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Matter & Antimatter Generation & Repulsive Gravity force

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Abstract :
Generalized special relativistic energy relations shows that velocity as well as field potential affect the energy . These relations were used to find vacuum energy by minimizing energy . The minimization shows that vacuum energy consists of photons having energy that can produce particle and anti particle pair . It also shows that the mass of antiparticle is negative , thus it repel ordinary particle . Another expression of vacuum energy shows that vacuum decays and transform may be to ordinary matter as proposed by scientists .

Keywords : generalized special relativity , vacuum energy , anti matter , repulsive force .

1-Introduction :

The existence of anti matter was first proposed by Dirac , when solving his Dirac relativistic equation . The solution of his equation gives an energy term with negative mass . He suggest that this negative mass term indicates the existence of anti matter [1] . later on Anderson found anti electron (positron) in cosmic rays that he detected on 1933 [2] . This important discovery opens a new era in the physics of elementary particles .

It was experimentally observed that a particle and its anti particle can be produced by photons . This pair production was explained easily on the bases of Max plank quantum hypothesis and Einstein mass energy relation [3]. It was also observed that when a particle and its anti particle meats they annihilate and produce a photon .

On the other hand the physics of the early universe shows that at very early stages elementary particles plays an important role in the universe evolution [4]. It is generally accepted that at the early universe , inflation takes place [5] . During this stage some scientists propose the existence of repulsive gravitational field that causes inflation [6] . The inflation of the universe solve some of the long standing problems like horizon , flatness and entropy problem [7] . This repulsive gravity force was proposed by many scientists , and some of them claim that they result from interaction of particles and anti particles [8,9,10] . This repulsive force between matter and anti matter can help in explaining the particle and anti particle asymmetry and the abundance of particles in our universe . It can also explain the stream of anti particles that leaves galaxies and escape [11,12].

The repulsive gravitational force and the origin of particles and anti particles and their production will be discussed in this research namely in sections (2) and (3) . sections (4) and (5) are devoted for discussion and conclusion .

2- Production of particles and anti particles on the basis of Generalized special Relativity and the Repulsive nature :

The energy relation according to Einstein generalized relativity is given by

$$E = \frac{m_0 c^2 (1+\frac{2\Phi}{c^2})}{\sqrt{1+\frac{2\Phi}{c^2}-\frac{v^2}{c^2}}} \tag{2.1}$$

When m_0 ,Φ, v stands for rest of mass , potential and velocity respectively

Thus

$$E = m_0 c^2 (1+\frac{2\Phi}{c^2})(1+\frac{2\Phi}{c^2}-\frac{v^2}{c^2})^{-\frac{1}{2}} \tag{2.2}$$

To find vacuum minimum energy , the energy one minimizes E to get

$$\frac{dE}{d\Phi} = m_0 c^2 \left[(1+\frac{2\Phi}{c^2}) \times \frac{-1}{2}(1+\frac{2\Phi}{c^2}-\frac{v^2}{c^2})^{-\frac{3}{2}} \times \frac{2}{c^2} + (1+\frac{2\Phi}{c^2}-\frac{v^2}{c^2})^{-\frac{1}{2}} \times \frac{2}{c^2} \right]$$

Thus

$$\frac{dE}{d\Phi} = \frac{2m_0 c^2}{c^2} \frac{(\frac{1}{2}+\frac{\Phi}{c^2}-\frac{v^2}{c^2})}{(1+\frac{2\Phi}{c^2}-\frac{v^2}{c^2})^{\frac{3}{2}}} \tag{2.3}$$

$$\frac{2m_0 c^2}{c^2} \frac{(\frac{1}{2}+\frac{\Phi}{c^2}-\frac{v^2}{c^2})}{(1+\frac{2\Phi}{c^2}-\frac{v^2}{c^2})^{\frac{3}{2}}} = 0 \tag{2.4}$$

