

# Exploring alternative SRG generators in one dimension

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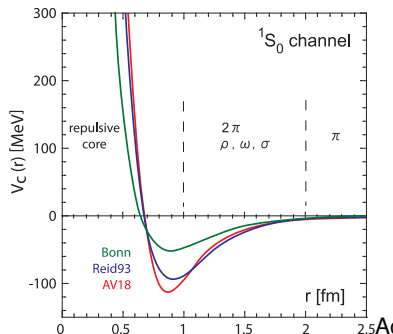


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# Potentials in Nuclear Physics

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



# The Similarity Renormalization Group (SRG)



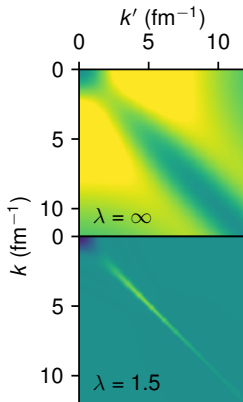
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SRG:

- ▶ 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  $G$



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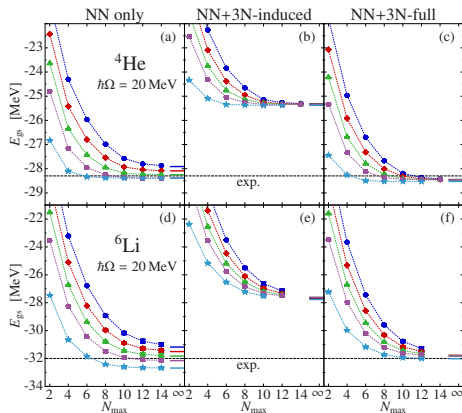
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## Features:

- ▶ Improved many-body convergence
- ▶ Induction of many-body forces



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

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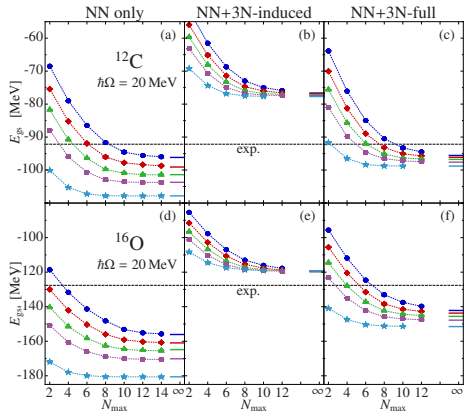
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For  $G = T_{rel}$ :

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

- ▶ Exponential suppression for far off diagonal matrix elements

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

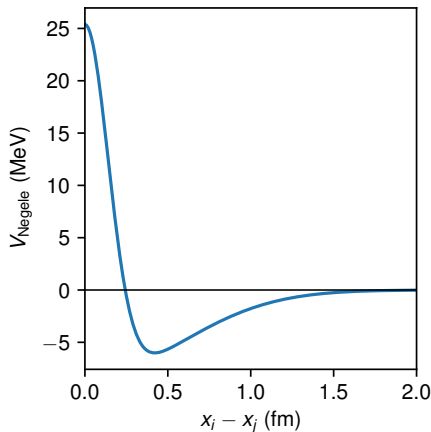
# The “Jurgenson” Model

## Features:

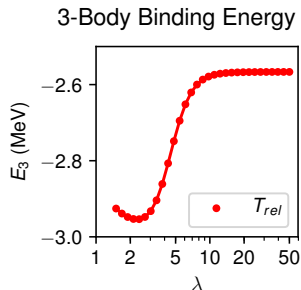
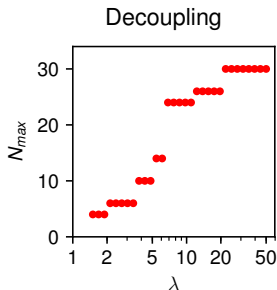
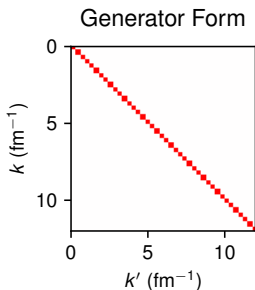
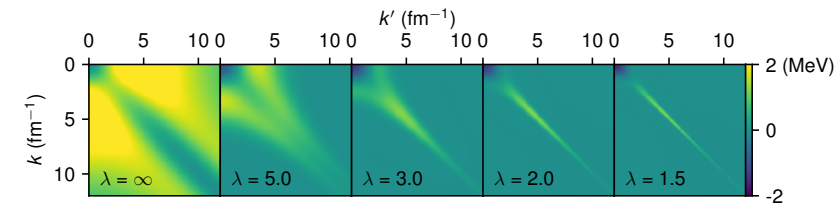
- ▶ 1-D
- ▶ Bosons
- ▶ Negele potential
- ▶ Jacobi harmonic oscillator for many-body results

