Bigravity and Interacting Higgs Fields: A Unified Framework for Mass Generation and Gravitational Dynamics

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Abstract

General Relativity (GR) has been remarkably successful at describing gravitational phenomena on large scales but faces challenges when addressing the accelerating universe, dark matter, and black hole singularities. Bigravity theories, which introduce two interacting gravitational fields, aim to extend GR by accounting for these phenomena.

This paper proposes a possible relationship between bigravity and interacting Higgs fields, offering a broader framework that establishes a physical connection between the massive and massless ripples generated by gravitational fields. This framework also provides a unified scenario in which the four known fundamental forces — gravitational, electromagnetic, strong, and weak — are interconnected.

In addition, the model provides new insights into neutron mass, charge asymmetry, and the presence of an electric dipole moment (EDM), challenging the Standard Model's assumption of perfect neutrality. By reinterpreting beta decay and introducing the antineutron as a transitional state in an antiproton-proton cycle, this framework offers fresh perspectives on long-standing issues such as proton decay and CP violation.

1 A Dynamic Framework for Gravitational Fields

We introduce a dynamic framework for gravitational fields that diverges from static models, focusing on continuous changes in curvature driven by expansion and contraction over time.

1.1 Static vs. Dynamic Gravitational Fields

In traditional GR, gravitational waves are often treated as perturbations on a static or nearly static background. However, our model conceptualizes gravitational fields as inherently dynamic entities.

As these fields expand or contract, their curvature evolves pulling inward with the negative side of its curvature while contracting or pushing outward with its positive side while expanding, producing ripples that propagate outward or inward at the speed of light. These gravitational waves propagate as disturbances in spacetime.

1.2 Interacting Fields and Bigravity Systems

A single gravitational field undergoing periodic expansion and contraction generates ripples. Expansion produces transverse ripples traveling outward, driven by the field's outward-pushing force caused by its positive (convex) curvature, akin to an expanding universe dominated by a strong cosmological constant. Contraction creates inward ripples resulting from the field's negative curvature pulling inward.

However, a single gravitational field alone cannot fully account for the strong, weak, and electromagnetic interactions. We propose that these phenomena emerge from a manifold structure formed by the interaction of two fields that vary in or out of phase, leading to the interplay of gravitational, strong, weak, and electromagnetic forces.

This model proposes that these interacting fields are two intersecting Higgs-like fields with curvature, alternating in and out of phase. Their intersection forms a coupled nucleus consisting of two transverse and two longitudinal gravitational regions that expand and contract over time.

When the intersecting fields vary out of phase as a result of their periodic expansion and contraction, the contracting dense gravitational regions create inward-pulling ripples interpreted as massive gravitons, while the expanding, less dense regions produce outward ripples corresponding to massless gravitons.

1.3 Gravitational Interactions through Intersecting Higgs Fields

In standard theories, the Higgs field generates mass through the action of Higgs bosons, which are ripples caused by fluctuations in the field that permeates the entire universe. This mass is then thought to curve spacetime according to GR, creating transverse gravitational waves. These gravitational fluctuations are traditionally viewed as massless gravitons, mediating gravitational forces. However, GR does not provide a mechanical explanation for how mass curves spacetime or how such fluctuations emerge from the gravitational field itself.

Bigravity theories Wikipedia contributors [2023a] extend GR by considering two metrics associated with interacting gravitational fields, linked to a massive and a massless graviton. These gravitons are typically conceptualized as ripples generated by gravitational fluctuations, mediating gravitational interactions.

1.4 Double Curvature and Singularities

In the intersecting fields model we propose, each gravitational region (or subfield) exhibits double curvature, coupled by a singularity representing a cusp that creates an abrupt change in curvature direction at the intersection of both fields. The double curvature can be entirely positive, entirely negative, or a combination of both, reflecting the shared subfield created by the intersecting fields.

1.5 In-Phase Dynamics and Symmetry

When the two Higgs fields are in phase, their influence on the longitudinal and transverse subfields differs:

Longitudinal subfields: The massive central longitudinal subfield directly follows the phase of the intersecting Higgs fields. Therefore, when both Higgs fields contract, the central longitudinal subfield in the concave side of the system contracts in unison, moving upwards. This contraction leads to an increase in the density and inner kinetic orbital energy of the subfield, creating a concentrated region. The double compression experienced in this state is consistent with the strong interaction and leads to the emission of a radiation pulse from the increased density and upwards displacement.

Transverse subfields: The transverse gravitational subfields exhibit mirrored symmetry as they contract or expand in phase. This phase is opposite to that of the intersecting Higgs fields. When both intersecting fields contract, the transverse subfields expand instead. During the contracting phase, they experience a compressive force from the bottom section of the intersecting contracting fields that harbour them, pulling inward, along with a decompressive force from the curvature of the opposing intersecting field. This combination of forces results in a balanced yet expanding structure.

During the interval when both Higgs fields are expanding, this behavior is inverted:

The central longitudinal subfield undergoes double decompression, moving downward and expanding, which reduces its density and inner kinetic energy. This phase is associated with a decay of the concentrated state, leading to an expansion and redistribution of density and energy, which then manifests in the convex side of the intersection as the inverted longitudinal subfield.

The transverse subfields now contract. They experience a compressive force from the outer side of the expanding intersecting Higgs field's curvature, which harbors them, and a decompressive force from the curvature of the opposite expanding field.

1.6 Phase Delay and Antisymmetric Dynamics

When the phase of one field lags or advances, a desynchronization introduces an additional time coordinate, represented as a purely imaginary diagonal, resulting in asymmetric states.

For instance, when the right field contracts and the left expands, the longitudinal subfield shifts rightward, following the contracting field.

The transverse subfield in the contracting field undergoes a double force of compression from the convex curvature of the expanding left field and the concave curvature of the contracting right field. An inverted mirror behavior occurs when the left field contracts and the right field expands.

This establishes an antimatter relationship between the left and right gravitational subfields over different time phases.

Regions undergoing double compression represent strong interactions (a strong bond formed by increased kinetic orbital energy), while those with double decompression represent weak interactions. Regions with half-compression and half-decompression correspond to electromagnetic interactions.

Electric charge is reinterpreted as the pushing force arising from the displacement of the longitudinal subfield in the antisymmetric system.

2 Mass, Inner Kinetic Energy, and Interaction Dynamics

In the context of intersecting Higgs fields, mass is represented inside of each gravitational subfield by a combination of density and volume, while energy is understood as the inner kinetic orbital energy within the subfields.

