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Ab Initio Nuclear Structure with Machine Learning

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Ab initio is the expression used to refer to the subset of techniques in nuclear structure that perform calculations from "first principles". While being the most accurate approach in describing atomic nuclei to the date, it is still not used in many fields of nuclear physics due to its high computational cost.

Recently, a method dubbed *Neural Quantum States* was proposed, and there are indications that it might be able to surpass the current state-of-the-art ab initio calculations. The idea is simple: one uses an artificial neural network as a wave function ansatz in a variational setting, and then the energy expectation is set as the loss function to minimise. Not only are neural networks, if sufficiently big, universal function approximators, but they also seem to be able to efficiently compress all the information in a Hilbert space.

In this talk I will present this method in some detail, and I will also illustrate both the achievements and the practical challenges that we are facing when using it to describe nuclei, namely numerical optimisation and neural network architecture. I will place a special focus on how to embed physical symmetries in neural network ansätze, which is my current line of research.

session

I. Nuclear Structure and Reactions

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