Importance-Truncated Shell Model

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Importance Truncation

Motivation

- valence-space shell model is a successful method for the description of a large variety of spectroscopic observables
- IT-SM: simple and straightforward extension of the shell model to larger valence spaces and a wider range of nuclei

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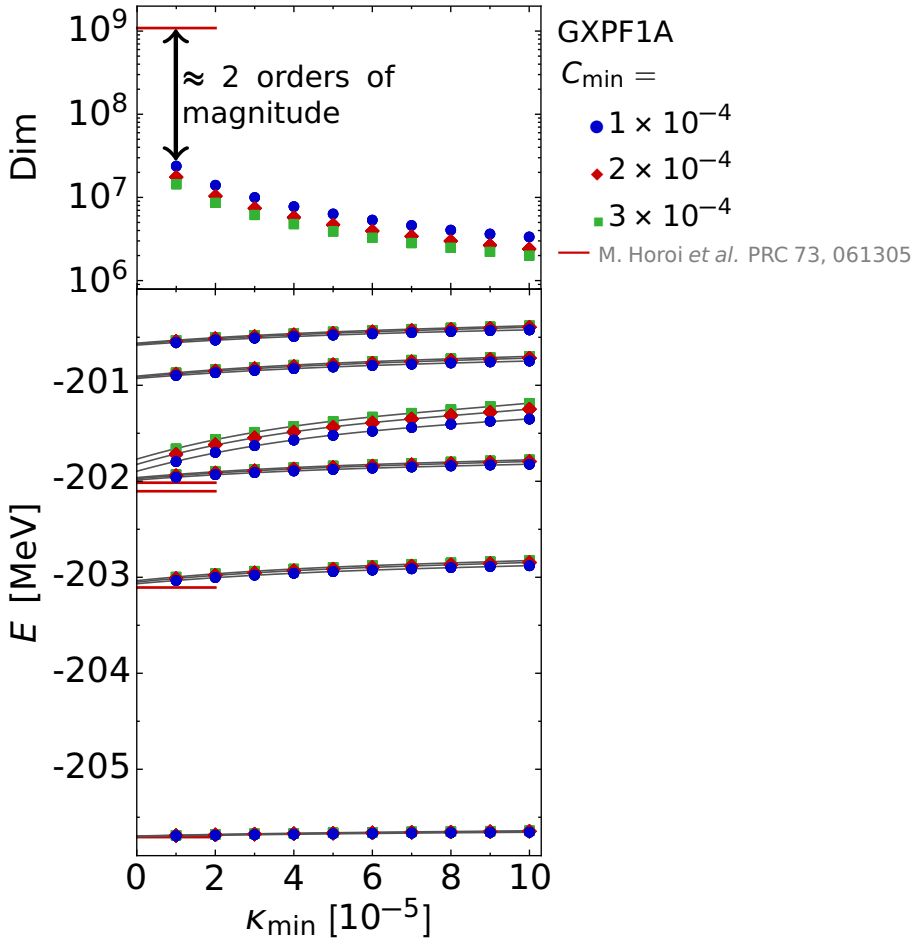
Importance Truncation – Idea

- introduce adaptive truncation criterion: importance threshold κ_{min}
- solve eigenvalue problem in IT model space and obtain approximation for target state
- vary κ_{min} and extrapolate to account for effects of basis states excluded from IT model space
  - threshold extrapolation
  - energy-variance (ΔE^2) extrapolation

Benchmark of the IT-SM: ^{56}Ni in pf shell



- significantly reduced valence-space dimension
- very weak $C_{\min}$ and $\kappa_{\min}$ dependence of the energies

