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# GENERALIZED SPECIAL RELATIVITY QUANTUM THEORY & JOSEPHSON SUPER CONDUCTING EFFECT

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## ABSTRACT

In this work Generalized Special Relativistic Quantum equation was derived. It is based on generalized special Relativity energy relation. This quantum relativistic model reduces to Klien-Gordon model when the potential vanishes; unlike Klien-Gordon it can describe relativistic particles affected by fields easily. This equation is proved to be successful in describing Josephson super conducting effect more easily than Schrödinger Equation.

***Keywords***- *Quantum Theory, Josephson super conducting effect etc.*

## I. INTRODUCTION

Super conductors are one of the widely used materials in many applications. they are characterized by a powerful generated magnetic field and a zero resistance below a certain critical temperature .the powerful generated magnetic resonance imaging (MRI) super magnetic trains and generation of powerful electricity energy [1,2,3].

Recently attention is played to the so called Josephson super conducting effect. In this effect an alternating current can be generated when an insulator inserted between two super conducting platen [4]. This alternating current generated car be utilized to generate high frequency electromagnetic waves (e.m).Such high frequency (e.m) are difficult to be generated by ordinary RLC circuits.

The expression for this super current for Josephson Effect can be found in any teat
[5]; this expression seems to be have nothing to which in concerned with high speed parties. This may be attributed to the fact that no relativistic quantum equation can explain this effect. This means that Klein-Garden and Dirac relativistic equations may suffer from some setbacks [6].

In this work quantum special relativity is derived in section three. Section four is devoted for expression of Josephson super current expression from this equation. Sections five & six are concerned with discussion and conclusion .Section two is concerned with speaking about Josephson Effect.

## II. NEW VERSION OF GSR ENERGY FORMULA AND GSR QUANTUM THEORY

The mass expression is given according to energy momentum conservation is given by [7]

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$$m = \gamma m_0 = \frac{m_0}{\sqrt{g_{00} - \frac{v^2}{c^2}}} \qquad (2.1)$$

This appears to be in direct conflict with the expression derived by [7]

$$m = g_{00}\gamma m_0 \qquad (2.2)$$

But this conflict can remove by re deriving the expression of energy [8]

Where
$T^{00} = \gamma m_0 c^2$(2.3)

$E = T_0^0 = g_{00} T^{00} = g_{00} \gamma m_0 c^2$ (2.4)
This conflict can be removed by lowering the insides in flat space by taking
$E = T_0^0 = \eta_{00} T^{00} = 1X\gamma m_0 c^2 = \frac{m_0}{\sqrt{g_{00} - \frac{v^2}{c^2}}}$ (2.5)

Therefore expressions (2.1) and (2.5) are the same.
Thus the energy is given by:

$$E = m_0 c^2 \left( g_{00} - \frac{v^2}{c^2} \right)^{-\frac{1}{2}} = (1 + \frac{2\phi}{c^2} - \frac{v^2}{c^2})^{-\frac{1}{2}} m_0 c^2$$

$$= \left( \frac{m^2 c^4 + 2(mc^2)(m\phi)}{m^2 c^4} - \frac{m^2 v^2 c^2}{m^2 c^4} \right)^{-\frac{1}{2}} m_0 c^2$$

$$= (E^{-2})^{-\frac{1}{2}} (E^2 + 2VE - P^2 c^2)^{-\frac{1}{2}} m_0 c^2$$

Therefore

$$(E^2 + 2VE - P^2 c^2)^{\frac{1}{2}} = m_0 c^2$$

$$E^2 + 2VE = P^2 c^2 + m_0^2 c^4 \quad (2.6)$$

It is very interesting to note that when the potential vanishes, i.e.
$v = 0$
Equation (2.6) reduces to

$$E^2 = P^2 c^2 + m_0^2 c^4 \quad (2.7)$$

This is the ordinary Einstein energy- momentum relation
The quantum new GSR equation can be obtained by using the free particle wave equation

