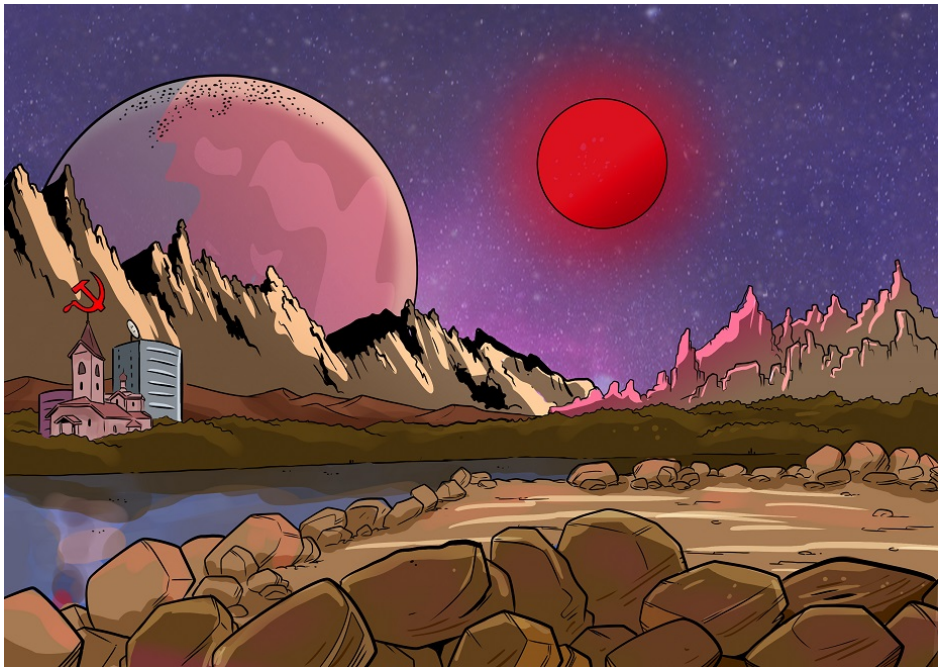

Gravitomagnetism as an Emergent Geometric Phenomenon: A Heuristic Model within a Quantized Spacetime Framework

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Abstract

This work presents a conceptual explanation of gravitomagnetism – a weak, relativistic effect involving the generation of magnetic-like fields by rotating masses – within a new ontology of fundamental physics.

We postulate that spacetime is quantized into dynamic geometric units called **p-gluons**. In this model:

- **Mass** is identified with a state of high compression and entanglement of p-gluons (the Z2 fastener).
- A **rotating mass** does not move *through* spacetime but sets the very rigid, entangled structure from which it is built into a global rotational motion (the Z3 fastener).
- **Gravitomagnetism** emerges as the macroscopic manifestation of this geometric vortex.

The gravitomagnetic field is not an abstract field but a physical state of rotation of the spacetime fabric itself around a rotating mass. A key prediction of the model is the existence of a *critical threshold* (of density, angular velocity), beyond which a 'geometric catastrophe' occurs – a sudden amplification of the effect, potentially explaining the extreme magnetic fields of magnetars. The work also generates a falsifiable prediction regarding the correlation of spin-axis orientations of the densest pulsars.

The role of this model is to serve as a *beacon for mathematics* – pointing the way for the development of a rigorous formalism. This paper is philosophical and heuristic in nature, acting as a roadmap and a call to undertake the effort of formalizing these ideas.

Contents

1 Introduction to the p-Gluon Model

This document presents a blend of physics concepts and metaphors designed to facilitate visualization and draw insightful conclusions about the fundamental nature of reality.

1.1 P-Gluon – The Spacetime Quantum

A **p-gluon** has a shape approximating a cube. It strives to maximize its volume for a given energy, which manifests as mutual "repulsion" between gluons. It can be compared to an air bubble in a quantum foam. The state of lowest energy for a gluon is its state of maximum volume. Any deviations from this state require an input of energy and manifest as local stresses in the spacetime structure.

In a vacuum of lowest energy, gluons have their largest sizes because they then possess the least energy. "Splitting" a gluon (with energy) is like striking a hard ball with a knife – the knife slips off. A gluon cannot be divided. The gluon is a "container" for energy. Introducing energy into spacetime causes the compression of gluons and the storage of this energy within them. This is the primary response of spacetime to increasing energy.

Just as foam bubbles share a common boundary, so too do gluons share a **Common Boundary (WG)**. The WG has a true vacuum energy density of approximately 10^{113} J/m^3, but we do not perceive this energy because it constitutes a background that we renormalize to zero. In the observable Universe, we record the cosmological vacuum energy density, which is what exists above this background.

