

Unified Electromagnetic Theory of Matter and Light

Section A — Structure of Matter

Part III - Electromagnetic Origin of Mass and Gravity

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Abstract

*This work develops a physical model connecting the electromagnetic supertorus introduced in Part II with inertial mass and gravity. The supertorus is treated as a localized, phase-coherent electromagnetic structure whose stability requires two complementary structural tendencies: an expansive tendency and a binding tendency. Their macroscopic manifestations are described as two scalar fields, termed the **Energy Field** and the **Binding Field**.*

A minimum-energy variational description of the fields outside the localized source leads, in the spherically symmetric far-field approximation, to a $1/r$ spatial dependence for both fields and consequently to an inverse-square dependence of their gradients. Because the two fields have opposite structural roles, their macroscopic contributions largely cancel. The small binding-dominated residual is identified with gravity. If their amplitudes are denoted by A_E and A_B , the gravitational residual is determined by

$$A_B - A_E = Gm_g.$$

Inertia arises differently from the same two-field structure. During acceleration, both the Energy Field and Binding Field are proposed to deform away from their preferred minimum-energy configurations. Since both deformations resist this departure, their inertial contributions act cooperatively rather than cancelling. Inertial mass is therefore associated with the combined deformation response of the two fields, characterized by the amplitude scale $A_B + A_E$.

*The model thus assigns gravity and inertia to two different manifestations of the same underlying structure: **gravity probes the small difference between the Energy Field and Binding Field, whereas inertia probes their combined resistance to acceleration-induced deformation**. This provides a possible physical basis for the common origin of gravitational and inertial mass and explains how weak gravity can coexist with substantial inertia.*

The framework also suggests a continuous relation between light and matter: light represents propagating electromagnetic organization, whereas matter is interpreted as a localized, geometrically and phase-closed electromagnetic state. The resulting chain connects electromagnetic dynamics, localized matter, macroscopic fields, inertia, and gravity within a single physical picture. A central quantitative objective is now to determine the absolute amplitudes A_E and A_B , both from the microscopic supertorus and independently from gravitational and inertial constraints.

1. Introduction

Mass and gravity are among the most fundamental properties of matter. Inertial mass determines the resistance of a body to acceleration, while gravitational mass determines its participation in gravitational interaction. Their experimentally observed equivalence suggests that the two phenomena may share a common physical origin.

Parts I and II of this work investigate the possibility that localized matter can be represented by a coherent electromagnetic structure. In Part II, the electron is modeled as an electromagnetic supertorus: a closed, dynamically organized configuration in which electric and magnetic fields, displacement currents, phase relations, and electromagnetic energy flow form a self-consistent localized system.

The present work starts from this internal structure and asks a different question:

What macroscopic physical properties follow from the existence of such a localized electromagnetic configuration?

In particular, the objective is to investigate whether inertia, mass, and gravity can emerge from the same electromagnetic organization that maintains the particle itself.

A stable supertorus cannot be characterized by electromagnetic energy alone. Its localization requires a dynamical balance between complementary structural tendencies. One contribution tends to oppose confinement and expansion of the electromagnetic configuration, while another provides the binding required to maintain a localized structure. In a stable particle these contributions must remain closely balanced, although their physical effects need not disappear.

The central hypothesis developed in this work is that these two internal structural tendencies also have macroscopic manifestations in the

space surrounding the particle. They will be represented by two scalar quantities: an **Expansive Energy Field**, hereafter referred to as the **Energy Field**, and a **Binding Energy Field**, hereafter referred to as the **Binding Field**.

These fields are not introduced as additional electric or magnetic vector fields. The internal dynamics of the supertorus remain described by the electromagnetic fields

$$\mathbf{E}(\mathbf{r}, t), \quad \mathbf{B}(\mathbf{r}, t),$$

and by Maxwell's equations. The Energy Field and Binding Field instead represent a macroscopic description of two complementary energetic consequences of the complete organized electromagnetic structure.

The distinction between their two possible modes of action is central to the proposed interpretation.

When the complete particle is accelerated, both structural contributions must participate in maintaining and reorganizing the coherent electromagnetic configuration. Their effects therefore act cooperatively. The resulting resistance to acceleration provides the proposed physical basis for **inertia and inertial mass**.

In the long-range interaction between particles, however, the two contributions are proposed to act oppositely. Because a stable supertorus requires them to be nearly balanced, their dominant effects can largely cancel, leaving only a small residual interaction. This residual is proposed as the physical origin of **gravity**.

The same underlying electromagnetic structure may therefore produce two effects of enormously different magnitude:

$\text{inertia} \longleftrightarrow \text{combined structural response}$
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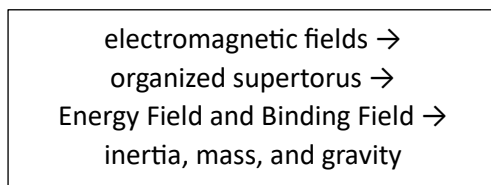
and

$\text{gravity} \longleftrightarrow \text{small residual imbalance.}$

This interpretation offers a possible physical explanation for why matter can possess substantial inertia while gravitational interaction between elementary particles is extraordinarily weak. Gravity would not need to originate from an independently weak microscopic mechanism; its weakness could instead result from the near cancellation of two much larger contributions. This central idea is retained from the previous formulation of the model, where the distinction between the combined inertial response and the small gravitational residual was already identified.

The present work develops this hypothesis in several stages. It first identifies the electromagnetic supertorus as the microscopic physical starting point and examines the two complementary structural tendencies required for its localization. It then introduces their macroscopic representation through the Energy Field and Binding Field and investigates the spatial form of these fields. Their residual is examined as a possible origin of gravity, while their cooperative response to acceleration is examined as a possible origin of inertia and mass.

The resulting conceptual chain is



The proposed connection is not yet a complete microscopic derivation. In particular, the transition from the full electromagnetic structure of the supertorus to the two macroscopic scalar fields, their amplitudes, and the gravitational coupling strength must ultimately be derived quantitatively. The purpose of the present work is to establish a physically coherent framework in which these quantities are no longer introduced independently, but can be investigated as different consequences of one underlying electromagnetic structure.

2. The Electromagnetic Supertorus as the Physical Starting Point

The interpretation developed in this work begins with the electromagnetic supertorus described in Part II. The supertorus is not treated as an abstract point particle carrying independently assigned properties such as mass, charge, spin, and magnetic moment. It is treated as a spatially extended and dynamically organized electromagnetic structure whose macroscopic properties are expected to follow from its internal organization.

The purpose of the present section is not to repeat the detailed construction of Part II. It is to identify those properties of the supertorus that are essential for the subsequent discussion of mass and gravity.

2.1. Localized Electromagnetic Structure

The elementary structure considered in Part II is based on toroidal electromagnetic organization. A large number of coherently related toroidal elements close into a larger ring, forming the electromagnetic supertorus.

The resulting object is therefore characterized by two geometric scales: the major radius R , describing the overall supertorus, and the minor radius a , describing its toroidal cross-section.

Its defining property is not geometry alone. The individual electromagnetic contributions are phase organized around the complete closed structure. A progressive phase shift along the supertorus completes a full 2π phase cycle around the major circumference, so that the electromagnetic oscillation satisfies a global phase-closure condition.

The particle is therefore represented not merely by electromagnetic energy confined to a toroidal volume, but by a coherent electromagnetic state whose geometry and phase organization close simultaneously.

This distinction is important. Localization is not imposed by an external boundary. It is proposed to arise from the internal organization of the electromagnetic configuration itself.

2.2. Internal Electromagnetic Dynamics

At the microscopic level, the supertorus remains an electromagnetic system. Its local dynamics are described by

$$\mathbf{E}(\mathbf{r}, t)$$

and

$$\mathbf{B}(\mathbf{r}, t),$$

together with the corresponding displacement currents and electromagnetic energy flow.

The electromagnetic energy density is therefore locally described by the conventional Maxwell expression

$$u_{\text{EM}} = \frac{\epsilon_0}{2} E^2 + \frac{1}{2\mu_0} B^2.$$

No negative local Maxwell energy density is introduced.

The time-dependent electric field produces displacement current,

$$\mathbf{J}_D = \epsilon_0 \frac{\partial \mathbf{E}}{\partial t},$$

and the phase organization of the individual toroidal elements causes the resulting current pattern to extend coherently around the complete supertorus.

Because the phase advances continuously along the major circumference, the displacement-current distribution acquires a spiral organization around the structure. One complete phase cycle corresponds to one complete progression around the supertorus.

The electromagnetic configuration is consequently characterized simultaneously by oscillation, circulation, and phase closure.

These properties distinguish the supertorus from a freely propagating electromagnetic wave. Electromagnetic energy is present and dynamically redistributed, but the complete organization is closed rather than continuously transported away from the particle.

2.3. Energy Circulation and Structural Closure

A localized electromagnetic particle must prevent its internal energy from escaping as ordinary radiation.

In the proposed supertorus, this requirement is associated with the closed geometry and coherent phase organization of the electromagnetic fields. The internal electromagnetic dynamics do not terminate at an edge of the particle. Each part of the structure continues into the next, and after one complete circuit the electromagnetic state returns to the phase required by the closure condition.

The supertorus is therefore a dynamically closed system.

This closure has two complementary aspects:

geometric closure

and

phase closure.

Geometric closure ensures that the electromagnetic structure has no physical endpoint, whereas phase closure ensures that the oscillating state remains continuous after one complete circuit.

Neither condition alone is sufficient to characterize the proposed particle. A closed geometric path with incompatible phase would not reproduce the same electromagnetic state after one circuit, while phase coherence without a closed spatial structure would not by itself provide localization.

The proposed particle therefore depends on their simultaneous satisfaction.

2.4. Stability as a Structural Constraint

The existence of a stationary supertorus imposes a further requirement.

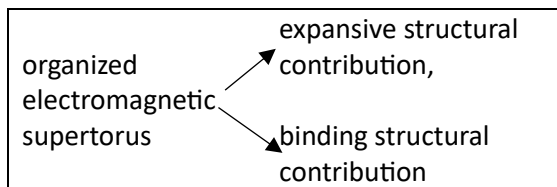
A localized electromagnetic configuration cannot remain stable if its internal dynamics produce an uncompensated tendency either toward indefinite expansion or toward collapse. The observed persistence of the structure therefore requires a dynamically preferred configuration.

This means that the internal electromagnetic organization must contain complementary structural effects.

One tendency is associated with expansion of the electromagnetic configuration. The other opposes this expansion and provides localization or binding.

At this stage these two tendencies should not yet be identified simply with the electric and magnetic Maxwell energy densities. Both electric and magnetic fields participate in the complete coherent structure, and their precise contributions must ultimately be determined from the full electromagnetic solution.

It is therefore more appropriate to write schematically



A stable localized particle requires the binding contribution to be sufficiently strong to overcome the expansive tendency. The fundamental stability condition is therefore not balance, but binding dominance:

$$|U_B| > |U_E|.$$

How close these two contributions must be in magnitude is a separate question. A structure with a much stronger binding contribution could in principle represent a more strongly

confined state, although its ability to sustain the oscillatory dynamics required by the supertorus would have to be examined separately.

The near equality

$$|U_B| \approx |U_E|$$

should therefore not be introduced merely as a condition of stability. If such near balance is required, it must follow from additional properties of the supertorus or from the observed weakness of the long-range gravitational interaction.

This distinction will become important later. **Stability requires binding dominance; the extreme weakness of gravity may require near cancellation.**

The balance does not imply that the individual contributions are small. On the contrary, a strongly organized structure may contain large internal electromagnetic contributions while their opposing structural effects remain close to equilibrium.

This observation will become essential for the interpretation of gravity.

2.5. The Supertorus as a Single Physical System

Although it is useful to distinguish electric and magnetic fields, displacement currents, inner and outer regions, and different paths of electromagnetic circulation, the supertorus must respond physically as one coherent system.

Its geometry, phase relations, field amplitudes, currents, energy distribution, angular momentum, and magnetic moment cannot be varied independently without changing the complete structure.

This becomes particularly important when the particle is accelerated.

Acceleration cannot act only on one isolated electromagnetic component. The momentum

distribution and field organization of the complete supertorus must adapt while the coherence and localization of the particle are preserved.

The resistance of such a structure to acceleration cannot therefore be understood solely from a static energy balance. It must ultimately be obtained from the dynamical response of the complete electromagnetic configuration.

This provides the first connection between the internal structure developed in Part II and the problem of inertia considered later in the present work.

2.6. Internal and External Levels of Description

Two levels of description must now be clearly distinguished.

At the microscopic level,

$$\mathbf{E}, \quad \mathbf{B}, \quad \mathbf{J}_D$$

and the corresponding electromagnetic energy and momentum flow describe the internal dynamics of the supertorus.

At distances large compared with the dimensions of the particle, however, the detailed toroidal geometry, local field directions, and rapid internal oscillations need not remain individually observable.

The external influence of the complete structure may therefore admit a reduced macroscopic description.

The central question of Part III is whether the two complementary structural tendencies required by the internal equilibrium of the supertorus also produce two distinguishable macroscopic energetic influences in the surrounding space.

