New cuprate superconductor may challenge classical wisdom
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Superconductivity is one of the most mysterious phenomena in nature in that materials can conduct electrical current without any resistance. Cuprates hold the record high superconducting temperature at ambient pressure so far, but understanding their superconducting mechanism remains one of the great challenges of physical sciences listed as one of 125 quests announced by Science.

The recent discovery by Prof. Jin Changqing’s team at Institute of Physics of the Chinese Academy of Sciences (IOPCAS) on a new high Tc superconductor Ba$_2$CuO$_{4-?}$ shows two unique features: an exceptionally compressed local octahedron and heavily over-doped hole carriers.

These two features are in sharp contrast to the favorable criteria for all previously known cuprate superconductors.

The compressed local octahedron results into a reversed orbital order with $3z^2$ lifted above $3dx^2-y^2$ leading to a strong multiband scenario, while the overdoped state violates the previous holding for a superconducting phase.

Impressively, the new material demonstrates superconducting transition temperature with Tc above 73 K, 30 K higher than that of the isostructural classical "conventional" superconductor based on La$_2$CuO$_4$.

Thus, the discovery of high Tc superconductivity in Ba$_2$CuO$_{4-?}$ calls into question the widely accepted scenario of superconductivity in the cuprates.

This discovery provides a totally new direction to search for further high Tc superconductors.
Fig. 3. XAS measurements (A) O-K edge. (B) Cu-L3 edge showing the extremely overdoping state. Credit: Jin Changqing


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