



Initial Four-Body Forces in Many-Body Calculations

Stefan Schulz and Robert Roth

Technische Universität Darmstadt



HGS-HIRe for FAIR
Helmholtz Graduate School for Hadron and Ion Research

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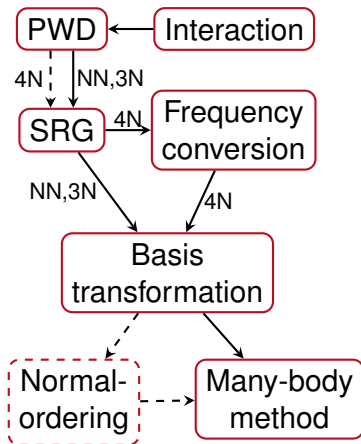
Why Four-Body Forces?

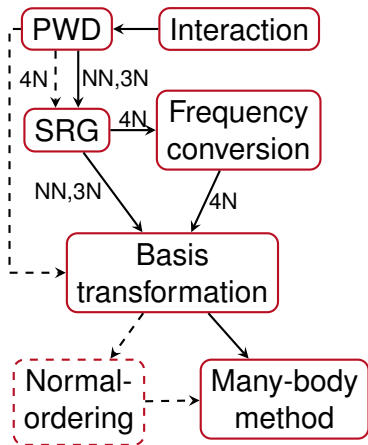


- ▶ Effect of SRG-induced 4N contributions increases with number of nucleons
 - ▶ Fine-tune interaction
 - ▶ Change SRG generator

- ▶ Effect of initial 4N contributions?
 - ▶ Similar scaling with number of nucleons?

- ▶ Goal: Consistent order-by-order calculations for chiral Interactions
 - ▶ Chiral 4N interaction necessary starting from $N^3\text{LO}$!





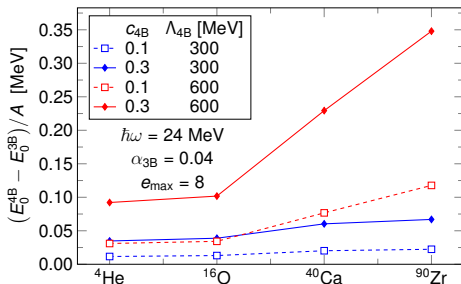
Contact interaction

- ▶ No angular integrals
- ▶ No isospin structure

Chiral $N^3\text{LO } 4N$ - class I

- ▶ PWD for three different terms
- ▶ Limit on energy quantum number

HF Results with 4N Contact Interaction

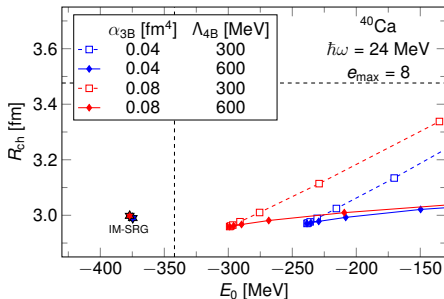
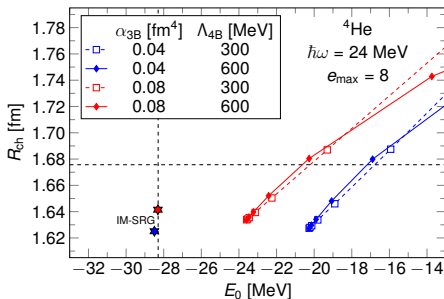


- ▶ Include 4N interactions in HF calculations explicitly
- ▶ Contact interaction becomes more important in heavier nuclei
 - ▶ Does this hold for chiral forces?

NN interaction at $N^3\text{LO}$ with $\Lambda = 500$ MeV/c D. R. Entem et al., PRC 68, 041001 (2003)

3N interaction at $N^2\text{LO}$ with $\Lambda = 400$ MeV/c R. Roth et al., PRL 109, 052501 (2012)

HF Results with 4N Contact Interaction



- ▶ Compensating overbinding does not substantially increase the radius
- ▶ HF calculations only, no correlations included!

IM-SRG results K. Vobig, priv. comm.

NN interaction at $N^3\text{LO}$ with $\Lambda = 500 \text{ MeV/c}$ D. R. Entem et al., PRC 68, 041001 (2003)

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