Nuclear matter saturation issues

- Old problem…
- Is it solved?
- Don't think so…

- Lattice calculations

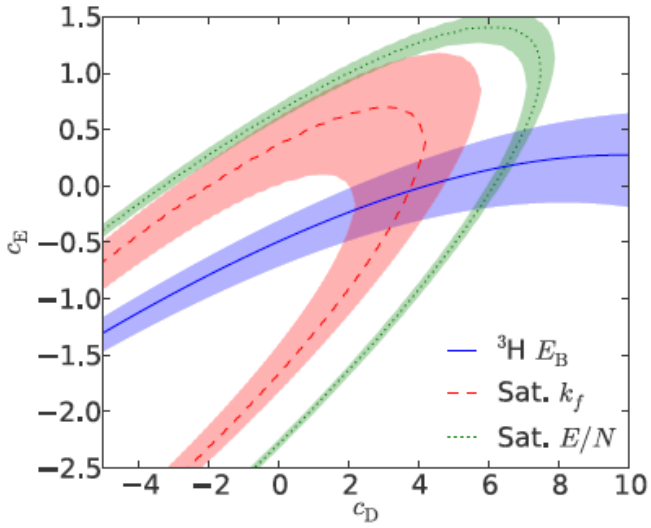
  Radius of ^{16}O

  $\langle r^2 \rangle^{1/2}$=2.3 fm<—> Exp 2.71 fm

  PRL112, 102501 (2014)

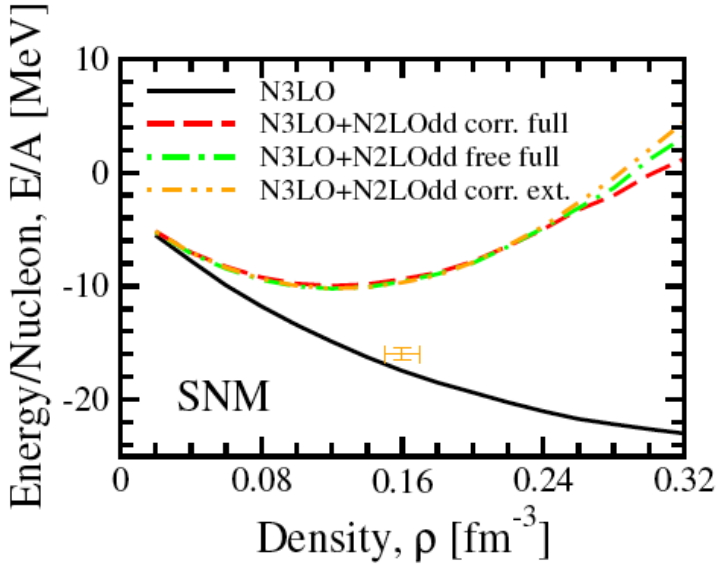
- SCGF only "SRC" no regulators

- Coupled cluster



PRC **89**, 014319 (2014)

Can't do triton and saturation at the same time



arXiv:1408.0717

3NF —> DD2NF

Saturation of symmetric nuclear matter: outlook

- Nuclear saturation problem
  - We know a lot …
  - We can't get it right
  - Why not?
- Forces & methods
  - Chiral interactions + 3NF
    - Underbinds in SCGF (SRC only)
    - Coupled cluster: triton <-> nuclear matter cannot be reconciled
  - Comments
    - Not enough high-momentum content (JLab) —> NN interaction too soft
    - LRC (mainly pionic) contribute to energy
    - pion physics missing (static only)
    - radii of heavier nuclei too small <—> saturation problem
    - empirical 3N in ^{40}Ca -0.64 MeV/A only —> PRL 112, 162503 (2014)
- What to do?
  - Make chiral interactions consistent with JLab data (a little harder) —> good for finite nuclei as well
  - Continue to develop the techniques to deal with such a harder interaction
  - Revisit the formulation of the nuclear matter problem
    - Why?
      - pion-exchange in matter ≠ pion-exchange in a finite system
      - Liquid drop notion only good for very short-range physics
      - LRC normally small q —> no energy
      - Nuclear matter pions —> finite q —> increasing binding with density —> messes up saturation
      - see PRL90, 152501 (2003)