Abstract

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"On stability of solitary waves of the nonlinear Dirac equation in the non-relativistic limit"

We study the point spectrum of the linearization at a solitary wave solution to the nonlinear Dirac equation with the Soler nonlinear term. We focus on the spectral stability, that is, the absence of eigenvalues with positive real part, in the non-relativistic limit. We prove the spectral stability of small amplitude solitary waves for the "charge-subcritical cases" and for the "charge-critical case".

We prove that there is no embedded eigenvalue beyond the embedded threshold and analyze the spectrum in the non relativistic limit to determine the different possible appearance of instabilities.

An important part of the stability analysis is the proof of the absence of bifurcations of nonzero-real-part eigenvalues from the embedded threshold points. Our approach is based on constructing a new family of exact bi-frequency solitary wave solutions in the Soler model, on using this family to determine the multiplicity eigenvalues of the linearized operator, and on the analysis of the behaviour of "nonlinear eigenvalues" (characteristic roots of holomorphic operator-valued functions).