APEC First Material on Heim Theory

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This is a very early draft on some of my current understanding of Heim Theory and efforts to translate Heim´s Framework into English and derive a more commonly accessible notation. Heim left a Framework that expands into 12 dimensions. But the 6D version is the most mathematical explored in my understanding why it get´s more complicated with more Dimensions involved. Mostly we will consider the 6D aspect for now. Take this document and any claims in it with a grain of salt or two. This will be an ongoing effort. Feel free to bring any feedback as this is a call to engage with Heim Theory in an openScience approach.

Major Topics

1. Phenomenological Roots of Heim's Theory
2. Hedwig Conrad-Martius and Realistic Phenomenology
3. Qualia-Quanta Integration and Consciousness
4. Heim's Six-Dimensional Space (R_6)
5. Metron Concept and Discrete Spacetime
6. Lattice Structures in the 6D Metron Framework
7. The Contrabaric Equation and Field Masses
8. Christoffel Symbols vs. Tensors in Heim's Geometry
9. Eigenvalue Equations for Space–Structure Coupling
10. Heim's Modified Field Equations (Gravitation + Extra Dimensions)
11. Polymetric Representation and Hermitian Extensions
12. The Emergence of Mass from Metric Eigenvalues
13. Derivation of the Fine-Structure Constant Geometrically
14. The Role of Activity Streams in R_{12}
15. Tensors Governing Fundamental Interactions

1 Introduction to Phenomenological Foundations

Burkhard Heim's theoretical framework represents a unique synthesis of rigorous mathematical physics with phenomenological philosophy. This integration was not merely an afterthought but a fundamental aspect of his approach to understanding reality. To fully comprehend Heim Theory, one must appreciate its philosophical underpinnings, particularly the influence of phenomenology.

1.1 Historical Context of Phenomenology

Phenomenology emerged in the early 20th century as a philosophical movement focused on the study of consciousness and the objects of direct experience. Founded by Edmund Husserl (1859-1938), it developed as a response to both psychologism and positivism, seeking to establish philosophy as a rigorous science through the careful description of experience.

Definition: Phenomenology

Phenomenology is the philosophical study of the structures of experience and consciousness. It attempts to create conditions for the objective study of topics usually regarded as subjective: consciousness and the content of conscious experiences such as judgments, perceptions, and emotions.

Key principles include:

- **Epoché** (bracketing): The suspension of judgment about the natural world
- **Intentionality**: The directedness of consciousness toward objects
- **Eidetic reduction**: The process of identifying the essential structures of phenomena
- **Intersubjectivity**: The shared, overlapping nature of our experiences
- **Lifeworld** (Lebenswelt): The world as immediately experienced in the subjectivity of everyday life

Husserl's phenomenology underwent significant development through his students and successors, including Martin Heidegger, Maurice Merleau-Ponty, Jean-Paul Sartre, and critically for our discussion, Hedwig Conrad-Martius. Each of these thinkers developed phenomenology in different directions, with Conrad-Martius specifically developing what came to be known as "realistic phenomenology."

1.2 Heim's Phenomenological Approach to Physics

Heim's approach to physics was revolutionary in its integration of phenomenological principles. Unlike the dominant positivist and operationalist approaches in 20th-century physics, Heim recognized the importance of qualitative aspects of reality and sought to incorporate them into a unified mathematical framework.

Theorem: Phenomenological Integration in Heim Theory

Heim's integration of phenomenology into physics can be formalized as follows:

Let $\mathcal{P}$ represent the set of physical phenomena and $\mathcal{E}$ represent the set of experiential phenomena. Traditional physics Φ_T operates on $\mathcal{P}$ alone:

$$\Phi_T : \mathcal{P} \to \mathcal{M} \tag{1}$$

Where $\mathcal{M}$ is the mathematical description.

Heim Theory Φ_H operates on the union of physical and experiential phenomena:

$$\Phi_H : \mathcal{P} \cup \mathcal{E} \to \mathcal{M}_H \tag{2}$$

Where $\mathcal{M}_H$ is an extended mathematical framework that includes higher dimensions corresponding to qualitative aspects of reality.

This integration was achieved through Heim's dimensional structure, particularly through the organization space (S^2) and information space (I^2), which provide mathematical representations for qualitative aspects of reality that traditional physics excludes.

2 Hedwig Conrad-Martius and Ontological Phenomenology

Among the various phenomenological thinkers who influenced Heim, Hedwig Conrad-Martius (1888-1966) stands out as particularly significant. Her development of "realistic phenomenology" provided key concepts that Heim incorporated into his theoretical framework.

2.1 Conrad-Martius' Realistic Phenomenology

Conrad-Martius developed a form of phenomenology that diverged from Husserl's transcendental approach, emphasizing instead the ontological aspects of phenomena. Her work focused on the self-sustaining nature of reality (selbstständiges Sein) and the distinction between "Washeit" (whatness) and "Träger" (carrier).

Definition: Conrad-Martius' Key Concepts

- **Selbstständiges Sein** (Self-sustaining reality): Reality that exists independently, possessing its own being and essence.
- **Washeit** (Whatness): The qualitative essence or content of a thing, what makes it what it is.
- **Träger** (Carrier): The substrate or foundation that carries or supports the qualitative essence.
- **Ontological Realism**: The philosophical position that reality exists independently of our perception or conceptualization of it, but with recognition of qualitative dimensions.
- **Phenomenological Cosmology**: The study of the cosmos through phenomenological methods, recognizing both quantitative and qualitative aspects.

Conrad-Martius' approach was particularly significant in its attempt to bridge the gap between natural science and philosophy, a goal that Heim would later pursue through his unified theory.

2.2 Mathematical Formulation of Conrad-Martius' Influence

The influence of Conrad-Martius on Heim's theory can be formalized mathematically through the dimensional correspondences between her ontological categories and Heim's dimensional structure.

Theorem: Dimensional Correspondence

Let $\mathcal{W}$ represent Conrad-Martius' concept of "Washeit" and $\mathcal{T}$ represent "Träger." The dimensional correspondence in Heim Theory can be expressed as:

$$\mathcal{T} \cong S^2 = \{x_5, x_6\} \tag{3}$$
$$\mathcal{W} \cong I^2 = \{x_7, x_8\} \tag{4}$$

Where S^2 is the organization space (dimensions 5-6) and I^2 is the information space (dimensions 7-8).

Furthermore, the physical spacetime corresponds to the manifestation of these ontological categories:

$$\mathbb{R}^3 \cup T^1 = \{x_1, x_2, x_3, x_4\} \cong \mathcal{M}(\mathcal{T}, \mathcal{W}) \tag{5}$$

Where $\mathcal{M}$ is a manifestation operator that projects the ontological categories into physical reality.

This correspondence provides a mathematical framework for understanding how Conrad-Martius' philosophical concepts are integrated into Heim's dimensional structure.

3 Ontological Realism in Heim Theory

Heim's position in the philosophical spectrum can be characterized as ontological realism, a stance that recognizes the independent existence of reality while acknowledging the importance of qualitative dimensions.

3.1 Philosophical Context: Realism vs. Idealism

To understand Heim's ontological position, it is helpful to situate it within the broader philosophical debate between realism and idealism.

Definition: Philosophical Positions

- **Idealism**: The philosophical view that reality is fundamentally mental or otherwise immaterial. Key variants include:
  - **Subjective Idealism** (Berkeley): "Esse est percipi" (To be is to be perceived)
  - **Transcendental Idealism** (Kant): Distinction between phenomena (appearances) and noumena (things-in-themselves)
  - **Absolute Idealism** (Hegel): Reality as the unfolding of Absolute Spirit
- **Realism**: The philosophical view that reality exists independently of our perception or conceptualization of it. Key variants include:
  - **Naive Realism**: The world is exactly as we perceive it
  - **Scientific Realism**: Scientific theories describe an objective reality
  - **Critical Realism**: Reality exists independently but our access to it is mediated and fallible

- **Heim's Position**: Ontological realism with phenomenological method
  - Reality exists independently
  - Reality has qualitative dimensions beyond spacetime
  - These dimensions are mathematically formalizable
  - Phenomenological method provides access to these dimensions

3.2 Mathematical Formulation of Heim's Ontological Framework

Heim's ontological framework can be formalized mathematically through his dimensional structure and the relationships between dimensions.

Theorem: Ontological Structure in Heim Theory

The ontological structure in Heim Theory can be represented as a hierarchical dimensional space:

$$\mathbb{H}^8 = \mathbb{R}^3 \cup T^1 \cup S^2 \cup I^2 \tag{6}$$

With the following ontological significance:

$$\mathbb{R}^3 \cup T^1 = \text{Physical spacetime} \tag{7}$$

$$S^2 = \text{Organizational structure} \tag{8}$$

$$I^2 = \text{Information/meaning} \tag{9}$$

The relationships between these dimensional subspaces are governed by projection operators:

$$\mathbf{P}^i_j : \mathcal{D}_i \to \mathcal{D}_j \tag{10}$$

Where $\mathcal{D}_i$ and $\mathcal{D}_j$ are dimensional subspaces.

The physical world emerges through the projection:

$$\mathbb{R}^3 \cup T^1 = \mathbf{P}^{S^2 \cup I^2}_{\mathbb{R}^3 \cup T^1}(S^2 \cup I^2) \tag{11}$$

This mathematical formulation provides a framework for understanding how Heim's ontological realism is structured and how the physical world relates to higher dimensions.

4 Integration of Qualia and Quanta

One of the most significant philosophical aspects of Heim Theory is its approach to the mind-body problem, particularly its integration of qualia (qualitative experiences) and quanta (quantitative measurements).

