Isotope effect

It was found that the critical temperature of superconductors varies with isotopic mass .

The value of T_C for mercury varies from 4.185 K to 4.146 K while the average atomic mass M varies from 199.5 to 203.4 a.m.u .

If the different isotopes of the same element are mixed , the transition temperature changes uniformly . For each series of isotopes the experimental results may be fitted by a relation given below

$$M^{\alpha} T_C = \text{constant} \qquad (1)$$

Where α is a number which is a generally equal to 0.5

$$M^{1/2} T_c = \text{constant} \qquad (2)$$

Thus we conclude that heavier the isotopic mass , lower the critical temperature .

Hence the heavier isotopic mass decreases the lattice vibration

which indicates that the superconductivity is due to lattice interactions .

The superconducting transition temperature does not depend upon the neutrons in the nucleus . According to the result obtained from BCS model we can write

$$T_C \alpha \theta_{Debye} \propto M^{-1/2}$$

Hence the value of $\alpha = ½$