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Superconductivity as a Condensate of Collective Cooper Pairs
CARLOS RAMIREZ, CHUMIN WANG, Instituto de Investigaciones en Materiales, Universidad Nacional Autonoma de Mexico — Along the last century, the fascinating phenomenon of superconductivity has recurrently been considered as a Bose-Einstein condensation (BEC) of Cooper pairs. However, creation and annihilation operators of the Cooper pairs do not satisfy the bosonic commutation relations [1] and then, the superconductivity theories based on the BEC have a weakness in their foundation. In this work, for the dilute limit we prove the bosonic nature of collective Cooper pairs (CCP), defined as linear combinations of Cooper pairs [2]. This bosonic nature is given rise from their diffuse character on the Cooper pairs, which allows the accumulation of many collective pairs at a single quantum state. Moreover, the superconducting ground state proposed by Bardeen, Cooper and Schrieffer (BCS) can be written in terms of these CCP, leading to a possible BEC theory of superconductivity. Finally, the energy spectra of CCP are calculated for a mixture of bosons and fermions, which permit to determine the condensation critical temperature as well as other thermodynamic properties of the CCP condensate.

[1] J. Bardeen, L.N. Cooper and J.R. Schrieffer, Phys. Rev. 108, 1175 (1957).
[2] C. Ramirez and C. Wang, Phys. Lett. A 373, 269 (2009).

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