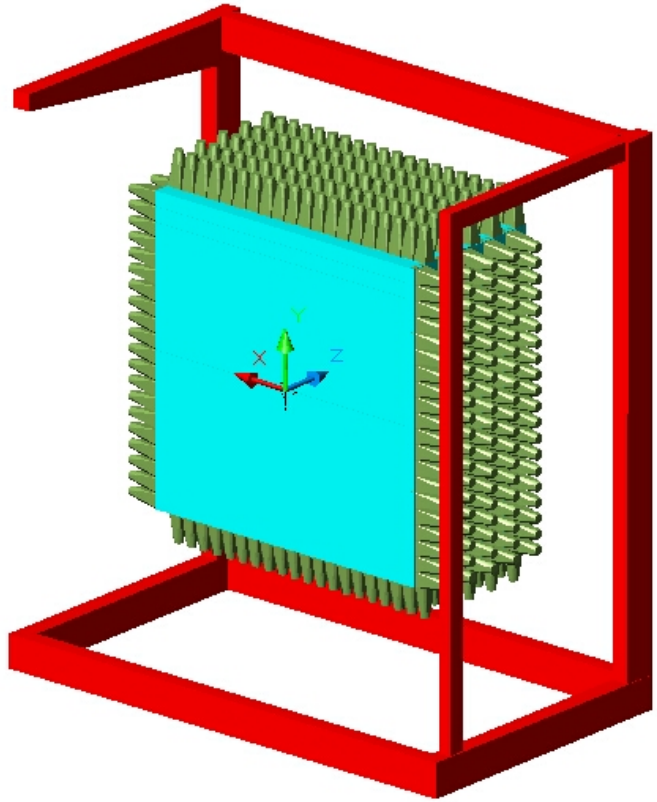


impact parameter orientation and modulus

Can LAND be used to measure differential proton/neutron flow ?