Hence

$$\frac{1}{2}+\frac{\Phi}{c^2}-\frac{v^2}{c^2}=0$$

Therefore

$$\frac{\Phi}{c^2}=\frac{v^2}{c^2}-\frac{1}{2}$$

$$\Phi=c^2(\frac{v^2}{c^2}-\frac{1}{2})$$

Thus the value of Φ which make E minimum is given by

$$\Phi=v^2-\frac{c^2}{2} \qquad (2.5)$$

Due to the wave nature of light

$$c_e=\frac{c_m}{\sqrt{2}}$$

$$c_m=\sqrt{2}\,c_e \qquad (2.6)$$

Let

$$c=c_m=\sqrt{2}\,c_e \qquad (2.7)$$

$$\Phi=v^2-c_e^2 \qquad (2.8)$$

When $v=0$

$$\Phi=-c_e^2 \qquad (2.9)$$

Thus the potential is given by

$$V=m_0\Phi=-m_0c_e^2 \qquad (2.10)$$

In this case the vacuum constituents are at rest ($v=0$) .

But when a photon , which constitute vacuum move with speed c , thus

$$v=c \qquad (2.11)$$

Substitute in (5) to get

$$\Phi = c^2 - \frac{c^2}{2} = \frac{c^2}{2} \qquad (2.12)$$

When inserting equation (2.7) , one gets

$$\Phi = c_e^2 \qquad (2.13)$$

But the potential energy is given by

$$V = m_0 \Phi$$

Thus from (2.13) and (2.1) the potential is given by

$$V = m_0 c_e^2$$

The vacuum energy can be found by inserting (2.11) and (2.12) in (2.1) to get

$$E = m_0 c^2 (1+1) = 2 m_0 c^2 \qquad (2.14)$$

Thus one can imagine vacuum energy levels as shown below

$E_+ = m_m c^2 = m_0 c_e^2$ ______________________________

$E = 0$ ______________________________

$E_- = -m_0 c^2 = m_a c_e^2$ ______________________________

Figure (1) : vacuum states as consisting of photons producing and destructing particles and anti particles with rest masses m_0 **.**

The production of pair particles can be regarded as due to electron transfer from state the lower to the upper state after absorbing a photon .

Where

$$m_m = matter\ \ mass = m_0$$
$$m_a = anti\ \ matter\ \ mass = -m_0 \qquad (2.15)$$

The energy diagram is shown in figure (1)

According to Newton's laws the potential is given by

$$\Phi = -\frac{G\ m}{r} \qquad (2.16)$$

For matter

$$m_m = m_0$$

Thus

$$\Phi_m = matter \ \ potential = -\frac{G\ m_m}{r} = -\frac{G\ m_0}{r} \qquad (2.17)$$

This is an attractive force .

For anti matter

$$m_a = -m_0$$

$$\Phi_a = anti \ matter = -\frac{G\ m_a}{r} = +\frac{G\ m_0}{r} \qquad (2.18)$$

This is a repulsive force

When matter and anti matter interact with each other the potential is given by

$$V = -\frac{G\,m\,M}{r} \qquad (2.19)$$

Where the force is given by

$$F = -\nabla V$$

$$= -\frac{\partial V}{\partial r} = +G\,m\,M\,\frac{\partial r^{-1}}{\partial r}$$

Hence the force is given by

$$F = -\frac{G\,m\,M}{r^2} \qquad (2.20)$$

For matter and anti matter reaction

$$m = m_m = m_0$$

$$M = m_a = -m_0 \qquad (2.21)$$

Thus the force between matter and anti matter is given by

$$F = -\frac{G\,(m_0)(-m_0)}{r^2} = \frac{G\,m_0^2}{r^2} \qquad (2.22)$$

Thus there is repulsive force between matter and anti matter .

