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Further developments of the Grand Unified Theory (GUT) and its Applications on Different Particles, Connections to Stars and Light Formulas

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Abstract: *In this paper further developments of the Grand Unified Theory GUT are presented. An extension of the Schwarzschild solution in General Relativity is performed, which leads to an expression of a summation of all forces like gravitation, electromagnetic force, weak interaction, and strong interaction. A calculation of the light speed along a geodetic line is also derived and also the elliptic shape along this geodetic line is verified. A development of the Orhtogonal Relativistic Laplace Equation ORLE is also shown, which probably has many applications in nature. The connections between the Dynamic R elativistic Laplace Equation DRLE and the optical formulas* T^4 *and the New Intensity Formula are also shown and discussed. A new method of determing the masses of partices, the s.c. Binary Particle Method, BPM, has also been developed. The mass of around 25 different particles and elementary particles have been determined with very good agreements and correlations with particle experimental data from CERN amd NASA Another method of determining the masses of particles uses the laws of Kepler and has also been developed. This method is based on the photoelectric law of photons.*

Keywords: *Particle physics, Astrophysics, Spiral galaxies, Theory of Relativity and Universal Formula, Atomic, Nuclear and Molecular Physics.*

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I. Introduction

A Grand Unified Theory (GUT) is a model in particle physics in which at high energy, the three gauge interactions of the Standard Model, which are the electromagnetic, weak and strong interactions or forces, are merged into one single force. Several such theories about have been proposed during many years, but none has been generally accepted and managed.

In a previous paper by us a new version of Grand Unified Theory(GUT) has been presented, which includes gravitation, electromagnetic - weak and strong interactions and also dark energy. In that paper a Schwartzschild solution of the Einstein gravitation formula in General Relativity was used. By combining quaternions with this solution we could extend the energy tensor by Einstein, which led to the knowledge that the mass term of the Schwartzschild solution could be divided into several masses of physics like gravitation, electromagnetic force, weak interaction, and strong interaction. By using the Dynamic Relativistic Laplace Equation DRLE in rectangular coordinates this equation has a complex solution similar to a light wave. Similar calculations have also been derived for different systems like galaxies, planets, molecules, atoms and atomic nucleus. In that previous paper many examples were shown using DRLE.

In this paper an extension of the Schwarzschild solution in General Relativity is performed which leads to an expression which sums up all forces like gravitation, electromagnetic force, weak interaction, and strong interaction. The light speed along a geodetic line has been calculated along this geodetic line together with the elliptic shape of this geodetic line. There is also developed an orhtogonal version of the DRLE -equation, the Orthogonal Relativistic Laplace Equation ORLE. This ORLE has probably many applications in nature. The optical formulas T^4 and the New Intensity Formula and their connections to DRLE and are also shown and discussed. A new method of determing the mass of partices, the s.c. Binary Particle Method, BPM, is also developed in connection with the determination of the mass of the photon. With this method the masses of around 25 different particles and elementary particles have been determined with very good agreements with particle experimental data from CERN amd NASA. There was also calculated another method for massdetermination of particles where the laws of Kepler were used. This method is based on the photoelectric law of photons but can be used on heavier particles too and seems to be promising.

II. Extended Schwartschild

The Schwartschild solution in Genaral Relativity can be extended by using the mass expression by Einstein in Ref 1 , where an expression between mass and restmass is shown in Ref 2. According to special relativity the following expression is valid for the masses m_1 and m_2 **:**

$$m_2 = m_1 / (1 - v^2 / c^2)^{1/2} \qquad (1)$$

Therefore the following ratio is valid for these masses

$$m_2 / m_1 = 1 / (1 - v_1^2 / c^2)^{1/2} = v_2^2 \qquad (2)$$

which gives when solving c^2 verus v_1 and v_2

$$c^2 = v_1^2 + v_2^2 \qquad (3)$$

The Schwatzschild solution in General Relativity gives

$$\gamma = c^2 - 2mG / r = c^2 - v_1^2 \qquad (4)$$

Setting $v_2^2 = \gamma$ (5)

then $c^2 = v_1^2 + v_2^2$ (6)

According to the extended Schwartzschild solution of in Ref 3 gives

$$\gamma = c^2 - v_1^2 - v_i^2 - v_j^2 - v_k^2 \qquad (7)$$

or

$$c^2 = v_1^2 + v_2^2 + v_i^2 + v_j^2 + v_k^2 \qquad (8)$$

This is the energy principle where $E_n^{kinetic} = m_n v_n^2 / 2$ (9)

and therefore $v_n^2 = E_n^{kinetic} / 2 m_n$ (10)

then the following expression is valid

$$2 (m_1 + m_2 + m_i + m_j + m_k) c^2 = E_1 + E_2 + E_i + E_j + E_k \qquad (11)$$

Integrating and rearranging terms the summation of forces gives

$$F_1 + F_2 + F_i + F_j + F_k = \int 2 (m_1 + m_2 + m_i + m_j + m_k) c^2 ds \qquad (12)$$

Therefore this extension of the Schwarzschild solution in General Relativity leads to an expression where a summation of all forces like gravitation, electromagnetic force, weak interaction, and strong interaction is done, where the total energies of all forces are constant in General Relativity and Special Relativity.

