Calculation of the energy density of space-time and study of zero energy states. A universe of matter and light

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Summary

A new relativistic wave equation for bosons has been developed. Applied to the cosmos, it predicts the creation of a universe of light and matter from zero energy states and leads to energy density values close to those measured. This explains dark matter without the need to modify the Standard Model.

1.- A new relativistic wave equation

To develop the wave equation that I will propose I start with the relativistic formula of the energy of a particle and the Schrodinger wave equation. The total mechanical energy in a physical system is given by the expression:

Total mechanical energy = kinetic energy + potential energy + mc^2

Where kinetic energy comes from motion, potential energy comes from the forces that interact on the masses and the third term corresponds to the relativistic energy that comes from the mass itself.

At the beginning of the twentieth century, the corpuscular character of electromagnetic waves, known as the photoelectric effect, and the wave character of moving matter, known as the corpuscle wave duality, were discovered.

From this the physicist Schrodinger developed a wave equation for matter that considered these hypotheses and was structured in a non-relativistic energy balance; this equation was as follows:

$ih(\psi/\eth t) = H_t\psi$

$H_t\psi = -(h^2/8\pi^2 m)\ (\eth\psi/(\eth^2(x,y,z)) + V(x,y,z,t)\psi$

Where H_t is the time-dependent Hamiltonian of the system and $V(x,y,z,t)$ is the potential. This equation is applicable to a single particle. Equation, on the other hand, well known to those present here.

Let's take a closer look at this equation from the point of view of the energy balance it describes:

The first member of the equation represents the Hamiltonian. In the second member the first term represents the kinetic energy of the mass "m" and the second term the potential energy. If we want the first member to represent the relativistic Hamiltonian, we must add the term mc^2 to the second member in this way:

$H_t\psi = -(h^2/8\pi^2 m)\ (\eth\psi/(\eth^2(x,y,z)+V(x,y,z,t)\psi + mc^2\psi$

Within the solutions of this equation, I look for those that satisfy the following equation of eigenvalues

$H_t\psi = E\psi$ (a) = $-(h^2/8\pi^2 m)$ $(ð\psi/(ð^2(x,y,z)+V(x,y,z,t)\psi + mc^2\psi$ (a)

Where "E" is a eigenvalue representing total energy.

I try to solve a differential equation of eigenvalues, with the physical meaning of an energy balance.

The potential, in this wave equation is usually calculated by determining the potential function of the force field, that is, a scalar function whose gradient is the force field.

Considering that the wave equation represents the energy balance, we can also calculate the potential in the same way that the potential energy is calculated in a force field, that is, as the divergence of the force field with opposite sign. We will apply this freely when establishing our wave equation.

Consider a field of forces that gives rise to an acceleration in a mass "m", we know that the force at each instant is equal to the mass multiplied by the acceleration and that the acceleration at each instant is the second derivative of the position with respect to time. We will apply this freely by proposing our wave equation by creating an acceleration vector through the wave function solution of the equation.

So, with all this and operating on equation (a) I propose the following relativistic wave equation for a mass "m" in problems with spherical symmetry:

$\mathbf{E_t\psi = -(h^2/8\pi^2 m)\ (ð\psi/(ð^2 r)) - m\ (ð/ð_r(ð\psi/(ð^2 t) + mc^2\psi}$

where $\Psi = \psi(r,t)$ is the wave function solution of the equation.

The space object of the wave function is the four space-time dimensions that Einstein develops is his theory of generalized relativity, the image space of the wave function, does not have a clear physical interpretation now, I am currently working on it, but it is expected that it is related to some in the movement of the particle in space-time and with some statistical parameter.

2.- Study of the new relativistic wave equation in physical states of light and matter with a total energy equal to zero. The beginning of the universe

Using the equation developed, I then study a physical system that includes photons and positive masses and whose total energy is equal to zero, as the beginning of the universe could be energetically.

The first thing I determine by my wave equation is the energy of the photons, treated as plane waves and as particles.

Let's take the following wave function for photons:

$\psi=e^{ict}= e^{ir}$

where c is the speed of photons, the speed of light.