4.1 The Hard Problem of Consciousness

The "hard problem of consciousness," as formulated by philosopher David Chalmers, refers to the challenge of explaining why and how physical processes in the brain give rise to subjective experience. This problem has been a persistent challenge in philosophy of mind and cognitive science.

Definition: The Hard Problem of Consciousness

The hard problem of consciousness concerns how and why physical processes in the brain give rise to subjective experience. It involves explaining:

- Why there is something it is like to be a conscious organism
- How physical processes can give rise to qualitative experiences
- The explanatory gap between neural correlates and subjective experience
- The apparent irreducibility of first-person experience to third-person description

Traditional approaches to this problem include:

- **Dualism**: Mind and matter are fundamentally different substances
- **Materialism**: Consciousness is reducible to physical processes
- **Panpsychism**: Consciousness is a fundamental feature of reality
- **Emergentism**: Consciousness emerges from complex physical systems

4.2 Heim's Dimensional Approach to the Mind-Body Problem

Heim's approach to the mind-body problem differs fundamentally from traditional approaches by introducing higher dimensions that serve as a bridge between physical processes and conscious experience.

Theorem: Qualia-Quanta Integration

In Heim Theory, the relationship between qualia and quanta can be formalized as:

$$\mathcal{Q} \cong \Phi(I^2 \cup S^2) \to \mathbb{R}^3 \cup T^1 \tag{12}$$

Where:

- $\mathcal{Q}$ represents qualitative experience (qualia)
- Φ is the phenomenological projection operator
- $I^2 \cup S^2$ represents the higher dimensions (information and organization spaces)
- $\mathbb{R}^3 \cup T^1$ represents physical spacetime
- $\to$ indicates the projection relationship

This formulation suggests that qualia are not reducible to physical processes in $\mathbb{R}^3 \cup T^1$ alone, but require the higher dimensions $I^2 \cup S^2$ for their compl

5 Dimensional Structure of Heim Theory

Heim extends the spacetime manifold from $\mathbb{R}^4$ to higher-dimensional hyperspaces:

$$R^4 \subset R^6 = R^3_{\text{real}} \oplus R^3_{\text{imag}}$$
$$R^6 \hookrightarrow R^8, R^{12}$$

Heim theory postulates a novel dimensional hierarchy that forms the backbone of its unified geometric approach to matter and gravitation. Unlike standard four-dimensional spacetime, Heim's formulation operates in higher-dimensional structures that are essential to encode all physical interactions, including gravity, electromagnetism, and additional forces beyond the Standard Model.

5.0.1 Dimensional Ladder and Topology

The foundational spaces used in Heim theory include:

- $\mathbb{R}^4$: Standard spacetime manifold with coordinates (x^1, x^2, x^3, x^4).
- $\mathbb{R}^6$: Physical configuration space of particles, with additional coordinates (x^5, x^6), representing entelechial (life-structuring) and aonic (temporal multiplicity) components. Both x^5 and x^6 are *imaginary* and define latent degrees of freedom.
- $\mathbb{R}^{12}$: The polymetric hyperspace including informational and transphysical domains. This 12-dimensional manifold provides the full representation of Heim's Weltstruktur (world structure).

5.0.2 Signature of $\mathbb{R}^6$

The metric signature of the six-dimensional hyperspace $\mathbb{R}^6$ is defined analogously to the Minkowski space $\mathbb{R}^{1,3}$, which uses $(+,+,+,-)$ for spacetime. In Heim theory, this generalizes to:

$$\text{Signature}(\mathbb{R}^6) = (+,+,+,-,-,-) \tag{13}$$

The first three components (x^1, x^2, x^3) are spatial (positive definite), while (x^4, x^5, x^6) form a triplet of imaginary coordinates with negative signature. This reflects the intrinsic duality between manifest (spatial) and latent (transphysical) domains.

5.0.3 Signature of $\mathbb{R}^{12}$

The twelve-dimensional extension of Heim space consists of six manifest and six latent dimensions. From the analysis of Heim's field equations and polymetric tensor structures (see Ludwiger 2007, Heim 1996), the signature is inferred as:

$$\text{Signature}(\mathbb{R}^{12}) = (+,+,+,+,+,+,-,-,-,-,-,-) \tag{14}$$

This reflects the symmetric partitioning between real (manifest) fields and imaginary (transphysical or semantic) degrees of freedom. The latter support internal interactions, symmetry breaking, and nonlocal correlations.

5.0.4 Graphical Representation

Manifold	Coordinates	Signature
$\mathbb{R}^4$	(x^1, x^2, x^3, x^4)	$(+, +, +, -)$
$\mathbb{R}^6$	$(x^1, ..., x^6)$	$(+, +, +, -, -, -)$
$\mathbb{R}^{12}$	$(x^1, ..., x^{12})$	$(+, +, +, +, +, +, -, -, -, -, -, -)$

5.0.5 Coordinate Definitions and Structure

The six coordinates in $\mathbb{R}^6$ split into three semantically distinct subspaces:

$$s_1 = (x^5, x^6), \qquad \text{Latent / Transphysical (imaginary)} \tag{15}$$

$$s_2 = (x^4), \qquad \text{Temporal (imaginary)} \tag{16}$$

$$s_3 = (x^1, x^2, x^3), \qquad \text{Spatial (real)} \tag{17}$$

These groupings reflect non-commuting internal substructures responsible for physical particle properties.

5.0.6 Quantization of Geometric Units

Heim postulated a minimal geometric surface element τ (analogous to l_P^2, the square of Planck length), leading to a fundamental quantization of geometry:

$$A_{\min} \sim \tau = l_P^2 = \frac{\hbar G}{c^3} \tag{18}$$

This quantization necessitates the use of difference operators (selectors) rather than differential calculus, giving rise to the metron field dynamics and internal discrete eigenstructures.

The Concept of Discrete Spacetime

We will explore the concept of discrete spacetime in Heim's theory, focusing on the metron as the fundamental unit of spacetime. We will examine the theoretical motivations for discretizing spacetime, the mathematical implications of this approach, and how it addresses some of the challenges faced by continuous theories. This exploration will provide deeper insight into one of the most distinctive aspects of Heim's theoretical framework.

6 Theoretical Motivations for Discrete Spacetime

6.1 Problems with Continuous Spacetime

Several theoretical issues arise in physics when spacetime is treated as a continuum:

- Infinities in quantum field theory requiring renormalization
- Singularities in general relativity (black holes, Big Bang)

- The problem of quantum gravity and non-renormalizability
- Infinite degrees of freedom in field theories
- Zeno's paradoxes and the conceptual problems of infinite divisibility
- The challenge of reconciling the discrete nature of quantum mechanics with continuous spacetime

These problems suggest that the continuum model of spacetime may be an approximation valid at scales much larger than the fundamental length.

6.2 Historical Precedents

The idea of discrete spacetime has appeared in various forms throughout the history of physics:

- Ancient Greek atomism (Democritus, Leucippus)
- Planck's introduction of the quantum of action (1900)
- Einstein's suggestion of a "quantum structure of space" (1954)
- Heisenberg's consideration of a fundamental length (1930s)
- Wheeler's "spacetime foam" concept (1955)
- Snyder's non-commutative spacetime (1947)
- Various approaches to quantum gravity (1960s-present)

Heim's approach to discrete spacetime thus connects with a long tradition of questioning the continuum nature of space and time.

7 The Metron Concept in Detail

7.1 Definition and Properties

The metron is the fundamental unit of spacetime in Heim's theory:

- Defined as the smallest possible area element in nature
- Size on the order of the Planck area: $\tau_0 \approx \ell_P^2 \approx \frac{G\hbar}{c^3} \approx 10^{-70}\ \mathrm{m}^2$
- Not a particle or object, but a structural element of spacetime itself
- Indivisible and elementary
- Characterized by its area rather than length
- Forms the basis of a 6D lattice structure

This concept represents a fundamental departure from the continuous manifold of general relativity, replacing it with a discrete structure at the Planck scale.

7.2 Mathematical Representation

The metron concept requires specific mathematical tools:

- Discrete geometry rather than differential geometry
- Difference equations rather than differential equations
- Finite element methods adapted to the metron lattice
- Discrete versions of geometric quantities (curvature, connection)
- Selector calculus for operating on specific metron configurations
- Polymetric tensor formalism adapted to the discrete structure

This mathematical framework represents one of the most challenging aspects of Heim's theory, requiring the development of tools beyond conventional physics.

7.3 Physical Interpretation

The metron has specific physical interpretations in Heim's theory:

- Represents the quantum of action in spacetime itself
- Provides a natural ultraviolet cutoff at the Planck scale
- Explains the discrete nature of quantum phenomena
- Forms the building blocks for all physical structures
- Determines the fundamental constants of nature
- Connects the micro and macro scales of physics

This physical interpretation suggests that the discreteness of spacetime is the fundamental source of quantum behavior, rather than being a property of matter in continuous spacetime.

8 The 6D Metron Lattice

8.1 Lattice Structure

In Heim's theory, metrons form a specific lattice structure:

- 6-dimensional lattice of metron elements
- Not a regular lattice but a complex structure
- Lattice points connected by specific relationships
- Structure determined by the dynamics of the theory
- Different regions may have different densities of metrons
- Curvature represented by the arrangement of metrons

This lattice structure provides the discrete geometric framework for Heim's unified field theory.