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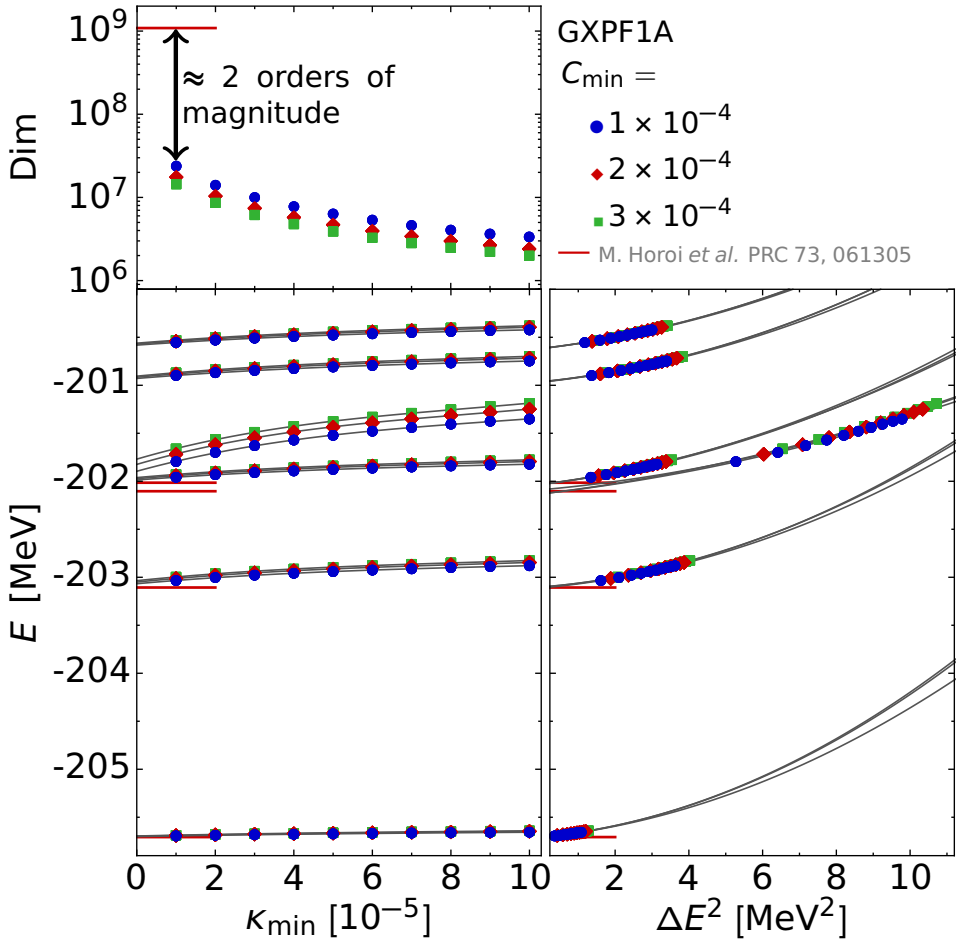

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- ΔE^2 extrapolation reproduces state ordering and energy of near-degenerate state

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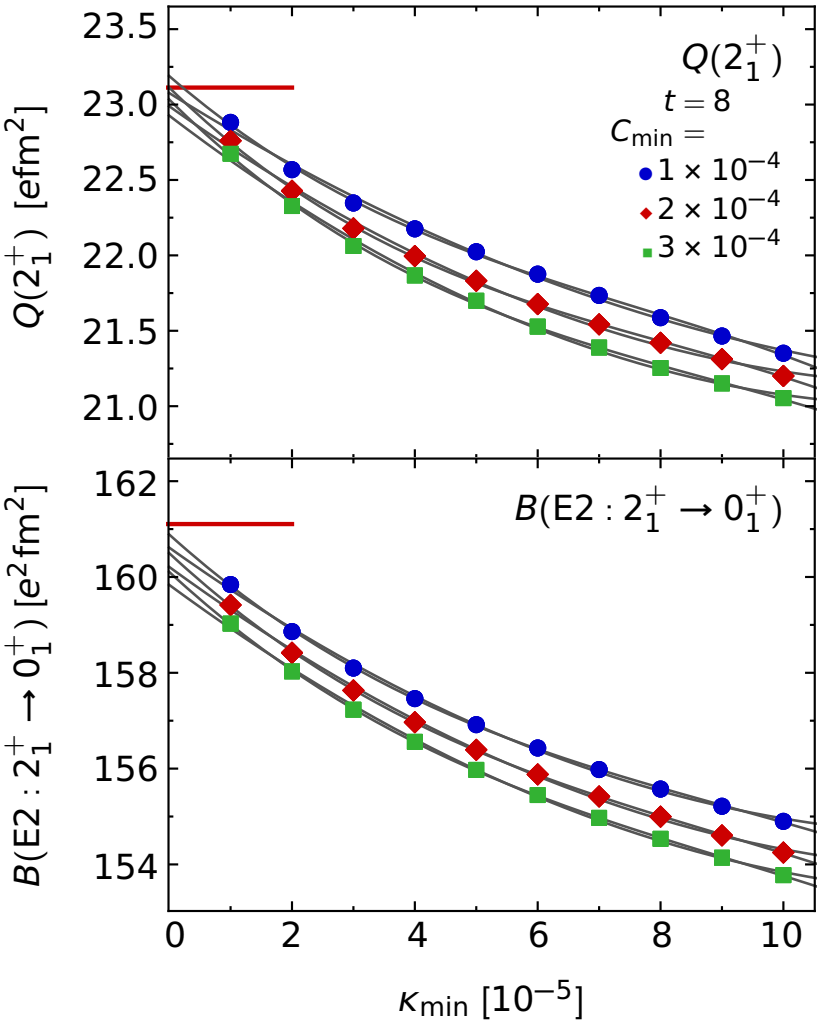