In addition, I consider in this work that the photon has a moving mass of value $m=E/c^2$, where E is the interaction energy of the photon that according to Planck's formula turns out to be $E = h\mu$ being μ the frequency

a) The second derivative of the wave function with respect to position turns out to be $\psi_r''=-e^{ir}$
b) The second derivative of the wave function with respect to time turns out to be $\psi_t''=-c^2e^{ict}=-c^2e^{ir}$
c) The derivative with respect to the position of this second derivative with respect to time turns out to be, $(\psi_t'')_r{}'=-ic^2e^{ir}$

The wave equation I have developed in this work for this case of spherical symmetry is as follows:

$E_t\psi = -(h^2/8\pi^2m)\ (\eth\psi/(\eth^2r)) - m\ (\eth/\eth_r(\eth\psi/(\eth^2t) + mc^2\psi$

substituting in it the values of the calculated partial derivatives we have

$E_t\psi = -(h^2c^{2/8}\pi^2h\mu)(-e^{ir})-(h\mu/c^{2)})(-ic^2e^{ir})+h\mu e^{ir}$

$E_te^{ir} = +(h^2c^2/8\,\pi^2h\mu)e^{ir}+i(h\mu e^{ir})+h\mu e^{ir}$

$(E_t - (h^2c^2/8\pi^2h\mu +ih\mu))e^{ir}= h\mu e^{ir}$

Taking modules into this equation results in

$\mathrm{mod}((E_t + (h^2c^2/8\pi^2h\mu-i(h\mu))).\mathrm{mod}(e^{ir}) =\mathrm{mod}(h\mu).\mathrm{mod}(e^{ir})$

$((E_t + h^2c^2/8\pi^2h\mu)^2+h^2\mu^2)^{1/2} = (h^2\mu^2)^{1/2}$

$(E_t + h^2c^2 /8\pi^2h\mu)^2 + h^2\mu^2 = h^2\mu^2$

$h^2c^2 /8\pi^2 = (6{,}63.10^{-34})^2.9.10^{16}/8.(3.14)^2 = 5.10^{-52}$

$(E_t + 5{,}10^{-52}/h\mu)^2 = 0$

$E_t = -(5.10^{-52}/h\mu)$ (a) , this equation is expressed in the international system of units

Thus, the energy of the photons, calculated through the relativistic energy balance that my wave equation represents, turns out to have a negative value.

If the relativistic mechanical energy of a moving mass "M" is given by:

$E = 1/2\ Mv^2+ Mc^2$

in our case, the total energy of photons and masses, E_{Total}, will be given by the equation:

$E_{Total} = -(5.10^{-52}/h\mu) + 1/2\ Mv^2 + Mc^2$

Applying it to the cosmos, the universe is a closed system and therefore its total energy remains constant over time. In addition, since there was nothing before the universe, its total energy must have a value equal to zero. That is, I am going to apply this equation to the universe as a zero-energy physical state.

Thus, substituting in the last equation yields:

$0 = -(10^{-51}/2h\mu) + 1/2\ Mv^2 + Mc^2$ (b),

we see that finally this equation has a solution for values of positive masses and photons coexisting both together, although the total energy balance is equal to zero.

It therefore justifies a beginning of a universe of light and matter from a state of zero energy. We are going to call this universe in the rest of the work "our model".

this equation is expressed in the international system of units.

3.- The cosmological constant problem

The problem of the value of the cosmological constant is linked to that of the energy density in the universe. This energy density has been measured having a value of $0{,}94.10^{-26}$ in units of the international system of units**.**

Let's see how our model of the universe described by this equation (b) predicts a very close value.

Our model of the universe reflects it as the creation of photon-neutrino pairs from zero-energy states.

First, we express equation (b) as:

$0 = -(5.10^{-52}/\rho$(electromagnetic energy density $(h\mu)) + \rho$(energy density due to mass (mc^2));

Neutrinos have a speed very close to that of light and in our model is based on a state of zero energy we can write:

$0 = -(10^{-51}/2h\mu) + 1/2\ Mv^2 + Mc^2$

$5.10^{-52} = h\mu.(3/2)(mc^2)$

$5.10^{-52} = \rho$(electromagnetic energy density)$.(3/2).\rho$(energy density due to mass) (c);

as the total moment is zero, we have:

$h\mu/c = mc \quad h\mu = mc^2$

then substituting in equation (c) we have:

$5.\ 10^{-52} = \rho$((energy density due to mass). 3/2. ρ((energy density due to mass) = (3/2).((energy density due to mass))^2

ρ((energy density due to mass)= $1{,}8.\ 10^{-26}$ value very close to the recently measured $0{,}94.\ 10^{-26}$. If this result is true, we would have that the greatest contribution to the energy density of the universe is due to neutrinos. In addition, as the production of photon-neutrino pairs is random, the energy density in the universe remains constant even if space expands.

According to this our model of the universe curves space-time with a curvature value very close to that measured experimentally. Thus, equation (b) seems to be valid and with it the relativistic wave equation for bosons that has been developed in this work is also valid.

The relativistic wave equation obtained in this work can be applied to gravitation. The results obtained here are very hopeful. Further study of the equation and its solutions is expected to augur even more surprising results. I therefore invite my fellow researchers to make this effort in the hope that it will not disappoint them.

4.- Bibliography

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