Each gluon is associated with a trapped photon (a standing wave) as the smallest portion of energy. The photon is both trapped and not trapped in the gluon – these are two sides of the same coin, like the wave and particle nature of matter. What is "material" is the gluon. The gluon is a fundamental "piece" of spacetime with the potential to carry information. This information is "written" on the "wall" of the gluon "bubble."

Every p-gluon in the **Expanded Vacuum Configuration (RKP)** state is in a state of vibration. The spacetime foam is not static. Its grains vibrate to "push apart" as much as possible and achieve the greatest volume; their interiors, in turn, rotate, and the p-gluons are oriented chaotically or in an ordered (polarized) manner: RKP(-) or RKP(+). This is a geometric polarization related to the spin of the p-gluon. Due to the rotation of the interior, spacetime grains have an intrinsic magnetic moment and spin.

1.2 Quark – Crystallization of Spacetime

If many gluons come too close together (energy is always the causative factor), they can become a "seed" for the crystallization of a new form of being – a quark. This is the second response of spacetime to increasing energy. The formation of a quark absorbs energy equal to approximately 4 MeV/c^2. The interior of a quark resembles a "tank" for "compressed" gluons that store this excess energy.

Gluons, if they come too close together, begin to "tolerate" each other and do not push apart, but rather attract. Delving into the structure of the attractive force makes no sense since the gluon is a spacetime quantum without structure. The "tank," i.e., the quark, has no walls. The tank is a certain potential barrier that must be overcome for the gluons to move away from each other. The force binding the gluons, in our metaphor "air bubbles" in foam, comes from the boundary of the bubbles and the pressure (energy) inside them.

1.3 Photon – Information Carrier

A photon is the smallest portion of electromagnetic field energy trapped in a bubble of quantum foam (a standing wave of a photon bound to a gluon) – this describes the potential. We can also write that a photon is a quantum excitation of the electromagnetic field that propagates through the fundamental spacetime network (gluons). Its essence is the dynamic process of state transfer. At a given moment, the photon's state – oscillation between electric and magnetic components – is realized by a specific gluon capable of carrying the excitation. It is like a taut string – not vibrating, but having the potential to vibrate. Its true nature is the sequential transmission of this excitation to neighboring gluons at speed c.

In this way, the photon, being temporarily "stitched" to its current host, is essentially a universal carrier of information about its source, carrying it across cosmic distances.

1.3.1 "Mexican Wave" Stadium Metaphor

A photon is not a single spectator, but the passing pattern of excitation. A spectator (gluon) receives information from a neighbor (previous gluon), imitates their movement (state transfer), and thereby passes the impulse to the next neighbor. The spectator themselves remain in place – information and excitation state travel. At the moment when a spectator rises from the bench (electric field component is at its lowest), they simultaneously lean

forward (magnetic field component is at its highest). This sequential process, where each spectator activates the next, is what allows us to observe distant galaxies through a telescope.

1.4 Fundamental Spacetime States

1.4.1 RKP – Expanded Vacuum Configuration

Has two polarizations (+) or (-), which are like sides of a coin: Heads (H) or Tails (T). A third, metastable state is also possible, i.e., a coin standing on its edge. RKP can be compared to a unfolded sheet of paper. It can be used (e.g., crumpled) from the top side (state "H" or (+)) or the bottom side (state "T" or (-)). The (+) and (-) polarizations are not related to electric charge, but to spacetime geometry.

1.4.2 ZKP – Compact Vacuum Configuration

In metaphor, it may correspond to a Crumpled Sheet of Paper from the conventional side "H" or "T".

1.5 Cosmological Constant Λ

It is a direct measure of vacuum energy density. Λ as the Energy of the Ground State of the "Gluon Foam". A gluon is a quantum of this spacetime, a "bubble" in the foam that strives for maximum size at minimum energy. In a vacuum, in the lowest possible energy state, gluons have reached their maximum, equilibrium volume. This energy, irremovable, inscribed in the very structure of spacetime, is precisely the Cosmological Constant.

Imagine that the "gluon foam" fills all of space. Each "bubble" (gluon) has a certain minimal, non-zero energy, even when nothing is happening inside it (no ZKP, no quarks). The total energy of all these bubbles per unit volume is the vacuum energy density (ρ_{vac}). From Einstein's equations we know that:

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

That is: Λ is the mathematical expression of the physical fact that empty space (RKP) has non-zero energy density.

