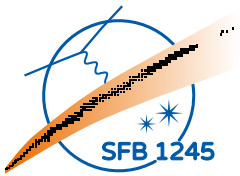
Project Report A2:

Next Generation Chiral Interactions

Thomas Hüther and Robert Roth



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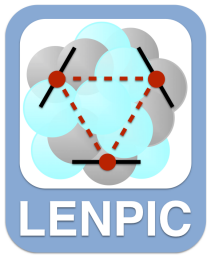


Motivation

chiral effective field theory (EFT)

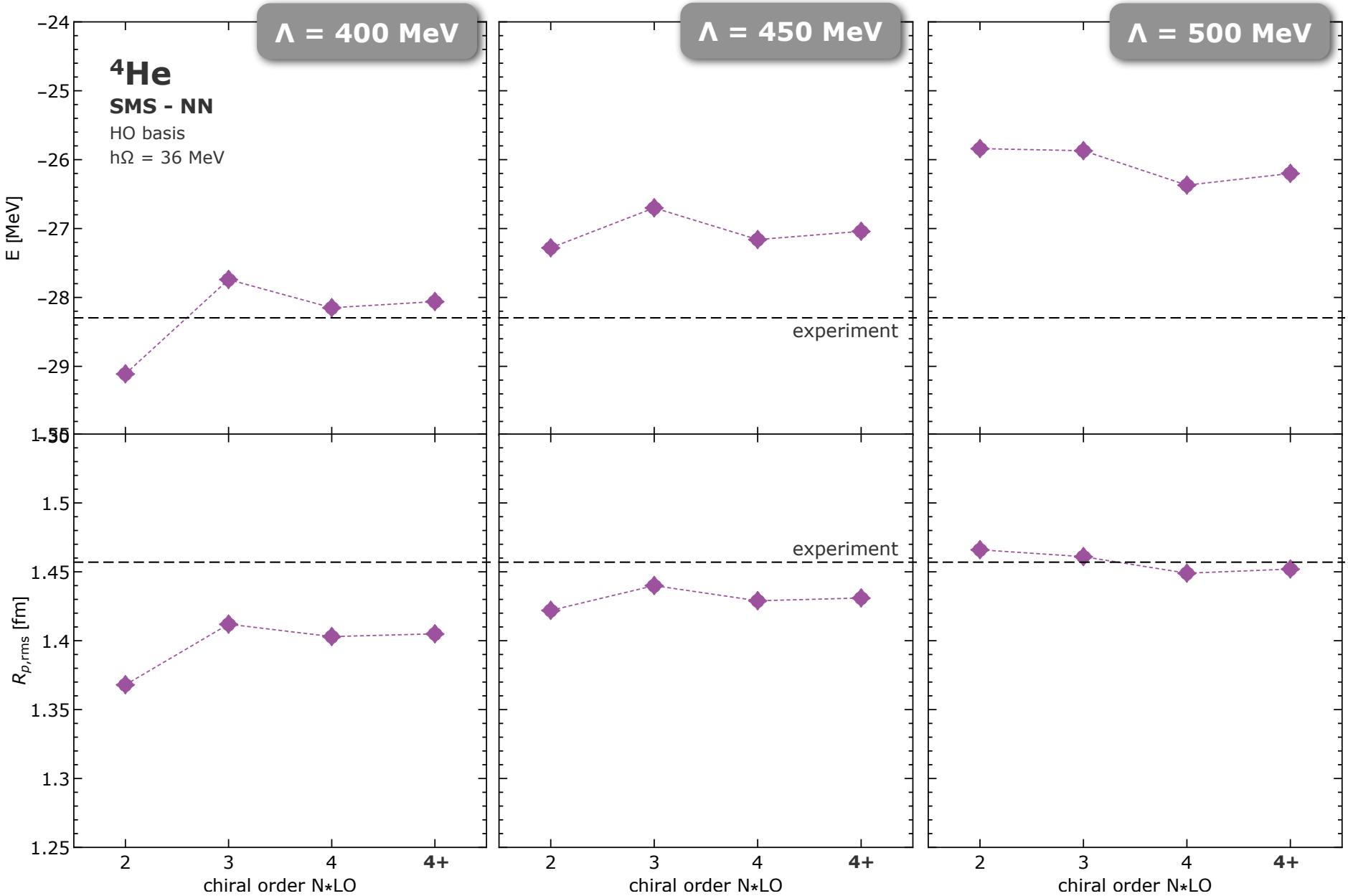
- uses pions and nucleons as degree of freedom
- satisfies underlying symmetries of QCD
- allow for a systematic uncertainty quantification via
  - order by order analysis
  - regularization schemes and scales
- multiple new interaction families from chiral EFT

