Excitation spectrum and quasiparticles in quantum gases. A rigorous approach.

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Abstract

The thesis is devoted to a rigorous study of interacting quantum gases. The main objects of interest are the closely related concepts of *excitation spectrum* and *quasiparticles*. The immediate motivation of this work is to propose a spectral point of view concerning these two concepts.

In the first part of this thesis we discuss the concepts of excitation spectrum and quasiparticles. We provide an overview of physical motivations and results, and based on that we propose mathematically precise definitions and propositions related to these concepts.

In the second part we recall the *Bogoliubov* and *Hartree-Fock-Bogoliubov* approximations, which in the physics literature are used to obtain the quasiparticle picture. We show how these two approaches fit into a universal scheme which allows us to arrive at a quasiparticle picture in a more general setup. This scheme is based on the minimization of Hamiltonians over the so-called *Gaussian states*.

In the last part we present a rigorous result concerning the justification of the Bogoliubov approximation. This justification employs the concept of the mean-field and infinite-volume limit. It can be seen as the main result of this thesis.