Symbolically,

$\mathbf{E}, \mathbf{B}, \mathbf{J}_D$, geometry, phase, energy flow $\rightarrow$
two macroscopic structural influences}.

The arrow in this relation is not yet a completed mathematical derivation. It represents the physical problem that must be investigated.

This is an important difference from introducing new fields independently of the supertorus. If two macroscopic fields are required, they should emerge as consequences of the internal electromagnetic organization rather than as unrelated additional ingredients of the model.

2.7. From Part II to Part III

Part II addresses the microscopic problem:

How can electromagnetic fields form a coherent localized particle?

Part III begins with that proposed structure and addresses the next question:

What macroscopic physical properties follow from such a structure?

The first consequence considered is inertia. If acceleration requires a coherent reorganization of the complete electromagnetic configuration, resistance to this reorganization may provide a physical origin of inertial mass.

The second consequence is gravity. If the internal stability of the supertorus requires two large but opposing structural contributions, their macroscopic manifestations may also oppose one another. A small residual difference could then remain as a much weaker long-range interaction.

This leads to the physical chain that will be developed in the following sections:

**Maxwell fields $\rightarrow$
coherent electromagnetic supertorus $\rightarrow$
two complementary structural tendencies $\rightarrow$
two macroscopic energetic fields $\rightarrow$
inertia and gravity.**

The next section therefore examines the two complementary structural tendencies of the supertorus before assigning them macroscopic field descriptions.

3. Two Structural Tendencies of the Supertorus

The preceding section treats the supertorus as a single coherent electromagnetic system. Its localization cannot be attributed to geometry alone. A stable structure must possess an internal dynamical organization that prevents both unrestricted expansion and collapse.

This suggests that two complementary structural tendencies must be distinguished.

One tends to increase the spatial extent of the electromagnetic configuration. It will be referred to as the **expansive tendency**.

The other acts in the opposite direction and maintains localization. It will be referred to as the **binding tendency**.

These tendencies should not yet be identified with the macroscopic Energy Field and Binding Field introduced later. At this stage they describe two physical roles within the internal electromagnetic organization of the supertorus.

3.1. The Expansive Tendency

Electromagnetic energy stored in a localized configuration does not by itself guarantee localization. A confined electromagnetic structure may possess internal stresses and energy flows that tend to increase its spatial extent.

The supertorus must therefore contain an expansive structural contribution. We denote its associated energetic scale by

$$U_E > 0.$$

The subscript E identifies the expansive energetic contribution. It should not be

interpreted as meaning that U_E is simply the conventional electric-field energy

$$U_{\text{electric}} = \int \frac{\epsilon_0 E^2}{2} dV.$$

The complete expansive contribution may depend on the electric and magnetic fields, their geometry, phase relations, momentum flow, and the electromagnetic stresses within the supertorus.

At the present stage it is therefore preferable to write schematically

$$U_E = U_E [E, B, \text{geometry, phase, energy and momentum flow}].$$

Its defining physical property is not its microscopic origin but its structural action:

$$U_E \rightarrow \text{expansion of the electromagnetic}$$

A complete electromagnetic calculation should ultimately determine this contribution directly from the supertorus developed in Part II.

3.2. The Binding Tendency

A localized supertorus must also contain a complementary contribution that opposes expansion.

We denote the magnitude of this contribution by

$$|U_B|.$$

Its structural action is binding:

$$|U_B| \rightarrow \text{localization of the electromagnetic structure.}$$

As with the expansive contribution, U_B should not at this stage be identified simply with the conventional magnetic-field energy

$$U_{\text{magnetic}} = \int \frac{B^2}{2\mu_0} dV.$$

The magnetic organization of the supertorus may play an important role in binding, but the

effective binding contribution belongs to the complete electromagnetic configuration.

It may therefore be represented schematically as

$$U_B = U_B [E, B, \text{geometry, phase, energy and momentum flow}].$$

The distinction between U_E and U_B is consequently a distinction between two **structural roles**, not between two independently existing substances or between the electric and magnetic Maxwell energy densities.

3.3. Binding Dominance as a Condition of Stability

The first requirement for a stable localized particle is that the binding tendency must be sufficient to prevent unrestricted expansion.

Therefore,

$$|U_B| > |U_E|.$$

This inequality expresses the basic stability condition of the proposed structure.

It does not require the two contributions to be exactly equal, nor does stability alone require their difference to be extremely small.

This distinction is important.

A configuration satisfying

$$|U_B| \gg |U_E|$$

could, in principle, represent a strongly bound state. Whether such a state could simultaneously sustain the oscillatory dynamics, phase organization, and internal energy circulation required by the supertorus is a separate dynamical question.

Conversely, a state satisfying

$$|U_B| \lesssim |U_E|$$

would represent a more weakly overbound configuration in which the two structural tendencies remain close in magnitude.

At the present stage, the internal dynamics developed in Part II do not by themselves establish how large the difference

$$\Delta U = |U_B| - |U_E|$$

must be.

The important conclusion is therefore limited but clear:

$$\text{stability requires binding dominance, not exact balance.}$$

3.4. Oscillation Around a Stable Configuration

The supertorus is not proposed as a static electromagnetic object. Its internal fields oscillate continuously while the complete structure remains localized.

This introduces an additional constraint on the relation between the expansive and binding tendencies.

A useful conceptual description is obtained by introducing a generalized structural coordinate q , representing a deformation of the supertorus away from its preferred configuration. The total effective structural energy may then be represented schematically as

$$U_{\text{eff}}(q).$$

A stable configuration corresponds to an equilibrium value q_0 satisfying

$$\left. \frac{dU_{\text{eff}}}{dq} \right|_{q=q_0} = 0,$$

together with the stability condition

$$\left. \frac{d^2U_{\text{eff}}}{dq^2} \right|_{q=q_0} > 0.$$

For a small displacement

$$\delta q = q - q_0,$$

the effective energy may be expanded as

$$U_{\text{eff}}(q) \approx U_{\text{eff}}(q_0) + \frac{1}{2}K(\delta q)^2,$$

where

$$K = \left. \frac{d^2 U_{\text{eff}}}{dq^2} \right|_{q=q_0}$$

characterizes the structural stiffness of the supertorus.

This distinction is useful because the **depth of binding** and the **ability to oscillate** are not the same physical quantity. Strong binding does not by itself exclude oscillation. Oscillatory behaviour depends on the local shape of the effective energy around the equilibrium configuration.

A complete model must therefore determine both the binding depth and the curvature of the equilibrium state from the electromagnetic structure.

3.5. Energetic Sign and Physical Role

It is useful to distinguish the positive local Maxwell energy from the sign assigned to the structural role of binding.

Locally,

$$u_E = \frac{\epsilon_0 E^2}{2} \geq 0$$

and

$$u_B = \frac{B^2}{2\mu_0} \geq 0.$$

The present model does not modify these expressions.

However, when the two structural tendencies are represented in an effective energetic description, it is convenient to assign opposite signs:

$$U_E > 0$$

for the expansive contribution and

$$U_B < 0$$

for the binding contribution.

The effective structural balance may then be written as

$$U_{\text{struct}} = U_E + U_B.$$

Because

$$U_B = -|U_B|,$$

this becomes

$$U_{\text{struct}} = U_E - |U_B|.$$

For a bound structure,

$$|U_B| > |U_E|,$$

and therefore

$$U_{\text{struct}} < 0$$

relative to the chosen unbound reference state.

The negative sign does **not** imply

$$\frac{B^2}{2\mu_0} < 0.$$

It indicates that positive energy must be supplied to overcome the binding and move the structure toward an unbound state.

This preserves the conventional positive Maxwell energy densities while allowing the effective energetic description to distinguish expansion from binding.

3.6. Stability and Near Balance Are Different Requirements

This distinction becomes particularly important for the later interpretation of gravity.

From the existence of a stable supertorus we can infer

$$|U_B| > |U_E|.$$

We cannot infer from stability alone that

$$|U_B| - |U_E| \ll |U_B|.$$

Near balance is therefore a stronger condition than stability.

If the later gravitational model requires

$$|U_B| \approx |U_E|,$$

this near equality must be justified independently. It may emerge from the detailed electromagnetic solution of the supertorus, or it may be required by the observed weakness of the residual long-range interaction.

Thus two logically distinct statements must be maintained:

$$\text{stability} \Rightarrow |U_B| > |U_E|$$

whereas

$$\begin{aligned} &\text{weak residual interaction} \Rightarrow \\ &\Rightarrow |U_B| - |U_E| \ll |U_B|, |U_E|. \end{aligned}$$

This separation prevents the weakness of gravity from being inserted into the microscopic stability condition without independent justification.

It also creates a quantitative question for the model: **why should the binding contribution exceed the expansive contribution by only a very small fraction if such a small difference is ultimately responsible for gravity?**

3.7. From Structural Tendencies to External Influence

The quantities U_E and U_B introduced above describe internal structural roles of the supertorus.

They do not yet constitute external fields.

The next step is therefore nontrivial.

If the expansive and binding properties of the supertorus influence another localized electromagnetic structure at a distance, then some information about these internal structural tendencies must persist outside the particle.

The central hypothesis to be examined is consequently

internal expansive tendency $\rightarrow$
macroscopic expansive influence

internal binding tendency, $\rightarrow$
macroscopic binding influence.

These two macroscopic influences will be described in the next section by two scalar fields.

The expansive manifestation will be termed the **Expansive Energy Field**, or more simply the **Energy Field**, while the binding manifestation will be termed the **Binding Energy Field**, or **Binding Field**.

The logical chain has therefore reached the point

electromagnetic supertorus $\rightarrow$
{expansive structural tendency $\rightarrow$
Energy Field,
binding structural tendency $\rightarrow$,
Binding Field.

The crucial question is no longer merely whether two fields can be postulated with suitable properties. It is whether these two macroscopic fields can be understood as consequences of the two complementary structural roles already required within the electromagnetic supertorus.

4. From Internal Structure to Two Macroscopic Fields

The preceding sections distinguish two complementary structural tendencies within the electromagnetic supertorus. The expansive contribution tends to increase the spatial extent of the electromagnetic configuration, whereas the binding contribution maintains localization.

Their associated internal energetic contributions are denoted by

$$U_E$$

and

$$U_B,$$

with the stability condition

$$|U_B| > |U_E|.$$

These quantities describe the internal organization of the particle. They do not yet describe an interaction extending into the surrounding space.

The next question is therefore fundamental:

Can the two internal structural tendencies of the supertorus produce corresponding macroscopic influences outside the localized particle?

The present model proposes that they can. Their external manifestations will be described by two scalar fields: the **Expansive Energy Field**, hereafter the **Energy Field**, and the **Binding Energy Field**, hereafter the **Binding Field**.

4.1. Why an External Description Is Needed

Inside the supertorus, the electromagnetic configuration is described by the local vector fields

$$\mathbf{E}(\mathbf{r}, t)$$

and

$$\mathbf{B}(\mathbf{r}, t),$$

together with displacement current, electromagnetic momentum, stresses, and energy flow.

At distances much larger than the dimensions of the supertorus, however, the detailed internal geometry need not remain individually observable. The external response may depend primarily on integrated properties of the complete organized structure.

This distinction is familiar in physical descriptions of spatially extended systems: a complicated microscopic configuration can produce a considerably simpler macroscopic influence at sufficiently large distances.

The present model therefore distinguishes between

microscopic electromagnetic structure

and

macroscopic energetic influence.

The second is proposed to retain information about the two structural roles identified in the preceding section: expansion and binding.

4.2. Expansive Energy Field

Let the internal expansive contribution of the supertorus be represented by

$$U_E.$$

As introduced in Section 3, U_E is not simply the conventional electric-field energy. More generally, it represents an effective contribution determined by the complete electromagnetic organization,

$$U_E = F_E[\mathbf{E}, \mathbf{B}, \text{geometry, phase, energy and momentum flow}].$$

We now hypothesize that this internal expansive tendency has a corresponding macroscopic manifestation outside the localized particle.

This manifestation is described by the scalar field

$$\Phi_E(\mathbf{r}),$$

which will be called the **Expansive Energy Field**, or simply the **Energy Field**.

Its physical role is defined by the correspondence

$$U_E \longrightarrow \Phi_E(\mathbf{r}).$$

The Energy Field therefore represents the spatially distributed macroscopic influence associated with the expansive structural contribution of the supertorus.

At this stage, this relation is a physical hypothesis rather than a completed derivation from Maxwell's equations.

4.3. Binding Energy Field

The same reasoning is applied to the binding contribution.

Let

$$U_B = F_B[E, B, \text{geometry, phase, energy and momentum flow}]$$

represent the effective internal binding contribution.

Its magnitude satisfies, for a stable localized structure,

$$|U_B| > |U_E|.$$

The proposed macroscopic manifestation of this contribution is represented by the scalar field

$$\Phi_B(\mathbf{r}),$$

called the **Binding Energy Field**, or simply the **Binding Field**.

Thus,

$$U_B \longrightarrow \Phi_B(\mathbf{r}).$$

The Binding Field represents the spatially distributed macroscopic influence associated with the tendency that maintains localization of the electromagnetic structure.

The two fields therefore have different physical roles even though they originate from the same supertorus.

