Chapter 8

EXPERIMENTAL VERIFICATIONS AND APPLICATIONS IN SUPERCONDUCTIVITY

8.0.1 Introduction

An understanding of hadronic mechanics requires the knowledge that the new discipline and its underlying new mathematics are applicable in fields beyond particle physics, nuclear physics, and astrophysics. Another field of applicability of hadronic mechanics is superconductivity.

There is no doubt that quantum mechanics provides a good description of an *ensembles* of *Cooper (or electron) pairs* in superconductivity (see, e.g., Ref. [1]), when necessarily represented as points in oder to prevent major conflicts with the basic axioms of the theory. However, there is equally no scientific doubt that quantum mechanics cannot possibly represent the *structure of one isolated Cooper pair.*

The Cooper pair is a physical system requiring an *attractive* interaction among two *identical* electrons via the intermediate action of Cuprate ions, and the bond-correlation of the two electron is so "strong" that cooper pairs can even tunnel as a single particle according to clear experimental evidence.

But electrons repel each other according to quantum mechanics. therefore, to achieve an understanding of the bond-correlation, a conjecture was submitted according to which there is a new interaction between the two electrons mediated by a hypothetical particle called "phonon."

However, phonons represent elementary heat excitations-oscillations in a *crystal.* Consequently, it is difficult to understand how phonons can be propagated in vacuum from atom to atom in the fixed lattice of a crystal. Even assuming that this is possible, it is difficult to understand how phonons can create an *attraction* between pairs of identical electrons.

In any case, considered *ad litteram,* phonons are sound waves or at best, vibrations of the superconducting medium, in which case, again, it is evidently difficult to understand how such vibrations could propagate in vacuum and, in case this can be explained, how could they produce a real attraction between identical electrons.

Also, the 20-th century physics has identified all possible particles. Yet, this branch of physics has no evidence of phonons, as well as of the interactions electron-phonon.

The Cooper pair (CP) is an excellent physical system to test the effectiveness of isotopic methods at large. Comprehensive studies along these lines have been conducted by A. O. E. Animalu [2] who has introduced a nonlinear, nonlocal, and non-Hamiltonian realization of hadronic mechanics for the Cooper pair known as *Animalu's isosuperconductivity* that is in remarkable agreement with experimental data, and possesses intriguing and novel predictive capacities.

8.0.2 Animalu's Hadronic Superconductivity and its Experimental Verification

The birth of Animalu's Hadronic Superconductivity, or *isosuperconductivity* for short can be traced back to the structure model of the π^o meson submitted by Santilli in the original proposal to build hadronic mechanics (Ref. [3], Sect. 5)

$$\pi^0 = (\hat{e}^+_\uparrow, \hat{e}^-_\downarrow)_{\rm HM}, \tag{8.1}$$

where HM stands for hadronic mechanics, and $\hat{e}^-$ represents the *isoelectron*, that is, the ordinary electron when described via the isomechanics and related Galilei-Santilli isosymmetry for nonrelativistic description or the Poincaré-santilli isosymmetry for relativistic treatments. For brevity, in this chapter we study only the nonrelativistic profile, and refer to the quoted literature for the relativistic extension.

As familiar from Chapter 6, model (8.1) is based on the property that the nonlocal-nonpotential interactions due to deep wave-overlapping results in being strongly attractive for singlet coupling (only) irrespective of whether the Coulomb interaction is attractive or repulsive.

Isosuperconductivity is based on the *isoelectron pairs* (IEP) proposed by Animalu [2] and studied in details by Animalu and Santilli [3] at the 1995 Sanibel Symposium held in Florida that can represented with the symbol

$$\mathrm{IEP} = (\hat{e}^-_\uparrow, \hat{e}^-_\downarrow)_{\rm HM}, \tag{8.2}$$

A main property of model (8.2) is that *the attractive force caused by deep waveoverlapping of isoelectrons in singlet coupling is so strong to overcome the Coulomb interactions even when repulsive,* thus permitting the extension from model (8.1) to (8.2).

