Numerical Analysis of Particle Mass: The Measure of the Universe

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Why, for example, should the ratio between the masses of the proton and the electron be about 1836?

A. Salam and V. Weisskopf
Istanbul Conference, 1981

Many researchers have tried to apply numerical analysis to the masses of elementary particles and the fundamental constants of physics. Their attempts have been critized and met with ridicule, such that research in these areas has become almost clandestine. Since 1982 I have been sending the results of my work to the Academy of Sciences in Paris, revealing my conclusions to a number of well-known specialists.

Since this is the first opportunity I have had to express myself publicly, I shall summarize the results obtained to date and discuss the consequences of my work. The object of the exercise is to establish a system of fundamental units and disclose an order in the structure of the Universe.

This report is divided into four parts: numerical analysis, presentation of a system of units, application of the notion of continuous creation of matter to the problem of redshift and the cosmic background, and a discussion of a few speculative points and directions for future research.

Numerical analysis of mass

The point of departure is the following observation: The ratio of the mass of a nucleon to the mass of the electron can be approximated by the power:

$$m_{nu}/m_e = 150^{1.5} = \left(2 \cdot 3 \cdot 5^2\right)^{1.5} = 1837.1173$$

which lies between the experimental results of 1838.684 for the neutron/electron ratio and 1836.1527 for the proton/electron ratio.

The baryons

The masses of the nucleons and hyperons can be expressed in the following general form (which we will call the expanded formula):

$$m = B \cdot R$$

where

$$B = \left(2 \cdot 3 \cdot 5 \cdot 7\right)^{1.5} = 210^{1.5}$$

and

$$R = 2^p \cdot 3^q \cdot 5^i \cdot 7^s$$

p, q, i and s being whole or half odd. These formulae are valid for the mass unit

$$m_0 = 4.395 \cdot 10^{-30}\,\mathrm{g}$$

This generates the following table.

	p	*q*	*i*	*s*
Nu	0	0	3	0
Λ	0	0	2.5	0.5
Σ	2	1	1	0.5
Ξ	0	0	2	1
Ω	2	1	0	1.5

Table 1 – Baryon Values

Note that the nucleon is the only particle with only whole multiples of 1.5 as exponents. It can also be seen that all the components of a single particle have the same formula.

Clearly, hyperons are "excited states" of a nucleon. This suggests an initial application of these formulae: the decay of hyperons that results when we shift the exponents of the "*R* root" according to the following schema, which surely requires no further explanation.

decay mode	*p*	*q*	*i*	*s*
Λ→p,n =	0	0	2.5	←0.5
Ξ→Λ =	0	0	2.	←1
Ξ→p =	0	0	2	←1
Σ→Λ =	2—	1→	1	0.5
Σ→p,n =	2—	1→	1	←0.5
Ω→Ξ =	2—	1→	0	←1.5
Ω→Λ =	2—	1→	0	←1.5

Table 2 - Hyperons

The leptons

The general formula for the leptons is:

$$5^a \cdot 7^b$$

where *a* and *b* are positive for the electron and *m* and *t* particles, and negative for three corresponding neutrinos. These formulae are summarized in Table 3.

$m_e=5^{1,5}\times7^{1,5}$	$m_{ve}=5^{-1.5}\times7^{-1.5}$
$m_\mu=5^3\times7^3$	$m_{n\mu}=5^{-3}\times7^{-3}$
$m_\tau=5^3\times7^{4.5}$	$m_{v\tau}=5^{-3}\times7^{-4.5}$

Table 3 – Lepton Formulae

The mass of the electron neutrino is approximately 11.9 electon volts. The electron neutrino is the most massive of the three neutrinos, and the *t*-neutrino is the lightest of the three.

The mesons

We will assume that the masses of the mesons expressed in units of electon mass are given by angles measured in sexagesimal degrees. The reasons for this will become clear when we discuss the second application of our formulae.

We therefore have:

$$m_p / m_e = 270$$

$$m_K / m_e = 970(4p + 250)$$

$$m_h / m_e = 1080 = 6p$$

Calculation of magnetic moments

Table IV summarizes the experimental data. The relationship established here has, to the best of my knowledge, never been proposed before. Normally, the magnetic moments of the proton and neutron are shown as a ratio. This suggests that there may be an angle to be found.

μ_{p+}=2.792747	μ_{μ}=1.001167
$\mu_{n°}$=1.91304	$m_{\Lambda°}$=-0.67±0.06
μ_e=1.001159	$\mu_{p+} + \lvert\mu_{n°}\rvert = 3\pi/2$

Table IV – Magnetic Moments

We find the magnetic moments (and consequently the angles) by using powers of prime numbers on the *X* and *Y* axes. Figures 1 through 5 show how the angles are calculated for the proton, the neutron, the Λ°, the electron and the electron neutrino. (Figures 1 through 5).

