Dimensionless solution for the cosmological constant

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Abstract

In this paper in an elegant way will be present that the gravitational fine-structure constant is a simple analogy between atomic physics and cosmology. We will find the expression that connects the gravitational fine-structure constant with the four coupling constants. Perhaps the gravitational fine-structure constant is the coupling constant for the fifth force. Also will be presented the simple unification of atomic physics and cosmology. We will find the formulas for the cosmological constant and we will propose a possible solution for the cosmological parameters. Perhaps the shape of the universe is Poincaré dodecahedral space. This article will be followed by the energy wave theory and the fractal space-time theory.

Keywords

Fine-structure constant , Proton to electron mass ratio , Dimensionless physical constants , Coupling constant , Gravitational constant , Avogadro's number , Fundamental Interactions , Gravitational fine-structure constant , Cosmological parameters , Cosmological constant

1. Introduction

One of the most important numbers in physics is the fine-structure constant α which defines the strength of the electro-magnetic field. The fine-structure constant α is defined as:

$$\alpha = \frac{q_e^2}{4\pi\varepsilon_0\hbar c}$$

The 2.018 CODATA recommended value of the fine-structure constant is α=0,0072973525693(11) with standard uncertainty $0{,}0000000011\times10^{-3}$ and relative standard uncertainty $1{,}5\times10^{-10}$. Also the fine-structure constant is universal scaling factor:

$$\alpha = \frac{2\pi r_e}{\lambda_e} = \frac{\lambda_e}{2\pi\alpha_0} = \frac{r_e}{l_{pl}}\frac{m_e}{m_{pl}} = \sqrt{\frac{r_e}{\alpha_0}}$$

We propose in [10] the exact formula for the fine-structure constant α with the golden angle,the relativity factor and the fifth power of the golden mean:

$$\alpha^{-1}=360\cdot\varphi^{-2}-2\cdot\varphi^{-3}+(3\cdot\varphi)^{-5} \tag{1}$$

with numerical value:

$$\alpha^{-1}=137{,}035999164...$$

Another beautiful forms of the equations are:

$$\frac{1}{\alpha} = \frac{360}{\varphi^2} - \frac{2}{\varphi^3} + \frac{1}{3^5\varphi^5}$$

$$\frac{1}{\alpha} = \frac{360}{\varphi^2} - \frac{2}{\varphi^3} + \frac{3^{-5}}{\varphi^5} \tag{2}$$

Other equivalent expressions for the fine-structure constant are:

$$\alpha^{-1}=(362-3^{-4})\cdot\varphi^{-2}-(1-3^{-5})\cdot\varphi^{-1}$$

$$\alpha^{-1}=(362-3^{-4})+(3^{-4}+2\cdot3^{-5}-364)\cdot\varphi^{-1}$$

$$\alpha^{-1}=1-2\cdot\varphi^{-1}+360\cdot\varphi^{-2}-\varphi^{-3}+(3\cdot\varphi)^{-5}$$

Also we propose in [11] a simple and accurate expression for the fine-structure constant α in terms of the Archimedes constant π:

$$\alpha^{-1} = \frac{2.706}{43}\pi \ln 2 \tag{3}$$

with numerical value:

$$\alpha^{-1}=137,035999078...$$

Other equivalent expression for the fine-structure constant is:

$$\alpha^{-1}=2\cdot3\cdot11\cdot41\cdot43^{-1}\cdot\pi\cdot\ln2 \tag{4}$$

The equivalent expressions in [25] for the fine-structure constant with the madelung constant $b_2(2)$ are:

$$\alpha^{-1} = \frac{2.706}{43} b_2(2) \tag{5}$$

$$\alpha^{-1}=2\cdot3\cdot11\cdot41\cdot43^{-1}\cdot b_2(2) \tag{6}$$

In Physics,the ratio of the mass of a proton to an electron is simply the remainder of the mass of the proton divided by that of the electron,from the system of units. The 2.018 CODATA recommended value of the proton to electron mass ratio μ is:

$$\mu=1.836,15267343$$

with standard uncertainty 0,00000011 and relative standard uncertainty $6,0\times10^{-11}$. The value of μ is a solution of the equation:

$$3\cdot\mu^4-5.508\cdot\mu^3-841\cdot\mu^2+10\cdot\mu-2.111=0$$

We propose in [12] the exact mathematical expression for the proton to electron mass ratio using Fibonacci and Lucas numbers:

$$\mu^{32}=\varphi^{-42}\cdot F_5^{160}\cdot L_5^{47}\cdot L_{19}^{40/19} \tag{7}$$

with numerical value:

$$\mu=1.836,15267343...$$

Also we propose in [12] the exact mathematical expression for the proton to electron mass ratio:

$$\mu = 165\sqrt[3]{\frac{\ln^{11}10}{7}} \tag{8}$$

with numerical value:

$$\mu = 1836{,}15267392...$$

Other equivalent expressions for the proton to electron mass ratio are:

$$\mu^3 = 7^{-1}\cdot 165^3\cdot \ln^{11}10$$

$$7\cdot\mu^3 = (3\cdot 5\cdot 11)^3\cdot \ln^{11}(2\cdot 5) \tag{9}$$

Also other exact mathematical expression in [12] for the proton to electron mass ratio is:

$$\mu = 6\cdot\pi^5+\pi^{-3}+2\cdot\pi^{-6}+2\cdot\pi^{-8}+2\cdot\pi^{-10}+2\cdot\pi^{-13}+\pi^{-15} \tag{10}$$

with numerical value:

$$\mu = 1.836{,}15267343...$$

In physics,the gravitational coupling constant α_G is a constant that characterizes the gravitational pull between a given pair of elementary particles. The gravitational coupling constant α_G is defined as:

$$\alpha_G = \frac{Gm_e^2}{\hbar c}$$

There is so far no known way to measure α_G directly. The approximate value of the constant gravitational coupling is $\alpha_G=1{,}7518099\times 10^{-45}$. Also the gravitational coupling constant is universal scaling factor:

$$\alpha_G = \frac{m_e^2}{m_{pl}^2} = \frac{\alpha_{G(p)}}{\mu^2} = \frac{\alpha}{\mu N_1} = \frac{\alpha^2}{N_1^2\alpha_{G(p)}} = \left(\frac{2\pi l_{pl}}{\lambda_e}\right)^2 = \left(\alpha\frac{l_{pl}}{r_e}\right)^2 = \left(\frac{l_{pl}}{\alpha\alpha_0}\right)^2$$

The gravitational coupling constant $\alpha_{G(p)}$ for the proton is produced similar to the electron,but replaces the mass of electrons with the mass of the protons. The gravitational coupling constant of the proton $\alpha_{G(p)}$ is defined as:

$$\alpha_{G(p)} = \frac{Gm_p^2}{\hbar c}$$

The approximate value of the constant gravitational coupling of the proton is $\alpha_{G(p)}=5{,}9061512\text{x}10^{-39}$. Also other expression for the gravitational coupling constant is:

$$\alpha_{G(p)} = \frac{m_p^2}{m_{pl}^2} = \mu^2\alpha_G = \frac{\alpha\mu}{N_1} = \frac{\alpha^2}{N_1^2\alpha_G}$$

The enormous value of the ratio of electric force to gravitational force was first pointed out by Bergen Davis in 1.904. The ratio N_1 of electric force to gravitational force between electron and proton is defined as:

$$N_1 = \frac{\alpha}{\mu\alpha_G} = \frac{\alpha\mu}{\alpha_{G(p)}} = \frac{\alpha}{\sqrt{\alpha_G\alpha_{G(p)}}} = \frac{k_e q_e^2}{Gm_e m_p} = \frac{\alpha\hbar c}{Gm_e m_p}$$

The approximate value of the ratio of electric force to gravitational force between electron and proton is $N_1=2{,}26866072\text{x}10^{39}$. The ratio N_1 of electric force to gravitational force between electron and proton can also be written in expression:

$$N_1 = \frac{5}{3} 2^{130} = 2,26854911 \times 10^{39}$$

The ratio N_2 of electric force to gravitational force between two electrons is defined as:

$$N_2 = \mu N_1 = \frac{\alpha}{\alpha_G} = \frac{N_1^2 \alpha_{G(p)}}{\alpha} = \frac{k_e q_e^2}{G m_e^2} = \frac{\alpha \hbar c}{G m_e^2}$$

The approximate value of N_2 is $N_2=4,16560745\times10^{42}$.

Avogadro’s number N_A is the fundamental physical constant that links the macroscopic physical world of objects that we can see and feel with the submicroscopic,invisible world of atoms. The exact value of the Avogadro's number is $N_A=6,02214076\times10^{23}$. The value of the Avogadro's number N_A can also be written in expressions:

$$N_A=84.446.885^3=6,02214076\times10^{23}$$

$$N_A=2^{79}=6,04462909\times10^{23} \tag{11}$$

In [12] was presented the exact mathematical expressions that connects the proton to electron mass ratio μ and the fine-structure constant α:

$$9\cdot\mu-119\cdot\alpha^{-1}=5\cdot(\varphi+42) \tag{12}$$

$$\mu-6\cdot\alpha^{-1}=360\cdot\varphi-165\cdot\pi+345\cdot e+12 \tag{13}$$

$$\mu-182\cdot\alpha=141\cdot\varphi+495\cdot\pi-66\cdot e+231 \tag{14}$$

$$\mu-807\cdot\alpha=1.205\cdot\pi-518\cdot\varphi-411\cdot e \tag{15}$$

Also in [14] was presented the unity formula that connects the fine-structure constant and the proton to electron mass ratio. It was explained that $\mu\cdot\alpha^{-1}$ is one of the roots of the following trigonometric equation:

$$2\cdot10^2\cdot\cos(\mu\cdot\alpha^{-1})+13^2=0 \tag{16}$$

The exponential form of this equation is:

$$10^2\cdot(e^{i\mu/\alpha}+e^{-i\mu/\alpha})+13^2=0 \tag{17}$$

This exponential form can also be written with the beautiful form:

$$10^2\cdot(e^{i\mu/\alpha}+e^{-i\mu/\alpha})=13^2\cdot e^{i\pi} \tag{18}$$

Also this unity formula can also be written in the form:

$$10\cdot(e^{i\mu/\alpha}+e^{-i\mu/\alpha})^{1/2}=13\cdot i \tag{19}$$

So other beautiful formula that connects the fine-structure constant,the proton to electron mass ratio and the fifth power of the golden mean is:

$$5^2\cdot(5\cdot\varphi^{-2}+\varphi^{-5})^2\cdot(e^{i\mu/\alpha}+e^{-i\mu/\alpha})+(5\cdot\varphi^2-\varphi^{-5})^2=0 \tag{20}$$

The formula that connects the fine-structure constant,the proton to electron mass ratio and the mathematical constants π,φ,e and i is:

$$10^2\cdot(e^{i\mu/\alpha}+e^{-i\mu/\alpha})=(5\cdot\varphi^2-\varphi^{-5})^2\cdot e^{i\pi} \tag{21}$$

2. Dimensionless unification of the fundamental interactions

In the papers [16], [26] and [27] was presented the simple unification of the fundamental interactions. The strong coupling constant α_s is one of the fundamental parameters of the typical model of particle physics. The value of the strong coupling constant,like other coupling constants,depends on the energy scale. As the energy increases,this constant decreases. The last measurement [24] in 23 November 2.021 of European organization for nuclear research (CERN) is used in a comprehensive QCD analysis at next-to next-to-leading order,which results in significant improvement in the accuracy of the parton distributions in the proton.

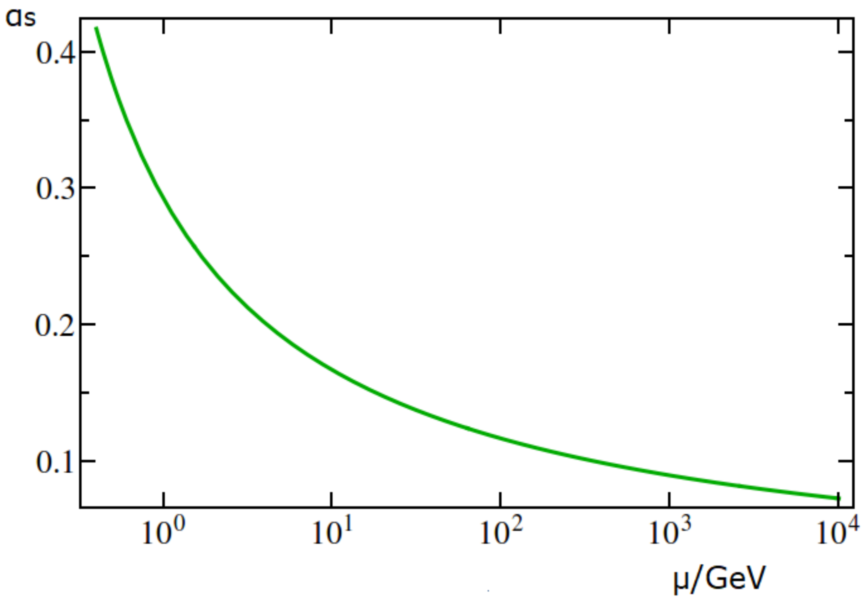

Figure 1. *Strong coupling constant as a function of the energy.*

Simultaneously,the value of the strong coupling constant at the Z boson mass is extracted as:

$$\alpha_{s(mZ)}=0{,}1170\pm0{,}0019$$

Thus,the constant of the electromagnetic interaction increases,and the constant of the strong interaction-decreases with increasing energy. For quarks in quantum chromodynamics,a strong interaction constant is introduced:

$$\alpha_s = \frac{q_{qg}^2}{4\pi\hbar c} = \frac{q_{qg}^2\varepsilon_0\alpha}{q_e^2} = \frac{\varepsilon_0 q_{qg}^2}{q_{pl}^2}$$

where g_{qg} is the active color charge of a quark that emits virtual gluons to interact with another quark. In [15] we presented the recommended value for the strong coupling constant:

$$\alpha_s = \frac{Eulers'\,number}{Gerford's\,constant}$$

$$\alpha_s = \frac{e}{e^{\pi}}$$

$$\alpha_s = e^{1-\pi} \tag{22}$$

with numerical value:

$$\alpha_s=0{,}11746\ldots$$

This value is the current world average value for the coupling evaluated at the Z-boson mass scale. Also for the value of the strong coupling constant we have the equivalent expressions:

$$\alpha_s=e\cdot e^{-\pi}=e\cdot i^{2i}=i^{-2i/\pi}\cdot i^{2i}=i^{2i-(2i/\pi)}=i^{2i(\pi-1)/\pi}$$