2.1 Mass and Kinetic Energy:

Mass, as a physical property, reflects how much material density is contained in a certain volume of space, and the energy corresponds to the motion of that mass within the gravitational subfields.

A contracting field which receives compression creates inward ripples moving at the speed of light, analogous to how massive gravitons behave as they propagate through spacetime. The pulling force increases the speed of the orbital motions inside the field.

2.2 Double Compression and mc^2

The standard relationship $E = mc^2$ ties mass to energy by multiplying mass by the square of the speed of light. This formula expresses that energy is (equal to) the result of relating the speed of light to the material density and volume.

It does not imply that mass and kinetic energy are identical or interchangeable. Instead, it expresses how kinetic energy is enhanced within the material field. The speed of light serves as a boosting factor for the kinetic energy contained within the mass.

In the framework of the intersecting gravitational fields, multiplying the inner kinetic energy by the speed of light once (mc) provides a measure of the kinetic energy associated with one-half of the curvature of the subfield, representing the energy of the ripple traveling at the speed of light.

To describe the energy caused by the double compression on the transverse subfield, it is necessary to consider the ripples caused by both sectors of the subfield's curvature. Thus, we multiply by c twice, resulting in mc^2.

When mass is multiplied by the speed of light twice (mc^2), it represents a double boost in the speed of the kinetic energy. This corresponds to a double compression in the gravitational subfield, concentrating both mass and energy. The resulting massive gravitons, or ripples caused by the contraction of the field that is gaining mass, are characterized by this intensified concentration of density and energy.

In summary, mc^2 would not simply represent mass converted to energy; it would indicate a state where mass, as a combination of density and volume, experiences a double compression, enhancing its kinetic energy due to the speed of light factor being applied twice. This reflects the nature of strong interactions in this model, where a gravitational subfield contracts with maximal density and energy.

In standard physics, the speed of light c is treated as a constant, the maximum possible speed for any form of information or energy propagation in a vacuum. According to General Relativity (GR), gravitational waves also travel at this speed, and Special Relativity (SR) asserts that nothing can exceed this limit in a vacuum.

However, while Einstein's formula assumes all gravitational waves move at the same speed, in the proposed model the ripples caused by the two sectors of the contracting curvature in the antisymmetric transverse subfield cannot travel at the same speed.

In the antisymmetric system, the inward compression generated by the outer pushing force of the intersecting field that expands creates a lower density region inside the half of the transverse subfield, while the pulling force caused by the negative side of the curvature of the contracting intersecting field creates a higher density region inside of the transverse subfield.

This difference implies that the transverse subfield is divided into two sectors: one generating ripples that travel at the speed of light, and another where ripples propagate more slowly than the speed of light.

Additionally, the mc^2 formula appears incomplete in the context of the topological landscapes of the two intersecting fields model. It does not account for the remaining mass in the double decompressed gravitational subfield — an issue potentially related to the mass gap problem — nor for the electromagnetic mass present in the half-compressed and half-decompressed subfields.

In the symmetric system, the longitudinal subfield located in the concave side does not move leftwards and downwards acting as its own anti-subfield, but it moves upwards (when contracting) or downwards (when expanding) through the central axis of symmetry of the coupled system.

This subfield experiences a double force of compression from the negative sides of the inner curvature of both intersecting fields. The result is a double boost of compression, with equal strength from both sources, and uniform inner density leading to a highly concentrated energy state. The ripples within the subfield rotate in a double helical orbit, emitting a pulsating photon.

In contrast, when the subfield expands losing density and energy in double decompression while moving downwards, the inverted central subfield on the convex side receives a double force of compression from the outer positive curvature of both intersecting expanding fields. However, the compressive forces and the density distribution in this region are significantly weaker, as they arise from expanding fields.

This discrepancy between the concave and convex sides suggests a violation of parity symmetry between the two longitudinal subfields. Since the concave subfield receives amplified energy through double compression, and the convex subfield experiences a weaker, less concentrated compressive force, this asymmetry disrupts the expected balance between the two. In this context, it can be viewed as a potential violation of the parity symmetry between matter and dark antimatter, where the energy density of matter exceeds that of its dark antimatter counterpart.

We consider dark the inverted longitudinal subfield because the convex side of the system is not directly detectable from the concave side.

The excess energy conserved in the concave longitudinal subfield could provide an explanation for the mass gap problem, which in the context of quantum field theory raises the question of why matter, in its lowest energy state, retains some energy rather than having zero energy.

Specifically, it deals with the observation that there is a gap between the vacuum ground state — expected to have zero energy — and the first excited state, rather than a continuum extending from zero mass. Institute [2024]

2.3 Symmetric vs. Antisymmetric Systems and the Emergence of Gravitons

The symmetric and antisymmetric systems may be considered as independent and separate linearly continuous transformations, corresponding to the smooth and gradual continuity of classical wave mechanics.

However, the rotational behavior of the model suggests an interpolation between the symmetric and antisymmetric systems through four successive states of synchronization and desynchronization.

2.3.1 Vector Dynamics in Gravitational Subfields

The periodic transformations of the four gravitational subfields can be represented by the dynamics of four vectors in a complex vectorial space.

Each subfield is characterized by two vectors representing a double force of compression, a double force of decompression, half compression and half decompression, or half decompression and half compression.

These vector pairs account for the behavior of each subfield as it evolves through four different stages:

- Strong Interactions: A subfield experiences double compression, represented by a pair of converging vectors. Each vector symbolizes a compressive force from the curvature, either an inward pull from a contracting field or a pushing force from the outer side of an expanding field. This increases the subfield's density.

- Weak Interactions: A subfield undergoes double decompression, represented by diverging vectors pointing away from each other. This reflects the outward pushing forces of the expanding curvature or the inward pulling forces of a contracting curvature manifested in an adyacent subfield, decreasing the subfield's density.

The transfer of mass and energy is facilitated by the shared curvature, with each subfield experiencing it from opposite sides — one convex and the other concave.

- Electromagnetic (EM) Interactions: Modeled by two diagonally oriented vectors touching at extremities. These two vectors represent a compression and a decompression in the subfield. This balanced state characterizes EM interactions, where forces are neither purely converging nor purely diverging.

2.4 Polarization modes, gravitational quadrupole ad EM diple

As gravitational waves Wikipedia contributors [2023b] propagate through space, they cause stretching and squeezing in directions perpendicular to their travel. This effect, called "polarization," describes the wave's orientation and distortion pattern — spacetime is alternately stretched in one direction and compressed in another.

