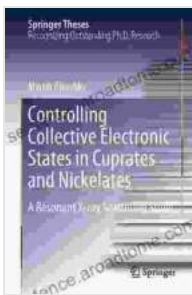


Controlling Collective Electronic States in Cuprates and Nickelates: A Journey into Advanced Materials and Quantum Phenomena

In the realm of condensed matter physics, cuprates and nickelates have emerged as captivating materials due to their exceptional electronic properties. These materials exhibit intriguing collective electronic states, such as high-temperature superconductivity, colossal magnetoresistance, and charge and spin density waves. Unraveling the mechanisms underlying these states holds the key to unlocking groundbreaking advancements in quantum computing, spintronics, and other cutting-edge technologies.



Controlling Collective Electronic States in Cuprates and Nickelates: A Resonant X-ray Scattering Study

(Springer Theses) by Janet Kellogg Ray

★★★★☆ 4.5 out of 5

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Enhanced typesetting : Enabled
Print length : 332 pages



Cuprates: A Paradigm for High-Temperature Superconductivity

Cuprates, a class of copper-oxide compounds, have been at the forefront of superconductivity research since their discovery in the late 1980s. Unlike conventional superconductors that require extremely low temperatures to

operate, cuprates exhibit superconductivity at relatively high temperatures, making them promising candidates for various applications. The collective electronic state responsible for superconductivity in cuprates arises from the formation of Cooper pairs, where electrons pair up and move through the material without resistance.

Nickelates: Unveiling Novel Electronic Phenomena

Nickelates, a family of nickel-oxide compounds, have recently garnered significant attention due to their diverse electronic properties. Unlike cuprates, nickelates exhibit a wide range of electronic behaviors, including magnetism, metallicity, and even superconductivity under certain conditions. The collective electronic states in nickelates emerge from the interplay of multiple electron orbitals and spin configurations, leading to a rich landscape of quantum phenomena.

Controlling Collective Electronic States: A Path to Advanced Technologies

The ability to control and manipulate collective electronic states in cuprates and nickelates opens up exciting possibilities for device engineering and the development of novel functionalities. By harnessing these materials' unique properties, researchers can tailor their electronic behavior for specific applications. For instance, modifying the charge density waves in cuprates could enhance their superconducting properties, while controlling the spin density waves in nickelates could lead to new spintronic devices.

Experimental Innovations and Theoretical Insights

Unveiling the secrets of cuprates and nickelates requires a synergistic interplay of experimental techniques and theoretical modeling. Advanced

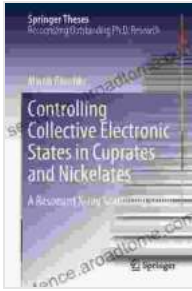
microscopy methods, such as scanning tunneling microscopy and photoemission spectroscopy, provide direct visualization and characterization of collective electronic states at the nanoscale. Theoretical approaches, including density functional theory and dynamical mean-field theory, offer valuable insights into the electronic structure and dynamics of these materials.

Applications in Quantum Computing and Beyond

The potential applications of controlled collective electronic states in cuprates and nickelates extend far beyond the realm of superconductivity. These materials hold promise for the development of quantum computers, where their ability to manipulate and entangle quantum states could enable groundbreaking computation and simulation capabilities. Additionally, their unique spintronic properties could lead to novel magnetic memory devices with ultra-low power consumption and high-speed operation.

The exploration of collective electronic states in cuprates and nickelates has opened a new frontier in condensed matter physics and materials science. By harnessing the power of these extraordinary materials, researchers are pushing the boundaries of our understanding of quantum phenomena. The ability to control and manipulate their electronic states holds immense promise for the development of advanced technologies that will revolutionize various fields, including electronics, quantum computing, and spintronics. As the research continues to unravel the mysteries of cuprates and nickelates, we eagerly anticipate the groundbreaking discoveries and transformative applications that lie ahead.

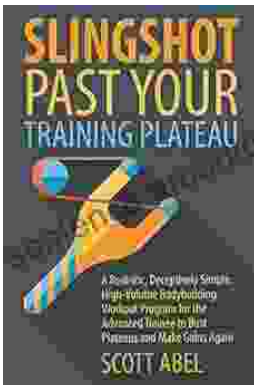
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