

Possible Hubble Tension Resolution

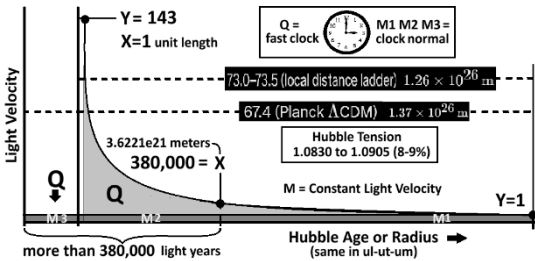
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Abstract

The discrepancy between the CMB/BAO measure of H_0 and Type 1A measurements might be resolved by a change in light velocity as a function of a changing fine structure constant here considered as a measure of the 'physical tension' of space that supports light velocity.

In the Standard Model the velocity of light is constant throughout time while space expands. In the model considered here the speed of light is variable and decreases (approximately) inversely as the 12th root of the Hubble radius (R^{12}). Its rough measure is the fine structure constant derived from the hydrogen ground state whose force is given as $F_{\text{hydrogen}} = \alpha^3 \beta^2$. The ground state force is proportional to $1/R^{1/2}$ and in this 'unit system' of measure the Planck constant is ... $\hbar = 1/R$. The speed of light then decreases from 'unit velocity' to $\sim 1/143$ since the "Big Bang". Spatial expansion is discarded in favor of a shrinking ruler.

A 3D Euclidean reference frame (α -field) retains uniform lengths while other parameters are variable to make up Standard Model differences. All physics constants change with the age and radius of the universe generally consistent with Dirac's Large Numbers Hypothesis.



The basic premise in regard to the Hubble Tension is that ... IF ... the speed of light were to change inversely as the 12th root of the Hubble radius, the first 380,000 years would disguise a longer length than 380,000 light years because the speed of light was initially ~ 143 times greater than the present speed (by definition $c=1$ now).

We take a definite integral to compute that added length ($Q+M_{1+2}$) then compare that with the same Hubble radius as though the speed of light was constant. The ratio of these two should be the same as the measured Hubble Tension. There is a big 'inflation' for only 380,000 years.

In the 'local distance ladder' we measure the red shifts of Type 1A supernovae after the 380,000-light-year decoupling phase and extrapolate a constant light speed the rest of the way to the Big Bang where nothing can be seen with a red shift to measure. So, $c/H_0 = R_{\text{megaparsecs}}$. However, if the universe hides a plummeting light velocity (equivalently a faster clock) ... we could stretch out the radius ... by alternatively slowing the clock rate back to 'normal time'.

Information from the unknown zone's output (CMB/BAO) computes a slower expansion rate and a longer Hubble radius when we arbitrarily slow the fast clock. The radius/age of the universe is then $M1+M2+M3$ instead of the $M1+M2$ calculated from Type1A redshift data.

Essentially, we are saying that the 67.4 (Planck Λ CDM) covers a longer length than theorized (Q flattened makes H_{radius} longer) ... and therefore equivalently, space would expand at a slower rate to cover the same apparent distance as the 73.0–73.5 (local distance ladder) which is computed as the lesser distance ($M1+M2$). Here the integral of velocity on the y-axis and age on the x-axis produces an area proportional to the radius of the universe because in the 'unit system of measure' the age of the universe is the same measure as its radius, i.e. 1 unit length is the distance between two unit masses (baryons) if all were uniformly distributed (on the scale of about a meter) ... and 1 unit of time is the time required for light to traverse that unit distance.

If we consider light speed unchanging, the radius of the universe is the thin area M1 + M2 as calculated by red-shift analysis of type 1A super novae. However, if we consider light speed as changing (with a changing fine structure constant), then area Q can be flattened to produce the flat extension M3. So that the 'true' radius is M1+M2+M3 if 'c' was constant. We flatten all of area Q to make the M3 addition (M3 = the equivalent Q-area at unchanging light speed). This gives a greater distance to cover (M2+M3) prior to the decoupling event instead of just M2. Note: Most of area Q occurs over M1 not where the 'Planck Λ CDM' calculation is made (M2).