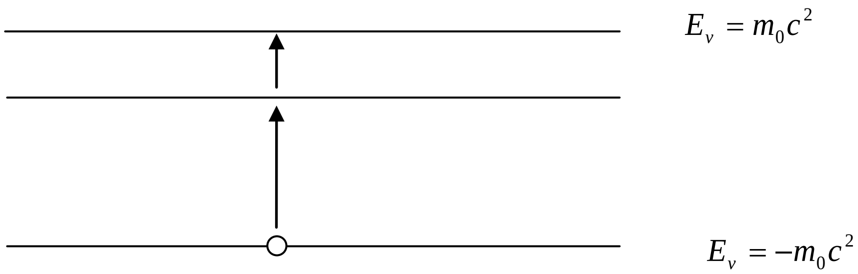

Figure (2) : vacuum energy levels

3-Generation of particle and anti particle on the basis of conservation law

In this work it is shown that; the energy conservation requires

$$E = mc^2 + 2m\Phi \qquad (3.1)$$

The GSR mass was proposed by some authors to be

$$m = \frac{m_0}{\sqrt{(1+\frac{2\Phi}{c^2}-\frac{v^2}{c^2})}} \qquad (3.2)$$

From (3.1) and (3.2) one gets

$$E = \frac{m_0 c^2}{\sqrt{(1+\frac{2\Phi}{c^2}-\frac{v^2}{c^2})}} + \frac{2m_0 c^2}{\sqrt{(1+\frac{2\Phi}{c^2}-\frac{v^2}{c^2})}}$$

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

To find vacuum state , the energy E need to be minimized W.r.t to Φ , to get

$$\frac{dE}{d\Phi} = -\frac{1}{2} m_0 c^2 (1+\frac{2\Phi}{c^2}-\frac{v^2}{c^2})^{-\frac{3}{2}} \times \frac{2}{c^2} + 2m_0 \left[\Phi \times \frac{-1}{2} (1+\frac{2\Phi}{c^2}-\frac{v^2}{c^2})^{-\frac{3}{2}} \times \frac{2}{c^2} + (1+\frac{2\Phi}{c^2}-\frac{v^2}{c^2})^{-\frac{1}{2}} \right]$$

Thus

$$\frac{dE}{d\Phi}=\frac{-m_0}{(1+\frac{2\Phi}{c^2}-\frac{v^2}{c^2})^{\frac{3}{2}}}-\frac{2m_0\Phi/c^2}{(1+\frac{2\Phi}{c^2}-\frac{v^2}{c^2})^{\frac{3}{2}}}+\frac{2m_0}{(1+\frac{2\Phi}{c^2}-\frac{v^2}{c^2})^{\frac{1}{2}}}$$

$$=\frac{-m_0-2m_0\Phi/c^2+2m_0(1+\frac{2\Phi}{c^2}-\frac{v^2}{c^2})}{(1+\frac{2\Phi}{c^2}-\frac{v^2}{c^2})^{\frac{3}{2}}} \qquad (3.3)$$

This equation can be satisfied , when

$$2m_0(1+\frac{2\Phi}{c^2}-\frac{v^2}{c^2})=\frac{2m_0\Phi}{c^2}+m_0$$

$$1+\frac{2\Phi}{c^2}-\frac{v^2}{c^2}=\frac{\Phi}{c^2}+\frac{1}{2}$$

$$\frac{\Phi}{c^2}=\frac{v^2}{c^2}-\frac{1}{2}$$

$$\Phi=v^2-\frac{c^2}{2} \qquad (3.4)$$

If vacuum particles are at rest $v=0$, thus equation (3.4) become

$$\Phi=-\frac{c^2}{2} \qquad (3.5)$$

Substituting this value in (3.1) and (3.2) yield

$$m=\frac{m_0}{0}=\infty \qquad (3.6)$$

Thus from (3.1)

$$E=\infty \qquad (3.7)$$

Thus condition (3.3) is the condition for maximum E .

