



CORRELATED MASS MODEL FOR CALCIUM ISOTOPES FROM AB INITIO CALCULATIONS

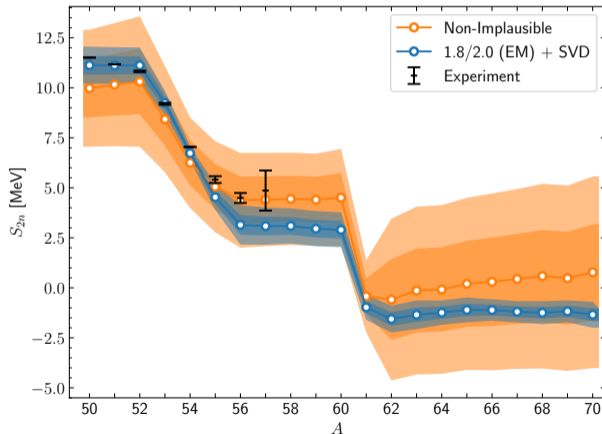
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Introduction & Motivation

- Nuclear structure from separation energies
- $S_{2n} = BE(Z, A) - BE(Z, A - 2)$
- Shell structure and shell closures
- Distributions for interactions
 - Non-implausible (NI)
 - [Hu et al. NP \(2022\)](#)
 - 1.8/2.0 (EM) + SVD
 - [Hebeler et al. PRC \(2011\)](#),
 - [Plies et al. arXiv:2509.24671 \(2025\)](#)
- We develop a model to include:
 - Additional uncertainties
 - Experimental data





Setup

- Interactions from chiral EFT order-by-order with **unknown low energy constants** c_i

$$H = H_0 + \sum_i c_i H_i + \dots$$

⇒ **Hamiltonian uncertainty**

- Solve the many-body problem approximately for using **IMSRG(2)**

$$E \approx E_{\text{IMSRG}(2)} = \langle \psi | H | \psi \rangle = \langle \phi | e^{\Omega} H e^{-\Omega} | \phi \rangle$$

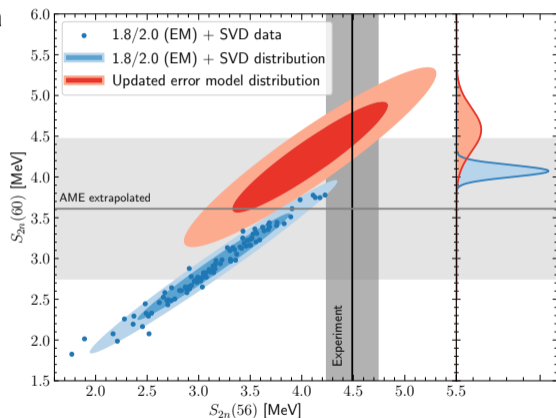
⇒ **Many-body uncertainty**

He et al. PRC (2024)



Error model

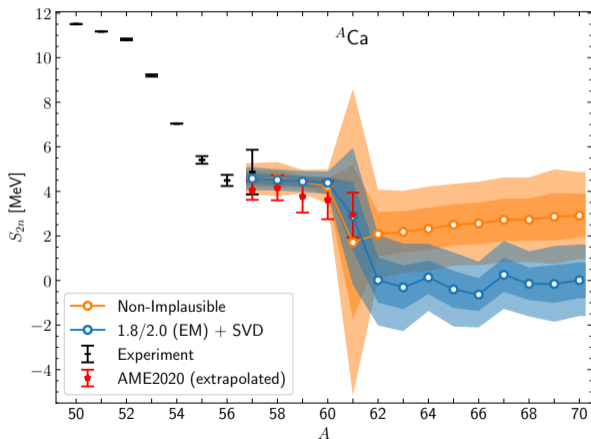
- Two-dimensional distribution for ^{56}Ca and ^{60}Ca
- Error model gives **updated prediction**
- Good agreement with AME 2020
[Meng, et al. CPC \(2021\)](#)
- Additional uncertainties:
 - Model-space uncertainty (finite basis size)
 - Many-body truncations
 - Systematic mean corrections





