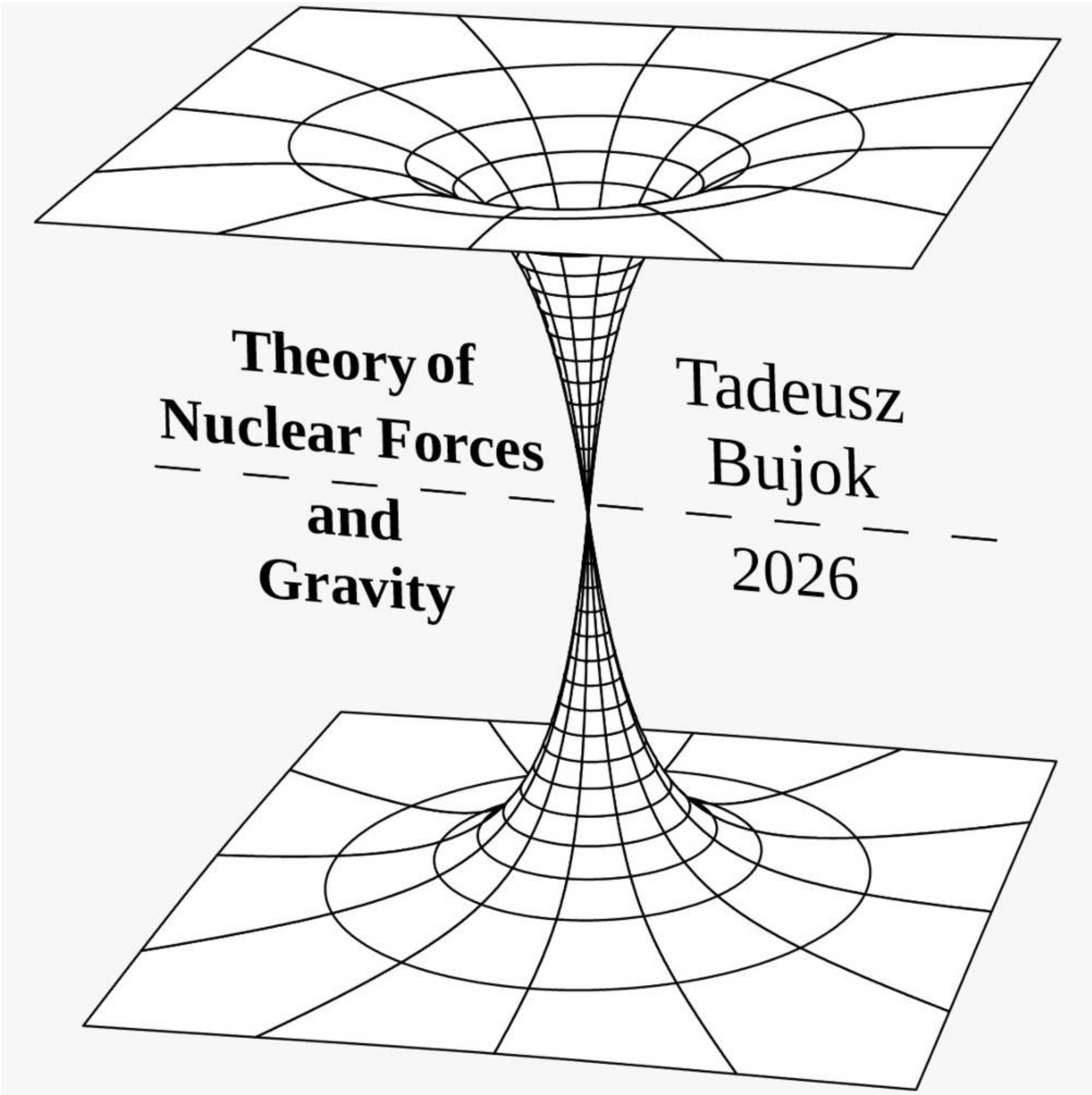
Theory of
Nuclear Forces
and
Gravity
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2026

Theory of Nuclear Forces and Gravity

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1. Introduction

Regarding the hypotheses contained in my book 'Theory of Everything' (Ref. 36), the imaginary and real forms of the infinite energy source are combined in one complex entity, which is the origin and the eternal source of everything.
Such a complex entity, called the complex singularity, is inseparable from the phenomenon of motion, in the sense of a mutual exchange of the real and imaginary forms of complex energy. The phenomenon of motion is associated with the concept of motion velocity defined by $c=1.$ The existence of complex singularity follows directly from Hamiltonian dynamics, describing the physical systems in our Universe, and is related to the Misner space as a solution to Einstein's equations. The eternal complex singularity is expressed mathematically by Euler's famous formula $T_c = e^{\pm i\varphi} = \cos(\varphi) \mp i \cdot \sin(\varphi).$ On the base of Euler's formula, the complex singularity can be taken conceptually as a complex entity that comes out in quanta, called complex-product singularity photons. Each photon is built of three interlinked 'complex elementary singularity quanta'.
The phenomenon of complex energy motion gives rise to the concept of generated complex-product tangent velocity vector spaces. Considering the vector model of a complex-product singularity quantum, expressed naturally in generalised polar coordinates $(T_i, \varphi_i \quad i = 1,2,3)$ we can assume that created tangent velocity vectors can be thought of as generators of a conceptual tangent velocity vector space, in the sense that they describe how a hypothetical complex object moves through the generated quantum complex-product tangent velocity vector space.
In such a model, the tangential velocity vector represents the ability to change position in the

generated space dimension, and its magnitude defines 'the amount of motion' in a sense of the degree of such ability in relation to velocity of complex-energy motion equal $c = 1$. In this sense, the phenomenon of motion does not introduce the constraints of progression in time, known from physical observations. Created 3D subspace denoted as $S^3_{singularity\text{-}photons}$ is defined actually without the concepts of distance and time. There is no difference between point and infinity in the conceptual 3D vector subspace $S^3_{singularity\text{-}photons}$ of complex-product singularity, (non-topological space). Therefore, the conceptual 3D $S^3_{singularity\text{-}photons}$ vector subspace exists actually within the complex-product singularity itself. It is important to state that a complex-product singularity quantum does not define any geometrical object. There are no points and no distances in the everyday meaning of these words. The complex-product singularity is a source of an infinite number of singularity-photons, which as complex-product entities with no real geometrical structure are in motion in the conceptual 3D subspace $S^3_{singularityphotons}$ of source singularity-photons. Photons interact, generating mass particles, which in turn generate their 4D microcosm. We can say, that complex energy motion leads to creation of 4D quantum tangent spaces and to the phenomenon of motion within generated spaces.

2. Complex-product matter and anti-matter quantum particles (a 3D visualisation of the 4D sheaf model of complex- product singularity quantum and a 3D cube diagonals projection of a 4D orthogonal tangent coordinate set)

Considering the complex singularity, expressed mathematically by Euler's formula $T_c = e^{\pm i\varphi} = \cos(\varphi) \mp i \cdot \sin(\varphi)$, we see that the solution is composed of two fundamentally distinct yet irreducible elements. In a sense, the solution represents the concept of dualism. Considering the 4D sheaf vector model of a complex-product singularity quantum, this concept can be understood in terms of rotational symmetry (singularity is inseparable from the phenomenon of motion).
In this sense, oppositely circulating complex vectors (in a vector model) generate tangent velocity vectors, which can be seen as ‘rotational mirror images’.

2.1 Matter and anti-matter creation from a collision of two complex-product singularity-photons.

Applying the rotational mirror symmetry in a 3D visualisation of the 4D sheaf model of complex-product singularity quanta (symmetry with respect to the sphere centre), two singularity-photons proceeding in opposite directions $\left(\overrightarrow{\frac{\partial}{\partial \varphi_3}}, -\overrightarrow{\frac{\partial}{\partial \varphi_3}}\right)$ could be depicted as in the following figure:

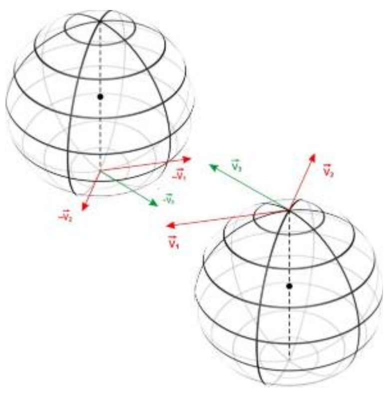

Fig. 1 Two photons in oppositely oriented motion with velocity $c = 1$, along one line within a conceptual $S^3_{singularityphotons}$.

After collision (at rest), two complex-product singularity photons become matter and anti-matter particles.