The quantitative representation of the above property can be outline as follows. Consider one electron with charge $-e$, spin up $\uparrow$ and wavefunction $\psi_\uparrow$ in the field of another electron with the same charge, spin down $\downarrow$ and wavefunction $\psi_\downarrow$ considered as *external*. Its Schrödinger equation is given by the familiar expression

$$H_{\text{Coul.}} \times \psi(t,r) = \left(\frac{1}{2m} p_k p^k + \frac{e^2}{r}\right) \times \psi_\uparrow(t,r) = E_0 \times \psi_\uparrow(t,r), \tag{8.3a}$$

$$p_k \times \psi_\uparrow(t,r) = -i \times \partial_k \psi_\uparrow(t,r), \tag{8.3b}$$

where m is the electron rest mass. The above equation and related wavefunction $\psi_\uparrow(t,r)$ represent *repulsion*, as well known. We are interested in the physical reality in which there is *attraction* represented by a new wavefunction here denoted $\hat{\psi}_\uparrow(t,r)$.

By recalling that quantum mechanical Coulomb interactions are invariant under unitary transforms, the map $\psi_\uparrow \to \hat{\psi}_\uparrow$ is representable by a transform $\hat{\psi} = U\psi$ which is *nonunitary*, $U \times U^\dagger = U^\dagger U = \mathcal{I} \neq I$, where $\mathcal{I}$ has to be determined (see below). This activates *ab initio* the applicability of hadronic mechanics as per Sect. 1.8. The first step of the proposed model is, therefore, that of transforming system (1.28) in $\psi_\uparrow$ into a new system in $\hat{\psi}_\uparrow = U \times \psi_\uparrow$ where U is nonunitary,

$$\begin{aligned} U \times H_{\text{Coulomb}} \times U^\dagger \times (U \times U^\dagger)^{-1} \times U \times \psi_\uparrow(t,r) = \\ = \hat{H}_{\text{Coulomb}} \times T \times \hat{\psi}_\uparrow(t,r) = \\ = \left(\tfrac{1}{2m} \hat{p}_k \times T \times \hat{p}^k + \tfrac{e^2}{r}\mathcal{I}\right) \times T \times \hat{\psi}_\uparrow(t,r) = E \times \hat{\psi}_\uparrow(t,r), \end{aligned} \tag{8.4a}$$

$$\hat{p}_k \times T \times \hat{\psi}_\uparrow(t,r) = -i \times T_k^i \times \partial_i \hat{\psi}_\uparrow(t,r). \tag{8.4b}$$

System (8.4) is incomplete because it misses the interaction with the Cu^{z+} ion represented by the familiar term $-ze^2/r$ [10]. The latter are not transformed (i.e., they are conventionally quantum mechanical) and, therefore, they should be merely added to the transformed equations (1.29). The formal equations of the proposed model $\text{CP} = (e^-_\uparrow, e^-_\downarrow)_{HM}$ are therefore given by

$$\begin{aligned} \left(\frac{1}{2m} \hat{p}_k \times T \times \hat{p}^k + \frac{e^2}{r} \times \mathcal{I} - z\frac{e^2}{r}\right) \times T \times \hat{\psi}_\uparrow(t,r) = \\ = \frac{1}{2m} \hat{p}_k \times T \times \hat{p}^k \times T \times \hat{\psi}_\uparrow + \frac{e^2}{r}\hat{\psi}_\uparrow - z\frac{e^2}{r} \times T \times \hat{\psi}_\uparrow(t,r) = \\ = E \times \hat{\psi}_\uparrow(t,r), \quad \hat{p}_k \times T \times \hat{\psi}_\uparrow(t,r) = -i \times T_k^i \times \partial_i \hat{\psi}_\uparrow(t,r). \end{aligned} \tag{8.5}$$

In order to achieve a form of the model confrontable with experimental data, we need an explicit expression of the isounit $\mathcal{I}$. Among various possibilities, Animalu [10] selected the simplest possible isounit for the problem at hand, which we write

$$\mathcal{I} = e^{-\langle\hat{\psi}_\uparrow|\hat{\psi}_\downarrow\rangle\psi_\uparrow/\hat{\psi}_\uparrow} \approx 1 - \langle\hat{\psi}_\uparrow|\hat{\psi}_\downarrow\rangle\psi_\uparrow/\hat{\psi}_\uparrow + \ldots,$$
$$\mathcal{T} = e^{+\langle\hat{\psi}_\uparrow|\hat{\psi}_\downarrow\rangle\psi_\uparrow/\hat{\psi}_\uparrow} \approx 1 + \langle\hat{\psi}_\uparrow|\hat{\psi}_\downarrow\rangle\psi_\uparrow/\hat{\psi}_\uparrow + \ldots, \tag{8.6}$$

