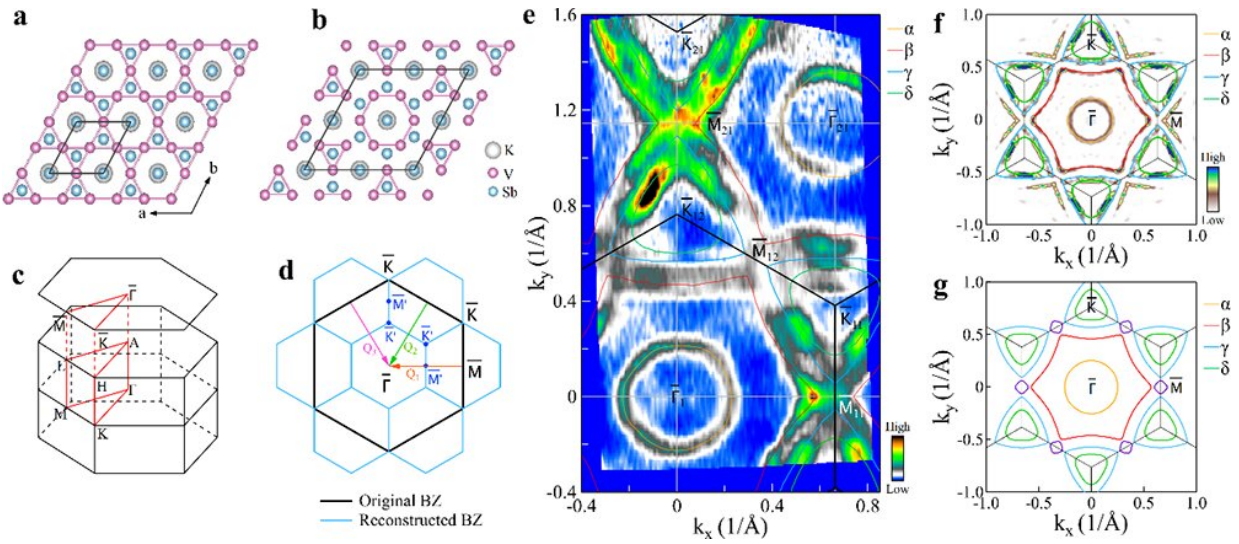
Researchers reveal electronic nature of charge density wave and electron-phonon coupling in Kagome superconductor

February 18 2022, by Zhang Nannan



Crystal structure and Fermi surface of KV_3Sb_5. Credit: Institute of Physics

Recently, the Kagome superconductors AV_3Sb_5 (A = K, Rb and Cs) have attracted enormous attention due to their novel phenomena and rich physics. They exhibit unconventional charge density wave (CDW), giant anomalous Hall effect and superconductivity. The CDW state is intimately related to the anomalous Hall effect and competes with superconductivity under pressure. Investigating the electronic structure of the CDW state is essential to understand its nature and the related

