Machine Learning Light Hypernuclei

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Content

We employ a feed-forward artificial neural network (ANN)to extrapolate at large model spaces the results of *ab-initio* hypernuclear No-Core Shell Model calculations for the Λ separation energy B_Λ of the lightest hypernuclei, ${}_{\Lambda}^{3}H$, ${}_{\Lambda}^{4}H$ and ${}_{\Lambda}^{4}He$, obtained in computationally accessible harmonic oscillator basis spaces using chiral nucleon-nucleon, nucleon-nucleon-nucleon and hyperon-nucleon interactions. The overfitting problem is avoided by enlarging the size of the input dataset and by introducing a Gaussian noise during the training process of the neural network. We find that a network with a single hidden layer of eight neurons is sufficient to extrapolate correctly the value of the Λ separation energy to model spaces of size N_{max}=100. The results obtained are in agreement with the experimental data in the case of ${}_{\Lambda}^{3}H$ and the 0^+ state of ${}_{\Lambda}^{4}He$, although they are off of the experiment by about 0.3 MeV for both the 0^+ and 1^+ states of ${}_{\Lambda}^{4}H$ and the 1^+ state of ${}_{\Lambda}^{4}He$. We find that our results are in excellent agreement with those obtained using other extrapolation schemes of the No-Core Shell Model calculations, showing this that an ANN is a reliable method to extrapolate the results of hypernuclear No-Core Shell Model calculations to large model spaces.

Reference

[1] I. Vidaña, Nucl. Phys. A 1032, 122625 (2023)

Field of Research: Production, structure and decay of hypernuclei
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