4.4. The Two Scalar Fields Are Not Maxwell Fields

A distinction essential to the present model is

$$\Phi_E \neq \mathbf{E}$$

and

$$\Phi_B \neq \mathbf{B}.$$

The symbols $\mathbf{E}$ and $\mathbf{B}$ represent ordinary electromagnetic vector fields governed locally by Maxwell's equations.

In contrast,

$$\Phi_E$$

and

$$\Phi_B$$

are proposed scalar descriptions of the macroscopic energetic influence of the complete organized supertorus.

They therefore belong to different levels of description.

At the microscopic level,

$$\mathbf{E}, \mathbf{B}, \mathbf{J}_D$$

describe local field amplitudes, directions, phase evolution, displacement current, momentum flow, and electromagnetic energy circulation.

At the macroscopic level,

$$\Phi_E, \Phi_B$$

describe the proposed spatial influence of the expansive and binding roles of the complete localized structure.

This may be summarized as

microscopic level $\mathbf{E}, \mathbf{B}, \mathbf{J}_D$	$\longrightarrow$	macroscopic level $\Phi_E, \Phi_B.$
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The arrow is the central physical hypothesis of this section. It must ultimately be obtained from the complete electromagnetic solution of the supertorus.

4.5. Scalar Character of the Macroscopic Fields

The internal electromagnetic fields are vector quantities. Their local directions vary throughout the toroidal structure and throughout the oscillation cycle.

The macroscopic quantities considered here are different. They are intended to characterize the energetic state associated with the complete localized structure at a position in surrounding space.

For this reason they are represented initially as scalar fields:

$$\begin{aligned}\Phi_E &= \Phi_E(\mathbf{r}), \\ \Phi_B &= \Phi_B(\mathbf{r}).\end{aligned}$$

Direction enters only when a spatial gradient is taken.

For example, a macroscopic influence associated with Φ_E would be related to

$$-\nabla\Phi_E,$$

while that associated with Φ_B would be related to

$$-\nabla\Phi_B.$$

Thus the scalar fields describe the spatial energetic configuration, whereas their gradients determine directional effects.

This distinction will become important when the inverse-square dependence of the resulting long-range interaction is considered.

4.6. Opposite Structural Roles

Although both fields originate from the same electromagnetic supertorus, they represent opposite structural tendencies.

It is therefore useful to assign them opposite signs in the effective macroscopic description.

For the Energy Field,

$$\Phi_E > 0,$$

representing the expansive contribution.

For the Binding Field,

$$\Phi_B < 0,$$

representing the binding contribution.

The sign convention reflects physical role, not negative local electromagnetic energy.

The total macroscopic energetic state associated with the particle can then be represented schematically by

$$\Phi_{\text{tot}} = \Phi_E + \Phi_B.$$

Because the two terms have opposite signs,

$$\Phi_{\text{tot}} = \Phi_E - |\Phi_B|.$$

The stability condition of the internal structure suggests

$$|\Phi_B| > |\Phi_E|$$

only if the mapping from the internal contributions to their external fields preserves the corresponding ordering of their strengths.

This qualification is important. From

$$|U_B| > |U_E|$$

alone, it does not automatically follow that

$$|\Phi_B| > |\Phi_E|$$

at every distance. The relation between internal energy and external field amplitude must ultimately be derived.

For the present model, the dominance of the external Binding Field is therefore a further hypothesis to be tested rather than a mathematical consequence of internal stability alone.

4.7. Internal Energy and External Field Amplitude

This distinction can be expressed more explicitly.

Let the amplitudes of the external fields be characterized by quantities

$$A_E$$

and

$$A_B.$$

In general,

$$A_E = \mathcal{G}_E(U_E, \text{structure})$$

and

$$A_B = \mathcal{G}_B(U_B, \text{structure}),$$

where $\mathcal{G}_E$ and $\mathcal{G}_B$ represent presently unknown relations between the microscopic supertorus and its macroscopic fields.

There is therefore no justification at this stage for assuming simply

$$A_E = U_E$$

or

$$A_B = |U_B|.$$

This distinction will later become crucial.

The stability condition concerns the **internal particle**,

$$|U_B| > |U_E|,$$

whereas the weakness of gravity will concern the **external field amplitudes**,

$$|A_B - A_E| \ll A_E, A_B.$$

These are related hypotheses, but they are not identical.

4.8. Near Cancellation as a Possible Macroscopic Property

If the two external fields have similar amplitudes and opposite signs, their resultant may be much smaller than either field separately.

Let

$$A_B = A_E + \Delta A,$$

with

$$|\Delta A| \ll A_E.$$

Then the dominant contributions nearly cancel.

Schematically,

**large Energy Field +
large opposing Binding Field =
small residual field.**

This possibility is central to the later interpretation of gravity.

Importantly, near cancellation is introduced here as a possible property of the **macroscopic fields**, not as a necessary condition for microscopic stability.

Thus,

internal stability is not equal to
macroscopic near cancellation.

A successful microscopic theory should eventually explain why both occur simultaneously.

4.9. A Common Spatial Dependence Is Required

Near cancellation can remain effective over large distances only if the Energy Field and

Binding Field have the same, or extremely similar, spatial dependence.

Suppose schematically that

$$\Phi_E(r) \propto f_E(r)$$

and

$$\Phi_B(r) \propto -f_B(r).$$

If

$$f_E(r) \neq f_B(r),$$

then a cancellation established at one distance would generally not persist at another.

For a weak residual interaction to remain proportional to the same spatial law over macroscopic distances, the model therefore requires

$$f_E(r) = f_B(r)$$

in the relevant far-field regime.

The fields may then be written as

$$\Phi_E(r) = A_E f(r)$$

and

$$\Phi_B(r) = -A_B f(r).$$

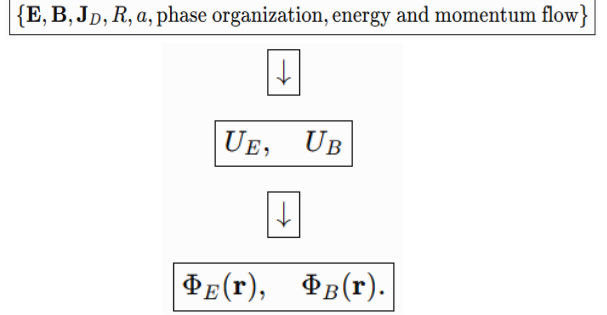
Their resultant becomes

$$\Phi_{\text{tot}}(r) = (A_E - A_B) f(r).$$

The common spatial dependence is therefore not merely a mathematical convenience. It is a necessary feature if gravity is to be interpreted as a persistent small residual between two much larger contributions.

4.10. The Microscopic-to-Macroscopic Problem

The complete physical chain proposed so far is



The first transition identifies two structural energetic roles within the electromagnetic supertorus.

The second transition assigns macroscopic spatial manifestations to those roles.

Neither transition should be regarded as arbitrary. Ultimately, both must be calculable from the same electromagnetic structure.

At present, however, the second transition remains the principal hypothesis of the model.

The quantitative objective is therefore eventually to derive relations of the form

$$\Phi_E = \mathcal{F}_E[\mathbf{E}, \mathbf{B}, \text{supertorus structure}]$$

and

$$\Phi_B = \mathcal{F}_B[\mathbf{E}, \mathbf{B}, \text{supertorus structure}].$$

Only such a derivation can determine their absolute amplitudes, relative signs, spatial dependence, and residual difference without fitting them to gravity.

4.11. Direction of the Following Analysis

The present section has therefore introduced two macroscopic fields, but has not yet specified their radial dependence.

The next problem is to determine what spatial configuration these fields may acquire outside a localized source.

The following section examines whether an energetic variational principle can provide this spatial dependence.

If both scalar fields obey the same spatial optimization principle outside the supertorus, the model may naturally obtain a common radial law,

$$\Phi_E(r) = A_E f(r), \quad \Phi_B(r) = -A_B f(r),$$

which is precisely the condition required for their near cancellation to persist over large distances.

The next section therefore turns from the **physical origin** of the two fields to their **spatial structure**

5. Spatial Structure of the Energy and Binding Fields

The preceding section introduced the Energy Field and Binding Field as macroscopic scalar descriptions of two complementary structural influences associated with the electromagnetic supertorus.

Their physical origin and their spatial dependence are separate questions.

The microscopic theory must ultimately explain how the internal electromagnetic structure generates the amplitudes of these fields. Once outside the localized source, however, their spatial form may be constrained by a more general principle.

The present section investigates whether the external fields can approach configurations that minimize their spatial energy. Under spherical symmetry, this assumption leads to a particularly important result: both fields acquire a $1/r$ dependence, while their gradients acquire the $1/r^2$ dependence characteristic of Newtonian gravity.

5.1. Far-Field Approximation

The supertorus is not spherically symmetric at microscopic distances. It possesses the characteristic toroidal dimensions

R

and

a.

Its internal electromagnetic fields therefore have a strongly structured angular dependence close to the particle.

At distances satisfying

$$r \gg R, a,$$

the detailed toroidal geometry becomes progressively less important for the leading macroscopic contribution.

The present analysis considers this far-field regime.

The scalar fields may then, to first approximation, be treated as functions only of radial distance,

$$\Phi_E = \Phi_E(r),$$

$$\Phi_B = \Phi_B(r).$$

This is not a statement that the microscopic supertorus itself is spherical. It is an approximation applied to the leading long-range component of its macroscopic influence.

5.2. Variational Hypothesis

Let a generic scalar field be denoted by

$$\Phi(\mathbf{r}).$$

We assume that, outside the localized source, its spatial configuration is associated with an energy functional of the form

$$\mathcal{U}[\Phi] = \frac{\kappa}{2} \int |\nabla \Phi|^2 dV$$

where κ is a positive coefficient characterizing the energetic scale of the field.

The square brackets in

$$\mathcal{U}[\Phi]$$

indicate that U depends on the complete spatial function $\Phi(r)$, rather than only on the value of Φ at one point.

The proposed physical principle is that, in a source-free region, the stable spatial configuration makes this functional stationary:

$$\delta\mathcal{U} = 0.$$

This variational principle is an assumption of the macroscopic model. It is not yet derived from the electromagnetic equations of the supertorus.

Its importance lies in the spatial equation that follows from it.

5.3. Variation of the Field Energy

Consider a small variation

$$\Phi \rightarrow \Phi + \delta\Phi.$$

The corresponding first-order change of the functional is

$$\delta\mathcal{U} = \kappa \int \nabla\Phi \cdot \nabla(\delta\Phi) dV.$$

Using integration by parts,

$$\int \nabla\Phi \cdot \nabla(\delta\Phi) dV = \oint \delta\Phi \nabla\Phi \cdot d\mathbf{S} - \int \delta\Phi \nabla^2\Phi dV.$$

If the variation vanishes at the boundary of the region considered, the surface term is zero. Therefore,

$$\delta\mathcal{U} = -\kappa \int \delta\Phi \nabla^2\Phi dV.$$

For the stationary condition

$$\delta\mathcal{U} = 0$$

to hold for arbitrary variations $\delta\Phi$, the field must satisfy

$$\boxed{\nabla^2\Phi = 0.}$$

Thus the variational hypothesis leads to Laplace's equation in the source-free region outside the supertorus.

5.4. Spherically Symmetric Solution

For a spherically symmetric scalar field,

$$\Phi = \Phi(r),$$

Laplace's equation becomes

$$\frac{1}{r^2} \frac{d}{dr} \left(r^2 \frac{d\Phi}{dr} \right) = 0.$$

Multiplying by r^2 ,

$$\frac{d}{dr} \left(r^2 \frac{d\Phi}{dr} \right) = 0.$$

Integration gives

$$r^2 \frac{d\Phi}{dr} = C_1,$$

and therefore

$$\frac{d\Phi}{dr} = \frac{C_1}{r^2}.$$

A second integration gives

$$\Phi(r) = C_2 - \frac{C_1}{r}.$$

If the field is chosen to vanish at infinity,

$$\Phi(\infty) = 0,$$

then

$$C_2 = 0.$$

Renaming the remaining amplitude constant gives

$$\boxed{\Phi(r) = \frac{A}{r}.}$$

The sign of A determines the physical orientation of the corresponding scalar contribution.

5.5. Application to the Energy Field

Applying the result to the Energy Field gives

$$\Phi_E(r) = \frac{A_E}{r}$$

with

$$A_E > 0.$$

Its radial derivative is

$$\frac{d\Phi_E}{dr} = -\frac{A_E}{r^2}.$$

The associated gradient therefore has the form

$$\nabla\Phi_E = -\frac{A_E}{r^2} \hat{\mathbf{r}}.$$

The important result at this stage is the radial dependence

$$|\nabla\Phi_E| \propto \frac{1}{r^2}.$$

The coefficient A_E is not determined by the variational calculation. It must ultimately follow from the microscopic structure of the supertorus.

5.6. Application to the Binding Field

The same variational principle is applied to the Binding Field.