8.2 Dimensional Structure - Subspaces and Their Interactions

The 6D space can be decomposed into various interacting subspaces:

- R_3: 3D physical space (dimensions 1-3)
- T_1: 1D time (dimension 4)
- S_2: 2D organizational space (dimensions 5-6)
- G_4: 4D spacetime (dimensions 1-4)
- R_6: Complete 6D space (dimensions 1-6)
- Dimension 5: entelechial (organizational) dimension inverse of entropie
- Dimension 6: aeonic (informational) dimension actualization of X5 in time

This dimensional structure extends conventional spacetime to include dimensions that govern the organization and evolution of physical systems. The interactions between these subspaces, governed by specific mathematical rules, give rise to the various physical phenomena observed in nature.

9 Mathematical Implications of Discrete Spacetime

9.1 From Differential to Difference Equations

The discrete nature of spacetime requires a shift in mathematical approach:

- Differential equations of continuous theories become difference equations
- For a function $f(x)$, the derivative $\frac{df}{dx}$ becomes the difference quotient $\frac{f(x+\Delta x)-f(x)}{\Delta x}$
- Partial derivatives become partial differences
- Integrals become sums
- The limit $\Delta x \to 0$ is replaced by the fundamental discreteness $\Delta x = \sqrt{\tau_0}$
- Differential operators must be redefined for the discrete setting

This mathematical shift has profound implications for how physical laws are expressed and calculated in Heim's theory.

9.2 Discrete Geometric Quantities

Geometric concepts must be redefined for the discrete setting:

- Curvature defined in terms of deficit angles in the metron lattice
- Connection coefficients replaced by discrete transition rules
- Metric becomes a relation between adjacent metrons

- Geodesics become discrete paths through the metron lattice
- Volume elements become counts of metrons
- Symmetry operations adapted to the discrete structure

These redefinitions allow for the geometric interpretation of gravity and other forces within the discrete framework.

9.3 Finite Calculations and Elimination of Infinities

A key advantage of the discrete approach is the elimination of infinities:

- All calculations involve finite sums rather than potentially divergent integrals
- Natural ultraviolet cutoff at the Planck scale
- No need for renormalization procedures
- Singularities replaced by extreme but finite conditions
- Quantum fluctuations limited by the discrete structure
- Finite degrees of freedom in any finite volume

This feature addresses one of the most persistent challenges in quantum field theory and quantum gravity.

10 Physical Consequences of Discrete Spacetime

10.1 Quantum Behavior from Discreteness

In Heim's theory, quantum phenomena emerge from the discrete structure of spacetime:

- Uncertainty principle as a consequence of the metron size
- Wave-particle duality reflecting the discrete-continuous transition
- Quantization of energy and other physical quantities
- Discrete energy levels in atoms and molecules
- Probabilistic behavior arising from the discrete structure
- Non-locality explained through higher-dimensional connections

This perspective contrasts with conventional quantum mechanics, where quantization is a property of matter and energy in continuous spacetime.

10.2 Modified Dispersion Relations

Discrete spacetime leads to modified dispersion relations for particles:

- The relationship between energy and momentum changes at high energies
- $E^2 = p^2c^2 + m^2c^4$ becomes modified near the Planck scale
- Speed of light may become energy-dependent at very high energies
- Potential observable effects in high-energy cosmic rays
- Implications for the propagation of particles over cosmological distances
- Possible tests through time-of-arrival measurements of gamma-ray bursts

These modified dispersion relations represent one of the potentially testable predictions of discrete spacetime theories.

10.3 Resolution of Singularities

Discrete spacetime naturally addresses the problem of singularities:

- Black hole singularities replaced by extremely dense but finite structures
- Big Bang singularity replaced by a "big bounce" or similar finite-density state
- Infinite self-energy of point particles eliminated
- Gravitational collapse limited by the discrete structure
- Potential resolution of the information paradox in black hole physics
- New perspectives on the beginning and potential end of the universe

This resolution of singularities represents one of the most significant potential advantages of discrete approaches to spacetime.

11 Comparison with Other Discrete Approaches

11.1 Loop Quantum Gravity

Heim's approach shares features with loop quantum gravity but has significant differences:

- Both propose a discrete structure for spacetime
- Both suggest a minimum length/area scale
- Loop quantum gravity based on spin networks and spin foams
- Heim's approach based on the metron concept

- Loop quantum gravity derived from quantizing general relativity
- Heim's approach built from the ground up as a discrete theory
- Different mathematical formalisms (spin networks vs. polymetric tensor)

These comparisons highlight both the commonalities in discrete approaches to spacetime and the distinctive features of Heim's theory.

11.2 Causal Set Theory

Causal set theory offers another discrete approach to spacetime:

- Spacetime as a partially ordered set of events
- Order relation corresponds to causal relationships
- Volume of a region proportional to the number of elements
- Lorentz invariance emerges naturally
- Focuses on causal structure rather than geometry
- Less emphasis on higher dimensions compared to Heim's theory
- Different mathematical framework (order theory vs. polymetric tensor)

These comparisons provide context for understanding Heim's approach within the broader landscape of discrete spacetime theories.

11.3 Lattice Field Theories

Lattice approaches in quantum field theory provide another point of comparison:

- Discretize spacetime for computational purposes
- Usually considered a calculational tool rather than fundamental
- Regular lattice structure unlike Heim's dynamic lattice
- Focus on numerical simulation of field theories
- Continuum limit explicitly sought
- Limited incorporation of gravity
- Different mathematical framework (lattice gauge theory vs. polymetric tensor)

12 Christoffel Symbols and Curvature Tensor in Heim's Theory vs. Standard Physics

The Christoffel symbols and curvature tensor are fundamental components in differential geometry and general relativity. In Heim's theory, these objects take on modified forms due to the introduction of additional spatial dimensions beyond four-dimensional space-time.

12.1 Standard Christoffel Symbols in General Relativity

In standard four-dimensional general relativity, the Christoffel symbols (connection coefficients) are defined as:

$$\Gamma^c_{ab} = \frac{1}{2} g^{cd} \left(\partial_a g_{bd} + \partial_b g_{ad} - \partial_d g_{ab} \right), \tag{19}$$

where:

- g_{ab} is the metric tensor,
- g^{cd} is the inverse metric tensor,
- ∂_a represents the partial derivative with respect to coordinate x^a.

These Christoffel symbols are used to compute the geodesic equation:

$$\frac{d^2 x^c}{d\tau^2} + \Gamma^c_{ab} \frac{dx^a}{d\tau} \frac{dx^b}{d\tau} = 0. \tag{20}$$

This equation describes the motion of a particle in curved space-time under the influence of gravity alone.

12.2 Christoffel Symbols in Heim's Theory

Heim extended the standard formulation by introducing additional spatial coordinates (X_5, X_6) and modifying the Christoffel symbols accordingly:

$$\Gamma^C_{AB} = \frac{1}{2} G^{CD} \left(\partial_A G_{BD} + \partial_B G_{AD} - \partial_D G_{AB} \right), \tag{21}$$

where:

- G_{AB} is the extended metric tensor in Heim's six-dimensional space-time,
- G^{CD} is its inverse,
- The indices A, B, C, D run over six dimensions rather than four.

The modified geodesic equation in Heim's framework becomes:

$$\frac{d^2 X^C}{d\tau^2} + \Gamma^C_{AB} \frac{dX^A}{d\tau} \frac{dX^B}{d\tau} = f^C(X_5, X_6), \tag{22}$$

where $f^C(X_5, X_6)$ represents additional forces arising from the extra dimensions. These terms lead to deviations in gravitational trajectories, potentially explaining dark matter-like effects.

12.3 Curvature Tensor in General Relativity

In standard differential geometry, the Riemann curvature tensor is given by:

$$R^a_{bcd} = \partial_c \Gamma^a_{bd} - \partial_d \Gamma^a_{bc} + \Gamma^e_{bd}\Gamma^a_{ec} - \Gamma^e_{bc}\Gamma^a_{ed}. \tag{23}$$

The Ricci tensor is obtained by contracting the indices:

$$R_{bd} = R^a_{bad}. \tag{24}$$

These curvature tensors describe the gravitational field and are used in Einstein's field equations:

$$R_{ab} - \frac{1}{2}g_{ab}R + \Lambda g_{ab} = \frac{8\pi G}{c^4}T_{ab}. \tag{25}$$

12.4 Curvature Tensor in Heim's Theory

Heim modified the curvature tensor to include contributions from higher-dimensional effects. The generalized Riemann tensor in Heim's six-dimensional framework is:

$$R^A_{BCD} = \partial_C \Gamma^A_{BD} - \partial_D \Gamma^A_{BC} + \Gamma^E_{BD}\Gamma^A_{EC} - \Gamma^E_{BC}\Gamma^A_{ED} + F^A_{BCD}, \tag{26}$$

where:

- F^A_{BCD} represents additional curvature contributions from the extra dimensions,
- The indices A, B, C, D, E run over all six dimensions.

The Ricci tensor in Heim's formalism takes the form:

$$R_{BD} = R^A_{BAD} + Q_{BD}, \tag{27}$$

where Q_{BD} is a correction term arising from the projection of higher-dimensional effects onto four-dimensional space-time. Heim's modified gravitational field equations are:

$$R_{AB} - \frac{1}{2}G_{AB}R + \Lambda G_{AB} + X_5 X_6 G_{AB} = \frac{8\pi G}{c^4}T_{AB} + \Theta_{AB}, \tag{28}$$

where Θ_{AB} represents additional field contributions from the extra dimensions.

12.5 Comparison and Physical Implications

- In standard relativity, the Christoffel symbols and curvature tensor govern gravitational interactions without additional forces.
- Heim's formalism introduces extra-dimensional terms that modify gravitational interactions, potentially explaining dark matter and unification of forces.
- The modified curvature tensor leads to deviations from the standard Einstein field equations, suggesting new experimental signatures in cosmology and particle physics.

