

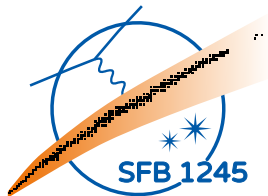
Exploring alternative SRG generators in one dimension



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DPG Spring Meeting 2019, Munich

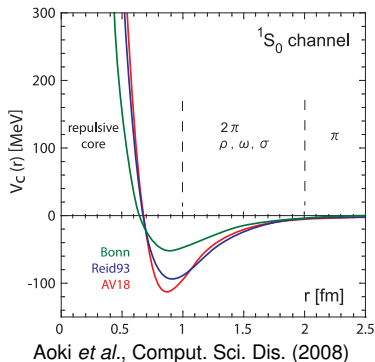


Potentials in Nuclear Physics



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- ▶ Finite-range attractive force
- ▶ Short-range repulsion
- ▶ Repulsion couples low and high momenta
- ▶ Leads to poor many-body convergence



The Similarity Renormalization Group (SRG)

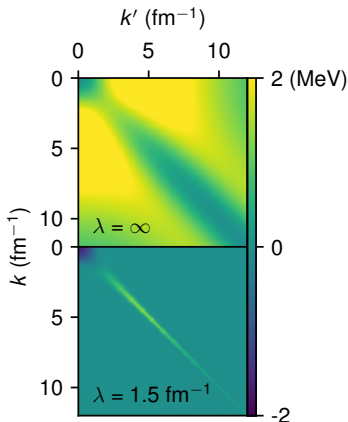


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- ▶ Class of continuous unitary transformations given by:

$$\frac{dH_s}{ds} = [[G, H_s], H_s]$$

- ▶ $s = 1/\lambda^4$
- ▶ H_s goes to form of G
- ▶ Typical choice: $G = T_{rel}$ (right)



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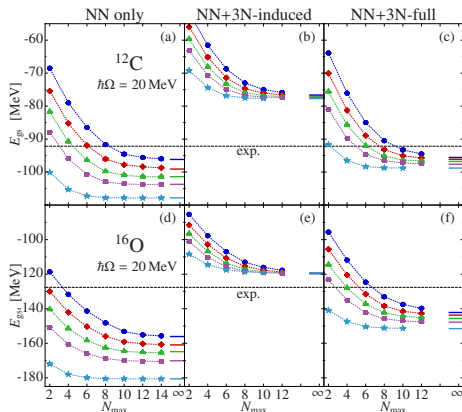
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Features/Challenges:

- ▶ Improves many-body convergence
- ▶ Induces many-body forces



Roth *et al.*, Phys.Rev.Lett. 107 (2011) 072501

The Case for Alternative Generators



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For $G = T_{rel}$:

$$\frac{dV_s(k, k')}{ds} = -V_s(k, k')(k^2 - k'^2)^2 + \dots$$

- ▶ Exponential suppression for far off diagonal matrix elements

The Case for Alternative Generators



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For $G_s = T_{rel} + X_s$ with $X_s(k, k') = W(k, k')V_s(k, k')$:

$$\frac{dV_s(k, k')}{ds} = -(V_s(k, k') - X_s(k, k'))(k^2 - k'^2)^2 + \dots$$

- ▶ Change in matrix elements small when $X_s(k, k') = V_s(k, k')$
- ▶ Choose $W(k, k')$ to reflect what we want SRG to do

The Negele Model

Alexandrou *et al.*, Phys.Rev. C39 (1989)
Jurgenson, Furnstahl, Nucl.Phys. A818 (2009)



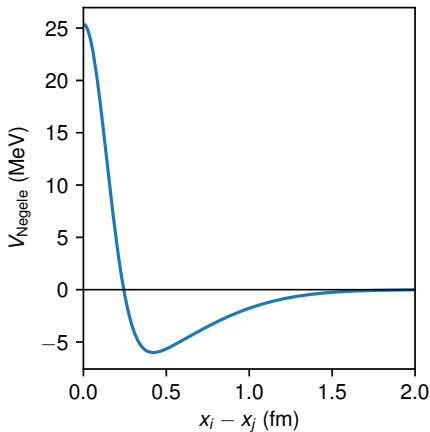
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Features:

