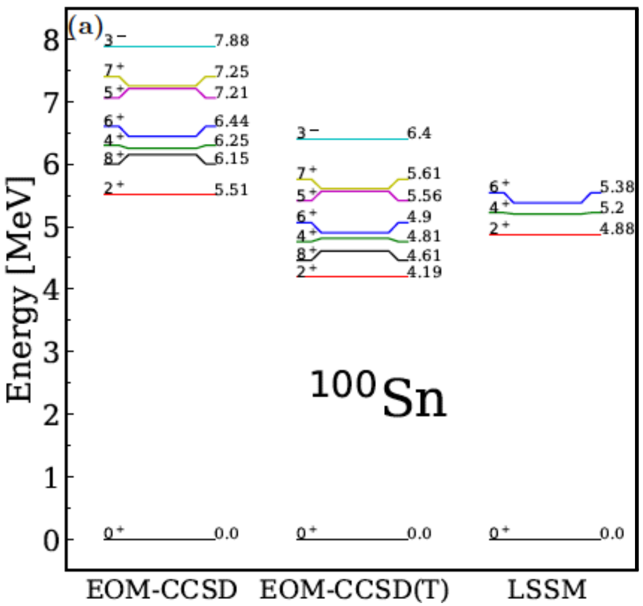
Computing the structure of the lightest tin isotopes

Objectives

- Determine the structure of the supposedly doubly magic nucleus ^{100}Sn consisting of 50 protons and 50 neutrons and its neighbors
- Tying the structure of this heavy nucleus to nuclear interactions that are constrained only in very light nuclei.
- Compute the 2_1^+ state in ^{100}Sn as a key indicator for the structure of this nucleus.
- Compute the structure of neighboring isotopes $^{101\text{-}105}$Sn to lay the ground work for understanding many more short-lived nuclei beyond ^{100}Sn

Impact

- Doubly magic nuclei such as ^{100}Sn have a simple structure and are the cornerstones for entire regions of the nuclear chart.
- Our results confirm that ^{100}Sn is doubly magic, and the predicted low-lying states of ^{100,101}Sn open the way for shell-model studies of many more rare isotopes.
- Separation energies enter models of nucleosynthesis.



Accomplishments

- Prediction that the energy of the 2_1^+ state in neutron-deficient ^{100}Sn is significantly higher than for neighboring nuclei.
- Finding that ^{100}Sn with charge Z=50 and neutron number N=50 is a doubly magic nucleus.
- Understanding of the structure of neighboring nuclei opens the way to compute many more isotopes beyond ^{100}Sn.
- Validation of nuclear interactions constrained in the lightest nuclei enables predictions for more heavy nuclei.

Caption: Low-lying states in 100Sn computed with the chiral interaction 1.8/2.0(EM) in the EOM-CCSD and EOM-CCSD(T) approximations and compared to LSSM calculations based on phenomenological interactions. The excitation gap of about 4 MeV identifies ^{100}Sn as a doubly magic nucleus, which is more strongly bound than its neighbors.

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