The strong interaction and weak interaction in [20] can be compared in a set of particle decays which yield the same final products. The decays of the delta baryons is:

$$\Delta^+ \rightarrow p + \pi^0$$

The lifetime of the delta baryons is:

$$\tau_\Delta \approx 6\times10^{-24}\ s$$

The decays of the sigma baryons is:

$$\Sigma^+ \rightarrow p + \pi^0$$

The lifetime of the delta baryons is:

$$\tau_\Sigma \approx 8\times10^{-11}\ s$$

The coupling constant ratio can then be estimated for this situation:

$$\frac{\alpha_w}{\alpha_s} = \sqrt{\frac{\tau_\triangle}{\tau_\Sigma}} = 10^{-7}e$$

$$\frac{\alpha_w}{\alpha_s} = 10^{-7}e \tag{23}$$

From this expression and (22) we can result the world average value of the weak coupling constant α_w:

$$\alpha_w = e\cdot\alpha_s\cdot10^{-7}$$

$$\alpha_w = e^{2-\pi}\cdot10^{-7}$$

$$\alpha_w = e\cdot e\cdot i^{2i}\cdot10^{-7}$$

$$\alpha_w = e^2\cdot i^{2i}\cdot10^{-7}$$

So the recommended theoretical current world average value for the weak coupling constant is:

$$\alpha_w = (e\cdot i^i)^2\cdot10^{-7} \tag{24}$$

with numerical value:

$$\alpha_w = 3{,}19310\cdot10^{-8}$$

From expression (23) can result other equivalent expressions:

$$\alpha_w\cdot\alpha_s^{-1} = e\cdot10^{-7}$$

$$\alpha_s\cdot\alpha_w^{-1} = e^{-1}\cdot10^{7}$$

$$e\cdot\alpha_s = 10^7\cdot\alpha_w \tag{25}$$

From this expression and (22) apply:

$$e^\pi\cdot\alpha_s\cdot\alpha_s = 10^7\cdot\alpha_w$$

$$e^\pi\cdot\alpha_s^2 = 10^7\cdot\alpha_w$$

$$\alpha_s^2 = 10^7\cdot e^{-\pi}\cdot\alpha_w$$

$$\alpha_s^2 = i^{2i}\cdot10^7\cdot\alpha_w \tag{26}$$

From this expression and Euler's identity resulting the beautiful formulas:

$$e^{i\pi}+1=0$$

$$(10^7\cdot\alpha_s^{-2}\cdot\alpha_w)^i+1=0$$

$$(10^{-7}\cdot\alpha_s^{2}\cdot\alpha_w^{-1})^i+1=0$$

$$10^{-7i}\cdot\alpha_s^{2i}\cdot\alpha_w^{-i}+1=0$$

$$10^{-7i}\cdot\alpha_s^{2i}\cdot\alpha_w^{-i}=i^2$$

$$\alpha_s^{2i}=i^2\cdot 10^{7i}\cdot\alpha_w^{i}$$

$$\frac{\alpha_s^{2i}}{\alpha_w^{i}}=i^2 10^{7i} \tag{27}$$

We reached the conclusion of the dimensionless unification of the strong nuclear and the weak nuclear forces:

$$e\cdot\alpha_s=10^7\cdot\alpha_w$$

$$\alpha_s^2=i^{2i}\cdot 10^7\cdot\alpha_w$$

Jesús Sánchez in [17] explained that the fine-structure constant is one of the roots of the following trigonometric equation:

$$\cos\alpha^{-1}=e^{-1} \tag{28}$$

Another elegant expression is the following exponential form equations:

$$e^{i/\alpha}-e^{-1}=-e^{-i/\alpha}+e^{-1}$$

$$e^{i/\alpha}+e^{-i/\alpha}=2\cdot e^{-1} \tag{29}$$

Also from [8] the fine-structure constant is one of the roots of the following trigonometric equation:

$$\cos(10^3\cdot\alpha^{-1})=\varphi^2\cdot e^{-1}$$

$$e\cdot\cos(10^3\cdot\alpha^{-1})=\varphi^2 \tag{30}$$

Another elegant expression is the following exponential form equation:

$$e^{1000i/\alpha}+e^{-1000i/\alpha}=2\cdot\varphi^2\cdot e^{-1} \tag{31}$$

From these expressions resulting the following equations:

$$\cos^{-1}\alpha^{-1}\cdot\cos(10^3\cdot\alpha^{-1})=\varphi^2$$

$$\cos(10^3\cdot\alpha^{-1})=\varphi^2\cdot\cos\alpha^{-1} \tag{32}$$

We will use the expressions (22) and (28) to resulting the unity formulas that connects the strong coupling constant α_s and the fine-structure constant α:

$$\cos\alpha^{-1}=e^{-1}$$

$$\alpha_s=e^{1-\pi}$$

$$\cos\alpha^{-1}=(e^{\pi}\cdot\alpha_s)^{-1}$$

$$\cos\alpha^{-1}=e^{-\pi}\cdot\alpha_s^{-1}$$

$$e^{\pi}\cdot\alpha_s\cdot\cos\alpha^{-1}=1 \tag{33}$$

Other forms of the equations are:

$$\cos\alpha^{-1}=(i^{-2i}\cdot\alpha_s)^{-1}$$

$$i^{-2i}\cdot \alpha_s \cdot \cos\alpha^{-1}=1$$

$$\cos\alpha^{-1}=i^{2i}\cdot \alpha_s^{-1}$$

$$\alpha_s \cdot \cos\alpha^{-1}=i^{2i} \tag{34}$$

So the beautiful formulas for the strong coupling constant α_s are:

$$\alpha_s=e^{-\pi}\cdot \cos^{-1}\alpha^{-1}$$

$$\alpha_s=i^{2i}\cdot \cos^{-1}\alpha^{-1}$$

Now we need to study the following equivalent equations:

$$\cos\alpha^{-1}=\frac{e^{-\pi}}{\alpha_s}$$

$$\cos\alpha^{-1}=\frac{i^{2i}}{\alpha_s}$$

$$\cos\alpha^{-1}=\frac{\alpha_s^{-1}}{e^{\pi}}$$

$$\cos\alpha^{-1}=\frac{\alpha_s^{-1}}{i^{-2i}}$$

The figure below shows the angle in α^{-1} radians. The rotation vector moves in a circle of radius e^{π}.

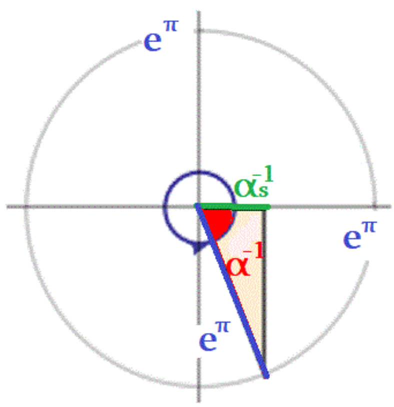

Figure 2. *The angle in α^{-1} radians. The rotation vector moves in a circle of radius e^{π}.*

This vector can rotate as the photon moves along.

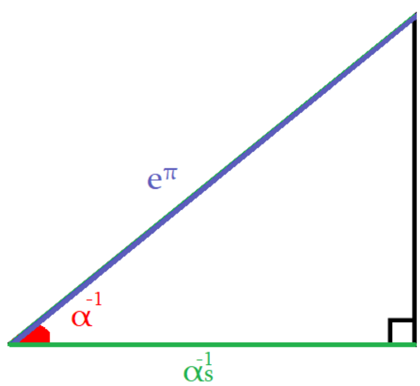

Figure 3. *The strong coupling constant α_s and the fine-structure constant α are in a right triangle with the variable acute angle α^{-1} radians. The adjacent side is the variable side α_s^{-1} while the hypotenuse is constant e^{π}.*

This means that $\cos\alpha^{-1}$ will be related to the interaction of these two properties of the photon and the electron. It would be related to their relative vector position at the time of interaction.

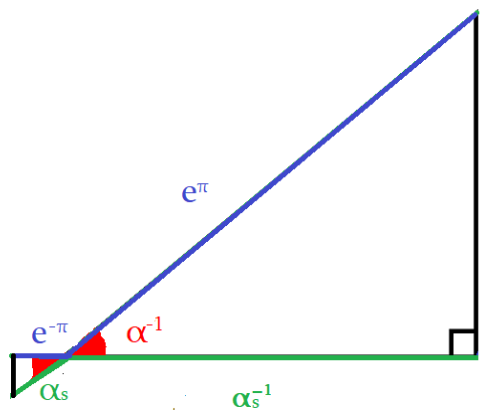

Figure 4. *Geometric representation of the dimensionless unification of the strong nuclear and the electromagnetic interactions.*

From expressions (22) and (29) resulting the formulas that connects the strong coupling constant α_s and the fine-structure constant α:

$$e^{i/\alpha}+e^{-i/\alpha}=2\cdot e^{-1}$$

$$e^{i/\alpha}+e^{-i/\alpha}=2\cdot(e^{\pi}\cdot\alpha_s)^{-1}$$

$$e^{i/\alpha}-(e^{\pi}\cdot\alpha_s)^{-1}=-e^{-i/\alpha}+(e^{\pi}\cdot\alpha_s)^{-1}$$

$$e^{i/\alpha}+e^{-i/\alpha}=2\cdot e^{-\pi}\cdot\alpha_s^{-1}$$

$$e^{\pi}\cdot\alpha_s\cdot(e^{i/\alpha}+e^{-i/\alpha})=2 \tag{35}$$

Other forms of the equations are:

$$e^{i/\alpha}+e^{-i/\alpha}=2\cdot(i^{-2i}\cdot\alpha_s)^{-1}$$

$$e^{i/\alpha}+e^{-i/\alpha}=2\cdot i^{2i}\cdot\alpha_s^{-1}$$

$$e^{i/\alpha}-i^{2i}\cdot\alpha_s^{-1}=-e^{-i/\alpha}+i^{2i}\cdot\alpha_s^{-1}$$

$$\alpha_s\cdot(e^{i/\alpha}+e^{-i/\alpha})=2\cdot i^{2i} \tag{36}$$

These equations are applicable for all energy scales. So the beautiful formulas for the strong coupling constant α_s are:

$$\alpha_s=2\cdot e^{-\pi}\cdot(e^{i/\alpha}+e^{-i/\alpha})^{-1}$$

$$\alpha_s=2\cdot i^{2i}\cdot(e^{i/\alpha}+e^{-i/\alpha})^{-1}$$

We reached the conclusion of the dimensionless unification of the strong nuclear and the electromagnetic forces:

$$\alpha_s\cdot(e^{i/\alpha}+e^{-i/\alpha})=2\cdot i^{2i}$$

The weak force acts only across distances smaller than the atomic nucleus,while the electromagnetic force can extend for great distances (as observed in the light of stars reaching across entire galaxies),weakening only with the square of the distance. We will use the expressions (25) and (33) to resulting the unity formula that connect the weak coupling constant α_w and the fine-structure constant α:

$$e\cdot\alpha_s=10^7\cdot\alpha_w$$

$$e^{\pi}\cdot\alpha_s\cdot\cos\alpha^{-1}=1$$

$$e^{\pi}\cdot10^7\cdot\alpha_w\cdot\cos\alpha^{-1}=e$$

$$e^{\pi-1}\cdot10^7\cdot\alpha_w\cdot\cos\alpha^{-1}=1$$

$$10^7\cdot\alpha_w\cdot\cos\alpha^{-1}=e^{1-\pi} \qquad (37)$$

Other forms of the equations are:

$$\alpha_w\cdot\cos\alpha^{-1}=e\cdot i^{2i}\cdot10^{-7}$$

$$10^7\cdot\alpha_w\cdot\cos\alpha^{-1}=e\cdot i^{2i} \qquad (38)$$

The figure below shows the angle in α^{-1} radians. The rotation vector moves in a circle of radius $10^7\cdot e^{\pi-1}$.

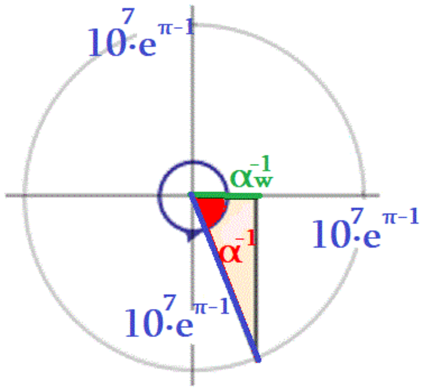

Figure 5. *The angle in α^{-1} radians. The rotation vector moves in a circle of radius* $10^7\cdot e^{\pi-1}$.

So the formulas for the weak coupling constant α_w are:

$$\alpha_w=(e^{\pi-1}\cdot10^7\cdot\cos\alpha^{-1})^{-1}$$

$$\alpha_w=e^{1-\pi}\cdot10^{-7}\cdot\cos^{-1}\alpha^{-1}$$

$$\alpha_w=e\cdot i^{2i}\cdot(10^7\cdot\cos\alpha^{-1})^{-1}$$

$$\alpha_w=e\cdot i^{2i}\cdot10^{-7}\cdot\cos^{-1}\alpha^{-1}$$

From (25) and (35) resulting the unity formulas that connects weak coupling constant α_w and the fine-structure constant α:

$$e\cdot\alpha_s=10^7\cdot\alpha_w$$

$$e^{\pi}\cdot\alpha_s\cdot(e^{i/\alpha}+e^{-i/\alpha})=2$$

$$e^{\pi}\cdot10^7\cdot\alpha_w\cdot(e^{i/\alpha}+e^{-i/\alpha})=2\cdot e$$

$$e^{i/\alpha}+e^{-i/\alpha}=2\cdot(e^{\pi-1}\cdot10^7\cdot\alpha_w)^{-1}$$

$$e^{i/\alpha}-(e^{\pi-1}\cdot10^7\cdot\alpha_w)^{-1}=-e^{-i/\alpha}+(e^{\pi-1}\cdot10^7\cdot\alpha_w)^{-1}$$

$$10^7 \cdot \alpha_w \cdot (e^{i/\alpha}+e^{-i/\alpha})=2 \cdot e^{1-\pi} \quad (39)$$

Other form of the equations is:

$$10^7 \cdot \alpha_w \cdot (e^{i/\alpha}+e^{-i/\alpha})=2 \cdot e \cdot i^{2i} \quad (40)$$

So the formulas for the weak coupling constant α_w are:

$$\alpha_w=2 \cdot [e^{\pi-1} \cdot 10^7 \cdot (e^{i/\alpha}+e^{-i/\alpha})]^{-1}$$

$$\alpha_w=2 \cdot e^{1-\pi} \cdot 10^{-7} \cdot (e^{i/\alpha}+e^{-i/\alpha})^{-1}$$

$$\alpha_w=2 \cdot e \cdot i^{2i} \cdot [10^7 \cdot (e^{i/\alpha}+e^{-i/\alpha})]^{-1}$$

$$\alpha_w=2 \cdot e \cdot i^{2i} \cdot 10^{-7} \cdot (e^{i/\alpha}+e^{-i/\alpha})^{-1}$$

These equations are applicable for all energy scales.