Where does this energy come from? The "tension" of spacetime is not a mysterious "dark energy", but a natural property of the geometric essence of the world. The p-Gluon "wants" to be as large as possible, but is squeezed

by neighboring gluons striving for the same. This creates a fundamental "tension" or "pressure" in the very fabric of spacetime.

Λ is a measure of the strength of this tension. The larger Λ, the greater the "innate" energy of each piece of space.

Why does Λ cause accelerated expansion of the Universe? In conventional physics, vacuum energy has negative pressure. In this model, expansion is a process in which the basic drive of p-gluons to maximum volume finds its global, cosmological realization.

At the fundamental level, in vacuum (RKP), the tension between gluons is in equilibrium. However, according to the author's broader concept, the state of quasi-antimatter (qAn) – being spacetime with negative geometric polarization – creates a "convex meniscus" at the edges of the Universe. This state generates effective repulsive pressure.

Thus, accelerated expansion is not "creation from nothing". It is the global manifestation of the geometric drive of p-gluons, fueled by the repulsive gravity of the qAn state, which pushes spacetime to expand, enabling gluons to realize their fundamental purpose – existing in a state of maximum volume.

2 Fastener Z1 – Electromagnetic Interactions

As mentioned, a p-gluon (pG) has a shape close to a cube. Two opposite faces are not smooth but resemble the shape of a screw thread. In this model, these are Z1 fasteners resulting from the "thread" polarization of the p-gluon. The shape of pG (cube, deformed cube, etc.) can change, since pG vibrates, but changing the volume of pG requires energy.

If we look at a single foam bubble, their shapes are also unique but geometrically similar to each other. Spacetime bubbles must always adhere to each other because the bubble itself is, in our observation, a rotating "void" and there cannot be free space between pG – i.e., void within void. Changing the shape of pG does not require energy – the spacetime grain behaves like a medium without viscosity. Changing the volume of the spacetime grain requires energy.

The basic volume of a p-gluon is V_0, V – current volume of the p-gluon. Compression limit: p-gluons have a minimum volume $V_{\min} > 0$ resulting from their structural energy $E_S = 10^{113}$ J/m^3.

2.1 Two Energies of the P-Gluon

1. **Structural Energy (E_S)**: The maximum energy a p-gluon can hold as a fundamental spacetime quantum. This is a property defining existence itself – the "cost of existence" of a geometry quantum, associated with maintaining the very "bubble" structure. For a p-gluon at the Planck scale, $E_S \sim E_P$.

2. **Activation Energy (E_A)**: The actual energy stored in the p-gluon in a given state, corresponding to its excitation or polarization. It is precisely the changes in E_A together with E_S that manifest as observable physics – matter, interactions, vacuum pressure.

Ground state: When $V \to V_{\min}$, further compression is impossible – the structural energy E_S constitutes a physical barrier.

2.2 Electron in the P-Gluon Model

Electron – a stable elementary particle (lepton). Rest energy 0.511 MeV (proton 938.27 MeV). Electron radius is less than 10^{-22} m (proton 0.842×10^{-15} m). According to our visualization, an electron is a ZKP. This means that a certain microscopic (electron diameter) region of spacetime has a higher vacuum energy density (0.511 MeV) than the background (6×10^{-10} J/m^3). Given its almost point-like diameter, this micro-region of ZKP has a gigantic energy density. Following the model or metaphor further, an electron is compressed pG and it is difficult to estimate how strongly, since we do not know the electron's diameter and the number of pG packed into one electron.

Let's treat the electron as a small paper tube, into which we press a piece of spacetime with polarization "H", i.e., Heads up (lid PBlu-H). State H or T is geometric polarization and has some relation to charge polarization, i.e., (+) or (-). Theoretically, a third state is possible – existence of RKP without geometric polarization – but nature does not tolerate this state. It is a metastable state of a coin standing on its edge. So the coin wants to fall over to state H or T.

Let's take a closer look at the lid, e.g., PBlu-H. As we know, the lid is the same as RKP with geometric configuration "H", i.e., heads up. The lid in our metaphor is the expanded vacuum configuration (quantum foam), in which each bubble is our pG, inside which the vacuum rotates. The grains of the lid have disordered orientation, their magnetic moments cancel each other out, but statistically there is more ordering towards Z1 left-handed or right-handed polarization for PBlu-T.

The rotation of the vacuum inside pG transfers to the entire pG (its vibrations), which prefers certain orientations in spacetime so that the Z1 fasteners couple with each other. Z1 are "threads" on two faces of pG and this corresponds to charge polarization (+) or (-). In turn, the vortex inside pG, its spin and angular momentum, corresponds to the geometric polarization of spacetime. Spin is a geometric consequence of the fact that p-gluons are not static, but dynamic and rotating. The Z1 interaction could be compared to a Yukawa force field – that is, what from inside pG (geometric polarization) goes beyond its boundary as an effect of the vacuum vortex inside pG.

