**Regular Distribution Pattern of charged Carriers in High-Temperature and Conventional Superconductors**

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**Abstract**

The transition from the normal to the superconducting state is considered to be a phase transition happening at a so-called critical transition temperature \(T_c\) which is a characteristic value of each material. For high-temperature superconductors (HTSC) the parent materials have to be doped at an appropriate level to become superconducting at all. A uniform doping distribution results in squared or hexagonal doping patterns depending on the tetragonal or orthorhombic unit cell of the parent compound. For HTSCs there exists a correlation between the doping distance \(x\) and the inverse of \(T_c\) in the form \((2x)^2 = \frac{m_1}{\frac{1}{T_c}}\) which can be explained by the particle-in-a-box (PiB) concept leading to the relation \((2x)^2n_1 \approx 2M_{\text{eff}}\pi k_B T_c \approx \hbar^2\), where \(n_1\) is the number of CuO\(_2\) planes per chemical formula and \(M_{\text{eff}} = 2m_e\).

In this paper it will be shown that conventional superconductors (SC) with simple and highly symmetrical structures also show a linear correlation in the form \((2x)^2 \cdot \frac{N_{\text{eff}}}{N_{\text{sym}}} = \frac{m_2}{\frac{1}{T_c}}\). Here \(x\) describes the distance between participating atoms forming a straight line of equidistant particles, \(N_{\text{eff}}\) is the number of participating electrons per atom and \(N_{\text{sym}}\) is a symmetry factor. As an example, MgB\(_2\) \((T_c \approx 39\ \text{K})\) and Nb \((T_c \approx 9.2\ \text{K})\) show a hexagonal current channel distribution with \(N_{\text{eff}} = 2\) outermost electrons and \(N_{\text{sym}} = 12\) for MgB\(_2\) and \(N_{\text{eff}} = 1\) and \(N_{\text{sym}} = 1\) for Nb respectively. Even the transition temperature of superfluid Helium-4 and the atomic distance \(x\) according to the density and \(N_{\text{eff}} = 2\) matches the straight line quite well.