III. Light speed along geodetic lines

In connection to chapter 2 a calculation is shown about the light speed along geodetic lines.

In Special Relativity we know that

$$E = m c^2 / (1 - v^2 / c^2)^{1/2} \qquad (13)$$

where E is the energy and m is the restmass Refs 4 and 5.

Now since E = h f we can set f = frequency :

$$h f = m c^2 / (1 - v^2 / c^2)^{1/2} \qquad (14)$$

When setting the mass of the photon to $h / 4\pi$ we obtain the following expression

$$h f = c^2 h / 4\pi (1 - v^2 / c^2)^{1/2} \qquad (15)$$

When solving the velocity we obtain

$$v = c^2 / 4\pi f = c^2 \lambda / 4\pi \qquad (16)$$

then

$$c^2 = v_1^2 + v_2^2 \qquad (17)$$

and along a geodetic line we obtain

$$d\psi / ds = c \qquad (18)$$

This means that a photon along a geodetic line has constant speed Ref 6

IV. Ellipse equation of Constant Velocity of Light

The velocity of light is given by :

$$c = (€ \mu_0)^{-1/2} \qquad (19)$$

with the electric constant $€_0$ and the magnetic constant μ_0 are shown Refs 7 and 8. By introducing complex numbers the following equation appears :

$$(i \sin \alpha) (\mu_0)^{-1/2} + (\cos \alpha) €_0)^{-1/2} = c \qquad (20)$$

or $v_1 + i v_2 = c$ (21)

Here $\alpha = (k r - \omega \mathbf{t})$ and it is proved by taking the square absolute value of a complex number, then :

$$(\sin \alpha)^2 / (\mu_0) + (\cos \alpha)^2 / (€_0) = 1 / (€ \mu_0) = c^2 \qquad (22)$$

or $v_1^2 + v_2^2 = c^2$ (23)

By multiplying by $€_0 \mu_0$ we derive an ellipse of the form :

$$x^2 / a^2 + y^2 / b^2 = 1 \qquad (24)$$

V. The Orthogonal Relativistic Laplace Equation, ORLE

In previous papers a Dynamic Relativistic Laplace Equation DRLE has been successfully developed and beeng used on several different systems like galaxies to atoms.This DRLE equation has the following appearance :

$$\mathbf{f(t)^2(} d^2\psi / d r^2) \mathbf{-} \mathbf{(f(r)^2 / c^2) (} d^2\psi / d t^2) \mathbf{= 0} \qquad (25)$$

This formula is a more flexible version of an earlier Relativistiv Laplace Equation RLE equation.These formulas have earlier been published by us Barrera and Thelin Refs 9 and 3 together with a much earlier version of RLE by Dirac Ref 10. From these DRLE and RLE equations we have also developed an orthogonal version the ORLE.

The Relativistic Laplace equationa RLE reads

$$d^2\psi / d r^2 - (1/c^2)(d^2\psi / d t^2) = 0 \qquad (26)$$

$$d^2\psi / d r^2 = (1/c^2)(d^2\psi / d t^2) \qquad (27)$$

To every plane and hyperplane curve there also exist anti geodetic line curves that lie orthogonally to the RLE equation. Therefore we define the two dimentional orthogonal equation.

$$d^2\psi / d r^2 = -(1/c^2)(d^2 t / d\psi^2) \qquad (28)$$

By integrating we obtain the following

After integration we derive the following expression

$$\psi(r) + r C_1 + C_3 = -(1/c^2)(r(\psi) + C_2\psi + C_4) \qquad (29)$$

By introducing

$$\Psi = C\,((\cos(2\pi/\lambda)(kr - \omega t) + i\sin(2\pi/\lambda)(kr - \omega t) \qquad (30)$$

we derive a solution to the ORLE with the following appearance.

$$\psi = r\,(\sin(2\pi/\lambda)\, i\alpha + \cos(2\pi/\lambda)\,\alpha)\, R_0 \qquad (31)$$

where R_0 is a summed constant.

VI. The T^4 law

An electromagnetic wave from a star shaped as a sphere

$x^2 + y^2 + z^2 = R^2$ has the form (32)

$$\psi(r,t) = A\cos(kr - \omega t) + i\sin(kr - \omega t) \qquad (33)$$

where , ω is the angular speed, r is a radial vector, t is time , k is a constant and imaginary term.