The polarization axis is the direction along which this stretching and squeezing occur. For gravitational waves, this axis describes how spacetime is distorted as the wave passes through. (In the case of electromagnetic waves, the polarization axis Wikipedia contributors [2023c] refers to the direction of oscillation of the electric and magnetic fields, relative to the wave's direction of propagation.

The two main types of gravitational polarization are known as "plus" (+) and "cross" (×) modes, oriented at 45 degrees relative to each other. These modes determine how the stretching and squeezing occur in the plane perpendicular to the wave's direction. Each polarization mode possesses two poles (left and right), resulting in a quadrupole dynamic.

In the intersecting fields model, the antisymmetric mechanism aligns naturally with these polarization modes. Each mode corresponds to a 45-degree tilt of the axis dividing the transverse subfields. When the left transverse subfield contracts and the right expands (Polarization Mode 1), the axis tilts 45 degrees down to the left. Conversely, when the left subfield expands and the right contracts (Polarization Mode 2), the axis tilts 45 degrees upward to the right. Each polarization mode consists of opposing dynamics of the left and right transverse subfields — one contracting while the other expands.

The expanding transverse subfield generates massless gravitational waves manifesting in the adjacent EM region, where the central electromagnetic subfield moves toward the contracting side of the system, generating EM waves in its displacement direction. The EM subfield then compresses the opposite transverse subfield, causing it to contract and produce gravitational waves, thereby creating a massive graviton. In this way, the EM subfield mediates between the massless and massive gravitons.

The central EM subfield undergoes a pendular motion toward the left or right, "attracted" to the contracting intersecting field and "repelled" by the expanding one. This pendular movement introduces a dipolar nature to the EM waves, but the dipole alternates rather than being simultaneous; the EM subfield swings between acting as an electronic and positronic subfield, resembling a sequential dipole effect expressed as two alternating monopoles.

Each polarization mode corresponds to the alternating contractions and expansions of the transverse subfields, forming dipoles oriented at 45 degrees relative to each other. These dipoles correspond to the quadrupole structure of gravitational waves, where each mode has two poles — one contracting and one expanding.

In the intersecting fields model, the interactions between the massless gravitons of the expanding subfields and the massive gravitons of the contracting subfields are mediated by the EM subfield, which balances the pressures and maintains the polarization dynamics. The forces transmitted below the axis (from the convex side to the concave side) complement the dynamics above the axis, unifying electromagnetism and gravity, and incorporating the interplay between visible and "dark" matter within the same framework.

During the symmetric moments of the system, when both transverse subfields vary in phase, they expand or contract simultaneously in a dipolar dynamic — left and right. In this phase, they do not generate massless or massive gravitons. Instead, they function as electromagnetic subfields, mediating between the two central regions of the system.

In the first case, they mediate between the double pressure experienced by the upper central subfield as it contracts and moves upward, emitting a photonic pushing wave, and the decompression of the inverted central subfield on the convex side.

In the second case, they mediate between the decaying central subfield, which moves downward while expanding on the concave side, and the inverted pushing force on the convex side, which emits an antiphoton.

In this case, the waves generated by the transverse subfields propagate perpendicularly through the central subspaces, following the central axis of symmetry that divides the system into two handed sides.

The pushing force of the central subfield can be thought of as generating electric-like behavior, while the inner orbital dynamics relate to magnetic-like effects.

From this perspective, however, the distinction between gravitational and electromagnetic dynamics is essentially a matter of convention. All the wave dynamics, spacetime distortions, and pressure interactions described previously arise from the interactions of the two intersecting Higgs fields, pointing to a deeper, unified origin for these seemingly separate forces.

2.5 Degrees of Freedom in the Nuclear Manifold

To fully describe the evolution of the system, four vectors inverting sign in pairs with each 90-degree rotation are necessary. The rotational behavior interpolates between symmetric and antisymmetric systems, resulting in changes by pairs. Consequently, this structure implies eight degrees of freedom within the nuclear manifold.

The vector evolution reflects a cyclic interplay between the contracting and expanding fields. Initially symmetric, the system shifts to a right-handed contracting subfield and a left-handed expanding subfield as phases desynchronize. This alternates to an expansive state, before reversing dynamics again, returning to the original configuration.

This eight-degree freedom structure, combined with the two additional degrees from the non-intersecting sides of the Higgs fields, leads to a total of ten degrees of freedom, offering a comprehensive framework for gravitational and electromagnetic phenomena.

2.6 Topological Transformations and Singularities

The four subfields possess inner singularities representing abrupt changes in direction. As each subfield undergoes four stages during the rotational evolution, this generates 16 singularities, connecting the nuclear manifold with Kummer-type surfaces and algebraic structures.

The interpolation of symmetric and antisymmetric stages can be described through Hodge cycles, enabling a topological transformation of 16 distinct subfields, each converging at singularities where curvature abruptly changes direction.

The existence of 16 differentiated subfields aligns with the particle count in the Standard Model, plus the Higgs boson. This model presents four particles that transform topologically into one another without requiring a superpartner particle to link bosonic and fermionic particles.

3 Fermions, Bosons, and Exclusion Principles

The intersecting fields model is deterministic, whereas the Standard Model is probabilistic. This introduces some divergences, particularly because the nucleus derived from the intersecting fields model integrates matter and antimatter through mirror symmetry or antisymmetry.

In two interacting fields, the Pauli exclusion principle operates at the mirror symmetric or antisymmetric level. In the antisymmetric system, one subfield's expansion excludes simultaneous expansion of its mirror subfield. Likewise, the vertical subfield's movement left precludes its simultaneous existence on the right.

However, this exclusion does not apply between the two longitudinal subfields on the convex and concave sides of the intersection.

3.1 Spin and Rotational Symmetry

The Standard Model states that a 180-degree rotation changes the phase of fermions, causing a sign change (-1). A 360-degree rotation is needed to return the fermion to its original state, indicating spin-$\frac{1}{2}$. This property is associated with the Pauli exclusion principle.

For bosons, which have integer spins, a 180-degree rotation changes the spin direction but not the wavefunction, which returns to its original state after a 360-degree rotation. This is consistent with our model's symmetric system, predicting two mirror transverse subfields with opposite inner kinetic energies.

In the symmetric system, left- and right-handed transverse subfields exhibit chiral symmetry, interchangeable under a 180-degree rotation and not ruled by the exclusion principle, resembling bosonic behavior.