We will give an example of how a calculation is done for the μ_{p+}. The others are obtained the same way, based on the expanded formula.

$$tg m_p + = \frac{5^{1.5} + 6^{1.5} + 7^{1.5}}{-5^3} = -0.35518$$

giving μ_{p+}=2.80031, which is very close to the experimental value.

Adding 1 to the numerator or denominator of the tangent (in the form e.n_e for example) improves the result. The formula for p^+ and $n°$ can then be written:

$$m_{p+} = Nu.e.n_e; \text{ and } m_{n°} = Nu.e.n_e.en_e$$

This also allows us to show how the electron and electron neutrino can be produced from the proton and neutron, even though this is not supposed to be possible.

The mechanisms we propose for the two fundamental reactions of nuclear chemistry are as follows:

$n° \to p^+ + e^- + n_e$ becomes $Nu.e^+ n_e e^- n_e \to Nu\, e^+ n_e + e^- + n_e$

$p^+ + n_e \to n° + e^+$ becomes $Nu\, e^+ n_e + (e^+ e^-) \to Nu\, e^+ n_e e^- n_e + e^+$

The latter reaction produces energy as (e^+, e^-).

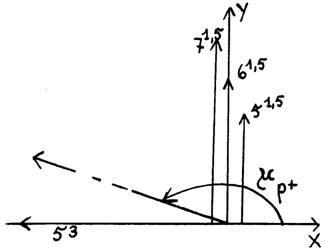

Figure 1

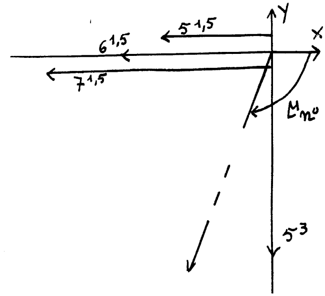

Figure 2

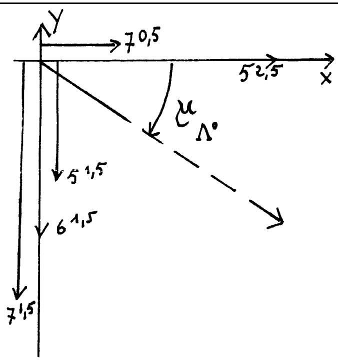

Figure 3

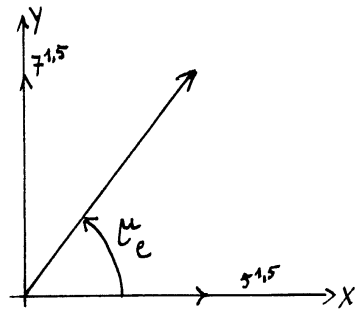

Figure 4

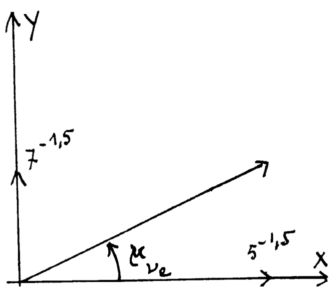

Figure 5

Angular equilibrium of nuclear reactions

Table V shows the angles which, as we have just seen, can be associated with the baryons, leptons and mesons examined in this study.

particle	*angle*	*particle*	*angle*
e	±57.3 or ±303	p+	160
n	±31.1 or ±329	n°	–109
π	±270 or ±90	Λ°	–39
κ	±250 to ±110		

Table V

In the interest of brevity, the essential data are summarized in Figure 6

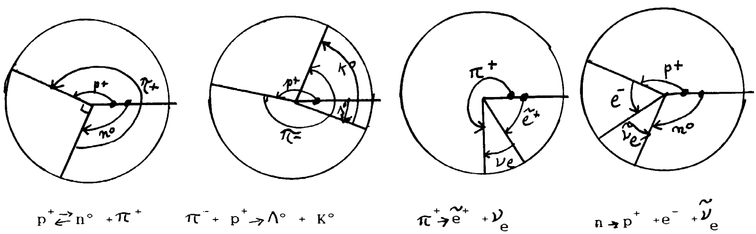

Figure 6

Number of components of particles

In the formula for the masses of baryons (m=B.R), we have assigned the exponents of R the labels p, q, i and s: i being for the exponent of 5 and s for 7. Now i and s can be related to the isospin and strangeness, respectively, by the following relations:

$$I = i \text{ or } i - 1.5, \text{ and } S = -2s$$

This analysis essentially shows that the “hadrons of the eightfold path” can be placed on a circle (Figure 7), while Gell-mann and Ne’eman’s schema leads to a hexagon with two centres. We also find the following anomaly: the nucleon should have four components, but the outermost two components (- and ++) undergo a “steric exclusion” (there is no room for them on the circle).