Because the Binding Field represents the opposite structural role, its sign is chosen oppositely:

$$\Phi_B(r) = -\frac{A_B}{r}$$

with

$$A_B > 0.$$

Its radial derivative is

$$\frac{d\Phi_B}{dr} = \frac{A_B}{r^2},$$

and therefore

$$\nabla\Phi_B = \frac{A_B}{r^2} \hat{\mathbf{r}}.$$

Again,

$$|\nabla\Phi_B| \propto \frac{1}{r^2}.$$

Thus the two scalar fields have opposite signs but the same radial dependence.

5.7. Why the Same Spatial Dependence Matters

The result

$$\Phi_E(r) = \frac{A_E}{r}$$

and

$$\Phi_B(r) = -\frac{A_B}{r}$$

has an important consequence.

Their sum is

$$\Phi_{\text{tot}}(r) = \Phi_E(r) + \Phi_B(r),$$

so that

$$\Phi_{\text{tot}}(r) = \frac{A_E - A_B}{r}.$$

The relative strength of the two contributions is therefore independent of distance:

$$\frac{|\Phi_B(r)|}{|\Phi_E(r)|} = \frac{A_B}{A_E}.$$

If the amplitudes are nearly equal at one distance, they remain nearly equal throughout the region in which the common $1/r$ dependence applies.

This solves an important structural problem identified in the preceding section. If the two fields had different radial dependences, their near cancellation could occur only at particular distances.

With a common spatial law,

near cancellation, once established,
persists with distance.

5.8. The Residual Field

Define the difference between the two positive amplitudes as

$$\Delta A = A_B - A_E.$$

If the Binding Field is slightly stronger,

$$A_B > A_E,$$

then

$$\Delta A > 0.$$

The total scalar field becomes

$$\Phi_{\text{tot}}(r) = -\frac{\Delta A}{r}.$$

If

$$\Delta A \ll A_E, A_B,$$

then

$$|\Phi_{\text{tot}}| \ll |\Phi_E|, |\Phi_B|.$$

Thus two individually large scalar fields can produce a much smaller resultant field without changing its radial form.

Its gradient is

$$\nabla \Phi_{\text{tot}} = \frac{\Delta A}{r^2} \hat{\mathbf{r}},$$

and therefore its magnitude satisfies

$$|\nabla \Phi_{\text{tot}}| = \frac{\Delta A}{r^2}.$$

The model has therefore produced the mathematical structure required for a weak inverse-square interaction.

The identification of this residual with gravity will be made in the following section.

5.9. What Has Been Derived

It is important to distinguish the mathematical result from the physical hypotheses used to obtain it.

Given the functional

$$\mathcal{U}[\Phi] = \frac{\kappa}{2} \int |\nabla \Phi|^2 dV,$$

the stationary condition gives

$$\nabla^2 \Phi = 0.$$

Given spherical symmetry in the far field and the boundary condition

$$\Phi(\infty) = 0,$$

this gives

$$\Phi(r) \propto \frac{1}{r}.$$

Consequently,

$$|\nabla \Phi(r)| \propto \frac{1}{r^2}.$$

If both the Energy Field and Binding Field obey the same variational principle, then

$$\Phi_E(r) = \frac{A_E}{r}, \quad \Phi_B(r) = -\frac{A_B}{r}.$$

Their difference necessarily retains the same 1/r dependence.

These statements are mathematical consequences of the assumptions introduced above.

5.10. What Has Not Yet Been Derived

The variational calculation does **not** establish why the electromagnetic supertorus generates the two scalar fields.

It also does not determine

$$A_E, \quad A_B,$$

or their difference

$$\Delta A = A_B - A_E.$$

Nor does it establish from the microscopic structure that

$$\Delta A \ll A_E, A_B.$$

Most importantly, obtaining

$$\frac{1}{r^2}$$

does not by itself prove that the resulting field is gravity. Many physical fields can possess inverse-square behaviour under appropriate conditions.

The still-required physical chain is therefore

$$\text{electromagnetic supertorus} \rightarrow A_E, A_B \rightarrow \Delta A \rightarrow \text{observable interaction.}$$

The strength, sign, universality, and coupling of that interaction to another supertorus must still be established.

This distinction is essential: the present section derives the **spatial form** of the proposed fields under the stated variational hypothesis, but not yet their complete physical origin or gravitational strength.

5.11. Transition to Gravity

The result of this section can be summarized compactly:

$$\text{variational principle} \rightarrow \nabla^2 \Phi = 0 \rightarrow \Phi \propto \frac{1}{r} \rightarrow |\nabla \Phi| \propto \frac{1}{r^2}.$$

Applied to the two structural fields,

$$\Phi_E = \frac{A_E}{r}, \quad \Phi_B = -\frac{A_B}{r},$$

and therefore

$$\Phi_E + \Phi_B = -\frac{\Delta A}{r}.$$

The mathematical framework thus permits two large opposing fields to leave a small residual with the same long-range spatial dependence.

The next section examines the physical hypothesis that this residual field is the phenomenon observed as **gravity**.

6. Origin of Gravity

The preceding sections introduced two macroscopic scalar fields associated with the electromagnetic supertorus:

$$\Phi_E(r) = \frac{A_E}{r}$$

and

$$\Phi_B(r) = -\frac{A_B}{r}.$$

They represent, respectively, the expansive and binding structural tendencies of the localized electromagnetic configuration.

Because both fields obey the same proposed variational principle, they acquire the same radial dependence. Their difference therefore preserves the same spatial law.

The present section examines the central hypothesis that the small residual between these two much larger fields is the physical origin of gravity.

6.1. Residual of the Two Fields

The resultant macroscopic scalar field is

$$\Phi_G(r) = \Phi_E(r) + \Phi_B(r).$$

Substituting the two contributions gives

$$\Phi_G(r) = \frac{A_E - A_B}{r}.$$

Define

$$\Delta A = A_B - A_E.$$

If the Binding Field is slightly stronger than the Energy Field,

$$A_B > A_E,$$

then

$$\Delta A > 0,$$

and therefore

$$\Phi_G(r) = -\frac{\Delta A}{r}.$$

The negative sign expresses the dominance of the binding contribution.

The present model identifies this residual scalar field with the gravitational potential produced by the particle.

Thus,

$$\text{gravity} \longleftrightarrow \text{residual of the Energy Field and Binding Field.}$$

This interpretation differs fundamentally from introducing gravity as a third independent interaction. The gravitational effect is instead proposed to emerge from the incomplete cancellation of two macroscopic manifestations of the same electromagnetic structure.

6.2. Why Gravity Can Be Extremely Weak

The weakness of gravity is one of the most striking features of nature.

Within the present model, the individual amplitudes

$$A_E$$

and

$$A_B$$

need not be small.

Instead, gravity can be weak because their difference is small:

$$\Delta A \ll A_E, A_B.$$

Consequently,

$$|\Phi_G| \ll |\Phi_E|, |\Phi_B|.$$

The hierarchy is therefore

$$\begin{aligned} &\text{large expansive contribution} - \\ &\text{almost equally large binding contribution} = \\ &\text{weak gravitational residual.} \end{aligned}$$

The smallness of gravity does not, in this picture, require the microscopic mechanism producing the two underlying fields to be intrinsically weak.

It requires their external manifestations to be very closely matched.

This distinction is important because the same underlying structure can then remain energetically substantial while producing only a very small net long-range interaction.

6.3. Stability and Weak Gravity

The condition for microscopic stability derived earlier is

$$|U_B| > |U_E|.$$

The condition for weak gravitational interaction is different:

$$|U_B| > |U_E|.$$

together with

$$A_B - A_E \ll A_E, A_B.$$

These two requirements should not be confused.

The first concerns the internal energetic organization of the supertorus.

The second concerns the amplitudes of its macroscopic external fields.

A complete theory must ultimately explain the relation between them:

$$\{U_E, U_B\} \longrightarrow \{A_E, A_B\}.$$

The present model therefore does not assume that microscopic stability automatically implies weak gravity.

Rather, it proposes that the internal binding dominance of a stable particle is reflected macroscopically by a slightly stronger Binding Field, while the observed weakness of gravity indicates that this external dominance is extremely small.

The quantitative origin of this small difference remains one of the central problems of the theory.

6.4. Emergence of the Inverse-Square Law

From

$$\Phi_G(r) = -\frac{\Delta A}{r},$$

the radial derivative is

$$\frac{d\Phi_G}{dr} = \frac{\Delta A}{r^2}.$$

The gravitational field is defined from the potential gradient as

$$\mathbf{g} = -\nabla\Phi_G.$$

For spherical symmetry,

$$\nabla\Phi_G = \frac{\Delta A}{r^2}\hat{\mathbf{r}},$$

and therefore

$$\mathbf{g}(r) = -\frac{\Delta A}{r^2}\hat{\mathbf{r}}.$$

Its magnitude is

$$g(r) = \frac{\Delta A}{r^2}.$$

The minus sign indicates that the field points toward the source.

Thus the proposed dual-field structure naturally produces an attractive interaction with the spatial dependence

$$g \propto \frac{1}{r^2}.$$

This inverse-square dependence is not introduced independently as a gravitational force law. It follows from the common $1/r$ dependence of the two scalar fields derived in the preceding section.

6.5. Why the Resultant Is Attractive

Obtaining a weak residual is not sufficient. Gravity must also have the correct direction.

For the convention adopted here,

$$\Phi_E(r) = +\frac{A_E}{r}$$

represents the expansive contribution, whereas

$$\Phi_B(r) = -\frac{A_B}{r}$$

represents the binding contribution.

If

$$A_B > A_E,$$

then

$$\Phi_G(r) < 0.$$

The resultant field is therefore binding-dominated.

Since

$$\mathbf{g} = -\nabla\Phi_G,$$

the resulting acceleration is directed toward the source:

$$\mathbf{g} = -\frac{\Delta A}{r^2}\hat{\mathbf{r}}.$$

The attractive nature of gravity therefore corresponds, within the present sign convention, to the condition

$$A_B > A_E.$$

This condition is consistent with the physical picture of a stable supertorus in which binding ultimately dominates expansion.

However, the equality between microscopic binding dominance and macroscopic field dominance is not yet derived. It remains a requirement that the microscopic-to-macroscopic mapping must reproduce.

6.6. Interaction with a Second Supertorus

A gravitational field has physical meaning only if it produces a response in another body.

Consider a second localized electromagnetic structure placed in the residual field generated by the first.

The second supertorus contains the same two types of structural contributions and is therefore expected to respond to the external Energy Field and Binding Field.

Let its effective gravitational response coefficient be denoted by

$$Q_G.$$

The interaction energy may then be represented schematically as

$$U_{\text{int}} = Q_G \Phi_G.$$

The corresponding force is

$$\mathbf{F}_G = -Q_G \nabla \Phi_G.$$

Using the residual field derived above,

$$\mathbf{F}_G = -Q_G \frac{\Delta A}{r^2} \hat{\mathbf{r}}.$$

Thus,

$$F_G \propto \frac{Q_G \Delta A}{r^2}.$$

At this stage, Q_G is not an independently postulated gravitational charge. It represents whatever property of the second supertorus determines its response to the residual field.

A complete microscopic theory must derive this response from the electromagnetic structure itself.

6.7. Many-Particle Sources

Macroscopic bodies contain large numbers of localized particles.

If the far-field residual produced by each constituent is weak and the interactions can be treated in the linear approximation, the scalar contributions may be summed.

Let the residual amplitude of the i -th constituent be

$$\Delta A_i.$$

For a body containing N constituents, the total far-field amplitude is then approximately

$$\Delta A_{\text{tot}} = \sum_{i=1}^N \Delta A_i.$$

The resulting potential becomes

$$\Phi_G(r) = -\frac{\Delta A_{\text{tot}}}{r}.$$

and the corresponding field is

$$\mathbf{g}(r) = -\frac{\Delta A_{\text{tot}}}{r^2} \hat{\mathbf{r}}.$$

If the total residual amplitude scales with the amount of matter,

$$\Delta A_{\text{tot}} \propto M,$$

then

$$\Phi_G(r) \propto -\frac{M}{r}$$

and

$$g(r) \propto \frac{M}{r^2}.$$

This is the functional form required by Newtonian gravity.

6.8. Connection with the Newtonian Potential

The Newtonian gravitational potential of a spherical body of mass M is

$$\Phi_N(r) = -\frac{GM}{r}.$$

The residual field of the present model has the form

$$\Phi_G(r) = -\frac{\Delta A_{\text{tot}}}{r}.$$

Therefore, agreement with the Newtonian limit requires

$$\boxed{\Delta A_{\text{tot}} = GM.}$$

For a single microscopic constituent, the corresponding relation would be

$$\Delta A = Gm_g,$$

where m_g denotes the gravitational mass associated with that constituent.

This relation should not be interpreted as a derivation of G .

It merely identifies what the microscopic theory must eventually reproduce.

The quantitative challenge is to derive

$$\Delta A$$

directly from the electromagnetic structure of the supertorus and to show that its relation to the amount of matter yields the experimentally observed constant G .

Thus the desired chain is

$$\boxed{\text{supertorus structure} \longrightarrow A_E, A_B \longrightarrow \Delta A \longrightarrow Gm_g.}$$

Only when this chain is obtained independently of measured gravitational data will the model provide a quantitative derivation of Newtonian gravity.