However, the upward contraction state of the central subfield is exclusive relative to the inverted dark subfield's decaying state on the convex side.

Spin-$\frac{1}{2}$ is interpreted as a state where only half of the vectors of the nuclear system have flipped signs, which occurs in the antisymmetric system's two stages, as opposed to the symmetric system's complete inversion.

3.2 Neutrons and the Symmetry of Transverse Subfields

In the context of the intersecting fields model, the neutron is not regarded as an independent, static subfield or particle but rather as a dynamic state of the two transverse subfields and the longitudinal subfields during the antisymmetric phase. This state occurs when the transverse subfields, opposing phases (one contracting and one expanding), momentarily coincide in shape, density, and inner kinetic energy. At this moment, the left or right transverse subfield contracts or expands, the right transverse subfield expands or contracts, and the longitudinal subfield, acting as an electron or positron, passes through the center of symmetry while moving left or right respectively.

In this specific configuration, the central longitudinal subfield in the concave side can be said to have a zero value, as it crosses the point of symmetry (as the inverted subfield does). The left and right transverse subfields, acting now as mirror symmetric fields, cancel out their opposing signs and can be momentarily considered as a single unified field. This unified "double field" is slightly more massive than the transverse contracting subfield during proton formation, as it encompasses the energy and density from both the contracting and expanding transverse subfields. The contracting transverse subfield contributes the most significant amount of energy and density, while the expanding transverse subfield retains some kinetic energy and density.

Remarkably, in the Standard Model the neutron is indeed slightly more massive than the proton. The intersecting fields model provides a natural explanation for this mass difference: the double neutron field aggregates the contributions from both transverse contracting and expanding subfields, in contrast to the proton, which only involves the contracting transverse subfield.

In the intersecting fields model, the neutrino is not a static subfield but rather represents a snapshot of a progressive expansion phase. As the neutrino transitions from contraction to expansion, its density and mass are not fixed but fluctuate throughout the process. What we observe as the mass and energy of the neutrino may be better understood as an average over its entire expansion phase, where the positive and negative sides of the double (half positive and half negative) curvatures of the expanding transverse subfield interact dynamically.

3.2.1 Neutron Electric Dipole Moment (EDM) and Charge Distribution Asymmetry

In standard particle physics, the neutron is considered electrically neutral, despite its internal structure consisting of quarks with fractional charges that result in a net neutral charge. However, an asymmetry in charge distribution is believed to exist, where the positive and negative charges inside the neutron are not perfectly balanced. This asymmetry is often referred to as a non-zero electric dipole moment (EDM) Wikipedia contributors [2023d], although no definitive experimental evidence has yet confirmed this feature.

In the intersecting fields model, the charge asymmetry in the neutron is driven by the same mechanism responsible for density distribution asymmetry within the contracting transverse fields in strong and weak interactions, which we previously analyzed in the context of gravitational waves. Just as the double compression experienced by the contracting subfield leads to non-uniform density distribution, resulting in slower gravitational wave propagation in one half of the subfield, the lack of uniformity in charge distribution similarly creates an asymmetric charge configuration within the neutron. This arises from the different strengths of the forces exerted by the outer side of the expanding field and the inner side of the contracting field.

The electron subfield, passing through the center of symmetry, exhibits its own electric dipole moment (EDM). The right side of the electron subfield (still at the right side of the center of symmetry of the system) experiences a positive compression, exerted by the outer side of the decompressing right transverse subfield, while the left side (already having passed to the left side of the system) experiences negative decompression. Although the electron field's cusp singularity resides at the center of symmetry, the positive compressive force on the right and negative decompressive force on the left create a separation of charge regions, forming an internal dipole moment. This asymmetry, already present in the electron subfield as it passes through the neutron structure, contributes to the overall charge dynamics, generating a non-zero EDM that further disrupts the expected neutrality at the zero point.

When the system transitions from proton to neutron in the proton-neutron-antiproton cycle, the left intersecting field contracts while the right one expands. The left transverse subfield experiences a stronger compressive force from the outer side of the right expanding field and the inner side of the left contracting field, while the right transverse subfield undergoes a double force of decompression. This results in a charge asymmetry, where the left side of the neutron exhibits a stronger charge distribution than the right side. This asymmetry generates an electric dipole moment (EDM) during this phase.

Conversely, when the system transitions from antiproton to neutron (now acting as an antineutron), the weaker charge distribution shifts to the right side, and the charge asymmetry flips. The longitudinal subfield moves rightward, passing through the center of symmetry to become a positron, already carrying an electric charge.

This alternation in charge distribution between the neutron and antineutron represents a time-reversed symmetry-breaking process, where the charge asymmetry flips depending on whether the neutron is evolving from a proton or an antiproton. As a result, this model predicts that the neutron exhibits an EDM during each transition, Although the overall charge symmetry is restored across the full proton-neutron-antiproton cycle, preserving the neutral feature of the neutron through time.

The mechanism that creates the charge asymmetry responsible for the neutron's EDM is the same one that governs the non-uniform density distribution inside the contracting subfields. The forces of compression and decompression affecting the longitudinal subfield's internal kinetic energy and pressure correspond directly to the formation of this dipole moment.

This suggests that the mass gap problem — where unexpected mass-energy persists at the lowest energy state — and reflection positivity may have a parallel in the unexpected charge within the neutron, challenging the Standard Model's assumption of perfect neutrality.

3.3 Beta Decay and the Role of Neutrinos in the Intersecting Fields Model

The standard explanation of beta decay involves a neutron transforming into a proton (β^- decay), accompanied by the emission of an electron and an antineutrino. Conversely, in β^+ decay, a proton transforms into a neutron, emitting a positron and a neutrino. However, this proton decay into neutron, positron and neutrino, despite decades of experimental searches, has not been observed.

The Standard Model assigns leptonic numbers to neutrinos and antineutrinos (+1 for neutrinos and -1 for antineutrinos) and considers them to be electrically neutral. This model does not account for the existence of antiprotons or antineutrons in the nucleus, as these would annihilate with protons and neutrons, releasing an energy that is not observed in stable nuclei. Historically, Heisenberg initially speculated that the neutron might be an antiproton, but this idea was not adopted in the Standard Model because their difference in mass.

In the intersecting fields model, the beta decay process is reinterpreted to introduce the antiproton while offering a clearer understanding of the neutron and describing the proton decay in a slightly different way. The weak interactions involving neutrinos and antineutrinos, as well as the strong interactions of protons and antiprotons, are interconnected and mediated by the adjacent longitudinal electronic subfield. In the antisymmetric system, governed by the Pauli exclusion principle, these transvere subfields acquire their topological and interchangeable identities through their alternating states of expansion and contraction.

