# ON THE COSMIC NUMBER (137)

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Richard Feynman: “There is a most profound and beautiful question associated with the observed coupling constant, e – the amplitude for a real electron to emit or absorb a real photon. It is a simple number that has been experimentally determined to be close to 0.08542455. (My physicist friends won’t recognize this number, because they like to remember it as the inverse of its square: about 137.03597 with about an uncertainty of about 2 in the last decimal place. It has been a mystery ever since it was discovered more than fifty years ago, and all good theoretical physicists put this number up on their wall and worry about it.) Immediately you would like to know where this number for a coupling comes from: is it related to pi or perhaps to the base of natural logarithms? Nobody knows. It’s one of the greatest damn mysteries of physics: a magic number that comes to us with no understanding by man. You might say the “hand of G-d” wrote that number, and “we don’t know how He pushed his pencil.” We know what kind of a dance to do experimentally to measure this number very accurately, but we don’t know what kind of dance to do on the computer to make this number come out, without putting it in secretly!”[1] In this note, a “computational dance” from which this number emerges without any need to put it in secretly is identified...

Let

$$\hbar = \text{the reduced Planck constant} = 6.66134 \times 10^{-16}$$
$$G = \text{the Gibbs constant} = \int_0^{\pi} \frac{\sin(x)}{x}\, dx$$

and let

$$R_\infty = \text{the Rydberg constant}$$
$$e = \text{the elementary charge}$$
$$c = \text{the speed of light in a vacuum}$$
$$\epsilon_0 = \text{the electric constant}$$
$$\mu_0 = \text{the magnetic constant}$$
$$R_K = \text{the von Klitzing constant}$$
$$Z_0 = \text{vacuum impedance}$$

$\alpha$ is derived from the measurement of the ratio $\frac{\hbar}{m\,R_b}$ between the Planck constant and the mass of the $R_b$ atom because

$$\alpha^2 = \frac{2\,R_\infty}{c}\,\frac{m\,R_b}{m_e}\,\frac{\hbar}{m\,R_b}$$

where $m_e$ is the electron mass. The recommended CODATA value is

$$\alpha = 7.2973525664 \times 10\wedge{-3} = \frac{1}{137.036} = \left(e^{2\gamma}\left(e^{-\left(\zeta(12)-\frac{1}{12-1}\right)}\right)^2 - e^{2\gamma}\left(e^{-\left(\sum_{n=1}^{1}\frac{1.00009}{1^{12}}-\int_1^1\frac{1.00009}{1^{12}}\,dn\right)}\right)^2\right)^2$$

And so

$$\left(e^{2\gamma}\left(e^{-\left(\zeta(12)-\frac{1}{12-1}\right)}\right)^2 - e^{2\gamma}\left(e^{-\left(\sum_{n=1}^{1}\frac{1.00009}{1^{12}}-\int_1^1\frac{1.00009}{1^{12}}\,dn\right)}\right)^2\right)^2 =$$

$$\frac{1}{\frac{\left(\frac{3\pi}{2}\right)^3 G}{\sqrt{2}}} = \sqrt{\frac{2\,R_\infty}{c}\,\frac{m\,R_b}{m_e}\,\frac{\hbar}{m\,R_b}} = \frac{e^2}{4\,\pi\,\epsilon_0\,\hbar\,c} = \frac{1}{4\,\pi\,\epsilon_0} = \frac{e^2}{\hbar\,c} = \frac{\pi\,\mu_0}{4}\,\frac{e^2\,c}{\hbar} = \frac{k_e\,e^2}{\hbar\,c} = \frac{c\,\mu_0}{2\,R_K} = \frac{e^2}{4\,\pi}\,\frac{Z_0}{\hbar}$$

