Neutron Reinterpretation: A Nonformal Octonionic Model for Strong, Weak, and Electromagnetic Interactions

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Abstract

In the context of a novel interacting fields model, this paper presents a reconceptualization of the neutron as an intermediate state between proton and antiproton transformations, incorporating antimatter and dark matter into the nucleon dynamics. Intro-

ducing a geometric interpretation of Quantum Chromodynamics (QCD) within an octonionic framework, the model provides a conceptual bridge between QCD and weak interactions, offering a unified framework for strong, weak, and electromagnetic forces. This

octonionic structure captures the interplay of symmetries in a complex, real and imaginary, time dimension within the nucleon, providing a topological foundation for nuclear transformations in beta decay.

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1 Introduction

Similarly to how bigravity or bimetric gravity theories consider two interacting gravitational fields, we propose a topological dual field model rooted in an octonionic framework, where several fields, varying in or out of phase, interact with each other through their mutual intersections.

These interactions occur inside the four subfields — two longitudinal and two transverse — created by the intersection, whose geometric configuration aligns with a nonformal octonionic structure. Within this structure, nuclear transformations in beta decay and the interactions that hold the nucleus together naturally emerge from the physical mechanics of these fields related to a complex, real and imaginary, time dimension.

The four subfields constitute the nucleus shared by this dual field system, which remains united due to the bonds formed by the strong, weak, and electromagnetic interactions that take place within them.

The shape, density, internal kinetic energy, electric charge, and spatial displacements of these fields — as well as their topological transformations and the bonds they create by exchanging mass and energy with other subfields in the nucleus — depend on the equal or opposite phases of variation of the intersecting fields.

With equal phases, both the left- and right-handed transverse subfields exhibit chiral mirror symmetry; they either expand or contract simultaneously, following a phase opposite to that of the intersecting fields that host them. The top longitudinal subfield moves upward when both intersecting fields contract, experiencing double compression and increased internal kinetic energy before descending and expanding, losing density and energy when the intersecting fields expand.

With opposite phases, both the left- and right-handed transverse subfields exhibit mirror antisymmetry. Following the phase of the fields that host them, when the left subfield contracts — experiencing double compression and an increase in its inner energy — the right-handed subfield expands, undergoing double decompression and a decrease in its inner energy. The top longitudinal subfield moves left or right, toward the side of the contracting field.

Within this field framework, we aim to provide a geometric representation of the abstract notion of quarks, which allows us to conceptually extend Quantum Chromodynamics (QCD) to the domain of weak interactions, where protons and neutrons are transformed through Beta decay radioactive processes.

In the context of the antisymmetric system, we will describe Beta reactions as cyclic processes between protons and antiprotons, considering antimatter within the nucleon and offering a novel interpretation of neutrons as a mirror symmetric state in the middle of these transformations.

We will also clarify the role of W bosons in these transformations when symmetry breaking occurs.

2 interpreting the Pauli Exclusion Principle

In the dual fields manifold framework, the Pauli Exclusion Principle is interpreted in terms of mirror symmetry or antisymmetry.

Two mirror-symmetric transverse subfields, which are interchangeable upon a 180-degree rotation, do not obey the Exclusion Principle. This is because, as they vary in phase, they will be simultaneously in the same state of contraction or expansion: both will expand together and later contract together.

On the other hand, two mirror-antisymmetric subfields, which follow opposite phases, will be governed by the Exclusion Principle. When one is in a state of expansion, its mirror counterpart will be in a state of contraction, and vice versa.

Considering this context, we take the Exclusion Principle as a fundamental guide to distinguish between a symmetric bosonic system, where the phases are equal, and an antisymmetric fermionic system, where the phases are opposite.

3 Bosonic symmetric System

The interactions within the bosonic system differ depending on whether the intersecting fields are contracting or expanding.

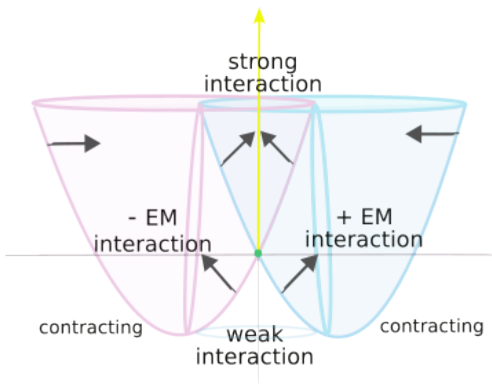

Figure 1: *Nuclear interactions and the manifold of two transverse and two longitudinal subfields in a bosonic symmetric system formed when both fields contract.*

3.1 Both Intersecting Fields Contract

When both intersecting fields contract, the top longitudinal bosonic subfield — adjacent to the left and right transverse bosonic subfields, as they share the same boundaries — experiences a double compressive force, causing it to contract while moving upward to emit a photonic radiation.

The longitudinal subfield has a double negative curvature coupled by a singularity point, representing an abrupt change in curvature direction. This occurs because the left and right sectors of its curvature correspond to the right and left curvatures of the left and right intersecting fields, respectively.

The forces of pressure, caused by the inward displacement of the contracting fields, operate within the subfield from the negative sides of its curvature, generating waves and inner orbital motions.

Given a uniform distribution of density and charge inside the subfield, these waves will travel at the speed of light. In this context, the famous formula $E = mc^2$ is applicable, where c, the speed of light, is multiplied by the material density twice, once for each curvature sector.

The dynamics inside this high-energy field represent a type of strong electromagnetic interaction.

We consider an interaction inside a subfield to be strong when the subfield receives a double compression that causes and accelerates its inner orbital motions, representing a bond that unites the system if the created energies waves remain enclosed in the subfield.