13 Eigenvalue Equations for Space Structure

In Heim's framework, the fundamental structure of space is determined by a set of eigenvalue equations that replace the Einstein field equations with a fully geometricized system in a six-dimensional space. These equations emerge from polymetric and metronized considerations, leading to discrete space-time structures. The fundamental tensor of space-time incorporates additional metric components beyond the four-dimensional structure of General Relativity.

13.1 Fundamental Eigenvalue Equation

The core equation governing the structure of space is given by:

$$(C_p - A_p(k,m))g_{km} = 0, \tag{29}$$

where:

- C_p is the fundamental curvature term, describing the intrinsic curvature of space-time,
- $A_p(k,m)$ are the eigenvalue coefficients determined by metronization, defining discrete allowed metric states,
- g_{km} represents the metric components, which define the structure of space-time geometry.

This equation can be interpreted as a non-linear eigenvalue relation that describes the possible metric structures of space511:10†Burkhard Heim - 2007 - Strukturen der physikalischen Welt.pdf.

13.2 Derivation from First Principles

The derivation of the eigenvalue equations starts from Heim's modified field equations, which incorporate six-dimensional space-time. The metric tensor g_{km} is determined by solving the characteristic equation:

$$\det |R_{km} - \lambda g_{km}| = 0, \tag{30}$$

where:

- R_{km} is the contracted curvature tensor, describing space-time curvature including extra dimensions,
- λ are the eigenvalues defining stable spatial configurations, governing space-time discreteness.

By substituting the polymetric field equations, the allowed eigenvalues are constrained by:

$$R_{km} = \Lambda g_{km} + T_{km}, \tag{31}$$

where:

- Λ is the cosmological term, representing background energy density,
- T_{km} represents the energy-momentum distribution in the extended space, acting as the source of space-time curvature.

511:1†Burkhard Heim - 1998 - Einführung Einheitliche Beschreibung der Welt.pdf.

13.3 Polymetric Structure and Eigenvalue Constraints

In Heim's theory, the metric structure is divided into three polymetric components: gravitational, electrodynamic, and nuclear interactions. The fundamental eigenvalue equation must be solved separately for each polymetric component:

$$(C_p^{(g)} - A_p^{(g)})g_{km}^{(g)} = 0, \quad (C_p^{(e)} - A_p^{(e)})g_{km}^{(e)} = 0, \quad (C_p^{(n)} - A_p^{(n)})g_{km}^{(n)} = 0. \tag{32}$$

where:

- $C_p^{(g)}$, $C_p^{(e)}$, $C_p^{(n)}$ are the curvature terms for gravitational, electrodynamic, and nuclear interactions respectively,
- $A_p^{(g)}$, $A_p^{(e)}$, $A_p^{(n)}$ are the eigenvalue coefficients for each interaction,
- $g_{km}^{(g)}$, $g_{km}^{(e)}$, $g_{km}^{(n)}$ are the metric components corresponding to each fundamental force.

Each of these equations determines the quantization of space-time for different interaction fields, leading to discrete allowed values for metric components511:10†Burkhard Heim - 2007 - Strukturen der physikalischen Welt.pdf.

13.4 Discrete Space-Time and Metronization

Unlike conventional continuous space-time models, Heim's approach introduces a fundamental discrete unit known as the *Metron*. The characteristic equation defining the allowed eigenvalues for spatial structures is given by:

$$X_i = n\lambda_0, \tag{33}$$

where:

- X_i is the spatial coordinate in Heim's framework, quantized in discrete steps,
- n is an integer quantum number, determining discrete metric states,
- λ_0 is the fundamental metron length scale, approximately the square of the Planck length.

This quantization ensures that space-time is composed of fundamental discrete units, forming a structured lattice511:1†Burkhard Heim - 1998 - Einführung Einheitliche Beschreibung der Welt.pdf.

13.5 Hermitian Extensions and Metric Tensor Eigenvalues

The eigenvalues of the metric tensor itself are defined in a higher-dimensional space, incorporating additional degrees of freedom that encode fundamental interactions. The generalized metric eigenvalue equation in Heim's formalism is expressed as:

$$\det |g_{km} - \lambda I| = 0, \tag{34}$$

where:

- g_{km} is the six-dimensional metric tensor, incorporating extra-dimensional components,

- λ represents the eigenvalues that define stable space structures, determining stable states of space-time curvature.

The solutions to this equation correspond to stable geometric states of space, providing the foundation for the emergence of mass and interaction fields511:10†Burkhard Heim - 2007 - Strukturen der physikalischen Welt.pdf.

13.6 Applications and Examples

The eigenvalue equations find applications in various aspects of Heim's theoretical framework. One example is the emergence of mass from the discrete structure of space. The allowed mass states are given by:

$$m_i = \hbar\lambda_i/c, \tag{35}$$

where:

- m_i is the mass of a fundamental particle,
- $\hbar$ is the reduced Planck constant,
- λ_i are the metric eigenvalues associated with different particle types,
- c is the speed of light.

Another application is in predicting the fine-structure constant α, which emerges as a function of metric eigenvalues:

$$\alpha = f(\lambda_1, \lambda_2, \lambda_3). \tag{36}$$

where:

- α is the fine-structure constant,
- $\lambda_1, \lambda_2, \lambda_3$ are eigenvalues associated with fundamental forces.

This suggests that the fundamental constants of nature are rooted in the geometric structure of space511:10†Burkhard Heim - 2007 - Strukturen der physikalischen Welt.pdf.

13.7 Conclusion

The eigenvalue structure in Heim's theory provides a discretized, geometric foundation for space-time and fundamental interactions. By replacing the traditional continuous field equations with polymetric eigenvalue relations, Heim's framework predicts the emergence of physical constants from fundamental geometric principles. Further investigation into the eigenvalue solutions may provide insights into quantum gravity and unified field theories.

14 Heim's Modified Field Equations

Heim's field equations represent a fundamental departure from Einstein's General Relativity by incorporating additional spatial dimensions and replacing the traditional energy-momentum tensor with a geometric construct. The result is a fully geometricized description of fundamental interactions, extending beyond four-dimensional space-time.

14.1 General Structure of Heim's Field Equations

The modified field equations are formulated in a six-dimensional space-time with coordinates $x^i = (x^1, x^2, x^3, x^4, X^5, X^6)$. The fundamental equation governing the curvature of space is:

$$R_{ik} - \frac{1}{2} g_{ik} R = \alpha \Theta_{ik}, \tag{37}$$

where:

- R_{ik} is the Ricci tensor, which describes the curvature of space-time,
- g_{ik} is the metric tensor, defining the geometric structure of space-time,
- R is the Ricci scalar, the trace of the Ricci tensor,
- α is a coupling constant that determines the strength of the interaction,
- Θ_{ik} is Heim's modified energy-momentum tensor, incorporating geometric contributions from additional dimensions.

Unlike Einstein's formulation, Θ_{ik} does not correspond to the traditional energy-momentum tensor but emerges from a higher-dimensional geometric structure537:0†Burkhard Heim - 2007 - Strukturen der physikalischen Welt.pdf.

14.2 Polymetric Representation and Tensor Structure

In Heim's framework, space-time consists of multiple polymetric components, each corresponding to a fundamental interaction. The field equations are decomposed into separate equations for gravitational, electromagnetic, and nuclear interactions:

$$(R_{ik}^{(g)} - \frac{1}{2} g_{ik}^{(g)} R^{(g)}) = \alpha_g \Theta_{ik}^{(g)}, \tag{38}$$

$$(R_{ik}^{(e)} - \frac{1}{2} g_{ik}^{(e)} R^{(e)}) = \alpha_e \Theta_{ik}^{(e)}, \tag{39}$$

$$(R_{ik}^{(n)} - \frac{1}{2} g_{ik}^{(n)} R^{(n)}) = \alpha_n \Theta_{ik}^{(n)}, \tag{40}$$

where:

- $R_{ik}^{(g)}, R_{ik}^{(e)}, R_{ik}^{(n)}$ are the Ricci tensors for gravitational, electromagnetic, and nuclear fields,
- $g_{ik}^{(g)}, g_{ik}^{(e)}, g_{ik}^{(n)}$ are the corresponding metric tensors,
- $R^{(g)}, R^{(e)}, R^{(n)}$ are the respective Ricci scalars,
- $\alpha_g, \alpha_e, \alpha_n$ are coupling coefficients for different interactions,
- $\Theta_{ik}^{(g)}, \Theta_{ik}^{(e)}, \Theta_{ik}^{(n)}$ are geometric energy-momentum contributions for each interaction.

This decomposition introduces additional curvature terms linked to the extra dimensions, suggesting that fundamental forces are inherently geometric537:1†Burkhard Heim - 2007 - Strukturen der physikalischen Welt.pdf.

14.3 Geometric Source Terms and the Fundamental Tensor

Heim replaces the traditional energy-momentum tensor with a geometric structure derived from a higher-dimensional space. The fundamental tensor governing interactions is defined as:

$$\Theta_{ik} = \Phi_{ik} + \Psi_{ik}, \tag{41}$$

where:

- Φ_{ik} represents contributions from the intrinsic space-time curvature,
- Ψ_{ik} accounts for additional interaction effects arising from higher dimensions.

This approach leads to a natural unification of gravitational and quantum forces, implying that interactions arise as manifestations of space-time structure537:2†Burkhard Heim - 1998 - Einführung Einheitliche Beschreibung der Welt.pdf.

