Disorder and interactions in high-temperature superconductors

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Stellingen

Behorend bij het proefschrift "Disorder and Interactions in High-Temperature Superconductors"

I. The sharpness of the quasiparticle scattering interference peaks in experiments, as compared to that seen in theory and numerics, shows that microscopic details need to be included in the modeling of STS experiments in the cuprates.
Chapter 3 of this thesis.

II. Smooth disorder due to off-plane dopants, despite its mild nature, can still give rise to a considerable number of low-energy electronic excitations in *d*-wave superconductors.
Chapter 4 of this thesis.

III. Whether the *d*-wave Bogoliubov quasiparticles are long-lived or not can be probed by the presence or absence of the quasiparticle scattering interference peaks.
Chapter 5 of this thesis.

IV. If the caustics characteristic of the marginal Fermi liquid STS power spectrum were not to be seen in the normal state of the optimally-doped cuprates, this would suggest that the normal state does not have any electron-like quasiparticles.
Chapter 5 of this thesis.

V. The absence of caustics in the STS power spectrum in the superconducting state at energies higher than the gap in experiments by Kohsaka *et al*. indicates that the normal state is described by a theory very different from Fermi-liquid theory.
Kohsaka *et al*.: *Nature* **454**, 1072 (2008).

VI. The gap-filling phenomenology seen in experiments by Reber *et al*. can largely be accounted for by thermal phase fluctuations in a *d*-wave superconductor.
Reber *et al*.: *Phys. Rev. B* **87**, 060506(R) (2013).

VII. In contrast to Abrahams and Varma's interpretation of the spectra of the normal state of the cuprates as that of a marginal Fermi liquid, the absence of peaks in the energy-distribution curves suggests that the theory of the strange metal is even more exotic than the marginal Fermi liquid.
Abrahams and Varma: *PNAS* **97**, 5714 (2000).

VIII. Riggs *et al*. show that the specific heat in underdoped cuprates is too small to be accounted for by Fermi-surface reconstruction due to density-wave order, indicating that a mechanism due to some combination of correlations and disorder is responsible for the oscillatory phenomena seen in high-field experiments.
Riggs *et al*.: *Nature Physics* **7**, 332 (2011).

IX. The difficulty data-driven analytics has in identifying good metrics for defensive performance in basketball—a strongly-interacting ten-body system—should give pause to anyone who proclaims Big Data as a panacea.

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