The photonic subfield receives the double compressive force, and the interactions triggered inside are strong. However, since its upper side is not enclosed within one of the intersecting fields, the radiation it emits is not retained within the system but propagates freely as light waves.

An electromagnetic interaction represents a weaker bond, as it exists within a subfield that is partially compressed and partially decompressed. This is the case for the left- and right-handed bosonic subfields, which experience compression from the negative sector of their curvature and decompression in the positive sector of their curvature.

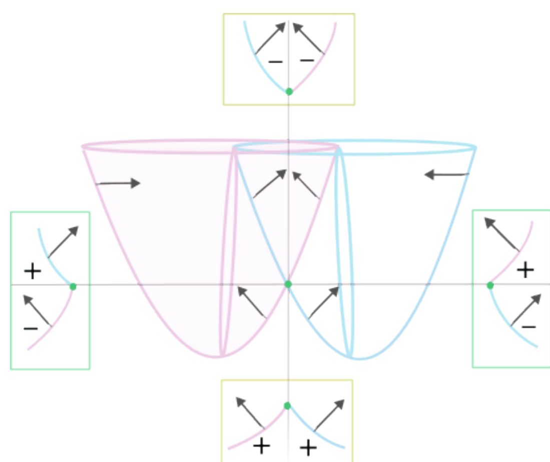

Figure 2: *Singularities, as abrupt changes in curvature, inside the nuclear subfields in the bosonic system when both intersecting fields contract.*

This decompression occurs because, in that region, the pressure force is inactive on the positive side of the curve but manifests on the negative side, which corresponds to the inner curvature of the adjacent longitudinal subfield.

3.2 Both Intersecting Fields Expand

The weak interaction occurs when a subfield is doubly decompressed, losing both density and internal kinetic energy.

This occurs on the concave side of the symmetric system when both intersecting fields expand, causing the longitudinal subfield to lose force and energy as it undergoes double decompression, expanding and moving downward.

The forces and energy previously concentrated in the single longitudinal subfield are now equally distributed between the left and right transverse subfields, where the pushing forces, now reversed in direction, manifest in the positive sectors of their half-positive, half-negative curvatures.

As a result, the negative sectors become decompressed as the pressing forces that previously acted within them now shift to the reverse side of the curvature. This shift results in double compression in the adjacent longitudinal subfield located on the convex side of the system, where a strong interaction now operates.

The anti-photonic mass and energy in the inverse longitudinal subfield, which has a double positive curvature, will be invisible from the perspective of the concave system, as it is directly undetectable from that position. In that sense, it may be considered "dark".

3.3 Hidden Asymmetries in the Bosonic System

Although the bosonic system is mainly symmetric, it exhibits several asymmetries.

When the intersecting fields contract and the top longitudinal subfield increases energy, the transverse subfields can be considered as W^- and W^+ bosons that mediate the transfer of mass, energy, and charge from the antiphotonic convex longitudinal subfield to the photonic concave longitudinal subfield.

When they contract, the transverse subfields revert the previous transfer. However, the strength of the charge or pushing force caused by the negative curvature of the contracting fields is greater than that caused by the outer side of the expanding fields. So, there is an asymmetry in mass and energy between the photonic and the antiphotonic longitudinal bosons.

In a similar way, we think that the longitudinal subfield that experiences a weak interaction during its decay can be considered as the Z boson that mediates the neutral interaction that takes place in the transverse subfields, as although their charges are reverse in direction, their charges are preserved, and the mirror neutrality continues.

However, a more precise analysis will show that those charges not only reverse direction but also change the pole inside the transverse subfields from where they operate.

In this sense, the neutral interactions during expansion and contraction reveal the existence of a virtual electric dipole that emerges through time inside each transverse subfield with an asymmetric charge distribution between their positive and negative sectors, and an actual Zero electric dipole moment formed by the negative and positive charges of both left and right transverse subfields.

4 Fermionic Antisymmetric System

The same mechanism operates with different effects when the phase of one intersecting field lags or advances with respect to the other, introducing a space-time antisymmetry into the system, which now becomes fermionic.

When the right intersecting field contracts while the left continues expanding, there will be a transfer of mass, energy, and charge from the left side of the system to the right.

The right-handed transverse subfield now experiences double compression in both the negative and positive sectors of its inner curvature. This represents the contracting scenario of a strong interaction, with increased internal kinetic energy, where the subfield itself acts as a proton.

The mass density distribution within this transverse proton subfield is not uniform because the positive curvature exerts a weaker inward force than the negative curvature does. This implies that the waves produced by the contraction of the subfield propagate through a non-uniform medium at different speeds.

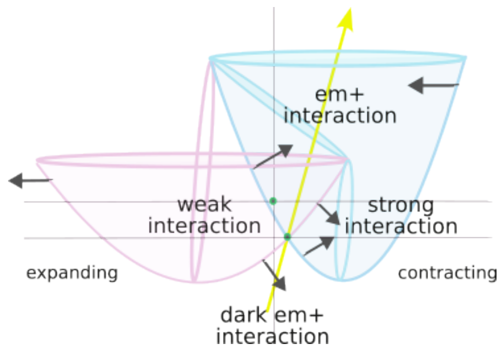

Figure 3: *Nuclear interactions in a fermionic antisymmetric system when the right field contracts and the left expands.*

In this scenario, the traditional energy formula cannot fully account for the kinetic energy, as the medium is non-uniform. Therefore, the formula should be modified to $E = mcc'$, where c' represents a speed lower than the speed of light.

The longitudinal subfield will tilt toward the side of the contracting intersecting field—not because it is attracted to that region and repelled by the other, but because it follows the displacement directions of the fields that form it, varying with opposite phases.