CHIMERA

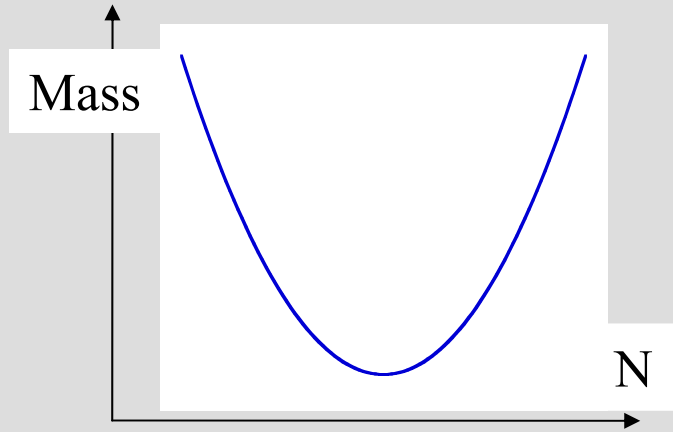




impact parameter orientation and modulus

The symmetry energy

Bethe-Weizsäcker



$B_{sym} = -23.4\ \text{MeV} \cdot (N - Z)^2 / A$

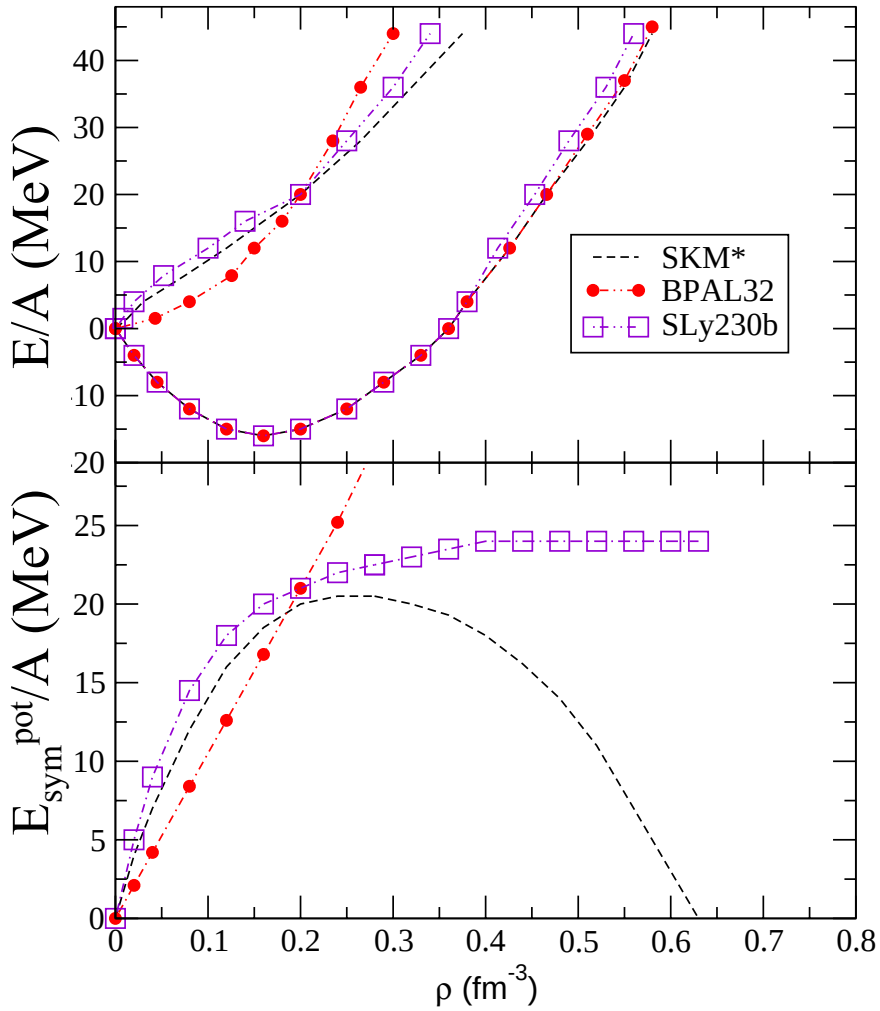
nuclear-matter equation of state

$$E_A(\rho,\delta) = E_A(\rho,0) + C_{sym}(\rho) \cdot \delta^2$$

asymmetry parameter

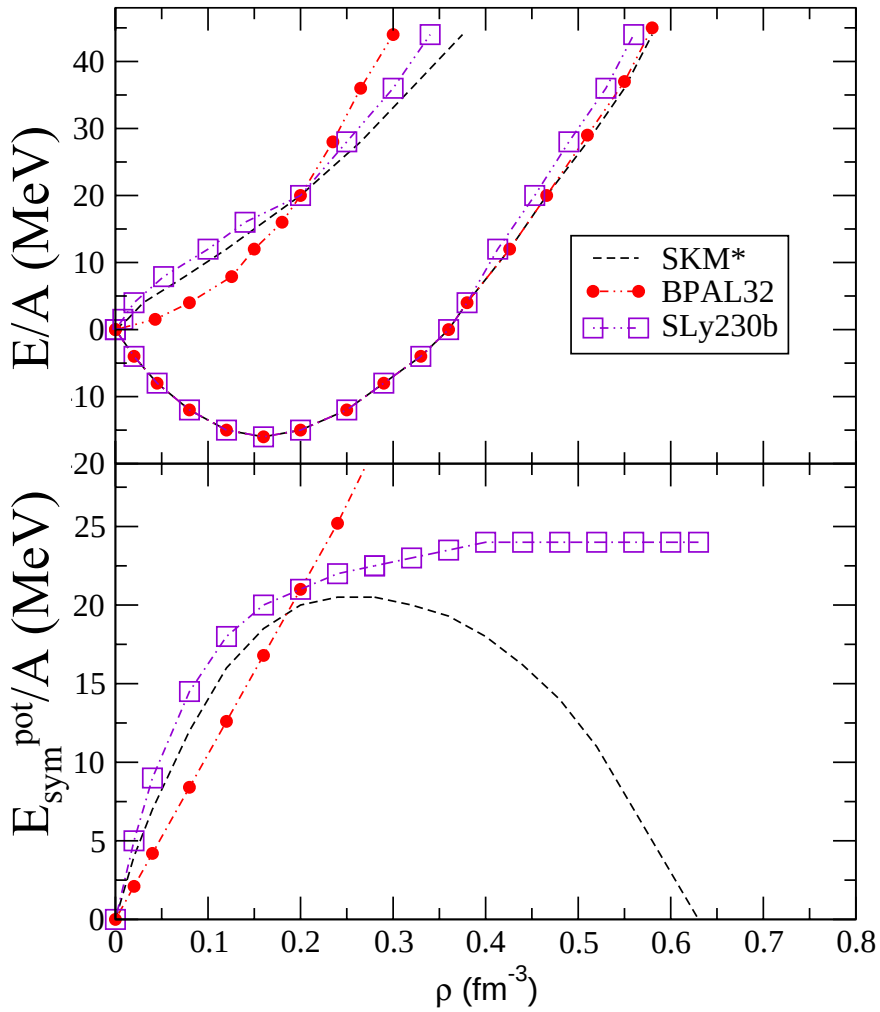
$$\delta = (\rho_n - \rho_p) / \rho$$

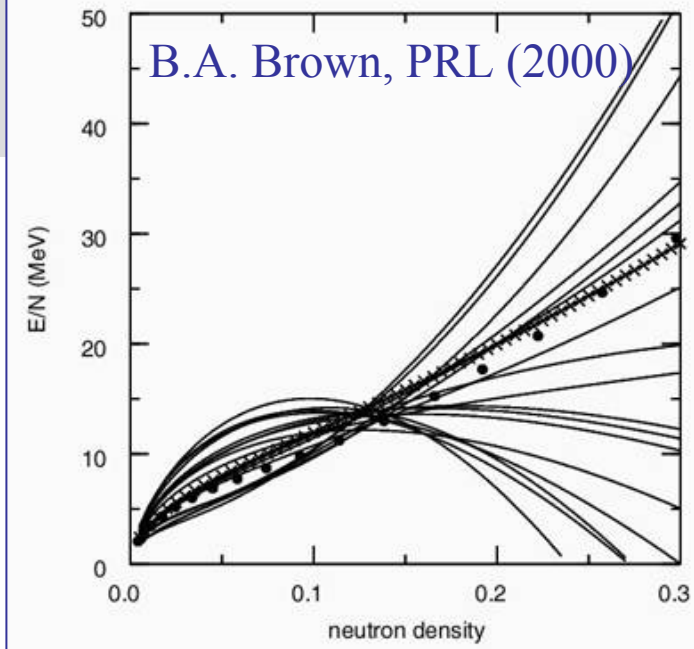
