**Universal nodal Fermi velocity**

The mechanism that causes high-temperature superconductivity in copper oxide materials (cuprates) is still unknown, more than 15 years after it was discovered\(^1\). As the charge carriers (electrons or holes) are introduced into the parent antiferromagnetic insulator, a process called doping, the material evolves from an insulator to a superconductor, and eventually to a normal metal. This marked change of physical properties with doping\(^2\)\(^\) indicates that doping dependence (non-universality) might be a general feature of these materials, but we find that, on the contrary, the low-energy Fermi velocity of electrons is in fact universal, even among different superconductor families.

We used high-resolution angle-resolved photoemission, which can directly probe the electronic structure, to investigate hole-doped materials at various dopings in five different families of cuprates. These included \((\text{La}_{1-x}\text{Sr}_x\text{CuO}_4\) (LSCO) and \((\text{La}_{1-x}\text{Nd}_{x}\text{Sr}_x\text{CuO}_4\) (Nd-LSCO), \((\text{Bi}_{2}\text{Sr}_2\text{CaCu}_2\text{O}_{8}\) \((\text{Bi}2212)), \((\text{Bi}_{2} \text{Sr}_2\text{CuO}_6\) \((\text{Bi}2201)), \((\text{Ca}_{1-x}\text{Na}_x\text{CuO}_2\text{Cl}_x\) \((\text{Na}-\text{CCOC})\) and \((\text{TlBa}_2\text{CuO}_6\) \((\text{Tl}2201)). The LSCO system in particular covers the entire doping range \((0 < x < 0.3)\) over which the physical properties vary from insulator \((0 < x < 0.03)\) to superconductors \((0.05 < x < 0.25)\) to overdoped non-superconducting metal \((x > 0.25)\). Apart from the Na-CCOC data taken at the Stanford Synchrotron Radiation Laboratory, all samples were measured at the Advanced Light Source at Lawrence Berkeley National Laboratory (experimental details are presented elsewhere\(^3\)).

Figure 1a shows the energy-momentum (dispersion) curves of the LSCO system with various dopings \((0 < x < 0.3)\), measured along the \((0.0)-(\pi_x\pi_y)\) direction in the Brillouin zone in reciprocal space. This diagonal direction is special in these superconductors because the anisotropic superconducting gap\(^4\), as well as the normal-state pseudogap\(^5,\)\(^6\), is zero along this so-called nodal direction. Figure 1a shows that, for all dopings, there is a kink at an energy of about 70 meV that separates the dispersion into a high-energy part (that is, further from the Fermi energy) and a low-energy part (that is, closer to the Fermi energy) with different slopes. Whereas the high-energy dispersion varies with doping, the dispersion converges within about 50 meV of the Fermi energy, revealing a behaviour that is independent of doping. Correspondingly, a decrease is seen in the electron-scattering rate at an energy of about 70 meV, as indicated in Fig. 1b for the LSCO \((x = 0.063)\) sample.

The electron velocity can be extracted quantitatively from the slope in dispersion, \(v = E/k\) \(\text{ok}\). We have obtained the low-energy velocity \((\text{the Fermi velocity})\) and the high-energy velocity \((\text{as a function of doping for all five families of materials})\) (see supplementary information). The Fermi velocity is nearly constant for all materials and dopings within an experimental error of about 20\%. In contrast, the high-energy velocity varies strongly with doping. This invariance of nodal Fermi velocity in cuprates is surprising, given the range of variability in many other physical properties\(^7\). This universal behaviour, together with the ubiquitous existence of a kink in the dispersion and a decrease in the scattering rate, are puzzles that require answers before the mystery of high-temperature superconductivity can be solved.

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**Spring algal bloom and larval fish survival**

The different factors that influence the prevalent decline in fish stocks are currently subject to urgent and intense scrutiny. Here we combine the use of remote-sensing satellite data with a long-term data set of haddock recruitment off the eastern continental shelf of Nova Scotia, Canada, to show that the survival of the larval fish depends on the timing of the local spring bloom of phytoplankton. This link has been suspected for more than 100 years, but its verification has had to wait for technology with sufficient spatial and temporal resolution.

A long-standing hypothesis\(^8\) contends that the abundance of fish year-classes is determined by food availability during the critical period of larval development. Variations in food supply between different years, probably determined by differences between the timing of the spring bloom of phytoplankton and the timing of fish spawning\(^9\), were thought to account for...