Using spherical coordinates gives

$$\psi(r,t) = (1/r)(A\cos(kr - \omega t) + i\sin(kr - \omega t)) \qquad (34)$$

which is a solution of the DRLE equation (25)

The wave is leaving the sphere radially, then the rest energy will be of the form

$$\psi^2(r,t) = (1/r)^2(A\cos(kr - \omega t) + iB\sin(kr - \omega t))^2 \qquad (35)$$

In equation (35) we set the constants A and B $\neq 0$ which means that the photon wave packet will oscillate with the kinetic energy $E = (m v^2)/2$, equal to the oscillating energy $E = (m f^2)/2$ at the frequency f. We now normalize equation (35) which gives equation (36)

$$\| \psi(r,t) \| = 1 \qquad (36)$$

By using spherical coordinates the normed frequency $\hat{f}$ becomes

$$\hat{f} = \| \psi^2(r,t) \| = (1/r)^2 \qquad (37)$$

The kinetic energy E_k will then be

$$E_k = \| m v^2 / 2 \| = \| m k \hat{f}^2 / 2 \| = (m k / 2 r^4) \qquad (38)$$

For some constant k and the area of the sphere equals $4\pi R^2$ which means that the energy of a wave is related to the square of it´s spectrum.

By using a scaling procedure and using de Moivre´s between Theorem, Ref 12 we obtain an expression between luminiocity and temperature according to equation (39), which is the Boltzmann formula Ref 11.

$$L = \| m k / 2 r^4 \| = 4\pi R^2 \rho T^4 \qquad (39)$$

7.1 Photon Energy and Mass in connection to the Binary Particle Modell

The energy of a photon equals :

$$E = h f \qquad (40)$$

where f is the frequency and h is the constant of Planck

By setting $E = m c^2$ (41)

we receive an energy equality

$$h f = m c^2 \qquad (42)$$

From this equality we derive an expression for the photon mass :

$$m = h f / c^2 \qquad (43)$$

The frequency is here emanating from a solution to DRLE equation using rectangular coordinates.

For example, at the spectral line at 121.7 nm we obtain the photon mass around :

$$m = 6 \cdot 10^{-43}\ \mathrm{kg} \qquad (44)$$

We now choose $m = m_v\ 2^{-N}\ (m_{evc})$ (45)

with binary numbers and choose the closest massvalue,which leads to the following massvalue of a photon :

$$m = m_v\ 2^{-142}\ \mathrm{kg} \qquad (46)$$

$$m = 5.88\ 10^{-43}\ \mathrm{kg} \qquad (47)$$

7.2 The Binary Particle Model

We express the rest mass of a particle or a elementary particle in the following way :

$$m_A = A\ m_{evc}\ K\ B^N \qquad (48)$$

In this method A , N € 2 and m_{evc} ,K and B € R (€ = belongs to)

where B preferable is an integer number and is the basis. m_{evc} (1 eV / c^2) = 1.7826610 10^{-36} kg. K is here an adjustment constant. We will especially focus on the case where B = 2 i.e. expressing rest mass of particles and elementary particles m_e with a binary basis. This will lead to the following expression :

$$m_A = A\ m_{evc}\ K\ B^N = A\ m_{evc}\ K\ 2^N \qquad (49)$$

and we will set K = 1.0 which will lead to :

$$m_A = A\ m_{evc}\ 2^N \qquad (50)$$

which is the same as :

$$m_i = \sum^{K}_{i=1}(m_{evc}\ 2^{N}_{i}\ K_1) \qquad (51)$$

7.3 Table of Particles with the Binary Particle Model (BPM) and from CERN / NASA particle experiments

Meson particles MeV / c^2 Refs 13 and 14

Particle	BPM	CERN / NASA	Correlation
Xi Quarks A	3624	CERN 3621	
Xi Quarks B	3621.781504	CERN 3621	99.98%
Electron	0.509410376	CERN 0.5097	100 %
Muon	104.8576	NASA 105	99.9%
PI-Meson π + 133 x 2^{20}	139.4655786	139.6	99.9%
PI0-Meson π^0 129.5 x 2^{20}	135.7754	135	99.4%
Kaon 1- Meson 470.8 x 2^{20}	493.66958	493.7	100 %
Kaon 2-Meson 474.6 x 2^{20}	497.7	497.7	100 %

Quark particles GeV / c^2

Higgs Boson	116.5 x 2^{30} = 125.0909	CERN 125.09	100 %
TOP	160 x 2^{30} = 171.79869	NASA 170, CERN 172	100 %
Z - boson	85 x 2^{30} = 91.276112	NASA 91	100 %
W - boson	75 x 2^{30} = 80.530636	CERN 80	99 %
Bottom	4 x 2^{30} = 4.2949672	NASA 4.2	100 %
Tauon	2 x 2^{30} = 2.1474836		