When tilting to the right, it acts as a positive positron, and when tilting to the left, it behaves as a negative electron. In this field model, the positron and electron, being their own antimatter, are considered Majorana particles.

Despite its double negative curvature, only one sector of this electromagnetic subfield is charged with an inward-pulling pressure force, which originates from the dynamics of the expanding transverse subfield. The other sector is decompressed, with a missing charge that acts on the reverse positive side of the subfield curvature, pushing outward against the compressing transverse subfield that represents a proton.

In this framework, the proton's positive charge and the positron's positive charge are not incompatible because the proton's charge originates from the positron decompressed sector that lacks charge.

The asymmetry in charge distribution inside the electron-positron subfield is compensated when the subfield reverses direction, acting as its own antiparticle. The subfield then carries an electric dipole, with each charge acting at different times.

The left transverse subfield acts as an expanding antineutrino, experiencing double decompression, which represents the stage of a weak interaction with decreased energy and density.

Once the intersecting fields reach their peak in contracting and expansion, the roles are interchange, and the right contracting field expands while the left contracts.

This reverts the transfers, driving the topological transformations of the nuclear subfields.

The right contracting proton becomes a right expanding neutrino; the left expanding antineutrino becomes a left expanding antiproton; and the longitudinal subfield tilts toward left, acting as electron.

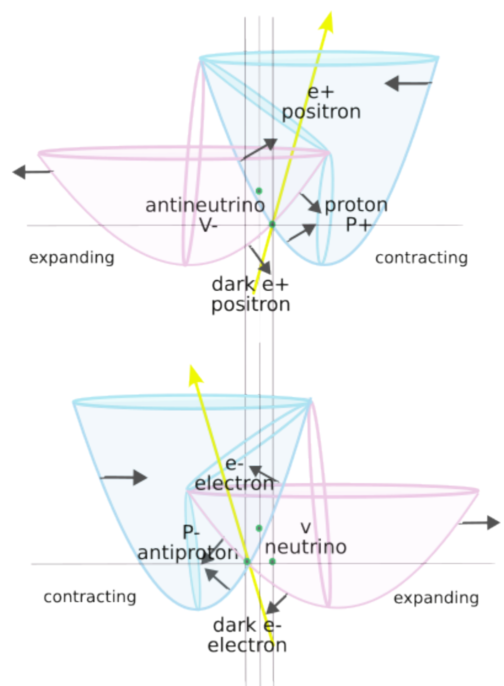

Figure 4: *subatomic particles in the fermionic antisymmetric system when the right field contracts and the left expands.*

5 Beta Decay Reactions in the Intersecting Fields Model

This, in essence, is the description of Beta plus and Beta minus reactions as explained by this model in terms of field interactions.

In the standard model, β^+ decay involves a proton converting into a neutron, emitting a positron and a neutrino. β^- decay involves a neutron converting into a proton, emitting an electron and an antineutrino.

In contrast, our model incorporates cyclic transfers of protons and antiprotons within the nucleon, rethinks the nature of the neutron, and offers an explanation for the emitted beta particle that differs from the Standard Model.

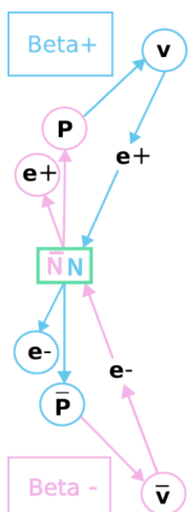

Figure 5: *Diagram that illustrates the neutron as an intermediate state during proton-antiproton transformations in beta decay reactions, showing the paths followed and the particles involved in each case.*

The predicted paths are: For β^+: Proton $\rightarrow$ Neutron $\rightarrow$ Antiproton, emitting an electron and a neutrino. For β^-: Antiproton $\rightarrow$ Antineutron $\rightarrow$ Proton, emitting a positron and an antineutrino.

6 The Transitional Nature of Neutron and Antineutron

While the contracting proton is decaying into a neutrino via its gradual expansion, it passes through an intermediate state, which is mirror symmetric to the antineutrino that is simultaneously transforming, via its gradual contraction, into an antiproton at the opposite side of the system.

In this intermediate state, during the evolution from proton to neutrino and antineutrino to antiproton, the electric longitudinal field passes through the central axis of symmetry, which represents a point of zero charge neutrality. This entire transitional scenario is considered, in this model, to represent the neutron.

6.1 Neutron Electric and Magnetic Dipole Moments

In this framework, where the fields coincide in curvature, the fact that one subfield is contracting from a previous expansion while the other is expanding suggests that the expanding subfield no longer carries an electric charge, and its inner kinetic energy is not currently being boosted. However, it seems reasonable to consider that its inertial motion is faster than the speed it will have when the subfield reaches maximum expansion.

By considering the inner orbital motions triggered by the compression of electric charges within the contracting subfield as magnetic, a magnetic dipole moment could potentially exist at this momentary symmetric stage, formed by both transverse subfields.

Whether this magnetic dipole in the neutron results in a non-zero magnetic dipole moment depends on the relative strength of the forces currently acting on the subfields, which may induce a density and energy imbalance.

In any case, any potential non-zero magnetic dipole moment in the neutron would later be compensated during the inverse reaction by a corresponding non-zero magnetic moment in the antineutron.

In turn, the longitudinal subfield will carry an electric monopole in the sector of its curvature that is currently being compressed, while the other sector is being decompressed, resulting in an asymmetric charge distribution in the neutron state.

This asymmetry will also be corrected by the opposite imbalance in the antineutron when the inverse reaction takes place. In this cyclic context, a virtual neutron-antineutron electric dipole moment could be considered to develop over time.

