清华大学
Tsinghua University

清华大学高等研究院 - 冷原子物理系列讲座

The BCS-BEC crossover with ultra-cold Fermi atoms

地点: 高等研究院，科学馆三楼322报告厅

报告人: G. C. Strinati
University of Camerino, Italy

Lecture 1: "Aspects of the BCS-BEC crossover"

10/8 Tuesday 3:30 p.m. - 5:00 p.m.

Historical background. The BCS wave function and the BEC limit. The Fano-Feshbach resonances and the interaction-induced crossover. The unitary limit. Mean-field solution at T=0 for a contact potential. Extension to finite temperature and calculation of the critical temperature.

Lecture 2: "Pairing interaction beyond mean field"

10/9 Wednesday 3:30 p.m. - 5:00 p.m.

Nozières-Schmitt-Rink diagrammatic approach to pairing fluctuations and its extensions. Various degrees of self-consistency within the t-matrix approximation. Gor'kov-Melik-Barkhudarov (screening) corrections. Scattering length of composite bosons in the BEC limit.

Lecture 3: "Intra- and inter-pair correlations"

10/10 Thursday 3:30 p.m. - 5:00 p.m.

The two characteristic lengths of the BCS-BEC crossover. Pair correlation function. Mean field vs pairing fluctuations. The Tan's contact. Correlation function of the order parameter. An interesting curiosity.

Lecture 4: "Single-particle spectral function and RF spectroscopy"

10/11 Friday 3:30 p.m. - 5:00 p.m.

Single-particle spectral function vs pseudo-gap. The underlying Fermi surface and the Luttinger wave vector. RF spectroscopy vs pairing gap. Final-state effects. Comparison with experimental data (via tomographic techniques). The Tan's contact again.

Lecture 5: "Inhomogeneous Fermi systems"

10/15 Tuesday 3:30 p.m. - 5:00 p.m.

Bogoliubov-deGennes equations. Regularization procedure. Effective equations for gap parameter in external fields: Ginzburg-Landau, Gross-Pitaevskii, and LPDA equations. Recovering the GL and GP equations from the LPDA equation. Coarse-grained number density and current.

Lecture 6: "Quantum vortices and proximity effect"

10/16 Wednesday 3:30 p.m. - 5:00 p.m.

Single quantum vortex vs coupling and temperature. Complex vortex structures in a rotating trap. Validity of Feynman's theorem. Moment of inertia in the presence of vortices. NLPDA equation and proximity effect.

Lecture 7: "Josephson and related effects"

10/17 Thursday 3:30 p.m. - 5:00p.m.

Josephson characteristics at T=0. Critical velocity and Landau criterion for superfluidity: pair breaking vs sound mode. Considerations on the energy stability. Absence of reflected wave in the Josephson tunneling.

Lecture 8: "Effects of weak disorder on the BCS-BEC crossover"

10/18 Friday 3:30 p.m. - 5:00 p.m.

Averaging over disorder. Diagrammatic approach in momentum representation. BCS and BEC limits. Effects of weak disorder on thermodynamic quantities. Effects of weak disorder on dynamical quantities. The role of the underlying Fermi surface.

Professor Giancarlo Calvanese Strinati

Professor Giancarlo Calvanese Strinati received hid Ph.D. at the University of Chicago in 1977 as a student of Ugo Fano. After spending one year the University of Chicago as a post-doc and one year at the Max Planck Institut für Festkörperforschung in Stuttgart as a Humboldt Fellow, he joined the faculty of the University of Rome "La Sapienza" as Assistant Professor in 1980 and as Associated Professor in 1983. He then moved to the Scuola Normale Superiore in Pisa from 1986 to 1991, and joined the University of Camerino as Professor of Physics in 1994 where has been since then. Professor Strinati is a theoretical physicist with research interests mostly in condensed matter and ultra-cold atoms, ranging from QDT for atomic systems, to the discontinuity of Bloch functions over the whole BZ, dynamical many-body effects in covalent crystals, core excitons in semiconductors, thermal properties and kinetic equations for electrons with strong disorder, and several aspects of the evolution from BCS superconductivity to Bose-Einstein condensation. He is a member of the Chicago Chapter of Sigma Xi from 2003 and a Fellow of the American Physical Society from 2010.