INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & MANAGEMENT

THE EFFECT OF SPEED AND POTENTIAL ON TIME, MASS AND ENERGY ON THE BASIS NEWTON AND RELATIVITY PREDICTION

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ABSTRACT

The nature of time, mass, and energy, and the effect of speed and potential field on them was experimentally tested. These experiments show that the time, mass, and energy are affected by both speed and potential.

Newtonian mechanics shows that only energy is affected by speed and potential. Thus it is in direct conflict with experiments that shows the effect of speed and potential on time and mass. However special relativity shows the effect of speed on time, mass, and energy but does not recognize the effect of potential on them.

But generalized special relativity shows that time, mass, and energy are affected by velocity as well as field potentials. Fortunately the theoretical relations agree with the empirical ones.

Keywords- *Newtonian Mechanics, Special Relativity, Generalized Special Relativity, Time Dilation, Relativistic mass.*

I. INTRODUCTION

The laws of physics depend on the concept of space, time and mass. According to Newton laws of motion these concepts are absolute in the sense that these quantities have the same value in all frames of references [1, 2]. Newton's laws of motion succeeded in explaining the motion of macro particles free space and fields.

Unfortunately the experiment done by Michelson and Morley found that the speed of light in vacuum is constant and in depend of the motion of the source or the observer . This result is in direct conflict with Newton's concept of the absoluteness of space and time. This motivates Einstein to propose his relativity theory which is known as special relativity (SR). In SR theory the space and time depends on the relative motion between the system and the observer .

Special relativity theory is concerned with relations between time length and masses in reference frames that moves relative to each others with constant velocity .

According to SR time length and mass are functions of the velocity with which physical events move with respect to the observer [3].

The SR succeed in explaining a great number of observations, for instance it can explain the meson decay, pair production and nuclear binding energy .

Despite these remarkable successes SR suffers from noticeable setbacks. The theory of SR suffers from noticeable setbacks. First of all its expression for energy does not satisfy Newtonian limit, for its expression at law speed gives matter energy beside kinetic energy only. The reduced SR energy does not contain an expression for the potential energy which is direct conflict with Newtonian one which consists of a term representing the potential energy beside the kinetic energy [4].

The theory of SR is also in direct conflict with the empirical relation for the red shift phenomena. The red shift phenomena states that the photon frequency change as it travels from free space to the gravitational field of the earth. The frequency change means that the mass and periodic time are effected as well . The observed effective mass in crystals show that the effect of crystal field on electron mass. The mass expression in SR has no room for the effect of the potential on mass .[5,6]

ISSN 2277 – 5528
Impact Factor- 3.145

Different attempts were made to modify SR [18]. In Savakas model the energy and length are found in a curved space [19]. But the expression are not linked with the SR. Moreover these expressions are restricted to gravity field only.

In generalized special relativity theory (GSR), time, space, mass and energy are found [20]. The energy expression is found to satisfy Newtonian limit and to explain the gravitational red shift. But unfortunately these expression are restricted to a weak field only [7, 8, 9].

In this work the expression of time mass and energy in Newtonian Mechanics (NM), SR and GSR are exhibited. Their relations with particle velocity and potential energy are compared with experiments that show empirical relations of time, mass and energy with velocity and potential. [10]

II. MECHANICAL EXPERIMENTS

The verification of the laws of mechanics was made by some experiments which show clearly the viability of these laws.

For the comparison between Newton's lows (NL), Einstein special relativity (ESR) and generalized Einstein special relativity (GESR), the following experiment can clearly enable performing this task.

1.Potential energy experiments

a .Motions of rockets and projectiles:

Rockets and projectiles motion can be described by using the newton expression of energy E

$$E = E_o$$

$$T + V = T_o + V_o$$

$$\frac{1}{2}mv^2 + V = \frac{1}{2}mv_0^2 + V_0 \qquad (2.1)$$

By knowimg the initial velocity v_0 and the initial potential V_o, one can obtain the velocity of the rocket V at any time t, when the potential V at this time t is known. This experiment shows clearly the importance of the potential energy in describing the motion of particles in any field. Any viable mechanical theory must include potential energy in its energy expression otherwise it predicts its own break down.

2.Time dilatation experiments

It was observed experimentally that the time is affected by speed as well as by potential of fields.