2.2.1 Polarization Summary

1. **Geometric Polarization (H/T)**: Concerns the global state of the p-gluon as a whole. This is the "side of the coin". It decides whether a given ZKP region will become matter or antimatter in our world.

2. **Z1 Polarization (+/-)**: Concerns the local property of two specific walls ("threads"). Determines electric charge.

2.3 Formation of the Electron

The tube is synonymous with a "container" for slightly compacted spacetime storing 20,000 pG (size *ad hoc*, adopted only for visualization). Let's glue a string twice the circumference of the tube to one end of the tube. The tube stands on the unfolded string. For a certain volume of spacetime (tube), some cause forces pG to be pressed in. During the filling of the tube, it begins to rotate because the Z1 fasteners are activated due to slight compression of pG. The rotation of the tube means that spacetime itself, as a future electron, begins to rotate due to the action of Z1.

pG are added to the tube, and when it makes two revolutions (the string wraps around the tube), the system gets a signal to make a "click". We have an electron with 20,000 pG. The external system performed work to create the electron (slight compression of pG and their Z1 polarization), it now has energy 0.511 MeV and spin $+\frac{1}{2}$ (two string revolutions per "click"). If the tube is larger, a different, heavier particle is formed, which according to this model can also have spin $+\frac{1}{2}$. Spin means that inside the tube, geometrically polarized spacetime rotates (vortices in the pG themselves) and negatively (charge) from the Z1 fasteners.

2.3.1 Initial Conclusions Requiring Verification

1. If matter density increases, geometric polarization of spacetime increases: more compressed pG, their vortices more readily transfer to Z1. Matter can create stronger magnetic fields.

2. According to this model, spin 1 means that the "click" occurs at one tube revolution and a particle is created.

3. The author does not know why nature invented so many spins like 1, $\frac{1}{2}$, 2, $2\frac{1}{2}$. This must be related to the existence of particles.

4. Since the Higgs boson has no spin, the tube does not receive a rotation "click" signal. Due to some force, pG are forcibly packed into the tube, and this "click" is the decay of the tube wall itself from internal pressure – which is why the Higgs boson is unstable.

Spacetime grains (CP), i.e., pG, have patterns resembling screw threads on two opposite walls. In the RKP state (H or T) the Z1 "threads" are inactive, i.e., their orientations are random, giving a net charge of zero. For charge to exist, an ordered Z1 polarization must occur in a region of space. A screw thread has a natural polarization – it can be right-handed (+) or left-handed (-). This is a direct analogy to positive and negative charge, i.e., state (+) or (-).

The electron has a charge of -1. If it were "smashed", the sum of the charges of the fragments would have to be -1. Since there are no particles with a fractional charge of the electron (quarks have fractional charges but are confined in hadrons with integer charge), electron decay is forbidden.

Following the analogy logically, one can predict something interesting. One can imagine making an electron like dough. We take two liters of spacetime with geometric polarization PLUS (it can be MINUS, but it doesn't matter) and with energy of 0.511 MeV "knead the dough", i.e., polarize the p-gluons. They undergo slight compression in the process. The electron's rest energy (0.511 MeV) would then be the sum of:

1. **Ordering Energy**: "Payment" for imposing uniform Z1 polarization on a group of p-gluons that would be random in the RKP state (entropy $\rightarrow$ order).

2. **Compression Energy**: Small cost associated with slight compression of these p-gluons (transition to ZKP). For light particles (electron, neutrino) the ordering cost dominates, and for heavy ones (proton) the compression cost dominates.

In this analogy, the electron's charge comes from the emergent summation of the pG "thread" settings relative to the direction of motion. Let's assume arbitrarily that an electron is built from, e.g., 20,000 pG. It cannot have one less, because only at 20,000 units the system makes a "click" and closes: an electron is formed. Although the threshold value itself (e.g., ∼20,000 p-gluons for an electron) is at this stage a parameter, its existence provides a geometric explanation for charge quantization. Deriving this number from the first principles of p-gluon network dynamics remains a key challenge for formalizing this theory.

This "click" is a mechanical, geometric explanation of why charge is quantized. The system must reach a critical stability threshold. Only when a sufficiently large group of p-gluons coherently polarizes and connects via Z2 does a stable, emergent entity form: the electron. When a group of p-gluons reaches the critical threshold ("click" at 20,000), mechanical "fastening" does not occur, but global quantum entanglement of this entire group inside the electron occurs. All p-gluons in this group become one, inseparable quantum system. Perhaps the "click" creating the electron (these 20,000 pG) not only establishes charge and mass, but also automatically, by mathematical necessity, gives this excitation a property called "spin $\frac{1}{2}$".