Solving the Many-Body Problem

nuclear Hamiltonian form chiral effective field theory

- **SMS**: Semilocal Momentum-Space regularized interactions
  Reinert, Krebs, and Epelbaum, arXiv:1711.08821 [nucl-th] (2017)
- SCS: Semilocal Configuration-Space regularized interactions
  Epelbaum, Krebs, and Meißner, EPJ A 51, 53 (2015) and PRL 115, 122301 (2015)
- EMN: Entem, Machleidt and Nosyk interactions
  Entem, Machleidt, and Nosyk, PRC 96, 02400 (2017)
- EM: Entem and Machleidt interaction
  Entem and Machleidt, PRC 68, 041001 (2003)

Order by Order Analysis with NN Interactions



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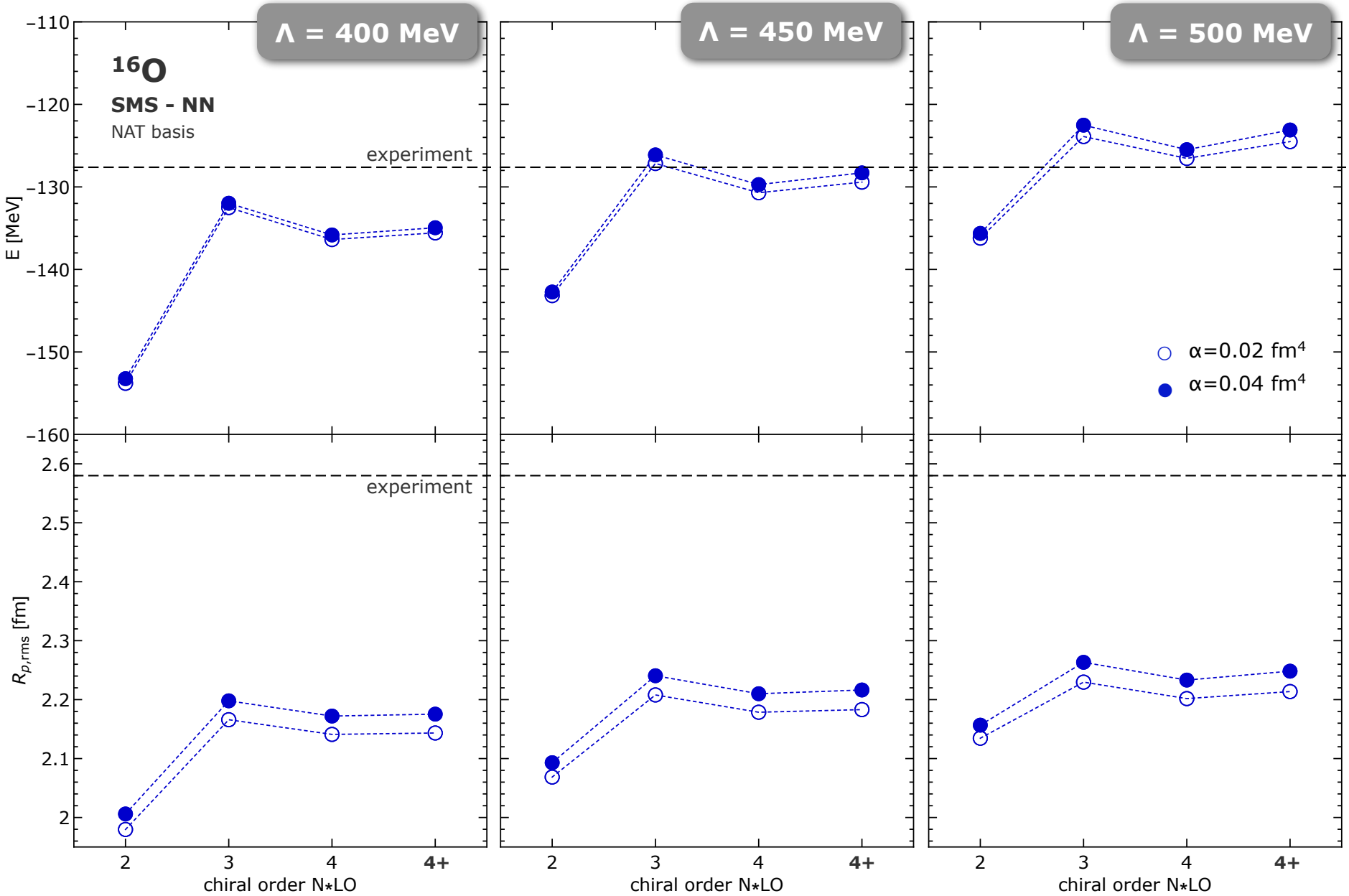