Meson particles MeV / c^2

Charm	4 x 2^{20} x 4 = 1 .1999992	NASA 1.2	100 %
Strange	114 x 2^{20} = 119.537	NASA 120	100 %
Strange	91 x 2^{20} = 95.420416	NASA 95.7	99.7 %
Muon	100 x 2^{20} = 104.85	NASA 105	100 %
Down	4 x 2^{20} = 4.194304	NASA 4	100 %
Up	2 x 2^{20} = 2.097152	NASA 2	100 %
Tau Neutrino	0.125	CERN 0.11	88 %
Electron Neutrino	0.125	CERN 0.11	88 %
Muon Neutrino	0.125	CERN 0.11	88 %
Proton uvd	894 x 2^{20} +4/5 x 2^{20} = 938.2658	CERN 938.272	99.99 %
Neutron ddu	896 x 2^{20} = 939.52409	CERN 939.5656	99.995 %
photon	5.88 10^{-43} kg		

VII. Photon Energy and Mass using the Photoelectric effect The 2nd law of Kepler

The following expression has shown to be valid by using the laws of Kepler :

$$m_\gamma = (v_e^2\ /\ v_\gamma^2)^3\ m_e \qquad (52)$$

$$m_\gamma = 5.88\ 10^{-43}\ \mathrm{kg} \qquad (53)$$

We will now break down equation (52) into 3 different equation for each direction x , y and z

$m_{\gamma}^{(1)} = (v_e^2 / v_{\gamma}^2) \; m_e^{(1)}$ (54)

$m_{\gamma}^{(2)} = (v_e^2 / v_{\gamma}^2) \; m_e^{(2)}$ (55)

$m_{\gamma}^{(3)} = (v_e^2 / v_{\gamma}^2) \; m_e^{(3)}$ (56)

where $m_{\gamma}^{(1)}, m_{\gamma}^{(2)}, m_{\gamma}^{(3)}$ are differemt photon particles and $m_e^{(1)}, m_e^{(2)}, m_e^{(3)}$ are different electron particles.

Multiplication of these expressions (54, 55, 56) gives :

$(m_{\gamma}^{(1)} \text{ x } m_{\gamma}^{(2)} \text{ x } m_{\gamma}^{(3)}) = (v_e^2 / v_{\gamma}^2)^3 \text{ x } (m_e^{(1)} \text{ x } m_e^{(2)} \text{ x } m_e^{(3)})$ (57)

These three parts can be written as :

$m_{\gamma}^{(k)} \; v_{\gamma}^2 = m_e^{(k)} \; v_e^2$ (58)

This calculation can be seen as a homeomorfism by Einstein Ref 6 :

$f (v_{\gamma}) \; g (m_{\gamma}) = f (v_e) \; g (m_e)$ (59)

We now study the rotation for a proton - electron system with the laws of Kepler:

$v_{\gamma}^2 = (2 m_e k_{\gamma}) / r$ and $v_e^2 = (2 M_{\gamma} k_e) / r$ (60)

The energy in the system will be :

$(m_{\gamma}^k M_e \; k_{\gamma}) / r = (m_e^k M_{\gamma} \; k_e) / r$ (61)

Schwartzschild solution in General Relativity :

$\gamma = c^2 - 2 m k / r$ $k =$ G, em,w, and s (62)

(gravity,el.magn.,weak,strong interaction)

$((c^2 - 2 m G / r)^{1/2})^2 + ((2 m k / r)^{1/2})^2 = c^2$ (63)

which is the law of Phytagoras and verify the correctness of these calculations.

VIII. Pictures From Computer Simulations

In chapter 9 **pictures** from different atoms , molecules, , particles, a star and two galaxies are shown from computer simulation calculations with the new DRLE equation and the older RLE equation. At these calculations a scaling procedure was used to manage to calculate and show pictures of different objects with completely different sizes, using the same formula.We have publshed many such pictures in the past (Barrera and Thelin Refs 17,18,19,9 and 3). Some of those are shown below. These pictures demonstrate the flexibility of using the DRLE equation 25.

Fig 1. A Centron (Bose - Einstein condensate) (computer simulation), Wikipedia Particle experiments,2017,Ref 15

Fig 2. A spherical Photon (computer simulation)

Fig 3 The Galaxy NGC 3200 (computer simulation,left) and photography from Hubble.A reproduction from Ref 3.

Fig 4 The Galaxy NGC 7606 (computer simulation,left) and photography from Hubble.A reproduction from Ref 19.

Fig 5 DNA molecule. (computer simulation)

Fig 6 The Benzene molecule $C_6 H_6$ (computer simulation)

Fig 7 The Neon atom. (computer simulation)

Fig 8 Quantum microscope picture of an H-atom. Dvorsky,G.,Wikipedia, Quantum microscopy,2017 Ref 16

Fig 9 The sun with prominences and magnetic fields. (computer simulation)

IX. Discussion

In **chapter 2** an extension of the Schwarzschild solution in General Relativity is performed which leads to an expression of a summation of all forces like gravitation, electromagnetic force, weak interaction, and strong interaction. Here we have used the mass formula by Einstein Ref 1. These kinds of results have earlier been achieved by Ref 3 using quaternions and real numbers

. In **chapters 3 and 4** a calculation of the light speed along a **geodetic line** is also derived and also the **elliptic** shape along this geodetic line are derived. These results are important because particles mostly move along geodetic lines with constant speed around a central body.