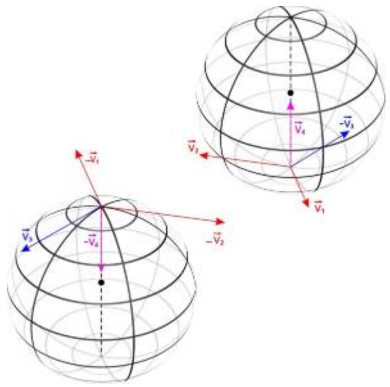

Fig. 2 Two complex-product singularity photons after collision (at rest) become complex-product matter and anti-matter particles, which are in obligatory, oppositely directed motion in the generated 4th tangent dimension with motion magnitudes $|\vec{V}_4| = |-\vec{V}_4| = c = 1.$

In such a model, particles called elementary leptons (a matter electron and an anti-matter positron), formed from two complex-product singularity photons (at rest), create oppositely oriented motion in the generated fourth tangent dimension, considered to be the common dimension of obligatory motion of all created mass particles (different radial nature of the generated fourth tangent velocity dimension).

The ‘mass phenomenon’ occurs as the manifestation of complex energy, associated with the phenomenon of generated resultant motion of the entire complex quantum structure in the generated fourth tangent dimension $\left(\frac{\vec{\partial}}{\partial T}\right)$. The created matter particles generate motion in the direction $\frac{\vec{\partial}}{\partial T}$. Anti-matter particles generate motion in the opposite direction $-\frac{\vec{\partial}}{\partial T}$. In that model, oppositely oriented velocity vectors $|\vec{V}_4| = |-\vec{V}_4| = c = 1$ are generators of the fourth quantum tangent velocity vector dimension. The created mass particles leave the conceptual 3D source singularity photon space $S^3_{singularity photons}$ and generate quantum 4D tangent velocity vector spaces denoted by $T_q S^{3+1}_{-matter}\left(\frac{\vec{\partial}}{\partial \varphi_1}, \frac{\vec{\partial}}{\partial \varphi_2}, \frac{\vec{\partial}}{\partial \varphi_3}, \frac{\vec{\partial}}{\partial T}\right)$ and $T_q S^{3+1}_{anti-matter}\left(\frac{\vec{\partial}}{\partial \varphi_1}, \frac{\vec{\partial}}{\partial \varphi_2}, \frac{\vec{\partial}}{\partial \varphi_3}, -\frac{\vec{\partial}}{\partial T}\right)$ Each quantum matter particle generates a path through obligatory motion, thus contributing to the creation of a topological complex-product 4D space of quantum matter particles paths, defined in hyper polar coordinates as $S^{3+1}_{-matter}(\varphi_1, \varphi_2, \varphi_3, T > 0)$ and naturally associated with the tangent velocity vector spaces of matter particles. Complex-product anti-matter quantum particles generate a separate 4D ‘topological path space’ of anti-matter particles, denoted by $S^{3+1}_{anti-matter}(\varphi_1, \varphi_2, \varphi_3, T < 0)$.

<u>As three-dimensional humans, we cannot imagine such a generated 4D quantum vector space structure. We can think of the fourth generated quantum tangent dimension as of an extra common dimension in which complex-product energy quanta may share a location.</u>

Based on a 3D cube diagonals projection of a 4D orthogonal tangent coordinate set, both models of the generated quantum tangent velocity vector spaces are presented below. The orientation of the fourth dimension being generated plays a crucial role in determining whether a particle is a matter or anti-matter particle. This orientation is unambiguous because the generated space has no more dimensions. The tangential velocity vector represents the intrinsic ability to change position in the generated space dimension, and its magnitude defines 'the amount of motion' in a sense of a degree of the ability to change position in relation to the complex energy motion velocity equal $c = 1$.

Fig. 3 An electron and a positron (considered to be point particles) generate opposite oriented tangent velocity vector dimensions of generated quantum 4D tangent velocity vector spaces (in relation to the orientation of the generated fourth tangent dimension).

Matter and anti-matter leptons 'created at rest' generate opposite oriented motion in the generated fourth tangent velocity dimension with velocity magnitude representing the degree of ability equal $\left|\vec{V}_T^{lepton}\right| = (c=1)$. ‘Created at rest’ means that a quantum particle remains stationary in its individually generated 3D tangent velocity subspace denoted by $T_q S^3_{\text{-}matter}\left(\frac{\vec{\partial}}{\partial\varphi_1},\frac{\vec{\partial}}{\partial\varphi_2},\frac{\vec{\partial}}{\partial\varphi_3}\right)$, while in motion in the generated 4th tangent velocity dimension, which has a radial nature. In the two-photon collision phenomenon, singularity-photons are converted into quantum mass particles. The resultant obligatory motion in the generated fourth common tangent dimension, called ‘proper time dimension’, underpins the concepts of ‘distance’ and ‘proper time’ measures.

2.2 Matter particle creation from a collision of three complex-product singularity- photons.

Let us consider a collision of three photons existing in the conceptual 3D singularity source photon subspace $TS^3_{singularityphotons}$ approaching each other in three orthogonal tangent velocity dimensions. Such a process is presented using the 3D visualisation of the 4D sheaf model of a complex-product singularity quantum, and using a 3D projection of a 4D coordinate set, based on cube diagonals.

We consider these conceptual models with the awareness that singularity is an edge of space and does not create a topological space. Unlike in the case of a two-photon collision, if three photons collide, it is not possible to create an equal number of matter and anti-matter particles.

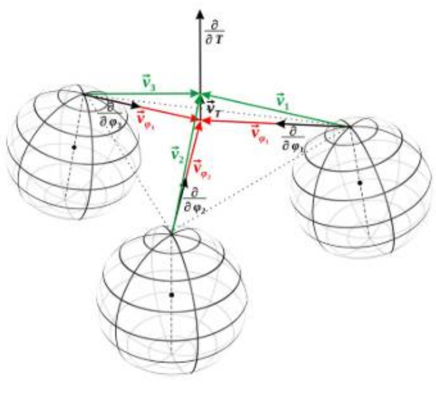

Fig. 4 Three photons after an ‘inelastic quantum collision’. The visualisation presents the resultant 4D component orthogonal velocity vectors.

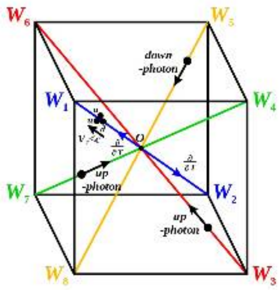

Fig. 5 Two ‘up-photons’ and one ‘down-photon’ colliding in their $TS^3_{singularityphotons}$, which leads to the creation of a proton.

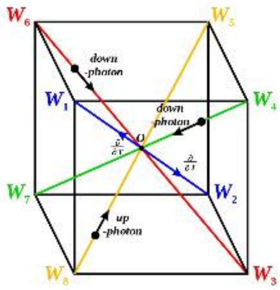

Fig. 6 Two ‘down-photons’ and one ‘up-photon’ colliding in their $TS^3_{singularityphotons}$, which leads to the creation of a neutron.

A detailed description of the proton and neutron creation process is contained in my book ‘Theory of Everything’ (Ref. 36). The essence of that process is the fact that three photons are converted into three ‘mass quarks’, where the ‘mass phenomenon’ occurs as the manifestation of complex energy, associated with the phenomenon of generated resultant motion of an entire complex quantum structure in the generated fourth tangent dimension $\left(\frac{\vec{\partial}}{\partial T}\right)$. Matter proton and neutron 'created at rest' start obligatory motion in the same direction of the generated fourth tangent velocity dimension, but with their relative motion magnitudes equal to: $v_T^{proton}/c \approx 0.099$ *and* $v_T^{neutron}/c \approx 0.112$. This result is dramatically different from leptons, or generally, from all matter particles created in a two-photon collision, which while being ‘created at rest’ start motion in the generated 4th tangent dimension $\left(\frac{\vec{\partial}}{\partial T}\right)$ always with the relative motion magnitude (motion velocity) $v_T/c = 1$.

It is worth repeating, that the tangential velocity vector represents the ability to change position in the generated space dimension, and its magnitude defines 'the amount of motion' in a sense of the degree of such ability in relation to the complex energy motion velocity equal $c=1$. In this sense, the 4D phenomenon of motion does not introduce the constraints of progression in time.

3. The rest mass indexes and energies of proton and neutron particles.

Let us look at this concept in more detail. Each colliding photon has its energy and momentum defined as follows: $(\vec{E}_{photon} = \vec{p}_{photon} \cdot c)$.

