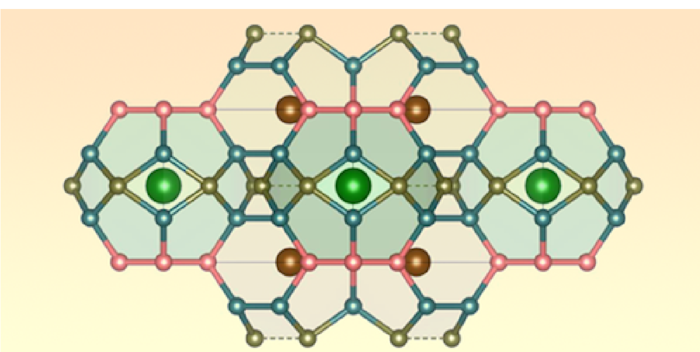
How a Superconductor Broke the Record

Researchers have identified the reason a high-pressure, high-temperature superconductor outperforms other similar compounds.

By **Marric Stephens**

Hydrogen-dense materials known as superhydrides can superconduct near room temperature—provided they are subjected to pressures above 150 gigapascals (GPa). Now Yanming Ma at Jilin University in China and colleagues have explained why one of those superhydrides, $LaSc_2H_{24}$, outperforms the best runner-up, LaH_{10} [**1**].

$LaSc_2H_{24}$ and LaH_{10} are metal clathrate superhydrides: Their unit cells consist of metallic elements surrounded by cages of hydrogen ions. This class of superconductor came to prominence in 2019 when LaH_{10} was shown to superconduct at the then-record temperature of 250–260 K (see **Viewpoint: Pushing Towards Room-Temperature Superconductivity**). Soon after, Ma and colleagues calculated that $LaSc_2H_{24}$ should go even higher, a prediction that was borne out when his team synthesized the compound and measured a critical temperature T_c of 298 K at 260 GPa. Despite this success, the theoretical tool that the researchers used to make their prediction did not elucidate why the additional scandium atoms in $LaSc_2H_{24}$ have the effect that they do.


Credit: Z. Wang *et al.* [**1**]

To solve this mystery, Ma and colleagues studied $LaSc_2H_{24}$ using a more sophisticated model. The T_c below which LaH_{10} becomes a superconductor, though high, is limited by an anisotropy in the material's electronic band structure that opens two different superconducting channels with two different values of T_c. The team found that the scandium atoms in $LaSc_2H_{24}$ modify this electronic structure via their 3*d* orbitals, which provide bridges that connect the 1*s* orbitals of the hydrogen atoms. This bridging provides a continuous pathway for electron transport, which makes the band structure more isotropic and unifies the two gaps. The scandium atoms also distort and soften the H–H bonds, which raises T_c by strengthening the quantized lattice vibrations that sustain the superconducting state. Next, the researchers will try to synthesize the related compound La_2ScH_{36}, which they predict could have an even higher T_c.

Marric Stephens is a Corresponding Editor for ***Physics Magazine*** based in Bristol, UK.

REFERENCES

1. Z. Wang *et al.*, "Isotropic superconductivity in the room-temperature superconductor $LaSc_2H_{24}$," **Phys. Rev. B 114, 154501 (2026).**

DOI: 10.1103/Physics.19.s109