under which Eqs. (8.5) can be written

$$\frac{1}{2m}\hat{p}_k T\hat{p}^k T\hat{\psi}_\uparrow - (z-1)\frac{e^2}{r}\hat{\psi}_\uparrow - \tag{8.7}$$
$$-z\frac{e^2}{r}\langle\hat{\psi}_\uparrow|\hat{\psi}_\downarrow\rangle(\psi_\uparrow/\hat{\psi}_\uparrow)\hat{\psi}_\uparrow(t,r) = E\hat{\psi}_\uparrow.$$

Now, it is well known from quantum mechanics that the radial part of $\psi_\uparrow$ in the ground state ($L = 0$) behaves as

$$\psi_\uparrow(r) \approx Ae^{-r/R}, \tag{8.8}$$

where A is (approximately) constant and R is the coherence length of the pair. The radial solution for $\hat{\psi}_\uparrow$ also in the ground state is known from Eqs. (5.1.21), p. 837, Ref. [3] to behave as

$$\hat{\psi}_\uparrow \approx B\frac{1 - e^{-r/R}}{r}, \tag{8.9}$$

where B is also approximately a constant. The last term in the l.h.s. of Eq. (8.9) behaves like a *Hulten potential*

$$V_0 \times \frac{e^{-r/R}}{1 - e^{-r/R}}, \quad V_0 = e^2\langle\hat{\psi}_\uparrow|\hat{\psi}_\downarrow\rangle. \tag{8.10}$$

After substituting the expression for the isomomentum, the radial isoschrödinger equation can be written

$$\left(-\frac{\mathcal{I}}{2\times\hat{m}}r^2\frac{d}{dr}r^2\frac{d}{dr} - (z-1)\frac{e^2}{r} - V_0\frac{e^{-r/R}}{1 - e^{-r/R}}\right)\times\hat{\psi}_\uparrow(r) = E\times\hat{\psi}_\uparrow(r), \tag{8.11}$$

where $\hat{m}$ is the isorenormalized mass of the isoelectron.

The solution of the above equation is known from Ref. [5e], Sect. 5.1. The Hulten potential behaves at small distances like the Coulomb potential,

$$V_{\text{Hulten}} = V_0 \times \frac{e^{-r/R}}{1 - e^{-r/R}} \approx V_0 \times \frac{R}{r}. \tag{1.37}$$

At distances smaller than the coherent length of the pair, Eq. (1.36) can therefore be effectively reduced to the form

$$\left(-\frac{1}{2\times\hat{m}}r^2\frac{d}{dr}r^2\frac{d}{dr} - V\frac{e^{-r/R}}{1-e^{-r/R}}\right)\times\hat{\psi}_\uparrow(r) = E\times\hat{\psi}_\uparrow(r), \tag{8.12a}$$

$$V = V_0\times R + (z-1)\times e^2, \tag{1.38b}$$

with general solution, boundary condition and related spectrum (see Ref. [3], pp. 837-838)

$$\hat{\psi}_\uparrow(r) = {}_2F_1(2\times\alpha+1+n, 1-\alpha, 2\times\alpha+1, e^{-r/R})e^{-\alpha\times r/R}\frac{1-e^{-r/R}}{r}, \tag{1.39a}$$

$$\alpha = (\beta^2 - n^2)/2n > 0, \quad \beta^2 = \hat{m}\times V\times R^2/\hbar^2 > n^2, \tag{8.12b}$$

$$E = -\frac{\hbar^2}{4\times\hat{m}\times R^2}\left(\frac{\hat{m}\times V\times R^2}{\hbar^2}\frac{1}{n} - n\right)^2, \quad n = 1,2,3,\ldots \tag{8.12c}$$

where we have reinstated $\hbar$ for clarity.