Hidden Parameters of the Interaction

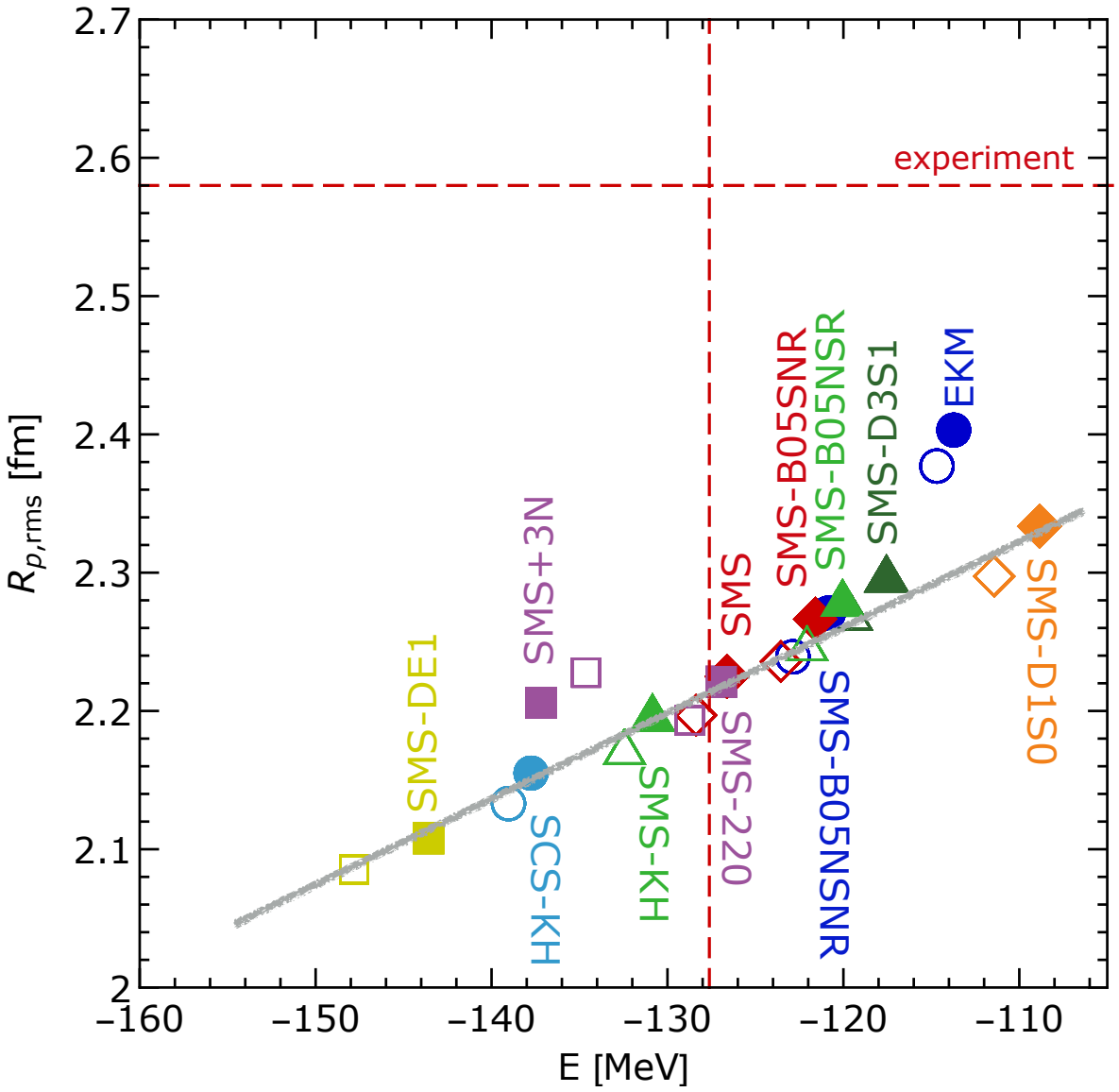
There are various options to modify NN interaction:

- fitting procedure
  - determination of πN LECs via
    - Roy-Steiner equation analysis
    - Karlsruhe-Helsinki parial-wave analysis
  - fit interaction to pp- and np-scattering data up to different $E_{\text{lab}}^{\text{max}}$

with P. Reinert and E. Epelbaum

- additional hidden parameter choices
  - different choices for off-shell parameter $D_{^1S0}^{\text{off}}$, $D_{^3S1}^{\text{off}}$ and $D_{\epsilon 1}^{\text{off}}$
  - unitary ambiguity parameters β_8 and β_9

^{16}O : Energy-Radius Correlation



^{16}O

NAT basis
radii $N_{max} = 10$
energies extrapolated
open symbols $\alpha = 0.04$ fm^4
filled symbols $\alpha = 0.08$ fm^4

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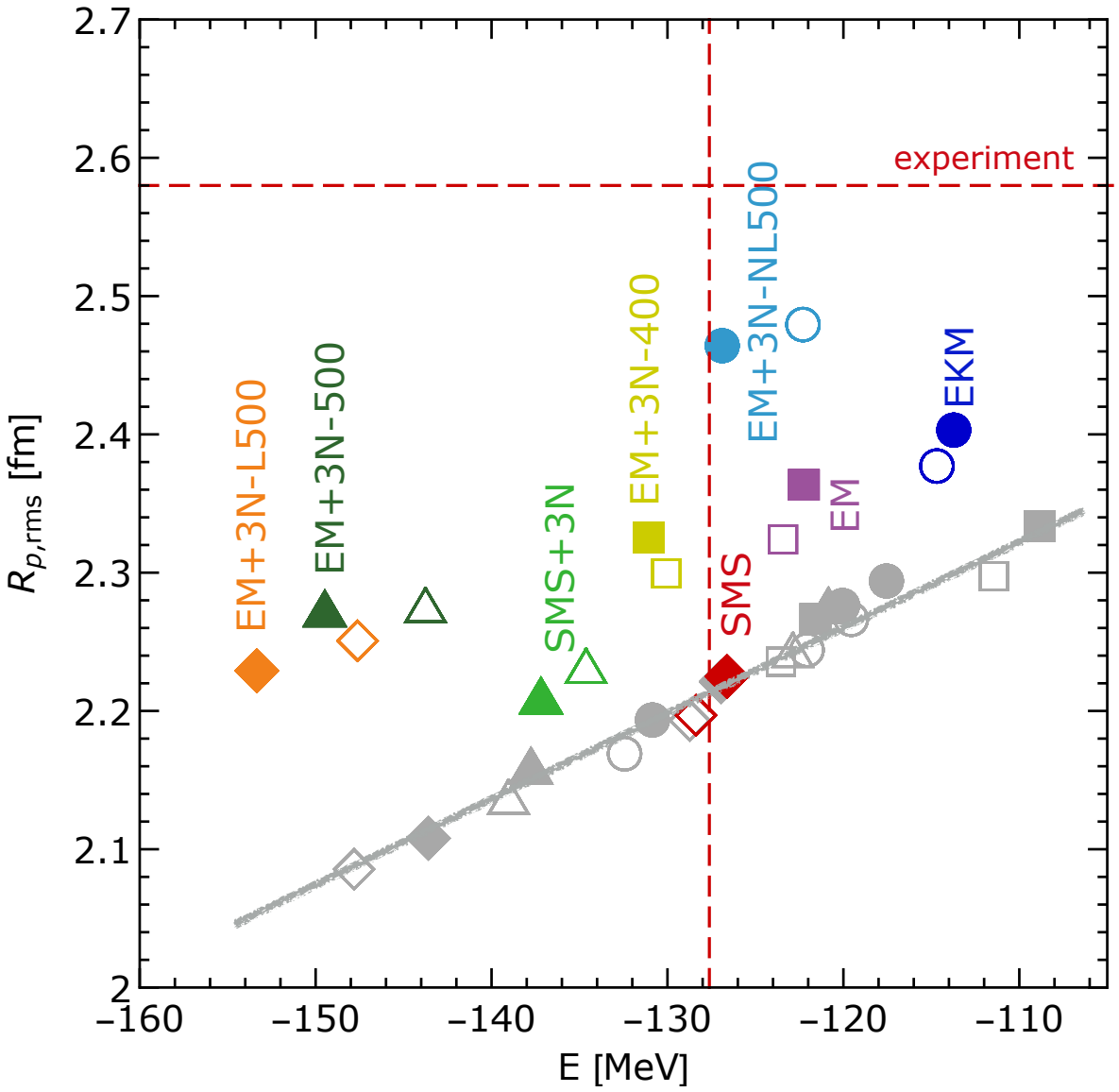