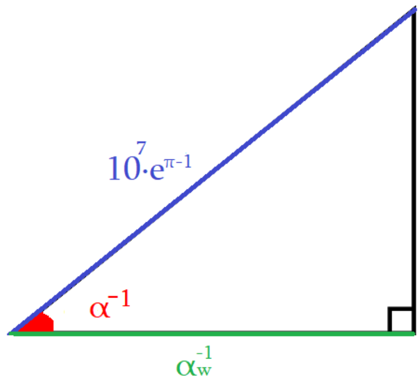

Figure 6. *Geometric representation of the dimensionless unification of the weak nuclear and the electromagnetic interactions*

We reached the conclusion of the dimensionless unification of the weak nuclear and the electromagnetic forces:

$$10^7 \cdot \alpha_w \cdot (e^{i/\alpha}+e^{-i/\alpha})=2 \cdot e \cdot i^{2i}$$

We will use the expressions (25) and (28) to find the expression that connects the strong coupling constant α_s,the weak coupling constant α_w and the fine-structure constant α:

$$e \cdot \alpha_s=10^7 \cdot \alpha_w$$

$$\cos\alpha^{-1}=e^{-1}$$

$$\cos\alpha^{-1}=\alpha_s \cdot \alpha_w^{-1} \cdot 10^{-7}$$

So the unity formula that connects the strong coupling constant α_s,the weak coupling constant α_w and the fine-structure constant α is:

$$10^7 \cdot \alpha_w \cdot \cos\alpha^{-1}=\alpha_s \quad (41)$$

Now we need to study the following equivalent equations:

$$\cos \alpha^{-1} = \frac{10^{-7}\alpha_w^{-1}}{\alpha_s^{-1}}$$

$$\cos \alpha^{-1} = \frac{\alpha_s}{10^7\alpha_w}$$

$$10^7 \cos \alpha^{-1} = \frac{\alpha_s}{\alpha_w}$$

$$\cos \alpha^{-1} = \frac{\alpha_s \alpha_w^{-1}}{10^7}$$

The figure below shows the angle in α^{-1} radians. The rotation vector moves in a circle of radius 10^7.

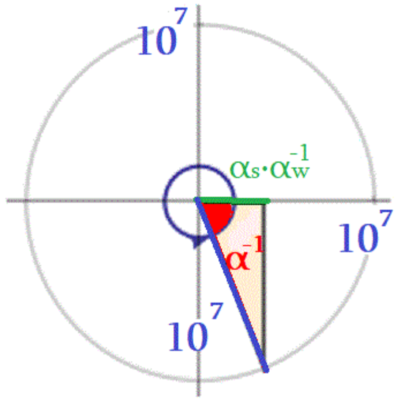

Figure 7. *The angle in α^{-1} radians.The rotation vector moves in a circle of radius 10^7.*

From expressions (25) and (29) resulting the beautiful formulas that connects the strong coupling constant α_s,the weak coupling constant α_w and the fine-structure constant α:

$$e \cdot \alpha_s = 10^7 \cdot \alpha_w$$

$$e^{i/\alpha} + e^{-i/\alpha} = 2 \cdot e^{-1}$$

$$e^{i/\alpha} + e^{-i/\alpha} = 2 \cdot 10^{-7} \cdot \alpha_s \cdot \alpha_w^{-1}$$

$$\alpha_w \cdot \alpha_s^{-1} \cdot (e^{i/\alpha} + e^{-i/\alpha}) = 2 \cdot 10^{-7}$$

$$10^7 \cdot \alpha_w \cdot (e^{i/\alpha} + e^{-i/\alpha}) = 2 \cdot \alpha_s \tag{42}$$

These equations are applicable for all energy scales.

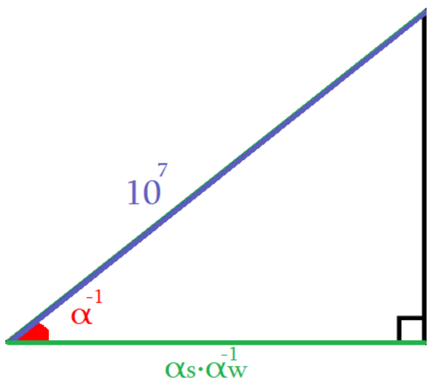

Figure 8. *Geometric representation of the dimensionless unification of the strong nuclear,the weak nuclear and the electromagnetic interactions.*

We reached the conclusion of the dimensionless unification of the strong nuclear,the weak nuclear and the electromagnetic forces:

$$10^7 \cdot \alpha_w \cdot (e^{i/\alpha} + e^{-i/\alpha}) = 2 \cdot \alpha_s$$

For the reduced Planck constant ħ apply:

$$\hbar=\alpha\cdot m_e\cdot a_0\cdot c$$

So from these expressions we have:

$$\hbar^2=\alpha^2\cdot m_e^2\cdot a_0^2\cdot c^2$$

$$(\hbar\cdot G/c^3)=\alpha^2\cdot m_e^2\cdot a_0^2\cdot(G/\hbar\cdot c)$$

$$(\hbar\cdot G/c^3)=\alpha^2\cdot a_0^2\cdot(G\cdot m_e^2/\hbar\cdot c)$$

$$l_{pl}^2=\alpha^2\cdot\alpha_G\cdot a_0^2$$

So the new formula for the Planck length l_{pl} is:

$$l_{pl}=a\sqrt{a_G}\alpha_0 \tag{43}$$

Jeff Yee proposed in [10] that the Avogadro's number N_A can be calculated from the Planck length l_{pl},the Bohr radius a_0 and Euler's number e:

$$\mathrm{N_A}=\frac{\alpha_0}{2el_{pl}}$$

We will use this expression and the new formula for the Planck length l_{pl} to resulting the unity formula that connects the fine-structure constant α and the gravitational coupling constant α_G:

$$a_0=2\cdot e\cdot N_A\cdot l_{pl}$$

$$\alpha_0=2e\mathrm{N_A}\alpha\sqrt{\alpha_G}\alpha_0$$

$$2e\mathrm{N_A}\alpha\sqrt{\alpha_G}=1$$

Therefore the unity formula that connects the fine-structure constant α,the gravitational coupling constant α_G and the Avogadro's number N_A is:

$$4\cdot e^2\cdot\alpha^2\cdot\alpha_G\cdot N_A^2=1 \tag{44}$$

The unity formula is equally valid:

$$\alpha^2\cdot\alpha_G=(2\cdot e\cdot N_A)^{-2} \tag{45}$$

So the new formula for the Avogadro number N_A is:

$$\mathrm{N_A}=\left(2e\alpha\sqrt{\alpha_G}\right)^{-1} \tag{46}$$

It was presented in [13] the mathematical formulas that connects the proton to electron mass ratio μ,the fine-structure constant α,the ratio N_1 of electric force to gravitational force between electron and proton,the Avogadro's number N_A,the gravitational coupling constant α_G of the electron and the gravitational coupling constant of the proton $\alpha_{G(p)}$:

$$\alpha_{G(p)}=\mu^2\cdot\alpha_G \tag{47}$$

$$\alpha=\mu\cdot N_1\cdot\alpha_G \tag{48}$$

$$\alpha\cdot\mu=N_1\cdot\alpha_{G(p)} \tag{49}$$

$$\alpha^2=N_1^2\cdot\alpha_G\cdot\alpha_{G(p)} \tag{50}$$

$$4\cdot e^2\cdot\alpha^2\cdot\alpha_G\cdot N_A^2=1 \tag{51}$$

$$\mu^2=4\cdot e^2\cdot\alpha^2\cdot\alpha_{G(p)}\cdot N_A^2 \tag{52}$$

$$\mu\cdot N_1=4\cdot e^2\cdot\alpha^3\cdot N_A^2 \tag{53}$$

$$4\cdot e^2\cdot\alpha\cdot\mu\cdot\alpha_G^2\cdot N_A^2\cdot N_1=1 \tag{54}$$

$$\mu^3=4\cdot e^2\cdot\alpha\cdot\alpha_{G(p)}^2\cdot N_A^2\cdot N_1 \tag{55}$$

$$\mu^2=4\cdot e^2\cdot\alpha_G\cdot\alpha_{G(p)}^2\cdot N_A^2\cdot N_1^2 \tag{56}$$

$$\mu=4\cdot e^2\cdot\alpha\cdot\alpha_G\cdot\alpha_{G(p)}\cdot N_A^2\cdot N_1 \tag{57}$$

Also from the expressions (28) and (44) resulting the expressions:

$$\cos(\alpha^{-1})=e^{-1}$$

$$4\cdot e^2\cdot\alpha^2\cdot\alpha_G\cdot N_A^2=1$$

$$4\cdot\alpha^2\cdot\alpha_G\cdot N_A^2=e^{-2}$$

$$\cos^2\alpha^{-1}=4\cdot\alpha^2\cdot\alpha_G\cdot N_A^2$$

$$\alpha^{-2}\cdot\cos^2\alpha^{-1}=4\cdot\alpha_G\cdot N_A^2 \tag{58}$$

This unity formula is equally valid:

$$\alpha^{-1}\cos\alpha^{-1}=2\mathrm{N_A}\sqrt{\alpha_G} \tag{59}$$

Also from the expressions (29) and (44) resulting another elegant exponential form equations:

$$e^{i/\alpha}+e^{-i/\alpha}=2\cdot e^{-1}$$

$$4\cdot e^2\cdot\alpha^2\cdot\alpha_G\cdot N_A^2=1$$

$$4\cdot\alpha^2\cdot\alpha_G\cdot N_A^2=e^{-2}$$

$$16\cdot\alpha^2\cdot\alpha_G\cdot N_A^2=(e^{i/\alpha}+e^{-i/\alpha})^2 \tag{60}$$

This unity formula is equally valid:

$$\alpha^{-1}\left(e^{\frac{i}{\alpha}}+e^{\frac{-i}{\alpha}}\right)=4\mathrm{N_A}\sqrt{\alpha_G} \tag{61}$$

The concept of power of two supports an idea of holographic concepts of the Universeor some of the fractal theories. Also it is used in wave mechanics,and it could be viewed in accordance with wave properties of the elementary particles in quantum physics

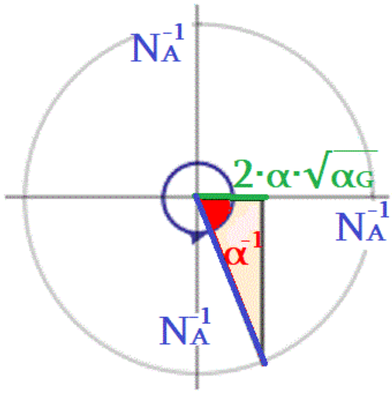

Figure 9. *The angle in α^{-1} radians. The rotation vector moves in a circle of radius N_A^{-1}.*

Also from the expressions (11),(44) and (60) resulting the expression with power of two:

$$2^{160}\cdot e^2\cdot\alpha^2\cdot\alpha_G=1 \tag{62}$$

$$\alpha^{-2}\cdot\cos^2\alpha^{-1}=2^{160}\cdot\alpha_G \tag{63}$$

$$2^{162}\cdot\alpha^2\cdot\alpha_G=(e^{i/\alpha}+e^{-i/\alpha})^2 \tag{64}$$

Other form of the equations is:

$$\alpha^{-1}\cos\alpha^{-1}=2^{3^4}\sqrt{\alpha_G} \tag{65}$$

Gravity and electromagnetism are able to coexist as entries in a list of classical forces,but for many years it seemed that gravity could not be incorporated into the quantum framework,let alone unified with the other fundamental forces.

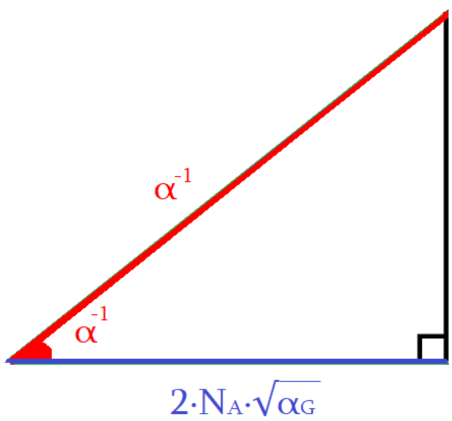

Figure 10. *First geometric representation of the dimensionless unification of the gravitational and the electromagnetic* interactions

For this reason,work on unification,for much of the twentieth century,focused on understanding the three forces described by quantum mechanics:electromagnetism and the weak and strong forces.

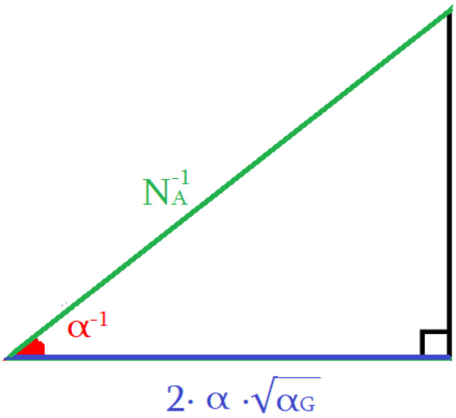

Figure 11. *Second geometric representation of the dimensionless unification of the gravitational and the electromagnetic* interactions

We reached the conclusion of the dimensionless unification of the gravitational and the electromagnetic forces:

$$4\cdot e^2\cdot\alpha^2\cdot\alpha_G\cdot N_A^2=1$$

$$16\cdot\alpha^2\cdot\alpha_G\cdot N_A^2=(e^{i/\alpha}+e^{-i/\alpha})^2$$

Now we will find the equation that connect the coupling constants of the strong nuclear,the gravitational and the electromagnetic interactions.