The symmetry energy



nuclear matter calculations

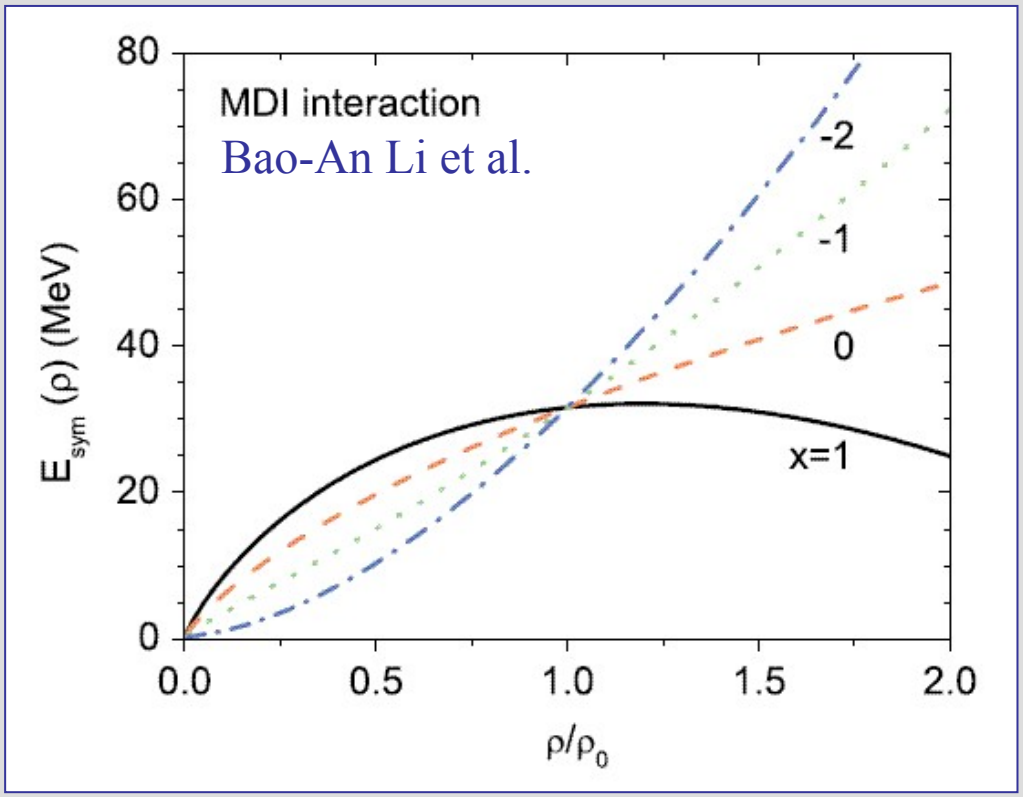
The symmetry energy

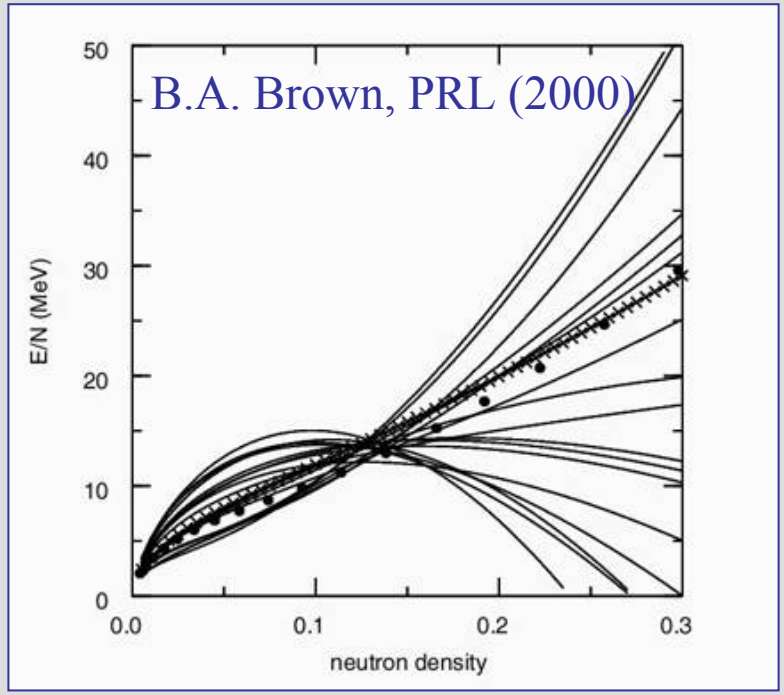




neutron-skin thickness

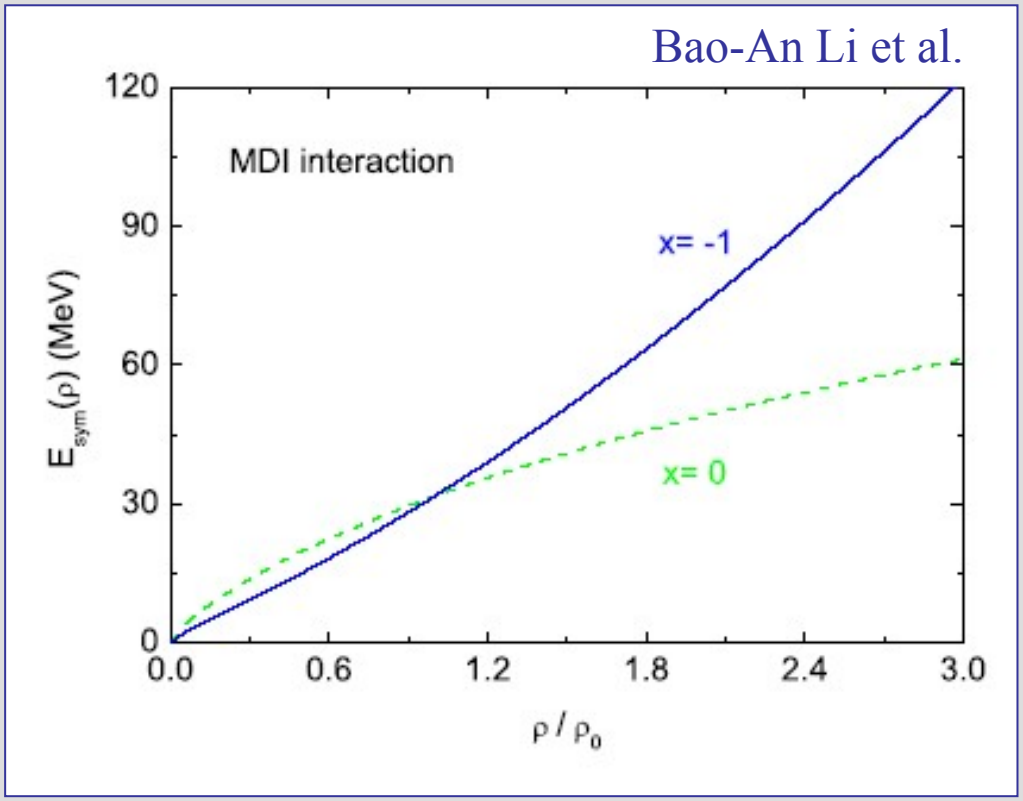
The symmetry energy

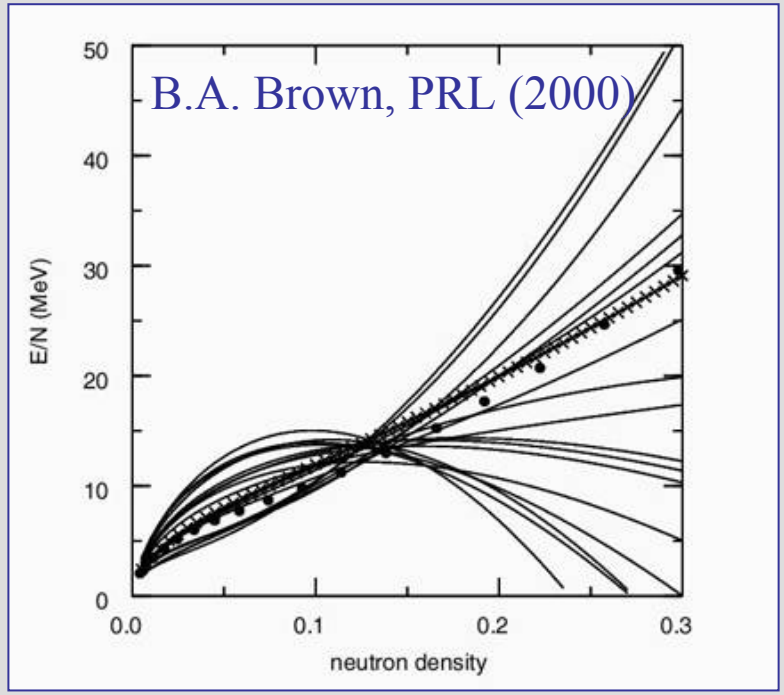




parameterizations used in transport models

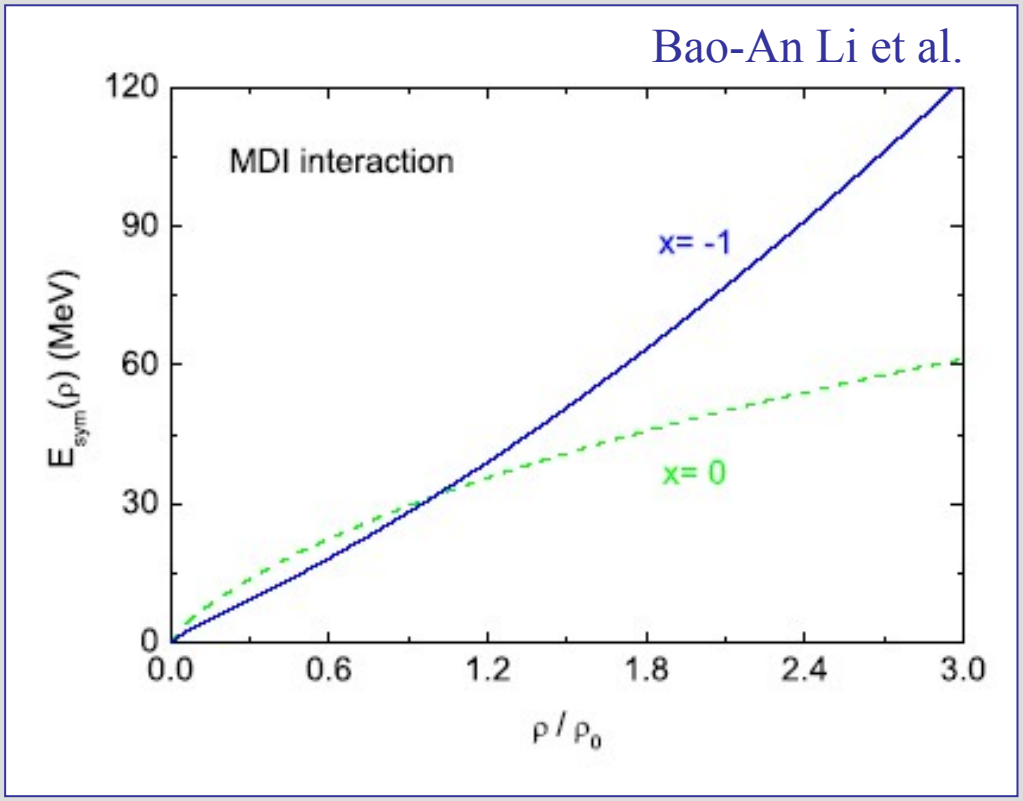
with recent constraints



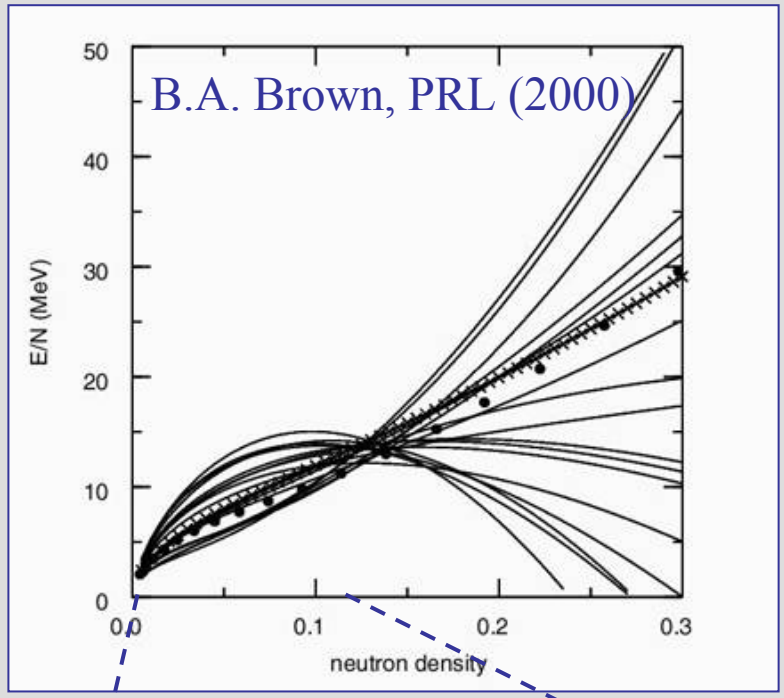