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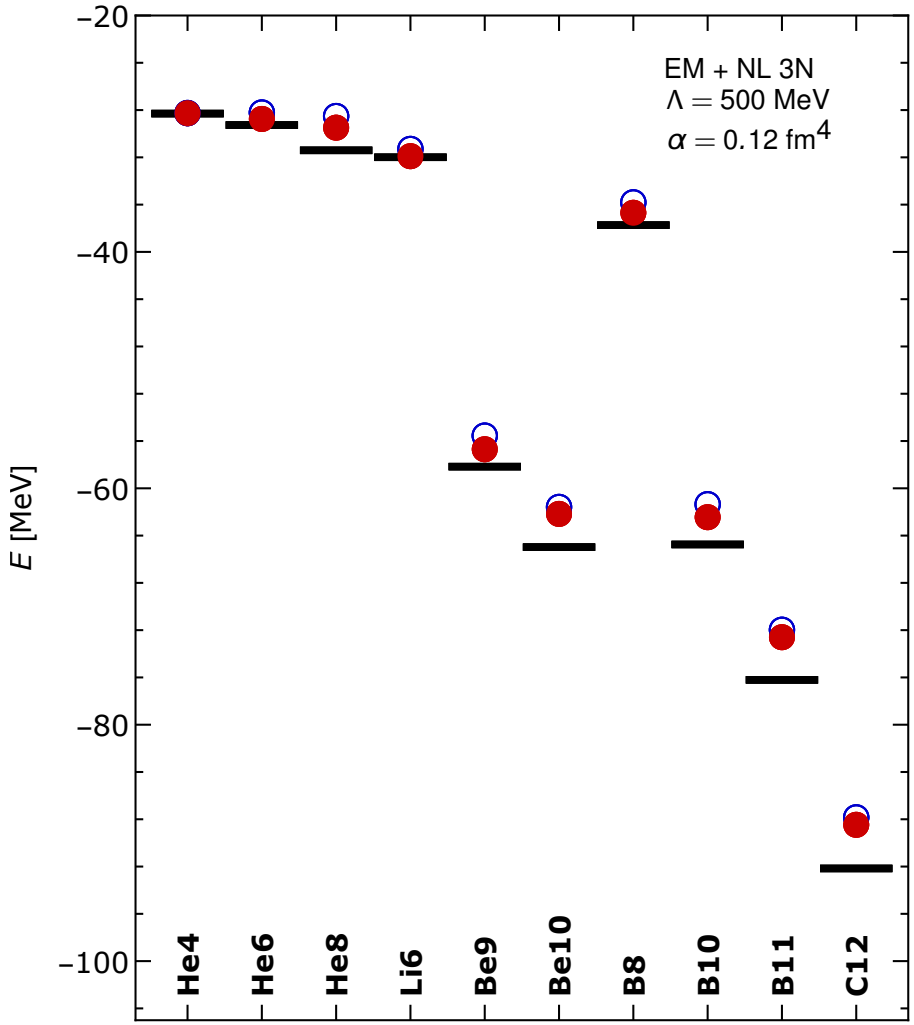
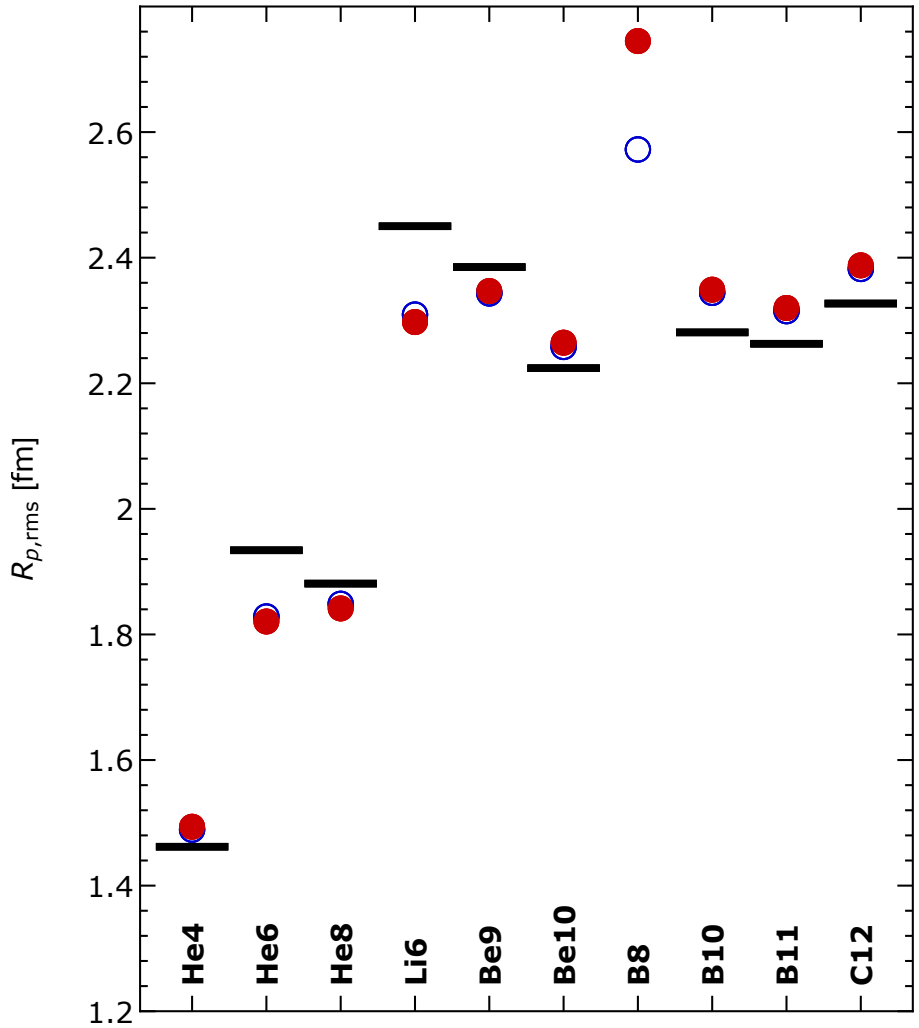
Non Local Regularized 3N Force : p-Shell Survey