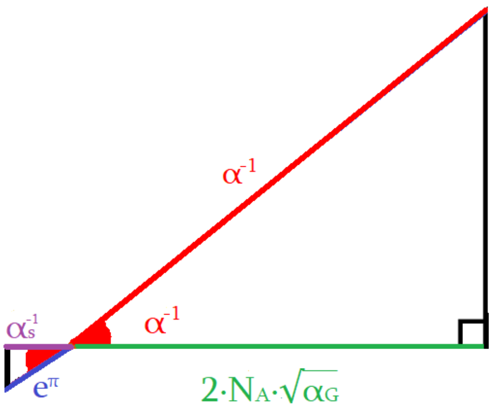

Figure 12. *Geometric representation of the dimensionless unification of the strong nuclear,the gravitational and the electromagnetic interactions*

We will use the expressions (22) and (44) to resulting the unity formulas that connect the strong coupling constant α_s,the fine-structure constant α and the gravitational coupling constant α_G:

$$4\cdot e^2\cdot\alpha^2\cdot\alpha_G\cdot N_A^2=1$$

$$4\cdot e^2\cdot(e^{\pi}\cdot\alpha_s)^2\cdot\alpha_G\cdot N_A^2=1$$

$$4\cdot e^{2\pi}\cdot\alpha_s^2\cdot\alpha^2\cdot\alpha_G\cdot N_A^2=1 \quad (66)$$

Other form of the equation is:

$$4\cdot\alpha_s^2\cdot\alpha^2\cdot\alpha_G\cdot N_A^2=i^{4i} \quad (67)$$

Also from the expression (22) and expression (51),(52),(53),(54),(55),(56),(57) resulting the mathematical formulas that connects the strong coupling constant α_s,the proton to electron mass ratio μ,the fine-structure constant α,the ratio N_1 of electric force to gravitational force between electron and proton,the Avogadro number N_A,the gravitational coupling constant α_G of the electron and the gravitational coupling constant of the proton $\alpha_{G(p)}$:

$$4 \cdot e^{2\pi} \cdot \alpha_s^2 \cdot \alpha^2 \cdot \alpha_G \cdot N_A^2 = 1 \tag{68}$$

$$\mu^2 = 4 \cdot e^{2\pi} \cdot \alpha_s^2 \cdot \alpha^2 \cdot \alpha_{G(p)} \cdot N_A^2 \tag{69}$$

$$\mu \cdot N_1 = 4 \cdot e^{2\pi} \cdot \alpha_s^2 \cdot \alpha^3 \cdot N_A^2 \tag{70}$$

$$4 \cdot e^{2\pi} \cdot \alpha_s^2 \cdot \alpha \cdot \mu \cdot \alpha_G^2 \cdot N_A^2 \cdot N_1 = 1 \tag{71}$$

$$\mu^3 = 4 \cdot e^{2\pi} \cdot \alpha_s^2 \cdot \alpha \cdot \alpha_{G(p)}^2 \cdot N_A^2 \cdot N_1 \tag{72}$$

$$\mu^2 = 4 \cdot e^{2\pi} \cdot \alpha_s^2 \cdot \alpha_G \cdot \alpha_{G(p)}^2 \cdot N_A^2 \cdot N_1^2 \tag{73}$$

$$\mu = 4 \cdot e^{2\pi} \cdot \alpha_s^2 \cdot \alpha \cdot \alpha_G \cdot \alpha_{G(p)} \cdot N_A^2 \cdot N_1 \tag{74}$$

Other equivalent forms of the equations are:

$$4 \cdot \alpha_s^2 \cdot \alpha^2 \cdot \alpha_G \cdot N_A^2 = i^{4i} \tag{75}$$

$$i^{4i} \cdot \mu = \alpha_s^2 \cdot \alpha^2 \cdot \alpha_{G(p)} \cdot N_A^2 \tag{76}$$

$$i^{4i} \cdot \mu \cdot N_1 = 4 \cdot \alpha_s^2 \cdot \alpha^3 \cdot N_A^2 \tag{77}$$

$$4 \cdot \alpha_s^2 \cdot \alpha \cdot \mu \cdot \alpha_G^2 \cdot N_A^2 \cdot N_1 = i^{4i} \tag{78}$$

$$i^{4i} \cdot \mu^3 = 4 \cdot \alpha_s^2 \cdot \alpha \cdot \alpha_{G(p)}^2 \cdot N_A^2 \cdot N_1 \tag{79}$$

$$i^{4i} \cdot \mu^2 = 4 \cdot e^{2\pi} \cdot \alpha_s^2 \cdot \alpha_G \cdot \alpha_{G(p)}^2 \cdot N_A^2 \cdot N_1^2 \tag{80}$$

$$i^{4i} \cdot \mu = 4 \cdot \alpha_s^2 \cdot \alpha \cdot \alpha_G \cdot \alpha_{G(p)} \cdot N_A^2 \cdot N_1 \tag{81}$$

From the expressions (34) and (75) apply:

$$\alpha_s \cdot \cos\alpha^{-1} = i^{2i}$$

$$2 \cdot N_A \cdot \alpha_G^{1/2} = \alpha^{-1} \cdot \cos\alpha^{-1}$$

$$2 \cdot \alpha_s \cdot \alpha \cdot \alpha_G^{1/2} \cdot N_A = i^{2i}$$

$$2 \cdot \alpha_s \cdot \alpha \cdot N_A \cdot \alpha_G^{1/2} \cdot \alpha_s \cdot \cos\alpha^{-1} = i^{2i} \cdot i^{2i}$$

$$2 \cdot \alpha \cdot \cos\alpha^{-1} \cdot \alpha_s^2 \cdot \alpha_G^{1/2} \cdot N_A = i^{4i}$$

$$4 \cdot \alpha^2 \cdot \cos^2\alpha^{-1} \cdot \alpha_s^4 \cdot \alpha_G \cdot N_A^2 = i^{8i} \tag{82}$$

From the expressions (36) and (75) apply:

$$\alpha_s \cdot (e^{i/\alpha} + e^{-i/\alpha}) = 2 \cdot i^{2i}$$

$$2 \cdot N_A \cdot \alpha_G^{1/2} = \alpha^{-1} \cdot (e^{i/\alpha} + e^{-i/\alpha})$$

$$2 \cdot \alpha_s \cdot \alpha \cdot N_A \cdot \alpha_G^{1/2} = i^{2i}$$

$$\alpha_s \cdot (e^{i/\alpha} + e^{-i/\alpha}) \cdot 2 \cdot \alpha_s \cdot \alpha \cdot N_A \cdot \alpha_G^{1/2} = 2 \cdot i^{2i} \cdot i^{2i}$$

$$\alpha \cdot (e^{i/\alpha} + e^{-i/\alpha}) \cdot \alpha_s^2 \cdot \alpha_G^{1/2} \cdot N_A = i^{4i}$$

$$\alpha^2 \cdot (e^{i/\alpha} + e^{-i/\alpha}) \cdot \alpha_s^4 \cdot \alpha_G \cdot N_A^2 = i^{8i} \tag{83}$$

Also from the expressions (11),(75) and (83) resulting the expressions with power of two:

$$2^{80}\cdot a_S\cdot a\cdot a_G^{1/2}=i^{2i}$$

$$2^{160}\cdot a_S^2\cdot a^2\cdot a_G=i^{4i} \tag{84}$$

$$2^{80}\cdot a\cdot(e^{i/a}+e^{-i/a})\cdot a_S^2\cdot a_G^{1/2}=i^{4i}$$

$$2^{160}\cdot a^2\cdot(e^{i/a}+e^{-i/a})^2\cdot a_S^4\cdot a_G=i^{8i} \tag{85}$$

We reached the conclusion of the dimensionless unification of the strong nuclear,the gravitational and the electromagnetic interactions:

$$4\cdot a_S^2\cdot a^2\cdot a_G\cdot N_A^2=i^{4i}$$

$$a^2\cdot(e^{i/a}+e^{-i/a})\cdot a_S^4\cdot a_G\cdot N_A^2=i^{8i}$$

Now we will find the equation that connects the coupling constants of the weak nuclear,the gravitational and the electromagnetic interactions.

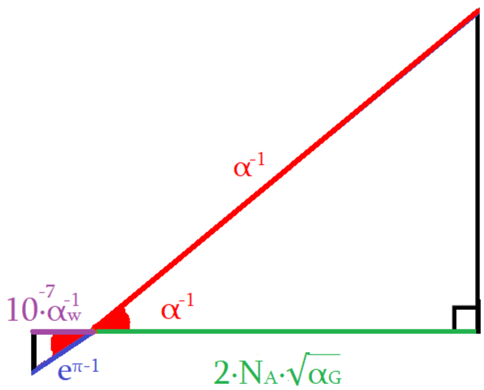

Figure 13. *Geometric representation of the dimensionless unification of the weak nuclear,the gravitational and the electromagnetic interactions*

We will use the expressions (25) and (68),(75) to resulting the unity formulas that connects the weak coupling constant a_W,the fine-structure constant a and the gravitational coupling constant a_G:

$$e\cdot a_S=10^7\cdot a_W$$

$$2\cdot e^{\pi}\cdot a_S\cdot a\cdot a_G^{1/2}\cdot N_A=1$$

$$2\cdot a_S\cdot a\cdot a_G^{1/2}\cdot N_A=i^{2i}$$

$$2\cdot e^{\pi}\cdot 10^7\cdot a_W\cdot a\cdot a_G^{1/2}\cdot N_A=e$$

$$4\cdot 10^{14}\cdot e^{2\pi}\cdot a_W^2\cdot a^2\cdot a_G\cdot N_A^2=e^2 \tag{86}$$

$$2\cdot 10^7\cdot a_W\cdot a\cdot a_G^{1/2}\cdot N_A=i^{2i}\cdot e$$

$$4\cdot 10^{14}\cdot a_W^2\cdot a^2\cdot a_G\cdot N_A^2=i^{4i}\cdot e^2 \tag{87}$$

Also from the expression (22) and (68),(69),(70),(71),(72),(73),(74) resulting the mathematical formulas that connects the weak coupling constant a_W,the proton to electron mass ratio μ,the fine-structure constant a,the ratio N_1 of electric force to gravitational force between electron and proton,the Avogadro's number N_A,the gravitational coupling constant a_G of the electron and the gravitational coupling constant of the proton $a_{G(p)}$:

$$4\cdot 10^{14}\cdot e^{2\pi}\cdot a_W^2\cdot a^2\cdot a_G\cdot N_A^2=e^2 \tag{88}$$

$$e^2 \cdot \mu^2 = 4 \cdot 10^{14} \cdot e^{2\pi} \cdot \alpha_W^2 \cdot \alpha^2 \cdot \alpha_{G(p)} \cdot N_A^2 \tag{89}$$

$$e^2 \cdot \mu \cdot N_1 = 4 \cdot 10^{14} \cdot e^{2\pi} \cdot \alpha_W^2 \cdot \alpha^3 \cdot N_A^2 \tag{90}$$

$$4 \cdot 10^{14} \cdot e^{2\pi} \cdot \alpha_W^2 \cdot \alpha \cdot \mu \cdot \alpha_G^2 \cdot N_A^2 \cdot N_1 = e^2 \tag{91}$$

$$e^2 \cdot \mu^3 = 4 \cdot 10^{14} \cdot e^{2\pi} \cdot \alpha_W^2 \cdot \alpha \cdot \alpha_{G(p)}^2 \cdot N_A^2 \cdot N_1 \tag{92}$$

$$e^2 \cdot \mu^2 = 4 \cdot 10^{14} \cdot e^{2\pi} \cdot \alpha_W^2 \cdot \alpha_G \cdot \alpha_{G(p)}^2 \cdot N_A^2 \cdot N_1^2 \tag{93}$$

$$e^2 \cdot \mu = 4 \cdot e^{\pi} \cdot 10^{14} \cdot \alpha_W^2 \cdot \alpha \cdot \alpha_G \cdot \alpha_{G(p)} \cdot N_A^2 \cdot N_1 \tag{94}$$

From the expression (22) and (75),(76),(77),(78),(79),(80),(81) other equivalent forms of the equations are:

$$4 \cdot 10^{14} \cdot \alpha_W^2 \cdot \alpha^2 \cdot \alpha_G \cdot N_A^2 = i^{4i} \cdot e^2 \tag{95}$$

$$i^{4i} \cdot e^2 \cdot \mu^2 = 4 \cdot 10^{14} \cdot \alpha_W^2 \cdot \alpha^2 \cdot \alpha_{G(p)} \cdot N_A^2 \tag{96}$$

$$i^{4i} \cdot e^2 \cdot \mu \cdot N_1 = 4 \cdot 10^{14} \cdot \alpha_W^2 \cdot \alpha^3 \cdot N_A^2 \tag{97}$$

$$4 \cdot 10^{14} \cdot \alpha_W^2 \cdot \alpha \cdot \mu \cdot \alpha_G^2 \cdot N_A^2 \cdot N_1 = i^{4i} \cdot e^2 \tag{98}$$

$$i^{4i} \cdot e^2 \cdot \mu^3 = 4 \cdot 10^{14} \cdot \alpha_W^2 \cdot \alpha \cdot \alpha_{G(p)}^2 \cdot N_A^2 \cdot N_1 \tag{99}$$

$$i^{4i} \cdot e^2 \cdot \mu^2 = 4 \cdot 10^{14} \cdot e^{2\pi} \cdot \alpha_W^2 \cdot \alpha_G \cdot \alpha_{G(p)}^2 \cdot N_A^2 \cdot N_1^2 \tag{100}$$

$$i^{4i} \cdot e^2 \cdot \mu = 4 \cdot 10^{14} \cdot \alpha_W^2 \cdot \alpha \cdot \alpha_G \cdot \alpha_{G(p)} \cdot N_A^2 \cdot N_1 \tag{101}$$

From the expressions (26) and (82) apply:

$$\alpha_W^{-1} \cdot \alpha_S^2 = i^{2i} \cdot 10^7$$

$$\alpha_S^2 = i^{2i} \cdot 10^7 \cdot \alpha_W$$

$$2 \cdot \alpha \cdot \cos\alpha^{-1} \cdot \alpha_S^2 \cdot \alpha_G^{1/2} \cdot N_A = i^{4i}$$

$$2 \cdot \alpha \cdot \cos\alpha^{-1} \cdot i^{2i} \cdot 10^7 \cdot \alpha_W \cdot \alpha_G^{1/2} \cdot N_A = i^{4i}$$

$$2 \cdot 10^7 \cdot \alpha \cdot \cos\alpha^{-1} \cdot \alpha_W \cdot \alpha_G^{1/2} \cdot N_A = i^{2i}$$

$$4 \cdot 10^{14} \cdot \alpha^2 \cdot \cos^2\alpha^{-1} \cdot \alpha_W^2 \cdot \alpha_G \cdot N_A^2 = i^{4i} \tag{102}$$

From the expressions (26) and (83) apply:

$$\alpha \cdot (e^{i/\alpha} + e^{-i/\alpha}) \cdot \alpha_S^2 \cdot \alpha_G^{1/2} \cdot N_A = i^{4i}$$

$$\alpha \cdot (e^{i/\alpha} + e^{-i/\alpha}) \cdot i^{2i} \cdot 10^7 \cdot \alpha_W \cdot \alpha_G^{1/2} \cdot N_A = i^{4i}$$

$$10^7 \cdot \alpha \cdot (e^{i/\alpha} + e^{-i/\alpha}) \cdot \alpha_W \cdot \alpha_G^{1/2} \cdot N_A = i^{2i}$$

$$10^{14} \cdot \alpha^2 \cdot (e^{i/\alpha} + e^{-i/\alpha})^2 \cdot \alpha_W^2 \cdot \alpha_G \cdot N_A^2 = i^{4i} \tag{103}$$

Also from the expressions (11),(102) and (103) resulting the expression with power of two:

$$2^{80} \cdot 10^7 \cdot \alpha_W \cdot \alpha \cdot \alpha_G^{1/2} = i^{2i} \cdot e$$

$$2^{160} \cdot 10^{14} \cdot \alpha_W^2 \cdot \alpha^2 \cdot \alpha_G = i^{4i} \cdot e^2 \tag{104}$$

$$2^{80} \cdot 10^7 \cdot \alpha \cdot (e^{i/\alpha} + e^{-i/\alpha}) \cdot \alpha_W \cdot \alpha_G^{1/2} = i^{2i}$$

$$2^{160} \cdot 10^{14} \cdot \alpha^2 \cdot (e^{i/\alpha} + e^{-i/\alpha})^2 \cdot \alpha_W^2 \cdot \alpha_G = i^{4i} \tag{105}$$

We reached the conclusion of the dimensionless unification of the weak nuclear,the gravitational and electromagnetic forces:

$$4 \cdot 10^{14} \cdot a_w^2 \cdot a^2 \cdot a_G \cdot N_A^2 = i^{4i} \cdot e^2$$

$$10^{14} \cdot a^2 \cdot (e^{i/a} + e^{-i/a})^2 \cdot a_w^2 \cdot a_G \cdot N_A^2 = i^{8i}$$

Finding a theory of everything is one of the major unsolved problems in physics.