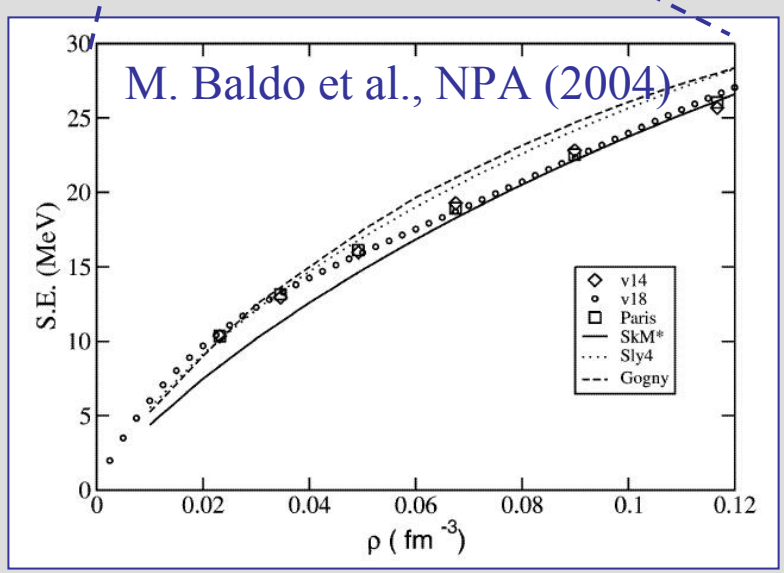
from data on isospin diffusion
and neutron skin thickness

with recent constraints



from data on isospin diffusion
and neutron skin thickness
clustering at low density

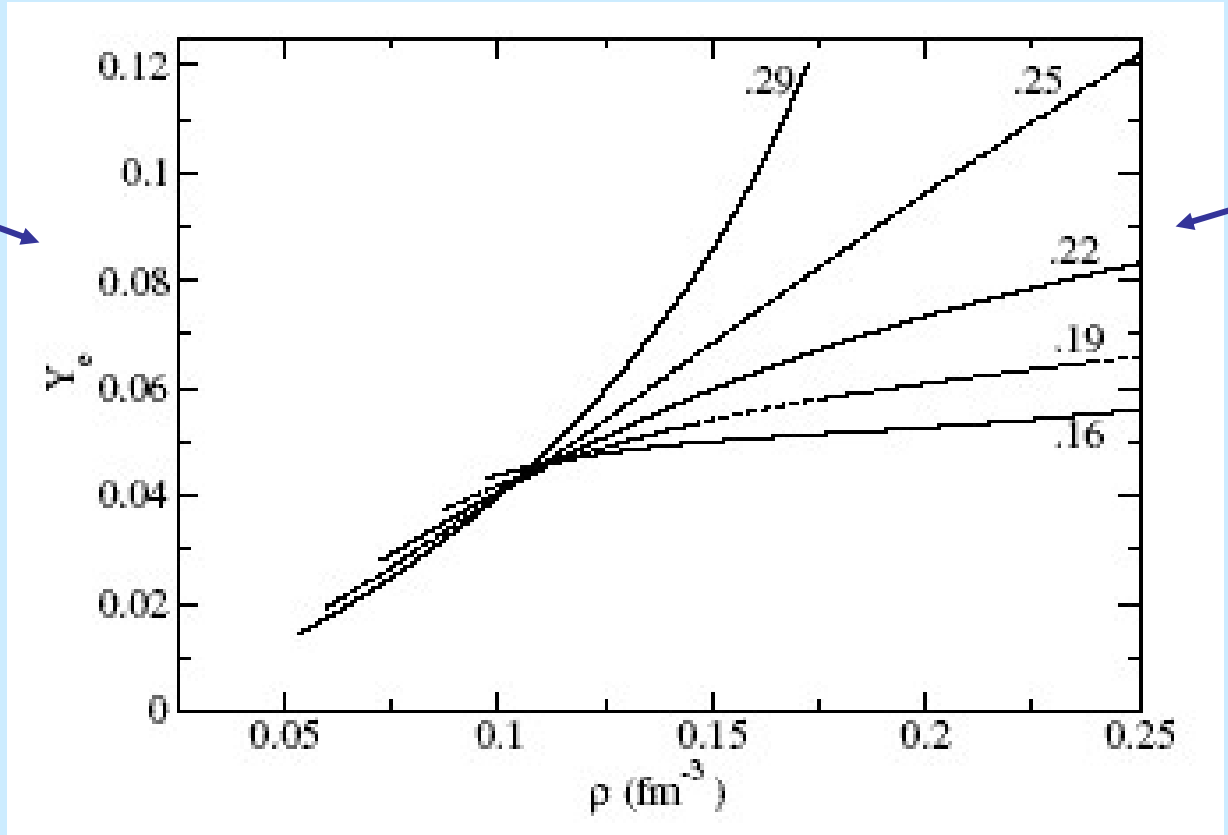




Sources of information

neutron skin thickness in ^{208}Pb

electron fraction

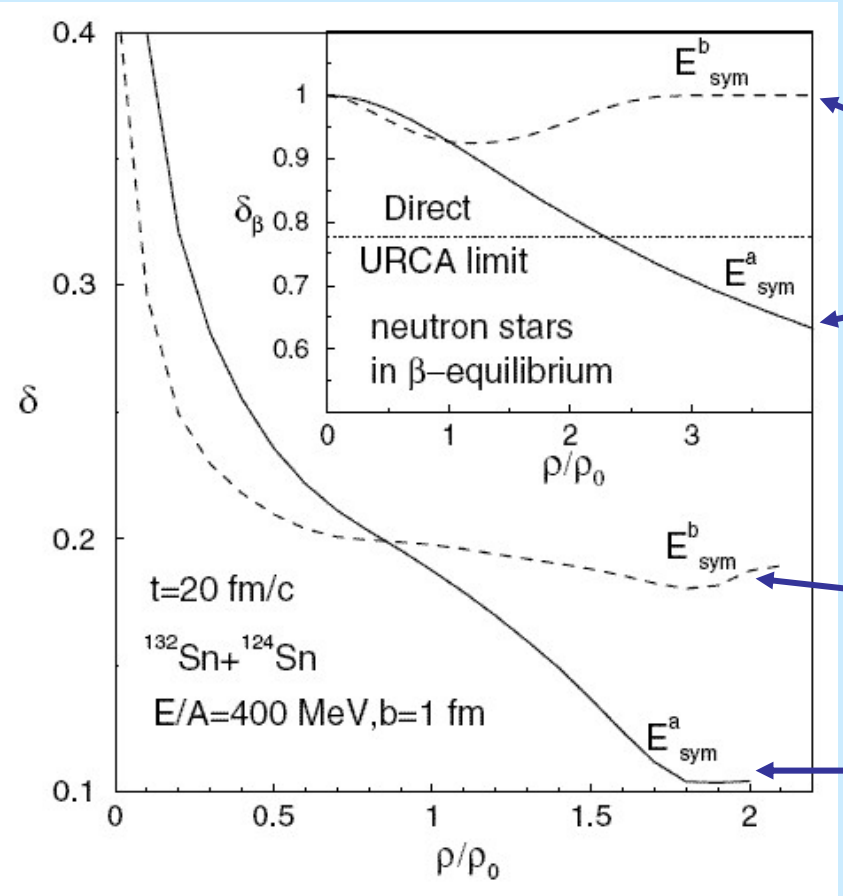


neutron skin

Horowitz & Piekarewicz, PRL 86, 5647 (2001)