According to the presented visualisation, after collision each photon’s momentum is split into two parts:

$$\vec{p}_i == \vec{p}_{\varphi_i} + \vec{p}_{T_i} \quad \rightarrow \quad \left(\vec{p}_{\varphi_i} = m_i \cdot \vec{v}_{\varphi_i}\right) + \left(\vec{p}_{T_i} = m_i \cdot \vec{v}_{T_i}\right) = m_i\left(\vec{v}_{\varphi_i} + \vec{v}_{T_i}\right) = m_i \cdot \vec{v}_i \quad i = 1,2,3$$

where $|\vec{v}_i| = c = 1$ and m_i is the respective 'collided photon mass index'.
Velocity magnitudes (v_φ, v_T) represent relative motion magnitudes, in the sense of the degree of ability to change position in the generated orthogonal space dimensions. Not in the sense of distances covered and measured using time pass parameter.
Sum of squares results in $(V_\varphi)^2 + (V_T)^2 = c^2$.
If the created complex structure is a proton, than after collision the absolute energy value is equal to:

$$E_{proton} = \left(m_{photonup} + m_{photonup} + m_{photondown}\right) v_\varphi^2 + \left(m_{photonup} + m_{photonup} + m_{photondown}\right) v_T^2.$$

Defining $m_{proton} = \left(m_{photonup} + m_{photonup} + m_{photondown}\right)$, we get:

$$E_{proton} = m_{proton}\left(v_\varphi^{proton}\right)^2 + m_{proton}\left(v_T^{proton}\right)^2 = m_{proton}\left(\left(v_\varphi^{proton}\right)^2 + \left(v_T^{proton}\right)^2\right) = m_{proton} c^2.$$

It is the most important equation, showing the relation between two portions of the total energy of a proton. Defining variable m_{proton} as the proton's rest mass index, the first energy portion can be called the **'**proton binding energy': $E_{bindingenergy}^{proton} = m_{proton}\left(v_\varphi^{proton}\right)^2$, which is responsible for the strong interaction within a proton.
Assuming that three collided photons are converted into three quarks, the remaining energy portion can be considered as the energy of the three confined quarks, responsible for the momentum in the motion direction $\left(\frac{\vec{\partial}}{\partial T}\right)$, with motion magnitude $\left|\left(\vec{v}_T^{proton}\right)\right| < c = 1.$ This portion of energy can be called 'rest-3 quarks energy', and is equal to:

$$E_{rest\text{-}3quarks}^{proton} = m_{proton}\left(v_T^{proton}\right)^2.$$

Defining $m_{neutron} = \left(m_{photonup} + m_{photondown} + m_{photondown}\right)$, we get:

$$E_{neutron} = m_{neutron}\left(v_\varphi^{neutron}\right)^2 + m_{neutron}\left(v_T^{neutron}\right)^2 = m_{neutron}\left(\left(v_\varphi^{neutron}\right)^2 + \left(v_T^{neutron}\right)^2\right) = m_{neutron} c^2.$$

Defining variable $m_{neutron}$ as a neutron's rest mass index, the first energy portion can be considered as the **'**neutron binding energy':

$$E_{bindingenergy}^{neutron} = m_{neutron}\left(v_\varphi^{neutron}\right)^2,$$

responsible for the strong interaction within a neutron.
Assuming that three collided photons are converted into three quarks, the remaining energy portion can be considered as the 'rest-3 quarks energy**'** of the three confined quarks, responsible for the momentum in the direction $\left(\frac{\vec{\partial}}{\partial T}\right)$, with velocity $\left|\left(\vec{v}_T^{neutron}\right)\right| < c = 1.$ This portion of energy is equal to:

$$E_{rest\text{-}3quarks}^{neutron} = m_{neutron}\left(v_T^{neutron}\right)^2.$$

3.1 Binding complex energies between quarks in a proton and a neutron in relation to their $V_{Tproton}$ and $V_{Tneutron}$ velocities.

The quark matter theory assigns specific properties to quarks, and these properties are responsible for all four fundamental interactions of contemporary physics: electromagnetism, gravitation, strong interaction, and weak interaction.
Up-quarks and down-quarks, the building blocks of protons and neutrons, have different masses and charges, which in turn affect their energy.
Quantum chromodynamics (QCD) estimates the range of up-quarks energy of roughly 2.2 MeV (megaelectronvolts) and the charge of +2/3, while down-quarks have the estimated energy of around 4.8 MeV and the charge of -1/3.
Quark charges play a crucial role in electromagnetic interactions. It is how they were generally discovered. The process is called deep inelastic scattering.
According to contemporary knowledge, there are two types of ‘potential energies’ within hadrons: the strong interaction binding energy, which binds the quarks together into protons and neutrons, and the electrostatic potential energy, which depends on the charges involved and their separation.
The electrostatic potential energy contributes to the overall potential energy, but it is the strong binding energy that is dominant.
The strong nuclear binding energy is about 100 times greater than the electrostatic potential energy, according to the U.S. Department of Energy. Since the electrostatic potential energy within a hadron is relatively small compared to the strong nuclear potential energy, we can assume for simplicity that the total energy of a hadron is associated with the strong nuclear binding potential energy.
A proton’s energy is about **938.272 MeV**, while its three quarks have only the total energy of about

$$(2.2\,MeV + 2.2\,MeV + 4.8\,MeV) \approx 9.2\,MeV\,.$$

A neutron’s energy is about **939.5 MeV**, while its three quarks have only the total energy of about

$$(2.2\,MeV + 4.8\,MeV + 4.8\,MeV) \approx 11.8\,MeV\,.$$

Let us make the following calculations considering the proton and the neutron:
The portion of energy $m_{proton} v_T^2$ is the energy that ‘flows’ in the direction $\left(\frac{\vec{\partial}}{\partial T}\right)$ with velocity $|\vec{v_T}| < c = 1$, and in the presented theory it is considered as the ‘rest-3 quarks energy' of the three confined quarks $E_{rest\text{-}3quarks} = m_{proton} v_T^2$.
Let us assume $m_{rest\text{-}3quarks}^{proton}$ to be the total quarks rest mass index in the proton. Then, we get the following equation:

$$E_{rest\text{-}3quarks}^{proton} = m_{rest\text{-}3quarks}^{proton} c^2 = m_{proton} v_T^2 \approx 9.2\,MeV$$

$$E_{proton} = m_{proton} c^2 \approx 938.272 \;\; MeV\,.$$

Due to the above relations, we can easily calculate:

$$m_{rest\text{-}3quarks}^{proton} / m_{proton} = v_T^2 / c^2 = 9.2\,MeV / 938.272\,MeV \;\; \rightarrow \;\; \approx \;\; 0.0098\,.$$

$$v_T^{proton} / c = \approx \;\; 0.099\,.$$

The same calculation for the neutron is as follows:
Let us assume $m_{rest\text{-}3quarks}^{neutron}$ to be quarks rest mass index in the neutron. Then, we get the following equation:

$$E_{rest\text{-}3quarks}^{neutron} = m_{rest\text{-}3quarks}^{neutron} c^2 = m_{neutron} v_T^2 \approx 11.8\,MeV$$

$$E_{neutron} = m_{neutron} c^2 \approx 939.5 \;\; MeV\,.$$

Due to the above relations, we can calculate:

$$m_{rest\text{-}3quarks}^{neutron} / m_{neutron} = v_T^2 / c^2 = 11.8\,MeV / 939.5\,MeV \;\; \rightarrow \;\; \approx \;\; 0.01256\,.$$

$$v_T^{neutron} / c = \approx \;\; 0.112\,.$$

Hypothesis 3.1.1
Protons and neutrons, made up of three confined quarks and created 'at rest', meaning stationarity in their individually generated quantum 3D tangent subspaces $T_q S^3_{singulritymatter}\left(\frac{\partial}{\partial\varphi_1},\frac{\partial}{\partial\varphi_2},\frac{\partial}{\partial\varphi_3}\right)$, **taken to be an approximation in any neighbourhood** (U^3_q) **of the created path subspace** $S^3_{matter}(\varphi_1,\varphi_2,\varphi_3)$, **are in motion in the fourth tangent dimension** $\left(\frac{\vec{\partial}}{\partial T}\right)$ **with their relative velocities equal to:** $v_T^{proton}/c \approx 0.099$ and $v_T^{neutron}/c \approx 0.112$

This result is dramatically different from leptons, or generally, from all matter particles created in a two-photon collision, which, while being stationary in their generated 3D tangent subspaces, are in motion in the fourth tangent dimension $\left(\frac{\vec{\partial}}{\partial T}\right)$, always with the relative velocity $v_T/c = 1$.
The next important point concerns the binding energies that depend on v_φ^{proton}/c and $v_\varphi^{neutron}/c$.
Let us assume for both particles:

$$v_\varphi^2 + v_T^2 = c^2 = 1 \quad \text{then we get:}$$
$$\left(v_\varphi^{proton}/c\right)^2 \approx 0.9902$$
$$\left(v_\varphi^{neutron}/c\right)^2 \approx 0.9874.$$

The binding energy of the proton equals:
$$m_{proton}\cdot\left(v_\varphi^{proton}\right)^2 \approx 938.272\,MeV \cdot 0.9902 \approx 929.08\,MeV.$$
The binding energy of the neutron equals:
$$m_{neutron}\cdot\left(v_\varphi^{neutron}\right)^2 \approx 939.565\,MeV \cdot 0.9874 \approx 927.73\,MeV.$$

<u>These results confirm the results estimated by quantum chromodynamics (QCD) and they support the legitimacy of the presented hypothesis.</u>

In physics, protons, like other charged particles, are accelerated using electric fields. Two primary methods are used: linear accelerators (linacs) and circular accelerators, such as cyclotrons and synchrotrons. Relativistic effects, arising from Einstein's theory of special relativity, become noticeable and significant when speeds approach a substantial fraction of the speed of light, specifically around 1/10 of the speed of light or greater (in a reference frame of an observer). At these speeds, phenomena like time dilation (moving clocks run slower) and length contraction (moving objects appear shorter) become measurable and deviate significantly from classical physics predictions.