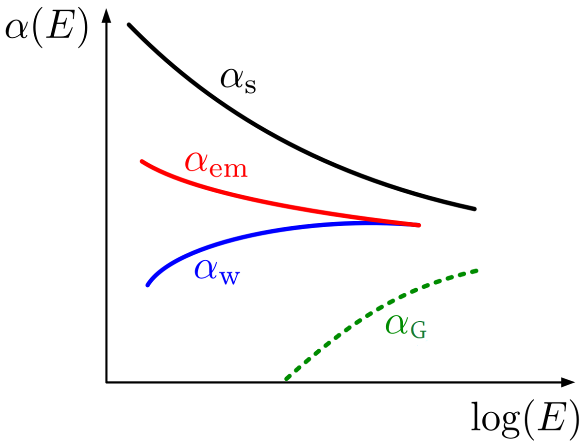

Figure 14. *Variation of the coupling constants of the four fundamental interactions of physics as a function of energy.*

Over the past few centuries,two theoretical frameworks have been developed that,together,most closely resemble a theory of everything. These two theories upon which all modern physics rests are general relativity and quantum mechanics.

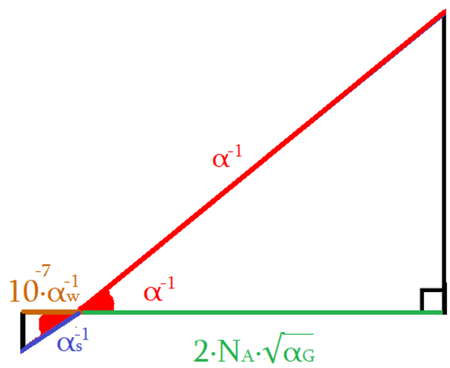

Figure 15. *Geometric representation of the dimensionless unification of the strong nuclear,the weak nuclear,the gravitational and the electromagnetic interactions*

Now we will find the equation that connect the four coupling constants. We will use the expressions (26) and (75) to resulting the unity formulas that connects the strong coupling constant a_s,the weak coupling constant a_w,the fine-structure constant a and the gravitational coupling constant a_G:

$$a_w^{-1} \cdot a_s^2 = i^{2i} \cdot 10^7$$

$$2 \cdot a_s \cdot a \cdot N_A \cdot a_G^{1/2} = i^{2i}$$

$$a_w^{-1} \cdot a_s^2 = 2 \cdot 10^7 \cdot a_s \cdot a \cdot N_A \cdot a_G^{1/2}$$

$$a_w^{-1} \cdot a_s = 2 \cdot 10^7 \cdot a \cdot N_A \cdot a_G^{1/2}$$

$$2 \cdot 10^7 \cdot N_A \cdot a_w \cdot a \cdot a_G^{1/2} \cdot a_s^{-1} = 1$$

$$a_w \cdot a \cdot a_G^{1/2} \cdot a_s^{-1} = (2 \cdot 10^7 \cdot N_A)^{-1} \qquad (106)$$

$$2\cdot 10^7\cdot N_A\cdot \alpha_w\cdot \alpha\cdot \alpha_G^{1/2}=\alpha_s$$

$$\alpha_w^2\cdot \alpha^2\cdot \alpha_G\cdot \alpha_s^{-2}=(2\cdot 10^7\cdot N_A)^{-2} \qquad (107)$$

So the beautiful unity formula that connects the strong coupling constant α_s,the weak coupling constant α_w,the fine-structure constant α and the gravitational coupling constant α_G is:

$$(2\cdot 10^7\cdot N_A\cdot \alpha_w\cdot \alpha)^2\cdot \alpha_G=\alpha_s^2$$

$$4\cdot 10^{14}\cdot N_A^2\cdot \alpha_w^2\cdot \alpha^2\cdot \alpha_G=\alpha_s^2 \qquad (108)$$

Sometimes the gravitational coupling constant for the proton $\alpha_{G(p)}$ is used instead of the gravitational coupling constant α_G for the electron:

$$\alpha_{G(p)}=\mu^2\cdot \alpha_G$$

$$\alpha_G^{1/2}=\alpha_{G(p)}^{1/2}\cdot \mu^{-1}$$

$$\alpha_s\cdot \mu\cdot (\alpha_w\cdot \alpha\cdot \alpha_{G(p)}^{1/2})^{-1}=2\cdot 10^7\cdot N_A$$

$$\alpha_s\cdot \mu=2\cdot 10^7\cdot N_A\cdot \alpha_w\cdot \alpha\cdot \alpha_{G(p)}^{1/2}$$

$$2\cdot 10^7\cdot N_A\cdot \alpha_w\cdot \alpha\cdot \alpha_{G(p)}^{1/2}\cdot \alpha_s^{-1}\cdot \mu^{-1}=1$$

$$2\cdot 10^7\cdot N_A\cdot \alpha_w\cdot \alpha\cdot \alpha_{G(p)}^{1/2}\cdot \alpha_s^{-1}=\mu\cdot \alpha_s$$

$$\alpha_w\cdot \alpha\cdot \alpha_{G(p)}^{1/2}\cdot \alpha_s^{-1}=(2\cdot 10^7\cdot N_A)^{-1}\cdot \mu \qquad (109)$$

So the beautiful unity formula that connect the strong coupling constant α_s,weak coupling constant α_w,the fine-structure constant α and the gravitational coupling constant $\alpha_{G(p)}$ for the proton is:

$$(2\cdot 10^7\cdot N_A\cdot \alpha_w\cdot \alpha)^2\cdot \alpha_{G(p)}=\mu^2\cdot \alpha_s^2$$

$$4\cdot 10^{14}\cdot N_A^2\cdot \alpha_w^2\cdot \alpha^2\cdot \alpha_{G(p)}=\mu^2\cdot \alpha_s^2 \qquad (110)$$

From the expressions (58) and (106) apply:

$$\cos\alpha^{-1}=2\cdot \alpha\cdot \alpha_G^{1/2}\cdot N_A$$

$$2\cdot 10^7\cdot N_A\cdot \alpha_w\cdot \alpha\cdot \alpha_G^{1/2}=\alpha_s$$

$$2\cdot \alpha\cdot \alpha_G^{1/2}\cdot N_A\cdot 2\cdot 10^7\cdot N_A\cdot \alpha_w\cdot \alpha\cdot \alpha_G^{1/2}=\alpha_s \cos\alpha^{-1}$$

$$4\cdot 10^7\cdot \alpha^2\cdot \alpha_G\cdot \alpha_w\cdot N_A^2=\alpha_s \cos\alpha^{-1}$$

$$\alpha^{-1}\cdot (e^{i/\alpha}+e^{-i/\alpha})=4\cdot N_A\cdot \alpha_G^{1/2}$$

$$2\cdot 10^7\cdot N_A\cdot \alpha_w\cdot \alpha\cdot \alpha_G^{1/2}=\alpha_s$$

$$2\cdot 10^7\cdot N_A\cdot \alpha_w\cdot \alpha\cdot \alpha_G^{1/2}\cdot 4\cdot N_A\cdot \alpha_G^{1/2}=\alpha_s\cdot \alpha^{-1}\cdot (e^{i/\alpha}+e^{-i/\alpha})$$

$$8\cdot 10^7\cdot N_A^2\cdot \alpha_w\cdot \alpha^2\cdot \alpha_G=\alpha_s\cdot (e^{i/\alpha}+e^{-i/\alpha})$$

From the expressions (25) and (51),(52),(53),(54),(55),(56),(57) resulting the mathematical formulas that connects the strong coupling constant α_s,the weak coupling constant α_w,the proton to electron mass ratio μ,the fine-structure constant α,the ratio N_1 of electric force to gravitational force between electron and proton,the Avogadro's number N_A,the gravitational coupling constant α_G of the electron and the gravitational coupling constant of the proton $\alpha_{G(p)}$:

$$\alpha_s^2=4\cdot 10^{14}\cdot \alpha_w^2\cdot \alpha^2\cdot \alpha_G\cdot N_A^2 \qquad (111)$$

$$\mu^2 \cdot a_s^2 = 4 \cdot 10^{14} \cdot a_w^2 \cdot a^2 \cdot a_{G(p)} \cdot N_A^2 \quad (112)$$

$$\mu \cdot N_1 \cdot a_s^2 = 4 \cdot 10^{14} \cdot a_w^2 \cdot a^3 \cdot N_A^2 \quad (113)$$

$$a_s^2 = 4 \cdot 10^{14} \cdot a_w^2 \cdot a \cdot \mu \cdot a_G^2 \cdot N_A^2 \cdot N_1 \quad (114)$$

$$\mu^3 \cdot a_s^2 = 4 \cdot 10^{14} \cdot a_w^2 \cdot a \cdot a_{G(p)}^2 \cdot N_A^2 \cdot N_1 \quad (115)$$

$$\mu \cdot a_s = 4 \cdot 10^{14} \cdot a_w^2 \cdot a_G \cdot G(p)^2 \cdot N_A^2 \cdot N_1^2 \quad (116)$$

$$\mu \cdot a_s^2 = 4 \cdot 10^{14} \cdot a_w^2 \cdot a \cdot a_G \cdot a_{G(p)} \cdot N_A^2 \cdot N_1 \quad (117)$$

Also from the expressions (11) and (108) resulting the expressions with power of two:

$$2^{80} \cdot 10^7 \cdot a_w \cdot a \cdot a_G^{1/2} \cdot a_s^{-1} = 1$$

$$2^{160} \cdot 10^{14} \cdot a_w^2 \cdot a^2 \cdot a_G \cdot a_s^{-2} = 1 \quad (118)$$

$$a_s = 2^{80} \cdot 10^7 \cdot a_w \cdot a \cdot a_G^{1/2}$$

$$a_s^2 = 2^{160} \cdot 10^{14} \cdot a_w^2 \cdot a^2 \cdot a_G \quad (119)$$

We reached the conclusion of the dimensionless unification of the strong nuclear,the weak nuclear,the gravitational and the electromagnetic interactions:

$$a_s^2 = 4 \cdot 10^{14} \cdot a_w^2 \cdot a^2 \cdot a_G \cdot N_A^2$$

$$8 \cdot 10^7 \cdot N_A^2 \cdot a_w \cdot a^2 \cdot a_G = a_s \cdot (e^{i/a} + e^{-i/a})$$

3. Gravitational fine-structure constant

The relevant constant in atomic physics is the fine-structure constant α,which plays a fundamental role in atomic physics and quantum electrodynamics. The analogous constant in cosmology is the gravitational fine-structure constant α_g. It plays a fundamental role in cosmology. The mysterious value of the gravitational fine-structure constant α_g is an equivalent way to express the biggest issue in theoretical physics. The new formula for the Planck length l_{pl} is:

$$l_{pl} = a\sqrt{a_G}\alpha_0$$

The fine-structure constant equals:

$$\alpha^2 = \frac{r_e}{a_0}$$

From these expressions we have:

$$l_{pl} = \frac{\alpha\sqrt{\alpha_G} r_e}{\alpha^2}$$

$$\frac{l_{pl}^3}{r_e^3} = \frac{\sqrt{\alpha_G^3}}{\alpha^3}$$

$$l_{pl} = \frac{\sqrt{\alpha_G}}{\alpha} r_e$$

The gravitational fine structure constant α_g is defined as:

$$\alpha_g = \frac{l_{pl}^3}{r_e^3}$$

$$\alpha_g = \frac{\sqrt{\alpha_G^3}}{\alpha^3}$$

$$\alpha_g = \sqrt{\frac{\alpha_G^3}{\alpha^6}} \tag{132}$$

with numerical value:

$$\alpha_g=1{,}886837\times10^{-61}$$

Also equals:

$$\alpha_g^2\cdot\alpha^6=\alpha_G^3$$

$$\alpha_g^2=\alpha_G^3\cdot\alpha^{-6}$$

$$\alpha_g^2 = \left(\frac{\alpha_G}{\alpha^2}\right)^3$$

Now we will try to find the best mathematical expression of the gravitational fine structure constant α_g with the mathematical constants. In trying to do this we found surprising coincidences and various approaches for the math constants. In [9] we presented exact and approximate expressions between the Archimedes constant π,the golden ratio φ,the Euler's number e and the imaginary number i. A approach for Archimedes constant π is:

$$\pi^6 \simeq \frac{2^{300}}{6\,7^{103}} \tag{133}$$

A approach for the Gelfond's constant e^π is:

$$e^\pi \simeq \frac{55}{\pi}\sqrt{\frac{2}{\ln\pi}} \tag{134}$$

A approximation expression that connects the golden ratio φ,the Archimedes constant π and the Euler's number e is:

$$2^2 11^2 e \simeq 3^4 \varphi^5 \sqrt[3]{\pi} \tag{135}$$

Two approximations expressions that connects the golden ratio φ,the Archimedes constant π,the Euler's number e and the Euler's constant γ are:

$$4e^2\gamma \ln^2(2\pi) \simeq \sqrt{3^3}\varphi^5 \tag{136}$$

$$\sqrt{3^5}e\gamma \ln(2\pi)\sqrt[3]{\pi} \simeq 11^2 \tag{137}$$

The expression that connects the gravitational fine-structure constant α_g with the Archimedes constant π,the Euler's number e and the Euler's constant γ is:

$$\alpha_g=[e\cdot\gamma\cdot\ln^2(2\cdot\pi)]^{-1}\times10^{-60}=1{,}886837\times10^{-61} \quad (138)$$