The Standard Model predicts a magnetic dipole in the neutron. It also predicts a zero electric dipole in the neutron. Both zero and non-zero neutron EDMs are currently the subject of active experimental research within the field of mainstream physics.

6.2 Neutron and Proton Different Weights

There may be several possible explanations for the neutron's increased mass compared to the proton.

One possibility is that the neutron intermediate stage effectively incorporates the mass of the previous proton and antineutrino, which now are being transformed into a neutrino and an antiproton. Since the neutrino carries a slight charge, this could result in the neutron's mass being heavier than that of the proton.

The same may be considered with respect to the masses of the previous antiproton and neutrino and the current antineutron stage.

Additionally, the density and energy of the longitudinal subfield may need to be considered when measuring the overall mass in this intermediate state, as it could contribute to the weight difference between the neutron and proton.

7 The Role of Dark matter in the Nucleon Transformations

In the bosonic system, we have previously defined in the inverted longitudinal subfield on the convex side of the system as a form of dark matter from the perspective of the concave side.

In the fermionic system, this longitudinal subfield acts as a dark electric subfield moving toward the side of the intersecting field that contracts, mimicking the oscillations of the electron-positron subfield on the concave side.

This subfield also carries an electric charge on the side of its curvature adjacent to the expanding transverse subfield, while it lacks electric charge on the decompressing sector of its curvature, which is cobordant with the contracting transverse subfield.

In this framework, the strong interaction can be understood as arising from the interplay between electric matter and electric dark antimatter, as the double compression experienced by the transverse proton (or antiproton) subfield requires the decompression of half of the curvature of both the electric subfield and the inverted dark electric subfield, which together act as a compressive force on it.

8 A Fields Landscape for Quantum Chromodynamics

In QCD, the bonds within the nucleus occur through the interaction of quarks and gluons: the strong interaction between quarks is mediated by the exchange of color charges through gluons, which are excitations of the gluon field that act as force carriers, dynamically transferring color charge between quarks in a process that leads to the confinement of quarks within protons and neutrons.

In our fields model, quarks are not viewed as elementary particles, but rather as forces of pressure that arise from the displacements of the two intersecting fields during contraction or expansion.

We also reinterpret quark confinement as a natural consequence of the contraction of the intersecting field that harbors a charged transverse subfield. As the intersecting field moves inward during contraction, it forms a barrier that confines the energy and dynamics inside the transverse subfield.

Additionally, the contraction and expansion of the intersecting fields cause an inclination of the subfield's elliptical orbit toward its host field, similar to the tilt of planetary orbits, further stabilizing the confinement in the strong interaction.

The color charge transfer between quarks and gluons in QCD parallels the way that compressive and decompressive forces operate across the positive and negative curvatures present within the transverse and longitudinal subfields in the intersecting fields model.

As one of the transverse subfields expands, its inner decompression exerts a force within the adjacent longitudinal subfield as they share the same curvature, with its positive side manifesting within the transverse subfield and the negative side within the longitudinal subfield.

In this dynamic, the decompression experienced by the left transverse subfield is felt as compression inside the left sector of the longitudinal subfield. Simultaneously, the right sector of the longitudinal subfield undergoes decompression, which in turn is experienced as compression within the right transverse subfield that contracts.

Thus, we observe a charge transfer from the left expanding transverse subfield to the right contracting transverse subfield, mediated by the adjacent longitudinal subfield, which acts as the force carrier, absorbing and emitting these charges.

We propose, then, a geometric bridge to the abstraction in QCD, identifying the electron-positron longitudinal subfield as analogous to the gluon field, whose excitations caused by compression and decompression interact with the transverse subfields where the neutrino or antineutrino, and proton or antiproton will reside.

In our model, color corresponds to the positive or negative side of curvature, which can combine as double negative, double positive, or a mix of half negative and half positive curvature within the subfields.

When a fermionic transverse subfield expands, there is a missing charge in the positive sectors of its curvature because that charge is transferred to (or is expressed within) the negative curvature of the adjacent longitudinal subfield. This transfer occurs when the quark of a previously contracting transverse subfield flips direction, changing the side of the curvature — from positive in the transverse subfield to negative in the longitudinal subfield — where it exerts its pushing force, or charge. This flip represents a change in the quark's color charge.

The electric longitudinal subfield, with double negative curvature, now has a compressed sector where the charge color operates and a decompressed sector with a missing charge. That missing charge is transferred to the positive curvature of the adjacent transverse subfield, which is being transformed into a proton or antiproton. The longitudinal subfield is adjacent to both the left and right transverse subfields, acting as a mediator that conveys charges between them.

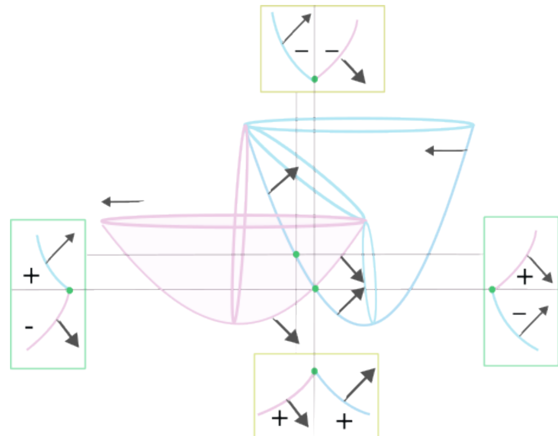

Figure 6: *Negative and positive sectors in the subfield curvatures during the fermionic antisymmetric system*

The color charge change in our model is physically caused by the transition between contraction and expansion in the intersecting fields that drive the system's dynamics. As these fields shift phases — from contraction to expansion or vice versa — the charge color of quarks changes accordingly, activating on the positive or negative sides of curvature and deactivating on the opposite side.