Hypothesis 3.1.2
The fact that observable phenomena like relativistic effects (in a generated reference frame of an observer) become significant when velocities are higher than 1/10 of the speed of light is directly associated with the v_T **velocity values of 'stationary' hadrons such as a proton and a neutron equal to:** $v_T^{proton}/c \approx 0.099$ **and** $v_T^{neutron}/c \approx 0.112$.

It is due to the fact that kinetic energies of protons and neutrons associated with motion in the

$S^3_{matter}(\varphi_1,\varphi_2,\varphi_3)$ with velocities greater than $v_T^{proton}/c \approx 0.099$ and $v_T^{neutron}/c \approx 0.112$ must not be a part of converted quarks binding energy, since that will lead to a change in the structure of hadrons.

4. Hypotheses concerning nuclear forces and gravity.

The fundamental hypothesis of the study states that all quantum matter particles generate individual surrounding 4D quantum complex-product vector spaces, while tangent velocity vectors in quantum particle models represent the physical concept of motion. In such an interpretation, one particular quantum tangent velocity vector is a generator of a one-dimensional quantum tangent space.
We can observe a key role of the generalised hyper-spherical polar coordinates.
The tangent velocity vectors $(\vec{v}_{\varphi_1},\vec{v}_{\varphi_2},\vec{v}_{\varphi_3},\vec{v}_T)$ coincide with the 4D coordinate basis vectors defined by differentials $\left(\frac{\vec{\partial}}{\partial\varphi_1},\frac{\vec{\partial}}{\partial\varphi_2},\frac{\vec{\partial}}{\partial\varphi_3},\frac{\vec{\partial}}{\partial T}\right)$. We define the generated 4D quantum tangent velocity vector space of a matter quantum particle by $T_q S^4_{singularity-matter}\left(\frac{\vec{\partial}}{\partial\varphi_1},\frac{\vec{\partial}}{\partial\varphi_2},\frac{\vec{\partial}}{\partial\varphi_3},\frac{\vec{\partial}}{\partial T}\right)$, then the hyper-spherical polar coordinates naturally describe a point $q_{(\varphi_1,\varphi_2,\varphi_3,T)}$ in the created 4D path space texture, denoted by $S^4_{singularity-matter}(\varphi_1,\varphi_2,\varphi_3,T)$, which is a continuous smooth space of all created paths (with the complex singularity as the origin of all paths).
The considerations concerning generated 4D tangent velocity vector structures are based on a 3D projection of the 4D coordinate set constructed upon 3D cube diagonals ('Theory of Everything', Ref. 36). According to such a projection, a fourth tangent orthogonal velocity vector $(\vec{v}_T)$ is generated (occurs) always as a result of three other quantum orthogonal tangent velocity vectors $(\vec{v}_{\varphi_1},\vec{v}_{\varphi_2},\vec{v}_{\varphi_3})$. In a 3D model based on cube diagonals, the generated fourth tangent velocity vector dimension defined as the 'proper time dimension' is represented by the oriented cube diagonal coordinate $\frac{\vec{\partial}}{\partial T}$. As stated, this generated fourth tangent velocity vector dimension is common for all matter particles. Three other orthogonal tangent velocity vector 'spatial dimensions' are oriented, as in the case of a proton and an electron, and non-oriented, as in the case of a neutron. These dimensions are represented by three other cube diagonals in 3D models, as presented in the following figure:

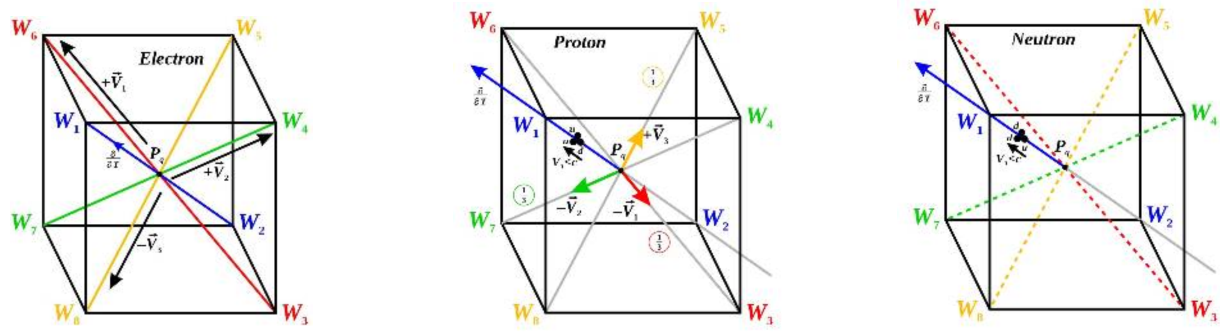

Fig. 7 Quantum matter particles of an electron, a proton and a neutron (considered to be point particles) generate quantum 4D tangent velocity vector spaces (in relation to the orientation of the generated fourth tangent dimension).

Each matter lepton 'created at rest' generates its quantum 3D tangent velocity vector subspace, and

remains stationary within that subspace, while in motion with $\left|\vec{v}_T^{lepton}\right| = (c=1)$ in the fourth generated tangent dimension. Protons and neutrons are made of three quarks that finally generate 4D quantum tangent spaces of protons and neutrons respectively.
The calculations (performed in Chapter 3) have shown that these particles 'created at rest' start motion in the generated fourth tangent velocity dimension with different relative motion magnitudes: $v_T^{proton}/c \approx 0.099$ and $v_T^{neutron}/c \approx 0.112$.
'Created at rest' corresponds to the '3D stationarity phenomenon'. Created quantum matter particles can be mutually stationary in any common generated (U_q^3) while in motion in the 4th common generated dimension with different motion volumes. It can be explained by the <u>different radial nature of</u> the 4th generated common tangent dimension and imagined according to the 3D sheaf model of 4D complex-product quantum structures.
<u>While we can logically comprehend 4D geometry, we cannot directly visualise what 4D structures look like, largely because our sensory experience is limited to three dimensions.</u>
Potential wells and barriers are key concepts in quantum mechanics, shaping particle behaviour in ways that defy classical physics. In essence, a potential well is a region where energy is stored and can be described as a manifestation of the system's potential energy, trapped within the well boundaries. It is crucial to remember that the concept of a potential well is only an analogy to a real physical system. The concept of a potential well is directly connected with the idea of forces, defining how objects interact. There are two kinds of forces: repulsive and attractive. In the sense of forces, the concept of energy corresponds to the work that must be done by applying a force over a distance. Using a math formula, energy E is defined by the following equation:
$E = \int F\,dr$, where force F is equal to $F = \frac{dE}{dr}$.
Since energy comes from the sum of repulsive and attractive forces, the term 'net energy' E_{net} is used. Using a math expression, the formula always has two terms with opposite signs (the attractive term is negative). The potential net energy is expressed by the formula:
$E_{net} = -\frac{A}{r^m} + \frac{B}{r^n}$. Depending on the nature of the forces and other factors, upon finding these different coefficients, we can plot a potential energy diagram expressed by a curve.
The graph presented below depicts the potential energy of a system as a function of a 3D position. It looks like a 'well', with the lowest point representing the stable equilibrium position.
Conveniently (in physics), such a potential well can be approximated as a finite three-dimensional square well.

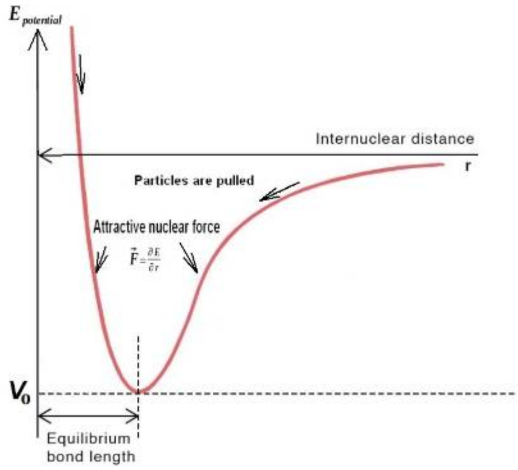

Fig. 8 A 3D model of a potential well.