experiment N_{max} =10 extrapolation

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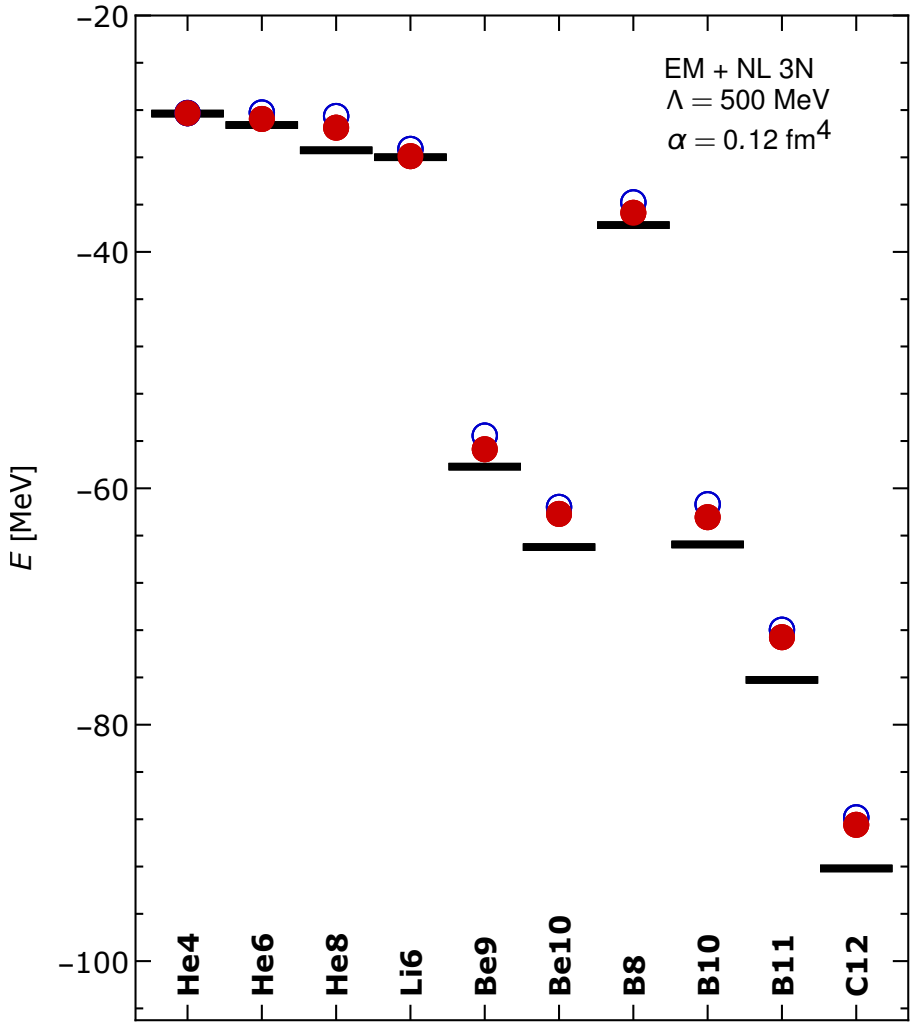