The quark transfer process is completed through the interaction of dark quarks. The missing charge in the negative sector of the transverse subfield's curvature is transferred to the positive sector of the curvature of the inverted dark gluon operating on the convex side of the system. As the other sector of the dark gluon experiences decompression, this charge is received by the transverse subfield as the additional half compression that determines its nature as a proton or antiproton.

This geometric interpretation of the abstract notion of color charge exchange between quarks and gluons in QCD allows us to propose an extension of QCD into the realm of the weak interactions, describing β^+ and β^- decay in terms of color charge exchange between quarks mediated by gluons.

In Quantum Chromodynamics, protons are composed of two up quarks and one down quark (uud), while neutrons consist of two down quarks and one up quark (ddu). Additionally, down quarks are considered slightly heavier than up quarks.

In our model, we propose that both protons and antiprotons directly consist of one up quark and one down quark, while also involving the participation of an additional down quark and one down dark quark in their formation, carried by the gluon and dark gluon subfields.

In our view, the proton and antiproton are not fixed states but rather cyclically changing topological regions. These topological transformations involve the participation of the aforementioned four quarks.

This same configuration would be present in the neutral intermediate stage during proton-antiproton transformations.

9 W and Z Bosons in the Fermionic system

In the Standard Model, gluons are the mediators of the strong nuclear force, responsible for holding quarks together in protons and neutrons. Meanwhile, the W and Z bosons are considered the mediators of the weak force, which governs proton-neutron transformations in Beta decay.

These transformations are thought to occur when a quark inside a proton or antiproton emits a W boson. During this emission, the quark's flavor changes from up to down, or from down to up, triggering a weak interaction that alters the internal structure of the proton or antiproton. The emitted W boson eventually decays into other particles, such as an electron and an antineutrino.

In our model, we propose that the change in the quark's flavor, which triggers the weak interaction and causes the proton or antiproton transformation, is driven by a phase change in the intersecting fields. These fields switch between contraction and expansion, initiating the quark's flavor change and the subsequent transformation of the proton or antiproton.

Furthermore, in our model, a change in quark flavor always implies a simultaneous change in color. This is because flipping the quark's flavor also changes the strength of the force acting on it: the up quark becomes driven by the weaker outer side of an expanding field, while the down quark is influenced by the stronger negative side of a contracting field.

In this sense, we propose that in both beta plus decay (where a proton is transformed into a neutrino, transferring charge and energy to an antineutrino, which becomes an antiproton) and beta minus decay (where an antiproton is transformed into an antineutrino, transferring charge and energy to a neutrino, which becomes a proton), the flavor change always involves a down quark becoming an up quark, and an up quark becoming a dark down quark.

We suspect that the consideration of the W^+ and W^- bosons as participants in this reaction arises from their identification as transverse subfields that correspond to decompressed neutrinos or antineutrinos, where the weak interaction operates.

However, in our view, the neutrino represents the expanding state of a decaying proton, and the antineutrino represents the expanding state of a decaying antiproton.

10 Redox and Acid-Base Analogies in Nuclear Transformations

Beta decay is typically considered a one-time event, mainly due to energy conservation reasons. A neutron decays into a proton, electron, and antineutrino (or vice versa for positron emission), but this process is generally not followed by the inverse reaction.

Our model envisions beta decay as a cyclic process, alternating between beta-minus (β^-) and beta-plus (β^+) reactions, much like redox reactions, where oxidation and reduction occur in cycles, and acid-base reactions, where protons are continuously transferred between acids and bases.

In redox reactions, electrons are transferred between chemical entities, with oxidation occurring when one loses electrons and reduction occurring when another gains electrons. The substance that loses an electron is said to be oxidized, and the one that gains an electron is said to be reduced.

Similarly, in acid-base reactions, protons (H^+) are transferred between chemical species, with acids donating protons to become conjugate bases, and bases accepting protons to become conjugate acids.

Both redox and acid-base reactions involve reciprocal transfers of subatomic particles, changing the identity of the species involved and alternating their roles in the cyclical process.

In the intersecting fields model, the right transverse subfield initially acts as an acidic region, poised to transfer its protonic charge, mass, and energy.

As it expands, it effectively donates a proton, transforming into a conjugate base that acts as a neutrino. Simultaneously, the left transverse subfield, acting as a basic region formed by an expanding antineutrino, is ready to accept the proton.

The transfer occurs as the left subfield contracts, gaining the proton that now is expressed as an acidic antiproton.

Concurrently, the left contracting region also gains an electron, increasing its oxidation state, while the right expanding region loses a positron, becoming reduced.

This process effectively describes a beta-plus transfer in terms of redox and acid-base reactions.

This cyclical process continues in beta-minus decay, where the roles of proton donor and proton acceptor are reversed. The left transverse subfield, now acting as an acidic region, donates a proton. The right transverse subfield, acting as a basic region, accepts the proton. Simultaneously, the left transverse subfield undergoes oxidation, while the right transverse subfield undergoes reduction.

This reciprocal exchange of protons and antiprotons, along with the corresponding transfer of electrons and positrons, maintains the overall stability of the system.

11 Non Linear Transformations in a Rotational Framework

An additional complexity arises in the system when considering a rotational scenario.

The symmetric and antisymmetric systems, when considered independently, follow linear transformations analogous to classical wave behavior.

However, if the entire system periodically rotates, the rotation introduces a nonlinear path in the system's evolution, alternating between symmetric and antisymmetric stages with each 90-degree rotation.