Beta-minus decay: In the standard model, Neutron decays emits proton, electron, and antineutrino. In the intersecting field model Neutron decay emits proton, positron, and antineutrino.

When the central longitudinal subfield acts as an electron moving leftward, pulled left by the left intersecting field that contracts and pushed left by the right intersecting field that expands, the transverse subfield on the right side expands, emitting (or acting as) a neutrino. Simultaneously, the left transverse subfield contracts, acting as an antiproton.

Beta-plus decay: In the standard model, proton decay emits neutron, positron, and neutrino. In the intersecting fields model, proton decay emits a neutron, which decays emitting an antiproton, an electron and a neutrino.

As the central longitudinal subfield passes through the zero point of symmetry, traveling rightward to start acting as a positron, and as the transverse subfields coincide for a moment, the Beta-negative process reverses into Beta-positive. This results in the formation of a right-expanding neutrino and a left-contracting antiproton, and a leftward moving electron.

In the intersecting field model proton simply decays into a neutrino and antiproton into an antineutrino, but proton decay in beta-plus can also be expressed in terms of decaying into a neutron, considering the neutron as the state of the two transverse subfields coincident in shape and energy during their gradual contraction and expansion in opposite phases. At that moment, the electron/positron subfield passes through the zero point of symmetry, the central Y-axis. It is when the central longitudinal subfield crosses to the other side of the system that it acquires a negative charge, with the left contracting subfield emerging as an antiproton and the right contracting subfield manifesting as a neutrino.

Thus, in beta-minus decay, it could be said the antiproton decays into a neutron, and the neutron decays into a proton, positron, and antineutrino. In beta-plus decay, the proton decays into a neutron, and the neutron decays into an antiproton, electron, and neutrino.

The Standard Model cannot accommodate the coexistence of a positive positron and a positive proton because their equal charges would repel each other. That is why the electron is related to the proton in beta-minus decay, and the positron is related to the neutral neutron in beta-plus decay.

We consider that proton decay has not been observed due to the inherent stability of the proton, which may arise from the fact that in a same nucleus proton and antiproton are mistakenly considered as the same particle.

The standard treatment of nuclear structure does not account for the presence of both protons and antiprotons in the same nucleus, as their opposing charges would disrupt stability. Instead, the neutron occupies the role of the antiproton, balancing the nuclear structure in a way that preserves stability without the need to directly address the antiproton's negative charge.

In the intersecting fields model, the positive charge of the proton is not incompatible with the positive charge of the positron (or the negative antiproton with the negative electron). On the contrary, the electric charge, as a pushing force created by the positron moving rightward, compresses the right transverse subfield, which contracts to become a proton. The proton double compression is received by the positron subfield and by the dark inverted positron subfield. The antiproton double compression is received by the electron subfield and by the dark inverted electron subfield.

The inverted longitudinal subfield, located on the convex side of the intersection and outside the observable system, integrates dark matter and energy directly into the nucleus itself.

3.4 Neutrinos and Antineutrinos in the Intersecting Fields Model

In the intersecting fields framework, the role of neutrinos and antineutrinos is reconsidered. Rather than being treated as separate leptonic particles, neutrinos and antineutrinos are understood as the expanding phases of the contracting proton and antiproton, respectively. The left antineutrino is the mirror-symmetric counterpart of the right neutrino from a past state, which is now functioning as a proton. The antineutrino mirrors this behavior, following an opposite phase, acting as the expanding transverse subfield associated with the antiproton.

This interpretation resolves the symmetry between matter and antimatter in the system, unifying the weak interactions of neutrinos and antineutrinos with the strong interactions of protons and antiprotons, as mediated by the adjacent electromagnetic longitudinal subfields.

The coexistence of protons, antiprotons, neutrinos and antineutrinos is thus accounted for through the periodic variations of the intersecting fields, rather than through the annihilation of particles.

In the intersecting fields model, the electromagnetic (EM) longitudinal subfield mediates the energy transfer between the right handed decaying proton and the formation of the left handed antiproton. When the right proton decays while expanding to become a neutrino at the right side, its inner kinetic energy is transferred to the left side of the system, where a previously expanding antineutrino is now contracting to form an antiproton. This energy transfer is mediated by the EM longitudinal subfield and its dark, inverted counterpart, which are adjacent to both the left and right transverse subfields.

This mechanism effectively unifies EM, strong, and weak interactions within the same framework by linking the energy dynamics between the proton-neutrino and antiproton-antineutrino phases.

3.5 Photon Field Decay and Rotational Symmetry

In the rotational model of intersecting fields, the decay of the photon field can be interpreted in two complementary ways. The photon field is a manifestation of the system's symmetric state, where the longitudinal subfield experiences upward and downward fluctuations through the central axis when both intersecting fields contract or expand. These fluctuations represent photonic emission, as the central subfield contracts upward (emitting a photon) or decays downward (emitting an antiphoton).

The photon field, however, does not remain static in this model. As the system rotates 90 degrees from its symmetric state, where electromagnetic fluctuations occur up and down, it transitions into the antisymmetric state. In this state, electromagnetic displacements occur left and right, introducing a new dynamic where the central subfield moves laterally rather than vertically.

3.5.1

sectionPhoton Decay Process

Each 90-degree rotation of the system represents a transition between symmetric and antisymmetric states, corresponding to the four stages of field contraction and expansion. The stages are as follows: both intersecting fields contracting, right field contracting while the left expands, both fields expanding, and left field contracting while the right expands. In these rotations, the longitudinal subfield takes on different roles. It is first interpreted as a photon, then a positron (as the photon decays), followed by an antiphoton (after photon and positron annihilation, along with the emergence of mirror transverse bosons), and finally, an electron before the photon reemerges, completing the cycle.

3.5.2 Photon Absorption and Emission

During the alternance between the symmetric and antisymmetric moments each 90-degree rotational shift, it becomes clear that the photon can be interpreted both:

- Absorb the compression caused by **electron and positron** on opposite sides of the system.
- Emit **photonic waves** when contracting upward or **antiphotonic waves** when decaying downward.

The simultaneous compression of the photon by the left and right transverse subfields gives it a **spin of 1**. This explains its classification as a **bosonic field**, which, unlike fermions, is not governed by the Pauli exclusion principle.

