Cosmological Constant and Universe

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Abstract:
Cosmological constant is proportional to the sum of binding energy and its absolute value, if we supposed that the absolute value of binding energy is a function of (A, Z') instead of (A,Z), we have vacuum electric energy density ρ_1 as a function of (A, Z) and Vacuum magnetic energy density ρ_2 as a function of (A, Z'). ρ_1 is proportional to the square value of electric field in empty space and ρ_2 is proportional to the square value of magnetic field. Using these definitions for ρ_1 and ρ_2 giving the exponential formula for the cosmological constant, but cosmological constant must be real value since ρ_1 and ρ_2 are real values and then it is a sine function.

Keywords: Gravity and Electromagnetism; Nuclear and particle physics; Cosmic Rays; Astrophysics and cosmology.

1. Introduction

Our universe is a huge collection of groups of nuclei. Cosmic rays are particles which have origin outside the Earth's atmosphere and they are nuclei of various kinds. Cosmic rays are outcome products of nuclear reactions and radioactive decay for gravitational objects [1-3]. Gravitational objects are nuclei having protons and neutrons numbers. Nucleus is a construction model for the universe, elementary particles, nuclei, planets, stars, black holes, galaxies and clusters are the constituents of the universe; These objects constitute groups of objects and every group have a number of subgroups.

2. Vacuum electric energy and vacuum magnetic energy

The ground state of the nucleus has $\rho_1(\mathrm{A},\mathrm{Z})$, $\rho_2(A,Z')$ which are functions of the same atomic mass number and also functions of the same protons number where ($Z'=Z$). Excited state of nucleus has protons number Z' and having $\rho_1(\mathrm{A},\mathrm{Z})$, $\rho_2(A,Z')$ which are functions of the same atomic mass number(A) but of different numbers for protons (Z,Z'). Excited states of nuclei having number for electrons may be equal the difference between Z,Z'. Every atomic state and their isobars compose a subgroup, this subgroup has nuclei of $Z'=Z,Z'_1,Z'_2,Z'_3.....,Z=Z_1$ or Z_2 or Z_3 or.....where Z is the number of protons for vacuum electric energy and Z' is the proton number for vacuum magnetic energy [4]. Cosmological constant equal to zero in case of the ground state but doesn't equal to zero for excited states and may be positive or negative value. Cosmological constant isn't one value as discussed by previous papers in this context but every nucleus has a specific value for it and varies from nucleus to another.

3. Cosmological constant

The cosmological constant is given by

$$\Lambda=\frac{8\pi G}{c^4}\left(\frac{B.E.}{A}\right)+\frac{8\pi G}{c^4}\left|\frac{B.E.}{A}\right| \qquad (1)$$

If Z , Z' are the proton numbers for vacuum electric energy and vacuum magnetic energy for the same nucleus, we find

$$\frac{B.E.}{A}=\left[\frac{M_N}{A}-\frac{Z}{A}m_p-\frac{(\mathrm{A}-\mathrm{Z})}{A}\mathrm{m}_n\right]c^2 \tag{2}$$

$$\left|\frac{B.E.}{A}\right|=\left[\frac{Z'}{A}m_p+\frac{(\mathrm{A}-\mathrm{Z}')}{A}\mathrm{m}_n-\frac{M_N}{A}\right]c^2 \tag{3}$$

And cosmological constant become

$$\Lambda=\frac{8\pi G}{c^4}\left(\left[\frac{M_N}{\mathrm{A}}-\frac{Z}{\mathrm{A}}m_p-\mathrm{m}_n+\frac{\mathrm{Z}}{\mathrm{A}}\mathrm{m}_n\right]c^2+\left[\frac{Z'}{\mathrm{A}}m_p+\mathrm{m}_n-\frac{\mathrm{Z}'}{\mathrm{A}}\mathrm{m}_n-\frac{M_N}{\mathrm{A}}\right]c^2\right) \tag{4}$$

$$\Lambda=\frac{8\pi G}{c^4}\left(-\frac{Z}{\mathrm{A}}m_p+\frac{\mathrm{Z}}{\mathrm{A}}\mathrm{m}_n+\frac{Z'}{\mathrm{A}}m_p-\frac{\mathrm{Z}'}{\mathrm{A}}\mathrm{m}_n\right)c^2 \tag{5}$$

$$\Lambda=\frac{8\pi G}{c^4}\left(\frac{\mathrm{Z}c^2}{\mathrm{A}}\left(\mathrm{m}_n-m_p\right)-\frac{Z'c^2}{\mathrm{A}}\left(\mathrm{m}_n-m_p\right)\right) \tag{6}$$

$$\Lambda=\frac{8\pi G}{c^4}\left(\rho_1+\rho_2\right) \tag{7}$$

Cosmological constant also defined by

$$\Lambda=\frac{8\pi G}{c^4}\left(-\frac{1}{2}E^2+\frac{1}{2}B^2\right) \tag{8}$$

