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Thermodynamics and quantum superconductivity

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ABSTRACT *According to the theories of superconductors can be classified depending on behavior against a magnetic field. Apart from having a zero resistance, the Meissner effect is produced, which is due to the formation of currents or superficial lines of force in the material that create a magnetic field equal to and opposite to the external field (as a mirror), generating a repulsion between the magnetic field generated by a magnet and the superconductor (levitates one over the other), but when a strong magnetic field is applied to a superconductor where the temperature of the material is less than or equal to the critical temperature the superconductivity state is destabilized when penetrating the magnetic field inside the material, returning to its normal state even though it has one below the critical temperature, finding a relationship of the lower the temperature of the material, the greater the magnetic field must be applied to leave the superconductor state.*

KEYWORDS *Superconductivity, magnetic induction, thermodynamics, Ginzburg-Landau, topological superconductor*

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I. INTRODUCTION

The thermal and electrical flow problem in materials or biomaterials is generally based on phenomenological models involving Newton, Fourier or generalized laws depending on the variables: temperature, pressure, external magnetic field ([4]-[11]).

With conventional technology, the electrical conductivity is limited by resistance in the flow of electric current, for this reason energy is lost when electrons move in the crystalline network the kinetic energy is transformed into heat (Joule effect), such condition can be overcome when developing superconductor technology.Every time that one speak about the external magnetic field cannot penetrate inside the superconductor in its superconductivity state or whatever other problem of contact as well. It depends on the involved material with or without memory at any way one has mainly the model given by a partial differential equation of type parabolic such is the case the topology considered plays a fundamental rol since is according to the solution that we want find out. As we know a topological space can be slightly equivalent to other topological space for instance if $\mathcal{S}$and $\mathcal{T}$ are two topologies on a nonempty set X . $\mathcal{S}$ is called finer than $\mathcal{T}$(or $\mathcal{T}$ is called coarser than $\mathcal{S}$), if every $\mathcal{T}$- open set is $\mathcal{S}$–open. That is, one can deform the elements of a set X through the topology and more still studying the isotopies of manifold. In spite of the quantum physics, the particles have their quantized properties such as energy, momentum, angular momentum, spin (intrinsic angular momentum of the electron). This means that these properties cannot take any value but only certain allowed values.

II. MAGNETIC INDUCTION VERSUS TEMPERATURE

According to the theories of superconductors can be classified depending on behavior against a magnetic field. Type I superconductors Apart from having a zero resistance, the Meissner effect is produced, which is due to the formation of currents or superficial lines of force in the material that create a magnetic field equal to and opposite to the external field (as a mirror), generating a repulsion between the magnetic field generated by a magnet and the superconductor (levitates one over the other), but when a strong magnetic field is applied to a superconductor where the temperature of the material is less than or equal to the critical temperature the superconductivity state is destabilized when penetrating the magnetic field inside the material, returning to its normal state even though it has one below the critical temperature, finding a relationship of the lower the temperature of the material, the greater the magnetic field must be applied to leave the superconductor state.

III. EMPIRICAL RELATIONSHIP OF MAGNETIC INDUCTION WITH TEMPERATURE

The empirical formula:

$$H_C(T) = H_0\left[1 - \left(\frac{T}{T_C}\right)^2\right]$$

Quadratic relationship of magnetic field strength (or magnetic induction) with temperature See Fig. 1 where Some of these curves for different metals are shown. Obviously, for $T = T_c$, $H_c = 0$. On the other hand $H_c = H_0$ for $T = 0$.

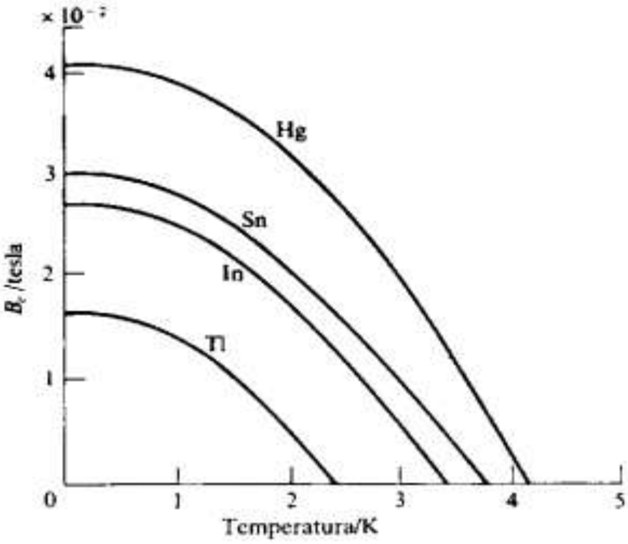

Figure 1: Conductor-superconductor phase diagram. Curve showing the dependence of the critical field, BC, with the temperature for different elements. Below the curve the materials are superconductors, being normal conductors above it (1).