$$\psi = e^{\frac{i}{\hbar}(px - Et)}$$

Where

$$-\hbar^2 \frac{\partial \psi^2}{\partial t^2} = E^2 \psi \qquad i\hbar \frac{\partial \psi}{\partial t} = E\psi$$

$$-\hbar^2 \nabla^2 \psi = P^2 \psi \quad (2.8)$$

Then by multiplying (2.6) by ψ and substituting (2.8)

$$E^2 \psi + 2VE\psi = P^2 c^2 \psi + m_0^2 c^4 \psi \quad (2.9)$$

$$-\hbar^2 \frac{\partial \psi^2}{\partial t^2} + 2i\hbar V \frac{\partial \psi}{\partial t} = -c^2 \hbar^2 \nabla^2 \psi + m_0^2 c^4 \psi \quad (2.10)$$

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This is the new quantum GSR equation.

## III. JOSEPHSON EFFECT CURRENT EXPRESSION ACCORDING TO NEW GSR

Consider solution of (5.10.10) in the form

$$\psi(\underset{\sim}{r},t) = f_0(t)C = f_0 e^{i\underset{\sim}{k}.\bar{r}} \quad (3.1)$$

A direct substitution of (3.1) in (2.10) yields

$$\left[-\hbar^2 \frac{\partial^2 f_0}{\partial t^2} + 2i\hbar V \frac{\partial f_0}{\partial t}\right] e^{i\underset{\sim}{k}.\bar{r}} = +c^2\hbar^2 k^2 f_0 e^{ikr} + m_0^2 c^4 f_0 e^{ikr}$$

Cancelling exponential terms on both sides yield

$$-\hbar^2 \frac{\partial^2 f_0}{\partial t^2} + 2i\hbar V \frac{\partial f_0}{\partial t} = P^2 c^2 f_0 + m_0^2 c^4 f_0 \qquad (3.2)$$

Consider very small mass and momentum such that

$$P^2 c^2 \longrightarrow 0 \qquad\qquad m_0^2 c^4 \longrightarrow 0$$

In this case equation (3.2) reads

$$-\hbar^2 \frac{\partial^2 f_0}{\partial t^2} + 2i\hbar V_e \frac{\partial f_0}{\partial t} = 0 \qquad (3.3)$$

Where $v_e$is the potential affecting one electron

Consider the solution

$$f_0 = D e^{\pm(\alpha t + \emptyset)i} \frac{\partial f_0}{\partial t} = \pm i\alpha f_0$$

$$\frac{\partial^2 f_0}{\partial^2 t^2} = -\alpha^2 f \qquad\qquad (3.4)$$

Substituting (3.4) in (3.3) yields

$$[\hbar^2\alpha^2 \pm 2\alpha V_e] f_0 = 0 \hbar^2\alpha^2 = \pm 2\alpha V_e$$

$$\alpha = \pm \frac{2V_e}{\hbar} (3.5)$$

Where

$$\theta = \emptyset - \alpha t \qquad (3.6)$$

According to equation (3.4) the general solution is in the form

$$f = D_1 e^{i\theta} + D_2 e^{-i\theta} \qquad (3.7)$$

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The current is given by

$$I = \frac{\partial Q}{\partial t} = e\frac{\partial|\psi|^2}{\partial t} = e\frac{\partial\psi\bar{\psi}}{\partial t}$$

$$I = e\frac{\partial f\bar{f}}{\partial t} \qquad (3.8)$$

When no potential is applied and when no separation is made by insulator between the super conductor sides.