Two famous experiments were made:

a. Effect of velocity (speed):

The Mesons which are at rest have life time

$$t_o = 2 \times 10^{-2}\ S \qquad \textbf{(2.2)}$$

But μ Mesons which are produced in the atmosphere by fast cosmic-ray particles arrive at the earth from space, in profusion, travelling a distance of more than 6km. if no time dilatation exists, the speed 2.994×10^8 m\s is given by

ISSN 2277 – 5528
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$$L_0 = vt_0 = 2.994X10^8X2X10^{-6} = 600m \tag{2.3}$$

This distance travelled is much less than the actual distance travelled which is more that 6km.one of the possible ways to explain this is to use time dilation relation of SR, where the life time t of μ Meson travelling with speed

$$v = 2.994X10^8 m/s$$

Is given by

$$t = \frac{t_0}{\left(\sqrt{1-\frac{v^2}{c^2}}\right)} = 31.7X10^{-6}S \tag{2.4}$$

In this case the meson travels distance

$$L = vt = 9.5\ km \tag{2.5}$$

Which agrees with the fact that μ meson reaches the earth after travelling more than 6km before decaying.

b. The effect of field potential:

The effect of gravitational field on periodic time of light was verified by Pound and Rebka in 1960 they allowed a -ray emitted by 14.4 keV, 0.1 μs transition in Fe^{57} to fall 22.6m, and observed its resonant absorption by a Fe^{57} target. The difference in the gravitational potential per unit mass for 22.6 m is

$$\Delta\Phi = -2.46X10^{-15} \tag{2.6}$$

The observed relative frequency shift was found to be

$$\frac{\Delta f}{f} = (2.57 \pm 0.26)X10^{-15} \tag{2.7}$$

This results indicates a change of the periodic time t which is related to F a according to the relation

$$T = 1/f \tag{2.8}$$

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This result was explained by general relativity (G) according to the relation

$$T_2 = To\left(-g_{oo}(x_2)\right)^{-1/2} = T_o\left(1 + 2\,\varphi/_{c^2}\right)^{-1/2}$$

$$T_1 = T_o\left(-g_{oo}(x_1)\right)^{-1/2} = T_o\left(1 + 2\,\varphi_1/_{c^2}\right)^{-1/2}$$

$$\Delta T = T_2 - T_1$$

$$\Delta f = f_2 - f_1 \qquad (2.9)$$

Where

$$f_1 = 1/_{T_1} \qquad , f_2 = 1/_{T_2}$$

Thus

$$\Delta f = f_2 - f_1$$

$$f = f_1$$

$$f_2/_{f_1} = \left(\frac{g_{oo}(x_2)}{g_{oo}(x_1)}\right)^{\frac{1}{2}} \qquad (2.10)$$

The metric g is given by

$$g_{oo} = -\left(1 + \frac{2\varphi}{c^2}\right) \qquad (2.11)$$

The predicted value by GR

$$\Delta f/_f = 2.46X10^{-15} \qquad (2.12)$$

Which is in excellent agreement with the experimental one.

1. Mass – Energy Relation Experiments

The Max Plank quantum theory explant's a wide variety of physical phenomena. One of these phenomenons is the so called pair production. In pair production a highly energy etic photon of energy hf produce pair of particles and anti-particles a according to the relation

$$hf = 2m_oc^2 + k_1 + k_2 \qquad (2.13)$$

Some of the photen energy is frozen in the form of rest mass energy with

m_o = rest mass.

k_1 = kinetic energy of the particle.

k_2 = kinetic energy of the anti-particle.

This phenomenon confirms the another phenomenon, also confirms the concept of rest mass energy.

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This phenomenon is concerned with the difference of mass between the total mass of protons and neutrons constituting a certain nucleus and the mass energy.

This the difference of mass between the total mass of portend and neutrons constituting a certain nucleus and the mass of the nucleus itself. This difference is called mass defect or binding energy B where:

$$B = [n_p m_p + n_n m_n]c^2 - Mc^2 \qquad (2.14)$$

With

n_p = number of proteins

n_n = number of neutrons

m_n= number of a neutron

M = mass of the nucleus

The energy liberated in nuclear power stations and unclear bomb confirms this relation.

The change of energy by the potential of the gravitational was observed in the gravitational red shift phenol men on. In this phenomenon the energy of the photon entering gravitation's field is given by:

$$h\acute{f} = hf + V$$

$$\acute{E} = E + V \qquad (2.15)$$

Where:

$\acute{f}$ = new photon frequency after entering the gravitational field

f = photon frequency in free space

V = potential energy

If one believes in the Einstein SR one has energy relation for photon in the form

$$hf = mc2 \qquad (2.17)$$

Therefore

$$\acute{m}c^2 = m + \frac{V}{c^2} \qquad (2.18)$$

Thus the mass is affected by the potential energy.