In **chaper 5a** we are discussing the formulas DRLE and ORLE. By using the Dynamic Relativistic Laplace Equation **DRLE** in rectangular coordinates means that this equation has a complex solution similar to a light wave. Similar calculations have also been derived for different systems like galaxies, planets, molecules, atoms and atomic nucleus in these papers, but also in this very paper, with similar results.We have also developed the Orthogonal Relativistic Laplace Equation ORLE which is the orhtogonal version of DRLE and has also probably many applications in nature.We think that equation (31) might have big influence on our planetary system.

In chapter 5b such ORLE forces could influence the sun and the planets. In a previous paper by Barrera and Thelin Ref 3 the DRLE equation was used on planets. This means that planet have relativistic background. The question is, if the orthogonal solution of DRLE equation, the ORLE, influences the prominences on the surface of the sun or the upflowing ionospheric ions from earth? In the geophysical field, the acceleration mechanism of these ionospheric ions is a very big question and has been studied in a statistical study using Viking satellite data by Thelin et al. Ref 20.The general opinion believes, that the acceleration mechanism behind the so called beams and conics, has plasma physical explanation of some sort. The question is, if there are similarities between prominences on the sun and upflowing ion beams and conics on earth? If so, these upflowing ionospheric ions might have relativistic origin too and follow the ORLE equation. In that case the solar wind from the sun should also have relativistic background. Maybee this can also mean that such orthogonal forces can affect the magma on earth causing vulcanism and earth quakes. Another application of ORLE might be to cause the spherical distribution of astroids(with ice) and materials around the sun and be the origin of our sees and the life on earth.

Chapter 6 The connection between DRLE and the optical formulas $\mathbf{T^4}$ and the New Intensity Formula is also shown and discussed. In this chapter we are discusssing and showing the relation between an electromagnetic wave to the expression between luminocity and temperature(the T^4 law) by Boltzmann Ref 11. This wave equation is a solution of the DRLE equation, which means that the origin of the T^4 law is the DRLE.This T^4 law is normally used in temperature measurements f.ex.in astronomy concerning temperature measurements of stars. Such mearurements have been studied by one of us (B.T.) using the T^4 law and the **New Intensity Formula** in optical emission spectroscopy OES in equation (64)

$$I = C\,\lambda^{-2}(\exp(-J/kT))/(\exp(h\nu/kT)-1) \qquad (64)$$

giving about the same temperature results for a big number of stars Refs 22 and 23.In this intensity formula J is here the ionization energy, C is a factor given by transition probabilities, number densities and sample properties. λ and ν are here the wavelength and frequency of the atomic spectral line. T is here the electron temperature and can be transformed to effective temperature. This new intensity formula has been used and studied by B.T. in a lot of different spectroscopies with very good results in a summary paper by Thelin Ref 21.The the inverted form of this new intensity formula is a photoelectric formula which gives very good photoelectric results Refs 24 and 25. Comparisons have also made with the other photoelectric equation (52) in this paper, giving similar proportionalities.The question is now if the New Intensity formula is a solution(in rewritten form) to the DRLE and in that case might be useful for particles too?

Chapter 7 new method of determing the mass of partices, the s.c. Binary Particle Method, **BPM**, has also been derived in connection with the determination of the mass of the photon. The masses of around 25 different paricles and elementary particles(Quarks,Mesons and Leptons) have been determined with very good agreements and correlations with particle experimental data from CERN amd NASA.One of the key ideas here is the use of binary numbers giving very exact masses.Our theoretical data and the experimental data from CERN and NASA are shown in chapter 7.3.

A conclusion here is that the rest masses of elementary particles relate to each other as binary multiples or descivies (1/2 - multiples). Particles are ordered in parts of $2^{10\,n}$ spans and the 4 forces in nature are generally separated into $2^{20\,n}$ parts of eV/c^2. This is similar to the data registers in a binary computer. Above 2^{20} eV/c^2 spannings from 2^{20} - 2^{30} eV/c^2 are Neutron, Proton , Quarks and Mesons situated. (These particles represent Middle range mass in a 2^{10} span.)

Above 2^{30} eV/c^2 we have the large Quarks, Top, Bottom and Barions. Below 2^{20} eV/c^2 are the Electron, Leptons, Neutrinos, Photons and Gravitons situated.This means that the matter in nature seems to follow a kind of "Periodic System" for particles.

Chapter 8 Another method of determining the mass of particles uses the laws of Kepler has also been tested. This method is based on the **photoelectric** law of photons and might be used on heavier particles too and is based on an homeomorfism by Einstein. Several tests have been done with this method giving very good results about mass values of particles.