Model Hypothesis :
 $\alpha = 1/137.0317$ $\beta = 1/1836.2365$
 $F = 1.1526\text{e-}13 = \alpha^3 \beta^2 = \frac{1}{\sqrt{R}}$

$R = 7.52735\text{e}25$ UL
 (x 1.674 = ~1.26 e26 meters)

Light velocity at 380,000 yr. decoupling
 $143.346 / (5.42427\text{e}21)^{1/12} = 2.214 \times c$

$\int_1^{7.52735\text{e}25} \frac{143.346}{12\sqrt{x}} dx = 8.21158\text{e}25$
 $\frac{8.21158\text{e}25}{7.52735\text{e}25} = 1.0909 \rightarrow \sim 9\%$

$Q \text{ (over M2)} = 3.351522\text{e}21 + Q \text{ (over M1)} = 6.838948\text{e}24$
 $M3 = 8.21158\text{e}25 - 7.52735\text{e}25 = 6.8423\text{e}24$

$\frac{380,000}{13,800,000,000} = 2.7536\text{e-}5$
 $2.7536\text{e-}5 \times 7.52735\text{e}25 = 2.072748\text{e}21$
 $2.072748\text{e}21 = R_{\text{H}} \text{ (from 1 to 380,000)} = M2$
 $5.42427\text{e}21 - 2.072748\text{e}21 = 3.35152\text{e}21$
 $(Q \text{ (over M2)} + M2) - M2 = Q \text{ (1 to 380,000)}$
 $8.21158\text{e}25 - 7.52735\text{e}25 = 6.8423\text{e}24$
 Total Q = 6.8423e24 = M3

By theory, the hydrogen ground state force is $\alpha^3 \beta^2$ and is equal numerically to $1/R^{1/2}$. Here the FSC used is $1/137.0317$. '137' is derived from 143 by probability modifications to account for the inequality of "parameters versus exponents" in the force equation $F = \alpha^3 \beta^2$ (see below). [Note: F , α and β are all pure numbers inviting a solution in pure mathematics] ... and applied to ensure that at the start of the universe the speed of light is many times greater than now ('c' is defined as '1 = unit velocity' since α is the present hydrogen ground state velocity).

$\frac{m_e v^2}{r} = \text{Force (ground state)} = \alpha^3 \beta^2$

$\frac{\hbar}{m_e c \alpha} = r \text{ (Bohr radius)}$

$F = \frac{m_e v^2}{m_e c \alpha} = \frac{m_e^2 c \alpha v^2}{\hbar}$

$\frac{m_e^2 c \alpha v^2}{\hbar} = \frac{m_e^2 \alpha^3}{\hbar} = \frac{[\beta \times \frac{1}{\sqrt{2\pi R}}]^2}{\frac{1}{2\pi R}} \alpha^3$

$c = 1 \text{ and } \alpha = v \text{ (in the hydrogen ground state)} \quad \hbar = 1/2\pi R; \quad 1/\sqrt{2\pi R} = \text{proton mass}$

$\frac{\omega}{\frac{1}{\omega}} = \omega^2 = \frac{2}{2} = \frac{\alpha \alpha}{\beta \beta} \rightarrow \frac{\omega \times \omega}{\frac{1}{\omega}} = \omega^3 = \frac{3}{2} = \frac{\alpha \times \alpha \alpha}{\beta \beta}$

$\omega = \sqrt[3]{\frac{3}{2}} \quad \text{and} \quad \frac{1}{\omega} = \sqrt[3]{\frac{2}{3}}$

$\left[\left(\frac{3}{2}\right)^{\frac{1}{3}} F^{\frac{1}{2}}\right]^{\frac{1}{3}} = \frac{1}{137.0317}; \quad \left[\left(\frac{2}{3}\right)^{\frac{1}{3}} F^{\frac{1}{2}}\right]^{\frac{1}{2}} = \frac{1}{1836.2365}$

Because of the vagaries involved in estimates of UL's/meter, it is only possible to produce general estimates. These are consistent with observations that make the Hubble Tension about 8-9%. The FSC ($1/137.0317$ instead of $1/137.036$) reflects a variation in large void spaces (> c) and concentrations of matter (< c) that creates a 'Dark Matter gradient'.