However, the electron subfield alternates between acting as an electron moving left and a positron moving right at different moments. The idea of them being absorbed by the photon or annihilating each other to create a photon, from the perspective of this model, is a fictional representation of the successive phases in the rotational system and the quantum interpolation between the symmetric and antisymmetric systems it generates.

In the antisymmetric system, the photon field does exhibit Pauli exclusion principles when interacting with its dark counterpart, the dark antiphoton field located on the convex side of the system. This interaction balances the photon field's energy and maintains its periodic behavior.

The photon field in this model is not purely massless. Because it experiences a double compression from the negative curvature of both intersecting fields as they simultaneously contract, it carries massive properties. This results in a higher mass and inner kinetic energy inside a uniformely compressed subfield, receiving an equal double force of compression, which is consistent with the energy-mass relation described by $E = mc^2$.

4 Quarks and QCD in the Intersecting Fields Model

In the context of the intersecting fields model, we propose that quarks can be understood as the forces of pressure generated by the curvatures of intersecting fields as they contract or expand. This reinterprets quarks as the manifestation of the pushing or pulling forces resulting from the dynamic interaction of the intersecting Higgs-like fields. In this sense, quarks are not point-like particles but emergent force carriers within the curved spacetime generated by these fields.

4.1 Quarks as Force Carriers

In this model, quarks would correspond to the variations in the pressure caused by the intersecting fields as they contract or expand. These pressure forces arise from the changes in curvature of the intersecting fields, analogous to the Higgs boson field, which generates mass through its interaction with other particles.

As force carriers, quarks in this framework can be represented as four vectors aligned within a 2d rhomboid structure, divided into an upper and lower sector. These vectors represent the compressive and decompressive forces caused by the contracting or expanding intersecting fields.

The rotational dynamics of the system define the evolution of these vectors, where their orientation changes based on the phase of the intersecting fields.

In the symmetric system (stage 1), where both intersecting fields contract, the four vectors are positioned as follows:

- Upper sector:
  - Left top vector points right
  - Right top vector points left
- Lower sector:
  - Left bottom vector points left
  - Right bottom vector points right

When both intersecting fields expand (stage 2), the four vectors flip and invert their directions:

This alternating behavior of the vectors captures the symmetrical dynamics of the system, where contraction and expansion lead to changes in vector orientation.

4.2 Vector Representation of Quarks in the Antisymmetric System

In the antisymmetric system, where the right intersecting field contracts and the left expands (stage 3), only two vectors change direction with respect to the symmetric system in contracting phase:

- Upper right vector points downward to the right
- Lower left vector points downward to the right

When the left intersecting field contracts and the right expands (stage 4), the four vectors invert their direction, completing the transition. It implies that only two vectors chage direction with respect the symmetric system in the expanding phase:

- Upper left vector points downward to the left
- Lower right vector points downward to the left

This dynamic flipping of vectors reflects the antisymmetric behavior of the system, with pressure forces shifting between contraction and expansion.

According to Quantum Chromodynamics (QCD), up quarks are slightly more massive than down quarks. This aligns with the idea that the up quark corresponds to the contracting field which causes a higher compression, while the down quark corresponds to the lower compressing expanding field.

Similarly, among multiple theories that involve two Higgs fields, the Minimal Supersymmetric Standard Model (MSSM) Wikipedia contributors [2023e] suggests that two distinct Higgs fields are responsible for giving mass to different types of particles. One Higgs field interacts with up-type quarks, while the other interacts with down-type quarks and leptons. This setup is similar to the intersecting fields model as mentioned before.

On the other hand, while the Standard Model assumes three quarks (two up and one down) for the proton and no quarks for neutrinos or electrons, the intersecting fields model suggests that the strong interaction is governed by the pressure exerted by two quarks: one up quark and one down quark in the antisymmetric system for proton or antiproton, or two up quarks (or two down quarks) in the symmetric system for the photon or antiphoton.

In this framework, it is further proposed that the electron subfield contains a quark, contrary to the Standard Model, where electrons and neutrinos are not composed of quarks. The outer side of the transverse right subfield, which expands to become a neutrino, creates an up quark that acts as the pushing force inside of the electron subfield, driving it leftward. This introduces a relationship between quarks and leptons, where the neutrino transfers its quark to the electron as part of the interaction.

4.3 Rotational Evolution

The system may experience two types of synchronization: gradual synchronization (due to the expansion and contraction of the intersecting fields) and rotational synchronization (caused by the rotation of the system's vectors). As the system rotates, the vectors appear to align similarly to either the symmetric or antisymmetric configuration, raising the question of whether this is a real change in topology or just a geometric effect from rotation.

It's possible that both types of synchronization are happening at the same time, making the system more complex than it seems. This dual synchronization could explain why quantum mechanics uses probabilistic models — not because the system is inherently random, but because the overlapping dynamics of the system are too complex to predict deterministically.

4.4 Differential Equations and Systems Integration

While the symmetric system may be described by a linear complex differential equation, and the antisymmetric system by a linear complex conjugate equation, the rotational behavior introduces nonlinearities that disrupt the expected continuity. This makes it impossible to describe the system's evolution using a simple linear or harmonic approach, requiring instead an interpolation of both functions to capture the full complexity.

4.5 Observational Implications and Background Radiation Discrepancies

The proposed model, which posits different propagation speeds for ripples within the double-compressed transverse subfield, aligns with discrepancies observed in cosmic background radiation. Specifically, the model predicts that not all gravitational ripples travel at the speed of light; instead, ripples generated by regions of varying density within the subfield propagate at distinct velocities — some at the speed of light, while others move more slowly.

These differing speeds could account for the anomalies observed in the cosmic microwave background (CMB) radiation. Wikipedia contributors [2023f]

Such anomalous differences might arise from the interplay between the two sectors of the curvature in the transverse subfield, each contributing ripples with different propagation characteristics.

By considering the mixed speeds of gravitational ripples, this framework provides a potential explanation for the detected discrepancies in background radiation measurements.

5 Possible Mechanics of Orbital Variation and Solsticial Inertia

General Relativity (GR) is compatible with a massless graviton, which, in the context of intersecting fields, corresponds to an expanding gravitational subfield. This subfield's pushing force is expressed on its outer convex side, moving forward and creating gravitational waves in the adjacent outward region. In this scenario, motion within the inner kinetic orbit is inertial.

In a bigravitational context, massless and massive gravitons are considered.

In the intersecting fields model, the massive graviton corresponds to a contracting transverse subfield, while the massless graviton is associated with a transverse expanding subfield. This occurs within a framework of mirror-symmetric or antisymmetric sectors undergoing periodic expansions and contractions.