In physics, quarks are never observed in isolation; they are always bound together within hadrons (protons, neutrons, etc.). This phenomenon is called quark confinement, and the strong interaction is the attractive force that binds quarks together to form nucleons like protons and neutrons themselves.
In the context of quarks, the energy minimum level V_0 means the potential energy level where quarks are in equilibrium. The value of V_0, understood as the depth of the potential well, does not have a single fixed value. It rather depicts a dynamic interaction, which depends on the relative distance between quarks and is directly related to the strength of the attractive force.

I claim that the binding energy of quarks within proton and neutron particles can be understood as a form of complex potential energy related to quarks confinement, caused by momenta associated with $\left(\vec{v}_{\varphi_1}, \vec{v}_{\varphi_2}, \vec{v}_{\varphi_3}\right)$ velocities.
These complex momenta push quarks to a configuration where the stored potential energy is a key part of the created total nucleon energy.

Hypothesis 4.1
The attractive strong nuclear force, observed as an attractive interaction phenomenon between quarks in matter hadrons, is related to the stored binding energy, corresponding to momenta associated with quantum tangent velocities $\left(\vec{v}_{\varphi_1}, \vec{v}_{\varphi_2}, \vec{v}_{\varphi_3}\right)$.
The attractive nuclear force is observed in the resultant generated 3D quantum tangent subspace of a particular hadron, denoted by $T_q S^{3hadron}_{singularitymatter}\left(\frac{\partial}{\partial \varphi_1}, \frac{\partial}{\partial \varphi_2}, \frac{\partial}{\partial \varphi_3}\right)$, **taken to be an approximation of the neighbourhood** $\left(U^3_q\right)$ **of the created 3D path subspace texture** $S^3_{singularitymatter}\left(\varphi_1, \varphi_2, \varphi_3\right)$.

5. The phenomenon of gravitation between elementary quantum particles.

Einstein postulated that the laws of gravity can be expressed as a system of equations, which highlights the geometric character of gravity.
Einstein's theory redefines gravity not as a force, but rather as a curvature of the real 4D spacetime caused by mass and energy. In other words, massive objects curve the real 4D spacetime around them, which is experienced as gravity.
Objects follow the straightest possible paths (geodesics) through this curved spacetime, which we perceive as gravitational acceleration or attraction.
This theory has withstood the test of time and has been rigorously tested in various experiments and observations. However, general relativity does not explain gravity at the quantum level.
Let us try to explain gravity in the light of the presented hypotheses.

When three photons collide, they are converted into mass quarks creating a nucleon. A big part of the photons' momenta is converted into strong nuclear binding energy, holding quarks together, and making a particular nucleon (quarks have never been observed in isolation).
A created quantum nucleon defines motion into the generated fourth tangent dimension with

velocity magnitude $v_T < (c=1)$, the same for three bound quarks.
The matter protons and matter neutrons ‘created at rest’ generate motion in the fourth resultant complex tangent dimension with different velocity magnitudes $\left(v_T^{proton} \neq v_T^{neutron}\right) \approx 1/10\,c$ and with the same vector orientation $+\frac{\vec{\partial}}{\partial T}$ (the fourth generated tangent velocity dimension is common for all matter particles). All quantum matter particles (including matter leptons and hadrons) generating their 4D complex-product quantum tangent velocity vector spaces are always in resultant motion. This motion phenomenon creates the 4D complex-product path space texture, denoted by $S^4_{singularity\text{-}matter}(\varphi_1, \varphi_2, \varphi_3, T)$.
While generating separate 4D paths, both protons and neutrons may approach each other. A neutron generates its non-oriented 3D subspace, therefore there is no interaction due to generated dimension orientations (electrostatic interaction -the phenomenon has been discussed in my book (Ref. 36). But, a neutron with its generated surrounding quantum tangent space ‘has greater degree of motion’ in the fourth tangent velocity dimension. Therefore, we can adopt the idea that a generated quantum tangent space of a proton will interact with a generated quantum space of a neutron, trying to slow down the motion of the neutron.
As stated, protons and neutrons are in motion with different v_T magnitudes, but of the same order, therefore I posit, that there is a possibility that both particles can create a bound state.

Concerning the idea of the creation of protons, visualised in Fig. 4 (applied also to neutrons), and upon finding $v_T^{proton} \neq v_T^{neutron} < (c=1)$, it is clear that the final 4D quantum complex structures of a proton and a neutron, built upon three quarks, define the sets of three resultant tangent velocities denoted as $(\vec{v}_{1P}, \vec{v}_{2P}, \vec{v}_{3P})$ for the proton and as $(\vec{v}_{1N}, \vec{v}_{2N}, \vec{v}_{3N})$ for the neutron.

To facilitate these considerations, the following pictures present a 2D simplification.
Since a neutron generates its non-oriented spatial dimensions, the picture on the right is more adequate:

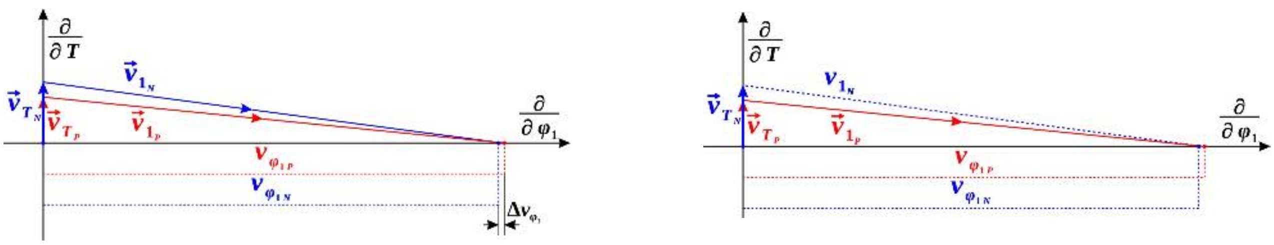

Fig. 9 Vector $\vec{v}_{1N}$ does not coincide with vector $\vec{v}_{1P}$ due to different magnitudes of vectors $\vec{v}_{TN}$ and $\vec{v}_{TP}$.

Different velocities $v_T^{proton} \neq v_T^{neutron} < (c=1)$ are the reason why vectors $\vec{v}_{1N}$ and $\vec{v}_{1P}$ do not coincide. This is associated with the difference of magnitudes of the component tangent velocity vectors $(v_{\varphi_{1P}})$ and $(v_{\varphi_{1N}})$. That can be seen in the pictures above as Δv_{φ_1}.
In the case of protons, a tangent velocity vector with a magnitude $(v_{\varphi_{1P}})$ generates a quantum tangent velocity vector space dimension defined by the coordinate axis $\left(\frac{\partial}{\partial \varphi_1}\right)$. In the case of neutrons, this tangent velocity vector space dimension is generated by a tangent velocity vector $(v_{\varphi_{1N}})$ which has a different magnitude. It can be assumed that $(v_{\varphi_{1P}}) \neq (v_{\varphi_{1P}})$ leads to the phenomenon of a strong

interaction between both generated quantum tangent velocity 3D vector subspaces $T_q S^{3\,proton}_{singularity\text{-}matter}\left(\frac{\partial}{\partial\varphi_1},\frac{\partial}{\partial\varphi_2},\frac{\partial}{\partial\varphi_3}\right)$ and $T_q S^{3\,neutron}_{singularity\text{-}matter}\left(\frac{\partial}{\partial\varphi_1},\frac{\partial}{\partial\varphi_2},\frac{\partial}{\partial\varphi_3}\right)$, forcing the quantum particles to relative motion in their generated common 3D neighbourhood (U_q^3). Both the proton and the neutron 'feel' a strong interaction, seen as the attractive force that pulls them together in their generated common 3D neighbourhood (U_q^3).

Hypothesis 5.1

The attractive nuclear force phenomenon at the quantum level between proton and neutron particles in their generated 3D neighbourhood (U_q^3) of the generated complex-product path subspace $S^3_{singularitymatter}(\varphi_1,\varphi_2,\varphi_3)$, is caused by the phenomenon of different relative tangent motion volumes $v_T^{proton} \neq v_T^{neutron} < (c=1)$.

This attractive nuclear force between matter particles at the quantum level occurs only in the case of matter particles created with different absolute relative values of their generated fourth tangent velocity volume v_T, assuming that the velocity magnitudes v_T, are less than c=1.