14.4 Connection to the Christoffel Symbols and Geodesic Motion

In Heim's formalism, the geodesic equation is modified due to the influence of extra-dimensional interactions. The standard geodesic equation is given by:

$$\frac{d^2x^i}{d\tau^2} + \Gamma^i_{jk}\frac{dx^j}{d\tau}\frac{dx^k}{d\tau} = 0, \tag{42}$$

where:

- τ is the proper time,
- x^i are the space-time coordinates,
- Γ^i_{jk} are the Christoffel symbols, representing affine connections in curved space-time.

Heim introduces additional terms derived from the extra-dimensional components:

$$\frac{d^2x^i}{d\tau^2} + \Gamma^i_{jk}\frac{dx^j}{d\tau}\frac{dx^k}{d\tau} + \Lambda^i_{jk}\frac{dx^j}{d\tau}\frac{dx^k}{d\tau} = 0, \tag{43}$$

where Λ^i_{jk} represents force-like modifications to the geodesic equation arising from the higher-dimensional curvature effects537:3†Burkhard Heim - 1998 - Einführung Einheitliche Beschreibung der Welt.pdf.

14.5 Implications and Physical Interpretation

Heim's modified field equations provide a geometric origin for fundamental forces, eliminating the need for ad hoc quantization schemes. The extra-dimensional contributions suggest that:

- Gravitational and quantum forces are unified through space-time structure,
- The discrete nature of space emerges from the eigenvalue problem of the metric tensor,
- The coupling constants of fundamental interactions are determined by geometric constraints537:4†Burkhard Heim - 1998 - Einführung Einheitliche Beschreibung der Welt.pdf.

14.6 Conclusion

Heim's modified field equations represent a significant extension of General Relativity, incorporating additional dimensions to provide a unified description of fundamental forces. By replacing the energy-momentum tensor with a geometric structure, Heim's approach offers insights into the nature of space-time, potentially leading to new avenues in quantum gravity research.

15 Eigenvalue Formulation for Mass in Heim's Framework

Heim's approach to mass quantization derives from the fundamental structure of space-time as described by eigenvalue equations in a six-dimensional framework. Unlike conventional theories, where mass arises from the Higgs mechanism, Heim's formulation treats mass as an emergent geometric property of space.

15.1 Fundamental Eigenvalue Equation for Mass

In Heim's theory, mass is not a fundamental quantity but a result of eigenvalue solutions to a polymetric field equation. The governing eigenvalue equation is given by:

$$(C_p - A_p(k,m))g_{km} = 0, \tag{44}$$

where:

- C_p represents the fundamental curvature term associated with space-time geometry,
- $A_p(k,m)$ are the eigenvalue coefficients defining discrete metric solutions,
- g_{km} are the metric components of the six-dimensional space-time,
- k, m are indices labeling the metric components in Heim's formalism.

Solving for the allowed eigenvalues λ_n provides a set of discrete values for mass states546:0†Burkhard Heim - 1998 - Einführung Einheitliche Beschreibung der Welt.pdf.

15.2 Derivation of Mass Quantization

Mass quantization emerges from the eigenvalue problem of the metric tensor. The characteristic equation governing mass states is given by:

$$\det |R_{km} - \lambda g_{km}| = 0, \tag{45}$$

where:

- R_{km} is the contracted curvature tensor,
- λ are the eigenvalues defining stable mass configurations,
- g_{km} is the metric tensor incorporating higher-dimensional modifications.

The solutions to this equation determine discrete mass levels that correspond to observed elementary particle masses. The relationship between mass and eigenvalues follows:

$$m_i = \frac{\hbar \lambda_i}{c}, \tag{46}$$

where:

- m_i is the mass of a fundamental particle,
- $\hbar$ is the reduced Planck constant,
- λ_i are the metric eigenvalues associated with different particle types,
- c is the speed of light in vacuum.

This equation establishes that mass is a geometric consequence of space-time curvature546:1†Burkhard Heim - 2007 - Strukturen der physikalischen Welt.pdf.

15.3 Higher-Dimensional Mass Operators

The presence of additional dimensions in Heim's theory introduces new mass-like terms that alter conventional eigenvalue formulations. These contributions arise from additional curvature terms in the six-dimensional metric tensor:

$$m_i^2 = \sum_{j,k} G_{jk} \lambda_j \lambda_k, \tag{47}$$

where:

- G_{jk} are metric components in higher-dimensional space,
- λ_j are eigenvalues corresponding to mass-energy levels,
- j, k are indices summing over eigenvalue contributions.

The eigenvalues λ_j depend on the intrinsic geometry of space, ensuring that mass values emerge naturally from the structure of space-time546:2†Burkhard Heim - 1998 - Einführung Einheitliche Beschreibung der Welt.pdf.

15.4 Applications to Elementary Particles

Heim's theory predicts the masses of elementary particles by solving the eigenvalue equations for specific boundary conditions. The resulting discrete mass spectrum corresponds closely to observed values in particle physics. The mass of a given particle follows the form:

$$m_i = \frac{n \lambda_0 \hbar}{c}, \tag{48}$$

where:

- n is an integer quantum number that defines the particle's discrete state,
- λ_0 is the fundamental eigenvalue associated with mass generation,

- $\hbar$ is the reduced Planck constant,
- c is the speed of light in vacuum.

This approach provides a geometric foundation for mass generation, suggesting that particle masses are determined by the underlying space-time structure546:3†Burkhard Heim - 2007 - Strukturen der physikalischen Welt.pdf.

15.5 Extended Interpretation: Coupling to Fundamental Forces

The eigenvalues λ_i not only determine mass states but also interact with coupling constants governing fundamental forces. Heim's framework suggests a relation of the form:

$$\alpha_i = f(\lambda_i, \lambda_j), \tag{49}$$

where:

- α_i are the fundamental interaction strengths (fine-structure constants),
- λ_i, λ_j are metric eigenvalues associated with different interaction sectors,
- $f(\lambda_i, \lambda_j)$ is a functional relation predicting interaction strengths from space-time geometry.

This formulation allows for a geometric derivation of fundamental interaction strengths, potentially linking gravity, electromagnetism, and nuclear forces through eigenvalue relations546:4†Burkhard Heim - 1998 - Einführung Einheitliche Beschreibung der Welt.pdf.

15.6 Conclusion

The eigenvalue formulation for mass in Heim's framework replaces the Higgs mechanism with a purely geometric approach. Mass arises from the eigenvalues of the metric tensor, demonstrating that particle properties can be derived from fundamental space-time structures. The explicit coupling between eigenvalues and force strengths suggests that all fundamental interactions have a common geometric origin. Further research into these eigenvalue solutions may provide deeper insights into quantum gravity and unified field theories.

16 Geometric Mass Relations in Heim's Framework

Heim's theoretical framework proposes that mass emerges as a geometric property of space-time. Instead of relying on the Higgs mechanism, mass is derived from the eigenvalues of a polymetric field equation. This section explores the geometric relations that determine mass values and their implications for fundamental particle structures.

16.1 Fundamental Geometric Relations for Mass

The concept of mass in Heim's six-dimensional space-time is governed by geometric relations derived from the metric tensor. The fundamental mass relation is expressed as:

$$m_i^2 = \sum_{j,k} G_{jk} \lambda_j \lambda_k, \tag{50}$$

where:

- m_i is the mass of the i-th particle,
- G_{jk} represents the metric components in Heim's extended space,
- λ_j are eigenvalues obtained from the field equations,
- j, k are summation indices over metric components.

This equation indicates that mass is a consequence of the intrinsic curvature of space-time568:2†Burkhard Heim - 2007 - Strukturen der physikalischen Welt.pdf.

16.2 Mass as an Eigenvalue Problem

In Heim's framework, mass quantization follows from solving the eigenvalue equation of the metric tensor:

$$\det |R_{km} - \lambda g_{km}| = 0, \tag{51}$$

where:

- R_{km} is the Ricci tensor defining space-time curvature,
- λ are the eigenvalues determining stable mass configurations,
- g_{km} is the metric tensor incorporating higher-dimensional modifications.

Solving this equation provides a discrete mass spectrum that aligns with the observed properties of elementary particles568:0†Burkhard Heim - 1998 - Einführung Einheitliche Beschreibung der Welt.pdf.

16.3 Metric Coupling and Mass Generation

The generation of mass is further refined by the coupling between metric eigenvalues and fundamental physical constants. Heim's framework suggests that mass follows a relation of the form:

$$m_i = \frac{\hbar}{c} \sum_j \lambda_j G_{jj}, \tag{52}$$

where:

- $\hbar$ is the reduced Planck constant,
- c is the speed of light in vacuum,
- G_{jj} represents diagonal metric components,
- λ_j are eigenvalues associated with mass generation.

This formulation provides a direct link between space-time geometry and the mass of fundamental particles568:2†Burkhard Heim - 2007 - Strukturen der physikalischen Welt.pdf.

16.4 Prediction of Particle Masses

Heim's mass eigenvalue formulation has been applied to predict the masses of elementary particles. The general form for stable mass states is given by:

$$m_i = n\lambda_0 \frac{\hbar}{c}, \tag{53}$$

where:

- n is an integer quantum number,
- λ_0 is a fundamental eigenvalue associated with particle mass,
- $\hbar$ is the reduced Planck constant,
- c is the speed of light in vacuum.

This approach yields mass values that closely match experimental results, demonstrating the predictive power of Heim's geometric formulation568:0†Burkhard Heim - 1998 - Einführung Einheitliche Beschreibung der Welt.pdf.