Santilli [3] identified the numerical solution of Eqs. (8.12) for the hadronic model $\pi^0 = (\hat{e}^+_\uparrow, \hat{e}^-_\downarrow)_{\text{HM}}$ (in which there is evidently no contribution from the Cuprate ions to the constant V), by introducing the parameters

$$k_1 = \hbar/2\times\hat{m}\times R\times c_0, \quad k_2 = \hat{m}\times V\times R^2/\hbar, \tag{8.13}$$

where c_0 is the speed of light in vacuum. Then,

$$V = 2\times k_1\times k_2^2\times\hbar\times c_0/R, \tag{8.14}$$

and the total energy of the state $\pi^0 = (e^+_\uparrow, e^-_\downarrow)_{\text{HM}}$ becomes in the ground state (which occurs for $n = 1$ for the Hulten potential)

$$\begin{aligned} E_{\text{tot},\pi^0} &= 2\times k_1\times[1-(k_2-1)^2/4]\times\hbar\times c_0/R = \\ &= 2\times k_1(1-\varepsilon^2)\times\hbar\times c_0/R. \end{aligned} \tag{8.15}$$

The use of the total energy of the π^0 (135 MeV), its charge radius ($R \approx 10^{-13}$ cm) and its meanlife ($\tau \approx 10^{-16}$ sec), then yields the values (Eqs. (5.1.33), p. 840, Ref. [3])

$$k_1 = 0.34, \quad \varepsilon = 4.27\times 10^{-2}, \tag{8.16a}$$

$$k_2 = 1 + 8.54\times 10^{-2} > 1. \tag{8.16b}$$

Animalu [10a] identified the solution of Eqs. (1.39) for the Cooper pair by introducing the parameters

$$k_1 = \varepsilon\times F\times R/\hbar\times c_0, \quad k_2 = KR/\varepsilon_{\text{F}}, \tag{8.17}$$

where $\varepsilon_{\rm F}$ is the iso-Fermi energy of the isoelectron (that for hadronic mechanics).

The total energy of the Cooper pair in the ground state is then given by

$$E_{\text{Tot, Cooper pair}} = 2\times k_1\times[1-(k_2-1)^2/4]\times\hbar\times c_0/R \approx k_2\times T_c/\theta_{\rm D}, \quad (8.18)$$

where $\theta_{\rm D}$ is the Debye temperature.

Several numerical examples were considered in Refs. [2]. The use of experimental data for aluminum,

$$\theta_{\rm D} = 428^0 K, \quad \varepsilon_{\rm F} = 11.6 \text{ eV}, \quad T_c = 1.18^0 K, \quad (8.19)$$

yields the values

$$k_1 = 94, \quad k_2 = 1.6\times 10^{-3} < 1. \quad (8.20)$$

For the case of $YBa_2Cu_3O_{6-\chi}$ the model yields [*loc. cit.*]

$$k_1 = 1.3 z^{-1/2}\times 10^{-4}, \quad k_2 = 1.0\times z^{1/2}, \quad (8.21)$$

where the effective valence $z = 2(7-\chi)/3$ varies from a minimum of $z = 4.66$ for $YBa_2Cu_3O_{6.96}$ ($T_c = 91^0 K$) to a maximum of $z = 4.33$ for $YBa_2Cu_3O_{6.5}$ ($T_c = 20^0 K$). The general expression predicted by hadronic mechanics for $YBa_2Cu_3O_{6-\chi}$ is given by (Eq. (5.15), p. 373, Ref. [10a])

$$T_c = 367.3\times z\times e^{-13.6/z}, \quad (8.22)$$

and it is in remarkable agreement with experimental data (see Figs. 1.21–1.23).

A few comments are now in order. The above Animalu-Santilli model of the Cooper pair is indeed nonlinear, nonlocal and nonpotential. In fact, the nonlinearity in $\hat\psi_\uparrow$ is expressed by the presence of such a quantity in Eqs. (1.31). The nonlocality is expressed by the term $\langle\hat\psi_\uparrow|\hat\psi_\downarrow\rangle$ representing the overlapping of the wavepackets of the electrons, and the nonpotentiality is expressed by the presence of interactions, those characterized by the isounit, which are outside the representational capabilities of the Hamiltonian H. This illustrates the necessity of using hadronic mechanics or other similar nonhamiltonian theories (provided that they are physically consistent), because of the strictly linear-local-potential character of quantum mechanics.

Note that, whenever the wave-overlapping is no longer appreciable, i.e., for $\langle\hat\psi_\uparrow|\hat\psi_\downarrow\rangle = 0$, $\mathcal{I}\equiv I$, quantum mechanics is recovered identically as a particular case, although without attraction.