Starting with the bosonic symmetric system, when both intersecting fields contract and a photon is emitted, this photon emission is followed by the emission of a positron, representing a positive electromagnetic interaction (when the right field contracts and the left expands).

Subsequently, the lowest state of the photonic subfield within the electroweak interaction (when both intersecting fields expand) leads to the creation of an electron, representing a negative electromagnetic interaction (when the left intersecting field contracts and the right expands), before the generation of a new photon (when both intersecting fields contract again).

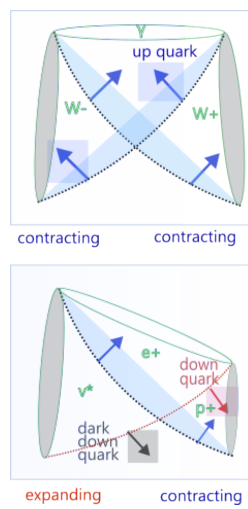

Figure 7: *The bosonic symmetric system is nonlinearly transformed into a fermionic antisymmetric system within a rotational scenario. The quark flavor changes from up to down after a 90-degree rotation.*

This nonlinear process can be interpreted either as the absorption of a photon by the electron and positron or as the annihilation of the electron and positron, resulting in the creation of a new photon.

In this context, the photon is emitted when both intersecting fields reach their peak contraction before beginning to expand. A clockwise 90-degree rotation will cause a change in color and flavor in the up quark associated with the force of pressure caused by the left intersecting field inside the photonic longitudinal subfield, causing a decompression inside that subfield that will conversely compress the right transverse subfield with a down quark operating from the positive side of its curvature. The left transverse subfield will be doubly decompressed because it will also change the color and flavor of the quark that operated inside of it in the bosonic system.

At that moment, the right-handed bosonic transverse subfield will experience double compression, as its previously decompressed region becomes compressed. The inward displacement of the other intersecting field, which previously caused decompression while contracting, now shifts to an outward displacement while expanding, leading to compression from its outer side. This transformation results in the right handed positive boson becoming a doubly compressed proton.

The half decompression experienced by the right sector of the previously doubly compressed photonic longitudinal subfield causes the transformation of the photonic boson into a fermionic positron.

We are now immersed in the fermionic antisymmetric system, with force and energy displaced to the right-handed region. In this configuration, there is a doubly compressed proton and a half-compressed and half-decompressed positron on the right, and a fully decompressed antineutrino on the left.

Another 90-degree rotation brings us back to the symmetric system, where both intersecting fields simultaneously expand, causing an electroweak interaction on the concave side and a dark strong interaction on the convex side.

An additional 90-degree rotation gives rise again to the antisymmetric system, where the left transverse subfield contracts as an antiproton, the longitudinal subfield moves left as an electron, and the right transverse subfield expands as a neutrino.

Each 90-degree rotation only changes the direction of half of the quarks in the system that were not changed in the previous rotation, periodically breaking and restoring symmetry.

This alternation between the symmetric and antisymmetric stages may imply the need for an interpolation between the complex differential equation that would describe the symmetric system and the complex conjugate differential equation that describes the harmonic antisymmetric system.

12 Field Configurations in an Octonionic Framework

The fields model may be expressed in terms of octonions.

12.1 Fermionic Sedenion

In the antisymmetric system, where the intersecting fields F_1 and F_2 vary out of phase, the transverse subfields f_1 and f_2 represent two paired quaternions, constituting an octonionic structure.

Three additional imaginary spatial hyperdimensions are introduced to represent the tilting displacement of both transverse subfields to the right when F_1 contracts and F_2 expands.

Conversely, when F_2 contracts and F_1 expands, f_1 and f_2 tilt towards the left, aligning with F_2 and introducing another three imaginary spatial hyperdimensions.

Together, these six imaginary spatial hyperdimensions fully describe the tilting dynamics of the transverse subfields in this fermionic antisymmetric octonion.

In addition to these spatial dimensions, two temporal dimensions are considered: a real temporal dimension describing the contraction and expansion phases of F_1 and f_1, and an imaginary temporal dimension describing the expansion and contraction of F_2 and f_2.

If we consider the real-time dimension of the lagged phase as representing a past time, and the advanced phase of the imaginary time dimension as a future time, relative to each other, or vice versa, then their convergence within the double curvature of the transverse subfields may be interpreted as complex present time.

This double curvature, as we previously saw, involves a positive sector in f_1 related to the positive outer side of F_2' curvature and a negative sector aligned with the inner negative side of F_1's curvature, while in f_2, the positive and negative associations are reversed (its positive sector corresponds to F_1 and its negative sector to F_2.

This configuration then implies an octonionic structure with 7 imaginary dimensions (6 spatial and 1 temporal) and 1 real temporal dimension.

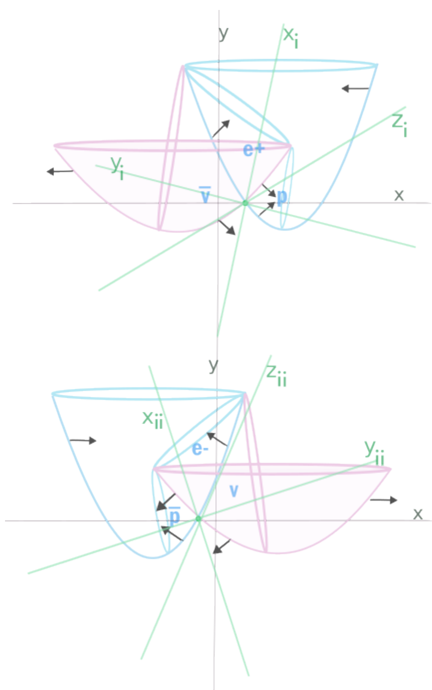

Figure 8: *Imaginary spatial hyperdimensions in the fermionic antisymmetric system.*

In the antisymmetric system, the two longitudinal subfields form another octonionic structure, pairing a quaternion with double negative curvature in the concave part of F_1F_2, and an inverse quaternion with double positive curvature in the convex part. Each longitudinal subfield follows the phase of the intersecting field that hosts it, tilting towards the contracting field.

