On the Origin of Hubble's Constant

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Abstract:

Cosmology is primarily based on the measured value of Hubble's constant. Though its value is still being refined, the currently available value shows interesting relations with the other physical constants, as derived here. These relations can be helpful for: (i) arriving at theoretical value of Hubble's constant, and (ii) for understanding correct mechanism behind the cosmological red-shift. The relationship of Hubble's constant H_0 with the other constants derived here are: $(h\, H_0 / m_e\, c^2) = [\, (G\, m_e\, m_p\,) / h\, c\,] = [\, \lambda_C / R_0\,] = [\, (G\, m_p / c^2) / \lambda_C\,] = [\, m_p / M_0\,]^{1/2}$; here: h is Planck's constant, c the speed of light, and λ_C is Compton-wavelength of the electron. These relations suggest that either the cosmological red-shift is based on gravity, or gravity is due to the cosmological red-shift-effect on the photons exchanged between the particles.

Introduction:

While the Big Bang Model of cosmology is the most popular among majority cosmologists, some physicists have raised doubts about the very expansion of space [1]; and there are some unresolved problems like dark-energy. Therefore it is good to keep our mind open for some alternative possibilities. The relations derived here can be useful for both: the expansionist cosmologists as well, as for the minority skeptics'.

The Derivations:

The derivations presented here are based on the following well-accepted relations:

$H_0\, R_0 = c$ .....(1)

Where H_0 is Hubble's constant, and R_0 is radius of the universe at which the recessional-velocity attains the speed of light.

$G\, M_0\, M_0 / R_0 = M_0\, c^2$ ……..(2)

Where : M_0 is mass of the universe required for the 'closer-density'.

And $\lambda_C = h / m_e\, c^2$ …….(3)

Where: h is Planck's constant.

Since: $G\, M_0\, M_0 / R_0 = M_0\, c^2$,

i.e. $G\, M_0\, m_e / R_0 = m_e\, c^2$,

i.e. $[\, G\, M_0\, H_0\, m_e / c\,] = m_e\, c^2$,

i.e. $G\, M_0\, H_0 = c^3$ ……(4)

Now: based on the expressions (1) and (3):

$(\, H_0\, h / m_e\, c^2\,) = (\, \lambda_C / R_0\,)$ ……(5)

The gravitational coupling constant is:

$G\, m_e\ m_p / h\, c$

Dividing both numerator and denominator by $G\, m_p / c^2$:

$[\, G\, m_e\ m_p / h\, c\,] = (\, m_e\, c^2\,)\,(\, G\, m_p / h\, c^3)$

And by making use of the expression-4:

$[\, G\, m_e\ m_p / h\, c\,] = (\, m_e\, c^2\,)\,(\, G\, m_p / h\, G\, M_0\, H_0)$

i.e. $[\, G\, m_e\ m_p / h\, c\,] = (m_e\, c^2 / h\, H_0\,)\,(\, m_p / M_0\,)$ ……..(6)

And from the expression-5:

i.e. $[\, G\, m_e\ m_p / h\, c\,] = (\, R_0 / \lambda_C\,)\,(\, m_p / M_0\,)$

i.e. $[\, G\, m_e\ m_p / h\, c\,]\,[\, \lambda_C / R_0] = (\, m_p / M_0\,)$ ……(7)

The three ratios of the expression-7 are similar to the well-known Large-Number-Ratios first noticed as an interesting coincidence by P.A.M. Dirac [3] and Arther Eddington [2]; whereas here we have derived it based on the well accepted relations. This derivation leads us to a conclusion that the Large-Number-Coincidence is not a coincidence; rather these large-numbers are theoretically-derivable relations. A preliminary attempt to explain the LNC was made by this author in 1997 [4].

Now, the linear part of the cosmological red-shift is expressed as:

Cosmological red-shift: $z_c = H_0 D / c$

For a distance equal to one wavelength of the received photon:

The loss in energy of the photon: $h f_0 - h f = (h f) (H_0 \lambda) / c$

i.e. The loss in energy of the photon at a distance λ : $h f_0 - h f = h H_0$ ……(8)

And the loss in energy of the photon at a distance D:

$(h f_0 - h f) / h f = H_0 D / c$

i.e. $(h f_0 - h f) = (h f) (H_0 D / c) = (h H_0) (D / \lambda)$ ……..(9)

Since, $h H_0 = (m_e c^2) [(G m_e m_p) / h c]$

The loss: $(h f_0 - h f) = (m_e c^2) [(G m_e m_p) / h c] (D / \lambda)$ ……..……..(10)

i.e. the loss : $(h f_0 - h f) = (h c / \lambda_C) [(G m_e m_p) / h c] (D / \lambda)$

i.e. the loss : $(h f_0 - h f) = [(G m_e m_p / \lambda_C)] (D / \lambda)$ ……..…..(11)

The expression-11 suggests that the Hubble's constant, and consequently, the cosmological red-shift, is related to the gravitational coupling constant.

It is currently believed that the expansion of the universe is getting accelerated at the rate $H_0 c$. The following derivation suggests that the cosmologically red-shifting photon can be viewed as decelerating at the same rate. The linear part of the cosmological red-shift is expressed as:

$z_c = h \Delta \nu / h \nu = H_0 D / c$

That is, the loss in energy of the photon, at a distance D, is:

$h \Delta \nu = (h \nu / c^2) (H_0 c) D$ ……(12)

That is, the loss in energy of the photon at a distance D is equal to its "mass" times the acceleration ($H_0 c$) times the distance D. Whether the expansion of the universe is accelerating, is still a hypothesis; whereas the cosmologically red-shifting photon is decelerating at the same rate ($H_0 c$), as shown here, is a consistently observed fact.

Attention of the reader is invited to an important difference between the standard expansionist interpretation of the 'cosmological red-shift' and the new interpretation proposed here. As seen in the expression-12, the photon decelerates at the rate $H_0 c$; so its kinetic-energy goes on reducing after every unit distance. So, the new input-frequency for the next unit distance is smaller than the previous one. And so the loss in energy $h \Delta \nu$ goes on reducing with every subsequent unit distance. The total loss in energy of the photon becomes a non-linear function of distance. This non-linearity of Red-shift-Distance-Curve is being currently interpreted as the 'accelerated-expansion' of the universe. Whereas, as per our new interpretation, this non-linearity is a natural consequence of the new mechanism.

References:

[1] Ling Jun Wang, "On the Flatness of Spacetime" *Physics Essays* Volume **27**, No. 3 (2014).

[2] A. Eddington (1931). "Preliminary Note on the Masses of the Electron, the Proton, and the Universe". *Proceedings of the Cambridge Philosophical Society* **27**: 15.

[3] P. A. M. Dirac (1937). "The Cosmological Constants" *Nature* **139** (3512): 323.

[4] Tank, Hasmukh K., "**An explanation for the large numbers in astrophysics and ...*www.new.dli.ernet.in/rawdataupload/upload/insa/.../20005975_469.pdf***