Sources of information

differential neutron-proton flow



soft

stiff

soft

stiff

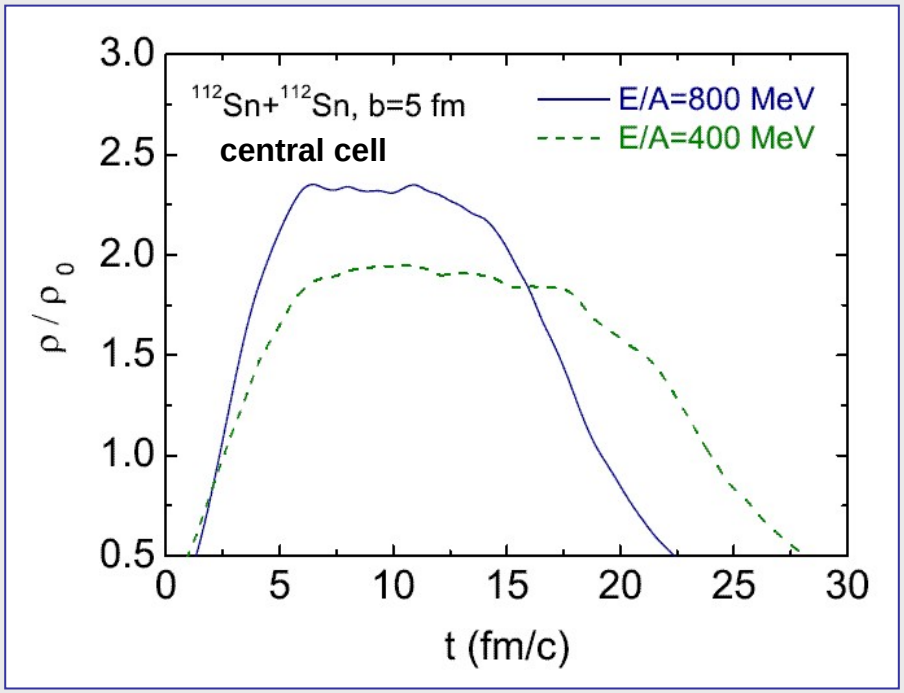
Bao-An Li, PRL 88, 192701 (2002)