It is understood that there is no experimental evidence for any changing constants in the corpus of cosmology or theoretical physics. For any such 'changing constants' theory to be true

would require a way to completely 'mask' the changes by a cancelation process. It must then be the case that the hydrogen ground state spectra (and subsequently all other atomic spectra) from distant galaxies MUST map to present measures except for the 'red shift' parameter. To accomplish this, it is conjectured that all the other ground state parameters change in conjunction with one another ... to do exactly that. The fine structure constant (α) weakens over time and a concomitant change in the e/P mass ratio (β) combines to yield the same spectral lines with only a red shift difference noticeable.

$R = 1/h; \quad 1/\hbar; \quad 1/(F^2)$

$\alpha_r \approx R^{1/12} \quad (\beta_r \approx R^{1/8})$
 $143.346 \quad 1716.245$

note equivalence

$\alpha^3 = (R^{1/12})^3 = R^{1/4}$
 $\beta^2 = (R^{1/8})^2 = R^{1/4} > \frac{1}{1}$

$F = 1/\sqrt{R} \text{ or } 1/\sqrt{2\pi R}$

$F = \alpha^3 \beta^2 = \frac{m v^2}{r} = \frac{\beta \alpha^2}{1/\alpha \beta}$

probabilistic modifiers '3/2 and 2/3'

$\alpha = \left[\left(\frac{3}{2}\right)^{\frac{1}{3}} F^{\frac{1}{2}}\right]^{\frac{1}{3}} = \frac{1}{137.0317}$

$\beta = \left[\left(\frac{2}{3}\right)^{\frac{1}{3}} F^{\frac{1}{2}}\right]^{\frac{1}{2}} = \frac{1}{1836.2365}$

How Changing Constants Map to Present Measures

As an example, we take the necessary values at the point where the speed of light is twice the present value, i.e. $2 \times 3 \times 10^8$ meters per second. By setting this velocity in the present model we also set the radius of the universe at that point. It is 1.83766×10^{22} unit lengths. We see that this distance is about .024% of the Hubble radius. So that this distance will compare to about 8.7 times greater than the decoupling phase or about 3,311,700 light years after the Big Bang.

$$\frac{143.346}{12\sqrt{x}} = 2c \Rightarrow x = 1.83766 \times 10^{22} = R$$

$$F = 1/\sqrt{1.83766 \times 10^{22}} = 7.37679 \times 10^{-12}$$

$$\frac{1.83766 \times 10^{22}}{7.52735 \times 10^{25}} = .000244132 = .024\%$$

$$\frac{380,000}{13,800,000,000} = .000027536 = .0027536\%$$

$$\frac{.000244132}{.000027536} = 8.715 \quad x(>380,000)$$

$$F = \frac{1}{\sqrt{R}} \begin{cases} \alpha = \sqrt[6]{(3/2)^{2/3} \times F} = \sqrt[6]{1.31037 \times 7.37679 \times 10^{-12}} = 0.0145952 = 1/68.5156 = \alpha \\ \beta = \sqrt[4]{(2/3)^{2/3} \times F} = \sqrt[4]{.763142 \times 7.37679 \times 10^{-12}} = 0.0015403 = 1/649.205 = \beta \end{cases}$$

$$r \text{ (Bohr radius)} = \frac{\hbar}{m_e c \alpha} = \frac{1/2\pi R}{\frac{\beta c \alpha}{\sqrt{2\pi R}}} = \frac{1}{\frac{\sqrt{2\pi R}}{1} \times \frac{1}{68.5156} \times \frac{1}{649.205}} = \frac{44,480.6701}{3.398 \times 10^{11}} = 1.309027 \times 10^{-7}$$

By setting the light speed value at '2' we can also extract from theory the fine structure constant (FSC) and electron-Proton mass ratio (e/P) as well as the Bohr radius (a_0) ... each of which has an altered value.