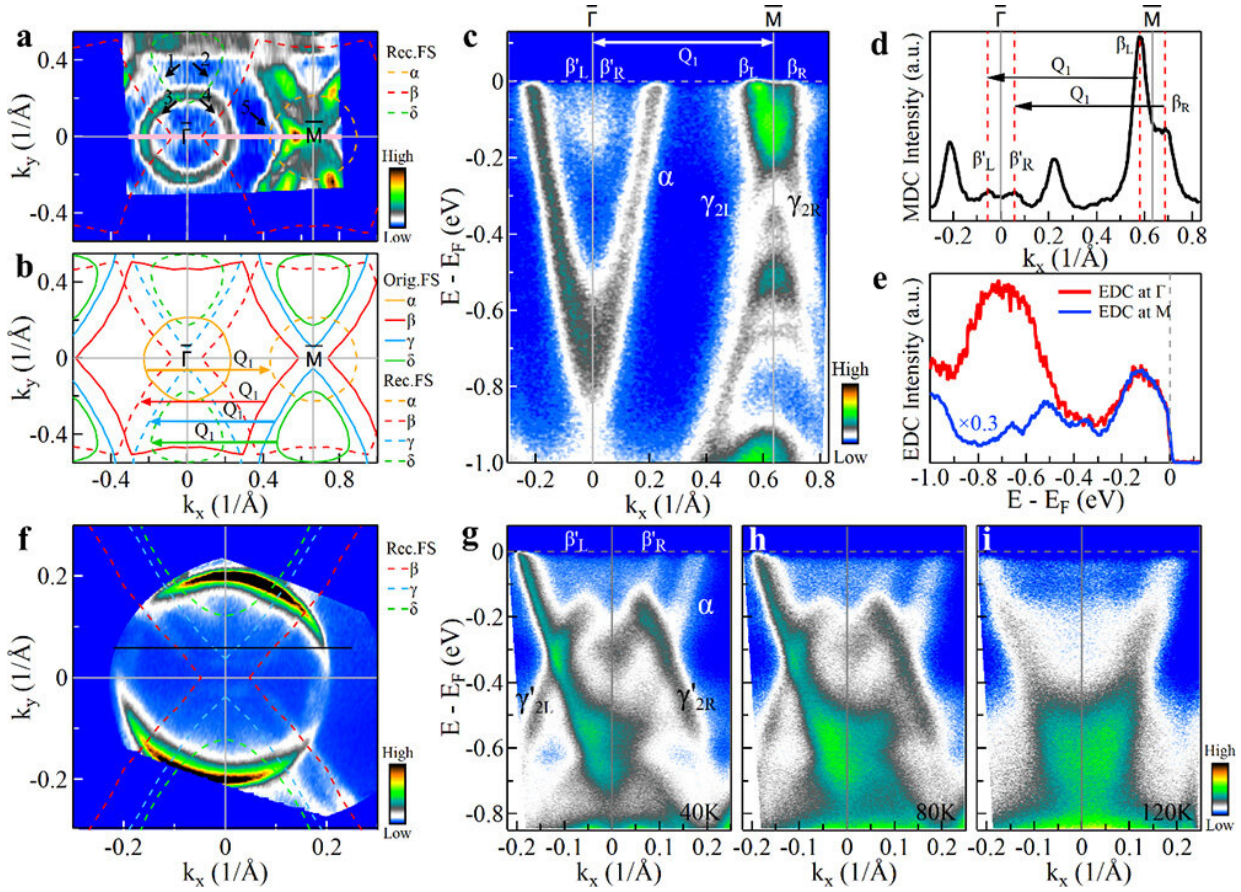
physical properties.

High-resolution angle-resolved photoemission spectroscopy (ARPES) is a powerful technique to study the electronic structures of materials in the momentum space. Recently, Luo Hailan in Prof. Zhou Xingjiang's group from the Institute of Physics of the Chinese Academy of Sciences (CAS) carried out high-resolution ARPES measurements on KV_3Sb_5 and revealed the nature of the CDW and electron-phonon coupling in KV_3Sb_5.

