# On the Theory and Physics of the Aether

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Physical Space is identified as the universal Aether Space. An Aether Equation is deduced, predicting the Temperature of the Cosmic Background Radiation $T_{\text{CMBR}}$, and indicating that $G$ and $c$ are universal dependent variables. The strong nuclear force is found to be a strong gravitational force at extreme energy densities of the neutron, indicating a Grand Unified Theory, when gravity is a process of enduring exchange of radiant energy between all astrophysical objects. The big bang hypothesis is refuted by interpretation of the Hubble redshift as evidence of gravitational work. Conditions for application of STR and GTR in the scientific cosmological research are deduced.

*Gravity must be caused by an agent acting constantly according to certain laws; but whether this agent be material or immaterial, I have left to the consideration of my readers.*

*Newton. Letter to Bentley, 1693.*

We assume to find in every point of space a flow in all directions of radiant energy from all astrophysical objects, meaning that space everywhere has a specific energy $U$ [erg] and an energy density $u = U/V$ [erg/cm$^3$], which of course is a local variable depending on the position in space.

The radiant energy will we name the "Aether", and since it is present throughout the Universe, we will call space the "Aether-Space". Presuming the aether the medium sustaining all physical fields and forces, the aether-space is the universal physical space.

A set of equations can be found for this situation [1] from which may be derived the aether equation with the minimum energy $U$ at the temperature $T_{\text{Aether}}$, which has been confirmed by the COBE observations of $T_{\text{CMBR}} = 2.735 \pm 0.06$ Kelvin [(1)]

$$\kappa UV = Ghc^2,$$

$$U = 3.973637 \times 10^{-13}\,\text{erg} \quad \text{at} \quad T_{\text{Aether}} = 2.692064\,\text{Kelvin},$$

$$K = Gc/\kappa L^2 = UL/hc = 2.000343 \times 10^3.$$

Defining $\kappa \equiv 1$ erg/(sec$\times$g$^2$) and $V = 1$ cm$^3$, it is seen that if $U$ is a variable, then the Newtonian $G$ and the velocity of light $c$ are dependent variables if Planck's $h$ is a universal constant.

At higher energy densities of the aether, such as in the galaxies, $G$ and $c$ would have other and higher values than $G = 6.672426 \times 10^{-8}$ cm$^3$/(g$\times$sec$^2$) and $c = 2.99792458 \times 10^{10}$ cm/sec of the aether equation and will need some coefficient $\rho$ to $G$, while the maximum value of $c$ is supposed from a possible coefficient function to be $c_{\max} = \sqrt{2}\,c$.

To have an idea of the extreme energy densities and their corresponding $\rho$-values, we will have a look at the Schwarzschild solution for the electron, from which to derive $G$: [(2)]

$$Gm_e/r_e c^2 = 1/\rho_e = Gm_e^2/e^2,$$

$$\rho_e G e^2 = c^4 r_e^2,$$

$$m_e = 9.109535 \times 10^{-28}\,\text{g},$$

$$e = 4.803242 \times 10^{-10}\,\text{esu},$$

$$r_e = 2.817937 \times 10^{-13}\,\text{cm},$$

$$\rho_e = 4.166705 \times 10^{42}.$$

Considering the composite neutron, the proton$^+$, and the neutron-meson$^-$ we find that the meson must be the mass difference between the neutron and the proton, and that the meson must be a special heavy neutron-electron, since the free neutron in relatively short time disintegrates into a proton, an electron, and some neutrino energy depending on the velocities and directions of the parting massive particles. We therefore have with $\alpha$, the fine structure constant:

$$m_n = 1.674954 \times 10^{-24}\,\text{g},$$

$$m_p = 1.672648 \times 10^{-24}\,\text{g},$$

$$m_m = 2.305589 \times 10^{-27}\,\text{g},$$

$$m_p m_m/m_e^2 = \alpha K^2/2\pi = K^3 e^2/UL = \rho_e/\rho_{p,m} = 4.64723 \times 10^3,$$

$$\alpha = 7.297349 \times 10^{-3},$$

$$\rho_{p,m} = 8.965996 \times 10^{38}.$$

As an analogon to the Schwarzschild electron solution we find:

$$\rho_{p,m} G m_n/r_n c^2 = \rho_{p,m} G m_p m_m/e^2 = 1,$$

$r_n = 1.11492 \times 10^{-13}$ cm would then be the radius of the neutron, and if the proton is calculated with the same coefficient $\rho_{p,m}$,

$$\rho_{p,m} G m_p/r_p c^2 = 1,$$

$$r_p = 1.113386 \times 10^{-13}\,\text{cm}.$$

If the neutron-meson should in fact be a heavy electron, and $m_m/m_e \sim 2.53$, it would make sense if the mass-difference $m_m - m_e$ was the virtual gravitational mass of the neutron's intrinsic proton-electron pair, whence we find from a first calculation $m_{\text{vir}}$:

$$\rho_{p,m} G m_p m_e / r_n c^2 = 9.096998 \times 10^{-28} \text{ g},$$

$$\rho_{p,m} G m_p m_e / r_p c^2 = 9.109531 \times 10^{-28} \text{ g}.$$

We have hereby accounted for a neutron-meson of twice the electron's mass, while we need an explanation for the extra mass of $\frac{1}{2}$ electron-mass in the neutron-meson. We will abstain from further calculations here and for the moment consider it sufficient to have shown a double electron-mass in the meson, pointing to the self-gravitation also of the virtual mass as a probable solution to the deficiency of $\sim 4.83 \times 10^{-28}$ g meson-mass.

Regarding the self-gravitation of the neutron, it may be shown from a normalization of the neutron's gravitational potential $P$, that the potential with respect of the central proton, when the self-gravitation means an increment of the meson-mass from $\sim 2m_e$ to $m_m$, would result in a slightly greater value of $\rho$ by a factor of $r_n/r_p = m_n/m_p = 1.001378$ [3] from $\rho_{p,m}$ to $\rho_n$, so that $\rho_n = 1.001378\, \rho_{p,m} = 8.978353 \times 10^{38}$. We then find from considering the gravitational potential of the neutron, as if produced by the central proton alone in the distance $r_n$, that it leads to the resulting potential

$$P = \rho_n G m_p / r_n = \rho_{p,m} G m_n / r_n = c^2,$$

$$\rho_n G m_p m_m / r_n = E_m .$$

$E_m = m_m c^2$ is the total energy of the heavily augmented neutron-electron to the full mass of the neutron-meson, $m_m = m_n - m_p$. That the virtual gravitational mass of the free neutron equals one electron-mass may be seen from the following equation, which interestingly shows the ratio between radii $r_p$ and $r_e$. It appears then that all the relational conditions of the free neutron are completely deduced:

$$m_{\text{vir}} = \rho_{p,m} G m_p m_e / r_p c^2 = m_m r_p / r_e = e^2 / r_e c^2 = m_e ,$$

$$m_m = e^2 / r_p c^2 .$$

Having demonstrated that the Newtonian $G$ must be a variable of very great values at extreme energy densities, such as in the composite neutron ($\rho_{p,m} G \sim 6 \times 10^{31}$), it seems reasonable to believe that the strong nuclear force is caused by such extreme values of the Newtonian gravitational factor.

We therefore assume that the neutron-meson would be able to bind two protons in the atomic nucleus by orbiting in such a way that it shifts constantly between the two protons, of which the one may be considered a neutron, when the other is a proton and vice versa in constant shifts of constitution in the neutron-proton pair of a nucleus.

The binding orbit may hence be thought of in a most simple theoretical illustration as the meson following an Oval of Cassini around the two heavy electrically positive charged particles, forcing them to the constant shifts of neutron-proton phase. And as will be known, the Lemniscate is the extreme curve of the Cassini Oval, with the parameters $a = b$, where the strong particle-binding would break in a proton and a free neutron that may possibly leave the nucleus.[4]

Of course, the real conditions of an "orbiting neutron-meson" cannot be made really lucid, since we know that the interaction is rather a question of probability of distribution of charges and masses, when we observe the weak magnetic moment of the electrically neutral neutron.

