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Title: Discrete diffraction managed solitons: Threshold phenomena and rapid decay for general nonlinearities

Abstract: We prove a threshold phenomenon for the existence/non-existence of energy minimizing solitary solutions of the diffraction management equation for strictly positive and zero average diffraction. Our methods allow for a large class of nonlinearities, they are, for example, allowed to change sign, and the weakest possible condition, it only has to be locally integrable, on the local diffraction profile. The solutions are found as minimizers of a nonlinear and nonlocal variational problem which is translation invariant. There exists a critical threshold such that minimizers for this variational problem exist if their power is bigger than the threshold and no minimizers exist with power less than the critical threshold. We also give simple criteria for the finiteness and strict positivity of the critical threshold. Our proof of existence of minimizers is rather direct and avoids the use of Lions' concentration compactness argument.

Furthermore, we give precise quantitative lower bounds on the exponential decay rate of the diffraction management solitons, which confirm the physical heuristic prediction for the asymptotic decay rate. Moreover, for ground state solutions, these bounds give a quantitative lower bound for the divergence of the exponential decay rate in the limit of vanishing average diffraction. For zero average diffraction, we prove quantitative bounds which show that the solitons decay much faster than exponentially. Our results considerably extend and strengthen earlier existence results.