The mechanism of the creation of the *attraction* among the *identical* electrons of the pair via the intermediate action of Cuprate ions is a general law of hadronic mechanics according to which *nonlinear-nonlocal-nonhamiltonian interactions due to wave-overlappings at short distances are always attractive*

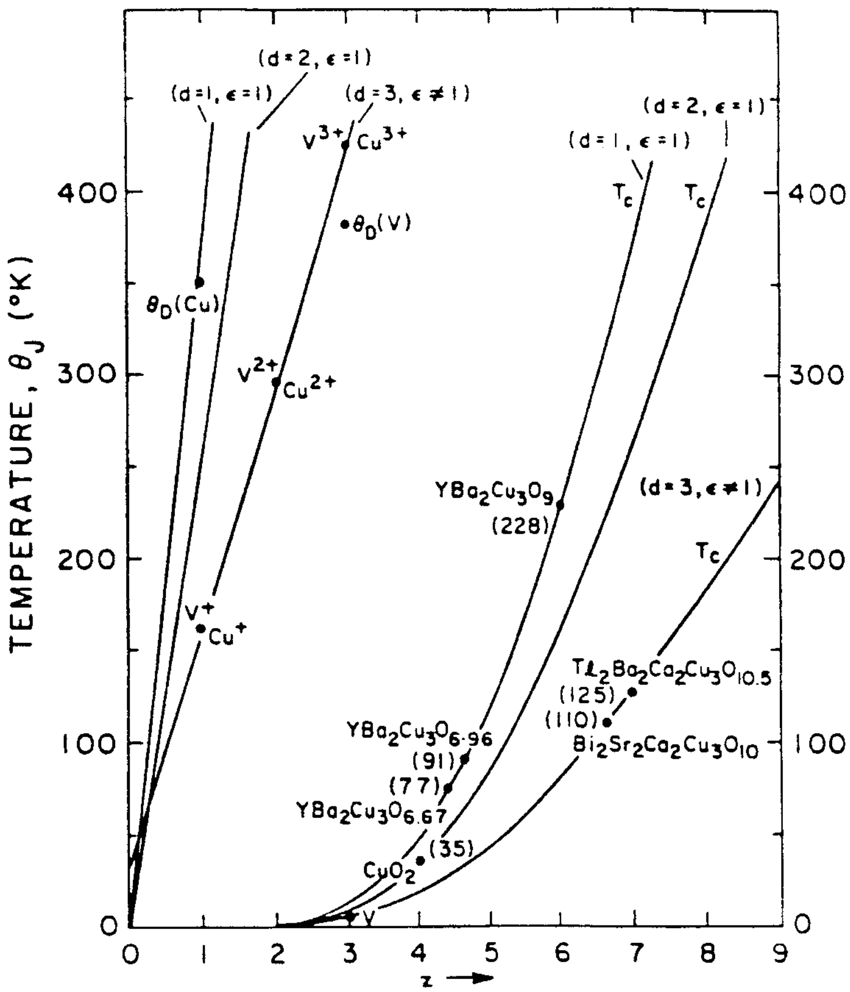

Figure 8.1. A reproduction of Fig. 10 of Ref. [10a] illustrating the remarkable agreement between the predicted dependence of T_c from the effective valence z of ions (continuous curve) and the experimental values on the "jellium temperature" for various compounds (solid dots).

in singlet couplings and such to absorb Coulomb interactions, resulting in total attractive interactions irrespective of whether the Coulomb contribution is attractive or repulsive. As noted earlier, the Hulten potential is known to behave as the Coulomb one at small distances and, therefore, the former absorbs the latter.