Let

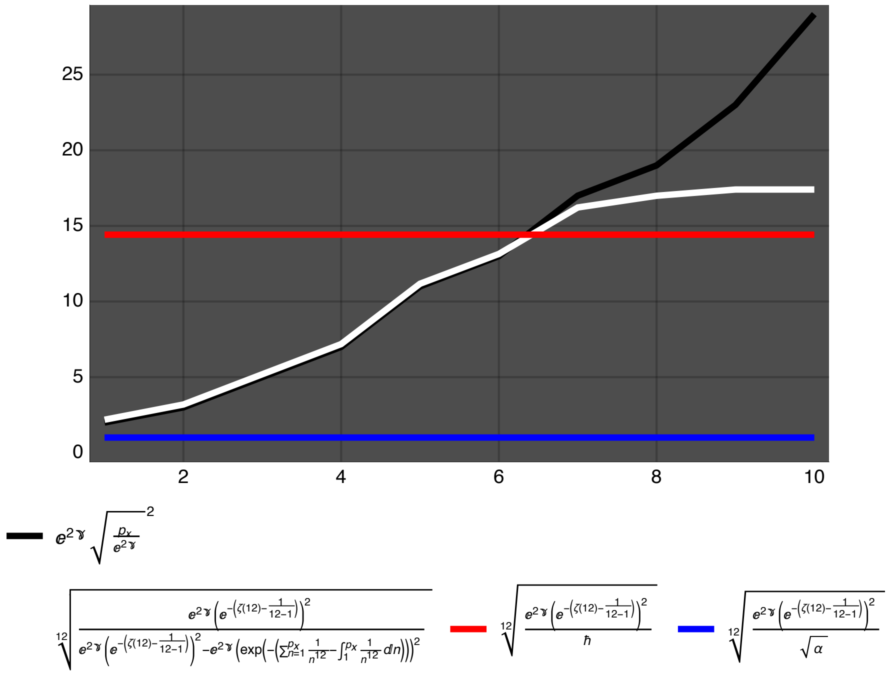
$$\alpha_G = \text{the gravitational coupling constant}$$

and in Planck units

$$\left(e^{2\gamma}\left(e^{-\left(\zeta(12)-\frac{1}{12-1}\right)}\right)^2 - e^{2\gamma}\left(e^{-\left(\sum_{n=1}^{1}\frac{1.00009}{1^{12}}-\int_1^1\frac{1.00009}{1^{12}}\,dn\right)}\right)^2\right)^2 = \alpha_G\left(\left(\frac{e}{m_e}\right)^2\right)$$

There is a difference of 0.0000127295 between the recommended value of $\alpha$ and $\left(e^{2\gamma}\left(e^{-\left(\zeta(12)-\frac{1}{12-1}\right)}\right)^2 - e^{2\gamma}\left(e^{-\left(\sum_{n=1}^{1}\frac{1}{1^{12}}-\int_1^1\frac{1}{1^{12}}\,dn\right)}\right)^2\right)^2$, but this difference is within the bounds of the variations in the fine structure constant suggested by data on quasars.[4-6]

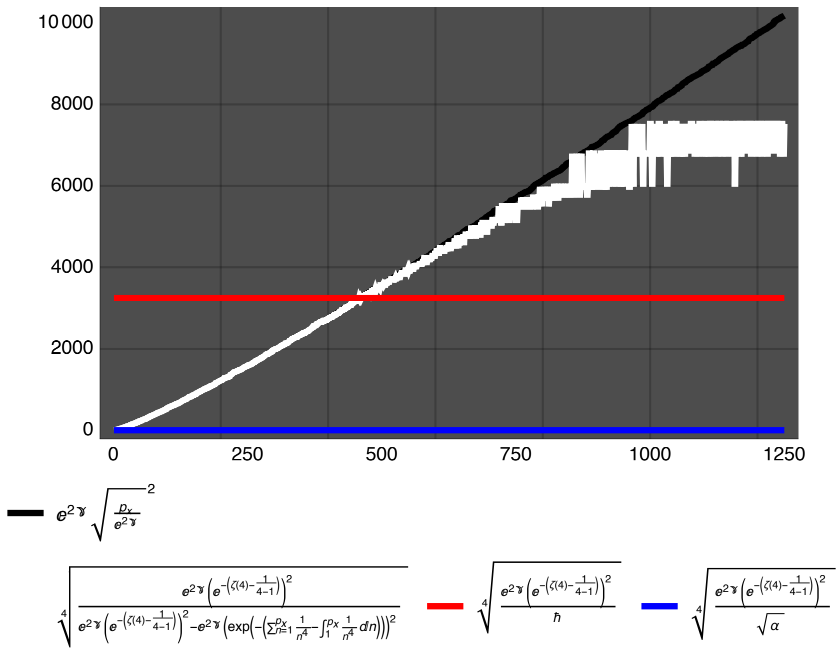
Arguably then, we have a non-arbitrary, non-subjective, number-line/time-line, whose units are associated to the fundamental physical constants as we know them from observation, and have a certain minimum and maximum size given at the one extreme by the Planck constant and at the other by the fine-structure constant:

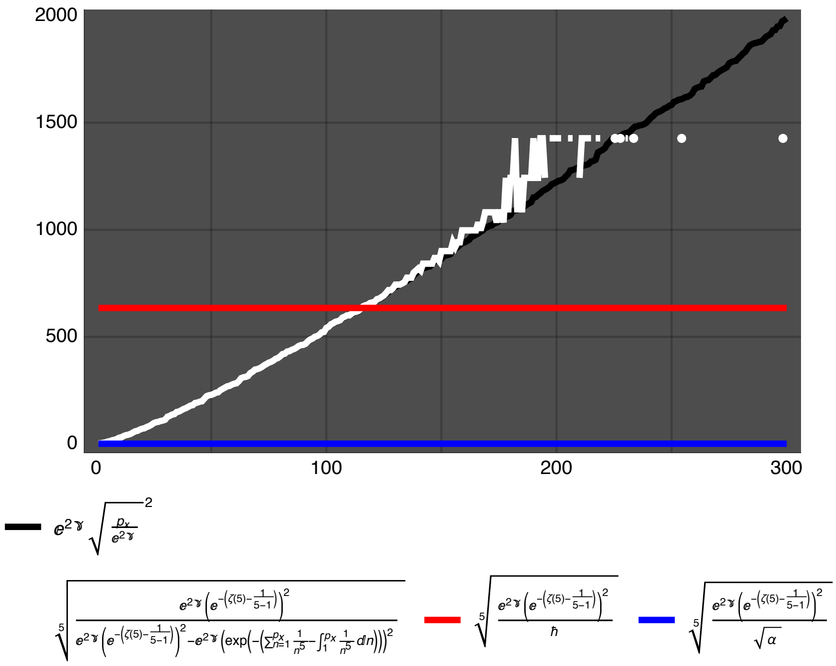


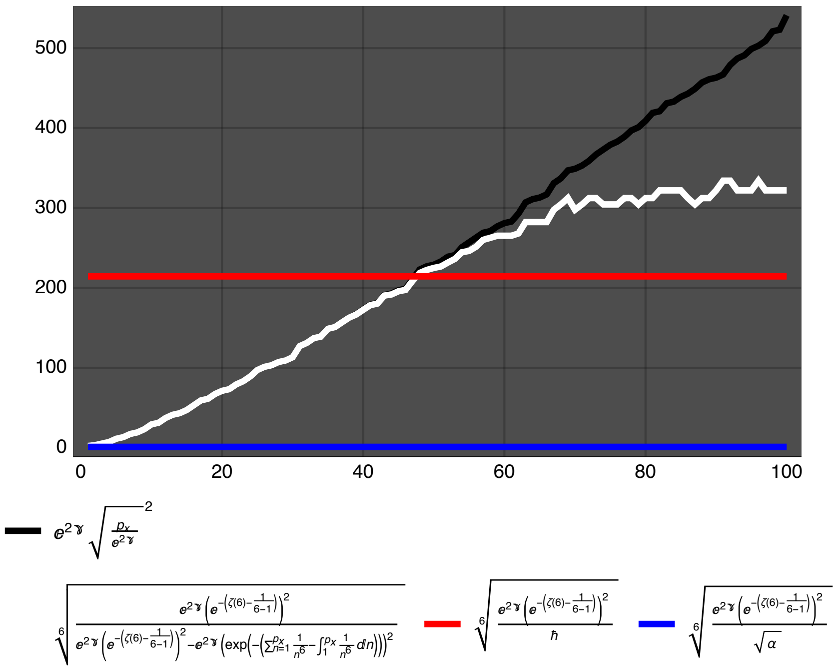

But it is clear that this is a *local* -a discontinuous- pair of lines, particular to a single cross-section of a global pair. Refining $\alpha$ as