Another experiment indicates that the mass of electrons are affected by the crystal field according to the relations

$$\acute{m} = m\frac{(f_e)}{(F_e + F_L)} \qquad (2.19)$$

III. THEORETICAL MODELS

For particle of mass m, velocity v moving in a field of potential V. the time, mass and energy in frames S and S_o moving with respect to each other with speed v is given in Newtonian mechanics by:

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$$t = to \tag{3.1}$$

$$m = mo \tag{3.2}$$

$$E = Eo \tag{3.3}$$

$$\frac{1}{2}mv^2 + V = \frac{1}{2}mv_o^2 + V_o \tag{3.4}$$

When the particle is at rest in S_o:

$$vo = o \tag{3.5}$$

According to SR Einstein theory [11] these relations are:

$$t = \frac{t_o}{\sqrt{1 - \frac{v^2}{c^2}}} \tag{3.6}$$

$$m = \frac{m_o}{\sqrt{1 - \frac{v^2}{c^2}}} \tag{3.7}$$

$$E = E_o + T \tag{3.8}$$

$$Ec^2 = m_o c^2 + T \tag{3.9}$$

$$E = mc^2 = \frac{m_o c^2}{\sqrt{1 - {v_2}/{c^2}}} \tag{3.10}$$

In the Newtonian limit, for low speed

$$E = mc^2 = m_o c^2 + T \tag{3.11}$$

According to mass and energy relation in SR the mass can be converted to energy according to equations (2.13) and (2.14).

This is since NM equation (3.4) has no term recognizing rest mass energy.

The NM energy equation (3.4) cannot explain the effect of lattice crystal force F_r an mass shown by equation (2.19)

However, Einstein SR can explain a wide variety of physical phenomena, but not all of them. While it cannot explain the motion of macro particle in fields [compare (2.1) with (3.10)], but it can explain the effect of velocity on life time [see equations (2.4) and (3.6)]. However as shown by equation (2.9) cannot explained by SR equation (3.6),

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Impact Factor- 3.145

Fortunately GSR can explain all there phenomena. This is straight forward from the comparison of all equations in secton2, with the GSR equations. The effect of shown experimentally to obey equations (2.4) and (2.9) can be easily explained by equations (3.12) by setting $\varphi = 0$ and $v = 0$ for the expressions of t respectively

$$t = \frac{t_o}{\sqrt{1 - \frac{2\varphi}{c^2} - v^2/_{c^2}}} \qquad (3.12)$$

$$m \frac{m_o}{\sqrt{1 + \frac{2\varphi}{c^2} - v^2/_{c^2}}} \qquad (3.13)$$

$$E = mc^2 = \frac{m_o c^2}{\sqrt{1 + \frac{2\varphi}{c^2} - v^2/_{c^2}}} \qquad (3.14)$$

IV. DISCUSSION

The viability of Newton, Special Relatively and Generalized Special Relatively Theories:

Consider first Newton's laws. It is clear from equations (2.1) and (3.4) that NM can explain the motion of macro particles in any field. The comparison of equations (2.4) with (3.1) shows the failure of NM in explaining time dilation experiments. This is since a according to equation (2.4) the life time is affected by velocity. It cannot also recognize the effected potential on mass. Newton laws cannot also explain pair production and mass defect in which energy can be converted to mass, Or the mass can be converted to energy according to equations (2.13) and (2.14).

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The NM energy equation (3.4) cannot explain the effect of lattice crystal force F_r an mass as shown by equation (2.19).

However, Einstein SR can explain a wide variety of physical phenomena, but not all of them. While it cannot explain the motion of macro particle in fields [compare (2.1) with (3.10)], but it can explain the effect of velocity on life time [see equations (2.4) and 93.6)]. However, the effect on potential on time as shown by equation (2.9) cannot explain by SR equation (3.6).

Fortunately GSR can explain all these phenomena. This is straight forward from the comparison of all equation in sections, with the GSR equations. The effect of velocity and potential on time shown experimentally to obey equations (2.4) and (2.9) can be easily explained by equations (3.12) by setting $\varphi = o$ and $v = o$ for the expressions of t respectively.Equations (2.13) and (2.14) which states that rest mass is a form of energy can be easily explained by equation (3.14), when the potential term φvanishes.

Moreover the empirical expressions for Energy and mass in equations (2.15) and (2.18) which explains the photon frequency red shift can be easily explained on the basis of relation (3.14) by considering the case of weak field, where

$$m = m_o \left(1 + \frac{2\varphi}{c^2} - \frac{v^2}{c^2}\right)^{-\frac{1}{2}}$$

$$m = m_o \left(1 + \frac{2\varphi}{c^2} + {}^1/_2 \, {}^{v^2}/_{c^2}\right) \qquad (4.1)$$

For the observer in the photon frame of reference and for negative attractive potential.

$$m = m_o + \frac{\varphi m_o}{c^2}$$

$$m = m_o + {}^{V}\!/_{c^2} \tag{4.2}$$

Multiplying both sides by C^2, yields

$$mc^2 = m_o c^2 + V \tag{4.3}$$

It is quite obvious that equations (4.2) and (4.3) are typical to equations (2.18) and (2.15) respectively.