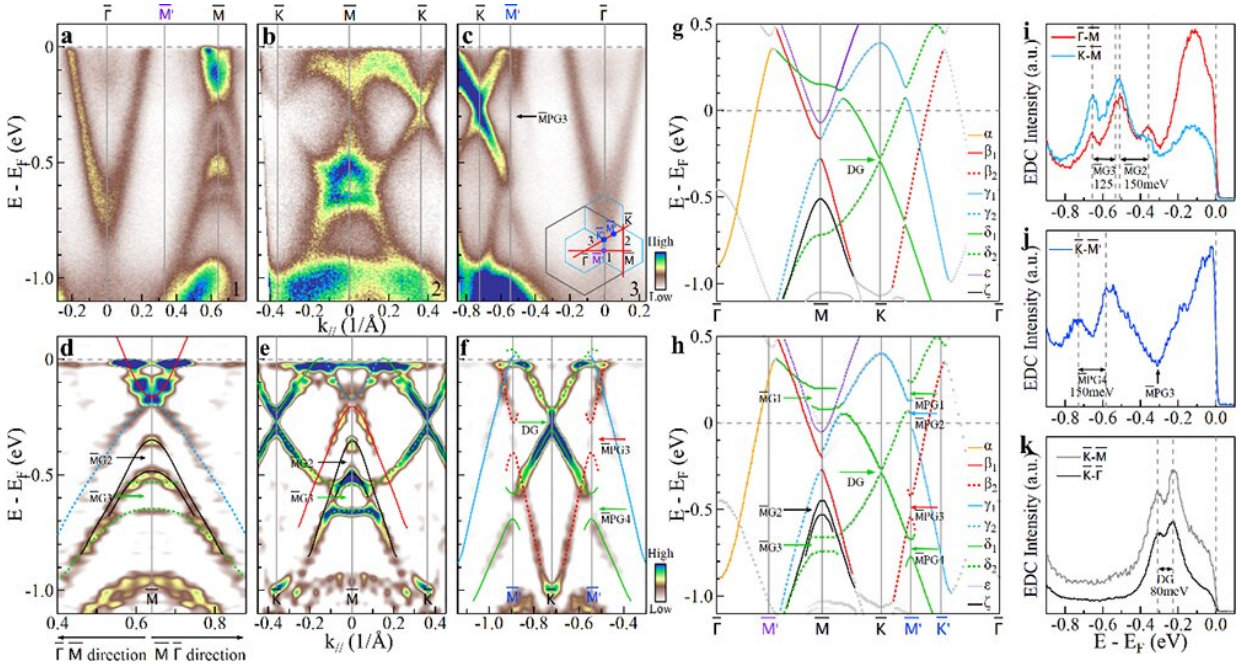
From the ARPES measurements, the researchers observed clear evidence of the 2×2 CDW-induced electronic structure reconstruction. These include the Fermi surface reconstruction, the associated band-structure foldings between the boundary and the center of the pristine Brillouin zone, and the CDW gap openings at the boundary of the pristine and reconstructed Brillouin zones.

Near the Fermi level, the Fermi surface-dependent and momentum-dependent CDW gap was measured and a strong anisotropy of the CDW gap was observed for all the V-derived Fermi surface sheets.

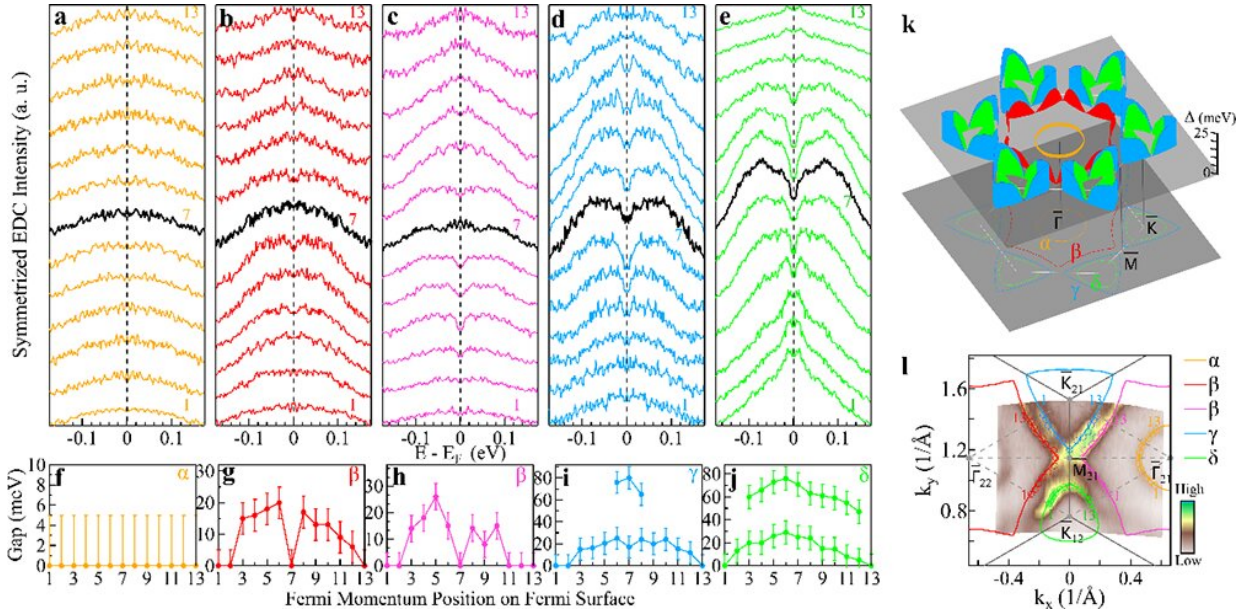
Moreover, signatures of the electron-phonon coupling were revealed for all the V-derived bands.



