Accurate *Ab Initio* Calculations of Electromagnetic Observables

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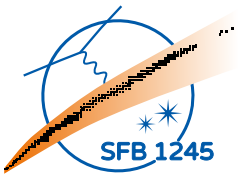

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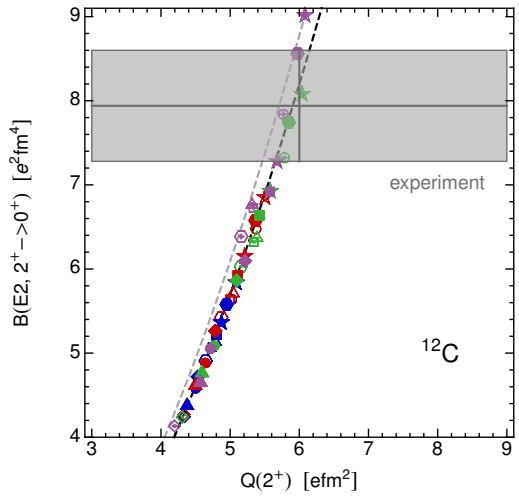
Exzellente Forschung für Hessens Zukunft

Motivation

- high precision experiments of electromagnetic observables provide good comparison between theory and experiment
- correlations between pairs of M1 and E2 observables allow prediction of hardly accessible observables
- two commonly neglected contributions to electromagnetic observables
  1. inconsistent SRG evolution
  2. two-body contributions of EM currents
- full quantification of theory uncertainties



Consistent Similarity Renormalization Group

- SRG aims to decouple low- and high-momentum states
- accelerate the convergence of many-body calculations with model-space size
- continuous unitary transformation via flow equation approach

$$\boldsymbol{H}_\alpha = \boldsymbol{U}_\alpha^\dagger \boldsymbol{H}_0 \boldsymbol{U}_\alpha \qquad \Rightarrow \qquad \frac{\mathrm{d}\boldsymbol{H}_\alpha}{\mathrm{d}\alpha} = [\boldsymbol{\eta}_\alpha, \boldsymbol{H}_\alpha]$$

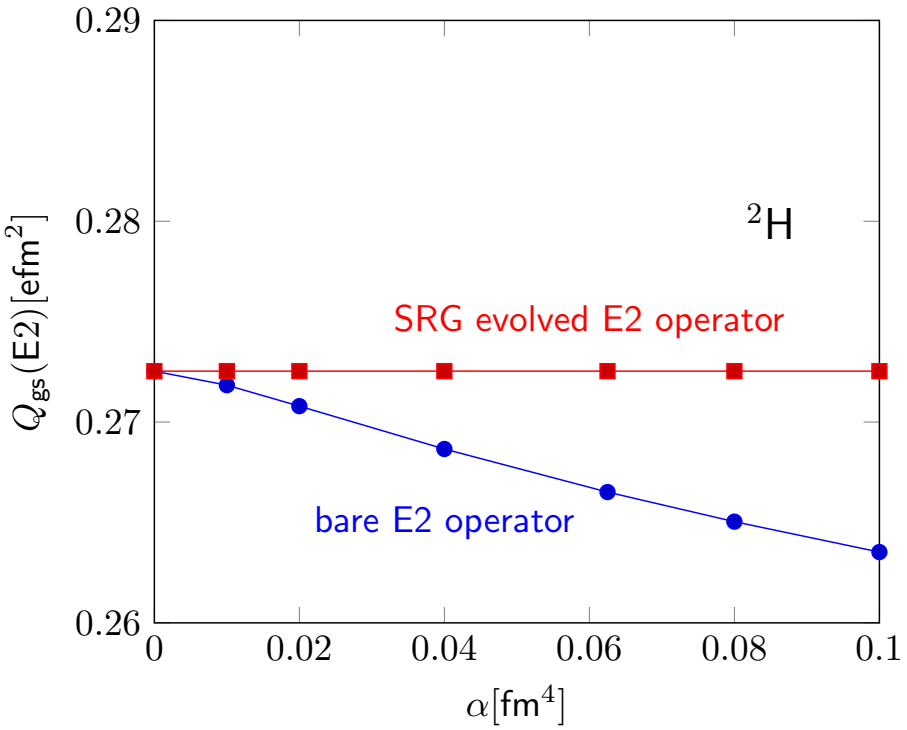
- need same transformation for arbitrary operators $\boldsymbol{O}$