$$\alpha = \left(e^{2\gamma}\left(e^{-\left(\zeta(s)-\frac{1}{s-1}\right)}\right)^2 - e^{2\gamma}\left(e^{-\left(\sum_{n=1}^{1}\frac{1}{1^s}-\int_1^1\frac{1}{1^s}\,dn\right)}\right)^2\right)^2$$

where $s$ is a positive integer, we see that there are a potentially infinite number of these cross-sections, each associated to a different (positive) real value of $s$ and to a potentially different set of potential constants:






We might link these lines and the nature of their separation to a state of infinite prime and energy density by reference to the following modification of the traditional equation for a circle of area 1 $\pi\sqrt{\frac{1}{\pi}}^2 = 1$ :

$$\lim_{x\to\infty} e^{2\gamma}\left(\sqrt{\frac{1}{e^{2\left(\sum_{n=1}^{x}\frac{1}{n}-\int_1^x\frac{1}{n}\,dn\right)}}}\right)^2 = 1$$

Where the traditional equation fails by implying that an energy source located at the center of this area unit-circle is undiminished from center to circumference (it has either a zero or an infinite radius), the second provides us with a potentially infinite number of necessarily non-infinite and non-zero energy levels. Since these lines would collapse in the context of the infinite prime/energy density associated to circle of no-radius (a point), or the infinite prime/energy sparsity associated to a circle of infinite radius (a line), the implication is that there is a global number line/time-line pair comprised of pairs of sub-lines, one of which is associated to the web of relationships between the fundamental physical constants as we know them, and therefore to a particular arithmetic/spatio-temporal epoch. These webs differ from epoch to epoch, but the balance of prime/energy-density and sparsity of each pair of lines is tightly constrained by the value $s = 1$, and by the limit $e^{2\gamma}\sqrt{\frac{1}{e^{2\gamma}}}^{2} = 1$ (and therefore by the balance of prime-density and sparsity associated to complex zeros of L-functions whose real part is equal to 1/2)[5]. Otherwise, the (global) number line would *per impossible* involve a strictly finite amount of prime density: let $g$ = Graham's number [6] (if every digit in Graham's number is considered to occupy as little as 1 Planck volume, it would nonetheless be too big to fit in the observable universe) and note that if $s$ in the limit

$$e^{(s+1)\left(\zeta(s)-\frac{1}{s-1}\right)}\left(\left(\frac{1}{e^{(s+1)\left(\zeta(s)-\frac{1}{s-1}\right)}}\right)^{\frac{1}{s+1}}\right)^{s+1}$$

were to differ from 1 by as little as

$$1 \times 10^{-g}$$

the number of primes in the progression(s) associated to

$$\left(\frac{e^{2\gamma}\left(e^{\frac{1}{s-1}-\zeta(s)}\right)^{2}}{e^{2\gamma}\left(e^{\frac{1}{s-1}-\zeta(s)}\right)^{2}-e^{2\gamma}\left(\exp\left(-\left(\sum_{n=1}^{x}\frac{1}{n^{s}}-\int_{1}^{x}\frac{1}{n^{s}}\,dn\right)\right)\right)^{2}}\right)^{1/s}$$

would be finite.

# References


A. [1] Feynman, R (1985), *QED: The Strange Theory of Light and Matter*

B. [2] Johnson, H (2010), *Changes spotted in fundamental constant*

C. [3] Webb, J (2010), *Evidence for the spatial variation of the fine-structure constant*

D. [4] King, J (2010), *Searching for variations in the fine-structure constant and the proton-to-electron mass ratio using quasar absorption lines*

E. [5] Davenport, H (2000), *Multiplicative number theory*

F. [6] Graham, R (1971), *Ramsey's Theorem for n-Parameter Sets*