Now one can use equation (3.1)

$$E=mc^2+2m\Phi$$

But the mass term is in the form

$$m=\frac{(1+\frac{2\Phi}{c^2})m_0}{\sqrt{1+\frac{2\Phi}{c^2}-\frac{v^2}{c^2}}} \qquad (3.8)$$

Inserting (3-8) in (3-1) yields

$$E=\frac{(1+\frac{2\Phi}{c^2})m_0c^2}{\sqrt{1+\frac{2\Phi}{c^2}-\frac{v^2}{c^2}}}+\frac{2m_0\Phi(1+\frac{2\Phi}{c^2})}{\sqrt{1+\frac{2\Phi}{c^2}-\frac{v^2}{c^2}}}$$

$$E=m_0c^2(1+\frac{2\Phi}{c^2})(1+\frac{2\Phi}{c^2}-\frac{v^2}{c^2})^{-\frac{1}{2}}+2m_0(\Phi+\frac{2\Phi^2}{c^2})(1+\frac{2\Phi}{c^2}-\frac{v^2}{c^2})^{-\frac{1}{2}}$$

The differentiation of E w.r.t to Φ requires

$$\frac{dE}{d\Phi}=m_0c^2\left[(1+\frac{2\Phi}{c^2})\times\frac{-1}{2}(1+\frac{2\Phi}{c^2}-\frac{v^2}{c^2})^{-\frac{3}{2}}\times\frac{2}{c^2}+(1+\frac{2\Phi}{c^2}-\frac{v^2}{c^2})^{-\frac{1}{2}}\times\frac{2}{c^2}\right]$$

$$+2m_0\left[(\Phi+\frac{2\Phi^2}{c^2})\times\frac{-1}{2}(1+\frac{2\Phi}{c^2}-\frac{v^2}{c^2})^{-\frac{3}{2}}\times\frac{2}{c^2}+(1+\frac{2\Phi}{c^2}-\frac{v^2}{c^2})^{-\frac{1}{2}}\times(1+\frac{4\Phi}{c^2})\right]$$

$$=\frac{-m_0(1+\frac{2\Phi}{c^2})}{(1+\frac{2\Phi}{c^2}-\frac{v^2}{c^2})^{\frac{3}{2}}}+\frac{2m_0}{(1+\frac{2\Phi}{c^2}-\frac{v^2}{c^2})^{\frac{1}{2}}}-\frac{2m_0/c^2(\Phi+\frac{2\Phi^2}{c^2})}{(1+\frac{2\Phi}{c^2}-\frac{v^2}{c^2})^{\frac{3}{2}}}+\frac{2m_0(1+\frac{4\Phi}{c^2})}{(1+\frac{2\Phi}{c^2}-\frac{v^2}{c^2})^{\frac{1}{2}}} \qquad (3.9)$$

Where for minimum energy one has

$$\frac{dE}{d\Phi}=0 \qquad (3.10)$$

$$\frac{-m_0(1+\frac{2\Phi}{c^2})+2m_0(1+\frac{2\Phi}{c^2}-\frac{v^2}{c^2})-2m_0/c^2(\Phi+\frac{2\Phi^2}{c^2})+2m_0(1+\frac{4\Phi}{c^2})(1+\frac{2\Phi}{c^2}-\frac{v^2}{c^2})}{(1+\frac{2\Phi}{c^2}-\frac{v^2}{c^2})}=0$$

$$(1+\frac{2\Phi}{c^2})+2(1+\frac{2\Phi}{c^2})-\frac{2v^2}{c^2}-\frac{2\Phi}{c^2}-\frac{4\Phi^2}{c^4}+2(1+\frac{4\Phi}{c^2})(1+\frac{2\Phi}{c^2}-\frac{v^2}{c^2})=0 \qquad (3.11)$$

$$(1+\frac{2\Phi}{c^2})-\frac{2\Phi}{c^2}-\frac{2v^2}{c^2}-\frac{4\Phi^2}{c^4}+2(1+\frac{2\Phi}{c^2})-\frac{2v^2}{c^2}+4\Phi(1+\frac{2\Phi}{c^2}-\frac{v^2}{c^2})=0$$

$$3(1+\frac{2\Phi}{c^2})-\frac{2\Phi}{c^2}-\frac{4v^2}{c^2}-\frac{4\Phi^2}{c^4}+\frac{4\Phi}{c^2}-\frac{8\Phi^2}{c^4}-\frac{4v^2\Phi}{c^4}=0$$

$$3+\frac{8\Phi}{c^2}-\frac{4v^2}{c^2}+\frac{4\Phi^2}{c^4}-\frac{4v^2\Phi}{c^4}=0 \qquad (3.12)$$