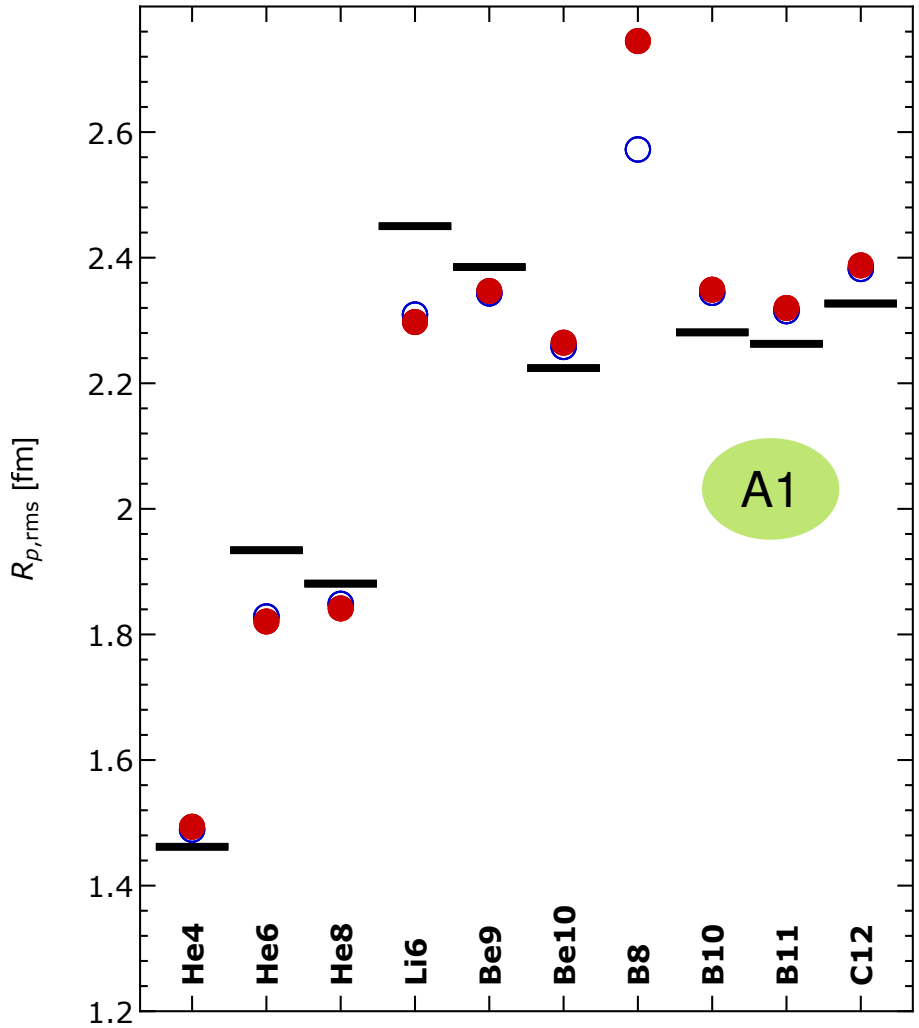

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