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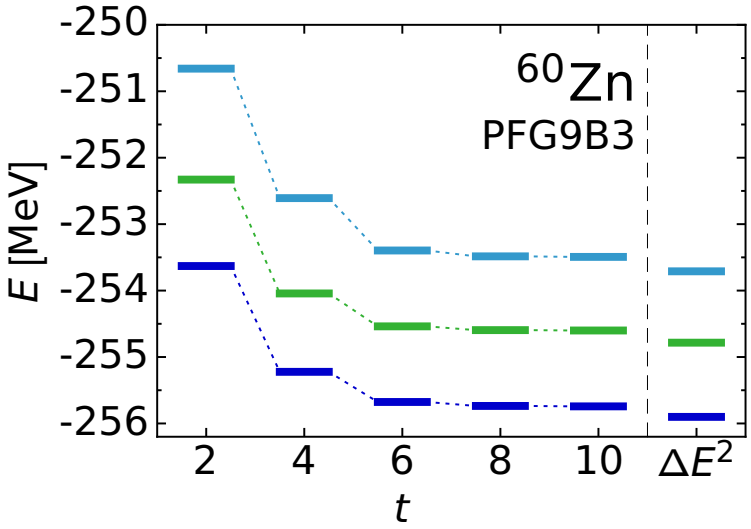
- observables can be described equally well

Highlights: pfg$_{9/2}$-shell nuclei ^{60}Zn and ^{64}Ge

- ^{60}Zn and ^{64}Ge in pfg$_{9/2}$ shell are beyond present SM calculations:

  $\mathrm{Dim}(^{60}\mathrm{Zn}) = 2.2 \times 10^{13}$



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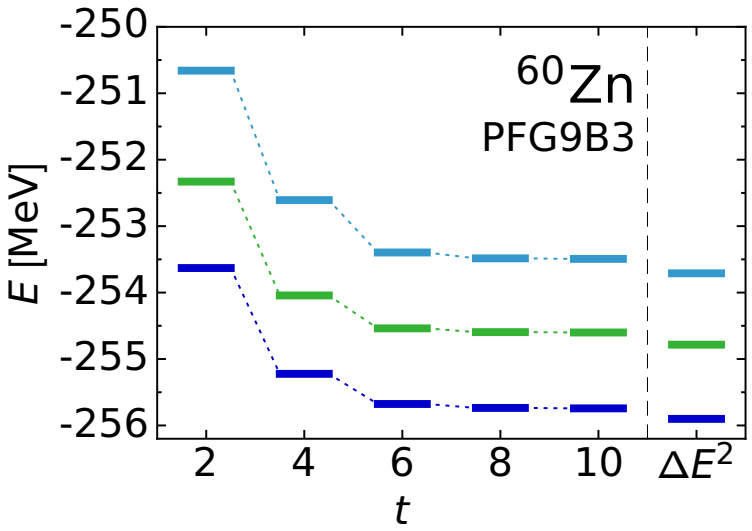

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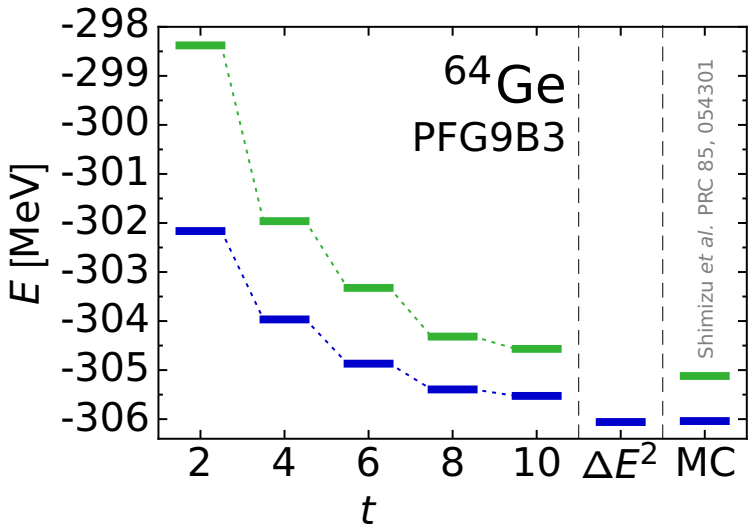
$\mathrm{Dim}(^{64}\mathrm{Ge}) = 1.7 \times 10^{14}$



- highly deformed nucleus ⇒ slow convergence
- ΔE^2 extrapolation reproduces ground-state energy precisely