The expression that connects the gravitational fine-structure constant α_g with the golden ratio φ and the Euler's number e is:

$$\alpha_g = \frac{4e}{3\sqrt{3}\varphi^5}\times 10^{-60} = 1,886837\times 10^{-61} \quad (139)$$

The expression that connects the gravitational fine-structure constant α_g with the Archimedes constant π is:

$$\alpha_g = \frac{\sqrt{3^5}\sqrt[3]{\pi}}{11^2}\times 10^{-60} = 1,886837\times 10^{-61} \quad (140)$$

The expression that connects the gravitational fine-structure constant α_g with the golden ratio φ and the Euler's constant γ is:

$$\alpha_g = \frac{7\varphi\gamma^2}{2}\times 10^{-60} = 1,886826\times 10^{-61} \quad (141)$$

The expression that connects the gravitational fine-structure constant α_g with the Archimedes constant and the golden ratio φ is:

$$\alpha_g = \frac{2\pi}{3\varphi^5}\times 10^{-60} = 1,888514\times 10^{-61} \quad (142)$$

From the expressions (120) and (132) resulting the unity formula for the gravitational fine-structure constant α_g:

$$\alpha_g=(2\cdot e\cdot\alpha^2\cdot N_A)^{-3} \quad (143)$$

Also apply the expressions:

$$(2\cdot e\cdot\alpha^2\cdot N_A)^3\cdot\alpha_g=1$$

$$8\cdot e^3\cdot\alpha^6\cdot\alpha_g\cdot N_A^3=1$$

From the expressions (123) and (132) resulting the unity formula for the gravitational fine-structure constant α_g:

$$\alpha_g=i^{6i}\cdot(2\cdot\alpha_s\cdot\alpha^2\cdot N_A)^{-3} \quad (144)$$

Also apply the expression:

$$(2\cdot\alpha_s\cdot\alpha^2\cdot N_A)^3\cdot\alpha_g=i^{6i}$$

$$8\cdot\alpha_s^3\cdot\alpha^6\cdot\alpha_g\cdot N_A^3=i^{6i}$$

From the expressions (127) and (132) resulting the unity formula for the gravitational fine-structure constant α_g:

$$\alpha_g=i^{6i}\cdot e^3\cdot(2\cdot10^7\cdot\alpha_w\cdot\alpha^3\cdot N_A)^{-3} \quad (145)$$

Also apply the expression:

$$(2\cdot10^7\cdot\alpha_w\cdot\alpha^3\cdot N_A)^3\cdot\alpha_g=i^{6i}\cdot e^3$$

$$8\cdot10^{21}\cdot\alpha_w^3\cdot\alpha^9\cdot\alpha_g\cdot N_A^3=i^{6i}\cdot e^3$$

From the expressions (130) and (132) resulting the unity formulas for the gravitational fine-structure constant α_g:

$$\alpha_g=(10^7\cdot\alpha_w\cdot\alpha_G^{1/2}\cdot e^{-1}\cdot\alpha_s^{-1}\cdot\alpha^{-1})^3 \quad (146)$$

Also apply the expressions:

$$\alpha_g=10^{21}\cdot\alpha_w^{3}\cdot\alpha_G^{3/2}\cdot\alpha_s^{-3}\cdot a^{-3}\cdot e^{-3}$$

$$\alpha_g\cdot\alpha_s^{3}\cdot a^{3}\cdot e^{3}=10^{21}\cdot\alpha_w^{3}\cdot\alpha_G^{3/2}$$

So the unity formula for the gravitational fine-structure constant α_g is:

$$\alpha_g^{2}=(10^{14}\cdot\alpha_w^{2}\cdot\alpha_G\cdot e^{-2}\cdot\alpha_s^{-2}\cdot a^{-2})^{3} \qquad (147)$$

Also apply the expressions:

$$\alpha_g^{2}=10^{42}\cdot\alpha_w^{6}\cdot\alpha_G^{3}\cdot e^{-6}\cdot\alpha_s^{-6}\cdot a^{-6}$$

$$e^{6}\cdot\alpha_s^{6}\cdot a^{6}\cdot\alpha_g^{2}=10^{42}\cdot\alpha_w^{6}\cdot\alpha_G^{3}$$

$$\alpha_g^{2}\cdot(e\cdot\alpha_s\cdot a)^{6}=(10^{14}\cdot\alpha_w^{2}\cdot\alpha_G)^{3}$$

From the expressions (130) and (132) resulting the unity formula for the gravitational fine-structure constant α_g:

$$\alpha_g=i^{6i}\cdot(10^{7}\cdot\alpha_w\cdot\alpha_G^{1/2}\cdot\alpha_s^{-2}\cdot a^{-1})^{3}$$

$$\alpha_g=10^{21}\cdot i^{6i}\cdot(\alpha_w\cdot\alpha_G^{1/2}\cdot\alpha_s^{-2}\cdot a^{-1})^{3}$$

$$\alpha_g=10^{21}\cdot i^{6i}\cdot\alpha_w^{3}\cdot\alpha_G^{3/2}\cdot\alpha_s^{-6}\cdot a^{-3} \qquad (148)$$

Also apply the expressions:

$$\alpha_g^{1/3}\cdot\alpha_s^{2}\cdot a\cdot\alpha_w^{-1}\cdot\alpha_G^{-1/2}=i^{2i}\cdot 10^{7}$$

$$\alpha_g\cdot\alpha_s^{6}\cdot a^{3}=10^{21}\cdot i^{6i}\cdot\alpha_w^{3}\cdot\alpha_G^{3/2}$$

So the unity formulas for the gravitational fine-structure constant α_g are:

$$\alpha_g^{2}=i^{6i}\cdot(10^{14}\cdot\alpha_w^{2}\cdot\alpha_G\cdot\alpha_s^{-4}\cdot a^{-2})^{3}$$

$$\alpha_g^{2}=10^{42}\cdot i^{12i}\cdot(\alpha_w^{2}\cdot\alpha_G\cdot\alpha_s^{-4}\cdot a^{-2})^{3}$$

$$\alpha_g^{2}=10^{42}\cdot i^{12i}\cdot\alpha_w^{6}\cdot\alpha_G^{3}\cdot\alpha_s^{-12}\cdot a^{-6} \qquad (149)$$

Also apply the expressions:

$$\alpha_g^{2}\cdot\alpha_s^{12}\cdot a^{6}\cdot\alpha_w^{-6}\cdot\alpha_G^{-3}=i^{12i}\cdot 10^{42}$$

$$(\alpha_s^{6}\cdot a^{3}\cdot\alpha_g)^{2}=(10^{14}\cdot i^{4i}\cdot\alpha_w^{2}\cdot\alpha_G)^{3}$$

$$\alpha_s^{12}\cdot a^{6}\cdot\alpha_g^{2}=10^{42}\cdot i^{12i}\cdot\alpha_w^{6}\cdot\alpha_G^{3}$$

So the unity formulas for the gravitational fine-structure constant α_g are:

$$\alpha_g=\left(\frac{10^{7}\alpha_w\sqrt{\alpha_G}}{e\alpha_s a}\right)^{3} \qquad (150)$$

$$\alpha_g^{2}=10^{42}\left(\frac{\alpha_G a_w^{2}}{e^{2}\alpha_s^{2}\alpha^{2}}\right)^{3} \qquad (151)$$

$$\alpha_g = 10^{21} i^{6i} \left(\frac{\alpha_w \sqrt{\alpha_G}}{\alpha_s^2 \alpha} \right)^3 \tag{152}$$

$$\alpha_g^2 = 10^{42} i^{2i} \left(\frac{\alpha_G a_w^2}{\alpha^2 \alpha_s^4} \right)^3 \tag{153}$$

This expression connects the gravitational fine-structure constant α_g with the four coupling constants. Perhaps the gravitational fine structure constant α_g is the coupling constant for the fifth force. Some speculative theories have proposed a fifth force to explain various anomalous observations that do not fit existing theories. The characteristics of this fifth force depend on the hypothesis being advanced. Many postulate a force roughly the strength of gravity with a range of anywhere from less than a millimeter to cosmological scales. Another proposal is a new weak force mediated by W and Z bosons. The search for a fifth force has increased in recent decades due to two discoveries in cosmology which are not explained by current theories. It has been discovered that most of the mass of the universe is accounted for by an unknown form of matter called dark matter. Most physicists believe that dark matter consists of new,undiscovered subatomic particles,but some believe that it could be related to an unknown fundamental force. Second,it has also recently been discovered that the expansion of the universe is accelerating,which has been attributed to a form of energy called dark energy. Some physicists speculate that a form of dark energy called quintessence could be a fifth force.

4. Dimensionless unification of atomic physics and cosmology

In the context of cosmology the cosmological constant is a homogeneous energy density that causes the expansion of the universe to accelerate. Originally proposed early in the development of general relativity in order to allow a static universe solution it was subsequently abandoned when the universe was found to be expanding. Now the cosmological constant is invoked to explain the observed acceleration of the expansion of the universe. The cosmological constant is the simplest realization of dark energy,which is the more generic name given to the unknown cause of the acceleration of the universe. Its existence is also predicted by quantum physics,where it enters as a form of vacuum energy,although the magnitude predicted by quantum theory does not match that observed in cosmology.

The cosmological constant Λ is presumably an enigmatic form of matter or energy that acts in opposition to gravity and is considered by many physicists to be equivalent to dark energy. Nobody really knows what the cosmological constant is exactly,but it is required in cosmological equations in order to reconcile theory with our observations of the universe. One potential explanation for the cosmological constant lies in the realm of modern particle physics. Experiments have verified that empty space is permeated by countless virtual particles constantly popping in and out of existence. It is commonly believed that the cosmological constant problem can only be solved ultimately in a unified theory of quantum gravity and the standard model of electroweak and strong interactions,which is still absent so far. But connecting vacuum energy to the cosmological constant is not straightforward. Based on their observations of supernovas,astronomers estimate that dark energy should have a small and sedate value,just enough to push everything in the universe apart over billions of years. Yet when scientists try to calculate the amount of energy that should arise from virtual particle motion,they come up with a result that's 120 orders of magnitude greater than what the supernova data suggest. The cosmological constant has the same effect as an intrinsic energy density of the vacuum,ρ_{vac} and an associated pressure. In this context,it is commonly moved onto the right-hand side of the equation,and defined with a proportionality factor of $\Lambda=8 \cdot \pi \cdot \rho_{vac}$ where unit conventions of general relativity are used (otherwise factors of G and c would also appear,i.e:

$$\Lambda = 8\pi \rho_{vac} \frac{G}{c^4} = \kappa \rho_{vac}$$

where κ is Einstein's rescaled version of the gravitational constant G. The cosmological constant has been introduced in gravitational field equations by Einstein in 1.917 in order to satisfy Mach's principle of the relativity of inertia. Then it was demonstrated by Cartan in 1.922 that the Einstein field tensor including a cosmological constant Λ:

$$\mathrm{E}_{\mu\nu} = R_{\mu\nu} - \frac{1}{2} R g_{\mu\nu} + \Lambda g_{\mu\nu}$$

,is the most general tensor in Riemannian geometry having null divergence like the energy momentum tensor $T_{\mu\nu}$. This theorem has set the general form of Einstein's gravitational field equations as $E_{\mu\nu}=\kappa\cdot T_{\mu\nu}$ and established from first principles the existence of Λ as an unvarying true constant. The cosmological constant problem dates back to the realization that it is equivalent to a vacuum energy density. One of the main consequences in cosmology of a positive cosmological constant is an acceleration of the expansion of the universe. Such an acceleration has been first detected in 1.981 in the Hubble diagram of infrared elliptical galaxies,yielding a positive value close to the presently measured one,but with still large uncertainties. Accurate measurements of the acceleration of the expansion since 20 years have reinforced the problem. The cosmological constant Λ,as it appears in Einstein's equations,is a curvature. As such,besides being an energy density,it is also the inverse of the square of an invariant cosmic length L.

In the early-mid 20th century Dirac and Zel'dovich were among the first scientists to suggest an intimate connection between cosmology and atomic physics. Though a revolutionary proposal for its time,Dirac's Large Number Hypothesis (1.937) adopted a standard assumption of the non-existence of the cosmological constant term $\Lambda=0$. Zel'dovich insight (1.968) was to realize that a small but nonzero cosmological term $\Lambda>0$ allowed the present day radius of the Universe to be identified with the de Sitter radius which removed the need for time dependence in the fundamental couplings. Thus,he obtained the formula:

$$\Lambda = \frac{m_p^6 G^2}{\hbar^6}$$

where m is a mass scale characterizing the relative strengths of the gravitational and electromagnetic interactions,which he identified with the proton mass m_p.

