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Abstract: A derivation of the fine structure constant by deduction
References: None

The Derivation of the Fine Structure Constant

By

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The electromagnetic force is defined:

$$e_f = 8.94*10^{18}*(Q_1Q_2/r^2)gcm^3/sec^2coulomb^2$$

This can be interpreted in the following way. Let $Q_1=n_1q$ and $Q_2=n_2q$, where q = $1.6*10^{-19}$coulomb/ecu. Then:

$$e_f = 2.30*10^{-19}(n_1*n_2/r^2)(gcm^3/sec^2ecu^2)$$

Under this interpretation, the electromagnetic force constant e has the dimensions gcm^3/sec^2ecu^2. I am primarily interested in the dimensions, call it:

$$e = 2.30*10^{-19}gcm^3/sec^2ecu^2$$

The gravitational force is defined:

$$G_f= 6.67*10^{-8}\ (m_1*m_2/r^2)\ (cm^3/gsec^2)$$

Again, I am primarily interested in the dimensions, call it:

$$G = 6.67*10^{-8}cm^3/gsec^2$$

Divide G by e $\quad G/e = G/e\ *(cm^3/gsec^2)/(gcm^3/sec^2ecu^2)$
$\quad = G/e *(ecu^2/g^2)$

Using dimensional methods, I will create a function whose dimension is the ecu.

Take the square root $\quad = (G/e)^{1/2}*(ecu/g)$

Multiply by m(g) $\quad = (G/e)^{1/2}*m(ecu)$

Call it n_3 $\quad n_3 = (G/e)^{1/2}*m(ecu)$

Now multiply G*e $\quad = (G*e)*(cm^3/gsec^2)*(gcm^3/sec^2ecu^2)$

$= (G*e)*(cm^6/sec^4 ecu^2)$

Invert it $= 1/(G*e)*(sec^4 ecu^2/cm^6)$

Multiply by c^4 $= c^4/(G*e)*(ecu^2)/(cm^2)$

Take the square root $= c^2/(G*e)^{1/2}*(ecu/cm)$

Multiply by λ (cm) $= c^2/(G*e)^{1/2}*\lambda$ (ecu)

Call it n_4 $n_4 = c^2/(G*e)^{1/2}*\lambda$ (ecu)

We have created another function whose dimension is the ecu.

If we multiply n_3*n_4 we arrive at:

$$n_3*n_4 = mc^2*\lambda/e$$

This equation is an extension of Einsteins's famous mass energy relationship. It is important because it connects our concepts of mass, energy, electromagnetism, and radiation, all together into one equation. Every student of physics should be aware of it.

However, Noting that $m\lambda = h/c$, if Einstein was right, we arrive at:

$n_3*n_4 = hc/e$ where $n_3*n_4 = 1/\alpha$ and α is the fine structure constant, not adjusted by 2π.

In this derivation I have used the same kind of dimensional analysis that was used in order to find Planck's system of natural units. It vindicates Eddington"s view that the fine structure constant could be derived by pure deduction.

Authors Note: The theoretical existence of n_3 and n_4 demands an answer as to their significance for physics. In a paper titled “Theoretical Limits on the Spectrum of Electromagnetic Radiation – The key to the Universe?”, I try to come to grips with this issue. Contact: RDowd@satx.rr.com