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Title:

Charge ordering in the cuprate high-temperature superconductors.

Abstract:

Key to understanding the superconducting phenomenon in copper-based high-temperature superconductors is the correct identification of coexisting orders, their microscopic nature, and whether they are in competition with superconductivity. Over the last decade there has been an escalating amount of evidence for ordering phenomena coming from different probes and materials, and which were apparently dissimilar amongst themselves. Bulk measurements coming from thermoelectric transport, Hall resistance, and quantum oscillations on $YBa_2Cu_3O_{6+x}$ (YBCO) pointed to Fermi surface reconstruction and indirectly to electronic ordering. Additionally, it had been long known that scattering experiments detected stripe order in La-based compounds. Simultaneous to those discoveries there was an increasing amount of evidence for a propensity toward charge ordering in the pseudogap phase coming from surface sensitive techniques such as angle-resolved photoemission spectroscopy (ARPES) and scanning tunneling microscopy STM, though these were detected in yet another family of cuprate materials, the Bi-based compounds. A common interpretation for all these experiments started to emerge after the discovery of charge ordering by nuclear magnetic resonance (NMR) and x-ray scattering measurements in $YBa_2Cu_3O_{6+x}$, followed by combined resonant x-ray scattering (RXS), STM and ARPES experiments on Bi-based cuprates. I will first give a review of these many results from an experimentalist's perspective, emphasizing how each contributed in their own way toward a "big-picture" understanding of the cuprate phenomenology. In doing so I will eventually focus on the STM technique for which I will give a more in-depth description. Nevertheless, the primary goal of this talk is to give the audience a perspective of how several years of research by different groups in different parts of the world, and using different experimental techniques, eventually led to the discovery of charge ordering which has now taken place at the forefront of research in the field of high-temperature superconductivity.