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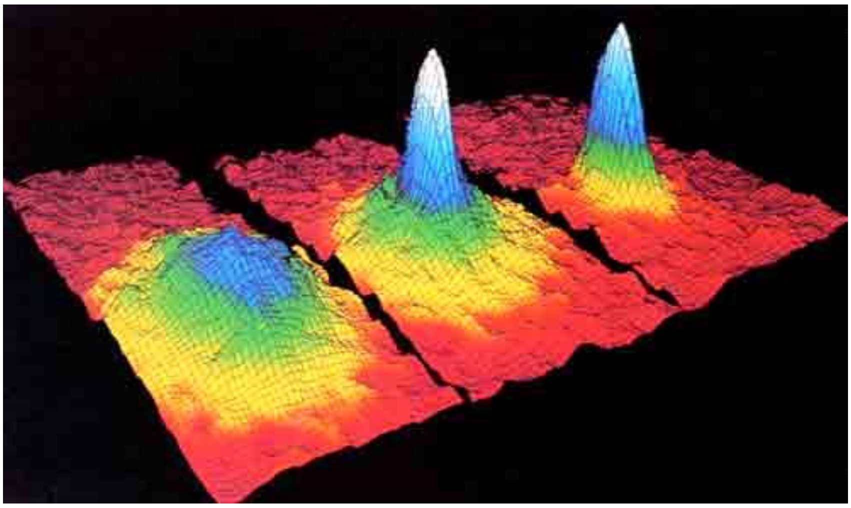

Fig 1 Computer simulation of a Centron (Bose - Einstein condensate)

