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Lowest energy configurations for Near-BPS Skyrme Models

The original Skyrme model first proposed over half a century ago, is now understood as a low-energy effective theory of QCD where baryons (and nuclei) emerge as topological solitons. It provides a relatively good picture of the nucleons, but it overestimates their binding energies in nuclei by at least an order of magnitude. The present work is based on a recent extension of the original Skyrme model, the so-called near-BPS Skyrme Model. As one departs from the pure BPS limit of the model, the solutions nearly saturate the Bogomol'nyi bound which means that the model can be fine-tuned to obtain small binding energies. However, there remains an open question: what solution configuration minimizes the energy? This is of interest since it has some bearing on the nuclei rotational and Coulomb energies. The lack of accuracy of full 3D numerical calculations does not allow for the unambiguous determination of the lowest energy configuration. Here, instead, we compare the two most prominent configurations, the axial and rational map ansatz, for a class of hybrid model that goes from the original to the pure BPS Skyrme model. Our results suggest that the axial solution is the lowest energy configurations for the set of parameters for which the binding energy per nucleon B/A agrees best with the experimental data thereby supporting even further the idea that nuclei could be near-BPS Skyrmions.

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