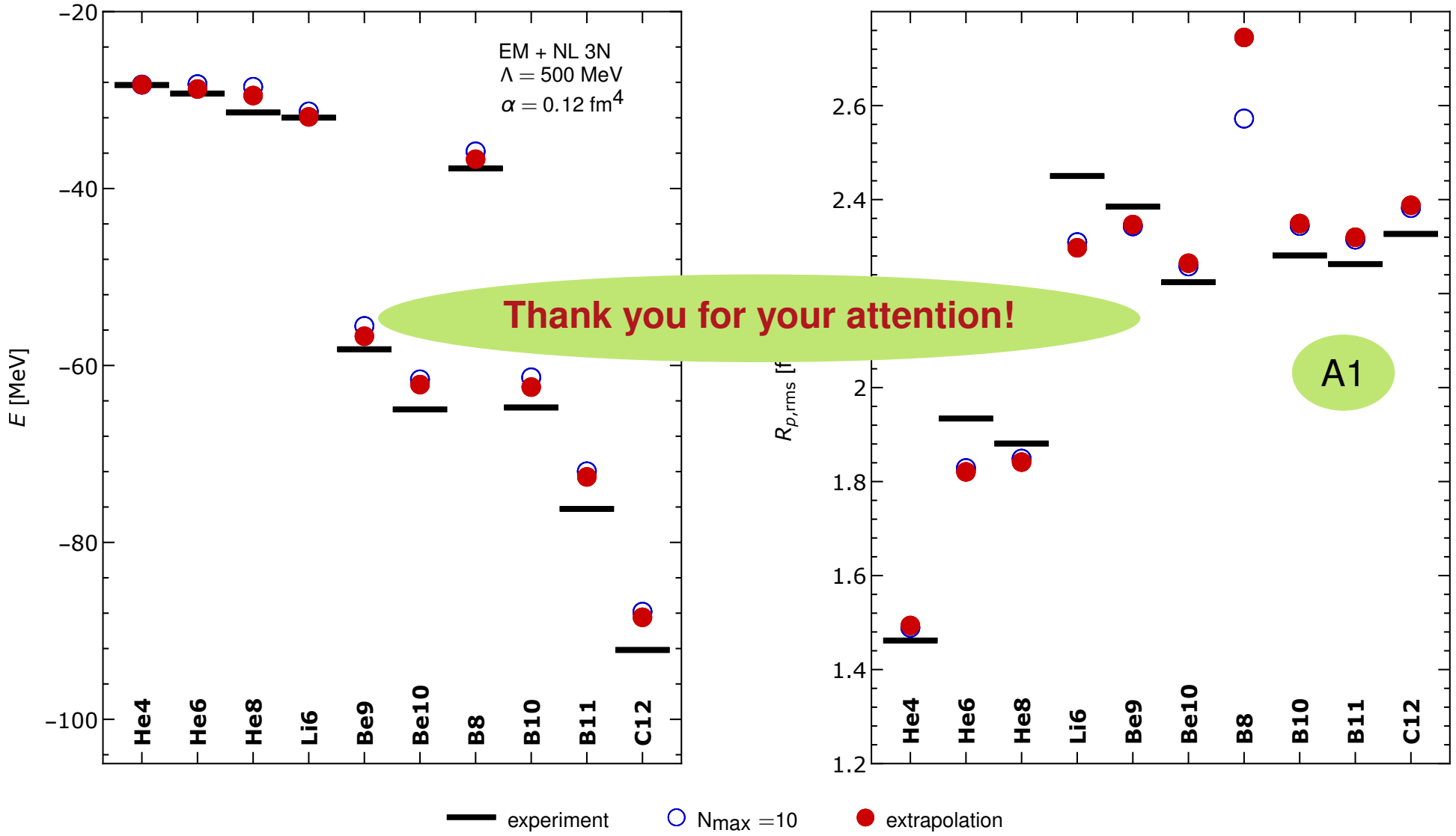

Thank you for your attention!