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Quantum magnetic skyrmions using neural network quantum states

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Variational methods aim to approximate the quantum states of interest efficiently. Recently, artificial neural networks are being used as the variational ansatz to represent the wave function. These variational states are known as neural network quantum states (NQSs). The success of these NQSs in finding the ground states of spin systems has motivated researchers to explore their capabilities in other more complicated systems. One such complicated system is of magnetic skyrmions, which are topologically nontrivial. These quantum skyrmions are stabilized by the Dzyaloshinskii-Moriya interaction (DMI), an antisymmetric spin exchange energy term. In this work, we study the formation of quantum skyrmions in the ground state of the Heisenberg Hamiltonian in presence of the DMI term using NQSs. We show that a stable skyrmion phase exists as the ground state, and can be obtained by the relatively cheap to train feed forward neural networks. We also test the limits of different neural network architectures in describing the skyrmion phase and compare their performance vs cost.

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