It should be noted that:∂_+ HC (0) =0.For the Niobio Nb the value of the critical field required to cause the superconductivity to disappear at 6 K is 0.112 T (1).

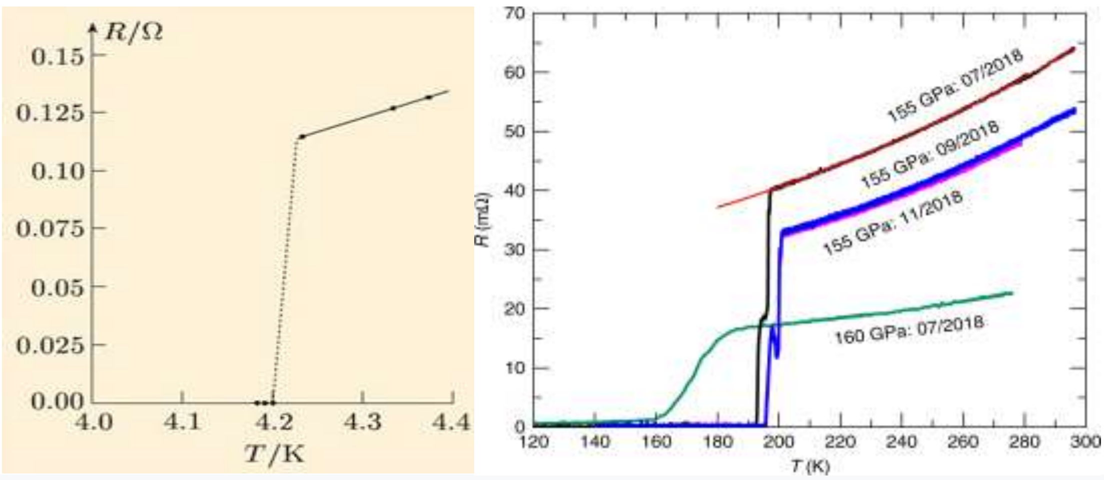

Figure 2. The variability of the resistivity with the Temperature–Pressure of the superconductor(1, 12)

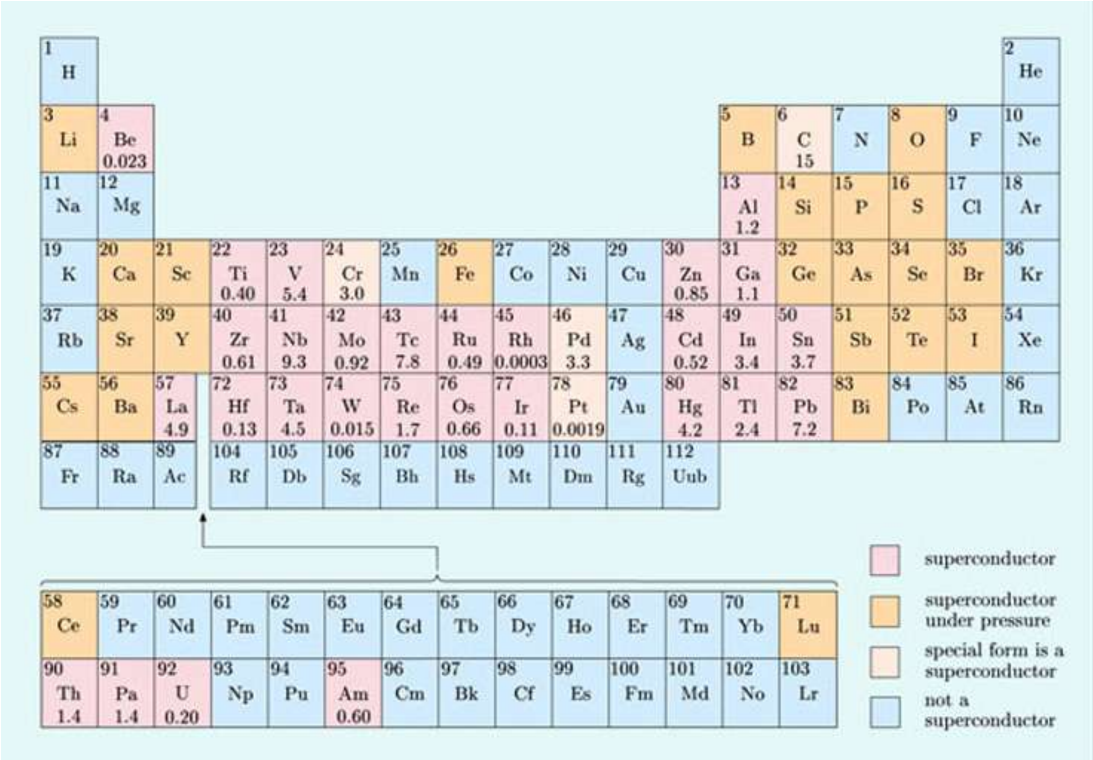

Figure 3. Non topological superconductors .