Based on the concept of distance (Ref. 36), this force is a short-range force compared to the electrostatic force. At the quantum level, there is not an attractive force between two stationary neutrons in their 3D neighbourhood (U_q^3) or two stationary protons (despite the proton's electrostatic repelling force phenomenon).

As mentioned before, all created matter leptons, stationary in their generated 3D neighbourhood (U_q^3) are in motion with maximum velocity $(V_T^{lepton}=c=1)$ (maximum degree of the ability to change position in the 4th generated tangent velocity dimension). It can be assumed, that matter leptons, due to much higher velocity $(V_T^{lepton} \gg V_T^{neutron})$ are scattered by free neutrons in the generated neutrons' 3D subspaces (unlike long-range electrostatic interaction with protons).

The velocity $v_T = (c=1)$ of all matter leptons is the reason why matter leptons do not experience the attractive force between themselves either. (leptons experience mutual electrostatic forces resulting from the generation of oriented space dimensions).

Let us make the following calculations:

Suppose that there are two particles: a proton and a neutron, 'stationary' and close to each other in any neighbourhood (U_q^3) of the created 3D path subspace texture $S^3_{singualrity\text{-}matter}(\varphi_1,\varphi_2,\varphi_3)$.

While stationary in (U_q^3) both particles are in motion in the generated fourth radial tangent dimension, but with different velocities $v_T^{proton} \neq v_T^{neutron} < (c=1)$.

Let us recall that:

$$v_T^{proton}/c \approx 0.099$$
$$v_T^{neutron}/c \approx 0.112.$$

According to the considerations presented above, a proton and a neutron attract each other in the neighbourhood (U_q^3) of the generated $S^3_{singularitymatter}(\varphi_1,\varphi_2,\varphi_3)$. That leads to the final bound state after collision.

We should remember that each quantum matter particle actually represents quantum complex energy, which through the motion phenomenon generates its quantum surrounding 4D complex-product tangent velocity vector space.

It is not a ‘typical object’ occupying some place in an existing space. Quantum particles generate their individual quantum surrounding vector spaces.
After collision, the proton and the neutron remain bound, creating the nucleus of a deuteron.

Hypothesis 5.2
In a bound state, the internal quark structures of a proton and a neutron must remain unchanged.

This assumption in turn evokes the hypothesis that the binding energies between constituent quarks, both in a proton and a neutron, should also remain unchanged.
The total energy of deuteron (total equivalent mass index) is known and is equal to $1875.6\,MeV$.
The sum of neutron and proton energies in a free state before collision is equal to $1877.837\,MeV$, so there is a difference in the total mass index of $2.237\,MeV$.
Taking this energy loss to be equivalent to the sum of kinetic energies of proton and neutron particles approaching each other, it is reasonable to split this energy loss evenly between the proton and the neutron $(2 \times 1.1185\,MeV)$ so that their new total energies (total new mass indexes) are:

$$m_{new}^{proton} = 938.272 - 1.1185 = 937.154\,MeV$$

$$m_{new}^{neutron} = 939.565 - 1.1185 = 938.447\,MeV.$$

The total energies of the proton and the neutron in a bound new state of a deuteron are:

$$m_{new}^{proton} \cdot \left[\left(v_{\varphi new}^{proton}\right)^2 + \left(v_{Tnew}^{proton}\right)^2\right] = m_{new}^{proton} \quad \text{since} \quad \left(v_{\varphi new}^{proton}\right)^2 + \left(v_{Tnew}^{proton}\right)^2 = C^2 = 1.$$

$$m_{new}^{neutron} \cdot \left[\left(v_{\varphi new}^{neutron}\right)^2 + \left(v_{Tnew}^{neutron}\right)^2\right] = m_{new}^{neutron} \text{since} \quad \left(v_{\varphi new}^{neutron}\right)^2 + \left(v_{Tnew}^{neutron}\right)^2 = C^2 = 1.$$

Assuming that the binding energies between constituent quarks both in the proton and the neutron should remain unchanged, we obtain:
the quarks-binding energy in the proton: $m_{new}^{proton} \cdot \left(v_{\varphi new}^{proton}\right)^2 = 929.08\,MeV$
the quarks-binding energy in the neutron: $m_{new}^{neutron} \cdot \left(v_{\varphi new}^{neutron}\right)^2 = 927.73\,MeV$.
Performing some simple calculations, we get:
$\left(v_{Tnew}^{proton}\right) \approx 0.09282/c$, where the value in the free unbound state is: $v_T^{proton} \approx 0.099/c$

$\left(v_{Tnew}^{neutron}\right) \approx 0.10686/c$ where the value in the free unbound state is: $v_T^{neutron} \approx 0.112/c$.

The final conclusion is the following: the mass index deficit (the energy deficit for a deuterium) equal to: $E_{deficit} = -2.23\,MeV$ is associated with the decreased $\vec{v_T}$ velocities of both the proton and the neutron, bound in a deuterium nucleus.
The same considerations can be applied to the phenomenon called nuclear fusion, which is the fundamental process in the core of the Sun.
A crucial step in this process involves deuterium, as its nucleus fuses with another proton to form helium-3. Finally, a series of reactions leads to the formation of a helium-4 nucleus, releasing a big amount of energy.
A helium-4 nucleus consists of two protons and two neutrons. Because it is a very stable and tightly bound nucleus, it is a common product of fusion reactions.
The total energy (total mass index) of a helium-4 nucleus is approximately 3727.379 MeV, whereas the total energy of two free protons and two free neutrons is:
$E_{total}(2\,freeprotons + 2\,freeneutrons) = 3755.674\,MeV$.
Therefore, the energy loss (mass index loss) is about $28.295\,MeV$.

Considering that this energy as associated with the kinetic energies of the constituent two protons and two neutrons, and splitting it evenly between them, we get the following energy loss per nucleon:

$E_{loss}(onenucleon) \approx 7.074\, MeV$.

Then, we obtain: $m^{proton}_{helium4} = 938.272 - 7.074 = 931.198\, MeV$

$m^{neutron}_{helium4} = 939.565 - 7.074 = 932.491\, MeV$

Performing similar calculations as in the case of deuterium, we get:

$\left(v^{proton}_{Thelium4}\right) \approx 0.04767/c$

$\left(v^{neutron}_{Thelium4}\right) \approx 0.07145/c$.

Consequently, there is a substantial drop in the velocities v_T of protons and neutrons in a bound state.

Referring to the above considerations and calculations, I submit the Hypothesis:

Hypothesis 5.3

Both a proton and a neutron bound in a deuterium and helium-4 nucleus have decreased motion volumes $\vec{v}_{Tbound}$, compared to $\vec{v}_{Tfree}$ motion volumes in free particle states, where velocity means degree of ability to change position in relation to velocity of complex energy motion equal c=1.

A bound state between a proton and a neutron in a nucleus can be seen as an attractive interaction between the generated 3D complex-product tangent subspaces. This interaction forces the neutron to accommodate its velocity $\left(v^{neutron}_{Tnew}\right)$ to the velocity of the proton $\left(v^{proton}_{Tnew}\right)$ As a result, both particles stay in relative motion in their common 3D neighbourhood $\left(U^3_q\right)$ within the 'quantum nuclear potential well'.

Due to its nature, I propose to call this force the 'quantum residual gravitation force', which holds the proton and the neutron in a bound state of the created nucleus.

Finally, the phenomenon of different v_T velocities $v^{proton}_T \neq v^{neutron}_T < c = 1$ causes a strong interaction between proton and neutron particles, experienced in their 3D neighbourhood $\left(U^3_q\right)$ within the 3D subspace $S^3_{singularity-matter}(\varphi_1, \varphi_2, \varphi_3)$ of the created 4D path manifold $S^4_{singularity-matter}(\varphi_1, \varphi_2, \varphi_3, T)$.

It is obvious that the nature of the 'quantum residual nuclear force' is different from the nature of the 'strong nuclear force', which binds quarks together within a proton and a neutron.

Each quantum matter particle actually represents quantum complex energy, which generates, through the phenomenon of complex energy motion, its surrounding 4D quantum tangent velocity vector space. A quantum matter particle is not a 'typical object' occupying some place in the existing space because each quantum matter particle generates its individual quantum space.

The possible relative motion of two bound complex energy quanta of a proton and a neutron considered on the base of the 3D unknot models of proton and neutron particles (discussed in detail in my 'Theory of Everything' Ref. 36) is presented in the following figure:

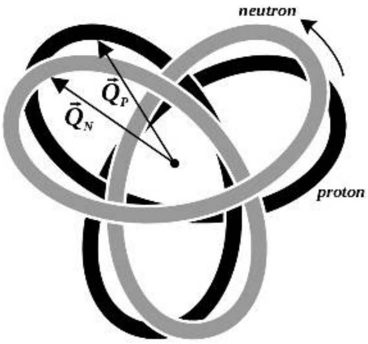

Fig. 10 The relative motion of a proton and a neutron bound in a deuterium nucleus within their generated 3D neighbourhood $\left(U_q^3\right)$, visualised by means of their 3D unknot models.