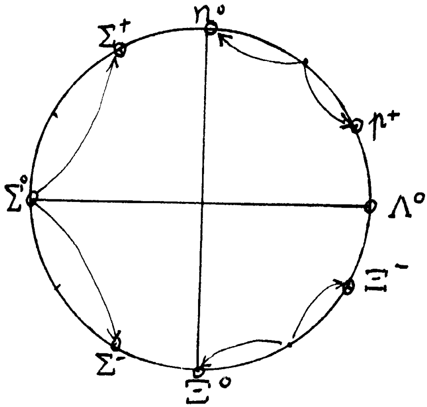

Figure 7

Extension to the other “particles” of the Universe

The observation that $210^{1.5}$ is common to all baryons gives rise to the following result: All matter is organized into particles whose mass (in the preferred system) is a whole power of $210^{1.5}$ (=3043.1891, the “supermagic” number). The results are presented in the Table VI.

	nuclei	genes	cells	stars	galaxies	clusters	superclusters	Universe
x =	3	7.5	9	27	31.5	33	34.5	36

Table VI

The expression 210^x gives the optimum mass. The masses of similar particles are grouped around this value between one twentieth and twenty times the optimum mass. This has been confirmed by nuclei, stars and galaxies.

The problem of the linear dimensions of particles must obviously also be addressed. After examining a number of particles, I find the following relationship between mass and diameter.

$$m = d^2$$

If we add the assumption that $c = 1$, this gives the unit of length and a unit of time for a system we will call preferred or natural. The system is as follows.

$$m_0 = 4.395\times10^{-30}\ \text{g}$$

$$l_0 = 3.9094\times10^{-14}\ \text{cm}$$

$$t_0 = 1.304\times10^{-24}\ \text{s}$$

The formula $m = d^2$ thus indicates both the optimal diameters and masses for the "particles" given in Table VI. The results are summarized in Table VII below:

particle	*x*	***m*** *(gr)*	***l*** *(cm)*
nuclei	3	4.07×10^{-23}	1.19×10^{-10}
macromolecules	4.5	1.24×10^{-19}	6×10^{-9}
genes	7.5	1.15×10^{-12}	2×10^{-5}
cells	9	3×10^{-9}	1.10×10^{-3}
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comets (Oort Cloud)	18 to 25.2	2.77×10^{12} to 7.24×10^{29}	3.10×10^{7} to 1.8×10^{16}
stars	27	2.2×10^{33}	8.76×10^{17}
galaxies	31.5	6.20×10^{43}	1.47×10^{23}
clusters	33	1.89×10^{47}	8.09×10^{24}
superclusters	34.5	5.75×10^{50}	4.46×10^{26}
Universe	36	1.75×10^{54}	2.47×10^{28}

Table VII

These results correspond to the average experimental values. However, it must be remembered that we are dealing with the diameters of nuclei and stars. Observations show that we have about

10^{-13} cm for nuclei and 1.4×10^{11} cm for the sun (much less for dwarfs and much more for giants).

To explain these predictions, it is necessary to define what we mean by the diameter of a particle. For the nucleus, the diameter given by $m = d^2$ is the diameter of the counter envelope as defined by Wesp (1964), which limits the configuration space of the mass. Of course it is astonishing that the proton and electron are assumed to have the same diameter.

We can consider the star as such to be an attractive nucleus. The diameter of the system is related to the maximum distance of attraction of nucleons at a temperature of 3 K. The correct value of the diameter is given in Table VII.

The three mechanical units presented above come directly from the numerical analysis suggested by observation. The only condition we have added is $c = 1$, and we are not the first to do so. We have also used dimensional analysis to calculate the "physical constants" in the proposed system of units, and this leads to more formulae. Finally, the problem of temperature has to be solved.

It is easy to see that, assuming $K \equiv hc$, the unit of temperature can be expressed in units of $(length)^{-1}$. Consequently we have:

$$W = \left(hc\right) l^{-1} = Kq$$

where K is Boltzmann's constant, h is Planck's constant and q is temperature.

This being the case, we have the following series of equalities:

$$a_e^{-3} = 2h = \pm Q^3 = \frac{9}{p}K = \frac{s}{8p^2} = 4p\,J^{-1}; G^{-1} = 4p^2 M_U^{0.5}$$

where a_e is the fine structure constant, Q is the electric charge, s is the Stefan constant, J is the magnitude of the Wesp field, G is Newton's constant and M_U is the mass of the Universe.

It should be remembered that these relations are only valid in the system of natural units.

The last relation is obtained by dimensional analysis, which indicates that:

$$G = \frac{dc^2}{4p^2 M_U} \tag{2}$$

where d is the diameter of the Universe.