The effective mass of electrons in crystal, having field V_l can also easily explained by the expression of mass in GSR, where fir a mass in an external field equation (3.13) gives.

$$m\left(1 + \frac{2\varphi}{c^2}\right)^{\frac{1}{2}} = m_o \tag{4.4}$$

$$m\left(1 + \frac{2m_o\varphi}{m_o c^2}\right)^{\frac{1}{2}} = m_o \tag{4.4}$$

For a weak field

$$m\left(1 + \frac{m_o\varphi}{m_o c^2}\right) = m_o$$

$$m\left(1 + \frac{V_o}{m_o c^2}\right) = m_o \tag{4.5}$$

Where one reglects the speed, with V_e standing for external potential.

Inside the crystal both external potential V_e and crystal potential V_L affect the mass thus the electron effective mass m can be found from equation (4.5) to be

$$m^*\left(1 + \frac{V_e V_L}{m_o c^2}\right) = m_o \tag{4.6}$$

Thus from (4.5) and (4.6)

$$m^* + \frac{m^*(V_e + V_L)}{m_o c^2} = m + 1 + \frac{mV_e}{m_o c^2}$$

It one considers an approximation

$$m^* \approx m$$

Are gets

$$\frac{m^*}{m} = \frac{V_e}{V_e + V_L} = \frac{{}^{V_e}\!/_{d}}{{}^{V_e}\!/_{d} + {}^{V_L}\!/_{d}} = \frac{F_e}{F_e + F_L}$$

$$m^* = m\frac{F_e}{F_e + F_L} \tag{4.7}$$

Where the furls is related to the potentials according to the relations.

ISSN 2277 – 5528
Impact Factor- 3.145

$$F_e d = V_e$$

$$F_L d = V_L \tag{4.8}$$

Another approach is based on the wave nature of particles can be also used. Where the wave backet representation of atomic particles states that a wave backet formed from a very large number of interfering waves, having different of interfering waves having different frequencies becomes highly localized in the forms of a particle. According to this version the potential and kinetic energy of waves can be assumed as that of a harmonic oscillator where the potential is given by

$$V = -\int f\,dx = m\omega^2 \int x dx = \frac{m\omega^2 x^2}{2} \tag{4.9}$$

$$x = x_o e^{iwt}$$

$$T = \left|\frac{1}{2} m v^2\right| = \frac{1}{2} m w^2 x^2 \tag{4.10}$$

They for harmonic as collator

$$T = V \tag{4.11}$$

For low speed and weak attractive potential

$$v << c^2 \qquad \varphi \to -\varphi \qquad \varphi << c^2 \tag{4.12}$$

Thus equation (3.14) reduced to

$$3X10 \qquad mc^2 = m_o c^2 \left(1 - \frac{2\varphi}{c^2} - \frac{v^2}{c^2}\right)^{\frac{1}{2}}$$

$$m_o c^2 = mc^2 \left(1 - 2\varphi/c^2 - \frac{v^2}{c^2}\right)^{\frac{1}{2}} \tag{4.13}$$

But from (4.11)

$$= mc^2 \left(1 - \frac{m_o \varphi}{m_o c^2} - \frac{m_o v^2}{2 m_o c^2}\right)$$

But from (4.11)

$$m_o c^2 = mc^2 \left(\frac{m_o c^2 - V - T}{m_o c^2}\right) = \frac{mc^2}{m_o c^2}[m_o c^2 - 2V] \tag{4.14}$$

For the effect of external field only

$$m = m_e \qquad , V = V_e = F_e d \tag{4.15}$$

But when crystal field affect electrons also, the effective mass

ISSN 2277 – 5528
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Since $m_o c^2$can not be measured directly, it behaves as abackground and can be ignored. Thus equation (4.14) reduces to

$$m_o^2 c^4 = mc^2[-2V] \quad (4.17)$$

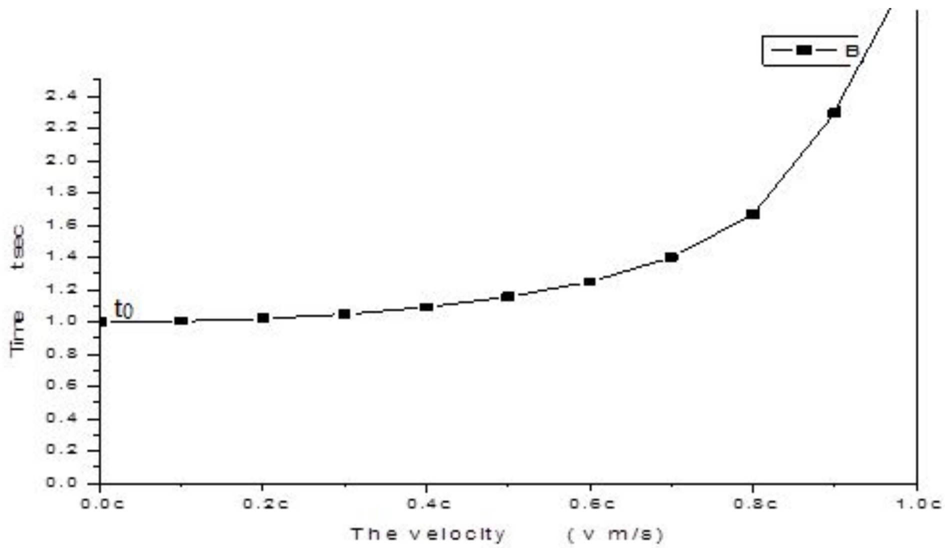
A directsubstitution of (4.15) and (4.16) in (4.17) yields

$$m_o^2 c^4 = m_e c^2[-2F_e d] = m^* c^2[-2(F_e + F_L)d]$$

Thus

$$m^* = m_e \left(\frac{F_e}{F_e + F_L}\right) \quad (4.18)$$

Which conformswith equation (2.19)



