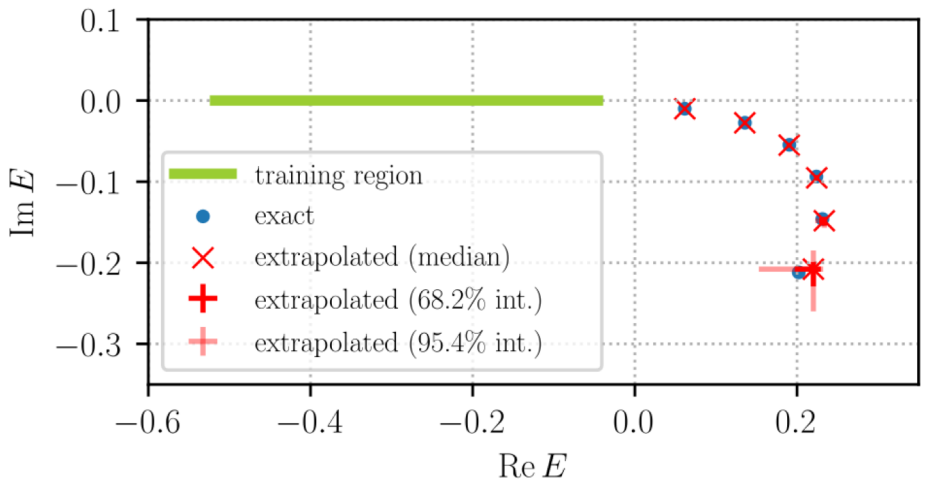
Eigenvector continuation for emulating and extrapolating two-body resonances

U.S. DEPARTMENT OF ENERGY | Office of Science

Theory Alliance
FACILITY FOR RARE ISOTOPE BEAMS

Objectives

- We generalized the newly introduced eigenvector continuation (EC) method for the emulation and extrapolation of resonances using the uniform complex-scaling method.
- We demonstrated that the conjugate-augmented EC (CA-EC) method developed in this work can successfully extrapolate both the energy position and width of resonances using bound state information only.



Location of the training region containing bound states (green) and resonances to reproduce (blue) in the complex-energy plane. The CA-EC results (red) accurately reproduce exact results using only five training points.

Impact

- The Facility for Rare Isotope Beams (FRIB) offers unprecedented opportunities to explore the limits of nuclear stability and is expected to produce thousands of new exotic isotopes in the coming years.
- As open quantum systems, exotic nuclei often exhibit resonance states which are difficult to describe theoretically due to the coupling to the continuum of scattering states.
- Being able to use bound state information, which is generally easier to obtain using established methods, to extract resonance properties, would provide a significant advantage both computationally and theoretically.
- The EC method presents a unique opportunity to perform such extrapolation in a mathematically well-defined and controlled way, but so far it had not been formulated in a non-variational environment.
- The results obtained in this work have demonstrated that bound-to-resonance EC extrapolations are possible at the two-body level and at a modest computational cost.

Accomplishments

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