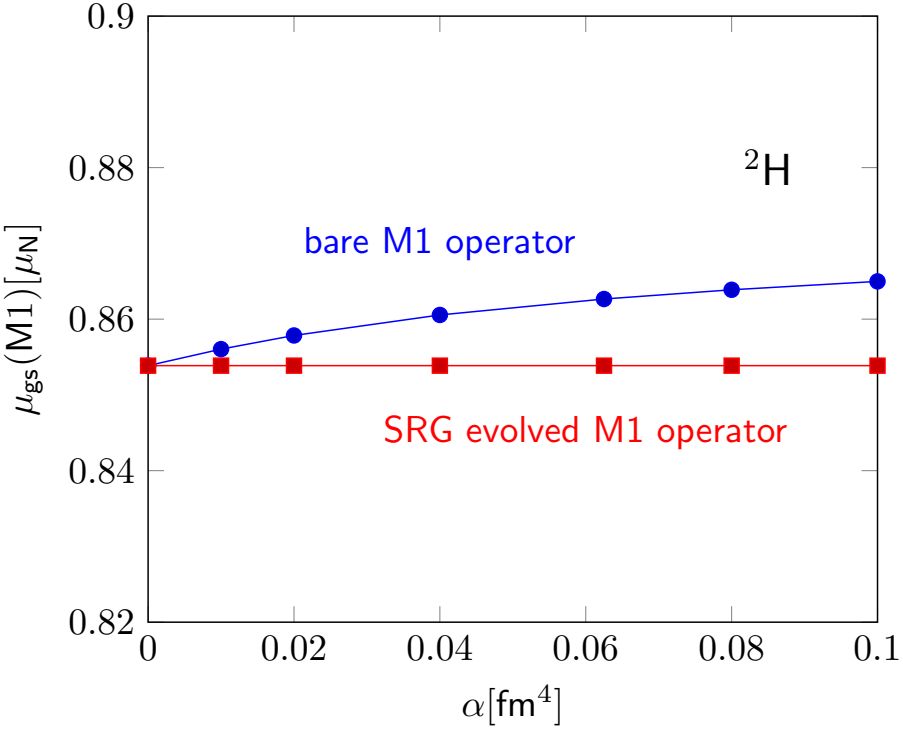
$$\boldsymbol{O}_\alpha = \boldsymbol{U}_\alpha^\dagger \boldsymbol{O}_0 \boldsymbol{U}_\alpha$$

- solve differential equation for $\boldsymbol{U}_\alpha$

$$\frac{\mathrm{d}\boldsymbol{U}_\alpha}{\mathrm{d}\alpha} = -\boldsymbol{U}_\alpha \boldsymbol{\eta}_\alpha$$