They do not ‘touch’ each other in a classical sense of the word.
It can be deduced that the interaction strength between two generated 3D quantum tangent subspaces depends on the alignment of the velocity vectors $\left(\overrightarrow{v_{1P}}, \overrightarrow{v_{2P}}, \overrightarrow{v_{3P}}\right)$ and $\left(v_{1N}, v_{2N}, v_{3N}\right)$ (the spin alignment; it is discussed in detail in my ‘Theory of Everything’ Ref. 36).
If spin alignments coincide for the generated tangent spaces of the proton and the neutron, then the residual-gravity nuclear attractive force is much higher, which makes it possible to construct a bound state. This phenomenon is practically observed in physics – there are no bound states between a proton and a neutron with opposite spins.

In quantum mechanics, a bound state is defined as a quantum state in which the wavefunction decreases rapidly with distance, resulting in a wavefunction that is localised around a potential well, leading to stable energy levels. However, any single proton or neutron can exist in a superposition of states, such as having multiple possible positions or momenta within the nucleus, rather than a single definite ‘location’. In other words, while individual protons and neutrons can be in superposition, a separate proton and a neutron are distinct particles that can interact and form a composite state through the strong nuclear force. Within a nucleus, a proton and a neutron can be in the same spatial region because they are not identical particles. They can have spatial wavefunctions that overlap with non-zero values at common locations. This does not mean that the particles overlap entirely. In essence, within a nucleus, a proton and a neutron can be in the same spatial region because they are not identical particles. The Pauli exclusion principle does not forbid that.

6. The phenomenon of gravitation of quantum atoms and macroscopic matter objects.

An electron created at rest can be present in the same 3D $\left(U_q^3\right)$ of the $S^3_{singularity\text{-}matter}\left(\varphi_1,\varphi_2,\varphi_3\right)$, together with the bound proton and neutron. A proton and an electron generate oppositely oriented quantum 3D velocity tangent dimensions, therefore between the proton's and the electron's quantum tangent 3D subspaces there exists a strong attractive (electrostatic) interaction. This interaction forces the electron to motion in the created 3D $\left(U_q^3\right)$ of the $S^3_{singularity\text{-}matter}\left(\varphi_1,\varphi_2,\varphi_3\right)$. We can deduce that the electron's velocity $\left|\vec{v}_T^{electron}\right| = \left(c=1\right)$ is slowed down to become $\left|\vec{v}_{Tnew}^{electron}\right| = \left|\vec{v}_{Tnew}^{proton}\right|$.
As a result, the electron generates motion with $\left|\vec{v}_{\varphi new}^{electron}\right| < \left(c=1\right)$, such that $\left|\vec{v}_{Tnew}^{electron}\right|^2 + \left|\vec{v}_{\varphi new}^{electron}\right|^2 = 1$.
The electron remains in a bound state with the proton, which additionally remains bound through the quantum residual gravitation force with the neutron due to $\left(v_T^{proton} \neq v_T^{neutron}\right)$.
Such a structure is called the deuterium atom, which is a stable isotope of hydrogen with one proton and one neutron in its nucleus, plus one electron.
An electron does not orbit the nucleus, at least not in the way planets orbit a star. Electrons, as complex energy quanta, generate their quantum tangent velocity vector spaces influenced by the generated quantum tangent velocity vector spaces of protons. Therefore, an electron's motion within an atom can be considered as a 3D complex energy wave, similar to the relative motion between a bound proton and a neutron in a nucleus presented in Fig. 10.
According to the hypothesis presented in my 'Theory of Everything' (Ref. 36), the electric fractional charge within a particular quantum mass particle corresponds to the orientation of a particular generated tangent velocity vector space dimension of the 3D tangent velocity subspace, in relation to the orientation of the generated 4th tangent dimension.
Essentially, similar atoms are attracted by the electrostatic force (due to the positively charged nucleus of one atom and the negatively charged electrons of another), 'felt' in the 3D neighbourhood $\left(U_q^3\right)$. This phenomenon forces atoms to form covalent bonds to achieve a stable electron configuration.
Therefore, stationary atoms 'feel' the attractive electrostatic force and start approaching one another in the 3D neighbourhood $\left(U_q^3\right)$.
Finally, in a bound state, both atoms form a complex-product structure, and similarly to deuterium or helium-4, they stay in motion in the $S^{3+1}_{singularity\text{-}matter}\left(\varphi_1,\varphi_2,\varphi_3,T\right)$ with a decreased average absolute velocity value of $V_{Taverage}^{boundatoms}$, such that $V_{Taverage}^{boundatoms} < V_{Taverage}^{atom}$.
Considering matter objects as collections of quantum atoms, we can deduce that at the macroscopic level such objects must generate lower individual absolute object velocities denoted by $V_{Taverage}^{object}$ as the object becomes larger (i.e., as it contains more bound atoms).

However, there is one fundamental difference between the quantum particles world and the matter objects world, and it is called locality. Let us consider it.

Each macroscopic matter object (a matter object built up of many matter atoms) also generates its individual surrounding 4D tangent velocity space, while in motion in the obligatory assigned $\frac{\vec{\partial}}{\partial T}$ direction of the generated oriented 4th tangent proper-time dimension. As discussed in 'Theory of Everything' (Ref. 36), matter objects generate individual orientable, but non-oriented 3D neighbourhoods.
The larger the objects are, the smaller is the volume of motion in the generated 4th tangent dimension denoted by $v_T^{object} \neq 0.$
In this context, the volume of motion (motion velocity) $v_T^{object} \neq 0.$ defines the degree of ability to change position in the created 4th tangent dimension in relation to complex energy motion velocity equal c=1.
When a quantum matter particle that generates distinguishable individual complex-product tangent 4D quantum space approaches a macroscopic matter object in the created 4D complex-product path space texture, the result is an interaction between the particles' tangent space and the tangent space generated by a matter observer.
Macroscopic matter objects define motion volumes in the fourth proper-time dimension that are much lower than those of free quantum matter particles, which may be marked by expression $\left(v_T^{particle} \gg v_T^{object}\right).$
We can assume that a big matter object tries to accommodate the particle's $v_T^{particle} \neq 0$ to its $v_T^{object} \neq 0.$
It is manifested as a force in the generated particle's 3D subspace neighbourhood $\left(U_q^3\right),$ causing an additional particle's motion phenomenon in the 3D object's subspace.
When it comes to the interaction between tangent spaces, then a quantum matter particle is forced to reduce its $v_T^{particle}.$ It results in the phenomenon of motion, such that $\left(v_{\text{in}\, object\ 3D}^{particle} \gg v_T^{object}\right).$
I posit that this fact is responsible for the phenomenon of 'superposition' occuring in the 3D object's tangent subspace taken to be the 3D neighbourhood $\left(U_q^3\right)$ of the generated 4D complex-product path space texture (our matter Universe), suggesting that the particle, or a set of particles, in fact also acts as a wave.
In this sense my hypothesis conforms to the results obtained by a team led by Markus Arndt (quantum double-slit interference with massive molecules composed of ~2,000 atoms).
According to my theses, the essence of this phenomenon lies in different 'volumes of motion' $\left(v_T\right)$ as assigned to quantum matter particles and matter macroscopic objects in the generated 4th tangent velocity dimension. A quantum matter particle 'stationary' in its generated 3D quantum tangent subspace is forced to motion in the 3D matter observer's neighbourhood with some motion volume $v_{3D}^{particle} \neq 0.$
In this context, the volume of motion (motion velocity) v_{3D} defines the degree of ability to change position in the created 3D tangent subspace and does not have any reference to the concepts of velocity calculated using covered distance and time as pass parameter.

When a matter object that generates its macroscopic complex-product tangent 4D space approaches another macroscopic object, then it comes to an interaction between the generated object's tangent spaces. We can assume, as in the case of quantum particles, that a matter object with a slower motion volume $v_T^{object\ 1}$ tries to reduce the motion volume of the second object $v_T^{object\ 2}.$ However, unlike in the relationship between quantum particles and macroscopic objects, the difference in motion velocity magnitudes v_T^{object} of macroscopic objects is not large and can be denoted as $\left(v_T^{object\,2} > v_T^{object\,1}\right),$ unlike $\left(v_{\text{in}\, object\ 3D}^{particle} \gg v_T^{object}\right).$
Therefore, it results in the phenomenon of motion in 3D sub-spaces, such that $\left(v_{\text{in}\ object\,1\ 3D}^{object\,2} < v_T^{object\,1}\right),$

which introduces the aspect of motion in the proper-time dimension. That in turn introduces the constraints of linear, sequential progression in time when observing physical phenomena.
In this sense, there is no manifestation of the superposition phenomenon, but we can rather talk about the process of 'decoherence'.
I posit that this fact is responsible for the phenomenon of 'locality' occurring in the 3D matter object's neighbourhood $\left(U_q^3\right)$ of the generated 4D complex-product path space texture.
The phenomenon that the larger the object is, the smaller is its v_T^{object} motion magnitude can be seen as the process of decoherence, which causes an object to behave classically.
This decoherence forces a macroscopic object into a specific 'localised state', while generating a 'localised 4D path' in the created matter path manifold texture.