Laurent Nottale in [18] which,instead,suggests the identification $m=m_e/\alpha$. He assumed that the cosmological constant Λ is the sum of a general-relativistic term and of the quantum,scale-varying,gravitational self-energy of virtual pairs. A renormalization group approach is used to describe its scale-dependence. We argue that the large scale value of Λ is reached at the classical electron scale. This reasoning provides with a large-number relation:

$$\alpha\frac{m_{pl}}{m_e} = \left(\frac{L}{l_{pl}}\right)^{\frac{1}{3}}$$

The cosmological constant Λ has the dimension of an inverse length squared. The cosmological constant is the inverse of the square of a length L:

$$L = \sqrt{\Lambda^{-1}}$$

For the de Sitter radius equals:

$$R_d = \sqrt{3}L$$

So the de Sitter radius and the cosmological constant are related through a simple equation:

$$R_d = \sqrt{\frac{3}{\Lambda}}$$

From this equation resulting the expressions for the gravitational fine structure constant α_g:

$$\alpha\frac{m_{pl}}{m_e} = \left(l_{pl}\sqrt{\Lambda}\right)^{-\frac{1}{3}}$$

$$\alpha_g = l_{pl}\sqrt{\Lambda}$$

$$\alpha_g = \sqrt{\frac{G\hbar\Lambda}{c^3}}$$

So the cosmological constant Λ equals:

$$\Lambda = \alpha_g^2 l_{pl}^{-2}$$

$$\Lambda = \frac{l_{pl}^4}{r_e^6}$$

$$\Lambda = \alpha_g^2 \frac{c^3}{G\hbar}$$

$$\Lambda = \frac{G}{\hbar^4}\left(\frac{m_e}{a}\right)^6$$

From the expression (143) resulting the dimensionless unification of the atomic physics and the cosmology:

$$\alpha_g = (2 \cdot e \cdot a^2 \cdot N_A)^{-3}$$

$$l_{pl}^2 \cdot \Lambda = (2 \cdot e \cdot a^2 \cdot N_A)^{-6} \quad (154)$$

$$(2 \cdot e \cdot a^2 \cdot N_A)^6 \cdot l_{pl}^2 \cdot \Lambda = 1 \quad (155)$$

Now we will use the unity formulas of the dimensionless unification of atomic physics and cosmology to find the equations of the cosmological constant. For the cosmological constant equals:

$$\Lambda = \left(2e\alpha^2 N_A\right)^{-6} \frac{c^3}{G\hbar} \quad (156)$$

From the expression (144) resulting the dimensionless unification of atomic physics and cosmology:

$$\alpha_g = i^{6i} \cdot (2 \cdot \alpha_s \cdot a^2 \cdot N_A)^{-3}$$

$$l_{pl}^2 \cdot \Lambda = i^{12i} \cdot (2 \cdot \alpha_s \cdot a^2 \cdot N_A)^{-6} \quad (157)$$

$$(2 \cdot \alpha_s \cdot a^2 \cdot N_A)^6 \cdot l_{pl}^2 \cdot \Lambda = i^{12i} \quad (158)$$

For the cosmological constant equals:

$$\Lambda = i^{12i}\left(2\alpha_s a^2 N_A\right)^{-6} \frac{c^3}{G\hbar} \quad (159)$$

From the xpression (145) resulting the dimensionless unification of atomic physics and cosmology:

$$\alpha_g = i^{6i} \cdot e^3 \cdot (2 \cdot 10^7 \cdot \alpha_w \cdot a^3 \cdot N_A)^{-3}$$

$$l_{pl}^2 \cdot \Lambda = i^{12i} \cdot e^6 \cdot (2 \cdot 10^7 \cdot \alpha_w \cdot a^3 \cdot N_A)^{-6} \quad (160)$$

$$(2 \cdot 10^7 \cdot \alpha_w \cdot a^3 \cdot N_A)^6 \cdot l_{pl}^2 \cdot \Lambda = i^{12i} \cdot e^6 \quad (161)$$

For the cosmological constant equals:

$$\Lambda = i^{12i} e^6 \left(2\,10^7 \alpha_w a^3 N_A\right)^{-6} \frac{c^3}{G\hbar} \quad (162)$$

From the expression (146) resulting the dimensionless unification of atomic physics and cosmology:

$$\alpha_g^2 = 10^{42}\left(\frac{\alpha_G a_w^2}{e^2\alpha_s^2\alpha^2}\right)^3$$

$$l_{pl}^2\Lambda = 10^{42}\left(\frac{\alpha_G\alpha_w^2}{e^2\alpha_s^2\alpha^2}\right)^3 \tag{163}$$

$$e^6\cdot \alpha s^6\cdot \alpha^6\cdot lpl^2\cdot \Lambda=10^{42}\cdot \alpha G^3\cdot \alpha w^6 \tag{164}$$

For the cosmological constant equals:

$$\Lambda = 10^{42}\left(\frac{\alpha_G\alpha_w^2}{e^2\alpha_s^2\alpha^2}\right)^3\frac{c^3}{G\hbar} \tag{165}$$

From the expression (147) resulting the dimensionless unification of atomic physics and cosmology:

$$\alpha_g^2 = 10^{42}i^{2i}\left(\frac{\alpha_G a_w^2}{\alpha^2\alpha_s^4}\right)^3$$

$$l_{pl}^2\Lambda = 10^{42}i^{12}\left(\frac{\alpha_G\alpha_w^2}{\alpha^2\alpha_s^4}\right)^3 \tag{166}$$

$$\alpha s^{12}\cdot \alpha^6\cdot lpl^2\cdot \Lambda=10^{42}\cdot i^{12i}\cdot \alpha G^3\cdot \alpha w^6 \tag{167}$$

This unity formula is a simple analogy between atomic physics and cosmology. For the cosmological constant equals:

$$\Lambda = 10^{42}i^{12}\left(\frac{\alpha_G\alpha_w^2}{\alpha^2\alpha_s^4}\right)^3\frac{c^3}{G\hbar} \tag{168}$$

The Equation of the Universe is:

$$\frac{\Lambda G\hbar}{c^3} = 10^{42}i^{12i}\left(\frac{\alpha_G\alpha_w^2}{\alpha^2\alpha_s^4}\right)^3 \tag{169}$$

5. Cosmological parameters

The Hubble constant H_0 is one of the most important numbers in cosmology because it is required to estimate the size and age of the universe. This number indicates the rate at which the universe is expanding. The Hubble constant can be used to determine the inherent brightness and masses of stars in nearby galaxies,examine the same properties in more distant galaxies and galaxy clusters,infer the amount of dark matter in the universe,and obtain the scale size of distant clusters as far as clusters test for theoretical cosmological models. In 1.929,American astronomer Edwin Hubble announced his discovery that galaxies,in all directions,seemed to be moving away from us and have greater displacement for attenuated galaxies. However,the true value for H_0 is very complicated. Astronomers need two measurements:

a) First, spectroscopic observations reveal the redshift of the galaxy, showing its radial velocity.

b) The second measurement, the most difficult value, is the exact distance of the galaxy from Earth.

The unit of the Hubble constant is 1 km/s/Mpc. The 2.018 CODATA recommended value of the Hubble constant is $H_0=67{,}66\pm0{,}42\ (km/s)/Mpc=(2{,}1927664\pm0{,}0136)\times10^{-18}\ s^{-1}$. Hubble length or Hubble distance is a unit of distance in cosmology,defined as the speed of light multiplied by Hubble time $L_H=c\cdot H_0^{-1}$. This distance is equivalent to 4,550 million parsecs,or 14,4 billion light-years,13,8 billion years. Hubble's distance would be the distance between the Earth and the galaxies currently falling away from us at the speed of light,as shown by the substitution $r=c\cdot H_0^{-1}$ in the equation for Hubble's law,$u=H_0\cdot r$.

The critical density is the average density of matter required for the Universe to just halt its expansion,but only after an infinite time. A Universe with a critical density is said to be flat. In his theory of general relativity, Einstein demonstrated that the gravitational effect of matter is to curve the surrounding space. In a Universe full of matter, both its overall geometry and its fate are controlled by the density of the matter within it. If the density of matter in the Universe is high (a closed Universe),self-gravity slows the expansion until it halts, and ultimately re-collapses. In a closed Universe, locally parallel light rays converge at some extremely distant point. This is referred to as spherical geometry. If the density of matter in the Universe is low (an open Universe),self-gravity is insufficient to stop the expansion, and the Universe continues to expand forever (albeit at an ever decreasing rate). In an open Universe, locally parallel light rays ultimately diverge. This is referred to as hyperbolic geometry. Balanced on a knife edge between Universes with high and low densities of matter, there exists a Universe where parallel light rays remain parallel. This is referred to as a flat geometry,and the density is called the critical density. In a critical density Universe, the expansion is halted only after an infinite time.

To date,the critical density is estimated to be approximately five atoms per cubic meter,whereas the average density of ordinary matter in the Universe is believed to be 0,2–0,25 atoms per cubic meter. A much greater density comes from the unidentified dark matter; both ordinary and dark matter contribute in favor of contraction of the universe. However,the largest part comes from so-called dark energy, which accounts for the cosmological constant term. Although the total density is equal to the critical density the dark energy does not lead to contraction of the universe but rather may accelerate its expansion. Therefore,the universe will likely expand forever. An expression for the critical density is found by assuming Λ to be zero and setting the normalized spatial curvature,k,equal to zero. When the substitutions are applied to the first of the Friedmann equations we find:

$$\rho_c = \frac{3H_0^3}{8\pi G}$$

It should be noted that this value changes over time. The critical density changes with cosmological time,but the energy density due to the cosmological constant remains unchanged throughout the history of the universe. The amount of dark energy increases as the universe grows,while the amount of matter does not. The density parameter Ω is defined as the ratio of the actual density ρ to the critical density ρ_c of the Friedmann universe. The relation between the actual density and the critical density determines the overall geometry of the universe,when they are equal,the geometry of the universe is flat (Euclidean). The galaxies we see in all directions are moving away from the Earth,as evidenced by their red shifts. Hubble's law describes this expansion. Remarkably,study of the expansion rate has shown that the universe is very close to the critical density that would cause it to expand forever.

The density parameter Ω is defined as the ratio of the average density of matter and energy in the Universe ρ to the critical density ρ_c of the Friedmann universe. The relation between the actual density and the critical density determines the overall geometry of the universe;when they are equal,the geometry of the universe is flat (Euclidean). In earlier models,which did not include a cosmological constant term, critical density was initially defined as the watershed point between an expanding and a contracting Universe. The density parameter is given by:

$$\Omega_0 = \frac{\rho}{\rho_c}$$

where ρ is the actual density of the Universe and ρ_c the critical density. Although current research suggests that Ω_0 is very close to 1,it is still of great importance to know whether Ω_0 is slightly greater than 1,less than 1,or exactly equal to 1,as this reveals the ultimate fate of the Universe. If Ω_0 is less than 1,the Universe is open and will continue to expand forever. If Ω_0 is greater than 1,the Universe is closed and this will eventually halt its expansion and recollapse. If Ω_0 is exactly equal to 1 then the Universe is flat and contains enough matter to halt the expansion but not enough to recollapse it. It is important to note that the ρ used in the calculation of Ω_0 is the total mass/energy density of the Universe. In other words,it is the sum of a number of different components including both normal and dark matter as well as the dark energy suggested by recent observations. We can therefore write:

$$\Omega_0=\Omega_B+\Omega_D+\Omega_\Lambda$$

$$\Omega_0=\Omega_m+\Omega_\Lambda$$

$$\Omega_0=\Omega_B+\Omega_{D+\Lambda}$$

where:
Ω_B is the density parameter for normal baryonic matter,
Ω_D is the density parameter for dark matter,
Ω_Λ is the density parameter for dark energy,
Ω_m is the sum of the density parameter for normal baryonic matter and the density parameter for dark matter,
$\Omega_{D+\Lambda}$ is the sum of the density parameter for the density parameter for dark matter and the density parameter for dark energy.
The sum of the contributions to the total density parameter Ω_0 at the current time is:

$$\Omega_0=1{,}02\pm0{,}02$$

Current observations suggest that we live in a dark energy dominated Universe with $\Omega_\Lambda=0{,}73$,$\Omega_D=0{,}23$ and $\Omega_B=0{,}04$. To the accuracy of current cosmological observations,this means that we live in a flat,$\Omega_0=1$ Universe. Instead of the cosmological constant Λ itself,cosmologists often refer to the ratio between the energy density due to the cosmological constant and the critical density of the universe,the peak point of a density sufficient to prevent the universe from expanding forever,at one level of the universe is the ratio between the energy of the universe due to the cosmological constant Λ and the critical density of the universe,that is what we would call the fraction of the universe consisting of dark energy.

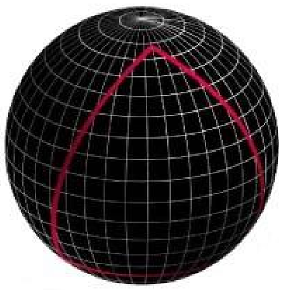

Figure 16. *If Ω0 is greater than 1,the Universe is closed and this will eventually halt its expansion and recollapse.*

The assessment of baryonic matter at the current time was assessed by WMAP to be $\Omega_B=0{,}044\pm0{,}004$. From the dimensionless unification of the fundamental interactions the density parameter for normal baryonic matter is:

$$\Omega_B=10^{-7}\cdot a_g^{1/3}\cdot a_s^2\cdot a\cdot a_w^{-1}\cdot a_G^{-1/2}$$

$$\Omega_B=2\cdot10^7\cdot N_A\cdot e^{-1}\cdot a_w\cdot a\cdot a_G^{1/2}$$

$$\Omega_B=2^{-1}\cdot e^{-1}\cdot 10^7\cdot a_w\cdot(e^{i/a}+e^{-i/a})$$

$$\Omega_B=2\cdot N_A\cdot a_s\cdot a\cdot a_G^{1/2}$$

$$\Omega_B=2^{-1}\cdot a_s\cdot(e^{i/a}+e^{-i/a})$$

$$\Omega_B=a_w^{-1}\cdot a_s^2\cdot10^{-7}$$

$$\Omega_B=e^{-1}\cdot a_s$$

$$\Omega_B=e^{-\pi}$$

$$\Omega_B=i^{2i} \tag{170}$$

$$\Omega_B=0{,}043214$$

$$\Omega_B=4{,}32\%$$

From the dimensionless unification of the fundamental interactions the density parameter for dark matter is:

$$\Omega_D=6\cdot\Omega_B=6\cdot e^{-\pi}=6\cdot i^{2i}=0{,}2592835=25{,}92\%$$

The fraction of the effective mass of the universe attributed to dark energy or the cosmological constant is $\Omega_\Lambda=0{,}73\pm0{,}04$. With 73% of the influence on the expansion of the universe in this era,dark energy is viewed as the dominant influence on that expansion. The previous history of the big bang is viewed as being at first radiation dominated, then matter dominated,and now having passed into the era where dark energy is the dominant influence. The density parameter for dark energy is defined as:

$$\Omega_\Lambda=\frac{\Lambda c^2}{3H_0^2}$$

From the dimensionless unification of the fundamental interactions the density parameter for the dark energy is:

$$\Omega_\Lambda=17\cdot\Omega_B=17\cdot e^{-\pi}=17\cdot i^{2i}=0{,}73463661=73{,}46\%$$

The sum of the density parameter for normal baryonic matter and the density parameter for the dark matter is:

$$\Omega_m=7\cdot e^{-\pi}=7\cdot i^{2i}=0{,}3024974=30{,}25\%$$

The sum of the density parameter for normal baryonic matter and the density parameter for the dark energy is:

$$\Omega_{D+\Lambda}=23\cdot\Omega_B=23\cdot e^{-\pi}=23\cdot i^{2i}=0{,}99392=99{,}39\%$$

The sum of the density parameter for normal baryonic matter and the density parameter for the dark energy is:

$$\Omega_0=\Omega_B+\Omega_D+\Omega_\Lambda=i^2+6\cdot i^{2i}+17\cdot i^{2i}=24\cdot i^{2i}=1{,}037134 \tag{171}$$

A positively curved universe is described by elliptic geometry, and can be thought of as a three-dimensional hypersphere, or some other spherical 3-manifold (such as the Poincaré dodecahedral space),all of which are quotients of the 3-sphere. Poincaré dodecahedral space is a positively curved space,colloquially described as "soccer ball-shaped",as it is the quotient of the 3-sphere by the binary icosahedral group,which is very close to icosahedral symmetry,the symmetry of a soccer ball. This was proposed by Jean-Pierre Luminet and colleagues in 2.003 and an optimal orientation on the sky for the model was estimated in 2.008. When the universe expands sufficiently,the cosmological constant L becomes more important than the energy density of matter in determining the fate of the universe. If $\Lambda>0$ there will be an approximately exponential expansion. This seems to be happening now in our universe.