(a)

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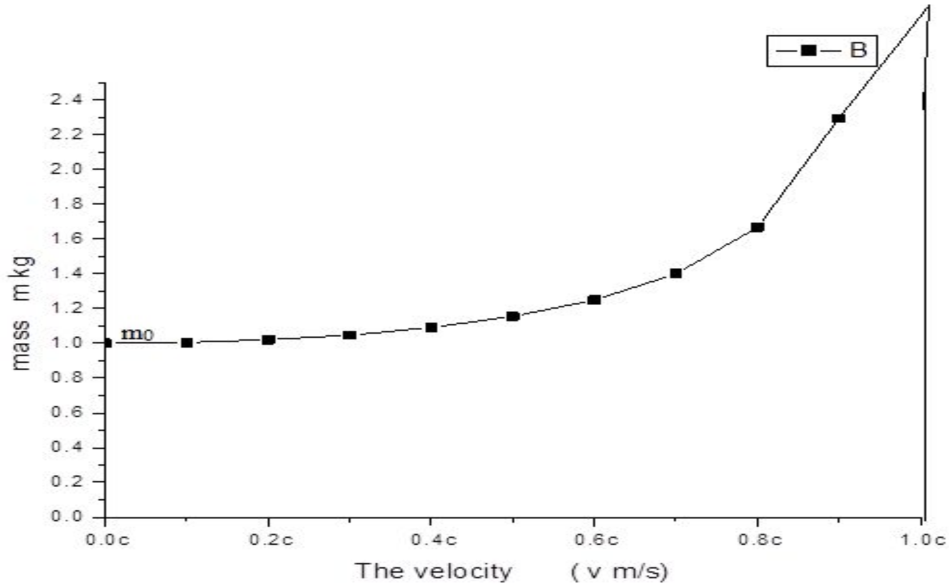

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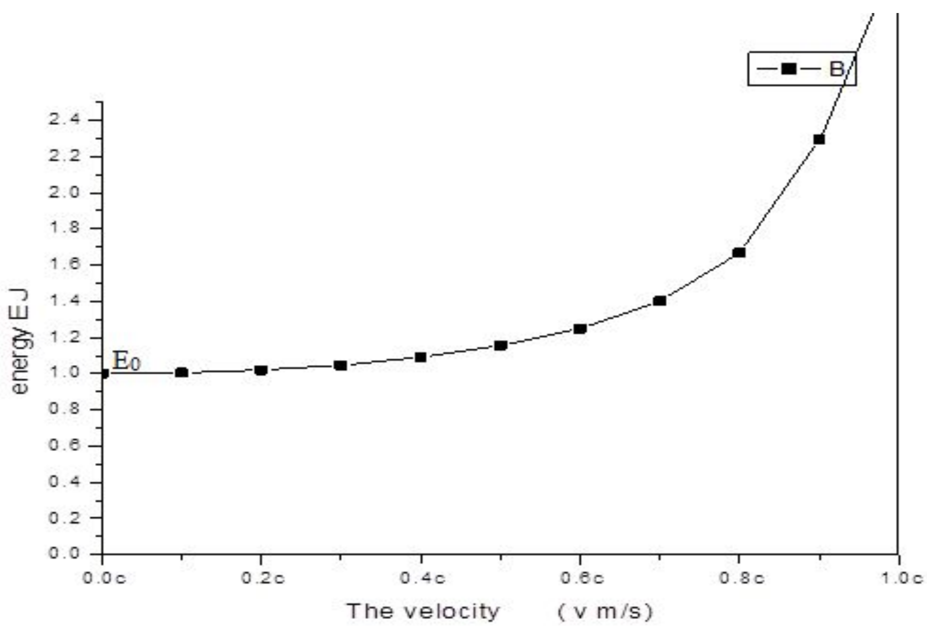

(c)

Fig 1. The empirical relation between (a) t and v, (b) m and v and (c) E and v, when ϕ=0

