

# Raman fingerprint of high-temperature superconductivity in compressed hydrides

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## Abstract (do not remove this word, but do remove all text between parentheses)

The discovery of high-temperature superconductivity in hydrogen-rich compounds under extreme

pressures [1, 2] has prompted great excitement, intense research, but also debate over the past decade. Electrical transport has been the primary diagnostic tool for identifying superconductivity in these systems, whereas complementary probes, including magnetic, spectroscopic, tunnelling and ultrafast methods, can be qualitative due to experimental constraints and sample heterogeneity [3–7]. Recent concerns over their reliability have fuelled controversy, leading to scepticism [8, 9] and pointing out the need for alternative, quantitative approaches [10, 11]. In this study, we acquired unprecedented high-quality Raman spectra of hexagonal LaH<sub>10</sub> at approximately 145 GPa and low temperatures, in conjunction with electrical transport measurements. Upon cooling, we observe a drop of resistivity and simultaneous remarkable variations of phonon frequencies and linewidths. These effects are interpreted and well reproduced by the Migdal–Eliashberg theory, providing strong evidences of phonon-mediated superconductivity and enabling a quantitative determination of the superconducting energy gap. Our results establish Raman spectroscopy as a robust, contact-free probe with micrometric resolution for studying high temperature superconductivity, opening a powerful route to its discovery and characterization.

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