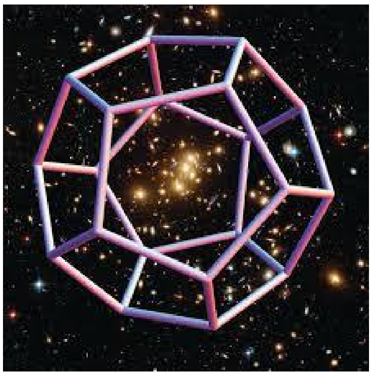

Figure 17. *Perhaps the shape of the universe is Poincaré dodecahedral space.*

In cosmology,the equation of state of a perfect fluid is characterized by a dimensionless number w,equal to the ratio of its pressure p to its energy density ρ:

$$w=\frac{p}{\rho}$$

Stable w of the state equation is the ratio of the pressure exerted by dark energy on the universe to the energy per unit volume. This ratio is $w=-1$ for a real cosmological constant and is generally different for alternating time changes of vacuum energy forms quintessence. This ratio is often used by scientists. The state equation w has value

$w=-1,028\pm0,032$. This number means how quickly the dark energy density changes as the universe expands.If $w=-1$,the density is strictly constant,if $w>-1$,the density decreases, and if $w<-1$,the density actually increases with time. Einstein's cosmological constant is just the idea that there is a fixed minimum energy density everywhere in the universe; this vacuum energy would correspond to $w=-1$. It's easy enough to get an energy density that slowly diminishes,with $w>-1$,all you need to do is invent some scalar field slowly rolling down a very gentle potential,so that the energy is nearly constant but in fact gradually diminishes. If $w<-1$,corresponding to a gradually increasing energy density. It's not what you would typically expect;the expansion of the universe tends to dilute energy,not increase it. So for some time cosmologists who put observational limits on the value of w would exclude $w<-1$ by hand. The energy density thus tends to increase,implying $w<-1$ called "phantom energy" because the Phantom Menace had just come out and also because negative-kinetic-energy fields also appear in the context of quantized gauge theories,where they are called "ghost" fields. If w is less than -1 and constant,the energy density grows without bound and everything in the universe is ripped to shreds at some finite point in the future. From the dimensionless unification of the fundamental interactions the state equation w has value:

$$w=-24\cdot e^{-\pi}=-24\cdot i^{2i}=-1,037134 \tag{172}$$

For as much as $w<-1$, the density actually increases with time.

The famous formula $E=m\cdot c^2$ of Einstein is better replaced by $E=K\cdot m\cdot c^2$. In this E becomes the sum of two types of energy,the measured normal energy density of the universe $E(O)$ and the sum of the dark energy and the dark matter density of the universe $E(D)$. This reveals hitherto unsuspected quantum roots for the equation $E=m\cdot c^2$. Einstein's equation $E=m\cdot c^2$ is actually the sum of two parts of quantum relativity $E(O)$ from the quantum particle and $E(D)$ from the quantum wave. From the dimensionless unification of the fundamental interactions for the measurable ordinary energy $E(O)$ apply:

$$E(O)=i^{2i}\cdot m\cdot c^2$$

Also from the dimensionless unification of the fundamental interactions for the sum of the dark energy with the dark matter density of the universe $E(D)$ apply:

$$E(D)=23\cdot i^{2i}\cdot m\cdot c^2$$

So for the total energy E apply:

$$E=K\cdot m\cdot c^2$$

$$E=E(O)+E(D)$$

$$E=i^{2i}\cdot m\cdot c^2+23\cdot i^{2i}\cdot m\cdot c^2$$

$$E=(i^{2i}+23\cdot i^{2i})\cdot m\cdot c^2$$

$$E=24\cdot i^{2i}\cdot m\cdot c^2 \tag{173}$$

Other forms of the equation are:

$$E=12\cdot i^{2i}\cdot m\cdot c^2+12\cdot i^{2i}\cdot m\cdot c^2$$

$$E=12\cdot i^{2i}\cdot m\cdot c^2-i^2\cdot 12\cdot i^{2i}\cdot m\cdot c^2$$

$$E=12\cdot i^{2i}\cdot m\cdot c^2-12\cdot i^{2i}\cdot m\cdot (i\cdot c)^2$$

$$12\cdot i^{2i}\cdot m\cdot (i\cdot c)^2+E=12\cdot i^{2i}\cdot m\cdot c^2 \tag{174}$$

The second theory is that the density parameter for normal baryonic matter is:

$$\Omega_B=e^{-\pi}=i^{2i}=0,043214=4,32\%$$

The density parameter for dark matter is:

$$\Omega_D=6\cdot e^{-\pi}=6\cdot i^{2i}=0{,}25928=25{,}928\%$$

The density parameter for dark energy is:

$$\Omega_\Lambda=16\cdot e^{-\pi}=16\cdot i^{2i}=(4\cdot i^i)^2=0{,}69142=69{,}142\%$$

The sum of the density parameter for normal baryonic matter and the density parameter for the dark matter is:

$$\Omega_m=7\cdot e^{-\pi}=7\cdot i^{2i}=0{,}3024974=30{,}25\%$$

The sum of the density parameter for normal baryonic matter and the density parameter for the dark energy is:

$$\Omega_{D+\Lambda}=22\cdot e^{-\pi}=22\cdot i^{2i}=0{,}95070=95{,}07\%$$

The sum of the density parameter for normal baryonic matter and the density parameter for the dark energy is:

$$\Omega_0=\Omega_B+\Omega_D+\Omega_\Lambda=i^2+6\cdot i^{2i}+16\cdot i^{2i}=23\cdot i^{2i}=0{,}99392=99{,}39\%$$

If Ω_0 is greater than 1,the Universe is closed and this will eventually halt its expansion and recollapse. A hyperbolic universe,one of a negative spatial curvature, is described by hyperbolic geometry,and can be thought of locally as a three-dimensional analog of an infinitely extended saddle shape. There are a great variety of hyperbolic 3-manifolds,and their classification is not completely understood.

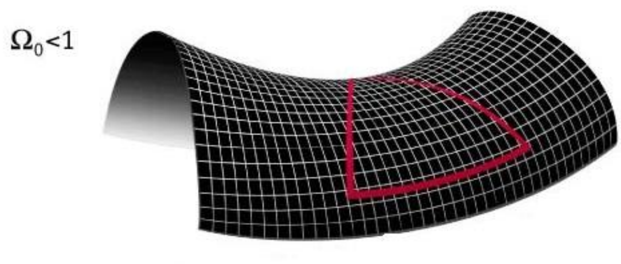

Figure 18. *If Ω_0 is less than 1,the Universe is open and will continue to expand forever.*

Those of finite volume can be understood via the Mostow rigidity theorem. For hyperbolic local geometry,many of the possible three-dimensional spaces are informally called "horn topologies",so called because of the shape of the pseudosphere,a canonical model of hyperbolic geometry. An example is the Picard horn,a negatively curved space colloquially described as "funnel-shaped". The state equation w has value:

$$w=-23\cdot e^{-\pi}=-23\cdot i^{2i}=-0{,}99392$$

The thirty theory is that the density parameter for normal baryonic matter is:

$$\Omega_B=e^{-\pi}=i^{2i}=0{,}043214=4{,}32\%$$

The density parameter for dark matter is:

$$\Omega_D=5\cdot e^{-\pi}=5\cdot i^{2i}=0{,}216069=21{,}60\%$$

The density parameter for dark energy is:

$$\Omega_\Lambda=17\cdot e^{-\pi}=17\cdot i^{2i}=0{,}73463661=73{,}46\%$$

The sum of the density parameter for normal baryonic matter and the dark matter is:

$$\Omega_m=6\cdot e^{-\pi}=6\cdot i^{2i}=0{,}25928=25{,}92\%$$

The sum of the density parameter for normal baryonic matter and the dark energy is:

$$\Omega_{D+\Lambda}=22\cdot e^{-\pi}=22\cdot i^{2i}=0{,}95070=95{,}07\%$$

The sum of the density parameter for normal baryonic matter and the density parameter for the dark energy is:

$$\Omega_0=\Omega_B+\Omega_D+\Omega_\Lambda=i^2+5\cdot i^{2i}+17\cdot i^{2i}=23\cdot i^{2i}=0{,}99392$$

The state equation w has value:

$$w=-23\cdot e^{-\pi}=-23\cdot i^{2i}=-0{,}99392$$

6. Conclusions

We reached the conclusion of the simple unification of the nuclear and the atomic physics:

$$10\cdot(e^{i\mu/a}+e^{-i\mu/a})^{1/2}=13\cdot i$$

We calculated the unity formulas that connect the coupling constants of the fundamental forces. The dimensionless unification of the strong nuclear and the weak nuclear interactions:

$$e\cdot a_s=10^7\cdot a_w$$

$$a_s^2=i^{2i}\cdot 10^7\cdot a_w$$

The dimensionless unification of the strong nuclear and electromagnetic interactions:

$$a_s\cdot(e^{i/a}+e^{-i/a})=2\cdot i^{2i}$$

The dimensionless unification of the weak nuclear and electromagnetic interactions:

$$10^7\cdot a_w\cdot(e^{i/a}+e^{-i/a})=2\cdot e\cdot i^{2i}$$

The dimensionless unification of the strong nuclear,the weak nuclear and electromagnetic interactions:

$$10^7\cdot a_w\cdot(e^{i/a}+e^{-i/a})=2\cdot a_s$$

The dimensionless unification of the gravitational and the electromagnetic interactions:

$$4\cdot e^2\cdot a^2\cdot a_G\cdot N_A^2=1$$

$$16\cdot a^2\cdot a_G\cdot N_A^2=(e^{i/a}+e^{-i/a})^2$$

The dimensionless unification of the strong nuclear,the gravitational and the electromagnetic interactions:

$$4\cdot a_s^2\cdot a^2\cdot a_G\cdot N_A^2=i^{4i}$$

$$a^2\cdot(e^{i/a}+e^{-i/a})\cdot a_s^4\cdot a_G\cdot N_A^2=i^{8i}$$

The dimensionless unification of of the weak nuclear,the gravitational and the electromagnetic interactions:

$$4\cdot 10^{14}\cdot a_w^2\cdot a^2\cdot a_G\cdot N_A^2=i^{4i}\cdot e^2$$

$$10^{14}\cdot a^2\cdot(e^{i/a}+e^{-i/a})^2\cdot a_w^2\cdot a_G\cdot N_A^2=i^{8i}$$

The dimensionless unification of the strong nuclear,the weak nuclear,the gravitational and the electromagnetic interactions:

$$a_s^2=4\cdot 10^{14}\cdot a_w^2\cdot a^2\cdot a_G\cdot N_A^2$$

$$8\cdot 10^7\cdot N_A^2\cdot a_w\cdot a^2\cdot a_G=a_s\cdot(e^{i/a}+e^{-i/a})$$

We found the formula for the Gravitational constant:

$$G = \alpha_s^2 \left(2\,10^7 \alpha_w \alpha N_A\right)^{-2} \frac{\hbar c}{m_e^2}$$

Perhaps for the minimum distance l_{min} apply:

$$l_{min} = 2 \cdot e \cdot l_{pl}$$

We calculated the expression that connects the gravitational fine structure constant with the four coupling constants:

$$\alpha_g^2 = 10^{42} i^{2i} \left(\frac{\alpha_G a_w^2}{\alpha^2 \alpha_s^4} \right)^3$$

Perhaps the gravitational fine structure constant is the coupling constant for the fifth force. It presented that the gravitational fine structure constant is a simple analogy between atomic physics and cosmology. The conclusion of the dimensionless unification of atomic physics and cosmology:

$$\alpha_s^{12} \cdot \alpha^6 \cdot l_{pl}^2 \cdot \Lambda = 10^{42} \cdot i^{12i} \cdot \alpha_G^3 \cdot \alpha_w^6$$

We found the formula for the cosmological constant:

$$\Lambda = 10^{42} i^{12} \left(\frac{\alpha_G \alpha_w^2}{\alpha^2 \alpha_s^4} \right)^3 \frac{c^3}{G\hbar}$$

The Equation of the Universe is:

$$\frac{\Lambda G \hbar}{c^3} = 10^{42} i^{12i} \left(\frac{\alpha_G \alpha_w^2}{\alpha^2 \alpha_s^4} \right)^3$$

We proposed a possible solution for the cosmological parameters. From the dimensionless unification of the fundamental interactions the density parameter for normal baryonic matter is:

$$\Omega_B = e^{-\pi} = i^{2i} = 0{,}043214 = 4{,}32\%$$

The density parameter for dark matter is:

$$\Omega_D = 6 \cdot e^{-\pi} = 6 \cdot i^{2i} = 0{,}2592835 = 25{,}92\%$$

The density parameter for the dark energy is:

$$\Omega_\Lambda = 17 \cdot e^{-\pi} = 17 \cdot i^{2i} = 0{,}73463661 = 73{,}46\%$$

The sum of the density parameter for normal baryonic matter and the density parameter for the dark energy is:

$$\Omega_0 = 24 \cdot e^{-\pi} = 24 \cdot i^{2i} = 1{,}037134$$

A positively curved universe is described by elliptic geometry,and can be thought of as a three-dimensional hypersphere,or some other spherical 3-manifold,such as the Poincaré dodecahedral space,all of which are quotients of the 3-sphere. The state equation w has value:

$$w = -24 \cdot e^{-\pi} = -24 \cdot i^{2i} = -1{,}037134$$

For as much as $w<-1$,the density actually increases with time. Finally we presented the law of the gravitational fine-structure constant α_g followed by ratios of maximum and minimum theoretical values for natural quantities.

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