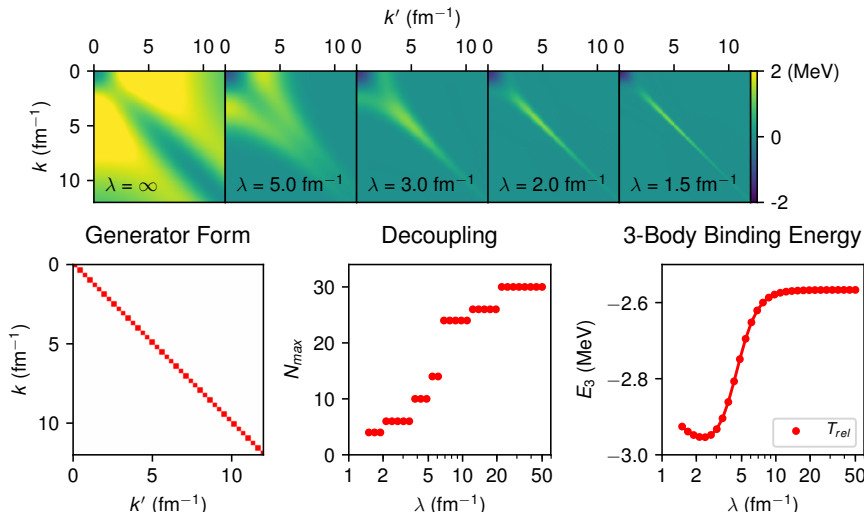
- ▶ 1-D
- ▶ Bosons
- ▶ Negele potential
- ▶ Jacobi harmonic oscillator for many-body results

Advantages:

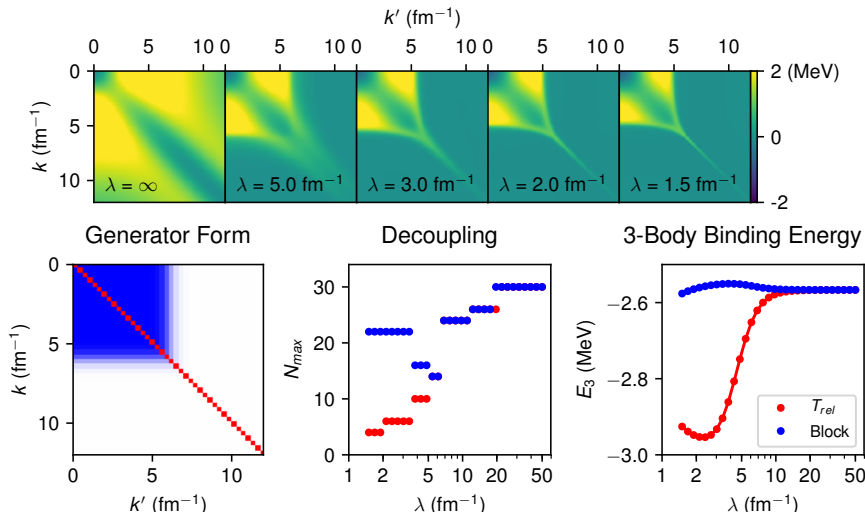
- ▶ Model is simple
- ▶ Results generalize well to 3-D calculations



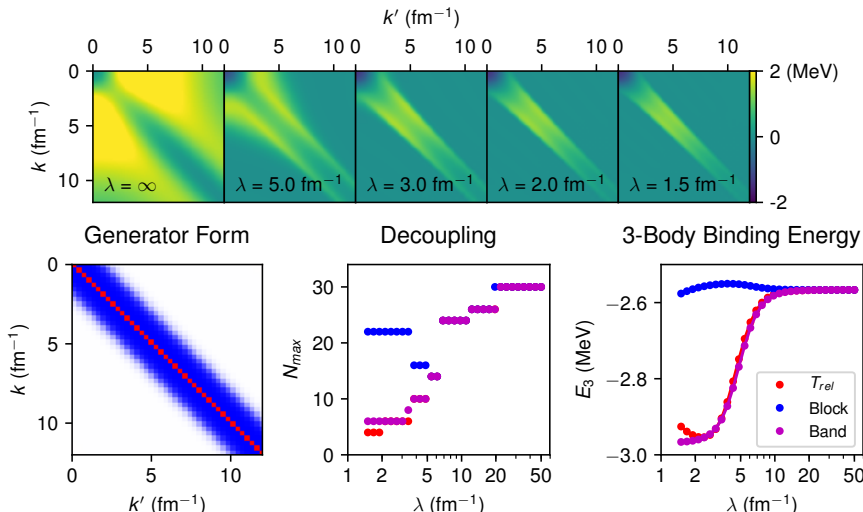
Generator: T_{rel}



Generator: Block Diagonal



Generator: Band Diagonal





Status:

- ▶ Have framework to test alternative generators
- ▶ Considering generators of form $T + WV_s$
provides an interesting way to explore alternative generators

Direction:

- ▶ Extend analysis to 4- and 5-body systems
- ▶ Learn what features of generators lead to what behavior
- ▶ Identify features that lead to small four and higher-body forces



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Thank you!