We now have sufficient information to calculate all the relevant data to see if a non-contradictory mathematical theory can be developed that gives the same measures in a changing constants model as found in the Standard Model that is considered permanently static.

$$\begin{aligned} h &= 1/R = 5.4417 \times 10^{-23} \\ \hbar &= 1/2\pi R = 8.6607 \times 10^{-24} \\ \frac{h}{\beta \alpha} &= \frac{5.4417 \times 10^{-23}}{6.61616 \times 10^{-17}} \\ &= \sqrt{2\pi \cdot 1.83766 \times 10^{22}} \\ &= 8.224858 \times 10^{-7} / 2\pi = 1.309027 \times 10^{-7} \\ &= (\text{radius of 1st Bohr orbit}) \\ m_e &= \beta / \sqrt{2\pi R} = 4.5331 \times 10^{-15} \end{aligned}$$

The following table reveals that although the FSC and e/P mass ratio are different, they produce the same relative wavelengths that exactly map to current hydrogen electron orbitals and will emit radiation that always maps to the present relative lengths. The spectrum of atoms in a changing constants model looks exactly like the non-changing Standard Model except that the wavelengths are longer (redshifted' in Standard Model interpretation). The numbers add up and fit together correctly as required by observation.

$r_n = n^2 a_0$		$m_e = 4.5331 \times 10^{-15}$	$F = (m_e v^2) / r$	$(\text{orbital velocity})$		$h = 5.4417 \times 10^{-23} = 1/R$	λ
#	x Bohr	r = radius in UL	$1/r^2$	centripetal = electrostatic	$v = \sqrt{Fr/m_e}$	$\hbar = m_e v r$	$2\pi(x \text{ radius}) \div h/m_e v = \text{orbital}$
n1	1 a_0	1.3090276e-7	1/1	7.37679e-12	0.014595213	8.6607e-24 x1	8.2248e-7 / 8.2248e-7 = 1
n2	4 a_0	5.2361104e-7	1/16	4.610493e-13	0.007297606	1.7321e-23 x2	3.2899e-6 / 1.6449e-6 = 2
n3	9 a_0	1.1781248e-6	1/81	9.107148e-14	0.004865071	2.5982e-23 x3	7.4024e-6 / 2.4674e-6 = 3
n4	16 a_0	2.0944441e-6	1/256	2.881558e-14	0.003648803	3.4643e-23 x4	1.3159e-5 / 3.2899e-6 = 4
n5	25 a_0	3.2725690e-6	1/625	1.180286e-14	0.002919042	4.3303e-23 x5	2.0562e-5 / 4.1124e-6 = 5
n6	36 a_0	4.7124993e-6	1/1296	5.691967e-15	0.002432535	5.1964e-23 x6	2.9609e-5 / 4.9349e-6 = 6

We need to calculate the redshift for the hydrogen spectrum at 3,311,700 light years which is where the proposed light velocity is twice the present value. Because the light emitted then had twice the speed, it is now redshifted twofold longer by decreasing light velocity alone. However, because our clocks are also now running at half-speed, that doubling is cancelled. The next consideration is the "shrinking ruler" effect. The Bohr radius then was 1.3090276×10^{-7} UL and now ... 1.157014×10^{-8} UL. So, our ruler is 11.3138 times smaller. The measured Standard Model 'z' factor for this distance is ~283 ... about 25 times larger.