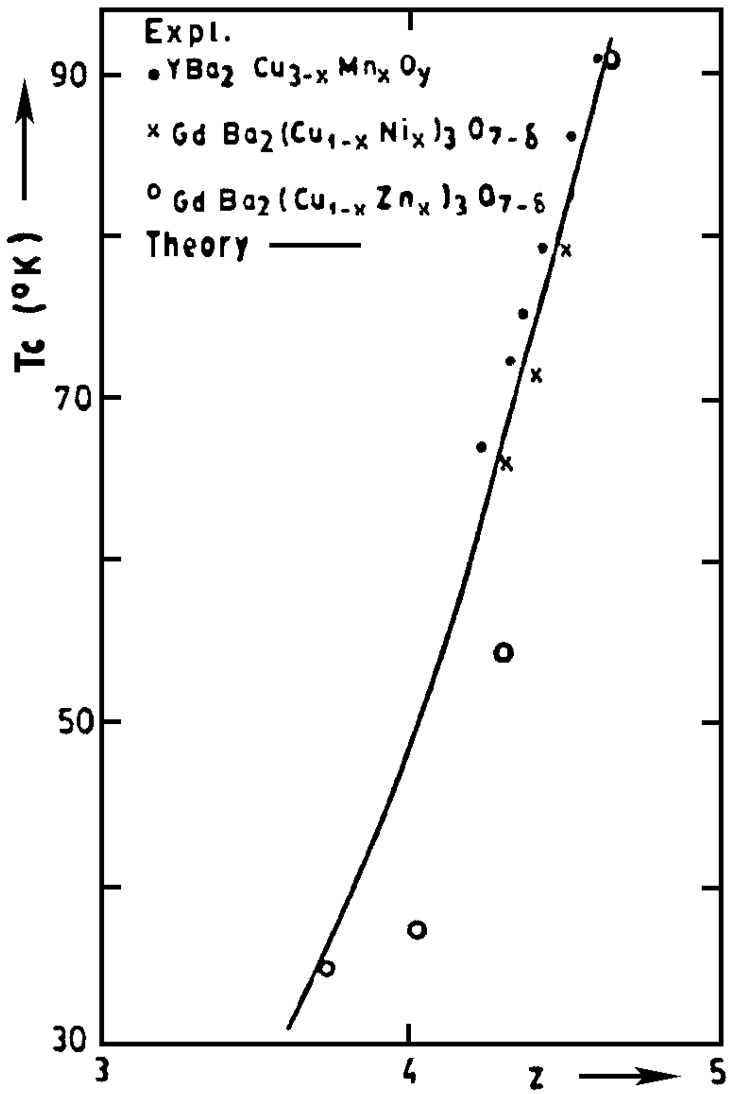

Figure 8.2. A reproduction of Fig. 5, p. 380 of Ref. [10a] showing the agreement between the prediction of isosuperconductivity for the doped 1:2:3 Cuprates and the experimental data.

Alternatively, we can say that within the coherent length of the Cooper pair, the Hulten interaction is stronger than the Coulomb force. This results in the overall attraction. Thus, the similarities between the model for the π^0 and that for the Cooper pair are remarkable. The applicability of the same model

Table 1. $YBa_2Cu_{3-x}Mn_xO_y$
(After N.L. Saini *et al.*, Int. J. Mod. Phys. B6, 3515 (1992)

x	y	z	T_c (theory)	T_c (expt.)
0.00	6.92	4.613	88.9	91
0.03	6.88	4.541	83.5	86.6
0.09	6.87	4.447	76.7	79.0
0.15	6.91	4.387	72.6	75.0
0.21	6.92	4.312	67.6	72.0
0.30	6.95	4.212	61.3	67.0

Note: T_c (theory) $= 367.3z\exp(-13.6/z)$, where the effect of replacing Cu_3 by $Cu_{3-x}Mn_x$ is obtained by replacing 3 by $(3-x)+2x=3+x$, which lowers the effective valence (z) on Cu^{z+} ions to $z=2y/(3+x)$.

Table 2. $GdBa_2(Cu_{1-x}Ni_x)_3O_{7-\delta}$
(After, Chin Lin *et al.*, Phys. Rev. B42, 2554 (1990))

x	$y=7-\delta$	z	T_c (theory)	T_c (expt.)
0.000	6.96	4.640	91.0	91
0.025	6.96	4.527	82.4	79
0.050	6.96	4.419	74.8	71
0.075	6.96	4.316	67.9	65

Note: T_c(theory) $= 367.3z\exp(-13.6/z)$, $z = 2y/3(1+x)$ as discussed in Table 1.

Table 3. $GdBa_2(Cu_{1-x}Zn_x)_3O_{7-\delta}$
(After, Chin Lin *et al.*, Phys. Rev. B42, 2554 (1990))

x	$y=7-\delta$	z	T_c (theory)	T_c (expt.)
0.000	6.96	4.640	91.0	91
0.025	6.96	4.309	67.4	54
0.050	6.96	4.009	49.0	37
0.075	6.96	3.737	36.1	35

Figure 8.3. A reproduction of the tables of p. 379, Ref. [10a] illustrating the agreement between the predictions of the model with experimental data from other profiles.

for other aspects should then be expected, such as for a deeper understanding of the valence, and will be studied in the next chapters.