The spin $\frac{1}{2}$ of the electron is not the sum of the spins of the constituent p-gluons. It is an emergent property of the entire entangled state inside the electron. This Z2 entanglement is what maintains the electron as a stable whole. Its "decay" would require simultaneous breaking of entanglement at all points at once, which is energetically unfavorable or forbidden by quantum rules. This gives the electron natural stability.

2.4 Spin – Geometric Consequence

Spin is one of the most non-intuitive and complex concepts in physics. The basic unit of spin (for electron, proton, photon) is $\hbar$ (h-bar), i.e., Planck's constant divided by 2π: $\hbar = h/2\pi$. Unit: joule × second [J·s]. This is the same unit as angular momentum in classical physics. Spin mathematically and dimensionally behaves like angular momentum. This is the reason it was given the name "angular momentum" – because it fits into the same mathematical structure. The unit [kg·m^2/s] combines mass, space (squared) and time. This suggests that spin is deeply connected to the geometry of spacetime itself.

This Z2 entanglement is what maintains the electron as a stable whole. Its "decay" would require simultaneous breaking of entanglement at all points at once, which is energetically unfavorable or forbidden by quantum rules. This gives the electron natural stability. When the critical number of p-

gluons to form an electron is reached, not only does Z2 entanglement and Z1 polarization occur, but all these p-gluons synchronize their rotation. Spin gives the electron a magnetic dipole moment (makes it a tiny magnet). When the electron is at rest, its magnetic moment comes solely from spin.

To "sculpt" an electron, the pG contained in it are glued together via Z2 fasteners. There is no other reason besides the algorithm of nature (its laws, i.e., when to make a "click") for pG to be able to polarize towards the "left-handed" side (-) only at a strictly defined number of pG. If we know the charge polarization mechanism, it means that electric charge can be divided. If we are to follow the model consistently and what it suggests, it means that the entire charge of the electron can disappear, since pG can lose entanglement and randomly realign. Only the energy previously used for Z1 polarization must then be released.

The motion of an electron through space is not the movement of a ball with 20,000 pG, but with a part of spacetime glued via Z2 fasteners to the electron itself. There is then no sharply defined boundary of the electron, since the electron itself is a ZKP. An electron is not a ball with 20,000 pG rolled on a table. It is a stable pattern of polarization (Z1) and bonds (Z2) that sequentially transfers its entangled state to neighboring p-gluons in the network.

2.4.1 Static Electron (No Motion)

An electron cannot exist in a state of complete rest, but we will adopt such a model to explain how an electrostatic field forms around the electron. Since in the electron the pG are left-hand polarized via Z1 fasteners, the same fasteners exist in the spacetime p-gluons around the electron. Without an electric field, the Z1 fasteners in the spacetime around the electron are randomly oriented: the state of Z2 maximization is preferred.

The Z1 polarization originating from the electron's surface reorients the position of the fasteners in its surroundings (spacetime). This reorientation results from geometry. Since two walls are corrugated with thread, only identical walls of other pG will adhere to them without gaps. The further from the electron, the less Z1 ordering vs Z2. Fewer and fewer walls with "thread protrusions" interlock with each other. We then observe that the electric field is stronger closer to charged objects and weaker further away.

What we call an "electrostatic field" is precisely this fading halo of Z1 ordering in the p-gluon network surrounding the central ZKP region. Close to the electron, Z1 are strongly ordered (strong field). Further away, competition with the drive to maximize Z2 (geometric connectivity) causes the ordering to weaken (weak field). A stationary electron: deforms the net-

work statically (Z1) ⇒ electric field. The quantum field in this model is the network of p-gluons in the RKP state, having the potential for various polarizations and bonds.

2.4.2 Electron in Motion

Now it gets interesting. Consider the motion of many electrons. When they fly in a beam, one after another, they cannot fly touching each other due to Coulomb repulsion, so electrons will be at some minimum distance from each other. Let's now compare an electron beam to a threaded rod of the beam's thickness. Around the rod are other p-gluons also left-hand polarized, i.e., in (-). So the rod squeezes through left-hand polarized spacetime grains (p-gluons) and sets them into vortex motion around the rod. The further from the rod, the less Z1 ordering in the gluon network and the weaker the vortex.