16.5 Numerical Evaluation of the Fine-Structure Constant in Heim's Framework

Heim's theory suggests a geometric derivation of the fine-structure constant α, which governs electromagnetic interaction strength. Heim's refined formulation states:

$$(2\pi)^2\alpha = 90(1-\delta), \tag{54}$$

where δ is a small correction factor derived from higher-dimensional metric components. Heim's calculation gives:

$$\alpha_{\text{Heim}} \approx \frac{1}{137.03596147}, \tag{55}$$

which aligns remarkably well with the empirical value:

$$\alpha_{\text{empirical}} \approx \frac{1}{137.036} \approx 0.007297. \tag{56}$$

The deviation is within measurement tolerances, demonstrating that Heim's approach provides a solid geometric foundation for fundamental constants588:13†Burkhard Heim - 1996 - Elementarstrukuren der Materie 2.pdf.

This result strengthens Heim's framework as a predictive model for fundamental physical constants, linking mass, charge, and interaction strengths to space-time geometry.

16.6 Extended Interpretation: Coupling to Fundamental Forces

The eigenvalues λ_i not only determine mass states but also interact with coupling constants governing fundamental forces. Heim's framework suggests a relation of the form:

$$\alpha_i = f(\lambda_i, \lambda_j), \tag{57}$$

where:

- α_i are the fundamental interaction strengths (fine-structure constants),
- λ_i, λ_j are metric eigenvalues associated with different interaction sectors,
- $f(\lambda_i, \lambda_j)$ is a functional relation predicting interaction strengths from space-time geometry.

This formulation allows for a geometric derivation of fundamental interaction strengths, potentially linking gravity, electromagnetism, and nuclear forces through eigenvalue relations568:2†Burkhard Heim - 2007 - Strukturen der physikalischen Welt.pdf.

16.7 Conclusion

Heim's geometric mass relations provide a purely geometric mechanism for mass generation, eliminating the need for the Higgs field. By treating mass as an emergent property of space-time curvature, Heim's approach offers an alternative to the Standard Model and opens new possibilities for understanding fundamental interactions.

17 Derivation of the Fine-Structure Constant in Heim's Framework

The fine-structure constant α is a fundamental physical constant governing electromagnetic interactions. In Heim's framework, α is derived from the geometric properties of space-time, linking it to the eigenvalues of the metric tensor in a six-dimensional space.

17.1 Geometric Definition of the Fine-Structure Constant

Heim's formulation of α follows from the eigenvalue structure of the metric tensor and its relation to fundamental physical quantities. The fine-structure constant is given by the relation:

$$(2\pi)^2\alpha = 90(1-\delta), \tag{58}$$

where:

- α is the fine-structure constant, which characterizes the strength of the electromagnetic interaction,
- δ is a small correction factor derived from higher-dimensional metric components accounting for extra-dimensional curvature contributions.

Using Heim's computed value for δ, the calculated fine-structure constant is:

$$\alpha_{\text{Heim}} = \frac{1}{137.03596147}. \tag{59}$$

This result aligns remarkably well with the empirical value of the fine-structure constant600:13†Burkhard Heim - 1996 - Elementarstrukuren der Materie 2.pdf.

17.2 Eigenvalue Relation and Charge Coupling

Heim's theory suggests that charge quantization arises from the structure of space-time itself. The fine-structure constant is further linked to the geometric coupling of charge through:

$$\alpha = \frac{e^2}{4\pi\varepsilon_0\hbar c}, \tag{60}$$

where:

- e is the elementary charge, which is the fundamental charge of the electron,
- ε_0 is the vacuum permittivity, defining how electric fields propagate in free space,
- $\hbar$ is the reduced Planck constant, describing the quantum of action,
- c is the speed of light in vacuum, setting the fundamental speed limit of information transfer.

In Heim's framework, e is not an independent parameter but emerges from the fundamental eigenvalues of the metric tensor, ensuring a geometric origin of charge600:13†Burkhard Heim - 1996 - Elementarstrukuren der Materie 2.pdf.

17.3 Correction Terms and Higher-Dimensional Effects

The correction factor δ accounts for higher-dimensional contributions that modify the classical electromagnetic interaction. The presence of extra spatial dimensions introduces small corrections that affect the numerical value of α. Heim derives δ from additional metric components as follows:

$$\delta = \frac{X_5 X_6}{r}\left(\frac{dG_{AB}}{dx^A}\right), \tag{61}$$

where:

- X_5, X_6 are coordinates in the additional dimensions beyond four-dimensional space-time,
- G_{AB} represents the metric tensor components in the higher-dimensional space-time,
- r is the characteristic radius of the fundamental charge distribution, influenced by extra-dimensional curvature.

This term is responsible for slight deviations from the classical QED result and leads to Heim's highly accurate prediction of α600:13†Burkhard Heim - 1996 - Elementarstrukuren der Materie 2.pdf.

17.4 Derivation from First Principles

The derivation of the fine-structure constant begins with Heim's field equations, which incorporate extra-dimensional components. The starting point is the action integral in six-dimensional space-time:

$$S = \int \mathcal{L} d^6 x, \tag{62}$$

where $\mathcal{L}$ is the Lagrangian density describing the geometric and interaction terms in Heim's space-time. By varying the action with respect to the metric tensor, the field equations are obtained:

$$R_{ik} - \frac{1}{2} g_{ik} R = \alpha \Theta_{ik}, \tag{63}$$

where R_{ik} is the Ricci tensor, g_{ik} the metric tensor, and Θ_{ik} the modified energy-momentum tensor in Heim's formalism. Solving these equations for the electromagnetic interaction component gives:

$$\alpha = \frac{e^2}{4\pi\varepsilon_0 \hbar c} = \frac{90}{(2\pi)^2}(1 - \delta). \tag{64}$$

To further refine the derivation, Heim introduces a scaling relation based on space-time curvature corrections:

$$\alpha = \frac{n}{(2\pi)^2} \left(1 - \frac{X_5 X_6}{r}\right), \tag{65}$$

where n is an integer corresponding to discrete charge eigenvalues, ensuring that charge is naturally quantized within the geometric framework600:13†Burkhard Heim - 1996 - Elementarstrukuren der Materie 2.pdf.

17.5 Extended Relations and Applications

By extending the metric coupling terms, Heim's framework also suggests a direct relationship between α and the gravitational constant G. This leads to:

$$\frac{G m_e^2}{\hbar c} \approx \alpha^2, \tag{66}$$

where m_e is the electron mass. This unexpected link between the gravitational and electromagnetic coupling strengths suggests a deeper unification of interactions within Heim's theory600:13†Burkhard Heim - 1996 - Elementarstrukuren der Materie 2.pdf.

17.6 Conclusion

The derivation of the fine-structure constant in Heim's framework demonstrates that fundamental constants may emerge from space-time geometry rather than being arbitrarily introduced. The remarkably close agreement with experimental values suggests that Heim's approach provides a viable geometric interpretation of charge and coupling constants. The extended relations between α, charge quantization, and gravitational interactions suggest a promising route toward unification within a higher-dimensional geometric framework.

18 Multidimensional Space Structure in Heim's Framework

Heim's theoretical framework extends beyond the four-dimensional space-time of General Relativity by incorporating additional dimensions. His model postulates a six-dimensional space in which physical processes take place, with the potential extension to a twelve-dimensional structure to unify all interactions618:1†Burkhard Heim - 2007 - Strukturen der physikalischen Welt.pdf.

18.1 Dimensional Structure of Heim's Space-Time

Heim proposes that space-time consists of:

- The standard four-dimensional space-time $\mathbb{R}_4 = \{x^1, x^2, x^3, x^4\}$,
- Two additional dimensions X_5, X_6 responsible for organizing fundamental interactions,
- A possible extension to $\mathbb{R}_{12}$ containing informational and structural components618:0†Burkhard Heim - 2012 - Einheitliche Beschreibung der Materiellen Welt.pdf.

The total metric tensor in Heim's six-dimensional space is given by:

$$ds^2 = g_{\mu\nu} dx^\mu dx^\nu + G_{AB} dX^A dX^B, \tag{67}$$

where:

- $g_{\mu\nu}$ is the standard four-dimensional metric tensor,
- G_{AB} represents the additional metric components in X_5, X_6,
- Greek indices μ, ν run from 1 to 4,
- Latin indices A, B run from 5 to 6.

This extended metric structure allows for geometric interpretations of fundamental physical properties, including mass and charge618:1†Burkhard Heim - 2007 - Strukturen der physikalischen Welt.pdf.

18.2 Field Equations in Higher-Dimensional Space

Heim generalizes Einstein's field equations to six dimensions:

$$R_{AB} - \frac{1}{2} G_{AB} R = \kappa T_{AB}, \tag{68}$$

where:

- R_{AB} is the Ricci curvature tensor in the six-dimensional space,
- G_{AB} is the metric tensor including higher-dimensional effects,
- R is the scalar curvature,
- T_{AB} is the extended energy-momentum tensor,
- κ is the gravitational constant in this framework.

The additional metric components contribute terms that modify the classical gravitational dynamics, leading to novel predictions for particle physics and cosmology618:0†Burkhard Heim - 2012 - Einheitliche Beschreibung der Materiellen Welt.pdf.

18.3 Curvature and Higher-Dimensional Effects

The inclusion of extra dimensions introduces modifications to the Riemann curvature tensor. Heim defines the modified Riemann tensor as:

$$R^C_{ABD} = \partial_A \Gamma^C_{BD} - \partial_B \Gamma^C_{AD} + \Gamma^C_{AE}\Gamma^E_{BD} - \Gamma^C_{BE}\Gamma^E_{AD} + \Lambda^C_{ABD}, \tag{69}$$

where:

- Γ^C_{AB} are the Christoffel symbols incorporating extra-dimensional components,
- Λ^C_{ABD} is a correction term accounting for higher-dimensional curvature effects.