Another main feature of the model is characterized also by a general law of hadronic mechanics, that *bound state of particles due to wave-overlappings at short distances in singlet states suppress the atomic spectrum of energy down to only one possible level.* The Hulten potential is known to admit a *finite* number of energy levels. Santilli's [5e] solution for the π^0 shows the suppression of the energy spectrum of the positronium down to only one energy level, 135 MeV of the π^0 for $k_2 > 1$. Similarly, the solutions for the Cooper pair [10] also reduce the same finite spectrum down to only one admissible level.

Excited states are indeed admitted, but they imply large distances R for which nonlinear-nonlocal-nonhamiltonian interactions are ignorable. This implies that all excited states are conventionally quantum mechanical, that is, they *do not* represent the π^0 or the Cooper pair. Said excited states represent instead the discrete spectrum of the ordinary positronium, or the continuous spectrum of repulsive Coulomb interactions among the two identical electrons.

Alternatively, we can say that, in addition to the conventional, quantum mechanical, Coulomb interactions among two electrons, there is *only one additional system* of hadronic type with *only one energy level* per each couple of particles, one for $\pi^0 = (e^+_\uparrow, e^-_\downarrow)_{\mathrm{HM}}$ and the other for the Cooper pair, CP $= (e^-_\uparrow, e^-_\downarrow)_{\mathrm{HM}}$.

The case of possible triplet couplings also follows a general law of hadronic mechanics. While singlets and triplets are equally admitted in quantum mechanics (read, coupling of particles at large mutual distances under their point-like approximation), this is no longer the case for hadronic mechanics (read, couplings of particles when represented as being extended and at mutual distances smaller than their wavepackets/wavelengths). In fact, *all triplet couplings of particles under nonlinear-nonlocal-nonhamiltonian interactions are highly unstable, the only stable states being the singlets.*

This law was first derived in Ref. [5e] via the "gear model", i.e., the illustration via ordinary mechanical gears which experience a highly repulsive force in triplet couplings, while they can be coupled in a stable way only in singlets. The possibility of applying the model to a deeper understanding of Pauli's exclusion principle is then consequential, and will be studied in Chapters 4 and 5.

The connection between the proposed model and the conventional theory of the Cooper pair is intriguing. The constant in the Hulten potential can be written

$$V_0 = \hbar\omega, \tag{8.23}$$

where ω is precisely the (average) *phonon frequency.* The total energy can then be rewritten

$$E_{Tot} = 2 \times \varepsilon_{\mathrm{F}} - E \approx 2 \times k_1 \times k_2 \times \hbar \times c_0 / R(e^{1/N \times V} - 1), \tag{8.24}$$

where $N \times V$ is the (dimensionless) *electron-phonon coupling constant.*

In summary, a main result of studies [2] is that *the conventional representation of the Cooper pair via a mysterious "phonon" can be reformulated without any need of such a hypothetical particle, resulting in a real, sufficiently strong attraction between the identical electrons, that is absent in the phonon theory.*

The above model of the Cooper pair see its true formulation at the relativistic level because it provides a *geometrization* of the Cooper pair, better possibilities for novel predictions and the best possible experiments tests. These profiles [10] will not be reviewed for brevity.