Density of vacuum electric energy is given by

$$\rho_1=-\frac{1}{2}E^2 \tag{9}$$

And Density of vacuum magnetic energy is given by

$$\rho_2=\frac{1}{2}B^2 \tag{10}$$

Vacuum electric energy has general coordinates (x_1,x_2,x_3,x_4) and vacuum magnetic energy has general coordinates (x_1',x_2',x_3',x_4'). Electric and magnetic fields in empty space are given by

$$\vec{E}=\vec{E}_{01}e^{i(k_1x_1-\omega_1x_4)}+\vec{E}_{02}e^{i(k_2x_2-\omega_2x_4)}+\vec{E}_{03}e^{i(k_3x_3-\omega_3x_4)} \tag{11}$$

$$\vec{B}=\vec{B}_{01}e^{i(k_1x_1'-\omega_1x_4')}+\vec{B}_{02}e^{i(k_2x_2'-\omega_2x_4')}+\vec{B}_{03}e^{i(k_3x_3'-\omega_3x_4')} \tag{12}$$

And their square values are given by

$$E^2=e^{2i(k_1x_1-\omega_1x_4)}+e^{2i(k_2x_2-\omega_2x_4)}+e^{2i(k_3x_3-\omega_3x_4)} \tag{13}$$

$$B^2=e^{2i(k_1x_1'-\omega_1x_4')}+e^{2i(k_2x_2'-\omega_2x_4')}+e^{2i(k_3x_3'-\omega_3x_4')} \tag{14}$$

Wave frequency and wave vector are given by

$\omega=\omega_1+\omega_2+\omega_3$, $\vec{k}=(k_1,k_2,k_3)$

The exponential formula for the cosmological constant can be written as

$$\Lambda=\frac{8\pi G}{c^4}\left[-\frac{1}{2}e^{2i(k_1x_1-\omega_1x_4)}-\frac{1}{2}e^{2i(k_2x_2-\omega_2x_4)}-\frac{1}{2}e^{2i(k_3x_3-\omega_3x_4)}\right.$$
$$\left.+\frac{1}{2}e^{2i(k_1x_1'-\omega_1x_4')}+\frac{1}{2}e^{2i(k_2x_2'-\omega_2x_4')}+\frac{1}{2}e^{2i(k_3x_3'-\omega_3x_4')}\right] \tag{15}$$

Let's suppose that $\omega_1 = \omega_2 = \omega_3$, $k_1 = k_2 = k_3$, $x_1 = x_2 = x_3$ and $x_1' = x_2' = x_3'$ we find

$$\Lambda = \frac{8\pi G}{c^4}\left(\frac{3}{2}e^{2i(k_1x_1' - \omega_1 x_4')} - \frac{3}{2}e^{2i(k_1x_1 - \omega_1 x_4)}\right) \tag{16}$$

$$\Lambda = \frac{8\pi G}{c^4}\left(\frac{3}{2}\right)\left(e^{2i(k_1x_1' - \omega_1 x_4')} - e^{2i(k_1x_1 - \omega_1 x_4)}\right) \tag{17}$$

The exponential formula for the two complex numbers in the previous equation can be written as

$$e^{2i(k_1x_1' - \omega_1 x_4')} = \cos 2(k_1x_1' - \omega_1 x_4') + i\sin 2(k_1x_1' - \omega_1 x_4') \tag{18}$$

$$e^{2i(k_1x_1 - \omega_1 x_4)} = \cos 2(k_1x_1 - \omega_1 x_4) + i\sin 2(k_1x_1 - \omega_1 x_4) \tag{19}$$

Cosmological constant in terms of sine and cosine functions is given by

$$\Lambda = \frac{8\pi G}{c^4}\left(\frac{3}{2}\right)\Big[\cos 2(k_1x_1' - \omega_1 x_4') + i\sin 2(k_1x_1' - \omega_1 x_4')$$

$$-\cos 2(k_1x_1 - \omega_1 x_4) - i\sin 2(k_1x_1 - \omega_1 x_4)\Big]$$

$$= \frac{8\pi G}{c^4}\left(\frac{3}{2}\right)\Big[\cos 2(k_1x_1' - \omega_1 x_4') - \cos 2(k_1x_1 - \omega_1 x_4)$$

$$+i\left(\sin 2(k_1x_1' - \omega_1 x_4') - \sin 2(k_1x_1 - \omega_1 x_4)\right)\Big]$$

$$= \frac{8\pi G}{c^4}\left(\frac{3}{2}\right)\Big[-2\sin\left((k_1x_1' - \omega_1 x_4') + (k_1x_1 - \omega_1 x_4)\right)\sin\left((k_1x_1' - \omega_1 x_4') - (k_1x_1 - \omega_1 x_4)\right)$$

$$+2i\cos\left((k_1x_1' - \omega_1 x_4') + (k_1x_1 - \omega_1 x_4)\right)\sin\left((k_1x_1' - \omega_1 x_4') - (k_1x_1 - \omega_1 x_4)\right)\Big]$$