The term Λ^C_{ABD} modifies geodesic motion and contributes additional force-like terms to particle trajectories. Heim introduces this modification by considering an asymmetric contribution to the connection coefficients:

$$\Lambda^C_{ABD} = \eta(X_5 X_6) G^{CE} \left(\partial_A G_{ED} + \partial_B G_{AE} - \partial_D G_{AB} \right), \tag{70}$$

where η is a dimensionless coupling constant controlling the strength of extra-dimensional interactions626:0†Burkhard Heim - 1998 - Elementarstrukuren der Materie 1.pdf.

This modification alters the geodesic equation, leading to:

$$\frac{d^2 X^C}{d\tau^2} + \Gamma^C_{AB} \frac{dX^A}{d\tau} \frac{dX^B}{d\tau} = \Lambda^C_{ABD} \frac{dX^A}{d\tau} \frac{dX^B}{d\tau}. \tag{71}$$

The additional term Λ^C_{ABD} acts as an effective force, influencing the motion of test particles beyond the standard predictions of General Relativity626:0†Burkhard Heim - 1998 - Elementarstrukuren der Materie 1.pdf.

18.4 Extended Geodesic Equations

Heim's modified geodesic equations account for additional interaction terms from higher-dimensional curvature:

$$\frac{d^2 x^i}{d\tau^2} + \Gamma^i_{jk} \frac{dx^j}{d\tau} \frac{dx^k}{d\tau} = F^i_{\text{extra}}, \tag{72}$$

where:

- $F^i_{\text{extra}} = \eta(X_5 X_6) G^{ij} \partial_j G_{AB}$ represents the additional force-like term from extra-dimensional interactions,
- Γ^i_{jk} are the standard Christoffel symbols for four-dimensional space-time,
- η is the coupling coefficient associated with extra-dimensional curvature.

These equations predict deviations from classical geodesic motion, implying new effects on particle trajectories and gravitational interactions634:0†Burkhard Heim - 2007 - Strukturen der physikalischen Welt.pdf.

18.5 Implications and Physical Interpretations

Heim's multidimensional space model leads to several key implications:

- Mass and charge arise from space-time geometry rather than external fields.
- The additional dimensions influence particle interactions and fundamental constants.
- Higher-dimensional curvature effects provide an alternative approach to unification theories.
- The additional force terms in the geodesic equation suggest potential applications in advanced propulsion physics.

Future research into these structures could reveal deeper insights into the nature of fundamental forces and their connection to space-time geometry618:0†Burkhard Heim - 2012 - Einheitliche Beschreibung der Materiellen Welt.pdf.

19 Tensors Used in Heim's Framework

Heim's theory extends standard tensorial formalisms of General Relativity by incorporating additional geometric structures in a higher-dimensional space. The key tensors used in his framework include the metric tensor, the curvature tensors, the energy-momentum tensor, and modified Christoffel symbols. Additional tensor structures such as the fundamental tensor, polymetric field tensors, and hermitian and anti-hermitian tensor components are also crucial to Heim's framework. This section provides a detailed formulation of these tensors, their notation, and their role in Heim's six-dimensional and higher-dimensional framework652:0†Burkhard Heim - 2012 - Einheitliche Beschreibung der Materiellen Welt.pdf.

19.1 Metric Tensor in Heim's Formalism

The fundamental tensor in Heim's space-time is defined in a six-dimensional manifold:

$$ds^2 = g_{\mu\nu} dx^\mu dx^\nu + G_{AB} dX^A dX^B, \tag{73}$$

where:

- $g_{\mu\nu}$ is the standard four-dimensional metric tensor,
- G_{AB} represents additional metric components in the extra dimensions,
- Greek indices μ, ν run from 1 to 4,
- Latin indices A, B run from 5 to 6.

This extended metric structure allows for the geometric interpretation of mass and charge, integrating them into space-time curvature652:0†Burkhard Heim - 2012 - Einheitliche Beschreibung der Materiellen Welt.pdf.

20 Activity Streams in Heim's Framework

20.1 Introduction

In modern physics, physical processes are often described phenomenologically, meaning that interactions and dynamics are determined based on experimental data without a fundamental structural derivation. In contrast, Burkhard Heim's theoretical framework introduces the concept of activity streams (Aktivitätenströme) as a fundamental mechanism governing physical interactions at a structural level107:1†source.

Activity streams in Heim's theory are linked to the fundamental structure of space, embedded in a twelve-dimensional metric space R_{12}. These streams represent intrinsic energy and information flows, playing a critical role in particle interactions, field formations, and space-time dynamics107:1†source.

20.2 Mathematical Formalism of Activity Streams

In Heim's framework, activity streams are formulated using tensorial and differential geometric methods in R_{12}. The fundamental representation of an activity stream A^A is given as:

$$A^A = \frac{d\Phi^A}{ds}, \tag{74}$$

where:

- A^A represents the activity stream in the A-th dimension,
- Φ^A is the potential function governing the activity stream,
- s is an intrinsic parameter linked to metronic evolution107:1†source.

Activity streams define the dynamics of fundamental fields in Heim's theory. The governing equation for an activity stream tensor A_{AB} is given by:

$$\nabla_C A^{AB} + \lambda g^{AB} A^C = 0, \tag{75}$$

where:

- ∇_C is the covariant derivative in R_{12},
- g^{AB} is the twelve-dimensional metric tensor,
- λ is a coupling coefficient that modulates interaction strength107:1†source.

A deeper structural understanding of activity streams can be obtained through their relation to the fundamental energy-momentum tensor in Heim's theory. The tensor formulation of activity streams is given by:

$$T^{AB} = \frac{1}{\mu} A^A A^B - g^{AB} \mathcal{L}_A, \tag{76}$$

where:

- T^{AB} represents the energy-momentum distribution associated with activity streams,

- μ is a fundamental metron-related scaling constant,
- $\mathcal{L}_A$ is the Lagrangian density derived from activity stream dynamics107:1†source.

Additionally, Heim's theory suggests that activity streams are responsible for coupling fundamental field interactions, leading to modified expressions for known forces such as gravity and electromagnetism. The metric structure defines an interaction potential:

$$V_A = \int g^{AB} A_B dV, \tag{77}$$

which governs the effective interaction energy107:1†source.

20.3 Physical Interpretation and Quantum Implications

Unlike gauge fields in the standard model, Heim's activity streams are seen as intrinsic components of space-time itself, not as independent entities. The discrete structure of metronic space suggests that activity streams may exhibit quantization effects, leading to the emergence of quantized interaction potentials:

$$E_n = \frac{h}{2\pi} \oint A^A ds, \tag{78}$$

where E_n represents discrete energy eigenstates corresponding to different interaction configurations107:1†source.

This formulation suggests a deep connection between activity streams and the quantization of fundamental interactions, providing a possible link between Heim's unified field theory and quantum mechanics107:1†source.

20.4 Comparison with Standard Physics

In the standard model, forces are described using gauge fields, where interaction terms are introduced phenomenologically through Lagrangians such as:

$$\mathcal{L} = -\frac{1}{4} F_{\mu\nu} F^{\mu\nu}, \tag{79}$$

where $F_{\mu\nu}$ represents the field strength tensor. Heim's approach, in contrast, replaces gauge fields with intrinsic activity streams that emerge naturally from the metric structure of R_{12}107:1†source.

The key differences are:

- **Unification of Interactions:** Activity streams inherently describe interactions without requiring separate gauge bosons as in the standard model.
- **Geometric Origin:** Unlike phenomenological gauge fields, activity streams arise from fundamental geometric constraints in Heim's extended space-time.
- **Quantization of Space-Time:** Heim's activity streams imply a discrete space-time structure, differing from the continuum-based formalism in general relativity107:1†source.
- **Role in Particle Generation:** The standard model requires external quantum numbers to classify particles, whereas Heim's framework derives quantum properties from the structure of activity streams.

- **Cosmological Implications:** Heim's theory links activity streams to large-scale space-time evolution, offering an alternative explanation for dark energy and cosmic expansion107:1†source.

20.5 Empirical Implications and Further Research

Activity streams in Heim's theory provide predictions regarding vacuum fluctuations, gravitational wave propagation, and dark energy effects. Future experimental validations may include:

- Detection of structured energy flows at microscopic scales,
- Constraints on gravitational anomalies linked to R_{12} activity structures,
- Potential deviations from standard quantum field behavior due to intrinsic metronic constraints107:1†source,
- High-energy tests for the existence of activity streams as structured eigenmodes of the vacuum field.

Additionally, Heim's activity stream concept predicts that observable deviations in astrophysical lensing effects could result from intrinsic metronic interactions rather than classical gravitational warping107:1†source.

20.6 Conclusion

The concept of activity streams in Heim's framework provides a structural basis for understanding fundamental interactions beyond the phenomenological approaches of standard physics. By embedding physical laws in a higher-dimensional metric space, Heim's approach offers a unified and predictive model with potential testable implications in quantum and gravitational physics107:1†source. Further mathematical exploration and experimental validation may lead to a deeper understanding of fundamental physical laws within the Heim framework.

21 Unification of Gravity and Electromagnetism in Heim's Framework

21.1 Introduction

One of the fundamental challenges in modern theoretical physics is the unification of gravity and electromagnetism. Standard physics describes gravity through Einstein's general relativity and electromagnetism through Maxwell's equations, treating them as separate fundamental interactions. In contrast, Burkhard Heim's theoretical framework offers a geometric unification, embedding both interactions within the structure of a twelve-dimensional space R_{12}107:1†source.

Heim's approach replaces the conventional field description with a fundamental metronic structure, in which gravitational and electromagnetic interactions arise as manifestations of the same underlying metric tensor components107:1†source.

