

## What causes superconductivity in materials?

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The conventional London-BCS theory of superconductivity [1] says that the electron-phonon interaction is what causes superconductivity in many materials, the so-called conventional superconductors. Instead, I will argue that what determines whether any material is a superconductor or not is the nature of its charge carriers, whether electrons or holes, and that superconductivity cannot exist without hole carriers [2]. This is supported by the observation that the vast majority of superconducting elements have positive Hall coefficient [3]. I will explain the two key reasons why only materials with hole carriers can be superconductors, and resulting guidelines for the search for higher temperature superconducting compounds including room temperature superconductors.

[1] J. Bardeen, L. N. Cooper and J. R. Schrieffer, Phys. Rev. 108, 1175 (1957).

[2] References in <https://jorge.physics.ucsd.edu/hole.html>

[3] J. E. Hirsch, “Correlations between normal state properties and superconductivity”, Phys. Rev. B 55, 9007 (1997)