## Advantages:

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

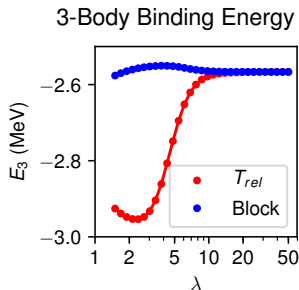
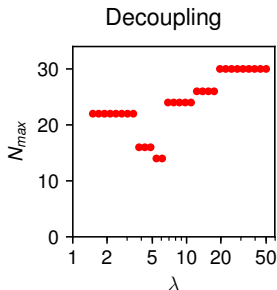
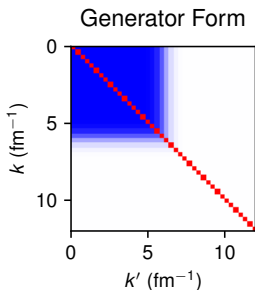
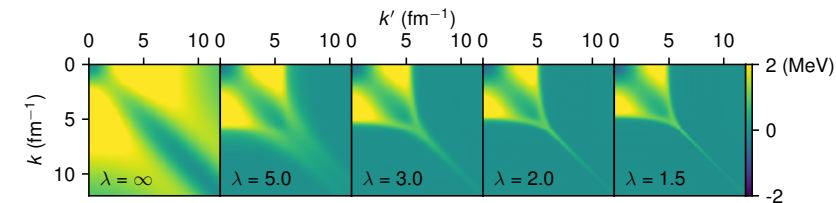


# Generator: $T_{rel}$

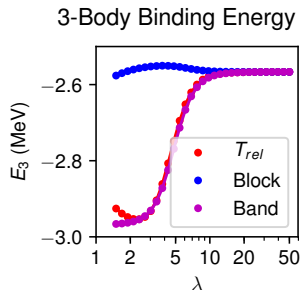
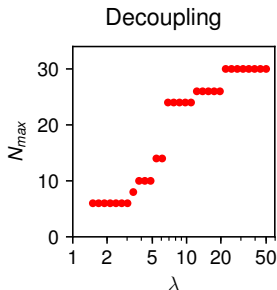
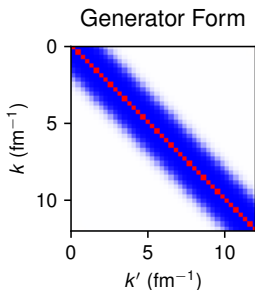
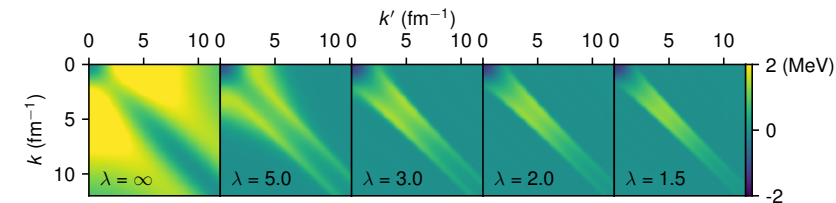




# Generator: Block Diagonal



# Generator: Band Diagonal





## Status:

- ▶ Have framework to test alternative generators
- ▶ Considering generators of form  $T + WV$   
makes implementation of new generators easy

## Direction:

- ▶ Incorporate 4- and 5-body binding energies
- ▶ Learn what features of generators lead to what behavior
- ▶ Identify features that lead to optimal results