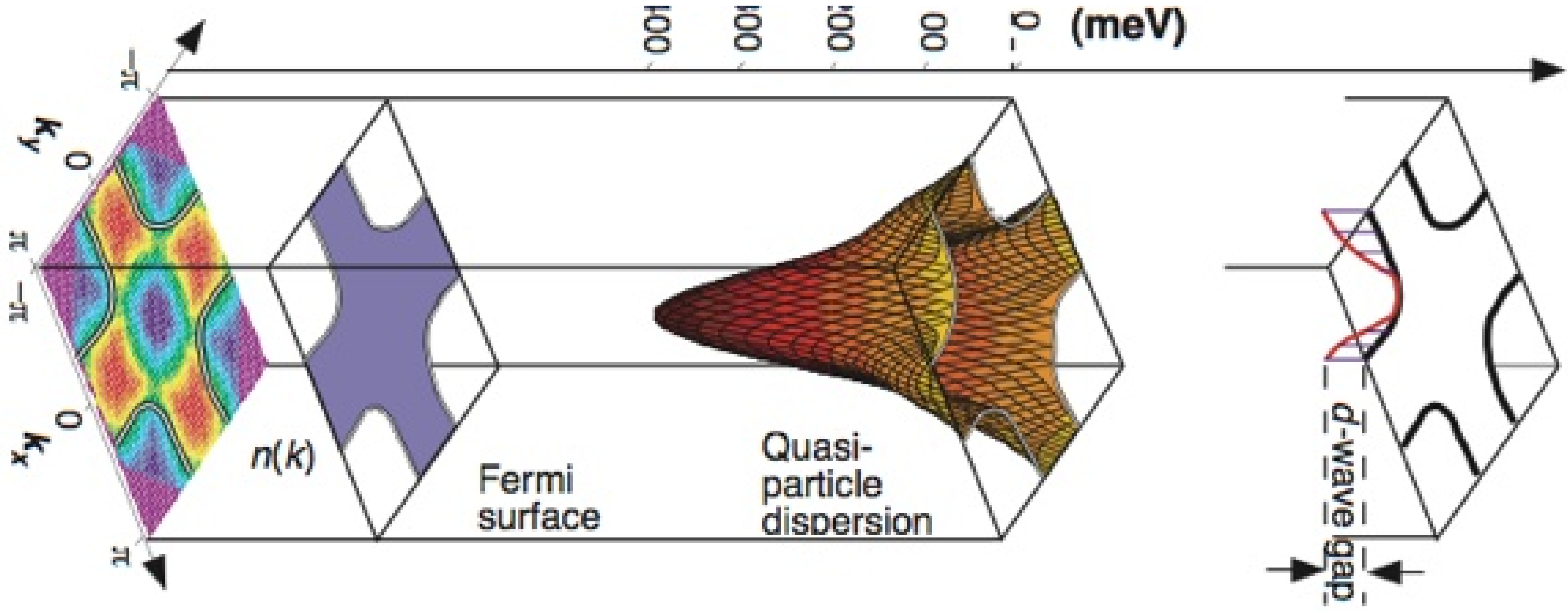

Superconductivity:
the Gift that Keeps on Giving

Superconductivity, first discovered at the beginning of the twentieth century, has presented new challenges for the physics community ever since. Most recently the discovery of high superconducting transition temperatures in the ceramic copper oxides has lead to the opening of new fields of research into the properties of so-called strongly correlated electron materials. Unlike metallic systems where the coulombic effects are highly screened, the strong forces between electrons in these new materials lead to a whole range of poorly understood phenomena. High resolution photoemission is one probe of these properties that has added considerably to our knowledge base. Indeed the technique is recognized as one of the most powerful probes of the electronic structure in condensed matter systems. In the present talk we focus on studies of the high Tc superconductors. In the under-doped or pseudo-gap phase of the cuprate superconductors, a significant portion of the Fermi surface is still gapped at temperatures above the transition temperature Tc. Further instead of a closed Fermi surface, photoemission studies indicate that the low-energy electronic excitations appear to form Fermi arcs separated by gapped regions. Here we show that the Fermi arcs may in fact be one side of Fermi pockets, consistent with the underlying nature of the spin liquids in these materials and indeed consistent with the fact that these materials are doped Mott insulators. By examining a range of reduced doping levels down into the non-superconducting regime it appears that the areas of the hole pockets scale with the doping level. A particle-hole asymmetry observed in the nodal region is clear evidence that electron pairing does not originate from the Fermi arcs in the normal state. However in contrast the particle-hole symmetry observed in the anti-nodal region is interpreted as evidence for singlet pairs forming along the copper-oxygen bond directions at temperatures above the superconducting transition temperature Tc. We also discuss studies of the recently discovered Fe based superconductors. We examine possible sources of the quasi one dimensionality or nematicity in these materials and also discuss pressure dependent effects on the Fermi surface.

Peter Johnson
BNL

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SCI 109, Metcalf Science Center, Boston University

Call: Winna Somers (wsomers@bu.edu) (617) 353-9320

Host: Kevin Smith