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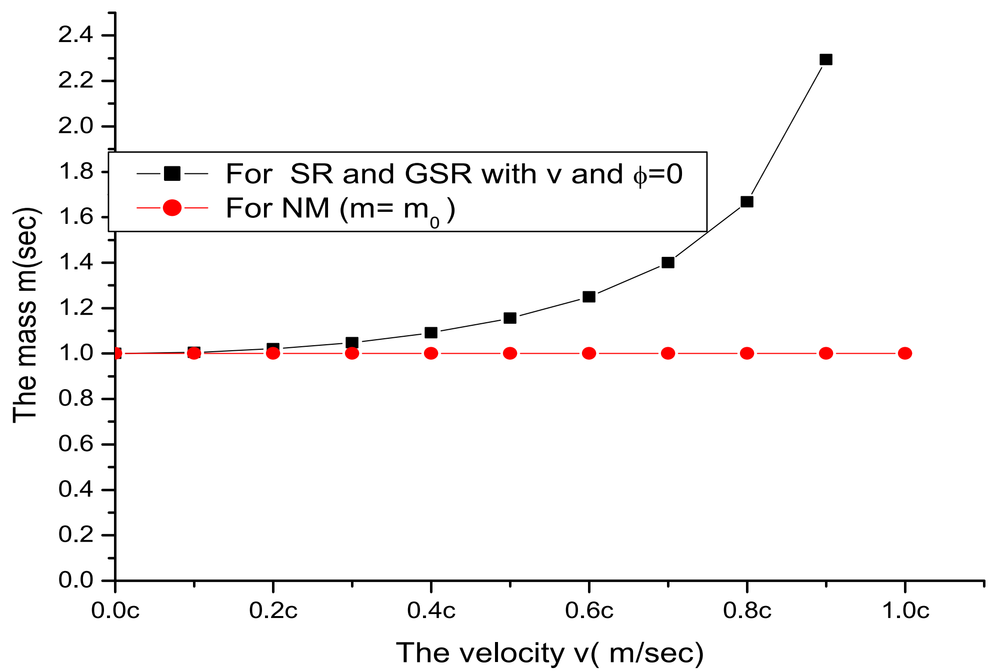

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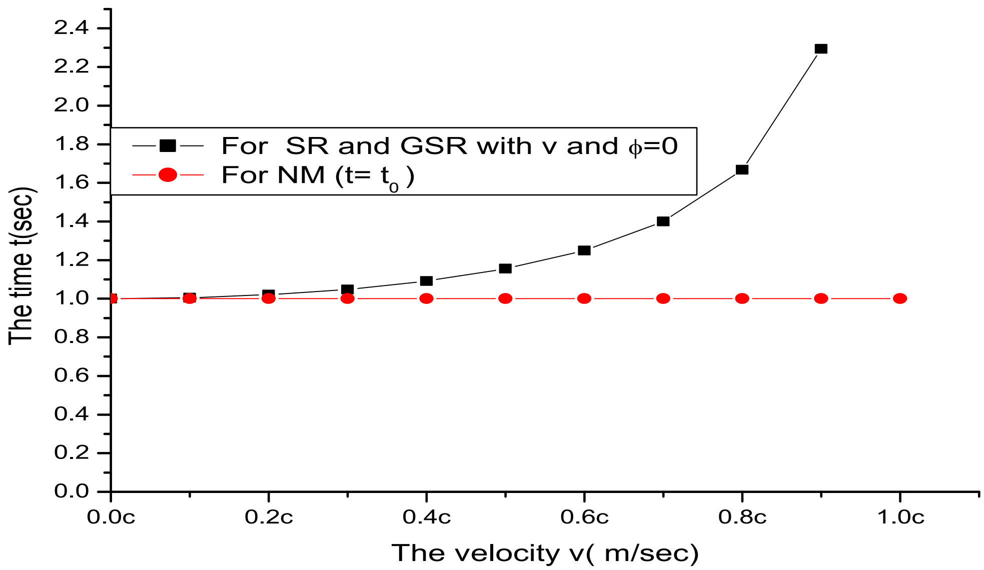
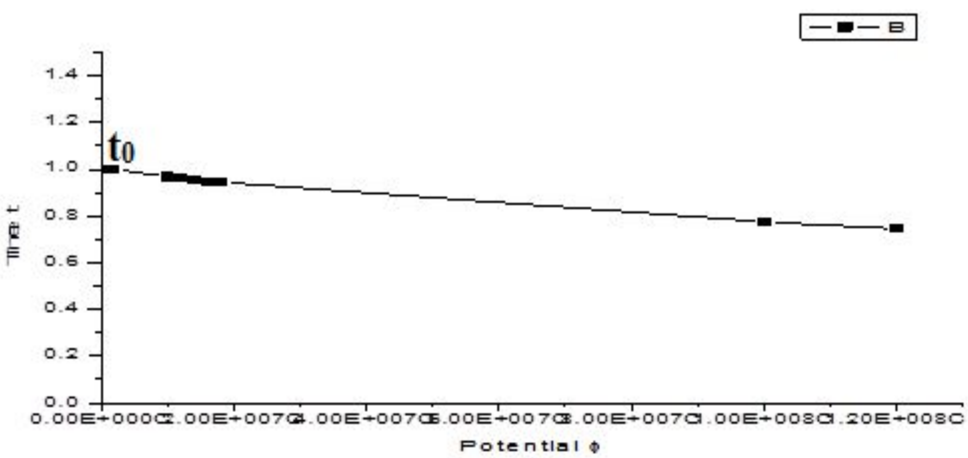
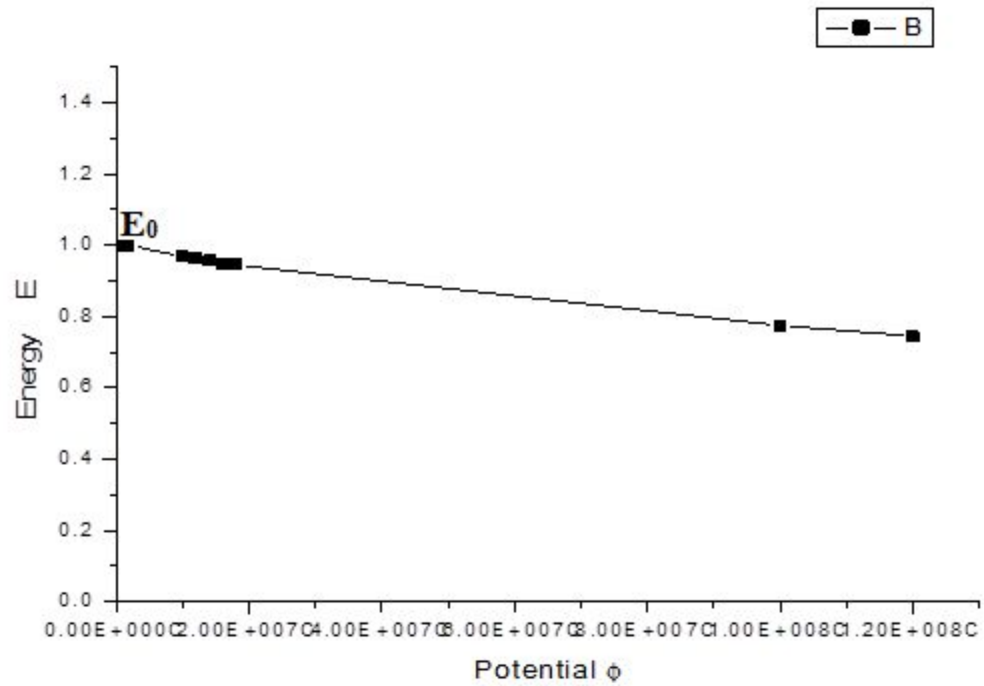