However, it seems that the strong nuclear force may be accounted for as a very strong gravitational force at extreme energy densities, to which it is remarked that in the galaxies, with their very intense radiation from stars and gasses, we may also expect special dynamics due to the variablility of the factor $G$, which would therefore account for the observed galactic differential velocities and probably would explain also the so-called "problem of missing mass in the Universe".

As in fact gravitational action according to the aether physics is an electromagnetic phenomenon of energy exchange in Planck quanta leaving an enduring train of impulses unto the gravitating masses, it seems that a unification of the four fundamental forces in nature may be expected from consideration of the physics of the aether.

From the aether equation we have found the constant $K$. Considering the composite neutron, $m_p + m_m = m_n$, we have the mass relation and the energy-charge relation:

$$(m_p m_m)/m_e^2 = K^3 (e^2/UL) = K^2 (e^2/hc),$$

$$E_e r_e = E_m r_p = E_p r_m = e^2 .$$

It further follows that $K\Phi/c = G m_x m_y / L^2$ for any pair of gravitating masses in mutual distance $L = 1$ cm, when the radiant flux $\Phi$ [erg/sec] is $\Phi_{x,y} = \kappa m_x m_y$.

We will therefore show that a radiant aether flux $\Phi$ is the common cause of the Coulomb force and the extremely strong force of gravity in the neutron, manifest as the strong nuclear force

$$e^2/r_n^2 = \rho_{p,m} [(K\Phi_{p,m})/c] \times [L^2/r_n^2] = \\ = \rho_{p,m} G m_p m_m / r_n^2 \text{ dynes},$$

$$e^2 c / r_n^2 = \rho_{p,m} K \Phi_{p,m} L^2 / r_n^2 = \rho_{p,m} G m_p m_m c / r_n^2 \text{ erg/sec},$$

$$e^2/m_p m_m = \rho_{p,m} K \kappa L^2 / c = \rho_{p,m} \kappa U V / hc^2 = \rho_{p,m} G ,$$

$$e^2/G = \rho_{p,m} m_p m_m = M_{\text{JS}}^2 .$$

For any pair of fundamental particles of unit charge $\pm$ esu there seems to exist a dimensionless factor of proportionality $\rho_{1,2}$, which, if made a coefficient of $G$, will balance the electrostatic Coulomb force and the Newtonian force of

gravity at any distance between the charged particles. For any charged pair of $mass_1$ and $mass_2$ the factor of proportionality will be $\rho$ with the Johnstone-Stoney mass squared $e^2/G$ as a constant: $\rho_{1,2} = M_{\text{JS}}^2/(m_1 m_2)$.

Demonstrating the validity of the foregoing derivations, it may be shown that, with the magnitude found for the coefficient $\rho_{p,m}$, the dimensions $r_n$, $r_p$, and $r_m$ of the neutron masses $m_n$, $m_p$, and $m_m$ are most easily given by the following simple relations:

$$\rho K \kappa m L^2/c^3 = \rho G m/c^2 = r\,;$$

as is with $\rho_e$ and $m_e$ the Schwarzschild radius of the electron $r_e$.

Generally, provided a local value of $\rho$ can be found or estimated, the local gravitational potential $P$ at any distance $R$ from the center of a gravitating mass $M$ will be:

$$P = \rho GM/R \text{ (cm/sec)}^2.$$

When, however, all ponderable matter is constituted as a sum of charged particles, and the force of gravity as shown is an electromagnetic phenomenon by energy exchange in the aether space between any pair of masses via a radiant flux $\Phi$ [erg/sec], which is proportional to the product of the two masses, we generally have with some local value of $\rho$ the Newtonian force between $M_1$ and $M_2$:

$$F = \rho GM_1M_2/R^2 = \rho \kappa M_1 M_2 UV/hc^2R^2 = \\ = \rho K[\Phi/c] \times [L^2/R^2] \text{ dynes}.$$

The radiant flux $K\Phi$ may be thought of as aether energy at the velocity of light, which is bound in the line of distance $R$ between the gravitating masses, representing the gravitational energy $K\Phi L^2/Rc$ and the equivalent virtual gravitational mass $K\Phi L^2/Rc^3$ that belongs to the binary system. It should therefore be added to the sum of gravitating masses for calculations of total potential and force including the self-gravitation of the aether energy in $\Phi$.