Is there another major factor at large distances? The only candidate offered here is gravitational redshift. The gravitational interaction (R table below) also varies with time being proportional to $R^{-3/2}$. At present, $R = 7.52735 \times 10^{25}$ so gravity has strength 1.5312×10^{-39} . However, at $R = 1.83766 \times 10^{22}$ the strength of gravity is greater at 4.01423×10^{-34} ... 262,162 times stronger.

In the general model I have proposed ... *"Existence as fundamentally the geometric embodiment of an integer count"* ... space (the α -field) must have both global and local properties such as global unit density (constant) and variable tension ($t > 0$) with local density variations (charges +,-) and twists (N,S poles) in it. That is, it is the seat of the electromagnetic interaction itself. Whereas in the Standard Model, space has no detectable 'tension property' like the tension in a violin string that supports a traveling wave structure. This 'FSC as tension' property regulates the speed of light by which 'c' **also** decreases proportional to the 'clumping' of matter by gravity. This creates a 'tension gradient' between empty space and galaxies and galactic clusters ... in the same direction as gravity ... giving rise to flat rotation curves (Rubin) and excessive galactic velocities (Zwicky). The gradient passes observationally for Dark Matter. Dark Matter is then an 'interaction' between normal mass and a 'property of space' rather than a 'new particle'. Hence, dark matter particles cannot be 'discovered' by any experiment.

A diminishing 'c' replaces the increasing Hubble constant (Perlmutter) in the equation $c/H_0 = R_{\text{mpc}}$ that then replaces the 'accelerated expansion' of the universe obviating any theoretical need for a Dark Energy parameter.

Everything in the model -MUST- change with R approximately as these Hubble radius functions. They are all mutual functions.

There is no wiggle room ...

baryon number	10^{78}	(pure no.)	$\propto R^3$
particle production rate	10^{32}	n/ut	$\propto R^2$
reaction velocity	10^{39}	ul/ut	$\propto R^{3/2}$
radius of universe	10^{26}	ul	$\propto R^1$
Compton wavelength	10^{13}	ul	$\propto R^{1/2}$
particle mass	10^{-13}	um	$\propto R^{1/2}$
elementary charge 'e'	10^{-13}	uC	$\propto R^{1/2}$
Planck constant	10^{-26}	um·ul ² /ut	$\propto R^{-1}$
gravitational constant	10^{-39}	ul ³ /um·ut ²	$\propto R^{-3/2}$
hydrogen ground state force	10^{-13}	um·ul/ut ²	$\propto R^{-1/2}$
e/P mass ratio	1/1836	(pure no.)	$\propto R^{1/8}$
fine structure constant	1/137	(pure no.)	$\propto R^{1/12}$
speed of light	1/143	ul/ut	$\propto R^{1/12}$

Conclusions

The proposal here is that a changing FSC and resultant variable light speed is roughly equivalent to a movie of the universe run at a faster or slower rate. The fastest rate was substantially around the decoupling at 380,000 years and a slower clock rate thereafter. Incorrectly assuming that the faster clock rate was always uniformly the same constant 'c' ... produces the "Hubble Tension".

The rate at which constants are assumed to change is now very slow. When the universe is one trillion times older than now ... its fine structure constant will still be about 1/1370, and light speed will be about 10 times slower. Though the speed of light was much greater prior to M1, most of the changes occur in M1 after the decoupling at which point the speed of light was $\sim 2.2c$. This physical tension parameter is also bound up with Dark Matter and Dark Energy.

It is understood here that changing constants are mandatory for any unique 'ex nihilo' theory of existence. We cannot pick numbers out of a hat and apply them to the entire universe without cause. So, if the most basic physics constants do not change ... any 'unique' ex nihilo theory is absolutely falsified ... and we must then fall back on a 'many worlds' hypothesis or some other intellectually indigestible theory. Ideally there is only one universe to explain, and it must be the simplest thing conceivable that accounts for all observations (but not more so).

References

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