This vortex is the movement of the left-hand polarized (-) spacetime itself around the rod, i.e., the conductor (or beam) with electrons. A new force carried by Z3 fasteners appears here - vortices in the grainy spacetime. It forms around every moving electron, whether single or in a beam. We have just logically derived the existence of the magnetic field from purely geometric properties of the p-gluon network. A moving electron (or beam) is no longer just a static excitation – it becomes a source of dynamic geometry that manifests as magnetism.

3 Fastener Z3 – From Magnetism to Gravitomagnetism

The Z3 fastener is the carrier of vortices in polarized (by Z1 fasteners) spacetime.

3.1 Fastener Summary

1. **Z1 (Electrostatics):** Static ordering of "thread" polarization.
2. **Z2 (Strong/Casimir):** The mechanism for binding and compressing p-gluons.
3. **Z3 (Magnetism):** Dynamic, vortex states of the p-gluon network, excited by the motion of Z1 charges.

Different forces are different types of deformations (static, compressive, rotational) of the same fundamental network. A moving electron: deforms

the network dynamically, introducing vorticity (Z3) ⇒ magnetic field. The magnetic field in this model is "rotating spacetime". What we call magnetic field lines wrapping around a conductor are, in this model, actual, geometric vortices in the p-gluon network. It is not an abstract field, but a physical state of rotation of the very fabric of spacetime around a moving charge.

The Lorentz force now has a geometric explanation: a second moving electron experiences a force because it moves through this rotating spacetime. Its trajectory is curved not by a mysterious "force" but by the geometric background on which it moves – exactly as in General Relativity, but for electromagnetism.

In this model, the Z3 fastener, being a vortex deformation of spacetime, corresponds to the magnetic moment of particles. The spin of, e.g., an electron is its internal, quantum "Z3 vortex". Interestingly, the described mechanism for generating magnetic field logically leads to the conclusion that a rotating mass (especially when very dense and rapidly rotating) should generate a magnetic field. Perhaps here too there will be critical parameters (density, radius, angular momentum) at which a geometric catastrophe occurs and the magnetic moment appears suddenly and is extremely strong. The same mechanism (Z3) works for both electron spin and the magnetic field of a neutron star.

Stating that there are "critical parameters" beyond which an "extremely strong" magnetic moment appears is a direct call for observers to check data from pulsars, magnetars, and black hole mergers. "Rotating mass should generate a magnetic field" – in the above model is not a separate rule. It is a geometric imperative, a consequence of the fact that mass is compressed Z2, and motion is deformation. This MUST happen.

3.2 Why is the Effect So Weak in Weak Gravity?

In standard physics (GR), gravitomagnetism is described by analogy to electromagnetism. The gravitomagnetic field B_g is proportional to the source's angular momentum. The key is the ratio of forces – why is gravitational interaction so weak compared to electromagnetic? In the above model, this makes deep sense:

- **EM Interaction (Z1):** Surface ordering ("threads")
- **Gravitational Interaction (Z2):** Volumetric ordering (density of Z2 "glue")

The strength of interactions depends on how many "fasteners" are involved. For a point particle: almost all its p-gluons are on the "surface"

(close to interaction) ⇒ Z1 is effective. Only p-gluons in the "volume" create mass ⇒ Z2 is "smeared out" and less effective at a distance. This leads to the known fact: gravitational constant G is about 10^{36} times smaller than Coulomb's constant for a proton. In our model, this huge factor may result from the ratio of Z1 to Z2 involved in the interaction.

3.3 When Does the Effect Become Strong? Model in Action

In extreme conditions, when matter density is enormous (neutron stars, black holes), Z2 ceases to be "smeared out" – the entire volume is extremely packed. Then effects related to Z2 (like gravity and gravitomagnetism) drastically increase.

Look at the formula for the gravitomagnetic moment (lever arm) for a rotating body:

$$B_g \sim (G/c^2) \cdot (J/r^3)$$

Where:

- G – gravitational constant (weak)
- c – speed of light
- J – angular momentum of the body
- r – distance from the source

For the Sun: J is large, but r is huge, and G is small ⇒ negligible effect.
For a pulsar (rotating neutron star):

- J is enormous (fast rotation)
- r is small (size ∼10 km)
- Density is monstrous ($\sim 10^{17}$ kg/m^3) ⇒ our Z2 is maximally active

The fastener model predicts that under such conditions, gravitomagnetism should be observable and powerful. And this agrees with data. The Lense-Thirring effect (frame-dragging) is measured around Earth (weakly), but around pulsars it may be a dominant effect.

