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Guest Lecture

Title: "Superconductivity in Dilute Metals"

Speaker: **Dr. Kamran Behnia**

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Date: Friday, 7th of March 2014
Time: 14:30
Place: Seminar Room CBEG02 (387, Photonics); Gußhausstraße 27

Abstract:

In many semiconductors, including silicon, diamond and germanium, a super-conducting ground state emerges upon doping the parent insulator.

Discovered as early as 1964, $SrTiO_3$, a large-gap insulator, has been one the first members of this loose family of “semiconducting superconductors”. It has been also the first oxide superconductor, the first multi-band superconductor and the first to present a non-monotonous variation of the critical temperature with carrier concentration. Such superconducting “domes”, ubiquitous across a wide range of materials, defy the expectations of the crudest version of the BCS theory.

We have found that down to concentrations as low as 5.5 X 10^{17} cm^{-3}, doped $SrTiO_3$ has both a superconducting ground state and a sharp Fermi surface [1]. Thus, the normal state is a metal whose Fermi energy is as little as 1.1 meV on top of a band gap as large as 3eV.

This is the smallest Fermi surface known to suffer a superconducting instability. We argue that the long Bohr radius, enhanced by the large dielectric coefficient is responsible for the formation of the shallow Fermi Sea. The survival of superconductivity in such a context, with a Fermi temperature much smaller than Debye temperature, excludes ordinary phonons as the pairing glue.

1) X. Lin, Z. Zhu, B. Fauqué and K. Behnia, Phys. Rev. X **3**, 021002 (2013)