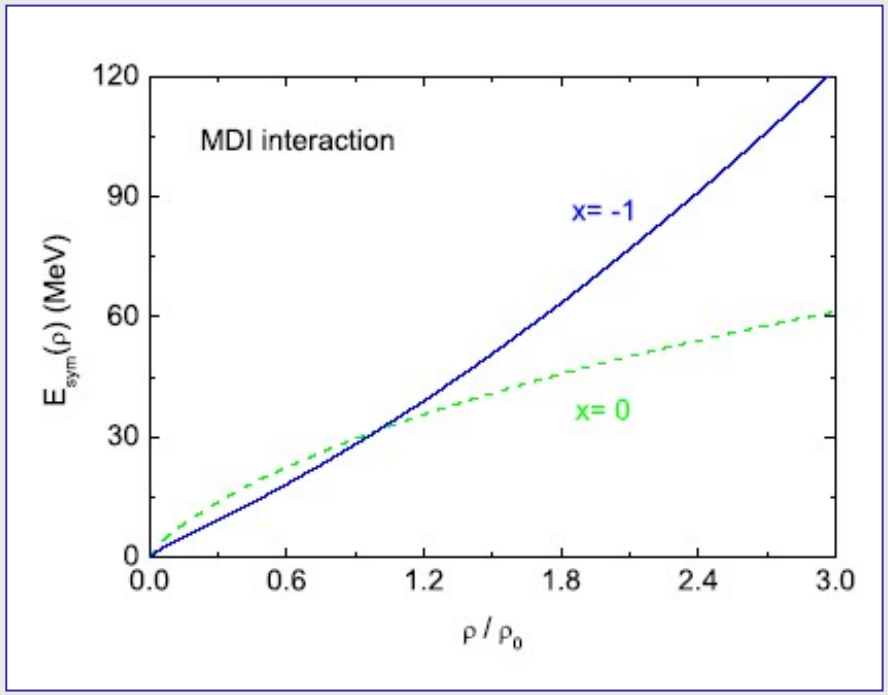
Predictions

stiff

soft

differential neutron-proton flow





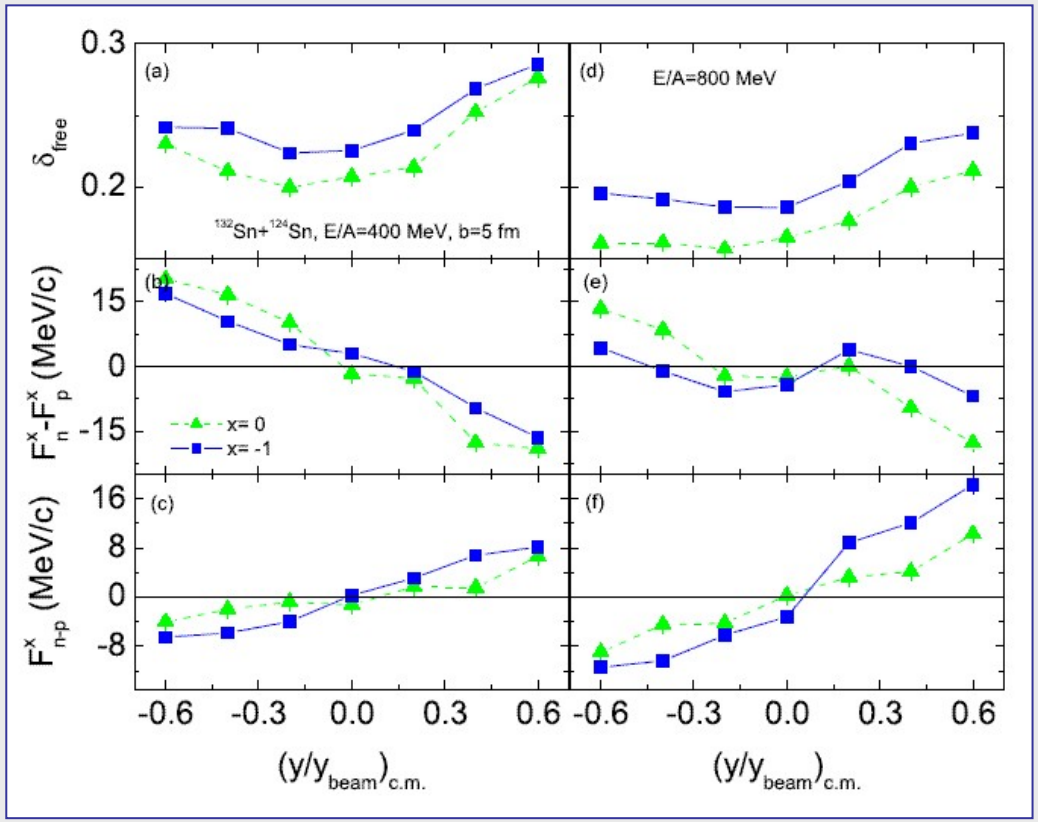
Yong, Li, Chen, arXiv:nucl-th/0606003

Predictions

differential neutron-proton flow

stiff

soft



asymmetry of free nucleons

difference of average flows

differential flow

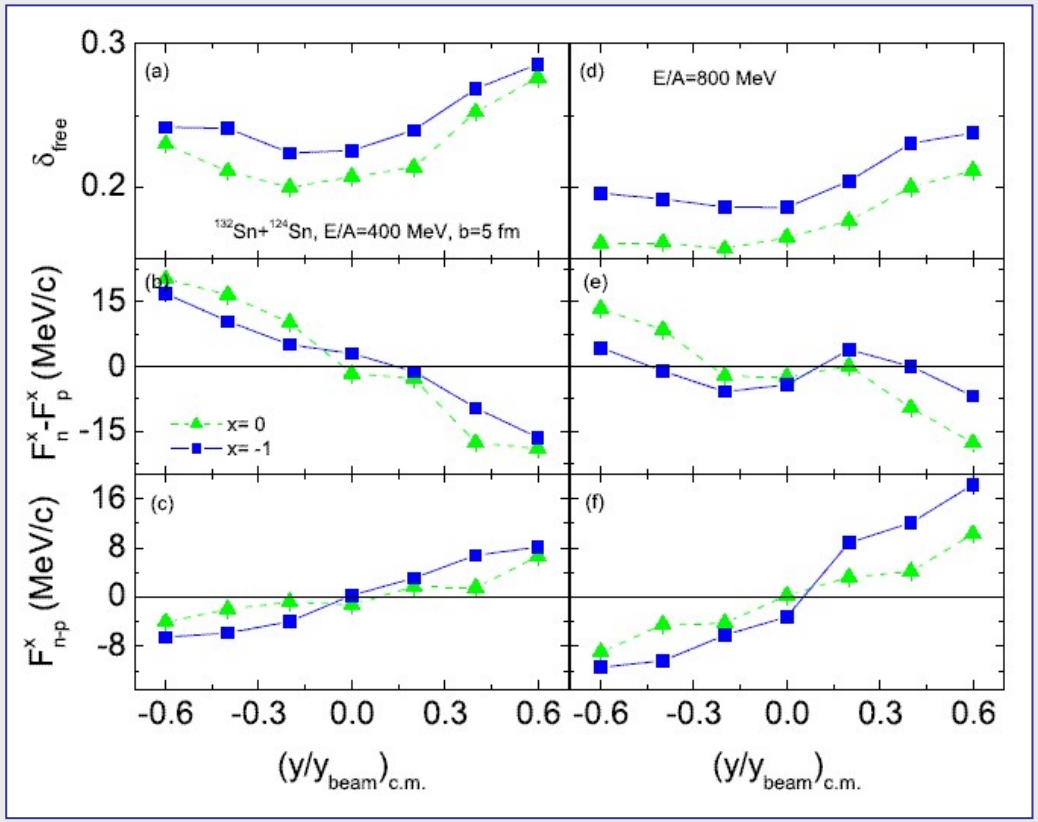
Yong, Li, Chen, arXiv:nucl-th/0606003