In a model of pulsating field mechanics, a phase of no variation occurs once the field reaches its peak expansion or contraction. During this phase, the field does not immediately reverse its dynamics; instead, it briefly maintains its state before beginning the opposite motion—either contracting or expanding. During this period of no variation, the orbital motions are also inertial.

This period of no variation resembles the behavior observed during solstices. At the solstices, the Sun's apparent position relative to Earth remains stationary before reversing its displacement. Once the solstice concludes, the Sun begins its opposite path.

This behavior aligns with the concept of a gravitational field undergoing two complete cycles of expansion and contraction per year.

During the contraction phase (perihelion), Earth would approach the Sun, and orbital motions would accelerate due to the increased gravitational pull. Conversely, during the expansion phase, Earth would move away from the Sun, and the absence of a contracting gravitational force would result in inertial motions, causing them to slow down.

Perihelion occurs around two weeks after the December solstice, and aphelion occurs about two weeks after the June solstice. The difference between these phenomena could be explained within the context of a manifold gravitational system by considering two intersecting gravitational fields curved by two parallel stars.

In this model, the gravitational field orbited by Earth would not be the Sun's gravitational field but rather an empty transverse gravitational field situated within the Sun's gravitational field that harbors it.

This transverse field would not be curved by a mass but would be formed by the intersection of the gravitational fields of both stars, having a half-positive and half-negative curvature, with a singularity point representing the abrupt change in curvature at the point of intersection.

In the antisymmetric system, when the intersecting fields vary out of phase, the transverse field and the field that harbors it would vary in phase.

Additionally, the transverse field would experience a pendular displacement of its orbit due to the periodic motions of the intersecting gravitational fields, resulting in two different inclinations during the course of a year, corresponding to the phases of expansion and contraction.

If the transverse subfield undergoes pendular inclinations twice a year during its expansion and contraction phases, this would align with the inclinations observed in the solar orbit. These inclinations would correspond to the maximum contraction and maximum expansion phases of the transverse subfield, matching the solstices where the Sun's path in the sky reaches its peak displacement. Similarly, the transitions from contraction to expansion (contracted-expanding) and from expansion to contraction (expanded-contracting) would correspond to moments of no variation, analogous to the equinoxes when the system's tilt is balanced.

This periodic behavior of the transverse subfield provides a potential explanation for the cyclical nature of solstices and equinoxes.

A dynamic bigravity interaction introduces possibilities for a more complex solar system model, providing a mechanical explanation for asymmetries currently attributed to chance or addressed with ad hoc hypotheses, including differences in orbital inclinations, speeds, and even opposite planetary rotations.

Possible perturbations between the orbit inside the host intersecting field and the elliptical orbit within the transverse subfield it harbors may cause an orbital loop near the perihelion. This interference could lead to a shared loop between the orbits of both the field and subfield, resulting in complex dynamics. Such a configuration could give physical reality to the currently considered apparent retrograde motion (epicycles) in planetary orbits, a concept already used in the old geocentric model. The synchronization or desynchronization between the orbital periods of the field and subfield in the symmetric and antisymmetric moments of the system may create observable deviations through time, offering a reinterpretation of planetary motions in a more intricate gravitational system.

6 Multiverse and nested universes

In this model, the Higgs fields can be interpreted as representing an expanding or contracting universe, but also as a cosmic gravitational field.

In this sense, the intersecting fields framework draws connections with multiverse theories, including parallel and nested universes.

Each phase of expansion or contraction in the coupled Higgs fields may correspond to different states or regions of a deterministic multiverse, suggesting that the gravitational dynamics described here could reflect interactions across multiple, coexisting universes or layers within a nested multiverse structure.

7 Additional considerations

The relationship of the model with black hole singularities and the atomic realm is described in Bueno [2023a]. A broader and more detailed mathematical background is conceptually provided in Bueno [2023b]. Possible connections with other theories are discussed in Bueno [2023c].

Keywords: black holes, singularities, intersecting gravitational fields, bigravity, bi-metric tensors, gravitational waves, mirror symmetry, strong and weak interactions, electromagnetic interactions, supersymmetry, quantum field theory, General relativity, quantum gravity, Gorenstein liaison, Hodge cycles, Kummer surfaces, T-duality, reflection positivity, SYZ conjecture, mass gap problem, equivalence principle, Pauli exclusion principle, cosmological constant, spin, polarization, quadripole.

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8 Related diagrams

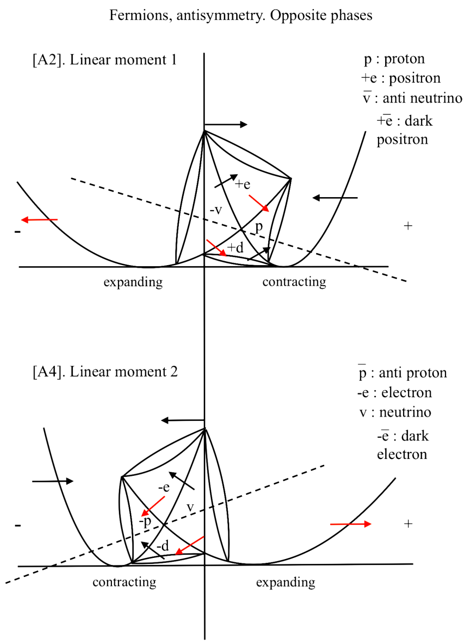

Figure 1: *Polarization Axis at 45 Degrees in the Antisymmetric System: Visualization of Polarization Modes 1 and 2*

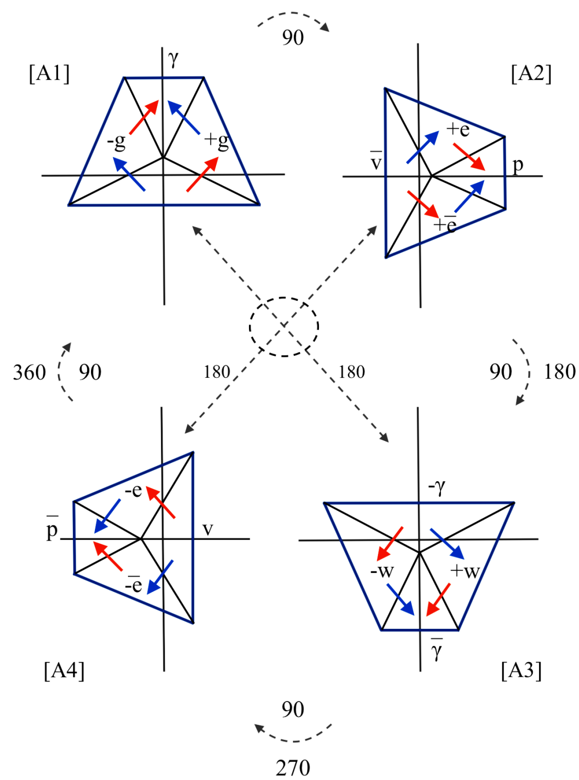

Figure 3: *Illustration of the rotational system*

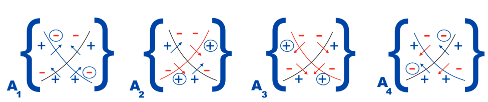

Figure 2: *Rotational system: Singularities represented as abrupt changes of curvature in the four subfields with double curvature*