Suppose that we have two matter objects on a macroscopic scale. $Object\,1$ is a much bigger collection of atoms, so the motion volume of $Object\,1$ is $\left(v_t^{object\,1} < v_t^{object\,2}\right) < (c=1)$.
Both objects generate individual surrounding 3D tangent subspaces (on the Universe scale), $T_q S^{3\ object\,1}_{singularity\text{-}matter}\left(\frac{\partial}{\partial\varphi_1},\frac{\partial}{\partial\varphi_2},\frac{\partial}{\partial\varphi_3}\right)$ and $T_q S^{3\ object\,2}_{singularity\text{-}matter}\left(\frac{\partial}{\partial\varphi_1},\frac{\partial}{\partial\varphi_2},\frac{\partial}{\partial\varphi_3}\right)$, while in motion in the tangent direction $\left(\frac{\vec{\partial}}{\partial T}\right)$. As a result, both objects generate individual 'localised paths'. This phenomenon is visualised in the following figure
(we are restricting the considerations to a 2D simplification $S^{1+1}_{singularity\text{-}matter}(\varphi_1,T)$ of the created complex-product 4D matter path space texture):

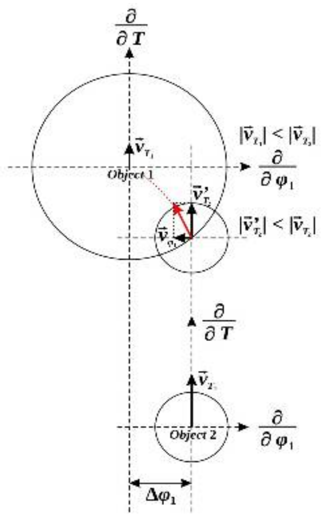

Fig. 11 The interaction between two generated matter object tangent spaces in relation to the modification of the object's tangent $\vec{V}_\varphi$ and $\vec{V}_T$ velocities.

Both objects generate their individual 4D velocity vector tangent spaces and create different local paths, thereby they create a 4D space texture of the complex-product path manifold $S^{3+1}_{singularity\text{-}matter}(\varphi_1,\varphi_2,\varphi_3,T)$.
When $Object\,2$ enters the generated surrounding tangent velocity space of $Object\,1$, then because of different $v_{T_1}^{object\,1} < v_{T_2}^{object\,2}$ the result is in an interaction of the tangent spaces, which forces $Object\,2$ to <u>decrease its velocity</u> v_{T_2}.
As a result of this interaction, velocity $\vec{V}_{\varphi_1}$ occurs. It is observed as the phenomenon of the '<u>gravitational force</u>' on a macroscopic scale in the object's generated surrounding 3D tangent velocity subspace $T_q S^{3\ object\,2}_{singularity\text{-}matter}\left(\frac{\partial}{\partial\varphi_1},\frac{\partial}{\partial\varphi_2},\frac{\partial}{\partial\varphi_3}\right)$.

The generated tangent spaces of both objects interact, forcing the much smaller $Object\,2$ to decrease its $\vec{v}^{\,object\,2}_{T\,average}$ velocity.
This phenomenon can proceed in two ways.
$Object\,2$ can create local continuous motion with some spatial velocity $\vec{V}_{\varphi}$ around $Object\,1$, or it can create a local macroscopic bound state. Such a scenario can be visualised as a local curvature introduced by object $Object\,1$.

It can be assumed that there exists the '<u>gravitational attractive force</u>' between $Object\,1$ and $Object\,2$, observed in the 3D neighbourhood $\left(U^3_q\right)$ on a macroscopic scale.

Hypothesis 6.1
The gravitational attractive force between matter objects, observed on a cosmic scale in the created 3D paths subspace manifold $S^3_{singularity\text{-}matter}(\varphi_1,\varphi_2,\varphi_3)$ is a phenomenon related to the velocities $\left(v^{object\,1}_t < v^{object\,2}_t\right) < (c=1)$. leading to the relation $\left(v^{object\,2}_{\text{in}\ object\,1\ 3D} < v^{object\,1}_T\right)$, which introduces the aspect of motion in the proper-time dimension.
The generated surrounding tangent spaces of these objects interact. Such an interaction can be visualised as local curvatures in the created complex-product 4D path space texture. The bigger an object, the lower the v^{object}_T velocity and the deeper the local path space texture curvature. This phenomenon generates the gravitational force experienced by objects in the 3D neighbourhood $\left(U^3_q\right)$ on a cosmic scale.
In reference to quantum particles, due to their 'non-locality feature', the gravitational phenomenon is primarily considered as the 'quantum residual gravity nuclear force' phenomenon, occurring between the nuclei of atoms.

Restricting our considerations to a 2D simplification $S^{1+1}_{singularity\text{-}matter}(\varphi_1,T)$ of the created complex-product 4D matter path manifold texture, and taking $v^{object\,1}_{T_1} < v^{object\,2}_{T_2}$, the surrounding macroscopic 'curved texture' locally created by $Object\,1$ is presented in the following figure:

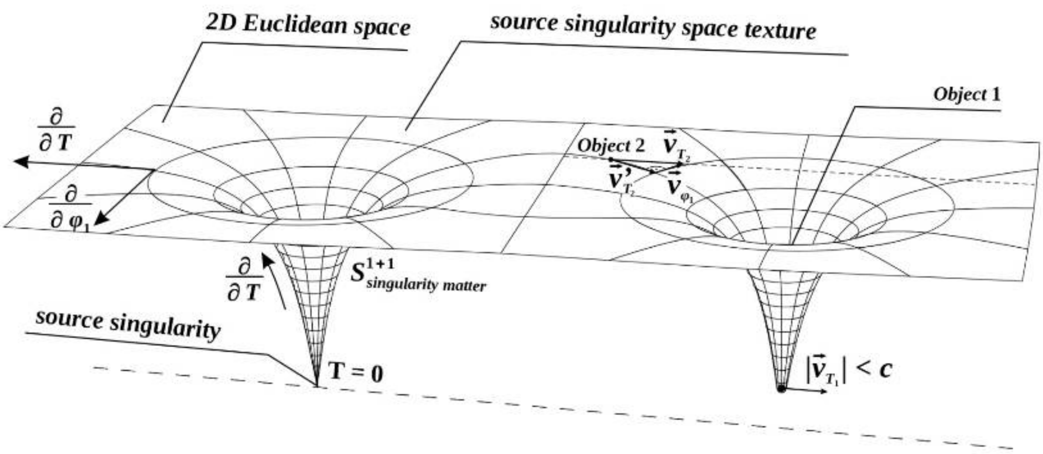

Fig. 12 The local surrounding 'curvature' of the texture created by a 'massive' $Object\,1$.

Considering the 4D complex-product matter path space $S^4_{singularity\text{-}matter}(\varphi_1,\varphi_2,\varphi_3,T)$ on a cosmic scale, all matter objects generating their 4D complex-product tangent velocity vector spaces, while in motion with velocities $v_{Taverage}^{object} < (c=1)$, 'locally curve' the created 4D complex-product space texture. The generated space is a collection of all created 4D quantum matter particles' and matter objects' paths, and it is considered to be the Universe that we live in.

In reference to quantum particles, due to their non-locality feature, the gravitational phenomenon is primarily considered as the 'quantum residual gravity nuclear force' phenomenon, occurring between protons and neutrons in the nuclei of atoms.

Because photons do not generate motion in the $\frac{\vec{\partial}}{\partial T}$ dimension, it is not possible for matter observers (matter objects) to recognise the existence of the complex-product source singularity. Stationary observers in their generated 3D complex tangent subspaces $T_q S_{singularity-matter}^3\left(\frac{\partial}{\partial \varphi_1}, \frac{\partial}{\partial \varphi_2}, \frac{\partial}{\partial \varphi_3}\right)$, taken to be a local approximation in any neighbourhood (U_q^3) of the created 4D matter path manifold, can only observe themselves by receiving matter photons generated by matter objects.

The presented hypotheses are described in more detail in my book 'Theory of Everything' and I encourage everyone interested to read my book.

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