Predictions

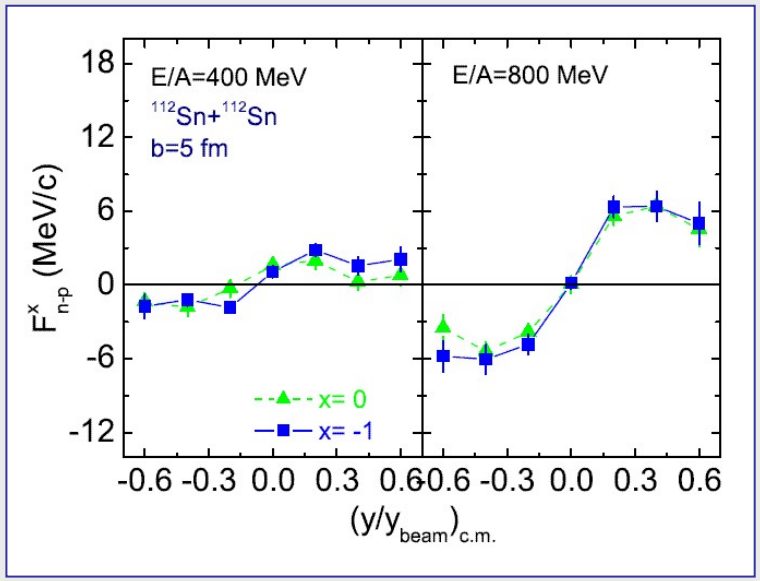
stiff

soft

differential neutron-proton flow



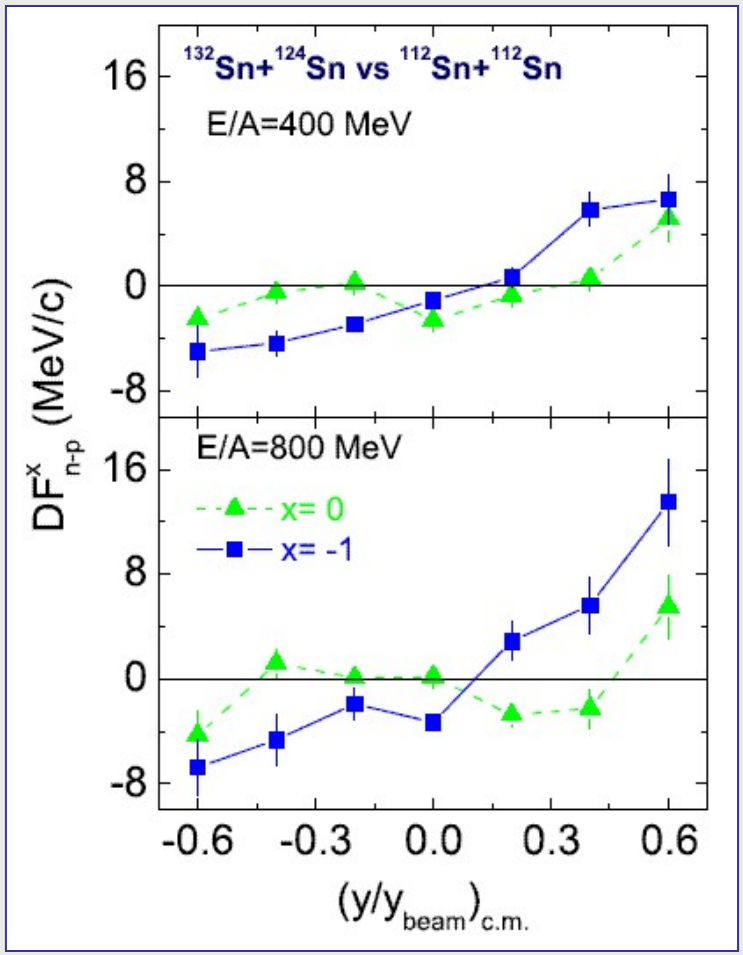
neutron poor system

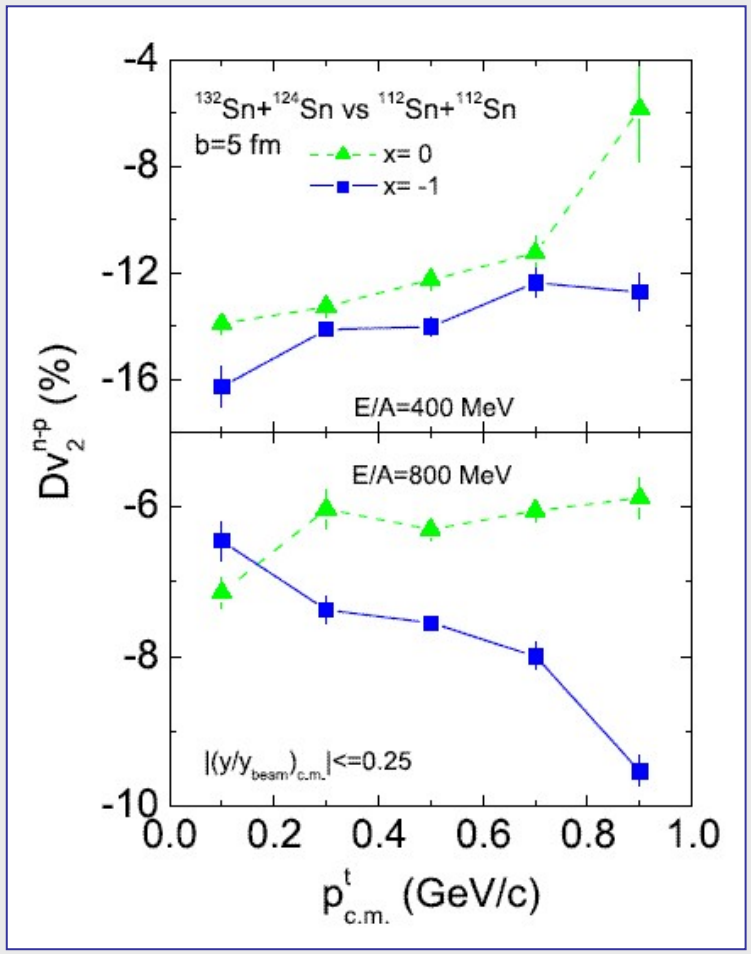


Yong, Li, Chen, arXiv:nucl-th/0606003

Predictions

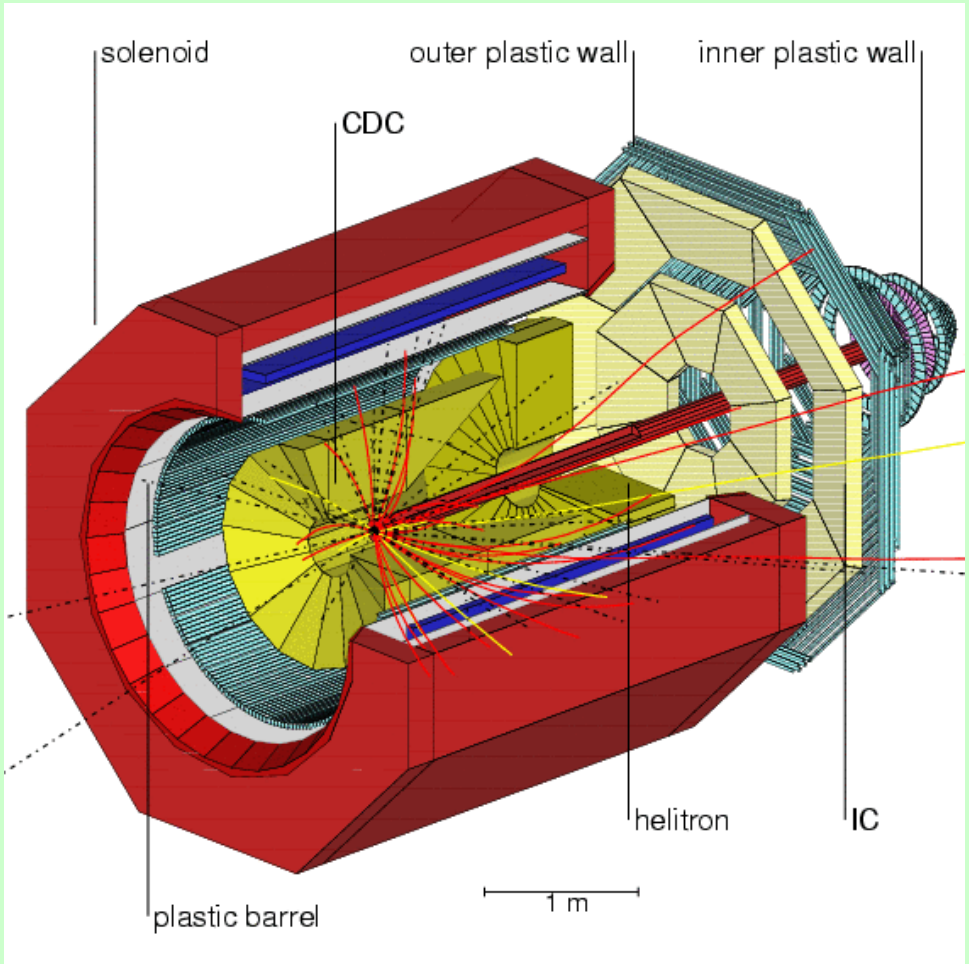
double neutron-proton differential transverse and elliptic flow