6.9. Universality of Gravitational Interaction

A further requirement is universality.

Experimentally, gravity acts on different forms of matter in a remarkably uniform way.

Within the present model, this means that the residual field generated by a particle and the response of another particle to that field must be related systematically to their complete electromagnetic structures.

For two bodies, let their effective gravitational quantities be

$$Q_{G1}$$

and

$$Q_{G2}.$$

The interaction should acquire the form

$$F_G \propto \frac{Q_{G1}Q_{G2}}{r^2}.$$

To reproduce Newtonian gravity,

$$F_G = G \frac{m_{g1}m_{g2}}{r^2},$$

the microscopic theory must ultimately establish

$$Q_G \propto m_g.$$

The universality of free fall therefore places a strong constraint on the model.

The residual interaction cannot depend arbitrarily on the detailed electromagnetic geometry of different particles. Its effective coupling must reduce, at the macroscopic level, to a universal quantity proportional to gravitational mass.

6.10. What the Present Model Explains Qualitatively

At its present stage, the dual-field interpretation provides a common qualitative explanation for several characteristic properties of gravity.

First, gravity is weak because

$$\Delta A \ll A_E, A_B.$$

Second, gravity is attractive because

$$A_B > A_E.$$

Third, its far-field spatial dependence is inverse-square because

$$\Phi_E, \Phi_B \propto \frac{1}{r}.$$

Fourth, gravity can scale with the amount of matter if the residual amplitudes of microscopic constituents add coherently in the weak-field limit.

These properties arise from one physical picture rather than from four unrelated assumptions:

two large opposing structural fields → small binding-dominated residual.

6.11. What Remains to Be Derived

Several decisive questions remain quantitative.

The model must derive from the electromagnetic supertorus:

$$A_E,$$

$$A_B,$$

and therefore

$$\Delta A = A_B - A_E.$$

It must explain why

$$\Delta A \ll A_E, A_B,$$

why

$$\Delta A > 0,$$

and why the residual amplitude scales universally with the gravitational participation of matter.

It must also derive the coupling of one supertorus to the residual field generated by another.

Most importantly, it must show that

$$\Delta A_{\text{tot}} = GM$$

without using the measured value of G as an input parameter.

The present section therefore does not claim a completed derivation of gravitational strength.

Its result is more specific:

if the two macroscopic structural fields arise from the supertorus and if their binding contribution is only slightly stronger, their residual naturally has the sign and spatial form required for gravity.

6.12. Gravity as an Indicator of Imperfect Balance

The proposed interpretation gives the weakness of gravity an additional physical meaning.

Instead of measuring the total energetic scale of matter, gravity measures only the small difference between two much larger structural contributions:

$$\Delta A = A_B - A_E.$$

In this sense, gravitational interaction becomes a measure of the **imperfection of the macroscopic balance** between the Energy Field and Binding Field.

The smaller the relative difference

$$\frac{\Delta A}{A_E},$$

the weaker gravity becomes compared with the underlying structural fields.

This suggests a useful conceptual distinction that will become central in the following section:

gravity measures the residual imbalance,

whereas

**inertia may measure the response of
the complete structure.**

The same two structural contributions may therefore produce gravity by opposing one another while producing inertia by acting cooperatively.

The next section develops this second consequence and investigates the **origin of inertia and mass**.

7. Origin of Inertia and Mass

The preceding sections associated gravity with the small residual between the Energy Field and Binding Field. Inertia requires a different aspect of the same two-field structure.

A particle moving uniformly can retain a stationary field configuration in its own state of motion. Acceleration is different. During acceleration, the supertorus changes its state of motion, and the spatial configurations of its Energy Field and Binding Field must adjust accordingly.

The central hypothesis of this section is that this adjustment is not instantaneous and energetically neutral. Acceleration deforms the two fields away from their preferred configurations. Because each field tends toward a minimum-energy spatial state, the deformation produces a response opposing the imposed acceleration.

In this interpretation, inertial mass is not introduced as an independent intrinsic property of a point particle. It emerges as a

measure of the resistance of the complete field structure to acceleration-induced deformation.

7.1. Undisturbed Field Configuration

For an isolated supertorus in a stationary state, the far-field configurations derived in Section 5 are

$$\Phi_E(r) = \frac{A_E}{r}$$

and

$$\Phi_B(r) = -\frac{A_B}{r}.$$

These spherically symmetric configurations represent the assumed minimum-energy far-field states of the two scalar fields.

Their individual field-energy functionals may be written schematically as

$$\mathcal{U}_E[\Phi_E] = \frac{\kappa_E}{2} \int |\nabla \Phi_E|^2 dV$$

and

$$\mathcal{U}_B[\Phi_B] = \frac{\kappa_B}{2} \int |\nabla \Phi_B|^2 dV.$$

In the absence of acceleration, the fields occupy their preferred configurations subject to the boundary conditions imposed by the supertorus.

The important point is that the spherical field distribution is not treated merely as a geometric shape. It represents an energetically preferred spatial state.

7.2. Acceleration Produces Field Deformation

Consider now an external force acting on the supertorus and producing an acceleration

a.

The localized source changes its state of motion. Its surrounding fields must consequently change their spatial configuration.

Instead of depending only on radial distance,

$$\Phi_E = \Phi_E(r), \quad \Phi_B = \Phi_B(r),$$

the accelerated configurations become, more generally,

$$\Phi_E = \Phi_E(\mathbf{r}; \mathbf{a})$$

and

$$\Phi_B = \Phi_B(\mathbf{r}; \mathbf{a}).$$

The acceleration introduces a preferred direction, so spherical symmetry is lost.

Schematically,

spherical equilibrium field $\rightarrow$
acceleration- induced asymmetric field.

The deformation need not be interpreted as a rigid displacement of an already existing field distribution. Rather, the complete spatial solution must continuously readjust to the changing motion of its source.

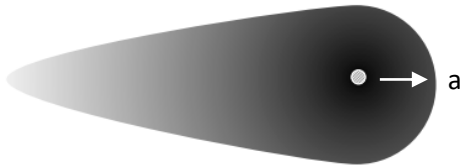


Figure 1. Conceptual deformation of the Energy Field and Binding Field during acceleration. The particle is shown by the central point. In the undisturbed state the fields tend toward a spherically symmetric minimum-energy configuration. Acceleration introduces a preferred direction and produces an asymmetric field configuration. The resulting tendency of both fields to return toward their minimum-energy states is proposed as the physical origin of the inertial reaction.

The elongated configuration illustrated conceptually by the acceleration-deformed field represents this departure from the minimum-energy spherical state.

7.3. Both Fields Participate in the Deformation

The Energy Field and Binding Field have opposite roles in the gravitational residual, but this does not mean that their inertial contributions cancel.

During acceleration, both spatial configurations are disturbed.

Thus,

$$\Phi_E^{(0)} \rightarrow \Phi_E^{(a)}$$

and

$$\Phi_B^{(0)} \rightarrow \Phi_B^{(a)},$$

where the superscript 0 denotes the undisturbed configuration and a the acceleration-deformed configuration.

For the Energy Field, define the deformation energy

$$\Delta\mathcal{U}_E = \mathcal{U}_E[\Phi_E^{(a)}] - \mathcal{U}_E[\Phi_E^{(0)}].$$

Similarly,

$$\Delta\mathcal{U}_B = \mathcal{U}_B[\Phi_B^{(a)}] - \mathcal{U}_B[\Phi_B^{(0)}].$$

If the undisturbed states are energy minima, then for sufficiently small admissible deformations,

$$\Delta\mathcal{U}_E \geq 0$$

and

$$\Delta\mathcal{U}_B \geq 0.$$

The total energetic cost of deformation is therefore

$$\Delta\mathcal{U}_{\text{def}} = \Delta\mathcal{U}_E + \Delta\mathcal{U}_B.$$

This is a crucial distinction between inertia and gravity.

In gravity the opposite signs of the two fields permit a small residual,

$$A_B - A_E.$$

In acceleration, however, deformation of either field costs energy. Their contributions therefore act cooperatively rather than cancelling.

7.4. Tendency Toward the Minimum-Energy State

Once a field is deformed away from its preferred configuration, the variational principle introduced in Section 5 implies a tendency to return toward a lower-energy state.

This provides the proposed physical origin of the inertial reaction.

The externally applied force attempts to change the motion of the supertorus, while the surrounding field structure continuously tends toward its preferred configuration.

Schematically,

external acceleration →
field deformation →
increase of field energy →
restoring response.

The restoring response acts opposite to the imposed acceleration.

Thus the resistance commonly represented by inertial mass is interpreted here as a dynamical property of the complete supertorus-field system.

7.5. Small-Deformation Approximation

For sufficiently small accelerations, the deformation may be treated as a perturbation around the equilibrium configuration.

Let q_E and q_B denote generalized coordinates describing the deformation of the two fields.

Near equilibrium,

$$\Delta\mathcal{U}_E \approx \frac{1}{2}K_E q_E^2$$

and

$$\Delta\mathcal{U}_B \approx \frac{1}{2}K_B q_B^2,$$

where K_E and K_B characterize the effective stiffness of the two field configurations.

The restoring generalized forces are then

$$F_E = -\frac{\partial\Delta\mathcal{U}_E}{\partial q_E} = -K_E q_E$$

and

$$F_B = -\frac{\partial\Delta\mathcal{U}_B}{\partial q_B} = -K_B q_B.$$

This illustrates an important principle: the magnitude of the inertial response depends not only on the amplitudes A_E and A_B , but also on how strongly their spatial configurations resist deformation.

Consequently, one should not yet assume simply that

$$m_i \propto A_E + A_B.$$

The inertial mass must emerge from the **dynamics of deformation**.

7.6. From Field Deformation to $\mathbf{F}=\mathbf{ma}$

To recover ordinary mechanics, the field response must reduce in the low-acceleration regime to a force proportional to acceleration.

The required macroscopic result is

$$\mathbf{F}_{\text{inertial}} = -m_i \mathbf{a}.$$

The external force required to maintain the acceleration is correspondingly

$$\mathbf{F}_{\text{external}} = m_i \mathbf{a}.$$

Within the present model, this familiar equation is interpreted as the macroscopic limit of a more detailed field process:

$$\mathbf{a} \longrightarrow \delta\Phi_E, \delta\Phi_B \longrightarrow \Delta\mathcal{U}_E, \Delta\mathcal{U}_B \longrightarrow \mathbf{F}_{\text{inertial}}.$$

A complete calculation must therefore determine how the field deformations depend on acceleration.

For sufficiently small acceleration one expects a linear-response regime. Schematically,

$$q_E = \chi_E a$$

and

$$q_B = \chi_B a,$$

where χ_E and χ_B characterize how readily the two fields deform.

Then

$$F_E = -K_E \chi_E a$$

and

$$F_B = -K_B \chi_B a.$$

Their combined response is

$$F_{\text{inertial}} = -(K_E \chi_E + K_B \chi_B) a.$$

Comparison with

$$F_{\text{inertial}} = -m_i a$$

gives

$$m_i = K_E \chi_E + K_B \chi_B.$$

This equation should at present be regarded as a schematic linear-response relation rather than a completed derivation. Its purpose is to identify what must ultimately be calculated from the two field configurations.

7.7. Relation to the Field Amplitudes A_E and A_B

The quantities K_E , K_B , χ_E , and χ_B cannot be independent of the amplitudes and spatial structures of the Energy Field and Binding Field.

Since

$$\Phi_E(r) = \frac{A_E}{r}$$

and

$$\Phi_B(r) = -\frac{A_B}{r},$$

their resistance to deformation should ultimately be expressible in terms of

$$A_E, A_B$$

together with the microscopic parameters of the supertorus.

Thus the desired relation has the general form

$$m_i = \mathcal{M}(A_E, A_B, R, a, \dots).$$

The exact function $\mathcal{M}$ remains to be derived.

This is one of the most important quantitative objectives of the present model.

If the leading result should eventually reduce to a relation involving the combined amplitudes,

$$m_i \propto A_E + A_B,$$

then inertia would provide precisely the complementary information required to determine the absolute field amplitudes.

But such a relation must emerge from the deformation calculation; it should not be assumed in advance.

7.8. Gravity Determines the Difference; Inertia May Determine the Absolute Scale

The gravitational analysis produced

$$A_B - A_E = G m_g.$$

This determines only the small difference between the two amplitudes.

It cannot determine A_E and A_B separately.

The inertial response offers a second, independent route.

If the deformation calculation eventually provides

$$m_i = \mathcal{M}(A_E, A_B, \dots),$$

then the experimentally known inertial mass supplies a second constraint.

The two directions of investigation are therefore

$$\text{gravity} \longrightarrow A_B - A_E$$

and

$$\text{inertia} \longrightarrow \mathcal{M}(A_E, A_B, \dots).$$

Together they may permit

$$A_E, A_B$$

to be determined separately.

This possibility is particularly valuable because it allows the model to be investigated in both directions.

From the microscopic side,

$$\text{supertorus} \longrightarrow A_E, A_B,$$

while from measured macroscopic properties,

$$G, m_g, m_i \longrightarrow A_E, A_B.$$

A successful theory should ultimately make these two routes converge on the same values.

