LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN

ARNOLD SOMMERFELD CENTER FOR THEORETICAL PHYSICS

Sommerfeld Theory Colloquium

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Ruhr-University Bochum

Cascade of Phase Transitions near Quantum Critical Point

In the standard picture of a quantum phase transition, a single quantum critical point separates the phases at zero temperature. Here we show that the two-dimensional case is considerably more complex. Instead of the single point separating the antiferromagnet from the normal metal, we have discovered a broad region between these two phases where the magnetic order is destroyed but certain areas of the Fermi surface are closed by a large gap. This gap reflects the formation of a novel quantum state characterized by a superposition of d-wave superconductivity and a quadrupole density wave (QDW), which builds a checkerboard pattern with a period incommensurate with that of the original spin density wave. At moderate temperatures both orders co-exist over comparatively large distances but thermal fluctuations destroy the long-range order. Below a critical temperature the fluctuations are less essential and superconductivity becomes stable. Applying a magnetic field destroys the superconducti-vity but establishes QDW. In addition to these phases we obtain also a charge density wave (CDW) arising as a result of interaction of electrons with superconducting fluctuations. This phase is possible when the superconductivity is destroyed by either thermal fluctuations or a magnetic field. The results of our theory can serve as explanation of recent experiments on cuprates performed with the help of STM, NMR, hard and resonant soft X-ray scattering, sound propagation, and other techniques.

Wednesday, 7 May 2014, 16:15h, Room A348/349, Theresienstr. 37/III

Prof. J. von Delft, Dr. O. Yevtushenko