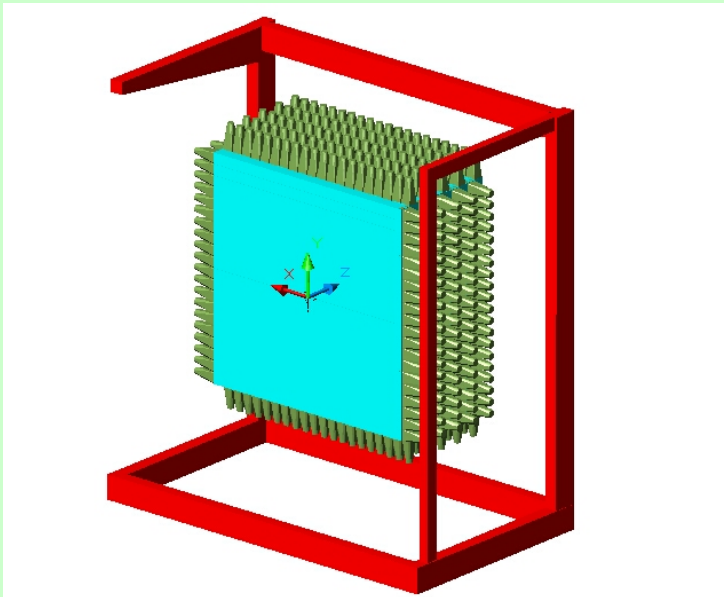


Yong, Li, Chen, arXiv:nucl-th/0606003

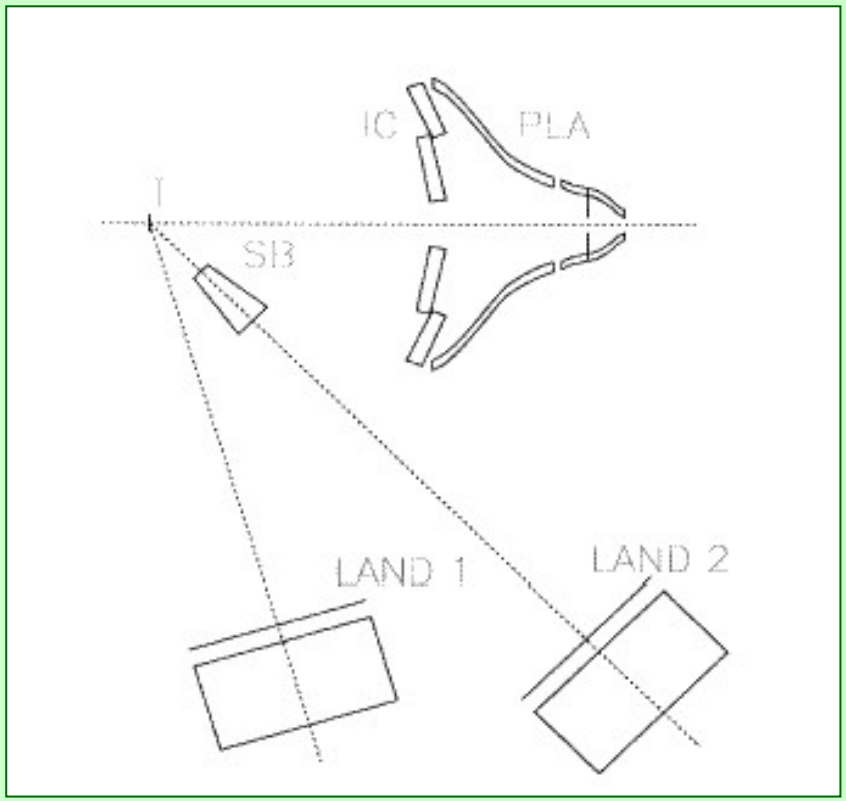
FOPI/LAND data

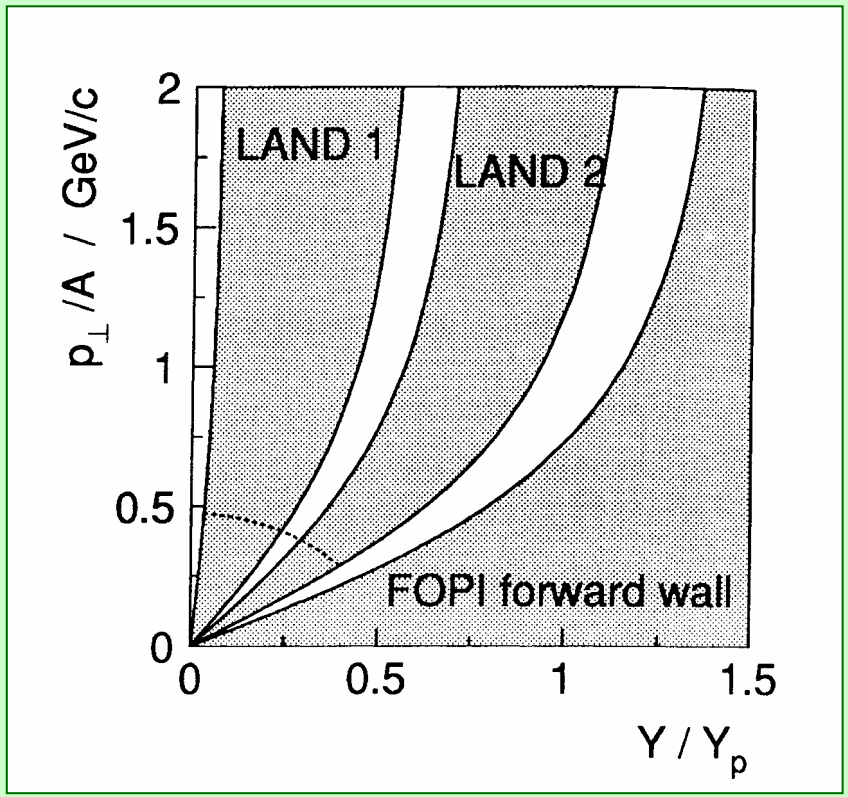


taken during
FOPI's phase I
i.e. when only the
forward wall existed



Au+Au 400 A MeV

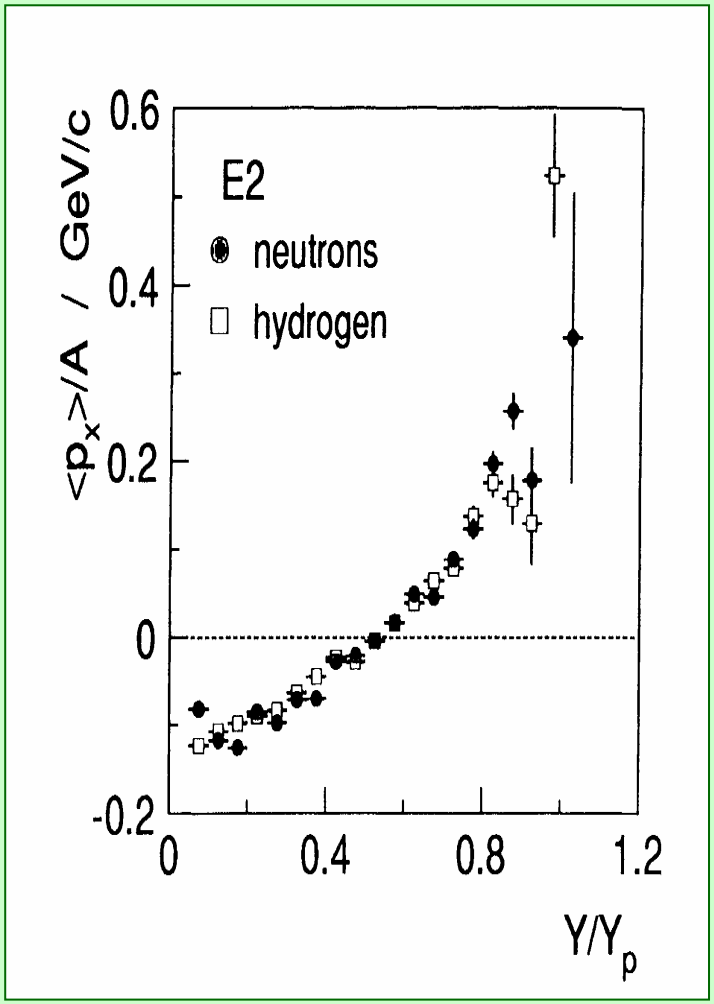


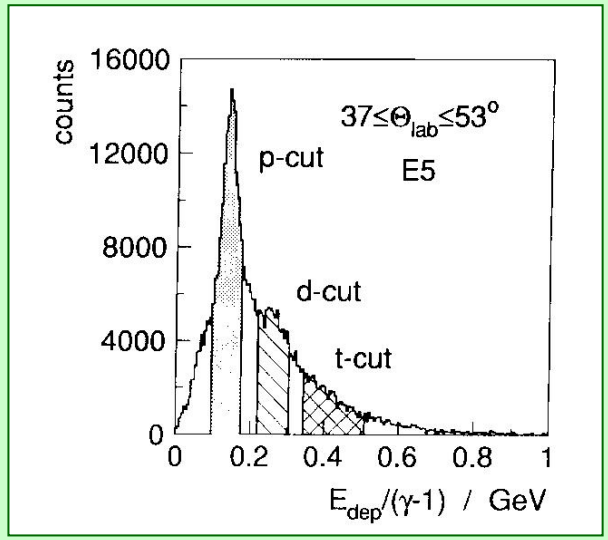


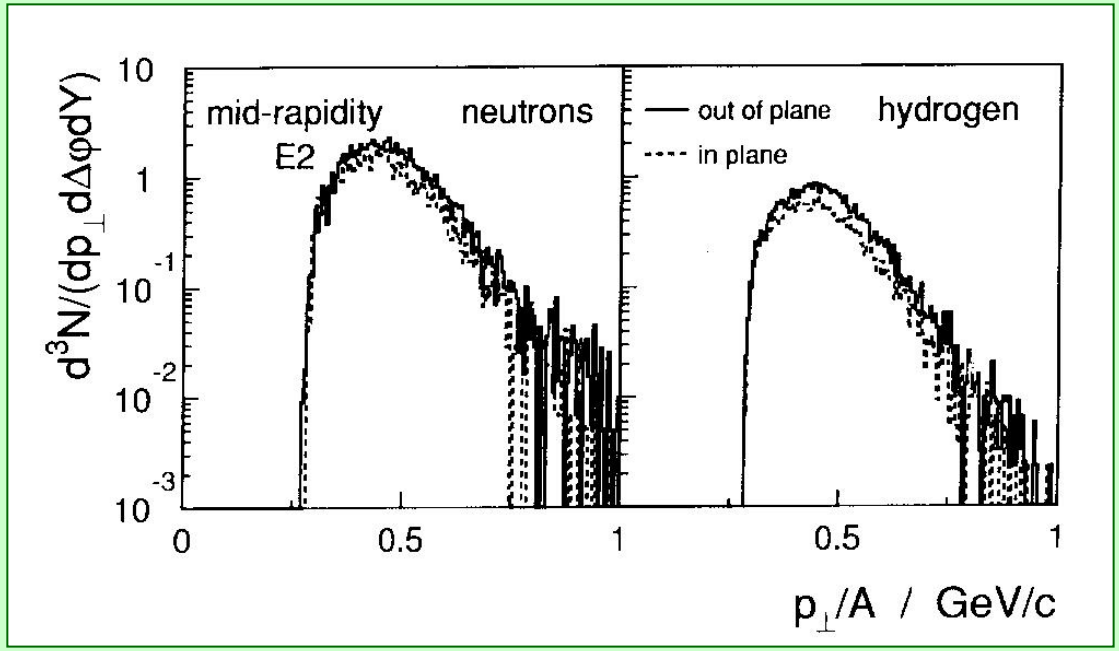
Y. Leifels et al., PRL 71, 963 (1993) 'neutron squeeze-out'

FOPI/LAND data

from Y. Leifels, thesis







A possible program

1. analyze existing FOPI/LAND data
2. produce a filter for the calculations
3. reproduce the individual flows
4. check the particle yields

5. use the experience for designing a new experiment with
   - mass symmetric system (Sn or Zr/Ru)
   - cross bombardments
   - same device for neutrons, hydrogens
   - precise determination of impact parameter and reaction plane

A possible program

5. use the experience for designing a new experiment with
   - mass symmetric system (Sn or Zr/Ru)
   - cross bombardments
   - same device for neutrons, hydrogens
   - precise determination of impact parameter and reaction plane

6. simulations for CHIMERA and LAND

7. in the long run: ^{132}Sn beam at FAIR
   4π detector for reaction studies