



UNIVERSITA' DEGLI STUDI DI PAVIA

DOTTORATO DI RICERCA IN FISICA

LEZIONE VOLTIANA

THE QUANTUM SONAR: fishing bosons in the depths of Fermi sea

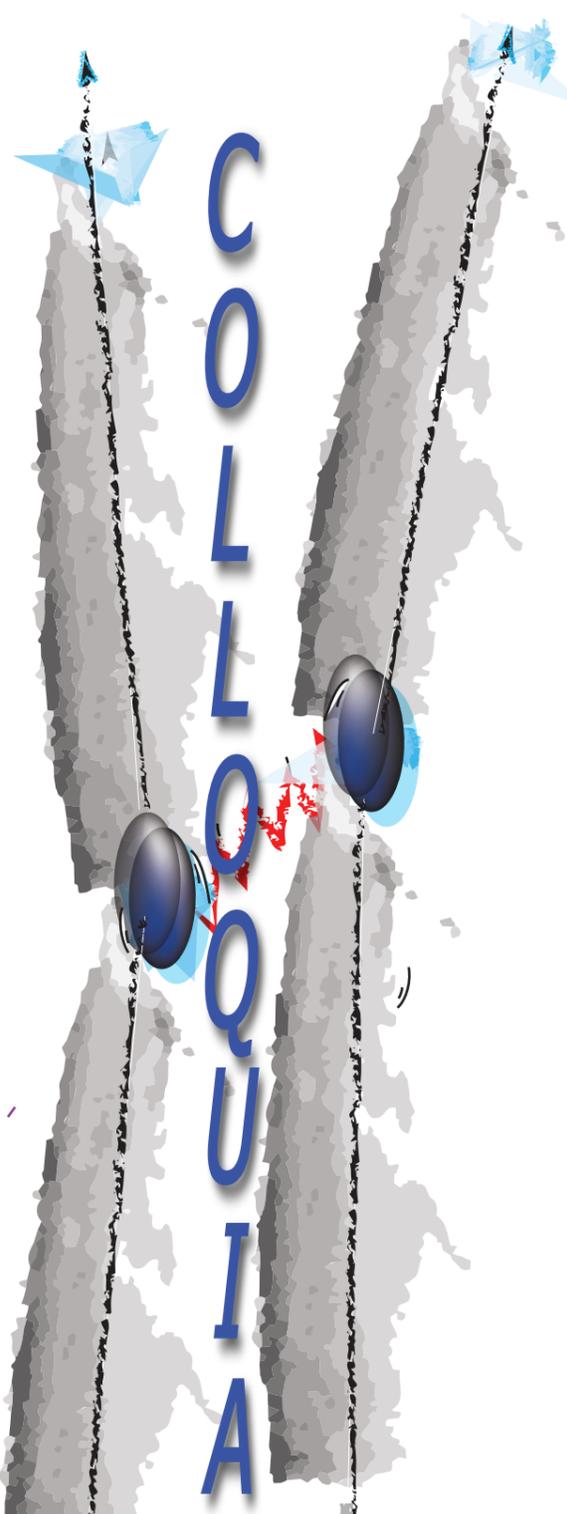
GIORGIO BENEDEK

Università di Milano Bicocca
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Inaugurazione

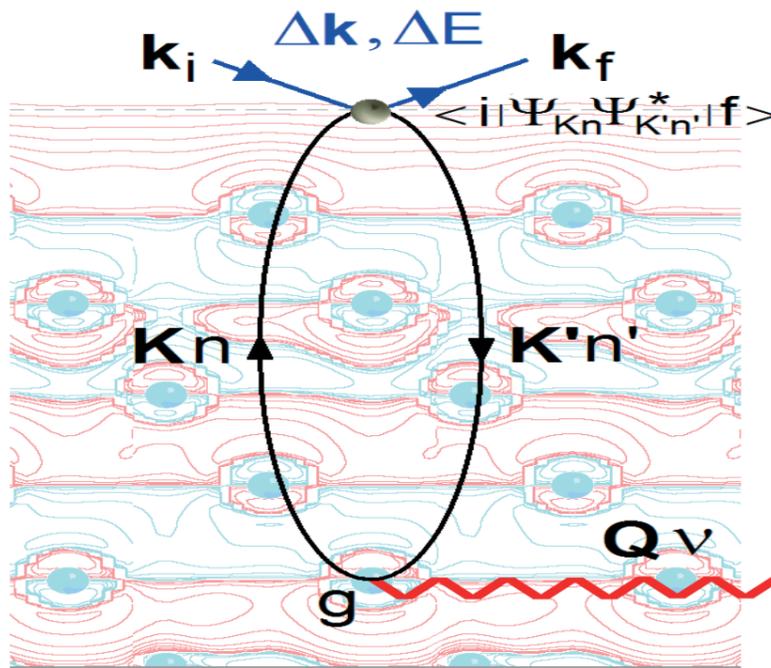
Colloquia del Dottorato di Ricerca in Fisica
Anno Accademico 2013/2014

Giovedì 6 Marzo 2014, ore 16.00

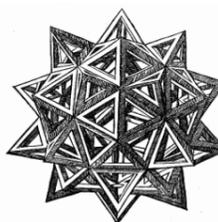
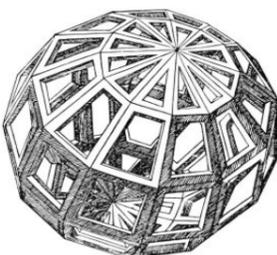


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The Quantum Sonar: fishing bosons in the depths of Fermi Sea

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In metals atom cores are fully immersed in the Fermi sea of free electrons, and the coupling between their respective degrees of freedom is a fundamental interaction in condensed matter. Important phenomena like electrical resistance and superconductivity are due to electron-phonon (EP) coupling. In one and two dimensions EP interaction plays a major role in phase transitions: graphene, topological insulators and 2D superconductivity are most debated examples for both fundamental reasons (with implications in nuclear and particle theory) and nanotech applications. Identifying the actors responsible for, e.g., 2D superconductivity is a major challenge, which recently found, however, an unexpected solution.

The quasi two-dimensional Fermi liquid of a superconductor metal film can transmit to the surface even minute mechanical disturbances occurring in the depth, thus allowing the gentlest of all surface probes, helium atoms, to perceive the vibrations of the deepest atoms via the induced surface-charge density oscillations. The EP interaction is shown to be responsible for the coupling of He atoms to in-depth phonon modes, which allows for a direct measurement of the phonon-selected EP coupling strength (mode-lambda spectroscopy). The cases of 2D superconductivity in lead and bismuth multi-layers and of chiral symmetry break in graphene are presented as paradigmatic examples.