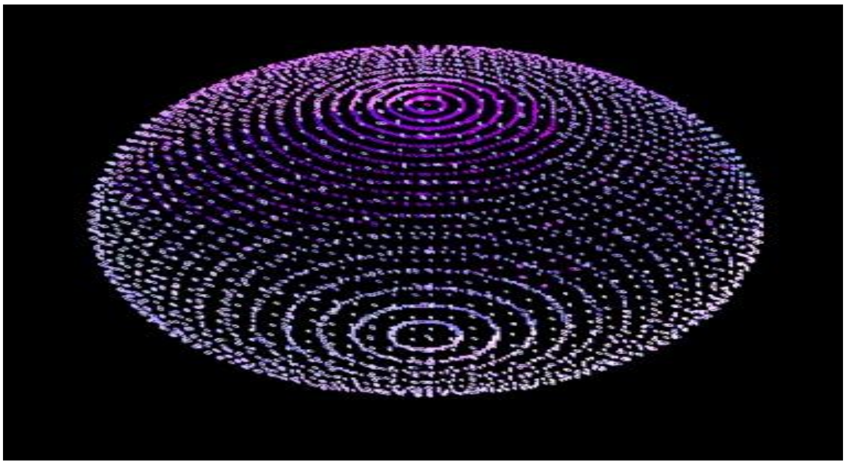

Fig 2. Computer simulation of a Photon

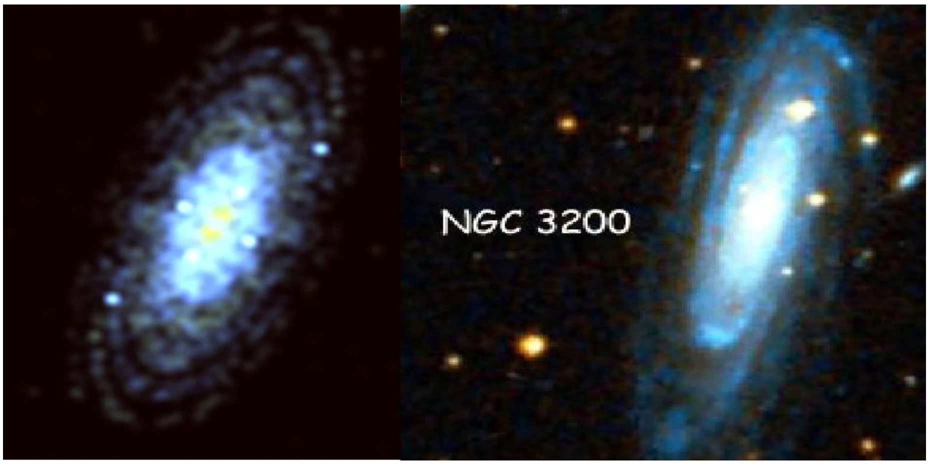

Fig 3 The Galaxy NGC 3200 and photography from Hubble

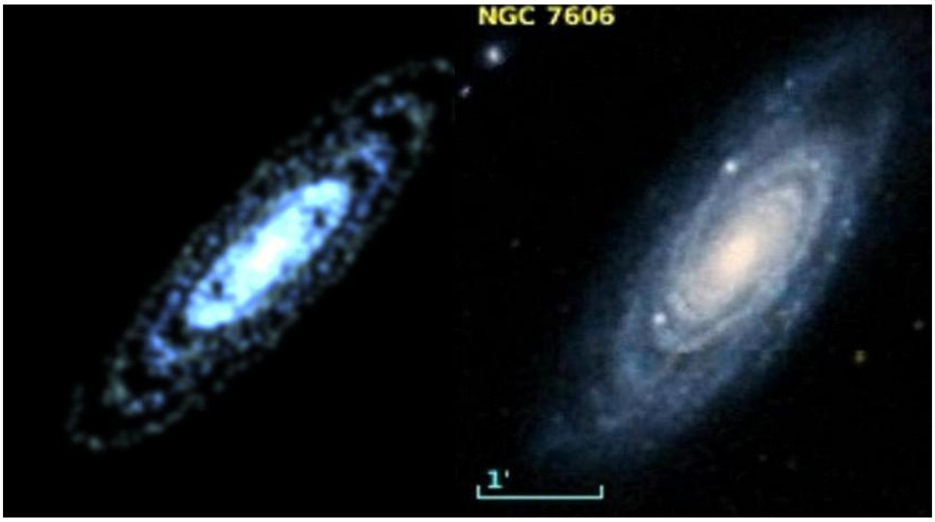

Fig 4: The Galaxy NGC 7606 and photography from Hubble

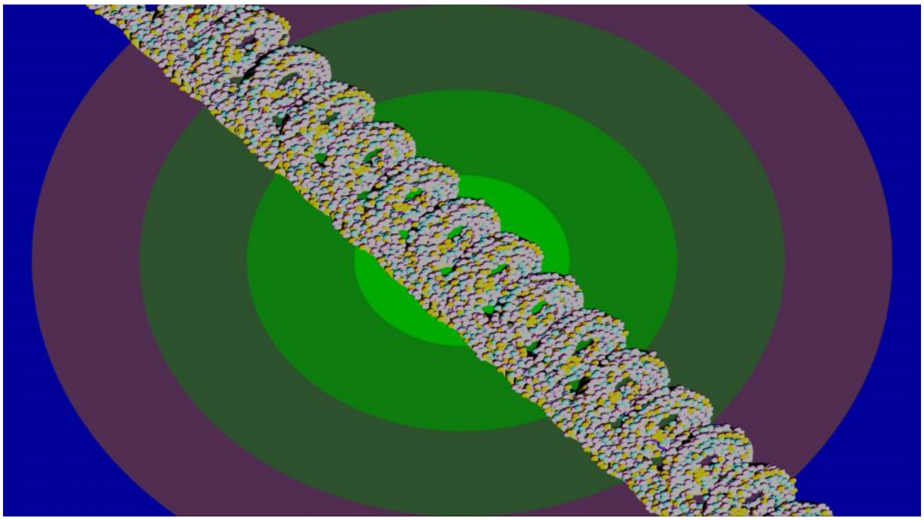

Fig 5 DNA molecule

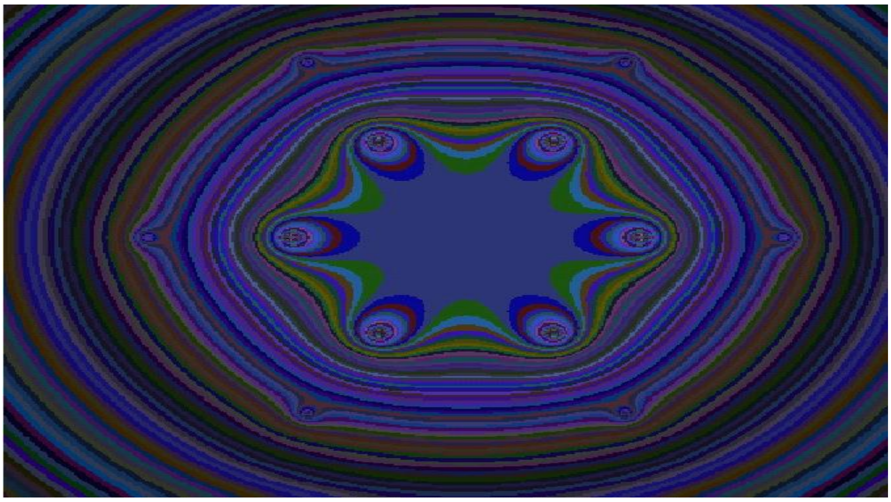

Fig 6 Benzene molecule $C_6\,H_6$

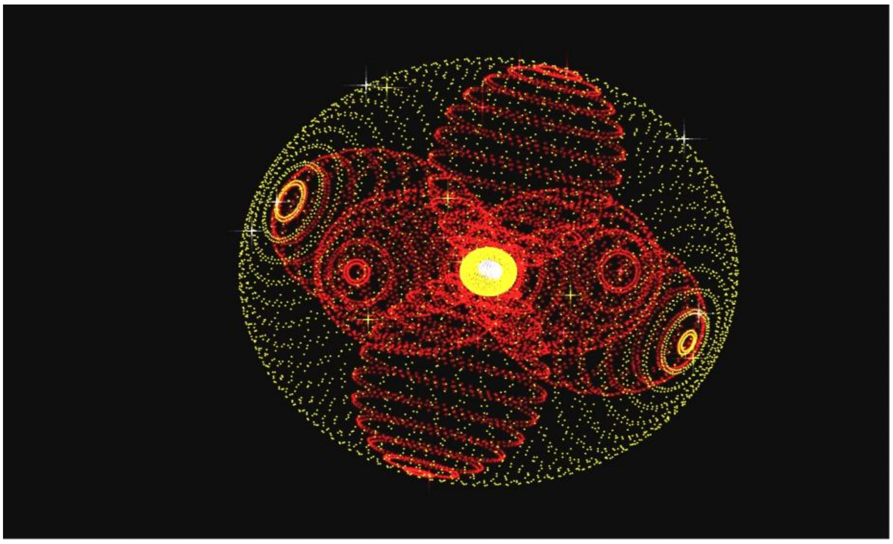