For stationary vacuum constituents

$$v=0 \qquad (3.13)$$

Equation (3.12) reads

$$\frac{4\Phi^2}{c^4}+\frac{8\Phi}{c^2}+3=0$$

$$4\Phi^2+8\Phi c^2+3c^4=0$$

Solving for Φ

$$\Phi=\frac{-b\pm\sqrt{b^2-4ac}}{2a} \qquad (3.14)$$

$$\Phi=\frac{-8c^2\pm\sqrt{16c^4-48c^4}}{8} \qquad (3.15)$$

Substituting (3.15) in the energy E relation (3.1) gives

$$E=\pm\sqrt{-2}\,mc^2 \qquad (3.16)$$

Consider now a vacuum is full of photons . this means that

$$\frac{4\Phi^2}{c^4}+\frac{8\Phi}{c^2}-1=0 \qquad (3.17)$$

Using (3-14)

$$\Phi=\frac{-4c^2\pm\sqrt{16c^4+16c^4}}{8}$$

$$\Phi=\frac{-4c^2\pm4\sqrt{2}\,c^2}{8}=-\frac{1}{2}c^2\pm\frac{1}{\sqrt{2}}c^2 \qquad (3.18)$$

Inserting equation (3.18) in equation (3.1) the energy is given by

$$E=mc^2+2m(-\frac{1}{2}c^2\pm\frac{1}{\sqrt{2}}c^2)$$

$$E = \pm\sqrt{2}\, mc^2 \qquad (3.19)$$

4-Discussion

The vacuum energy is found by minimizing GGR energy relation (2.1) , together with the velocity and potential given by (2.11) and (2.12) . one here assumes the vacuum consisting of photons , where we assume v to be equal to c in (2.11) . In this case vacuum energy is given by equation (2.14) to be

$$E_v = 2m_0c^2 \qquad (4.1)$$

According to figure (1) , one can assume vacuum as consisting of photon of energy

$$E_p = hf = 2m_0c^2$$

Beside matter and anti matter particle with energies

$$E_m = m_0c^2 \quad , \quad E_a = -m_0c^2$$

Thus the total vacuum energy is

$$E_v = E_p + E_m + E_a = 2m_0c^2 \qquad (4.2)$$

Where the particle exists in the energy state $= m_0c^2$

This is equivalent to the existence of the particle and anti particle representing this lower state , together with non interacting photon . When the photon is incident on this particle in the lower state ($-m_0c^2$) it gives it an energy ($2m_0c^2$) . This the particle transfer itself to the state of energy (m_0c^2) appearing as a particle and leaving a vacancy in the state ($-m_0c^2$) which appears as an anti particle , with numerical masses m_0c^2 . The photon of energy $2m_0c^2$ disappear producing a particle and anti particle pair of total numerical mass $2m_0c^2$.

Using also Mubarak energy conservation expression (3.1) , vacuum energy is again obtained by minimizing E and assuming vacuum to constitute stationary particles to get relation (3.16)

$$E = \sqrt{2}\, m_0c^2 i = \hbar w = i\hbar w_0$$

$$w = iw_0 \qquad w_0 = \sqrt{2}\, m_0c^2 \qquad (4.3)$$

The wave function of vacuum particles takes the form

$$\psi = Ae^{\frac{iE}{\hbar}t} = Ae^{iwt} = Ae^{-w_0t} \qquad (4.4)$$

Thus the number of vacuum particles is given by

$$n \sim |\psi|^2 \sim A^2\, e^{-2w_0t} \qquad (4.5)$$

This means that vacuum particles decay and transforms to other forms like elementary particles . This result conforms with what proposed by cosmology physists at the early universe .

5- Conclusion

The energy expressions of GSR shows that vacuum fluctuation produces particles and anti particles and photon periodically . It shows also that vacuum decays to produce matter .

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