Some neutron stars, so-called magnetars, have magnetic fields trillions of times stronger than Earth's. The dynamo model cannot explain such extreme values without introducing "fitted" parameters. In the above model, there is no separation. The magnetic field of a neutron star is not an "add-on". It is a direct, geometric consequence of its existence and motion.

- **Mass is Z2:** The enormous mass and density of a neutron star is simply extreme concentration and activation of Z2 fasteners. This is not "plasma", this is rock made of spacetime in a critical state.
- **Rotation is Z3:** The rapid rotation of the star does not move charged particles. It sets the very rigid, Z2-entangled structure from which the star is built into global rotational motion (Z3).
- **"Geometric Catastrophe" / Z3 Activation Threshold:** At some point, Z2 density and angular velocity reach a critical value. The rotating Z2 "ignites" Z3 on a macroscopic scale. This is no longer a single vortex around a moving charge (magnetism). This is a global, gigantic Z3 vortex, "carved" into the very structure of compact matter.

In this view, the strong magnetic field of a neutron star does not result from a "dynamo effect". It is the EXPLICIT, MACROSCOPIC AND SUDDEN MANIFESTATION OF SPIN. Just as an electron has its spin (micro-vortex Z3), a neutron star has ITS spin (macro-vortex Z3), only trillions of times stronger, because it arose from the catastrophic amplification of Z3 by Z2.

In this model, gravitomagnetism is the rotation of spacetime (Z3) caused by MASS in motion (analogously to magnetism, which is rotation caused by CHARGE in motion).

- **Source of Magnetism (Z3):** charge (Z1) + motion $\Rightarrow$ Z3 vortex
- **Source of Gravitomagnetism ($\mathbf{Z3_{grav}}$):** mass (Z2 density) + motion $\Rightarrow$ $Z3_{grav}$ vortex

3.4 Model Predictions

The described gravitomagnetism mechanism generates concrete, testable predictions:

1. **Geometric catastrophe** (sudden manifestation of spin)
2. **Pulsar orientation correlation** (the spin axis of a pulsar should "level out" relative to the global geometric background, like a compass needle aligning in the Earth's magnetic field)
3. **Non-linear growth of magnetic fields** at extreme densities

3.4.1 Model Prediction

In extremely dense matter (where Z2 is dominant), the dependence of gravitomagnetism on density (ρ) ceases to be linear. "Amplification" appears due to saturation of Z2 "fasteners". This can be described by a correction:

$$B_{g_{\text{effective}}} \sim B_{g_{\text{classical}}} \cdot (1 + \alpha \cdot (\rho/\rho_{\text{critical}})^n)$$

Where:

- α and n are constants
- ρ_{critical} is the density at which Z2 begins to dominate

Or by another formula:

$$B_{g_{\text{effective}}} \sim B_{g_{\text{classical}}} \cdot \Theta(\rho - \rho_{\text{critical}}) \cdot f(\omega)$$

Where:

- $\Theta(\rho - \rho_{\text{critical}})$ is the Heaviside step function – the effect "switches on" abruptly after exceeding the critical density
- $f(\omega)$ is a function dependent on angular velocity, which becomes nonlinear after exceeding the threshold

This means that orbital precession around a rapidly rotating neutron star would be slightly different than predicted by classical GR.

The model suggests the existence of a correlation between pulsar spin axes. The first verification step should be to check whether such a correlation even exists. If detected, the next stage will be to study whether its strength correlates with pulsar density and rotation period, and to search for a possible global reference direction.

4 Fastener Z5 (Gravity)

According to this model, gravity does not belong to 4D spacetime – it shapes 4D spacetime from the outside (4D brane). Gravity is not "just another interaction", but a fundamental metaphysical force shaping the very arena on which physics plays out. The gravity we measure (G-1) is merely a projection of the true force G from a higher dimension. 4D spacetime is not a "dynamic geometry", but a rigid brane in a higher dimension.

Conclusions stem from the hydrodynamic analogy: fragment "Description of the analogy: If we look at a vessel with water, on which metal pins,

polystyrene balls and polystyrene dust float, we will observe phenomena allowing – by analogy – to understand some mysteries of the Universe.

1. **Metal pin (matter analog):** Earth's gravity (force G-1) pulls it into the water, but surface tension (cohesion forces) prevents it from sinking. A concave meniscus (dent, D) forms around the pin. Pin density: $d_3 > d_2$ (where d_2 is water density).
2. **World of "Flatlanders" (Fl) and their measurement error:** Fl live on the pin (their world is CP 2D + time = CP 3D). They see that pins attract each other and think it's the curvature of their CP by mass M. We (4D observers) know that it's the effect of real gravity G-1 from a higher dimension.