7.9. Physical Interpretation of Inertial Mass

The present picture gives inertial mass a direct physical interpretation.

Mass is not simply the amount of electromagnetic energy contained in the supertorus, nor is it identified directly with either of the two scalar-field amplitudes.

Instead,

inertial mass measures the resistance of the complete field structure to acceleration-induced deformation.

A structure whose Energy Field and Binding Field can be deformed with little energetic cost would possess a smaller inertial response.

A structure whose fields strongly resist deformation would possess a larger inertial response.

Thus inertial mass characterizes the dynamical stiffness of the complete localized electromagnetic system and its surrounding macroscopic fields.

7.10. Uniform Motion and Acceleration

The proposed mechanism also makes an important distinction between velocity and acceleration.

Uniform motion does not by itself require a continuously increasing deformation energy. A particle in uniform motion can possess a stationary field configuration appropriate to that state of motion.

Acceleration, however, continually changes the required configuration.

Therefore the inertial response is associated with

$$\mathbf{a}$$

rather than simply with

$$\mathbf{v}.$$

This is consistent with the mechanical relation

$$\mathbf{F} = m_i \mathbf{a}.$$

The field interpretation therefore does not require a resistance to uniform translational motion. It requires resistance to the continual reorganization associated with acceleration.

7.11. A Common Physical Structure Behind Mass and Gravity

The Energy Field and Binding Field now play two different roles.

For gravity, their opposite signs produce a small residual:

$$\text{gravity} \longleftrightarrow A_B - A_E.$$

For inertia, both fields must be deformed when the particle accelerates:

$$\text{Inertia} \leftrightarrow \text{combined deformation response of both fields.}$$

Thus the same two-field structure can produce a weak gravitational interaction and a much stronger inertial response without requiring the underlying fields themselves to be weak.

This leads to the central distinction:

$$\text{gravity measures a residual,}$$

Whereas

$$\text{inertia measures resistance to deformation of the complete field structure.}$$

The two phenomena are therefore different manifestations of the same underlying physical system.

7.12. Open Quantitative Problem

The central unresolved calculation is now clearly defined.

Starting from

$$\Phi_E(r) = \frac{A_E}{r}$$

and

$$\Phi_B(r) = -\frac{A_B}{r},$$

one must determine their acceleration-dependent deformations,

$$\delta\Phi_E(\mathbf{r}, \mathbf{a})$$

and

$$\delta\Phi_B(\mathbf{r}, \mathbf{a}),$$

calculate the associated change in field energy and momentum, and derive the resulting reaction force.

The required result is

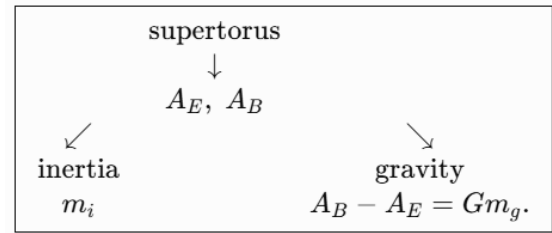
$$-\mathbf{F}_{\text{reaction}} = \mathbf{F}_{\text{external}} = m_i \mathbf{a}.$$

If this calculation also yields a definite relation

$$m_i = \mathcal{M}(A_E, A_B, R, a, \dots),$$

then it provides the missing second equation needed to determine the absolute amplitudes A_E and A_B .

This would create a closed quantitative bridge between the microscopic supertorus, inertial mass, and gravity:



The next question is then whether the common origin of these two phenomena can also account for the observed relation between **inertial and gravitational mass**.

8. Common Origin of Gravity and Inertia

The preceding sections describe gravity and inertia as two different manifestations of the same underlying physical structure. Both originate from the Energy Field and Binding Field associated with the electromagnetic supertorus, but they depend on these fields in fundamentally different ways.

Gravity is associated with the small residual between the two fields. Inertia, by contrast, arises from the deformation of both fields when the supertorus is accelerated.

The same two fields may therefore produce a weak gravitational interaction and, at the same time, a much stronger resistance to acceleration.

8.1. One Structure, Two Responses

The far-field configurations of the Energy Field and Binding Field are written as

$$\Phi_E(r) = \frac{A_E}{r},$$

$$\Phi_B(r) = -\frac{A_B}{r},$$

where $A_E > 0$ and $A_B > 0$ denote the magnitudes of the two field amplitudes.

It is useful to introduce two combinations:

$$D = A_B - A_E$$

and

$$S = A_B + A_E.$$

These quantities describe two fundamentally different properties of the same two-field structure.

The difference D determines the small residual that remains when the opposing fields are combined.

The sum S represents the combined amplitude scale of the two fields. Since both fields must deform when the particle accelerates, this combined scale is relevant to the inertial response.

Thus,

$$\text{gravity} \longleftrightarrow D = A_B - A_E$$

Whereas

$$\text{Inertia} \longleftrightarrow \text{combined response associated with } S = A_B + A_E.$$

8.2. Gravity as a Residual

For gravity, the two fields oppose one another:

$$\Phi_G = \Phi_E + \Phi_B$$

Therefore,

$$\Phi_G(r) = -\frac{A_B - A_E}{r} = -\frac{D}{r}.$$

Comparison with the Newtonian potential gives

$$D = A_B - A_E = Gm_g.$$

Gravity therefore reveals only the difference between the two field amplitudes.

If

$$D \ll A_E, A_B,$$

then the gravitational field is much weaker than either of the underlying fields.

The gravitational interaction can consequently be weak even if the Energy Field and Binding Field themselves are strong.

8.3. Inertia as a Combined Field Response

Acceleration produces a different situation.

When the supertorus accelerates, both the Energy Field and Binding Field are deformed away from their preferred spatial configurations. Although their signs are opposite in the gravitational residual, the energetic costs of their deformations do not cancel.

Both fields resist deformation.

Their inertial effects therefore act cooperatively.

The characteristic amplitude scale relevant to this combined response is

$$S = A_B + A_E.$$

The inertial mass may consequently be represented schematically as

$$m_i = \mathcal{M}(S)$$

or equivalently,

$$m_i = \mathcal{M}(A_B + A_E).$$

The function $\mathcal{M}$ is not yet derived. It represents the relation between the combined field structure and its resistance to acceleration-induced deformation.

The present model therefore does not yet assume a linear relation such as

$$m_i \propto A_B + A_E.$$

Such a relation, if valid, must emerge from a quantitative calculation of the deformation of both fields during acceleration.

The essential physical statement is simpler: **inertia depends on the participation of both fields, not on their small difference.**

8.4. Why Gravity Can Be Weak While Inertia Remains Strong

The distinction between

$$D = A_B - A_E$$

and

$$S = A_B + A_E$$

provides a simple explanation for the very different magnitudes of gravitational and inertial effects.

If

$$A_B \approx A_E,$$

then

$$D \ll S.$$

Gravity depends on the small quantity D , whereas inertia depends on the deformation response associated with the much larger scale S .

Thus,

$$D = A_B - A_E \quad \text{small gravitational residual}$$

while

$$S = A_B + A_E \quad \text{large underlying field scale.}$$

The same physical structure can therefore be almost balanced in its gravitational action while remaining strongly resistant to acceleration.

In this interpretation, weak gravity and substantial inertia are not contradictory properties. They are consequences of two different ways in which the same Energy Field and Binding Field participate in physical processes.

8.5. Common Physical Origin

Gravitational mass and inertial mass are experimentally found to correspond to the same amount of matter.

The present model proposes a possible structural reason for this connection.

Both originate from the same supertorus and the same pair of macroscopic fields.

Gravitational behaviour reveals their imbalance,

$$A_B - A_E,$$

whereas inertial behaviour reveals their combined response to deformation,

$$A_B + A_E.$$

Thus gravitational and inertial properties are not assigned independently to the particle. They are two macroscopic manifestations of one underlying field structure.

This common origin does not yet constitute a quantitative derivation of the equality

$$m_i = m_g.$$

Such a derivation requires a complete calculation of the acceleration-induced deformation of the Energy Field and Binding

Field. It must show how their combined response produces the observed inertial mass and how this response is related to the small gravitational residual.

The equality of inertial and gravitational mass therefore becomes a quantitative test of the proposed common origin rather than an additional assumption of the model.

8.6. Two Complementary Views of the Same Fields

The central result of this section can be summarized by considering the same two amplitudes in two different combinations:

$$D = A_B - A_E$$

and

$$S = A_B + A_E.$$

The first describes what remains when the two opposing fields nearly cancel:

Gravity probes the difference of the two fields.

The second describes the field scale whose two components must both respond when the particle is accelerated:

Inertia probes their combined deformation response.

The same Energy Field and Binding Field thus appear in both phenomena, but nature reveals them differently: **gravity through their small imbalance, and inertia through their combined resistance to deformation.**

9. Relation Between Light and Matter

The electromagnetic supertorus suggests a close connection between light and matter. Both are described in terms of electric and magnetic fields, electromagnetic energy, momentum, and oscillatory dynamics. The essential difference is therefore not necessarily

the physical nature of their underlying fields, but the way in which those fields are organized in space and time.

Light represents a propagating electromagnetic configuration. The supertorus represents a localized and phase-closed electromagnetic configuration.

This distinction provides a possible bridge between electromagnetic radiation and matter without requiring them to be constructed from fundamentally different physical ingredients.

9.1. A Common Electromagnetic Basis

A propagating electromagnetic wave is characterized by electric and magnetic fields,

$$\mathbf{E}(\mathbf{r}, t)$$

and

$$\mathbf{B}(\mathbf{r}, t),$$

which transport electromagnetic energy and momentum through space.

The supertorus is described by the same fundamental electromagnetic quantities.

Its local energy density is

$$u_{\text{EM}} = \frac{\epsilon_0}{2} E^2 + \frac{1}{2\mu_0} B^2,$$

and its local energy flow is described by the Poynting vector

$$\mathbf{S} = \frac{1}{\mu_0} \mathbf{E} \times \mathbf{B}.$$

Thus the distinction between light and the proposed particle does not begin with different forms of energy.

Both contain electromagnetic energy.

The difference begins with its organization.

light and matter may share the same electromagnetic basis

while differing in the spatial and phase structure of their fields.

9.2. Propagating and Localized Electromagnetic Organization

For freely propagating light, electromagnetic energy advances through space.

Schematically,

light $\longrightarrow$ open propagation.

There is no requirement that the electromagnetic state return to its starting point after one spatial cycle.

The supertorus has a fundamentally different organization. Its electromagnetic dynamics are arranged along closed paths, and the phase evolution is required to satisfy a global closure condition.

Thus,

supertorus $\longrightarrow$ closed circulation.

The distinction can be expressed conceptually as

propagation $\longleftrightarrow$ localization.

Light transports its electromagnetic organization through space, whereas matter, in the proposed model, preserves electromagnetic organization around a localized structure.

9.3. Phase Closure as the Essential Difference

Geometry alone does not distinguish the supertorus from an arbitrary closed electromagnetic path.

The decisive additional condition is phase closure.

As developed in Part II, the electromagnetic oscillations of the toroidal elements are coherently related around the complete supertorus. After one complete progression

around the major circumference, the phase must return consistently to its initial state.

For a single complete phase cycle,

$$\Delta\varphi = 2\pi.$$

More generally, a closed coherent state requires

$$\Delta\varphi = 2\pi n,$$

where n is an integer.

Thus the electromagnetic structure satisfies simultaneously

geometric closure + phase closure.

This combination permits a propagating electromagnetic process to be reorganized into a persistent localized state.

The proposed distinction between light and matter is therefore not simply that one moves and the other does not. It is that their electromagnetic energy belongs to fundamentally different global organizations.

9.4. Energy Flow in Light and Matter

The Poynting vector provides a useful way of expressing this distinction.

For freely propagating light, the average electromagnetic energy flow has a net direction of propagation:

$$\langle \mathbf{S} \rangle \neq 0$$

along the direction in which the wave travels.

The energy therefore leaves one region and enters another.

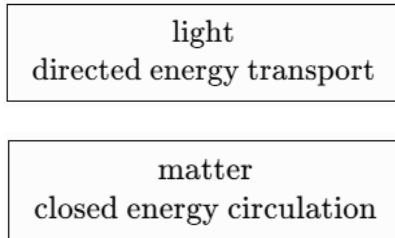
In the supertorus, local electromagnetic energy flow may also be nonzero,

$$\mathbf{S}(\mathbf{r}, t) \neq 0,$$

but its global organization is closed.

Energy circulates within the coherent structure rather than producing a persistent net outward transport to infinity.

Schematically,



This distinction provides a physical basis for localization without requiring the electromagnetic fields themselves to become static.

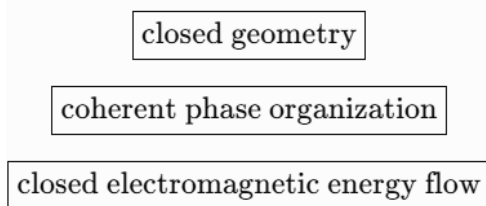
Matter can therefore be stationary as a whole while remaining dynamically active internally.

9.5. Localization and the Supertorus

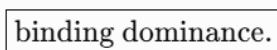
A central difficulty for any electromagnetic model of matter is explaining why electromagnetic energy does not simply radiate away.