(b)

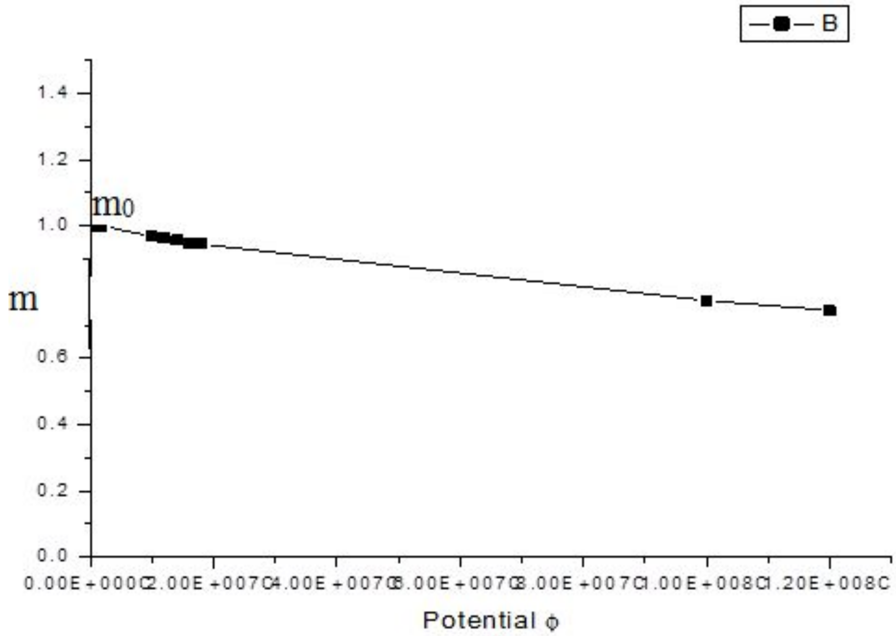
Fig 2.The empirical relation between (a) m and v and (b) t and v, when ϕ=0 for (NM, SR and GRS)



(a)


B
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
E0
Energy E
0.00E+000
2.00E+007
4.00E+007
6.00E+007
8.00E+007
1.00E+008
1.20E+008
Potential ϕ

