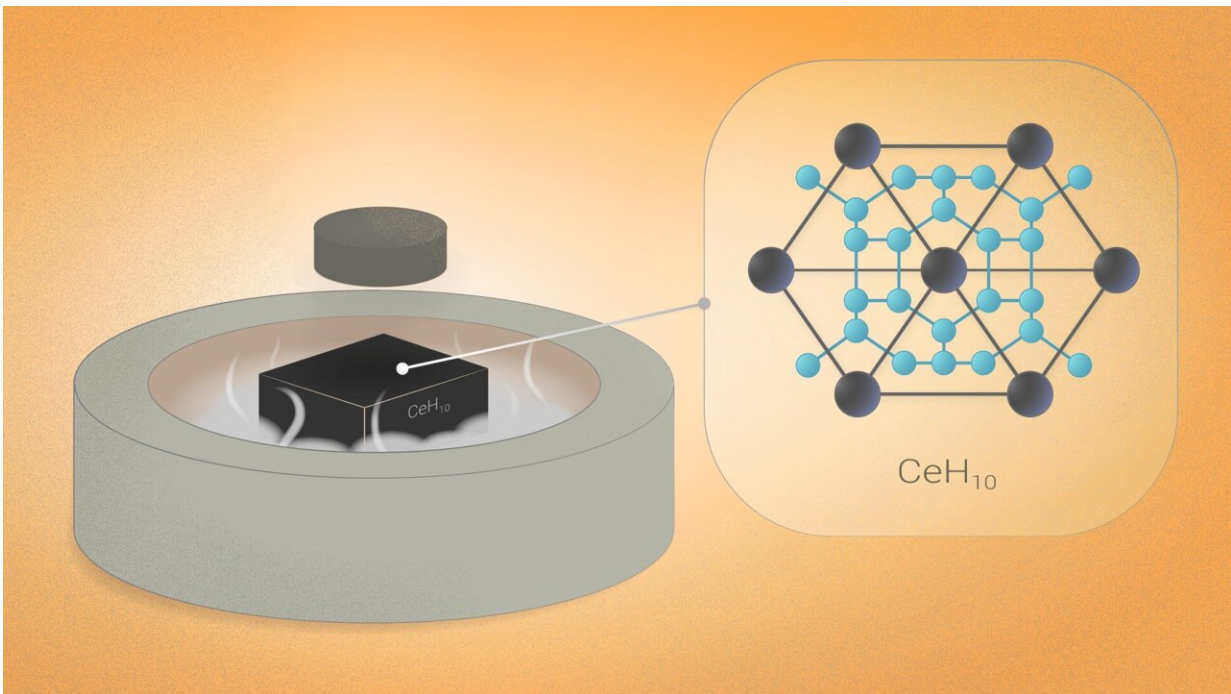


New cerium superhydrides become stepping stones to 'Goldilocks' superconductors

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Structure of cerium superhydride CeH_{10} synthesized by the researchers and shown to be a high-temperature superconductor. Credit: Pavel Odinev/Skoltech

Researchers from Skoltech and their colleagues from China have experimentally shown superconductivity in cerium superhydrides CeH_9 and CeH_{10} , pointing the way to lower-pressure and potentially room-temperature superconductors. The paper was published in the journal *Physical Review Letters*.

The road to superconductivity, an extremely attractive physical property of some materials that do not lose energy to heat because they have zero resistance, lies through tough terrain. It requires either extremely [low temperatures](#) (we're talking 135 K, or minus 138 degrees Celsius, at the warmest) or extremely [high pressure](#) (in 2019, LaH10 was found to become superconducting at -23 C and 1.7 million atmospheres, and in 2020 a S-C-H compound was found to superconduct at +15 C and 2.7 million atmospheres). Scientists are working to "normalize" superconductors, looking for compounds that would have this property at close to [room temperature](#) and a somewhat less terrifying [pressure](#).

Continuing the long-running quest that combined theory and experiment, Skoltech Professor Artem R. Oganov and Ph.D. student Dmitrii Semenov joined forces with the team of Professors Tian Cui, Xiaoli Huang (Jilin University) and Ph.D. student Wuhao Chen. This team has demonstrated superconductivity in CeH₉, a cerium superhydride they had discovered earlier in 2019, and in the newly synthesized CeH₁₀.

"Cerium hydrides are remarkable compounds. Stable and displaying [high-temperature superconductivity](#) at lower pressures than any other superhydrides (about 0.8 million atmospheres), they serve as an ideal starting point to further study the mechanism of superconductivity in these fascinating compounds, and design other superconductors, stable at even lower pressures," the authors write.

"Earlier we established a remarkably close relationship between the periodic table and superconductivity of hydrides—and we believe it should apply not just to hydrides. Take La and Ce—they are neighbors in the [periodic table](#) and indeed both form high-temperature superconductors. However, there are differences: LaH₁₀ superconducts at higher temperatures, while CeH₁₀ is stable at lower pressures," Artem R. Oganov says.

The authors point out that now binary hydrides are mostly explored. "Now we need to carefully think how to combine the elements to achieve higher-temperature superconductivity at lower pressures in ternary hydrides. We know which elements lead to higher-temperature [superconductivity](#) and begin to learn which lead to stability at lower pressures. These are the main notes, but it takes imagination to combine them in a melody," Dmitrii Semenov adds.

More information: Wuhao Chen et al, High-Temperature Superconducting Phases in Cerium Superhydride with a T_c up to 115 K below a Pressure of 1 Megabar, *Physical Review Letters* (2021). [DOI: 10.1103/PhysRevLett.127.117001](https://doi.org/10.1103/PhysRevLett.127.117001)

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