In the present model, localization is associated with the complete organization of the supertorus rather than with an externally imposed confining boundary.

Several properties act together:



and



The binding contribution satisfies the stability requirement

$$|U_B| > |U_E|.$$

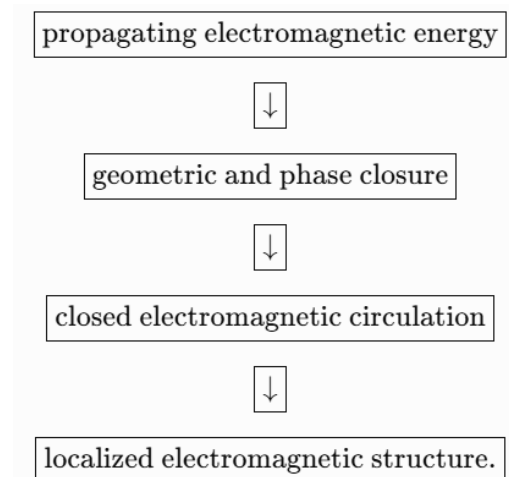
This prevents the expansive structural tendency from destroying the localized configuration.

Localization therefore results from the cooperation of geometry, phase, electromagnetic dynamics, and binding.

No single one of these properties should by itself be identified as the complete explanation of matter.

9.6. From Propagating Energy to a Particle

The proposed relation between light and matter can now be expressed as a change in organization:



This does not imply that an arbitrary light wave can simply be bent into a circle to produce a particle.

The resulting configuration must simultaneously satisfy the geometric, phase, energetic, angular-momentum, magnetic-moment, and stability constraints developed for the supertorus.

Matter is therefore not interpreted merely as trapped light.

It is better described as a **self-organized localized electromagnetic state**.

9.7. Why Matter Has Properties That Free Light Does Not

Once electromagnetic energy becomes part of a localized coherent structure, new

macroscopic properties can emerge from the organization itself.

The supertorus possesses an internal geometry characterized by

$$R$$

and

$$a.$$

It possesses phase closure, circulating electromagnetic momentum, displacement-current organization, angular momentum, and magnetic moment.

In the present Part III, two additional macroscopic consequences are proposed:

$$\Phi_E$$

and

$$\Phi_B,$$

the Energy Field and Binding Field.

These fields then provide the proposed physical basis for gravitational and inertial behaviour.

Thus the sequence is not

electromagnetism + mass + gravity,

with each introduced independently.

Instead, the model seeks the chain

electromagnetic organization →
localized matter →
Energy and Binding Fields →
mass and gravity.

Mass and gravity would then be emergent properties of organized electromagnetic matter rather than independent ingredients added to it.

9.8. Matter as an Organized Electromagnetic State

The proposed relation between light and matter can therefore be summarized by a simple distinction:

Light = propagating electromagnetic organization

Whereas

matter=localized, phase-closed electromagnetic organization.

Both remain dynamical.

Both contain electromagnetic energy and momentum.

Both are described locally by electric and magnetic fields.

Their difference lies primarily in the global organization of those fields.

This interpretation also clarifies why the present model does not require a separate material substance to be added to the electromagnetic supertorus. The particle itself is the organized field structure.

Its mass is associated with the resistance of its Energy Field and Binding Field to acceleration-induced deformation, while its gravity is associated with the small residual between those same fields.

The resulting conceptual chain is

Light →
electromagnetic
propagation

And

Matter →
electromagnetic closure
and localization →
mass and gravity.

The distinction between light and matter is therefore interpreted not as a distinction between fundamentally different physical substances, but as a distinction between **different stable organizations of electromagnetic energy**.

10. Quantitative Constraints and Open Problems

The preceding sections establish a qualitative physical chain connecting the electromagnetic supertorus with the Energy Field, Binding Field, gravity, and inertia. The model has therefore reached a stage at which its principal unknowns can be formulated quantitatively.

The central quantities are the amplitudes

$$A_E$$

and

$$A_B$$

of the two macroscopic fields,

$$\begin{aligned}\Phi_E(r) &= \frac{A_E}{r}, \\ \Phi_B(r) &= -\frac{A_B}{r}.\end{aligned}$$

Gravity constrains their small difference, whereas inertia is proposed to depend on their combined deformation response.

The principal quantitative objective is therefore to determine the absolute values of A_E and A_B and to derive them independently from the electromagnetic structure of the supertorus.

10.1. Microscopic Origin of the Two Fields

The most fundamental unresolved step is the transition

electromagnetic supertorus $\rightarrow$
Energy Field and Binding Field.

At present, the internal structure is described through

$$\mathbf{E}, \quad \mathbf{B}, \quad \mathbf{J}_D,$$

together with the geometry, phase organization, electromagnetic energy flow, and momentum distribution of the supertorus.

The external structure is represented by

$$\Phi_E$$

and

$$\Phi_B.$$

A complete theory must derive relations of the general form

$$\Phi_E = \mathcal{F}_E[\text{supertorus}]$$

and

$$\Phi_B = \mathcal{F}_B[\text{supertorus}].$$

Such a derivation must explain why two macroscopic contributions arise, why they have opposite structural roles, and why they acquire the same long-range spatial dependence.

This microscopic-to-macroscopic transition remains the central theoretical problem of the model.

10.2. Determination of A_E and A_B

The amplitudes A_E and A_B determine the absolute scale of the two macroscopic fields.

Their difference is

$$D = A_B - A_E,$$

whereas their sum is

$$S = A_B + A_E.$$

These two combinations play very different physical roles.

Gravity constrains D , while inertia may provide information about S .

Once D and S are known independently, the two amplitudes follow from

$$A_B = \frac{S + D}{2}$$

and

$$A_E = \frac{S - D}{2}.$$

Thus the determination of the two absolute amplitudes can be reduced to the determination of one difference and one combined scale.

10.3. Gravitational Constraint

Comparison of the residual field

$$\Phi_G(r) = -\frac{A_B - A_E}{r}$$

with the Newtonian gravitational potential

$$\Phi_N(r) = -\frac{Gm_g}{r}$$

gives

$$D = A_B - A_E = Gm_g.$$

This is already a quantitative constraint on the two-field model.

For a source with

$$m_g = 1 \text{ kg},$$

the residual amplitude is

$$D = 6.67430 \times 10^{-11} \text{ m}^3 \text{ s}^{-2}.$$

Gravity therefore determines the difference between the two amplitudes, but not their individual values.

Even a precise knowledge of G and m_g leaves infinitely many possible pairs

$$(A_E, A_B)$$

having the same difference.

A second independent relation is required.

10.4. Inertial Constraint

The proposed second route is inertia.

During acceleration, both the Energy Field and Binding Field are deformed. Their contributions to the deformation energy act cooperatively rather than cancelling.

The characteristic combined amplitude is

$$S = A_B + A_E.$$

The inertial mass is therefore expected to depend on the combined deformation response associated with this scale:

$$m_i = \mathcal{M}(S)$$

or

$$m_i = \mathcal{M}(A_B + A_E).$$

The function M remains unknown.

Its derivation requires calculation of the acceleration-dependent field configurations,

$$\Phi_E(\mathbf{r}; \mathbf{a})$$

and

$$\Phi_B(\mathbf{r}; \mathbf{a}),$$

followed by calculation of their energy and momentum changes.

The resulting reaction force must reproduce

$$\mathbf{F}_{\text{reaction}} = -m_i \mathbf{a}$$

in the low-acceleration limit.

If this calculation determines S, then gravity and inertia together determine A_E and A_B separately.

10.5. Investigating the Model in Both Directions

The model can therefore be investigated along two complementary paths.

The first proceeds from the microscopic structure outward:

$$\begin{aligned} &\boxed{\text{supertorus} \longrightarrow A_E,} \\ &\boxed{A_B \longrightarrow \text{gravity and inertia.}} \end{aligned}$$

This is the direct theoretical route.

The second proceeds from measured macroscopic properties inward:

$$\begin{aligned} &\boxed{G, m_g, m_i \longrightarrow \text{constraints on } A_E,} \\ &\boxed{A_B \longrightarrow \text{constraints on the supertorus.}} \end{aligned}$$

This inverse route may be equally useful.

Rather than waiting for a complete microscopic derivation of the two field amplitudes, measured gravitational and inertial properties can be used to determine what the supertorus must ultimately reproduce.

The two approaches are complementary rather than competing. A successful model should reach the same values of A_E and A_B from both directions.

Their convergence would constitute a substantially stronger test than fitting either gravity or inertia independently.

10.6. Relative Imbalance and the Weakness of Gravity

Once the absolute scale

$$S = A_B + A_E$$

is known, the relative imbalance can be calculated:

$$\eta = \frac{A_B - A_E}{A_B + A_E} = \frac{D}{S}.$$

Since

$$D = Gm_g,$$

this becomes

$$\eta = \frac{Gm_g}{S}.$$

The parameter η would quantify how accurately the Energy Field and Binding Field compensate one another in their gravitational action.

If

$$\eta \ll 1,$$

then

$$A_E \approx A_B,$$

and the weakness of gravity acquires a direct quantitative meaning: gravity measures only a very small fractional imbalance between two much larger fields.

Determining S is therefore important not only for inertial mass, but also for understanding quantitatively why gravity is weak.

10.7. Origin of the Gravitational Constant

The relation

$$A_B - A_E = Gm_g$$

can also be read in the opposite direction.

Once the microscopic theory determines

$$A_E$$

and

$$A_B,$$

it should be possible to calculate

$$G = \frac{A_B - A_E}{m_g}.$$

Thus the gravitational constant should ultimately emerge from the structure rather

than being introduced as an independent empirical parameter.

The desired result is therefore

$$\text{supertorus parameters} \longrightarrow A_E - A_B \longrightarrow G.$$

At the present stage this remains a target rather than a derivation.

Nevertheless, the model specifies clearly which microscopic quantity must reproduce G : the very small residual between the two macroscopic field amplitudes per unit gravitational mass.

10.8. Equality of Inertial and Gravitational Mass

The experimentally observed equality

$$m_i = m_g$$

provides another strong quantitative constraint.

Within the proposed model, gravitational and inertial behaviour arise differently:

$$\text{gravity} \longleftrightarrow A_B - A_E,$$

Whereas

$$\text{Inertia} \longleftrightarrow \text{combined deformation of } A_B \text{ and } A_E.$$

Their equality is therefore not automatic.

A successful quantitative theory must show that the same electromagnetic supertorus produces both the observed gravitational residual and precisely the corresponding inertial response.

The equivalence of inertial and gravitational mass can consequently serve as one of the most demanding tests of the model.

10.9. Universality Across Different Forms of Matter

A further requirement concerns different particles and different forms of matter.

If the Energy Field and Binding Field originate from electromagnetic organization, different microscopic structures may in principle possess different values of

$$A_E, \quad A_B.$$

Nevertheless, macroscopic gravity exhibits a high degree of universality.

The theory must therefore explain why different stable forms of matter produce gravitational and inertial properties that obey the same macroscopic relations.

In particular, the model must determine whether the relative imbalance

$$\eta = \frac{A_B - A_E}{A_B + A_E}$$

is universal, approximately universal, or dependent on microscopic particle structure.

This question provides a potential connection between the internal geometry of elementary particles and precision tests of gravitational universality.

10.10. Near-Field Structure

The $1/r$ dependence derived in Section 5 applies to the spherically symmetric far-field approximation,

$$r \gg R, a.$$

Close to the supertorus, the toroidal geometry cannot be neglected.

The fields may then acquire angular dependence,

$$\Phi_E = \Phi_E(r, \theta, \varphi),$$

$$\Phi_B = \Phi_B(r, \theta, \varphi).$$

Their near-field structure may contain information that disappears from the leading $1/r$ term.

A complete microscopic theory should therefore connect the detailed near-field

geometry continuously to the far-field solutions

$$\Phi_E \rightarrow \frac{A_E}{r},$$

$$\Phi_B \rightarrow -\frac{A_B}{r}.$$

This connection may ultimately provide the route by which the amplitudes A_E and A_B are derived from the geometry and electromagnetic dynamics of the supertorus.

10.11. Acceleration-Dependent Field Geometry

The corresponding unresolved problem for inertia is the actual shape of an accelerated field.

The conceptual picture developed in Section 7 assumes

spherical field $\rightarrow$ deformed field

during acceleration.

This deformation must ultimately be calculated rather than illustrated qualitatively.

The theory should determine

$$\delta\Phi_E(\mathbf{r}, \mathbf{a})$$

and

$$\delta\Phi_B(\mathbf{r}, \mathbf{a})$$

and from them calculate the corresponding change in field energy and momentum.

This calculation is particularly important because it may provide the missing relation between inertial mass and

$$S = A_B + A_E.$$

It therefore represents one of the most direct routes toward determining the absolute magnitudes of the two fields.

10.12. Principal Quantitative Targets

The remaining quantitative program can be summarized by four closely connected objectives:

1. derive the Energy Field and Binding Field from the electromagnetic supertorus;
2. determine their absolute amplitudes A_E and A_B ;
3. derive the inertial relation between field deformation and m_i ;
4. reproduce G , the inverse-square gravitational interaction, and the equivalence of inertial and gravitational mass from the same microscopic structure.

