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Vacuons and quasi-phonons: The hidden side of Bogoliubov collective excitations

Loris Ferrari
DIFA– University of Bologna, Italy

In a gas of N interacting bosons, the Hamiltonian Hc, obtained by dropping all the interaction terms between free bosons with moment hK≠0, is diagonalized exactly. The resulting eigenstates |S, k, n) depends on two discrete indices S, n= 0,1,… where Ŋ numerates the quasiphonons carrying a moment hK, responsible for transport or dissipation processes. S, in turn, numerates a ladder of 'vacua'| S,k, 0), with increasing equispaced energies, formed by boson pairs with opposite moment. Passing from one vacuum to another (S -> S + 1), results from creation/annihilation of new momentless collective excitations, that we call vacuons. Exact quasiphonons originate from one of the vacua by "creating" an asymmetry in the number of opposite moment bosons. The well known Bogoliubov collective excitations (CEs) are shown to coincide with the exact eigenstates |0,k, Ŋ } ,i.e. with the quasiphonons (QPs) created from the lowest-level vacuum (S=0). All this is discussed, in view of existing or future experimental observations of the vacuons, a sort of bosonic Cooper pairs, which are the main factor of novelty beyond Bogoliubov theory.

Biography

Loris Ferrari graduated in Physics from the University of Bologna in 1973, summa cum laude. He got the "Enrico Fermi" award for the best thesis in Physics in 1974. He became Associate Professor in Condensed Matter Physics in 1981. He worked on the theory of disordered systems and glasses, cooperating, in particular, with sir N F Mott (Nobel Prize for Phyisics in 1977), W A Phillips (Cambridge University, UK), S A Dembovsky (Russian Academy of Science) and M I Klinger (Bar-Ilan University, Israel). He worked on non autonomous quantum sysyems, in cooperation with R Lewis (Dartmouth College, USA). He is author of 85 publications on international reviews of physics and physical chemistry.

loris.ferrari@unibo.it

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