Fig 7 The Neon atom

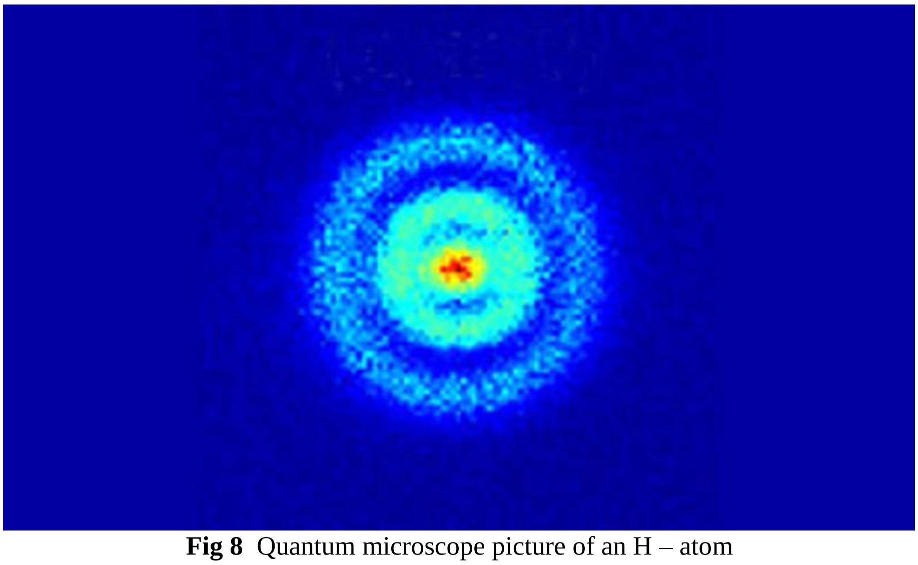

Fig 8 Quantum microscope picture of an H – atom

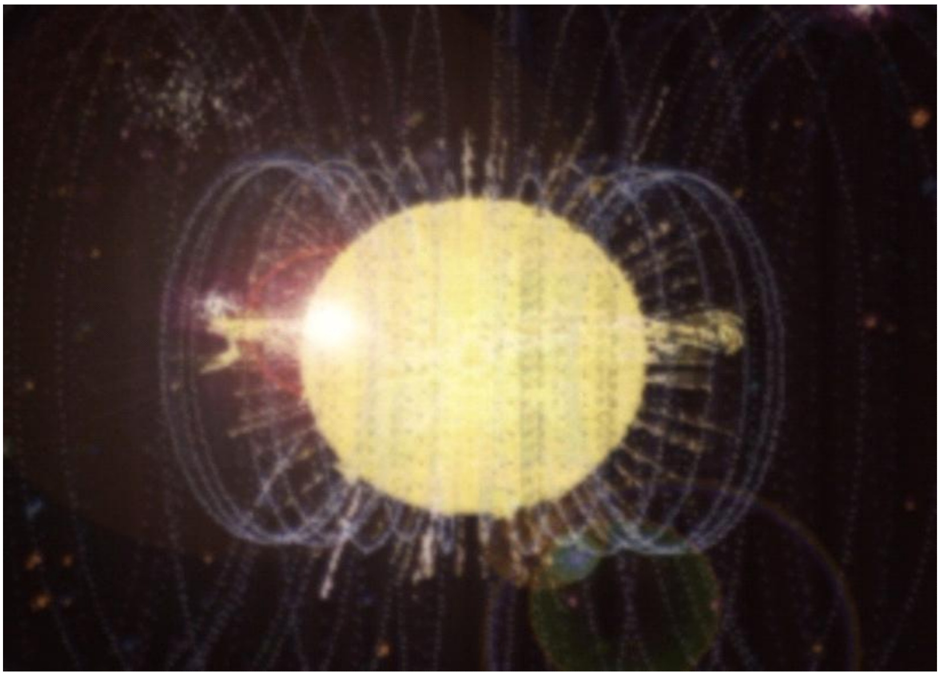

Fig 9 Computer simulation of the Sun with prominences and magnetic fields

Tony Barrera "Further developments of the Grand Unified Theory (GUT) and its Applications on Different Particles, Connections to Stars and Light Formulas." IOSR Journal of Applied Physics (IOSR-JAP) , vol. 9, no. 6, 2017, pp. 72-81.