These objectives define a closed research loop:

supertorus $\rightarrow A_E, A_B \rightarrow$ mass and gravity

and, independently,

measured mass and gravity $\rightarrow A_E, A_B \rightarrow$ constraints on the supertorus.

The model will become quantitatively predictive when these two directions meet without introducing additional fitted parameters.

11. Discussion

The model developed in this work begins with a localized electromagnetic structure and follows its consequences toward macroscopic properties normally introduced as independent characteristics of matter. The resulting picture is not yet a complete quantitative theory, but it provides a continuous physical chain from the electromagnetic supertorus to localization, macroscopic fields, inertia, and gravity.

Its central proposal is that the internal electromagnetic organization of the supertorus gives rise to two distinct macroscopic manifestations: the **Energy Field** and the **Binding Field**. These fields retain the two structural tendencies already present within

the localized electromagnetic configuration and provide the bridge between microscopic organization and macroscopic behaviour.

The significance of this construction lies not in any single equation, but in the possibility that several apparently separate properties of matter may emerge from one underlying physical structure.

11.1. From Electromagnetic Structure to Matter

The supertorus is not treated as a static object containing electromagnetic energy. It is a dynamically organized electromagnetic state in which geometry, phase, energy flow, momentum, and binding are mutually constrained.

This distinction is essential.

A freely propagating electromagnetic wave transports energy through space. In the supertorus, electromagnetic energy is organized into a closed and phase-coherent configuration. Localization is therefore attributed to organization rather than to the introduction of an additional material substance.

The proposed chain is

electromagnetic fields →
closed coherent organization →
localized matter.

Part III extends this chain further by proposing that the localized structure has macroscopic consequences beyond the immediate electromagnetic configuration.

Thus,

localized electromagnetic structure →
Energy Field + Binding Field →
mass and gravity.

Matter, inertia, and gravity are thereby placed within one connected physical framework.

11.2. The Role of the Energy Field and Binding Field

The introduction of two macroscopic fields is the central step of the present model.

The Energy Field,

$$\Phi_E,$$

is associated with the expansive structural tendency, while the Binding Field,

$$\Phi_B,$$

is associated with the tendency toward localization and binding.

Their far-field forms are represented as

$$\Phi_E(r) = \frac{A_E}{r},$$

$$\Phi_B(r) = -\frac{A_B}{r}.$$

The important point is that these are not identified with the ordinary electromagnetic vector fields

$$\mathbf{E}$$

and

$$\mathbf{B}.$$

They are proposed macroscopic scalar manifestations of the complete organized electromagnetic structure.

This distinction allows the microscopic dynamics to remain electromagnetic while the macroscopic behaviour can acquire a simpler scalar description.

The physical problem is therefore shifted from introducing mass and gravity independently to explaining how the supertorus generates

$$A_E$$

and

$$A_B.$$

If these two quantities can eventually be derived from the microscopic structure, much of the subsequent macroscopic behaviour follows from their relation.

11.3. Two Large Fields and One Small Residual

A particularly important feature of the model is that gravity is not associated with the absolute magnitude of either field.

Instead,

$$D = A_B - A_E$$

determines the gravitational residual.

The observed weakness of gravity can therefore be interpreted as

$$D \ll A_E, A_B.$$

This changes the physical question.

Instead of asking why the field responsible for gravity is intrinsically so weak, the model asks why two much larger structural contributions are so closely balanced.

Their resultant is

$$\Phi_G(r) = -\frac{D}{r},$$

and comparison with the Newtonian potential gives

$$D = Gm_g.$$

The gravitational constant therefore constrains the **difference** between the two field amplitudes.

This is one of the most useful quantitative consequences of the model because it provides information about the proposed fields even before their absolute values have been derived microscopically.

11.4. Mass as a Dynamical Property

The interpretation of inertia leads to a different view of mass.

When a particle accelerates, the Energy Field and Binding Field can no longer retain the same spatial configuration as in the undisturbed state. Both must readjust.

If the undisturbed configurations represent minimum-energy states, their deformation requires energy and produces a restoring response.

In this picture, inertia is not primarily resistance of an abstract quantity called mass. It is resistance of the complete field structure to acceleration-induced deformation.

Thus,

Acceleration →
field deformation →
restoring response → inertia.

This gives the equation

$$F = ma$$

a possible underlying physical interpretation.

The parameter m_i then characterizes how strongly the complete two-field structure resists acceleration.

Both fields participate in this process. Their inertial contributions therefore need not cancel merely because their gravitational contributions have opposite signs.

This leads naturally to the combined amplitude scale

$$S = A_B + A_E.$$

The present model proposes that the inertial response is related to this combined field structure,

$$m_i = \mathcal{M}(S),$$

although the function $\mathcal{M}$ remains to be derived.

11.5. Difference and Sum

The distinction between gravity and inertia can therefore be reduced to two combinations of the same field amplitudes:

$$D = A_B - A_E$$

and

$$S = A_B + A_E.$$

The first measures imbalance.

The second measures the combined scale of the field structure relevant to deformation.

Consequently,

gravity probes D

Whereas

inertia probes the response associated with S.

This provides a simple explanation for how weak gravity and substantial inertia can coexist.

If

$$D \ll S,$$

the same object may possess a strong resistance to acceleration while producing only a very weak gravitational field.

The distinction between sum and difference is therefore more than a convenient mathematical notation. It expresses two different ways in which the same physical structure becomes observable.

11.6. A Possible Physical Basis for the Equivalence of Masses

The equality of inertial and gravitational mass is one of the strongest empirical constraints on any model attempting to connect gravity and inertia.

The present framework does not yet derive

$$m_i = m_g.$$

It does, however, provide a possible reason why these two quantities should be closely related.

Both originate from the same two field amplitudes.

Gravitational behaviour depends on their residual,

$$A_B - A_E,$$

while inertial behaviour depends on the deformation of the complete structure associated with

$$A_B + A_E.$$

The equality of gravitational and inertial mass therefore becomes a relation between two different responses of the same underlying system rather than an unexplained equality between unrelated properties.

A future quantitative derivation of the deformation response will provide a direct test of this interpretation.

11.7. Investigation in Both Directions

An important methodological consequence of the model is that it can be investigated from both microscopic and macroscopic directions.

The direct route is

Supertorus $\rightarrow$ AE,
AB $\rightarrow$ gravity and inertia.

Starting from the electromagnetic geometry and dynamics, the objective is to derive the two macroscopic field amplitudes and then calculate observable behaviour.

The inverse route begins with measured properties:

gravity and inertia $\rightarrow$
constraints on AE, AB $\rightarrow$
constraints on the supertorus.

Gravity already provides

$$A_B - A_E = Gm_g.$$

A quantitative theory of inertia may provide the complementary information needed to determine the absolute field scale.

The two routes should eventually meet.

This is important because it makes the proposed fields more than qualitative concepts. Their values are constrained from the macroscopic side while simultaneously being targets for derivation from the microscopic side.

11.8. Relation Between Light and Matter

The model also suggests a broader interpretation of the relation between radiation and matter.

Both light and the supertorus are described using electromagnetic fields, energy, and momentum. Their essential difference lies in global organization.

Light represents propagating electromagnetic organization.

Matter represents localized, phase-closed electromagnetic organization.

Schematically,

light = propagating electromagnetic state

and

matter = localized electromagnetic state.

The transition from light-like propagation to matter-like localization therefore need not require a change in the fundamental physical substance. It may require a change in geometry, phase organization, energy flow, and stability.

If this interpretation can be developed quantitatively, matter becomes a particular stable organization of electromagnetic energy

rather than an independent ingredient added to electromagnetic physics.

11.9. Scope of the Present Model

The present work deliberately separates the principal structure from higher-order effects.

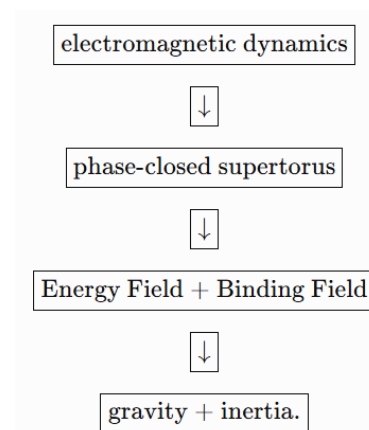
For example, two neighbouring particles may deform each other's Energy and Binding Fields in addition to experiencing their weak residual gravitational interaction. Such mutual deformation may produce corrections to the simple far-field description.

This restriction keeps the model focused on the physical origin of the two principal macroscopic effects before considering more complicated multi-particle field interactions.

11.10. Significance of the Proposed Framework

The principal result of this work is therefore not a completed numerical theory of gravity or mass.

It is the identification of a possible continuous physical chain:



Each step imposes a quantitative requirement on the next.

The model therefore does not merely associate electromagnetism with mass and gravity. It identifies intermediate physical quantities through which such a connection could be calculated and tested.

The most important of these are

$$A_E, \quad A_B,$$

or equivalently,

$$D = A_B - A_E$$

and

$$S = A_B + A_E.$$

Gravity already constrains D. The next major quantitative task is to determine S from the deformation dynamics and to derive both amplitudes independently from the supertorus.

If these routes converge, the model would connect electromagnetic structure, matter, inertia, and gravity within a single quantitative framework.

12. Conclusions

This work develops a possible physical connection between the electromagnetic supertorus introduced in Part II and the macroscopic properties of matter.

The starting point is a localized, phase-coherent electromagnetic structure whose stability requires two complementary structural tendencies: an expansive tendency and a binding tendency. Their proposed macroscopic manifestations are identified as the **Energy Field** and the **Binding Field**.

In the far-field approximation, both fields are represented by scalar potentials with the same spatial dependence,

$$\Phi_E(r) = \frac{A_E}{r},$$

$$\Phi_B(r) = -\frac{A_B}{r}.$$

Their common $1/r$ dependence follows from the proposed minimum-energy variational description in a source-free, approximately spherically symmetric region. Their gradients consequently exhibit the inverse-square

dependence required for a long-range interaction.

The two fields provide different physical combinations in gravity and inertia.

For gravity, their opposing contributions leave the residual

$$D = A_B - A_E.$$

The resulting potential is

$$\Phi_G(r) = -\frac{D}{r}.$$

Comparison with the Newtonian potential gives

$$A_B - A_E = Gm_g.$$

Gravity is therefore interpreted as the small binding-dominated residual between two potentially much larger field contributions. Its weakness need not imply weak underlying fields; it may instead reflect their close macroscopic balance.

Inertia involves the same two fields in a different way. When the supertorus accelerates, both field configurations are proposed to deform away from their preferred minimum-energy states. Both deformations contribute to the restoring response and therefore act cooperatively rather than cancelling.

The characteristic combined field scale is

$$S = A_B + A_E.$$

The inertial mass is consequently represented at the present stage by

$$m_i = \mathcal{M}(A_B + A_E),$$

where the function M must be obtained from the dynamics of acceleration-induced field deformation.

This distinction provides the central physical result of Part III:

gravity probes the difference of the two fields,

Whereas

inertia probes their combined deformation response.

The same underlying field structure can therefore produce both weak gravity and substantial inertia.

The model also provides a possible physical basis for the close connection between gravitational and inertial mass. They are not introduced as two unrelated properties of matter. Both originate from the same electromagnetic supertorus and the same Energy and Binding Fields, although they reveal different aspects of that structure. A quantitative derivation of their observed equality remains an important test of the model.

The proposed framework further suggests a continuous relation between light and matter. Both are electromagnetic in their local description, but differ in global organization. Light represents propagating electromagnetic organization, whereas matter is proposed to represent a localized, geometrically closed and phase-closed electromagnetic state.

The resulting physical chain is

electromagnetic fields $\rightarrow$
phase-closed supertorus $\rightarrow$
Energy Field + Binding Field $\rightarrow$
inertia and gravity.

The principal remaining quantitative problem is the determination of the absolute amplitudes

$$A_E$$

and

$$A_B.$$

The model offers two complementary routes toward this goal. The direct route proceeds from the electromagnetic structure of the supertorus toward the macroscopic fields,

$$\text{supertorus} \rightarrow A_E, A_B,$$

while the inverse route uses measured gravitational and inertial properties to constrain those same amplitudes,

$$\text{gravity and inertia} \rightarrow A_E, A_B \rightarrow \text{constraints on the supertorus.}$$

Gravity already determines their difference,

$$A_B - A_E = Gm_g.$$

A quantitative theory of acceleration-induced deformation may provide the complementary information required to determine their combined scale and hence their individual values.

The convergence of these two directions would transform the present qualitative framework into a quantitative model. It would allow the proposed Energy Field and Binding Field to be calculated from the supertorus and independently constrained by the observed properties of matter.

The present work therefore identifies a specific path forward: **derive the two macroscopic fields from the electromagnetic supertorus, determine their absolute amplitudes, and test whether their difference reproduces gravity while their combined deformation reproduces inertia.**

If successful, this would provide a unified physical description in which light, matter, inertial mass, and gravity emerge as different manifestations of organized electromagnetic structure.