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Nanostructures in Unconventional Superconductors DIRK MORR, NIKOLAOS STAVROPOULOS, University of Illinois at Chicago — Nanoscale structures by design provide the unique opportunity to reveal the wave-like nature of electrons in condensed matter systems. This has led to the discovery of many new quantum phenomena, such as quantum imaging using electronic waves. In this talk I argue that a new class of quantum effects can be expected to emerge when nanoscale impurity structures are coupled to host systems with complex electronic correlations, such as superconductors. Using some recently developed theoretical approaches, I show that this coupling leads to new types of quantum imaging which possess geometry based selection rules. As a result, one can create nanoscale copying machines, suppress pair-breaking effects of magnetic impurities, and project quantum images "around the corner". Moreover, nanostructure consisting of more complex building blocks, such as molecules, can be used to manipulate the electronic structure of unconventional $d_{x^2-y^2}$-superconductors in a controlled way. This in turn allows us to gain insight into the nature of electronic correlations and to study the role played by collective modes in the appearance of unconventional superconductivity. Finally, I discuss the relevance of these results for recent scanning tunneling experiments on the high-temperature superconductors.

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