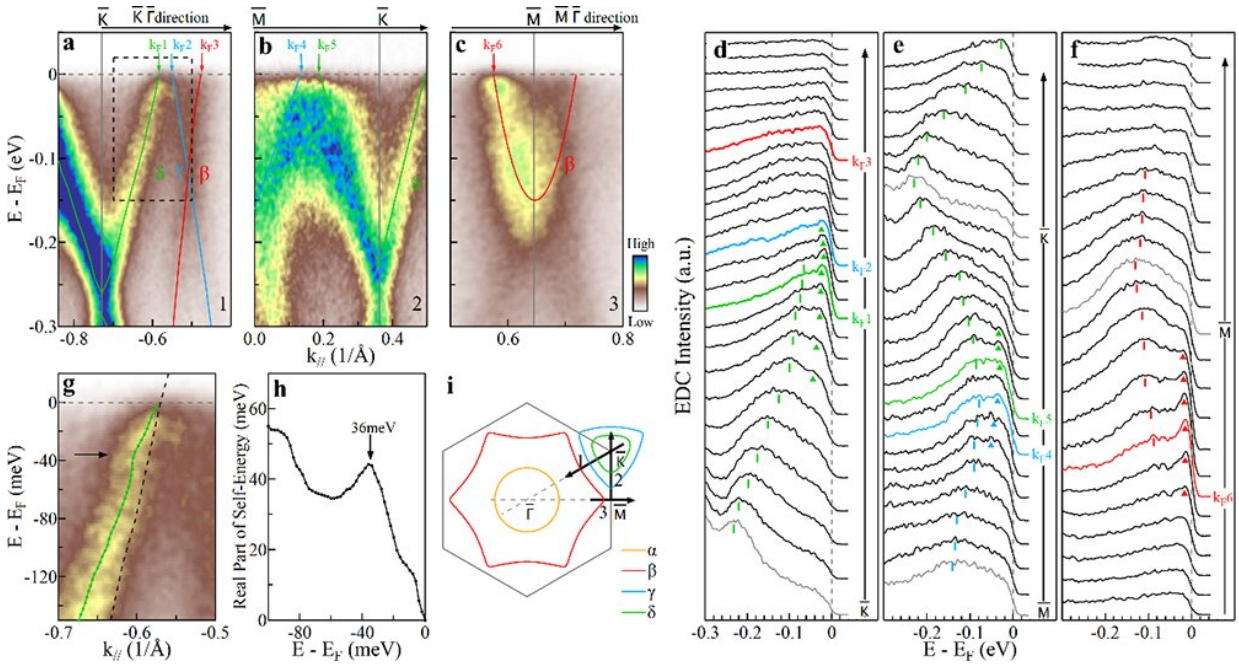
Evidence of electronic structure reconstruction in KV_3Sb_5. Credit: Institute of Physics



CDW-induced band splitting and gap opening in the measured band structures of KV_3Sb_5 at 20 K and their comparison with band-structure calculations. Credit: Institute of Physics



Fermi surface-dependent and momentum-dependent CDW gaps of KV_3Sb_5 measured at 5 K. Credit: Institute of Physics



Signatures of the electron–phonon coupling in KV_3Sb_5. Credit: Institute of Physics

These observations indicate that the electron-phonon coupling may play a dominant role in driving the CDW transition. They also provide key information in understanding the origin of the CDW and its interplay with other physical properties in AV_3Sb_5 Kagome superconductors.

This study was published in *Nature Communications*.

More information: Hailan Luo et al, Electronic nature of charge

density wave and electron-phonon coupling in kagome superconductor KV3Sb5, *Nature Communications* (2022). DOI: 10.1038/s41467-021-27946-6

Provided by Chinese Academy of Sciences