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Effectively flat potential in the Friedberg-Lee-Sirlin model

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The Friedberg-Lee-Sirlin (FLS) model is a well-known renormalizable theory of scalar fields that provides for the existence of non-topological solitons. Since this model was proposed, numerous works have been dedicated to studying its classical configurations and its general suitability for various physical problems in cosmology, quantum chromodynamics, etc. In this paper, we study how Q-balls in effective field theory (EFT) reproduce non-topological solitons in full FLS theory. We obtain an analytical description of the simplified model and compare results with numerical calculations and perturbation theory. We also study the condensation of charged bosons on the domain wall. A full numerical solution allows us to check the EFT methods for this problem. The latter analysis is based on the application of EFT methods to significantly inhomogeneous configurations. We give an interpretation of the results in terms of the shifted boson mass and the vacuum rearrangement.

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