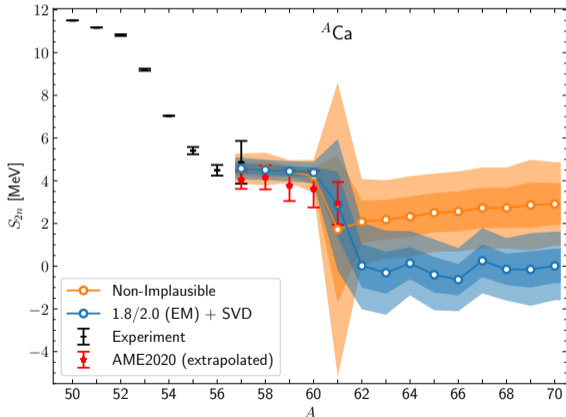
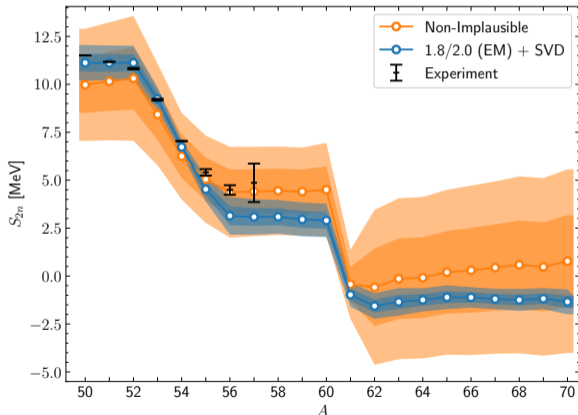
Results for Ca isotopic chain

- Experimental data for $^{50-56}\text{Ca}$
- Strong constraints for $A = 57 - 60$
- Increase in S_{2n} for $A \geq 62$
- Neutron dripline** between ^{62}Ca and ^{70}Ca
- Future work: Apply to heavier nuclei
- Challenge: Cost of solving IMSRG(2)



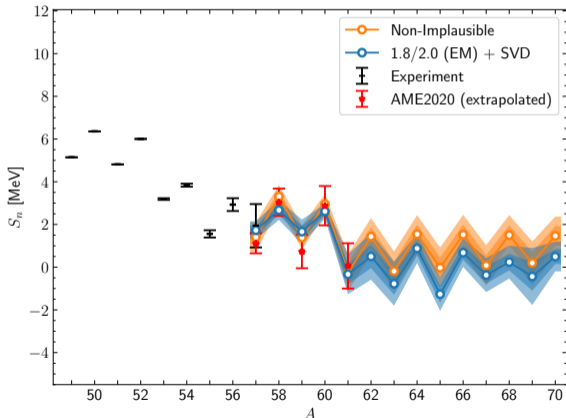
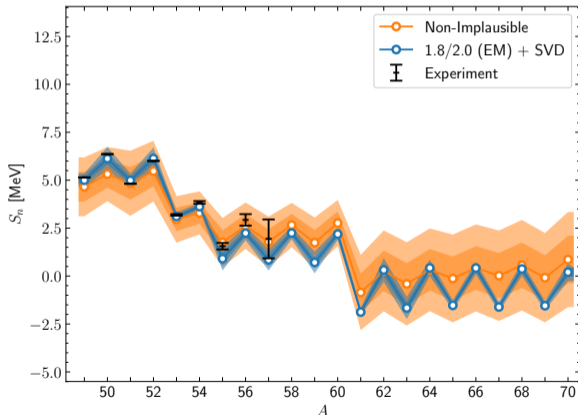


Backup - S_{2n} comparison





Backup - S_n comparison





Backup - Corner plot correlations

