Unconventional polaronic ground state in superconducting $LiTi_2O_4$

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To understand superconductivity, one needs to understand the interplay of electron-electron and electron-phonon interactions. The situation becomes more complicated—and more interesting—if the composition and structure of the material allow for correlated phenomena. For example, in half-valence spinel materials the interplay of correlated metallic behavior and charge frustration can lead to a superconducting state in $LiTi_2O_4$ or to heavy fermion behavior in LiV_2O_4.

Until the discovery of superconductivity in the cuprates in 1986, $LiTi_2O_4$ and $BaPb_{0.7}Bi_{0.3}O_3$ were the oxides with the highest known transitions temperatures, 12 K and 13 K, respectively. As $LiTi_2O_4$ does not cleave, angle-resolved photoemission spectroscopy (ARPES) had not been achieved on $LiTi_2O_4$, until now.

Here, **PARADIM's MBE+ARPES signature tool** was used to synthesize thin films of superconducting $LiTi_2O_4$, enabling a detailed spectroscopic investigation using resonant inelastic x-ray scattering and ARPES for comprehensive insights of the low-energy physics of $LiTi_2O_4$. The users observe strong electronic correlations and signatures of strong electron–phonon coupling indicating a novel polaronic ground state—also found in weakly doped cuprates. Theoretical calculations (DFT) can reproduce some of the features observed by ARPES but are unable to reproduce the full interplay of both interactions. By revealing the complex correlations in $LiTi_2O_4$ the work challenges the notion of phonon-dominated BCS superconductivity in the material.

Z. Hasan *et al.* *Nat. Commun.* **17**, 1303 (2026).

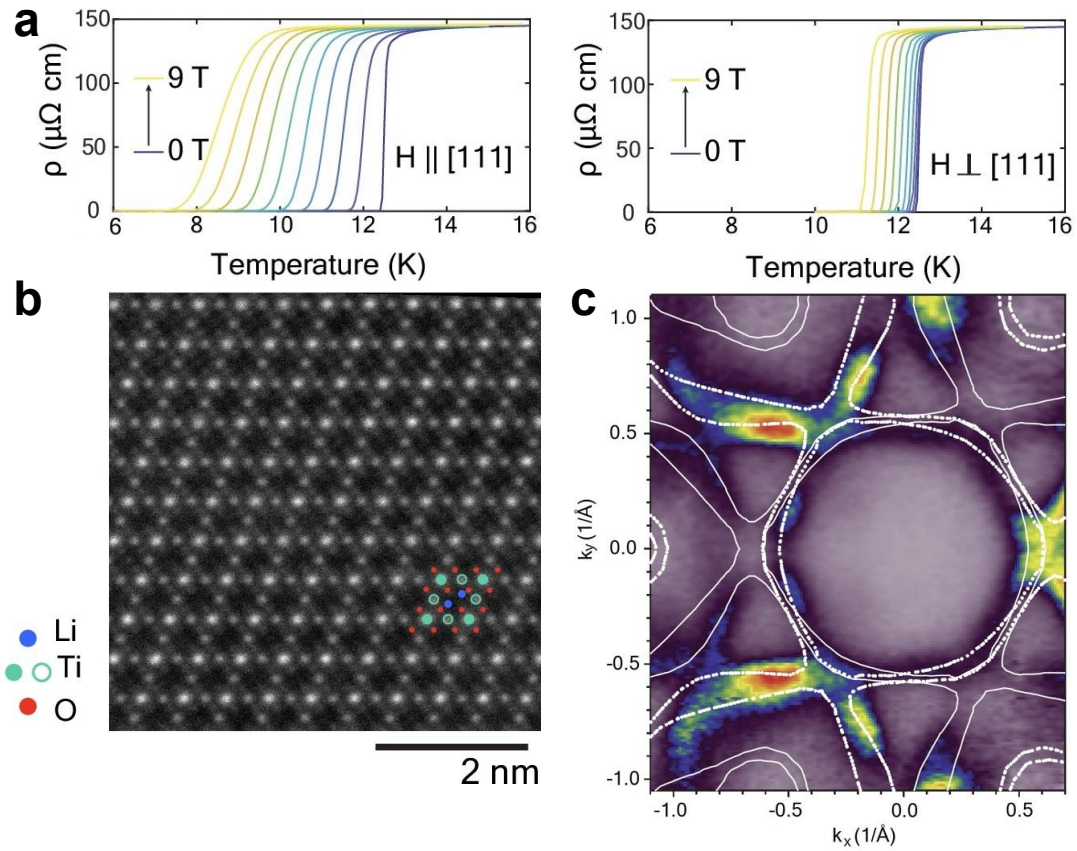

Figure. a) Resistivity vs. temperature curves showing the superconducting transition at ~ 12.5 K and with applied magnetic field (0 to 9 T) parallel and perpendicular to the sample. **b)** Electron micrograph of $LiTi_2O_4$ overlaid with the corresponding atoms. **c)** ARPES measured Fermi surface overlaid with DFT-calculated Fermi surface.