In the composite neutron, however, only two elementary charges are acting, the proton's $+e$ esu and the meson-electron's $-e$ esu. The latter is an ordinary electron, when the neutron disintegrates, and we have no idea whatsoever of a variation in the elementary charge $e = 4.803242 \times 10^{-10}$ esu. We conclude from the neutron equation, as from Schwarzschild's electron solution:

$$e^2/r_n^2 = \rho_{p,m} G m_p m_m/r_n^2\,,$$

$$e^2/m_p m_m = \rho_{p,m} G\,,$$

that gravity is an electromagnetic phenomenon, and that it is the relation shown herein between charges and masses which governs the gravitational force between the neutron's proton and electron at the extreme energy density of the free neutron.

Presumably, it is the gravitational interaction between the free neutron and all other masses in the aether space, by enduring energy exchange with the radiant energy of the aether, that makes the neutron unstable by emitting more energy to the aether field than is absorbed in the same interval of time. This loss of energy is by radiation at the cost of the meson-mass, which diminishes, meaning a loss of mass and of the neutron's energy density, thereby a reduction of the coefficient $\rho$, of $G$. That means an increase in $r_n$, the radius of the free neutron, to a considerably greater dimension as a so-called "cold neutron" until the proton and the neutron-electron part with a random measure of the electron-meson's binding energy as a massless supply of neutrino-energy to the aether.

The aether energy represented in the radiant flux $\Phi$ is, according to the theory, present in the aether space of infinite energy as random radiation at all wavelengths and in all directions to and from the gravitating systems. Therefore the action of gravity is immediate, say if one of the gravitating masses is suddenly increased, while any change in the gravitating system will result in a signal which propagates in the aether space as a gravitational wave with the velocity of light. Such a signal may therefore be thought of as a modulation of the present radiant aether energy. The flux $\Phi$ is not a flow of energy from mass 1 to mass 2 and back again. It is a result of the energy exchange in all directions between the aether and the complete system and its single gravitating masses. According to the aether theory we have:

$$\alpha(Km_e)^2 = 2\pi m_p m_m \text{ g}^2,$$

$$\Updownarrow$$

$$[e^2/h\nu] \times [Gm_e^2/\lambda^2] = [L\Phi_{p,m}/U] \times [h/\lambda] \text{ erg}\,.$$

Aether energy which is absorbed by a mass is immediately re-emitted randomly to the aether, and in all directions. The action of gravity means work by impulses $h\nu/c = h/\lambda$ both at absorption and radiation of energy, while reflection means a double-pulse [2]. The gravitational work done by the aether causes an increasing loss of aether energy, shown in the Hubble-effect of increasing redshift with distance of all light from distant sources. The universal redshift thus is evidence of gravitational work, and not of any universal expansion interpreted as a Doppler-effect. The redshift is in complete accordance with the gravitational effect described by Einstein's theory of relativity, where we have to discriminate between two types of gravitational effects: (1) the local redshift of a single mass also deflecting passing rays of light; (2) the redshift of distance called the Hubble redshift.

The speculative big-bang hypothesis therefore seems absurd and way beyond rational science, since General Relativity has meaning only in application to a finite physical space of known and observable contents of masses and energy, while the Universe is for all reasons of an infinite mightiness beyond some apparent limit of observation, and

when the idea of the Newtonian gravitational factor $G$ as an universal constant cannot be upheld. The multitude of individual "galactic worlds" of very different types and ages in some general ongoing process of creation and decay by age should, on the other hand, be an obvious goal for scientific cosmological research.

The loss of energy to gravitational work is replenished by the stars and all the energy producing astrophysical objects by irradiation of new energy into the aether space at the cost of their masses. It seems clear that there ought to exist a feedback effect working to keep the aether at a constant energy level, which, however, may be left to future research.

