Bayesian approach to model-based extrapolation of nuclear observables

U.S. DEPARTMENT OF ENERGY | Office of Science

NUCLEI Nuclear Computational Low-Energy Initiative

Objectives

- In many cases, nuclear information is not available experimentally and must be provided by theoretical models using extreme extrapolations.
- To take full advantage of the information contained in current nuclear models and in experimental data one can utilize Bayesian machine-learning techniques, such as Gaussian processes and Bayesian neural networks, to improve predictions.

Impact

- The increase in the predictive power of microscopic models aided by the statistical treatment is excellent.
- While both Gaussian processes and Bayesian neural networks reduce the deviation from experiment significantly, the former offer a better and much more stable performance
- The proposed robust statistical extrapolation approach can be useful for assessing the impact of current and future experiments.

Accomplishments

- Publication: L. Neufcourt, Y. Cao, W. Nazarewicz, and F. Viens, Phys. Rev. C 98, 034318 (2018).
- Highlighted as Editors' suggestion.

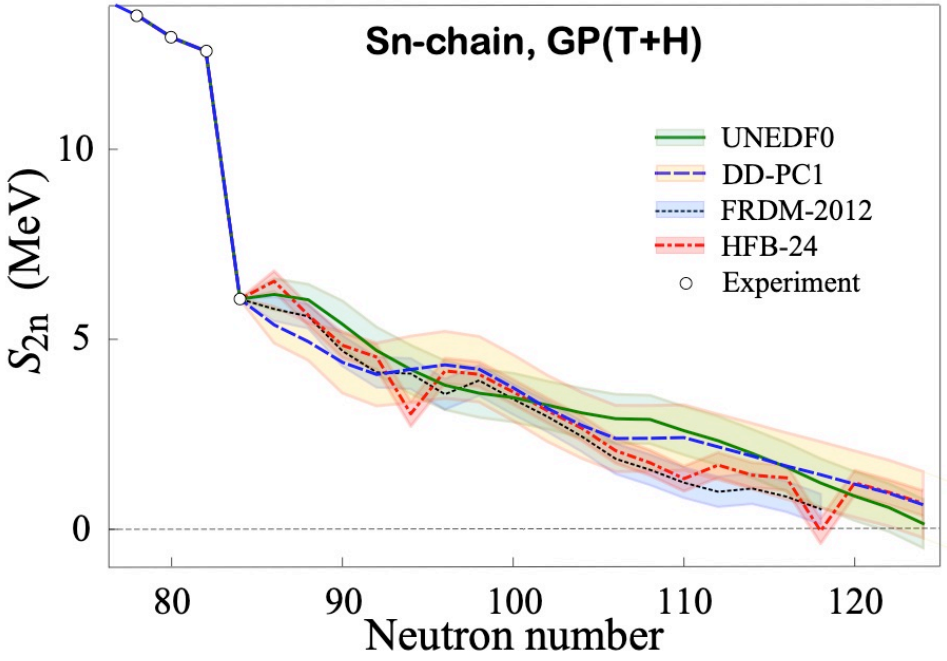

Figure: Extrapolations of two-neutron separation energies for the tin isotopic chain corrected with Bayesian Gaussian processes, combined for four representative models. The different models are consistent overall once the statistical correction and uncertainty are taken into account.