Types of superconductors of the quantic and non-quantic type. Of the non-quantic type we have the so-called type I and type II. The so-called unconventional superconductivity (12) for quantum computing application.

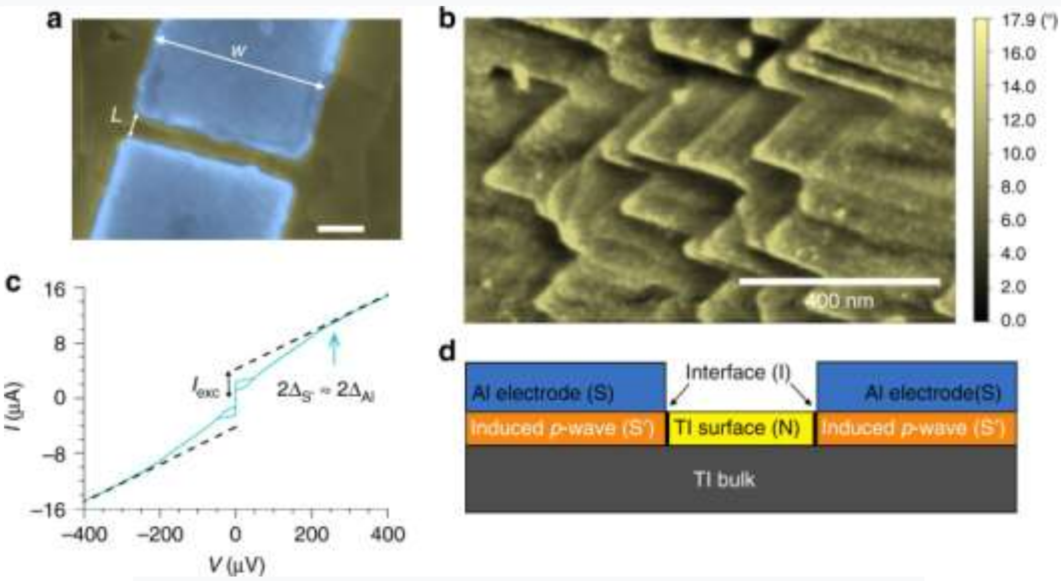

Figure 4. Superconductors of the quantic type of Charpentier, S. (12).

IV. THERMODYNAMICS WITH THE Ginzburg-LANDAU MODEL FOR SUPERCONDUCTORS

For the problem of the figure 4 we can formulate the Ginzburg-LANDAU MODEL and obtain the indicators. Similar problems are solved in [13].

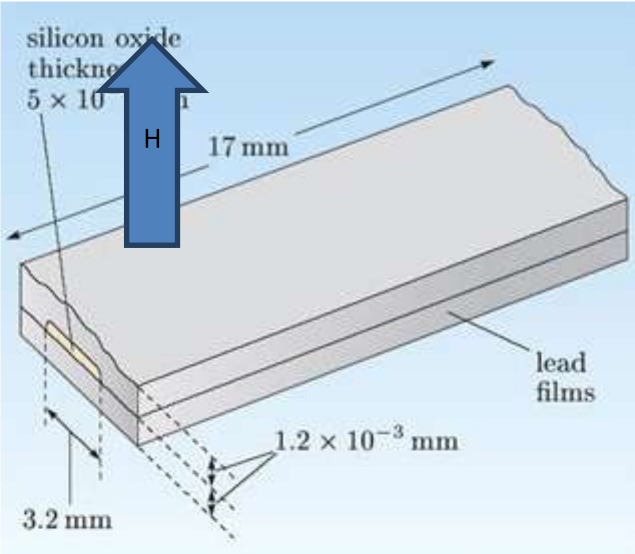

Figure 4. Superconductors with control parameters.

V. CONCLUSION

Null electrical resistance is the most important property of superconducting states, a second important feature is the fact that the external magnetic field cannot penetrate inside the superconductor in its superconductive state. The field generated by this current would cancel Bexterior exactly. The persistent induced current is estimate with another indicator (magnetic field).

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