The replenishment of free radiant energy to the aether-space by irradiation of Planck quanta at the velocity of light is, as seen from the aether equation, regardless of any local coefficient $\rho$:

$$h\nu/c = \kappa UV/(Gc^2\lambda) = (U/Kc) \times L/\lambda\,;$$

$$Kh\nu = U \times L/\lambda\,.$$

By the foregoing presentation of the theory and physics of the aether we have shown that gravitation is an electromagnetic phenomenon, and that the force of gravity is the result of an enduring exchange of radiant energy between mass and aether, by which the energy of the fundamental particles fluctuates consistently with the QED-findings regarding the fundamental charge/mass proportion of the electron.

The theory of the aether thereby seems to confirm also Einstein's finding 1928 [3] that "The separation of the gravitational and the electromagnetic field appears artificial", — when, of course, the aether-space is the seat of all physical fields and forces.

In modern 5-dimensional Kaluza-Klein Theory the specific space energy of the aether, or some identical local aether-parameter, such as for instance $T_{\text{Aether}}$ Kelvin, would apparently represent the 5th dimension.

Provided the speculative unphysical STR is defined with a local energy density $u$ of the aether space, and with the condition that $u$ shall be constant all over the actual physical space, ensuring a constant light-velocity $c$, the Special Theory of Relativity is a valid physical theory confirmed by observations.

Provided in any application of GTR the $\lambda$-term is defined with the parameters of a black body radiation of energy density $u$ at the temperature $\mathrm{T}_{\text{Aether}}$ in the actual finite physical aether space, and provided the local coefficient $\rho$ to the Einsteinian gravitational factor $\chi$ is estimated correct, the General Theory of Relativity may be applied to a first approximation.

STR and GTR thereby should be useful sub-theories in the Theory and Physics of the Aether which, as here described, appears as a natural continuation and extension of Drude's famous *Physik des Aethers* [4]. In thermodynamics it should be noted that gravitational energy exchange by radiation is a reversible process in open systems, therefore in no matter of the 2nd law.

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**Endnotes**

(1) Since the aether is a perfect boson-gas, we have with $a = 8\pi V/c^3$ and $b = kT/h$, when $\zeta(x)$ is the Riemann $\zeta$-function, $L = 1$ cm, $V = 1\,\text{cm}^3$, $m = 1$ g the following solutions:

$$pV/kT = a2b^3\zeta(4)\,, \qquad U = ah6b^4\zeta(4)\,;$$

$$p = u/3\,, \qquad pV = U/3\,;$$

$$R/N = R_G/N_A = k = 1.380662\times10^{-16} \text{ erg/Kelvin};$$

$$RT = ah2b^4\zeta(3) = kTN\,;$$

$$R_{\text{Aether}} = 5.464489\times10^{-14} \text{ erg/Kelvin}\,;$$

$$N_{\text{Aether}} = a2b^3\zeta(3) = 3.957876\times10^2;$$

$$S = 4U/3T = R\zeta(4)/\zeta(3) = 4Ghc^2/3kVT\,;$$

$$S_{\text{Aether}} = 1.968074\times10^{-13} \text{ erg/Kelvin}\,;$$

$$\kappa = \Phi/m^2 = \chi hc^4/8\pi UV = 4Ghc^2/3SVT\,;$$

$$\chi = \text{Einstein's gravitational factor}\,;$$

$$\Phi/L^2 = (Gm^2/L^2) \times (4hc^2/3SVT) = \kappa m^2/L^2.$$

(2) When for every mass $m$ it holds that $E = mc^2$, and the de Broglie wavelength $\lambda_{\text{B}} = h/mv$, we have for $v = c$ that $E_m\lambda_{\text{B}=\text{C}} = hc$. When further the fine structure constant is $\alpha = 2\pi e^2/hc$, a precise theoretical value of the Newtonian $G$ may be derived from iterations on the shown Schwarzschild solution for the electron and the very well known value of $\alpha$.

This theoretical value of $G$, which of all physical magnitudes is the most difficult to measure experimentally, is the universal Newtonian constant $G = 6.672426\times10^{-8}$ $\text{cm}^3/(\text{g}\times\text{sec}^2)$ at the minimum specific energy of the aether at the defined universal mimimum temperature $T_{\text{Aether}} = 2.692064$ Kelvin $= T_{\text{CMBR}}$ according to the theory of the aether. At any higher aether temperature $T_{\text{Aether}} > T_{\text{CMBR}}$, thus at a proportionally greater local energy density $u$ erg/cm$^3$, $u_{\text{Aether}} > u_{\text{CMBR}}$, the Newtonian constant becomes a variable: $\rho G > G_{\text{CMBR}}$ by a dimensionless coefficient of proportionality.