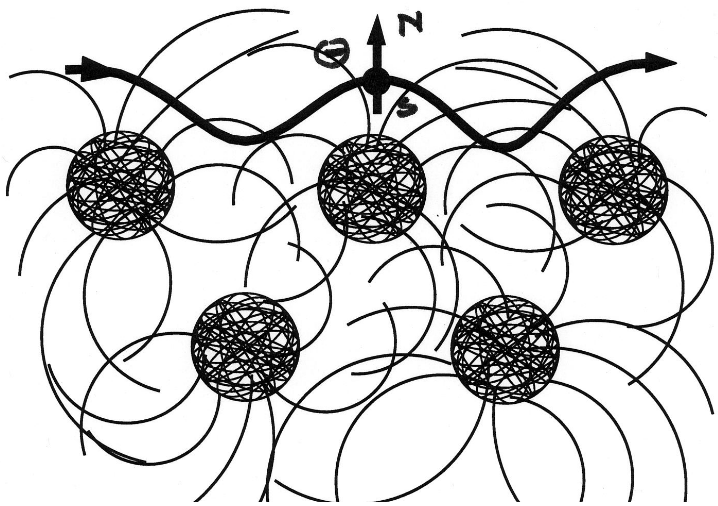

Figure 8.4. A schematic view of a conventional electric current, here represented with one electron (top view), moving in the surface of an ordinary conductor (lower view), illustrating the origin of the electric resistance due to interactions of both electric and magnetic type with the electromagnetic fields of the atoms of the conduyctor.

8.0.3 Novel Predictions of Animalu's Hadronic Superconductivity

As indicated in Section 1.2, besides the inability to achieve any understanding of the Cooper pair, anotehr major insufficiency of quantum mechanics is superconductivity is the well known exhaustion of all predictive capacities for the main objective of the theory, the achievement of superconductive capacity at ambient temperature.

Besides the achievement of a quantitative representation of the structure of the Cooper pair, one of the most important features of hadronic mechanics in superconductivity is precisely its capability of permitting *new* predictions.

One of them is a realistic possibility of achieving a form of superconductivity at ambient temperature that can be outlined as follows. Recall that the electric resistance originates from the interactions between the electric and magnetic fields of the electrons and those of atomic electron clouds (see Figure 8.4). Particular "obstructions" against the flow of electrons in conductors (thus causing resistance) originates from the interaction of the intrinsic magnetic field of electrons and the atomic electron cloud of the conductor.

The achievement of a quantitative understanding of the Cooper pair then permits the prediction and quantitative treatment of a *new electric current*

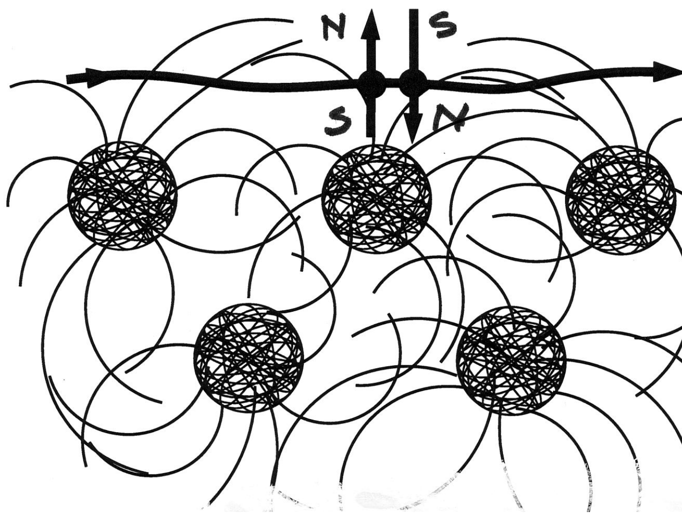

Figure 8.5. A schematic view of the new electric current predicted by hadronic superconductivity, consisting of the current of *electron pairs bonded in singlet,* in which case there is the absence of the magnetic field of the current constituents, with consequential reduction of the electric resistance.

characterized by a flow through ordinary conductors of isoelectron pairs, rather than individual electrons, as illustrated in Figure 8.4.

In fact, the total magnetic moment of the isoelectron pair can be considered as being null at interatomic distances, thus implying a dramatic decrease of the electric resistance, due to the reduction of the interactions between the current and the conductor to the sole Coulomb interactions.

Moreover, hadronic mechanics can assist in the creation of such a new current via the removal under sufficiently intense external electric fields of "valence pairs", rather individual electrons, from various substances (including plastic compounds and non-conducting materials), said substances being selected under the condition of having two unbonded valence electrons.

This is due to the fact that, as experimentally established in the helium, when not bonded into molecules, the electrons of a valence pair are not separated in an orbital but are generally coupled in singlet exactly along the structure of the isoelectron pair.

A rather intense research to achieve superconductivity at ambient temperature is under way in corporate circles which research, unfortunately, is not generally available to academia due to its novelty, that is, the use of methods and theories generally opposed by organized interests in academia at this time.

It is regrettably for scientific knowledge that this type of advanced corporate research cannot be reported in this monograph at this time.

References

[1] xxxxx

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