This configuration introduces 6 additional imaginary spatial dimensions—3 for each tilting direction—while sharing the same real and imaginary time dimensions as the transverse octonion.

Being adjacent and cobordant to the transverse octonion, the longitudinal octonion can be considered related to it through their shared time dimensions, forming a non-formal fermionic sedenion with 16 theoretical dimensions but only 14 actual dimensions due to the shared temporal components.

12.2 Bosonic Sedenion

In the symmetric system, when F_1 and F_2 are in phase, the transverse subfields f_1 and f_2 share the same imaginary temporal phase, opposite to the real temporal phase of F_1F_2. The longitudinal subfields, however, follow the real phase of F_1F_2, moving up or down along the central axis of symmetry while expanding or contracting.

In this configuration, the transverse subfields form a bosonic octonion structure with six imaginary spatial hyperdimensions and a shared imaginary time dimension, while the longitudinal subfields align along the real spacetime dimensions.

The sedenion configuration is then concentrated in this case in the transverse subfields. When they both contract (while the intersecting fields expand), each transverse subfield has its own 3 imaginary spatial coordinates, converging their vertical imaginary axis on the negative real Y-axis. They represent a first bosonic octonion.

When they both expand (while the intersecting fields contract), each transverse subfield has its own additional 3 imaginary spatial coordinates, converging their vertical imaginary axis on the positive real Y-axis. They represent a second octonion, paired with the first in a bosonic sedenion of 12 imaginary space dimensions, 1 imaginary time dimension, and 1 real time dimension.

Although each transverse subfield follows the same imaginary time, its double curvature is formed by the curvature of the intersecting fields, which follow the same real time dimension.

12.3 Supersymmetric Trigintaduonion

The whole topological transformations that occur during the periodic synchronization and desynchronization of the intersecting base fields can then be interpreted as a non-formal trigintaduonion, which here can be considered a supersymmetric structure in the sense that it periodically reaches and breaks its inner symmetry, being transformed into each other through the converging and diverging evolution of time.

Non-Formal Framework and Mathematical Relevance

We think the intersecting fields model may be considered aligned with a non-formal framework because each subfield shares the cohomology of both the host and non-host intersecting fields F_1 and F_2.

This overlap manifests through curvature singularities and the complex time dimension in the antisymmetric octonion, forming a bilateral cohomological structure that cannot be decomposed into simpler, independent components without breaking the whole intertwined structure.

The shared cohomology across subfields reflects the dynamic interplay of the base intersecting fields, where the geometry of each subfield inherently incorporates contributions from both fields.

This may be particularly relevant in light of Lucía Martín-Merchán's recent work [1], which refuted the conjecture that compact G_2 manifolds necessarily exhibit a formal structure. Such a refutation opens new avenues for exploring topological models aligned with a non-formal scenario.

G_2 is the group of automorphisms or symmetry transformations that preserve the structure of the octonions. The number of dimensions associated with G_2, the symmetry group governing octonions, is 14—the same number of actual dimensions observed in the mentioned sedenions of this model.

On the other hand, in the rotational context of the system described earlier, the symmetric and antisymmetric octonions would periodically alternate with each 90-degree rotation, introducing a non-linear discontinuity in the transitions between the symmetric and antisymmetric sedenions, or at least in their vectorial configuration.

Octonionic configurations have been previously explored in attempts to describe the particles of the Standard Model and beyond [2]. Researchers such as Cohl Furey [3] have demonstrated how octonions can naturally encode certain aspects of particle physics, including gauge symmetries and the three generations of particles. However, despite their theoretical elegance, these approaches remain a niche territory in physics, primarily due to their high degree of abstraction.

The fields model presented here provides a topological, mechanical, and visual description of octonions, aiming to bridge the gap between the highly abstract and challenging-to-represent octonionic realm and a physically concrete, albeit unconventional, nuclear model.

13 Other Mathematical Implications and Future Research

Although the fields model presented in this article is primarily conceptual, lacking a specific algebraic or quantitative formulation, it offers several additional insights for further mathematical exploration, which are addressed in greater depth in [4].

- One key area is the potential relationship between the cusp singularities in the curvature of the intersecting fields and Gorenstein liaison.

- The four singularities that arise in the four stages of the system (both fields contracting, the right field contracting while the left expands, both fields expanding, and the left field contracting while the right expands) drive a total of 16 singularities in the system. This suggests a possible link between the geometry of the intersecting fields and Kummer-type surfaces in algebraic geometry.

- Additionally, the alternation and interpolation between the symmetric and antisymmetric systems, driven by the rotation of the system, may connect the transformations of the subfields to the mathematical structures of Hodge cycles. The rotational behavior hints at deeper symmetries that could relate these field dynamics to the cycles governing cohomological structures in complex algebraic varieties.

- In the rotational framework as well, interpolation may be conceptually related to Sobolev spaces and to Tomita-Takesaki modular theory.

- Furthermore, the two intersecting fields can be considered in the framework of two gravitational fields, as in bigravity or bimetric gravitational models. However, they could also be modeled as two interacting Higgs fields, where the Higgs boson represents the force of pressure caused by the fluctuations in these fields.