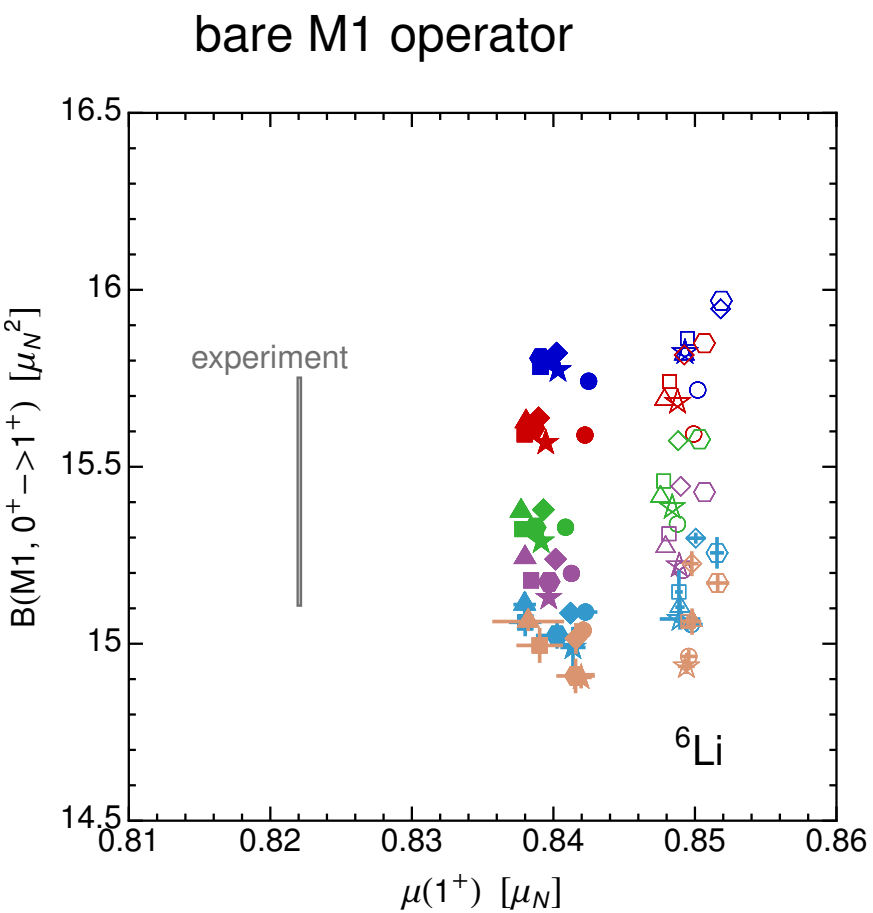
Electric Quadrupole and Magnetic Dipole Moment of ^{2}H

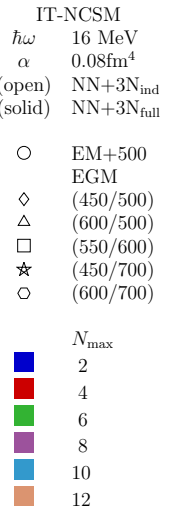




- expectation value of bare operator is α dependent
- SRG changes electromagnetic observables by a few percent

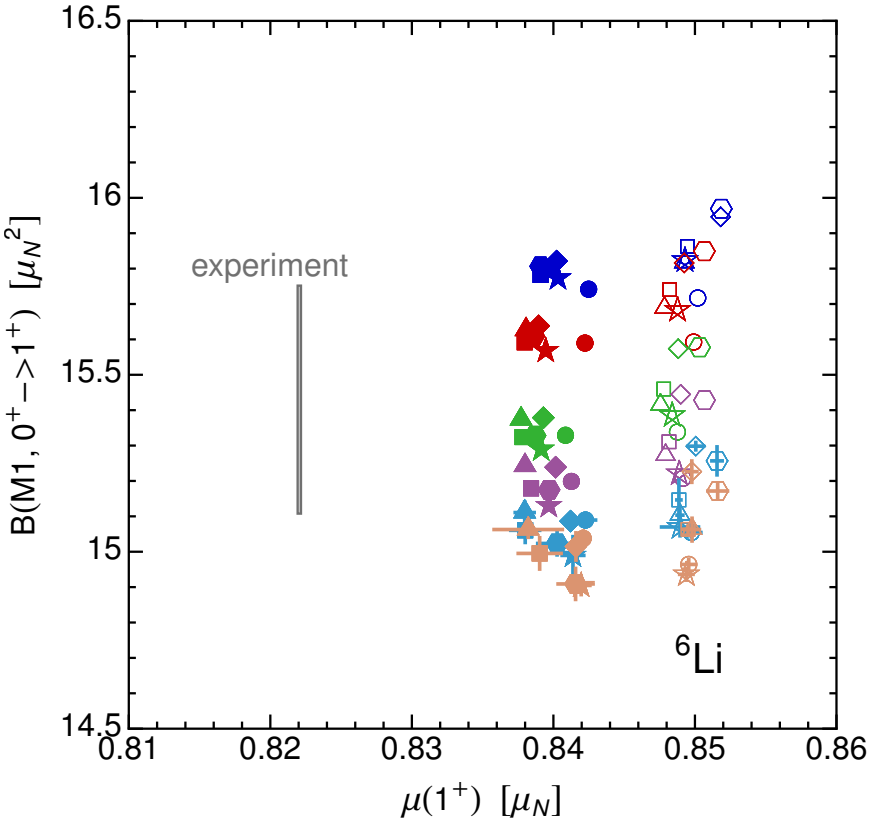
Correlations of Magnetic Observables in ^{6}Li



