
TcSUH Special Seminar

Generalized BEC Theory in Superconductors

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ABSTRACT: The generalized Bose-Einstein condensation (GBEC) theory [1-4] of super-conductivity hinges on three distinct new ingredients: a) treatment of Cooper pairs (CPs) as actual bosons, in contrast to BCS pairs which do not obey Bose commutation relations, b) inclusion of two-hole (2h) pairs on an equal footing with two-electron (2e) ones (thus making this a complete boson-fermion, or BF, model), and c) inclusion in the resulting ternary ideal BF gas of particular BF vertex interactions that drive boson formation/disintegration processes. Besides subsuming as special cases both BCS (having its well-known 50-50 symmetry) and ordinary BEC theories (having no 2hCPs) as well as the now familiar BCS-Bose crossover theory [5][6], the GBEC theory leads to several-orders-of-magnitude enhancements in the critical superconducting temperature T_c upon slight departures from perfect 50-50 symmetry of the 2e/2h pairs.

In all the above, nonzero center-of-mass CPs were ignored in the interaction Hamiltonian (but not in the zero-order Hamiltonian also as in BCS theory) in order to exactly diagonalize the total GBEC Hamiltonian via a Bogliubov-Valatin transformation. In Refs.[7] such pairs were brought back into the picture via two-time Green function techniques. All this leads---even after ignoring 2hCPs altogether---to the familiar superconducting dome, Fermi “arcs,” etc.

BIO: Prof. Manuel de Llano received the PhD and MS degrees from Catholic University of America in Washington, DC, and the B.S. degree from Fordham University. He has been affiliated with the Texas Center for Superconductivity at the University of Houston since 2005, and since 1996 is Investigador Titular “C” at the Instituto de Investigaciones en Materiales, UNAM Mexico City. From 1990 to 1997 he was Professor of Physics at North Dakota State University, having also served as Chair of the Physics Department from 1985 to 1990. Prior to this appointment, he was Investigador Titular “C”, Instituto de Fisica at UNAM, a consultant for the Comisión de Energía Nuclear in Mexico City, a Research Scientist at the U.S. Naval Research Laboratory in Washington, DC., and a junior physicist at the National Bureau of Standards. He has served as visiting professor (1969 through 2009) at the University of Connecticut, Bristol University, TcSUH at University of Houston, Loughborough University, U New Mexico, Universitat de les Illes, Universitat van Pretoria, Universidad Autónoma de Madrid, Southern Illinois University at Carbondale, Iowa State University, Instituto de Fisica Teórica Sao Paulo, and Universidad de Chile, Santiago.

A summary of Prof. de Llano’s professional output includes a Published textbook, *Mecánica Cuántica* (now in its 3rd edition, 2015). First and second editions sold over 2,000 copies. He has authored over 230 research papers [including publications with G.A. Baker, Jr. (Los Alamos), H. Feshbach (MIT), E.H. Lieb (Princeton), W.C. Stwalley (UConn) and V.V. Tolmachev (Moscow)]. Prof. de Llano has supervised 45 theses (10 doctoral, 22 master’s and 13 undergraduate). He is co-founder in São Paulo, Brazil of *International Workshops in Condensed-Matter Theories*, held annually in every continent of the globe since 1977, its proceedings published yearly since 1985 by Plenum Press and then Nova in New York, and now World Scientific in Singapore.

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