

Research Highlights

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Electrons Move in Preferred Direction in Cuprate Superconductors

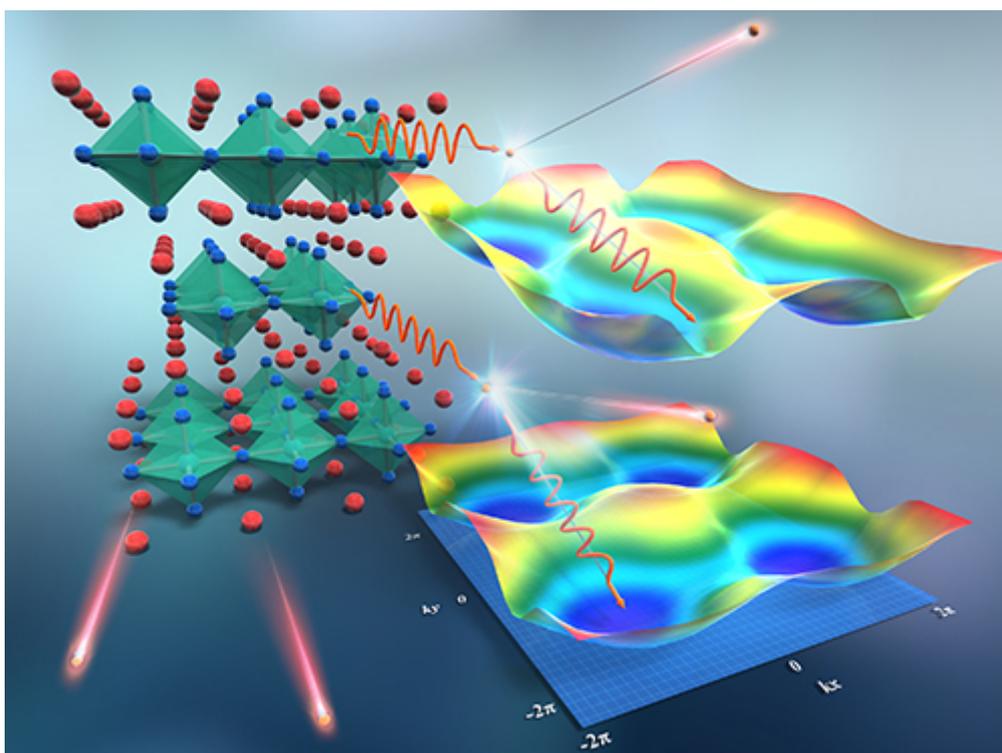
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A team at MANA has gleaned important insights into the properties of Lanthanum-based cuprate superconductors, the highest-temperature superconducting family yet discovered under ambient pressure.



The team's results imply that, in contrast to common belief among researchers for the last 35 years, electrons have a preferred direction along either the x or the y axis in each CuO_2 plane, and the preferred direction alternates between the planes.

High-temperature cuprate superconductors have continued to generate keen interest for more than 30 years due to the various phenomena they exhibit with changes in carrier doping and temperature, such as the pseudogap phase, nematic order, charge-density wave and spin-density wave, as well as superconductivity.

The Fermi surface is fundamental in condensed matter physics for understanding metallic properties. Its shape directly reflects the electron motion inside the material and as such it is the key to understanding materials' properties.

High-temperature cuprate superconductors are characterized by stacks of copper-oxygen (CuO_2) planes, a fact that has convinced many researchers that electrons exhibit two-dimensional motion

in CuO_2 planes.

The WPI-MANA team, led by Hiroyuki Yamase, applied the high-resolution X-ray Compton scattering technique to a sample of $\text{La}_{2-x}\text{Sr}_x\text{CuO}_4$ and imaged the momentum distribution of electrons.

The results provide new understanding of the electronic properties of cuprate superconductors. Compton scattering can be a powerful tool to elucidate electronic properties in materials and sometimes works beyond other widely employed techniques. The researchers said it will be exciting to see the technique employed as a complement to other methods.

This research was carried out by [Hiroyuki Yamase](#) of WPI-MANA and his collaborators.

Reference

“Fermi Surface in La-Based Cuprate Superconductors from Compton Scattering Imaging”
[Hiroyuki Yamase](#), Yoshiharu Sakurai, Masaki Fujita, Shuichi Wakimoto, and Kazuyoshi Yamada
Journal: Nature Communications 12, 2223 (2021)
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