(b)


B
1.4
1.2
m0
1.0
m
0.6
0.4
0.2
0.0
0.00E+000
2.00E+007
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6.00E+007
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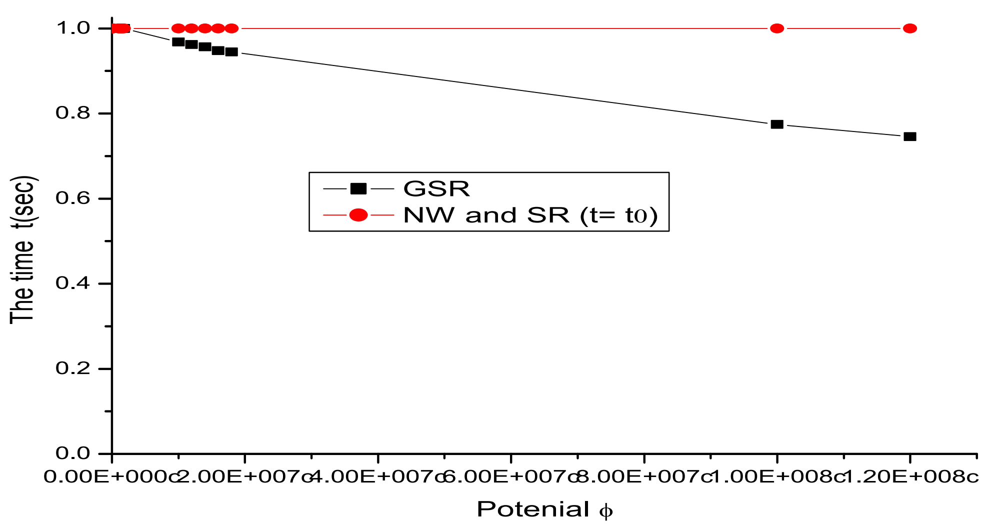
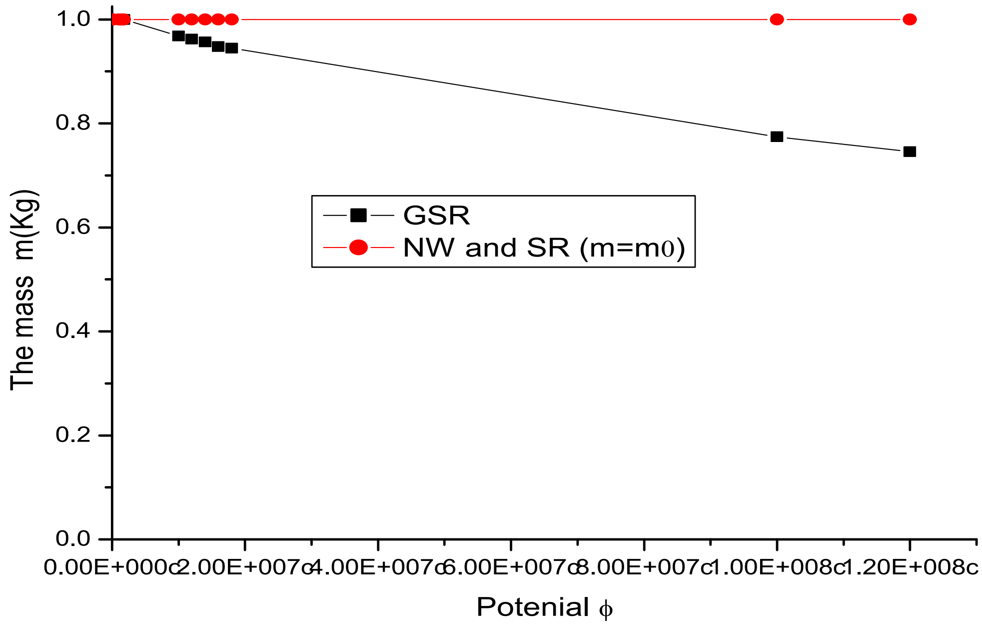
1.00E+008
1.20E+008
Potential ϕ


1.0
0.8
0.6
0.4
0.2
0.0
The time t(sec)
GSR
NW and SR (t= t0)
0.00E+000
2.00E+007
4.00E+007
6.00E+007
8.00E+007
1.00E+008
1.20E+008
Potenial ϕ

(a)



(b)

Fig 2.The empirical relation between (a) m and v and (b) t and v, when v=0 for (NM, SR and GRS)

V. CONCLUSION

The direct comparison of NM, SR and GSR with the experiments that shows the effect of speed and potential an time, mass and energy shows that GSR is the best candidate that can describe physical phenomena concerning time - mass – energy relations.

VI. ACKNOWLEDGEMENTS

I would like to thank and praise worthy Allah who taught me all the knowledge. Would like also to express my gratitude to prof. Mubarak Dirar for his supervision and valuable help and fruitful suggestion.

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