Scuola Superiore di Catania

CORSO SPECIALISTICO

Ambito Scienze e tecnologie

a.a. 2016-2017

Complementi di Fisica teorica

Modulo 1 Many-body theory at finite temperature: thermal Green's functions. Re-minder on superconductivity and superfluidity. Phenomenological theories: Ginzburg-Landau theory and inhomogeneous superconductors. Gauge symmetry and symmetrybreaking. Thermal fluctuations. Vortex matter. Microscopic theories: Cooper instabi-lity. Bethe-Goldstone equation. BCS theory. Nambu formalism and Gor'kov equations.Effect of impurities. Fluctuation effects on thermal and transport properties of high-T_c superconductors.

Modulo 2 Pairing in nuclei and nuclear matter. Pair correlation for Fermions and Bo-sons (Gas). Dilute Bose-Einstein condensate and Gross-Pitaevskii equation. Hanbury-Brown-Twiss Effect. Pairing in materia nucleare e nei nuclei (Seniority and Quasispin Model for pairing.) Pairing in isospin-asymmetric matter. Pairing in neutron stars.(Path-integral formulation of Quantum mechanics.)

Modulo 3 Pairing fluctuations in the mesoscopic regime. Universal model for interac-ting electrons in quantum dots and metallic grains. Superconducting fluctuations in the canonical ensemble. Bethe Ansatz solutions of the BCS model beyond the mean-field approximation. Pairing correlations in the canonical ensemble. The quantum critical regime. Generalizations.

Suggested readings include:
1. J. von Delft and D.C. Ralph, Spectroscopy of discrete energy levels in ultrasmall metallic grains, Physics Reports 345, 61 (2001).
2. L. Amico, A. Osterloh, Bethe Ansatz approach to the pairing fluctuations in the mesoscopic regime, Ann. Phys. (Berlin) 524, 133 (2012).
3. J. Dukelsky, S. Pittel, G. Sierra, Exactly solvable Richardson-Gaudin models for many-body quantum systems, Rev. Mod. Phys. 76, 643, 2004.