$$= \frac{8\pi G}{c^4}(-3)\Big[\sin\left((k_1x_1' - \omega_1 x_4') + (k_1x_1 - \omega_1 x_4)\right)\sin\left((k_1x_1' - \omega_1 x_4') - (k_1x_1 - \omega_1 x_4)\right)$$

$$-i\cos\left((k_1x_1' - \omega_1 x_4') + (k_1x_1 - \omega_1 x_4)\right)\sin\left((k_1x_1' - \omega_1 x_4') - (k_1x_1 - \omega_1 x_4)\right)\Big]$$

$$= -\frac{24\pi G}{c^4}\sin\left((k_1x_1' - \omega_1 x_4') - (k_1x_1 - \omega_1 x_4)\right)\Big[\sin\left((k_1x_1' - \omega_1 x_4') + (k_1x_1 - \omega_1 x_4)\right)$$

$$-i\cos\left((k_1x_1' - \omega_1 x_4') + (k_1x_1 - \omega_1 x_4)\right)\Big] \tag{20}$$

[5].

It is appeared from eq.(6) that eq. (20) must be real number not complex number i.e.

$$\Lambda = -\frac{24\pi G}{c^4}\sin\left((k_1x_1' - \omega_1 x_4') - (k_1x_1 - \omega_1 x_4)\right)\sin\left((k_1x_1' - \omega_1 x_4') + (k_1x_1 - \omega_1 x_4)\right) \tag{21}$$

$$\cos\left((k_1x_1' - \omega_1 x_4') + (k_1x_1 - \omega_1 x_4)\right) = 0 \tag{22}$$

$$\left((k_1x_1' - \omega_1 x_4') + (k_1x_1 - \omega_1 x_4)\right) = n\frac{\pi}{2} \tag{23}$$

$$n = 1, 3, 5, 7, \ldots\ldots$$

$$k_1x_1' - \omega_1 x_4' = n\frac{\pi}{2} - (k_1x_1 - \omega_1 x_4) \tag{24}$$

$$\Lambda = -\frac{24\pi G}{c^4}\sin\frac{n\pi}{2}\sin\left(\frac{n\pi}{2} - 2(k_1x_1 - \omega_1x_4)\right) \quad (25)$$

Every group of nuclei have a level number n and if n=1, we find

$$\Lambda = -\frac{24\pi G}{c^4}\sin\left(\frac{\pi}{2} - 2(k_1x_1 - \omega_1x_4)\right) \quad (26)$$

If $Z' = Z$ then $\Lambda = 0$ and

$$\frac{\pi}{2} - 2(k_1x_1 - \omega_1x_4) = m\pi \quad (27)$$

$m = 0,1,2,3,.....$

For every sublevel number m we have a subgroup of nuclei, this subgroup is the ground state and their isobars and for $m = 0$, we have

$$\frac{\pi}{2} - 2(k_1x_1 - \omega_1x_4) = 0 \quad (28)$$

$$(k_1x_1 - \omega_1x_4) = \frac{\pi}{4} \quad (29)$$

Let n=3, we find

$$\Lambda = \frac{24\pi G}{c^4}\sin\left(\frac{3\pi}{2} - 2(k_1x_1 - \omega_1x_4)\right) \quad (30)$$

If $Z' = Z$ then $\Lambda = 0$ and then

$$\frac{3\pi}{2} - 2(k_1x_1 - \omega_1x_4) = m\pi \quad (31)$$

If m=0, we have

$$(k_1x_1 - \omega_1x_4) = \frac{3\pi}{4} \quad (32)$$

Cosmological constant is the curve of sine function and its interval values are given by

$$\left(-\frac{24\pi G}{c^4} \le \Lambda \le \frac{24\pi G}{c^4}\right) \quad (33)$$

4. Conclusions

Universe is a nuclear reactor contains infinite number of groups of nuclei at a wide range, each group have infinite number of subgroups of nuclei. This paper created new study will be deeper, more comprehensive for the universe and in the context of nuclear physics.

5. References

[1] F. G. Schroder, Instruments and Methods for the Radio Detection of High Energy Cosmic Rays, Springer Theses, DOI: 10.1007/978-3-642-33660-7_2

[2] S. Ogio "The energy spectrum and chemical composition of primary cosmic rays with energies from10^{14} to 10^{16}ev" The Astrophysical Journal, 612:268–275, 2004 September 1

[3] P. V. Ramana Murthy, A. W. Wolfendale "Gamma-ray Astronomy"

[4] Mohammed A. El-Lakany. "Unification of Gravity and Electromagnetism" Journal of Physical Science and Application 7 (3) (2017): 15-24

[5] Wei- Chau Xie "Differential equations for engineers" ISBN 978-0-521-19424-2

[6] W. Greiner and B. Muller "Quantum Mechanics, Symmetries" ISBN 3-540-58080-8 2. Auflage Spriger-Verlag Berlin Heidelberg New York

[7] P. Schneider "Extragalactic Astronomy and Cosmology, An Introduction"

ISBN-10 3-540-33174-3 Springer Berlin Heidelberg New York
[8] A. Liddle “an introduction to modern cosmology”. Second Edition-Wiley