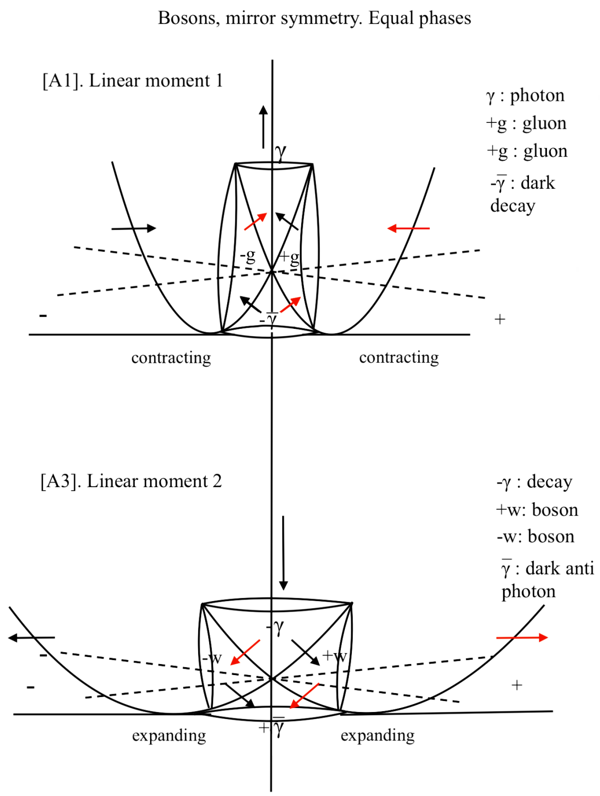

Figure 4: *Polarization in the symmetric system: The central subfield moves up or down along the vertical axis as the transverse subfields expand or contract*

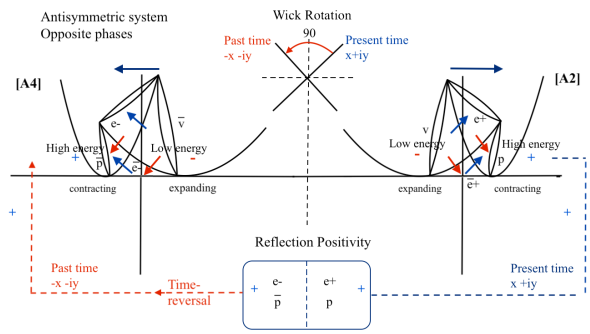

Figure 5: *Depiction of reflection positivity in the antisymmetric system*

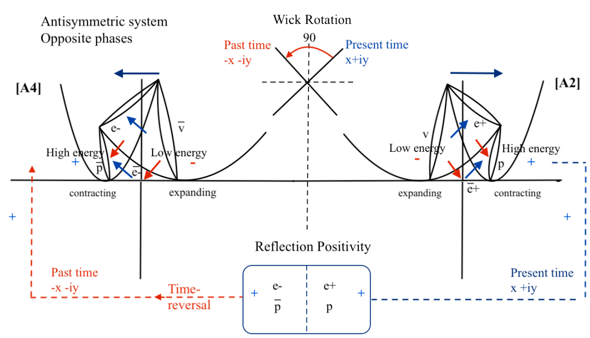

Figure 6: *Depiction of reflection positivity in the symmetric system.*

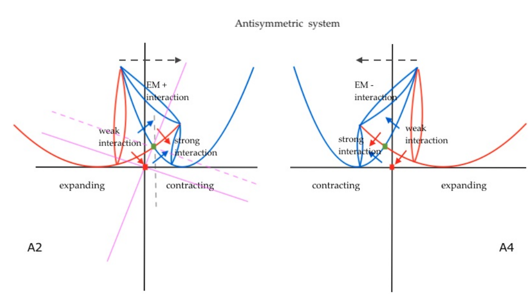

Figure 7: *Mass gap in the antisymmetric system*

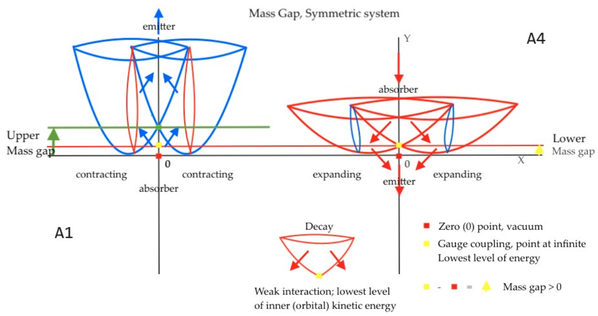

Figure 8: *Mass gap in the symmetric system*

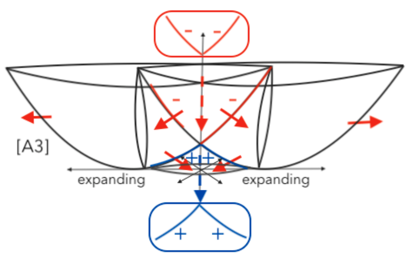

Figure 9: *symmetric system: Singularities in central subfields represented as abrupt changes of curvature.*

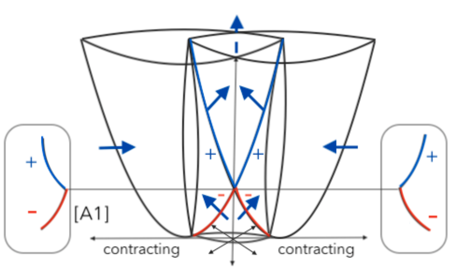

Figure 10: *Antisymmetric system: Singularities in transverse subfields represented as abrupt changes of curvature.*