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Visualizing strongly-correlated electrons with a novel scanning tunneling microscope

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PROPOSITIONS

accompanying the thesis

VISUALIZING STRONGLY-CORRELATED ELECTRONS WITH A NOVEL SCANNING TUNNELING MICROSCOPE

1. The phenomena of pseudogap and electronic order are not specific to cuprate superconductors, but generic to a wider class of lightly doped Mott insulators. (*Chapter 4 of this thesis*).
2. In order to build a very stiff scanning tunneling microscope, both materials and geometry need to be optimized. (*Chapter 3 of this thesis*).
3. Even when STM spectra on poorly conducting materials do not change with tip-sample distance, one cannot rule out the presence of tip-induced band bending. (*Chapter 5 of this thesis*).
4. Photoemission, optics and transport results on electron-doped Sr_2IrO_4 have to be interpreted in light of the spatially inhomogeneous electronic structure as found by STM experiments. (*Chapter 4 of this thesis*).
5. The gradual suppression of the Mott gap as reported by Yan et al. on surface-doped Sr_2IrO_4 is due to disorder rather than to electron doping. *Yan et al., Phys. Rev. X* **5**, 041018 (2015).
6. Zhao et al. do not consider electric field penetration when retrieving the gap value on the Mott insulating phase of $\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}_{8+x}$ and, therefore, the estimated gap width is not reliable. *Zhao et al., Nat. Mater.* **18**, 103 (2019).
7. While Wang et al. conclude to have good agreement between STM quasiparticle interference measurements and photoemission results, the extracted Fermi velocities do not agree. *Wang et al., Nat. Phys.* **13**, 799 (2017).
8. The enhancement of superconductivity in $\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}_{8+x}$ break junctions upon irradiation with microwave power, as claimed by Vedenev et al., can simply be explained by energy broadening. *Vedenev et al., Phys. Rev. B* **78**, 052509 (2008).
9. An efficient design for a liquid helium dewar should not contain tubes prone to develop Taconis oscillations.

Irene Battisti
Leiden, 08-05-2019