

# Using the Magnus expansion to SRG-evolve operators

## Objectives

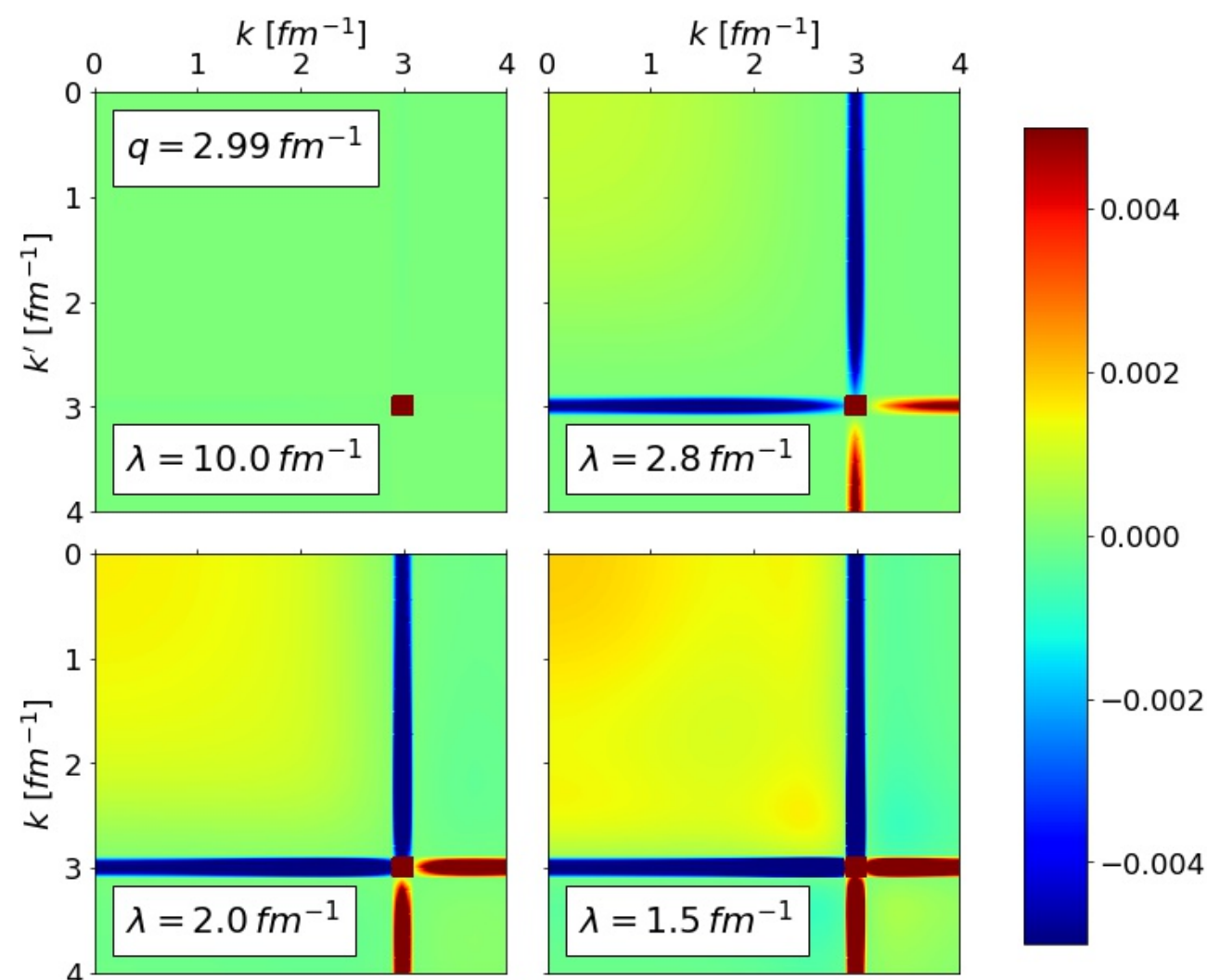
- Compare similarity renormalization group (SRG) operator evolution using Magnus expansion to standard approach.
- The Magnus expansion drastically reduces the memory needed to evolve operators besides the Hamiltonian, which is otherwise prohibitive for medium-mass nuclei.
- Test numerical precision and stability.
- Investigate operator evolution with new chiral potentials.

## Impact

- The SRG transformation shifts the strength of operators to low-energy in the form of smeared contact operators.
- Calculations of deuteron observables with evolved wave functions and operators show very small error relative to the unevolved value due to exact unitarity in Magnus transformations.
- Enables re-examination of SRG calculations with new chiral potentials and consistently evolved wave functions and operators. Applications to observables such as radii, electromagnetic moments and transitions, etc.
- Validated the Magnus expansion as an avenue for in-medium (IM)-SRG evolution of A-body operators.

## Accomplishments

- A. J. Tropiano, work in progress.



**Figure:** SRG evolution of the momentum distribution operator  $\langle k | a_q^\dagger a_q | k' \rangle$  for  $q \doteq 3 \text{ fm}^{-1}$  in the  $^3S_1$  partial wave evolved from  $\lambda = 10$  to  $1.2 \text{ fm}^{-1}$ , with a chiral NN potential<sup>1</sup>. We SRG-evolve the potential using the Magnus expansion and apply the unitary transformation to the operator directly. <sup>1</sup>Potential from P. Reinert *et al.* (2018).