A GENERALIZED BOSE–EINSTEIN CONDENSATION THEORY OF SUPERCONDUCTIVITY INSPIRED BY BOGOLYUBOV

M. de Llano[1,2], *V.V. Tolmachev*[3]

[1]Physics Department, University of Connecticut, Storrs (*CT 06269 USA*),
[2]Instituto de Investigaciones en Materiales, Universidad Nacional Autónoma de México (*Apdo. Postal 70-360 04510 México, DF, Mexico*),
[3]N.E. Baumann State Technical University (*5, 2-ya Baumanskaya Str., Moscow 107005, Russia*)

S u m m a r y

We survey the unification of the Bardeen, Cooper, Schrieffer (BCS) and the Bose–Einstein condensation (BEC) theories via a generalized BEC (GBEC) formalism. The GBEC describes a *ternary* boson-fermion gas mixture consisting of fermion-particle- as well as fermion-hole-Cooper-pairs (CPs) that are bosons in thermal and chemical equilibrium with unpaired electrons. One then switches on an interaction Hamiltonian ($H_{\rm int}$) that is reminiscent of the single-vertex Fröhlich "two-fermion/one-boson" interaction. In contrast with the well-known BCS "four-fermion" two-vertex $H_{\rm int}$, the full GBEC $H \equiv H_0 + H_{\rm int}$ is *exactly* diagonalized with a Bogolyubov–Valatin transformation provided only that one ignores nonzero-total-momenta CPs in the interaction $H_{\rm int}$ although *not* in the unperturbed H_0 that describes an *ideal* ternary gas. Nonzero-total-momenta CPs are completely ignored in the full BCS H. Exact diagonalization is possible since the reduced GBEC H becomes *bilinear* in the fermion creation/annihilation operators on applying the Bogolyubov "recipe" of replacing the remaining zero-total-momenta boson hole- and particle-CP operators by the square root of their respective temperature- and coupling-dependent boson c-numbers. The resulting GBEC theory subsumes all five statistical theories of superconductors, including the Friedberg–T.D. Lee (1989) BEC theory, and yields hundredfold enhancements in predicted T_cs when compared with BCS predictions with the same two-electron BCS model phonon interaction producing the CPs.