Some interesting correlations between cosmological red-shift and the strength-ratio of gravitational and electric forces

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Abstract:

This letter reports interesting correlations between cosmological red-shift and the strength-ratio of gravitational and electric forces, which may prove to be a clue to a deeper understanding of gravitation and cosmology. Cosmological red-shift, smaller than unity, \( z_c = \Delta \lambda / \lambda_0 = [G \, m_p^2 / h \, c] \) times the luminosity-distance measured in the units of a wavelength \( [D / \lambda_c] \) where \( \lambda_c = (h / m_p \, c) \), the Compton-wavelength of a fundamental-particle pi-meson. Also, the energy lost by cosmologically red-shifted photon can be viewed as due to deceleration experienced by the photon; Energy lost \( (h \Delta f) = \text{mass} (h / c^2) \) times the acceleration \( (H_0 \, c) \) times the luminosity-distance \( D \); where the rate of deceleration \( (H_0 \, c) \) turns out to be equal to the accelerated-expansion of the universe! Thus this letter provides some interesting correlations for the experts to think further.

Detailed description:

The ‘cosmological red shift’ less than unity, is generally expressed as:

\[
z_c = \Delta \lambda / \lambda_0 = H_0 \, D / c\]

(1).

The right-hand-side of expression-1 can be written as:

\[
H_0 \, D / c = h \, H_0 / (h \, c / D)\]

Now, Steven Weinberg [1] has found an interesting relation that:

\[
m_p^3 = h^2 \, H_0 / c \, G, \quad \text{where}, \quad m_p \quad \text{is mass of a fundamental-particle, pi meson.}
\]

i.e. \( G \, m_p^2 / (h / m_p \, c) = h \, H_0 \). .................................................................(2).

So, from the expressions 1 and 2, we get:

\[
z_c = \Delta \lambda / \lambda_0 = [G \, m_p^2 / (h / m_p \, c)] / [h \, c / D] \]. ......................................................(3).

i.e. \( z_c = \Delta \lambda / \lambda_0 = [G \, m_p^2 / h \, c] \) \( [D / (h / m_p \, c)] \), where \( (h / m_p \, c) \) is a unit of distance, measured in terms of Compton-wavelength of pi-meson; and the constant \( [G \, m_p^2 / h \, c] \) denotes the strength-ratio of gravitational and electric forces.

Or, in terms of energy:
\[ z_c = h \Delta \nu / h \nu = [G m_p^2 / h c] [ D / (h/m_p c)] . \] ……………………(4).

That is, the reduction in energy of photon due to cosmological-red-shift is proportional to the strength-ratio of gravitational and electric forces.

Alternatively, let us define \( z_e \) as:

\[ z_e = [ e^2 / r_e ] - [ e^2 / (r_e + D)] / [ e^2 / (r_e + D)] , \]

where \( e \) is electric-charge, \( r_e \) is ‘classical radius of electron’ and \( D \) is ‘luminosity distance’

i.e. \( z_e = e^2 [ r_e + D - r_e ] [ r_e + D] / [ r_e ( r_e + D) e^2 ] . \)

i.e. \( z_e = D / r_e . \)

From Dirac’s Large-Number-Coincidence, we know, that:

\( (G m_e m_p / e^2) = ( r_e / R_0 ) = ( m_p / M_0 )^{1/2} = 10^{-40} , \)

Where \( M_0 \) is total mass, and \( R_0 \) radius of the universe.

i.e. \( z_e = 10^{40} ( D / R_0) . \) ……………………………………………………………(5)

Because: \( H_0 R_0 = c \) and \( z_c = H_0 D / c = D / R_0 . \) ………………………………………(6)

Comparing the expressions (5) and (6), we get:

\( z_c = 10^{-40} z_e . \) …………………………………………………………………………. (7)

That is: ‘cosmological-red-shift, at a distance \( D \) is \((G m_e m_p / e^2) \) times the reduction expected from the ‘electrostatic potential energy of an electron at that distance \( D \).

(ii) We can express the cosmological red-shift \( z_c \) in terms of de-acceleration experienced by the photon: [2]

For \( z_c \) smaller than unity:

\[ z_c = (f_0 - f) / f = H_0 D / c \]

i.e. \( (h \Delta f / h f) = H_0 D / c \)

i.e. \( h \Delta f = (h f / c^2) (H_0 c) D \) ………(8)

That is, the loss in energy of the photon is equal to its mass \((h f / c^2) \) times the deceleration \( a = H_0 c \), times the distance \( D \) travelled by it. Where: \( H_0 \) is Hubble-parameter. And the value of constant deceleration \( a \) is: \( a = H_0 c \), \( a = 6.87 \times 10^{-10} \) meter/sec², equal to the rate of said accelerated expansion of the universe!
**Discussion:**
Supposing there were only two atoms, of appropriate masses, in the universe, such that a photon emitted by atom-1, by partly converting its electrostatic potential-energy into a less exited atom and a photon, which gets cosmologically red-shifted while travelling a distance $D$ and then gets absorbed by the other atom-2. This system of two atoms lost a part of their electrostatic potential energy. Will this lost energy manifest as ‘gravitational-potential-energy’ of the system of these two atoms?

**Summary:**
We presented here two interesting correlations, which are likely to be the clue for deeper understanding of gravitation and cosmology.

**References:**

Steven Weinberg “Gravitation and Cosmology” (1972) John Willy and Sons, New York

Tank, Hasmukh K. (2011) “Some clues to understand MOND and the accelerated expansion of the universe” AP&SS 336 No.2 p 341-343