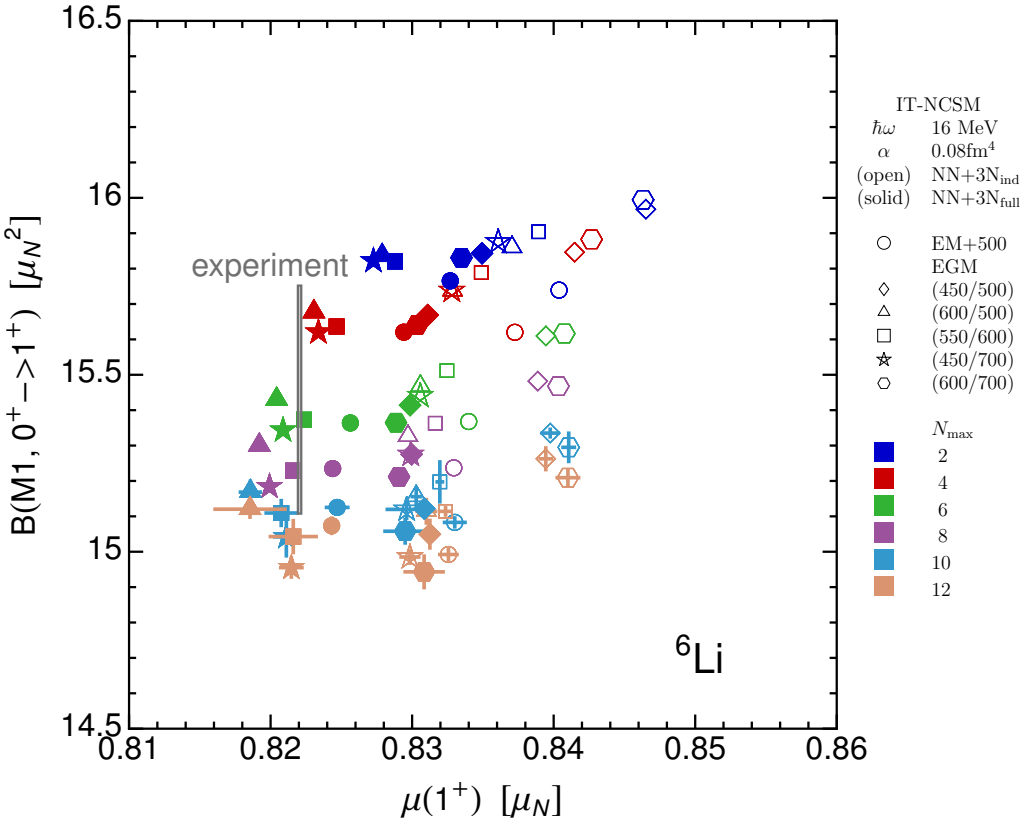


Correlations of Magnetic Observables in ^{6}Li

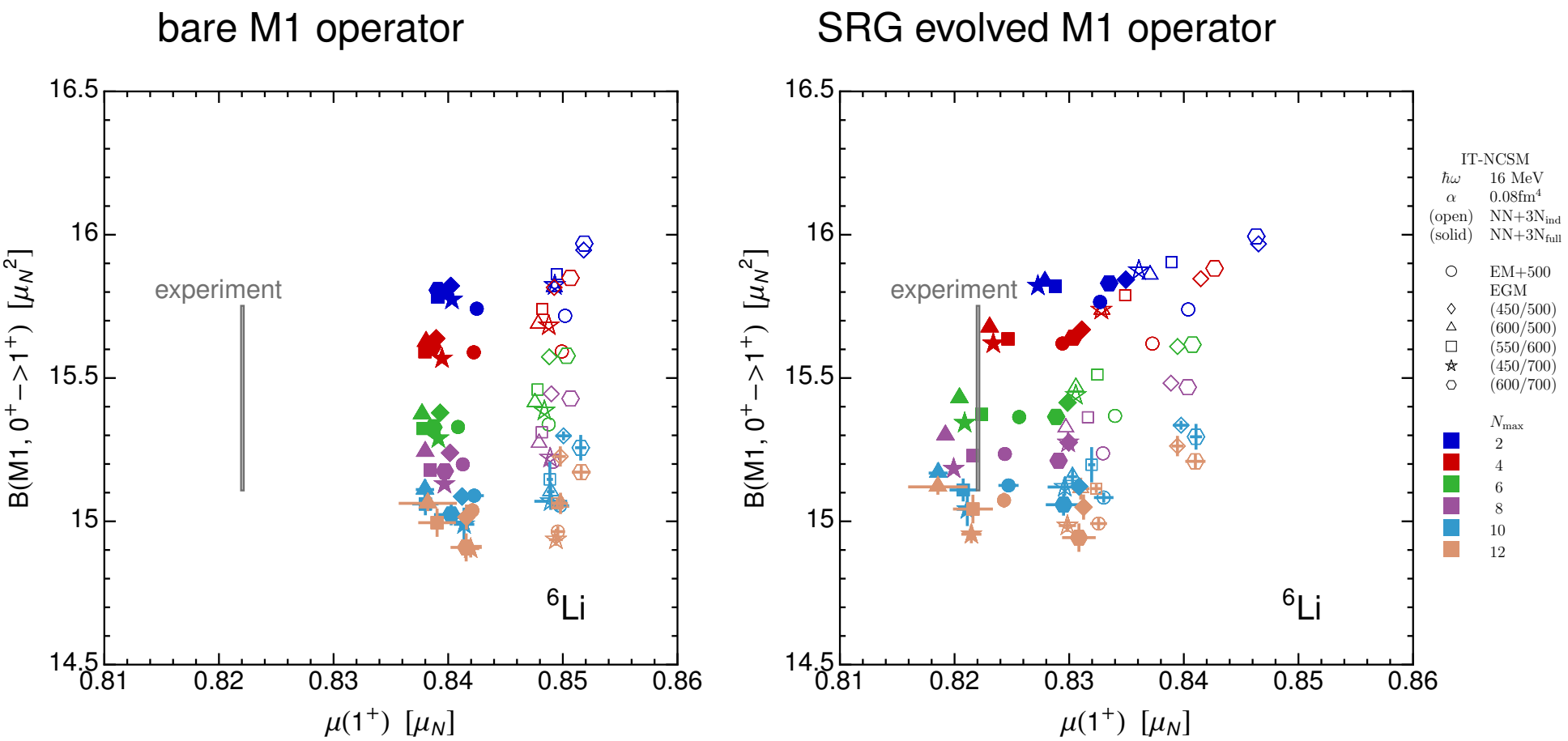
bare M1 operator



SRG evolved M1 operator



Correlations of Magnetic Observables in ^{6}Li



- consistent evolved dipole moment closer to experiment
- additional contributions from two-body currents for transition strength

Pastore *et al.* Phys. Rev. C 87,035503(2013)

Outlook

- inclusion of EM two-body currents
  - partial wave decomposition
  - inclusion in SRG framework
- induced SRG 3-body contributions
- full quantification of theory uncertainties, for example, consistent inputs of chiral interactions developed within the LENPIC collaboration

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Thank you