Medium-Mass Nuclei from Improved Chiral Interactions

Klaus Vobig, Sven Binder and Robert Roth

Institut für Kernphysik

Motivation

- great progress with χEFT

- developed versatile toolbox of ab initio many-body methods for medium-/heavy-mass nuclei:
    - In-Medium Similarity Renormalization Group (IM-SRG)
    - Coupled Cluster (CC)
    - Many-Body Perturbation Theory
    - Self-consistent Green's functions

- problems with previous chiral NN+3N interactions:
    - significant overestimation of binding energies   S. Binder et al., PLB 736, 119 (2014)
      beyond oxygen chain
    - underestimation of radii

NN at N^3LO: D. R. Entem et al., PRC 68, 041001 (2003)

3N at N^2LO with $\Lambda = 400$ MeV: R. Roth et al., PRL 109, 052501 (2012)

New generation of chiral interactions

- N^2LO_{sat} interaction
  A. Ekström et al., PRC 91, 051301 (2015)
  - include information from heavier systems for LEC fitting

- improved chiral interaction
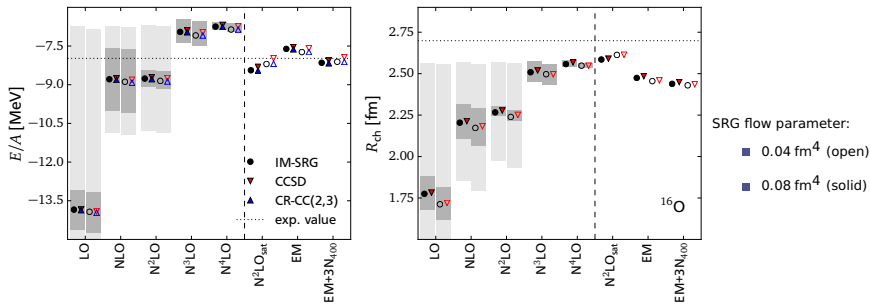 E. Epelbaum et al., Eur. Phys. J. A 51, 53 (2015)
S. Binder et al., arXiv:1505.07218 (2015)
  - up to N^4LO
  - developed within LENPIC
  - semi-local regulators (⤳ talk of Kai Hebeler)
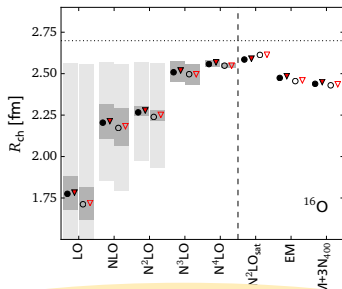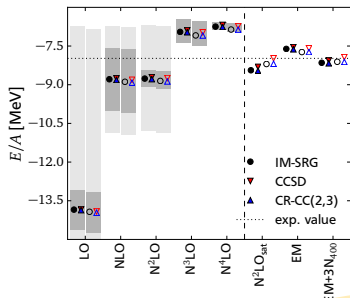
Goals

- study of order-by-order convergence

- systematically assess χEFT uncertainties

- perform study of light systems

- use most-advanced many-body methods for studying medium-mass range

- many-body methods agree well with each other

- characteristic pattern

- compared to NN of E. & M.
  - more attractive 3N forces necesssary (N^3LO, N^4LO)
  - radii improved, still underestimated

- many-body me...
- characteristic pattern
- compared to NN of E. & M.
  - more attractive 3N forces necesssary (N^3LO, N^4LO)
  - radii improved, still underestimated

What about 3N forces?
What about heavier nuclei?
How does the error estimation work?