According to the aether equation we furthermore find $KE_m\lambda_{\text{C}} = UL$, confirming the derived magnitudes of $U$ and $G$ with utmost precision; thereby also the predicted temperature $T_{\text{Aether}}$ comparable with the experimental value from measurements of $T_{\text{CMBR}}$.

The relation $K = UL/E_m\lambda_C = UL/hc$ may be of interest in particle physics as in wave mechanics, since according to Planck the fundamental particles may be regarded as oscillating electromagnetic energy in standing waves, with the oscillator parameters $L$ [cm] and $C$ [Farad], in which case we have for the elementary charged particles of energy $E_m$, and besides for the electron of energy $E_e = m_e c^2$ especially: $E_m = h\nu = mc^2 = hc/\lambda_{B=C} = mLC\omega^2$; $E_e = E_{m(e)} = = e^2/r_e$.

(3) One finds from the small factor $1.001378 = r_n/r_p = m_n/m_p$,

$$r_n m_p/r_p m_n = r_e m_e/r_p m_m = 1\,,$$

$$r_e m_e = e^2 m_e/m_e c^2 = e^2/c^2 = r_p m_m\,,$$

$$r_n m_p/r_e m_e = r_n/r'_p = r_n/(r_n - r_p)\,,$$

$$r_n - r_p = r'_p = e^2/m_p c^2\,,$$

$$r_e m_e m_n/m_m m_p r_n = 1\,,$$

$$[e^2/m_m m_p] \times m_n/r_n c^2 = 1\,,$$

$$e^2/(m_m m_p) = \rho_{p,m} G\,,$$

$$e^2/G = \rho_{p,m} m_m m_p = M_{JS}^2\,,$$

$$\rho_{p,m} G m_n/r_n = c^2,$$

that both $\rho_{p,m}G$ and the Johnstone-Stoney mass $M_{JS}^2$ can be derived with extreme precision alone from the found dimensions $r_x$ and masses $m_x$, when at the same time showing correctly that the meson-mass $m_m$ and the proton-mass $m_p$ are both charged with $e$ esu, whereas no electric charge occurs at the neutron $m_n$. It is such an overwhelming demonstration of the valid derivation of all the found dimensions, that no doubt seems possible.

The small extension $r'_p = 1.534 \times 10^{-16}$ cm of space the proton-radius up to the neutron-radius, which in fact would be the radius $r'_p$ of the proton, if calculated strictly like the radius of the electron according to the Schwarzschild solution, is the thickness of an outer spherical shell surrounding the central proton of the free neutron, is why we may say that the volume of this spherical shell of extremely narrow depth $r'_p$ is the location of the bound heavy neutron-meson.

Calculation of $r'_n = 1.532 \times 10^{-16}$ cm $= e^2/m_n c^2$ retains the ratio $1.001378 = r'_p/r'_n$ and the exceedingly small difference $r'_p - r'_n = 2.113 \times 10^{-19}$ cm $< 0.002$ pro mille of the neutron radius $r_n$. If of any relevance at all, it will have to await the results and precision of future research.

(4) From two protons in a torus of radii $r_p$ and $r_e$ may be generated the family of Cassini Ovals in planes parallel with the torus axis. The Lemniscate may be seen in a section cut in a plane parallel to the axis through a point on the inside of the torus, i. e. in the distance $(r_e - r_p)$ from the axis.

The mutual distance of the protons in the Lemniscate is $2\sqrt{(r_e)^2 - (r_e - r_p)^2} = 4.488 \times 10^{-13}$ cm, or $4.031 \times r_p$ cm apart (according to Pythagorean calculation).

In case of a change of radii, $r_e \to r_p$, or contrary $r_p \to r_e$, the torus will degenerate into a non-Riemannian surface with one singularity in the axis.

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