- Alternatively, these fields could be interpreted as two interacting pion fields that harbor a shared nucleus of united solitons, pointing towards a solitonic structure governing nucleon transformations and interactions.

- Relational Time Metric: The concept of time in this work is treated as a relational metric, where "past" and "future" serve as descriptors for the topological variations of the subspaces. The notions of "lagged" or "advanced" time are inherently relative, depending on the chosen reference metric.

- Real and Imaginary Dimensions: Similarly, the distinction between "real" and "imaginary" is also relational. Imaginary time is represented as an axis rotated to the imaginary diagonal within a coordinate system, signifying a distortion relative to real time, which is associated with the unrotated real coordinate and the unchanged phase.

- Topological Explanation of Mass Gap and Reflection Positivity: The model offers a natural topological framework to address the mass gap problem and reflection positivity. These features emerge intrinsically from the dynamics of the intersecting fields, providing conceptual insights into foundational challenges in quantum field theory.

- Unified Sedenionic Framework for Interactions: The intertwined transverse and longitudinal octonions in the antisymmetric system reveal how the longitudinal electromagnetic quaternions mediate the physical transfers occurring between the transverse strong and weak quaternions that form the nucleon. This intermediation provides a unified sedenionic framework for the strong, weak, and electromagnetic interactions, as previously discussed.

keywords

Quantum Chromodynamics (QCD), Neutron reinterpretation, Cyclic quark model, Beta decay, W and Z bosons, Electric Dipole Moment (EDM), non zero nEDM, Strong and weak interactions, Proton-neutrino decay, Antineutron, Bigravity, Bimetric gravity, Electroweak theory, Field compression and decompression, Dark matter, Unified field theory, Matter-antimatter Symmetry, Matter-antimatter transfer, Curvature singularities, Topological field theory, imaginary time, complex time, Octonions, nonformal octonions, fermionic and bosonic sedenions, supersymmetric trigintaduonion, G2.

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[3] Cohl Furey. Three generations, two unbroken gauge symmetries, and one eight-dimensional division algebra. `https://arxiv.org/abs/1910.08395`, 2019. arXiv preprint arXiv:1910.08395.

[4] Alfonso De Miguel Bueno. Neutron reinterpretation: A unified model for strong, weak, and electromagnetic interactions. `https://osf.io/preprints/osf/sz95c`, 2024. OSF preprint.

Additional diagrams

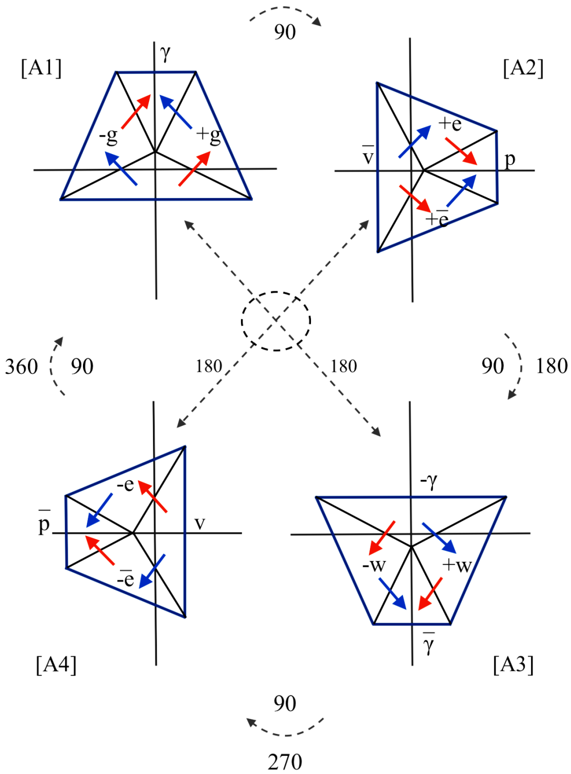

Figure 9: *Interpolating states in the rotational system*

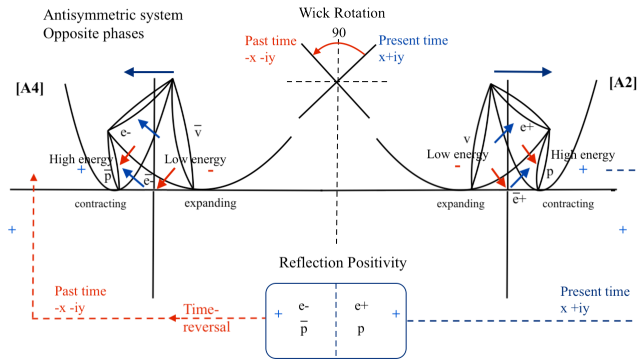

Figure 10: *Reflection positivity in the antisymmetric system*

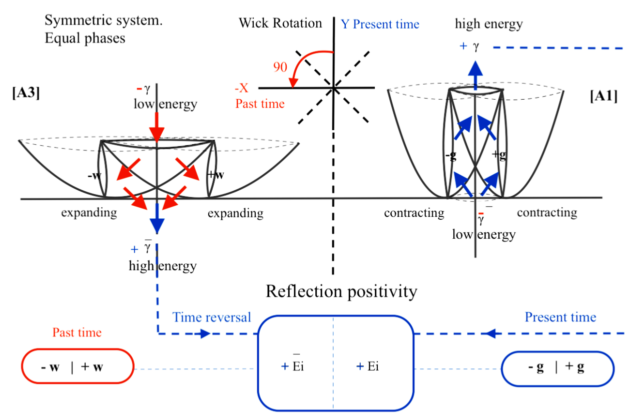

Figure 11: *Reflection positivity in the Symmetric system*