It should be added that if the preceding relations are used to define the diameter of the electron and a_e^{-1}, we can add the relation:

$$a_e^{-2} = 2p\, d_e m_e \tag{3}$$

still in the system of natural units.

It is important to note that numerical analysis fixes d_e and m_e, and consequently also a_e^{-1}.

Continuous creation of matter

The above numerical analysis describes the division of the masses of the Universe into particles, each level contained within the next higher level. This description pertains to what we see today, and so it tells us nothing about the history of creation (the Big Bang, continuous creation or some other process).

Despite its rigidity, numerical analysis is not incompatible with the Big Bang. All we would have to do is allow the units of the natural system to vary with time. All particles would then exist in the primordial ball, which would then dilate through a growth of m_0 and l_0.

Now the relict 3 K background radiation and the redshift of light from distant galaxies are explained by the Big Bang theory as well as the tired-light hypothesis proposed by deBroglie, Vigier and Pecker

(1972). I shall try to show that these two phenomena can also be explained by a "continuous creation" based on a variation of physical quantities.

The background radiation temperature simply corresponds to the current temperature of the Universe, which declines as more matter is created. This temperature is not a local phenomenon; it is identical throughout the Universe, as appears clearly in the formulae. For the calculation, I assumed that the interaction range of a star (characterized by the diameter d_s), is defined by the balance of gravitational forces on nucleons with their thermal agitation. The formula has been known for some time:

$$q_s = \frac{4G_s M_s M_{Nu}}{3K_s d_s}$$

where G_s, K_s, M_s, d_s and M_{Nu} are the Newton and Boltzman constants, the mass and interaction diameter of the star, and the mass of a nucleon). M_{Nu}, M_s and d_s remain constant, while G_s and K_s vary. Consequently, q_s depends on the age of the Universe, t_u, and not on the age of the star. This obviously implies that the temperature is uniform throughout the Universe.

To characterize the redshift of spectral lines, I have made the following hypotheses (where Q is the elementary charge):

1. The energy emitted by atoms is:

$$W \cong \frac{Q^4}{h^2}$$

2. This energy is transmitted as

$$W = \frac{hc}{l}$$

3. We suppose that Q_s, h_s and c_s vary as exp (k_{ts}/2), and G_S varies as

$$\exp(k)\cdot\left(t_s - \frac{t_u}{2}\right)$$

where k is a constant.

4. We assume that c and W are adjusted during the flight of a light signal.

Lastly, we suppose that

$$a = \exp\left(\frac{k\Delta t}{2}\right)$$

where *Dt* is the time taken by the light to travel from the emitter (l) to the receiver (i).

When the light leaves the emitter, we have

$$W_{v,l} = \frac{h_l c_l}{l_l} = a^2 \frac{h_i c_i}{l_i}$$

$$l_l = l_i$$

When the light reaches the receiver, h_l, which is the value of h at the source, has not changed. It is still equal to ah_i.

Because c has been changed, we have

$$W_{v,i} = \frac{ah_i c_i}{l_i'}$$

where l_i' is the wavelength observed at the receiver, as it left the emitter. So the energy emitted and observed at i by the same atom is:

$$W_i = \frac{h_i c_i}{l_i}$$

Assuming that $W_{v,i} = W_i$, then we have

$$\frac{ah_i c_i}{l_i^{'}} = \frac{h_i c_i}{l_i}$$

and we may easily conclude that

$$l_i^{'} = a\,l_i$$

Note that the adjustment of W and c can be understood as a tired light phenomenon. However, a small difficulty arises due to the variability of the speed of light when compared to equation (2). If the gravitational interaction is propagated at the speed of light, not all the masses can enter into the calculation of G, and (2) is thrown in doubt. The more likely case is that the interaction that underlies gravitation propagates instantaneously. In fact, we might call this an organic law of the Universe. Consequently, for a diameter d_u and mass M_u of the Universe, in a place where the speed of light is c, we will measure a G given by (2).

Conclusion

Numerical analysis is only really convincing if it can be used to explain other physical properties of particles. In this study, I have presented four applications of the mass formulae (system of hyperons, calculation of magnetic moments, equilibrium of nuclear reactions and an explanation of the quantum numbers I and S. The same method of calculating masses and linear dimensions for other "particles" (genes, stars, galaxies, clusters, the Universe) has yielded interesting results.

There remains the problem of linking this numerical analysis with the laws of physics. I lean toward the continuous creation of matter, and have proposed a variable "preferred" system of units, which certainly represent a unique view of matter, light and their interactions. I also believe that the physical quantities (h, Q, K, s, J, and perhaps even d_e and m_e) can be combined in a_e. I would even go so far as to say that this dimensionless number is a kind of birthmark imprinted on all forms of existence.

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