Non-Perturbative Results on the Mass Shell in Nelson-Type Models

Benjamin Hinrichs

Friedrich Schiller University Jena

Abstract

We consider the infrared problem in translation-invariant Nelson-type models describing a single quantum mechanical particle linearly coupled to a field of scalar bosons at fixed total momentum. Physical examples include the non- and semi-relativistic Nelson models. If the bosons are massless, then the model is infrared divergent and the infimum of the spectrum is not an eigenvalue for any total momentum, i.e., no ground state exists. Applying an appropriate dressing transformation, dependent on the total momentum, one obtains an infrared-renormalized representation of the model, which exhibits a ground state. Previously, this situation has been investigated using perturbative methods, i.e., for small total momenta and (possibly dependent on the total momentum) small coupling constants. In this talk, we discuss non-perturbative proofs both for the absence of ground states in the usual Fock space representation of Nelson-type models (for all total momenta) and the existence of ground states in the non-equivalent representation (for almost all physically relevant total momenta). We emphasize that our results hold for all values of the coupling constants, due to the non-perturbative nature of their proofs.

Based on joint work with Thomas Norman Dam, David Hasler and Oliver Siebert.