$$I = 0 \qquad V_0 = 0 \qquad \alpha = 0 \qquad (3.9)$$

One of the possible solutions is to set

$f = 0$

In view of (3.8) and (3.4) one gets

$o = (D_1 + D_2)e^{i\emptyset}$

Thus

$$D_1 = D_2 = D \qquad (3.10)$$

Hence the solution will be according to equations (3.4), (3.6) and (3.10) in the form

$$f = D[e^{+i\theta} - e^{-i\theta}]$$

$$= D[\cos\theta + i\sin\theta - \cos\theta + i\sin\theta]$$

In view of equation (3.6) one gets

$$f = 2iD\sin\theta = 2iD\sin(\emptyset - \alpha t) \qquad (3.11)$$

According to cooper theory on have two electron pairs,if the total electric potential on both pairs is$V_0$. Thus the potential for each is ${}^1/_2\, V_0$.thus the total potential energy on the pair is

$$V = 2e\left(\frac{1}{2}V_0\right) = eV_0 \qquad (3.12)$$

The total potential of the cooper electron pair is also double that of a single electron. Thus

$$V = 2V_e \qquad (3.13)$$

Thus ὰ in equation (5.11.5) is given by

$$\alpha = \frac{\forall}{\hbar} = \frac{eV_0}{\hbar} \qquad (3.14)$$

The electric current can be obtained by inserting (3.11) in (3.8) to get

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$$I = e\frac{\partial}{\partial t}[4(i)(-i)D^2\sin^2(\emptyset - \alpha t)]$$

$$8eD^2\sin(\emptyset - \alpha t)[-\alpha\cos(\emptyset - \alpha t)]$$

$$I = -8e^2\alpha D^2\sin(\emptyset - \alpha t)\cos(\emptyset - \alpha t)$$

$$= -4e^2\alpha D^2\sin 2(\emptyset - \alpha t)$$

$$I = D_0\sin(\emptyset_0 - 2\alpha t) \quad (3.15)$$

Where

$$D_0 = -4e^2\alpha\, D^2\emptyset_0 = 2\emptyset \quad (3.16)$$

According to equations (3.4) ,(3.15)and (3.16) the super current is given by

$$I = D_0\sin\left(\emptyset_0 - \frac{2eV_0t}{\hbar}\right) (3.17)$$

The periodicity of Current requires

$$I(t+T) = I(t) \quad (3.18)$$

A according to equation (3.17)

$$\sin[\emptyset_0 - 2\alpha(t+T)] = \sin[\emptyset_0 - 2\alpha t]$$

$$\sin[\emptyset_0 - 2\alpha t]\cos 2\alpha T - \cos[\emptyset_0 - 2\alpha t]\sin 2\alpha T = 0$$

This requires

$\cos 2\alpha T = 1$ $\quad\quad$ $\sin 2\alpha T = 0$

$$2\alpha T = 2n\pi$$

$$\alpha = \frac{n\pi}{T} = n\pi f \quad (3.19)$$

If one choose n to by unity then

$n = 1$ $\quad\quad$ $\alpha = \pi f$ (3.20)

Thus equation (3.15) became

$$I = D_0\sin(\emptyset_0 - 2\pi f t) \quad (3.21)$$

Comparing eqn(3.17) and (3.21) yields

$$2\pi f = \frac{2eV_0}{\hbar}$$

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Hence:

$f = \frac{2eV_0}{\hbar}$ (3.22)

It is interesting to note that expressions (3.17, 3.21and 3.22) for super current and frequency are completely consistent with Josephson super current formula or expression.

## IV. DISCUSSION

Generalized Special relativity energy relation (2.7) beside the wave equation (2.8) for free particle isused to derive new relativistic equation as shown by equation (2.10). It is very interesting to observe that this equation reduces to Klein- Gordon equation in the absence of potential. This new equation is more advanced than Klein-Gordon one since it contains an expression of potential energy for any field. In Klein- Gordon equation the potential energy for each field requires deriving the quantum equation for each case which is very complex and time consuming.

## V. CONCLUSION

Generalized Special relativity quantum theory is more advanced that Schrödinger and Klein- Gordon equation. This is since it is capable of describing relativistic particles moving in afield. The success of this model in describing Josephson Effect raises a hope for using this model to describe all super conducting phenomena.

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