We are "flatlanders" living on a 3-brane spacetime. 4D gravity is our illusion. p-gluons are grains (quanta) of the 4D brane itself:

- Z1, Z2, Z3... = fasteners inside the 4D brane (EM, strong, weak)
- Lack of gravitational fastener = because gravity acts *on* the brane, not within it
- Gravity is not an interaction – it is deformation of the substrate

Gravity deforms the BRANE by compressing p-gluons inside it. Gravitational waves are not "wrinkles of spacetime", but undulations of the brane itself.

If we approach the hydrodynamic analogy consistently and allow it freedom in reasoning, a certain absurdity arises that the author finds difficult to accept. According to the hydrodynamic model, flatlander gravity results from stretching their 3D spacetime fabric (water surface), not compression. If we directly transfer the analogy to our 4D brane and assume that gravity, energy and mass are merely effects of spacetime geometry, it would mean that inside, e.g., a neutron star, mass is stretched, not compressed. In this case, we will reject the model's conclusions and assume that gravity compresses, not stretches (unless we live in a mirror world and what is stretching for us is perceived as compression).

Conclusions

The presented model offers a coherent, geometric description of reality in which various interactions emerge as consequences of deformations of the

fundamental p-gluon network. A key achievement is the explanation of gravitomagnetism as a macroscopic manifestation of the same mechanism (Z3) that at the quantum level corresponds to the spin of elementary particles.

The model generates concrete, falsifiable predictions, including the existence of a critical threshold ("geometric catastrophe") for extremely strong magnetic fields and correlation of pulsar spin axis orientations. Although work on mathematical formalization of the model is only at a preliminary stage, it constitutes a promising roadmap for future research on the quantum nature of spacetime.

7. Summary and Research Program

The presented geometric spacetime model based on p-gluons offers a coherent framework for unification of fundamental physics.

7.1 Fundamental Conceptual Breakthroughs

- **Geometry as the substrate of reality:** mass, charge and spin emerge as states of deformation of a fundamental network, not as fundamental properties of particles.
- **Unification of physical scales:** the same Z3 mechanism explains both electron spin (microscale) and extreme magnetic fields of magnetars (macroscale).
- **Solution to the hierarchy problem:** the vast difference in strength between electromagnetic and gravitational interactions results directly from fastener geometry – Z1 (surface) vs Z2 (volumetric).

7.2 Cosmological Implications and Connections

- **Dark energy as quasi-antimatter:** the model finds natural development in the concept of the Morpheus Sphere, where quasi-antimatter (qAn) forms a boundary layer responsible for the accelerated expansion of the Universe.
- **Geometric catastrophe:** sudden amplification of Z3 effects at critical parameters offers a mechanism for generating extreme magnetic fields without needing to introduce ad hoc parameters.

- **The Great Segregation:** the process of pushing qAn to the periphery of the Universe naturally solves the cosmological coincidence problem and explains the homogeneity of dark energy.

7.3 Research Program

Priority 1: Mathematical Formalization

- Derivation of the p-gluon network equation of state
- Formalization of the geometric catastrophe threshold (Z2/Z3 phase transition)
- Development of a geometric analog of the Dirac equation
- Connection with the formalism of "A Tale of Deep Symmetry"

Priority 2: Observational Predictions and Data Analysis

- Analysis of pulsar spin axis orientation correlations in LIGO/Virgo/KAGRA data
- Search for characteristic signatures of geometric catastrophe in neutron star merger signals
- Verification of non-linear magnetic field scaling in extremely dense matter

Priority 3: Decisive Experiments

- Precise measurements of the dark energy equation of state parameter w (Euclid, Roman Space Telescope missions)
- Studies of particle lifetimes under extreme geometric deformations (LHC, future accelerators)
- Search for characteristic signatures of quasi-annihilation in background radiation

7.4 Philosophical Revolution and Perspectives

This model proposes a radical paradigm shift: from particles *in* spacetime to particles *as* spacetime. In this perspective:

- Material reality is an emergent manifestation of geometric states of a fundamental network
- Laws of physics are consequences of geometric constraints and optimization principles
- The unity of nature results from the universality of geometric deformation mechanisms

Ultimate test: Does nature indeed prefer the elegance of geometric principles over the complexity of quantum fields? The answer lies in the data we are currently collecting and that will be collected by future generations of observatories.

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Note: The terms "fasteners" and "p-gluons" are conceptual metaphors for building physical intuition. Much like "strings" in string theory, this language builds bridges to new paradigms before full mathematical formalization. The value of these metaphors lies in their ability to generate testable predictions.

Model under further development. To be continued.