21.2 Mathematical Foundation of Unification

The unification of gravity and electromagnetism in Heim's theory is rooted in the extended metric tensor g_{AB} within the twelve-dimensional space R_{12}. Heim introduces a polymetric structure, where different components of the metric tensor give rise to distinct interactions:

$$g_{AB} = \begin{bmatrix} g_{\mu\nu} & g_{\mu i} \\ g_{i\mu} & g_{ij} \end{bmatrix}, \tag{80}$$

where:

- $g_{\mu\nu}$ represents the standard four-dimensional spacetime metric for gravity,
- $g_{\mu i}$ and $g_{i\mu}$ encode the coupling between gravity and electromagnetism,
- g_{ij} governs the higher-dimensional structure responsible for additional forces107:1†source.

From this metric, Heim derives an extended field equation similar to Einstein's field equations but incorporating electromagnetic effects:

$$R_{AB} - \frac{1}{2} g_{AB} R + \Lambda g_{AB} = \kappa T_{AB}, \tag{81}$$

where:

- R_{AB} is the Ricci tensor in R_{12},
- R is the curvature scalar,
- Λ is the cosmological constant,
- T_{AB} is the extended energy-momentum tensor107:1†source.

The electromagnetic field tensor emerges naturally from the antisymmetric components of the metric tensor:

$$F_{\mu\nu} = \partial_\mu g_{\nu i} - \partial_\nu g_{\mu i}, \tag{82}$$

which reduces to Maxwell's equations in the weak-field limit107:1†source.

21.3 Derivation of Field Equations

To explicitly demonstrate the unification, Heim's theory derives the gravitational and electromagnetic field equations from a common action principle. The total action S in R_{12} is given by:

$$S = \int \left(R + \frac{1}{4} F_{\mu\nu} F^{\mu\nu} + \mathcal{L}_{\text{int}} \right) \sqrt{-g}\, d^{12}x, \tag{83}$$

where $\mathcal{L}_{\text{int}}$ represents interaction terms coupling the fields107:1†source.

By varying this action with respect to the metric, Heim derives:

$$G_{\mu\nu} + \alpha T^{(EM)}_{\mu\nu} = \kappa T^{(M)}_{\mu\nu}, \tag{84}$$

where:

- $G_{\mu\nu}$ is the Einstein tensor,
- $T_{\mu\nu}^{(EM)}$ is the energy-momentum tensor of the electromagnetic field,
- $T_{\mu\nu}^{(M)}$ is the matter energy-momentum tensor,
- α is a geometric coupling constant107:1†source.

This equation shows that the presence of an electromagnetic field modifies the gravitational field equations, demonstrating their geometric unification.

The matter energy-momentum tensor $T_{\mu\nu}^{(M)}$ can be influenced by the energy stored in the electromagnetic field. In Heim's framework, the total stress-energy contribution takes the form:

$$T_{\mu\nu}^{(M)} = T_{\mu\nu}^{(0)} + \beta g_{\mu\nu} F_{\rho\sigma} F^{\rho\sigma}, \tag{85}$$

where:

- $T_{\mu\nu}^{(0)}$ represents the standard matter contribution,
- $F_{\rho\sigma} F^{\rho\sigma}$ is the electromagnetic field energy density,
- β is a coupling parameter that describes how the electromagnetic field influences matter curvature107:1†source.

This term suggests that strong electromagnetic fields can locally modify the gravitational curvature, leading to potential experimental tests in astrophysical environments such as neutron stars and magnetars107:1†source.

21.4 Physical Consequences and Predictions

Heim's unification of gravity and electromagnetism has several implications:

- **Gravitationally Induced Electromagnetic Effects:** The coupling term $g_{\mu i}$ suggests that strong gravitational fields can induce electromagnetic effects, potentially explaining astrophysical phenomena such as jets from black holes107:1†source.
- **Modification of Gravitational Waves:** Heim's theory predicts that gravitational waves may carry an electromagnetic component, leading to testable deviations from general relativity107:1†source.
- **Electromagnetically Induced Gravitational Curvature:** The additional term $\beta g_{\mu\nu} F_{\rho\sigma} F^{\rho\sigma}$ in the energy-momentum tensor implies that intense electromagnetic fields could alter local gravitational fields, which could be tested through precision measurements near strong magnetic sources107:1†source.
- **Anomalous Space Propulsion:** The geometric coupling may provide a basis for novel propulsion concepts, linking gravity manipulation to electromagnetic fields107:1†source.

21.5 Conclusion

Heim's framework provides a geometric unification of gravity and electromagnetism by embedding both interactions in the structure of a twelve-dimensional metron space. This approach eliminates the need for separate gauge fields, instead deriving Maxwell's equations from the fundamental metric structure. The coupling between the electromagnetic field and the matter energy-momentum tensor introduces additional testable effects, such as electromagnetic field-induced modifications to local spacetime curvature. Future experimental tests, particularly in strong gravitational fields, could provide further validation for this theory107:1†source.

22 Gauge Field Structures in Heim's Framework

22.1 Introduction

In modern physics, gauge fields serve as the fundamental framework for describing interactions between elementary particles. The Standard Model of particle physics describes these interactions through local gauge symmetries associated with the groups $U(1)$, $SU(2)$, and $SU(3)$. Heim's theoretical framework, however, extends beyond this conventional formalism by embedding gauge field structures into a twelve-dimensional space, denoted as R_{12}. In this formulation, gauge fields are not introduced as separate entities but emerge naturally from the geometric structure of spacetime107:1†source.

Heim's approach to gauge fields introduces additional interactions beyond those predicted by the Standard Model, providing a potential avenue for unification and new physical insights into fundamental interactions.

22.2 Mathematical Formalism of Gauge Fields in Heim's Framework

In Heim's theory, the gauge fields arise as a consequence of the metric structure of the twelve-dimensional space R_{12}. The generalized metric tensor is expressed as:

$$g_{AB} = \begin{bmatrix} g_{\mu\nu} & g_{\mu i} \\ g_{i\mu} & g_{ij} \end{bmatrix}, \tag{86}$$

where:

- $g_{\mu\nu}$ represents the standard four-dimensional spacetime metric,
- $g_{\mu i}$ and $g_{i\mu}$ describe interactions between spacetime and additional internal dimensions,
- g_{ij} defines the structure of the additional dimensions associated with new interaction fields107:1†source.

The gauge field strength tensor in Heim's framework is derived from the metric structure and takes the form:

$$F_{AB} = \partial_A g_{BC} - \partial_B g_{AC} + C^D_{AB} g_{DC}, \tag{87}$$

where:

- C^D_{AB} are the structure coefficients of the extended gauge group,
- F_{AB} represents the curvature of the gauge connection in the twelve-dimensional space107:1†source.

This extends conventional gauge theory by incorporating higher-dimensional curvature terms.

The generalized field equations that describe the dynamics of gauge fields are obtained from the variational principle applied to the extended action functional:

$$S = \int \left(R + \frac{1}{4} F_{AB} F^{AB} + \mathcal{L}_{\text{int}} \right) \sqrt{-g}\, d^{12}x, \tag{88}$$

where:

- R is the twelve-dimensional Ricci scalar,
- $\mathcal{L}_{\text{int}}$ describes additional interaction terms coupling the gauge fields to matter and gravity107:1†source.

22.3 Gauge Group Structure and Interaction Unification

The gauge group structure in Heim's framework differs from the Standard Model by introducing new symmetry groups that arise from the geometry of R_{12}. The additional internal dimensions contribute to an extended gauge symmetry of the form:

$$G_H = SU(2) \times U(1) \times SU(3) \times G_X, \tag{89}$$

where:

- G_H is the full symmetry group in Heim's theory,
- G_X represents an extended symmetry group arising from the higher-dimensional structure107:1†source.

In this model, the standard electroweak and strong interactions remain embedded within $SU(2)\times U(1)\times SU(3)$, while G_X introduces additional fields that could account for new interactions beyond the Standard Model. The emergence of new force carriers linked to G_X suggests potential testable deviations in high-energy physics experiments107:1†source.

22.4 Connection to Gravity and Quantum Effects

Unlike conventional gauge theories, Heim's framework integrates gravity directly into the gauge field structure. The gravitational field equations take the form:

$$G_{\mu\nu} + \alpha T^{(G)}_{\mu\nu} = \kappa T^{(M)}_{\mu\nu}, \tag{90}$$

where:

- $G_{\mu\nu}$ is the Einstein tensor,
- $T^{(G)}_{\mu\nu}$ represents contributions from higher-dimensional gauge fields,
- $T^{(M)}_{\mu\nu}$ is the conventional matter energy-momentum tensor,
- α and κ are coupling parameters related to gravity and gauge interactions107:1†source.

This equation suggests that modifications to gravitational effects may arise due to additional gauge fields, leading to potential experimental tests in astrophysical and cosmological observations.

The quantum effects of gauge fields in Heim's framework also differ from conventional quantum field theories. The discretization of space-time in Heim's metron model implies that gauge fields exhibit quantized interaction strengths, given by:

$$g_X = \frac{h}{cl_X}, \tag{91}$$

where:

- g_X is the coupling constant associated with the extended gauge group G_X,
- l_X is the fundamental length scale associated with the higher-dimensional interaction107:1†source.

22.5 Physical Implications and Experimental Tests

The inclusion of extended gauge fields in Heim's framework leads to several physical predictions:

- **New Force Carriers:** The existence of additional gauge bosons corresponding to the symmetry group G_X could lead to new fundamental forces observable at high energies107:1†source.
- **Modified Gravitational Behavior:** The interaction between gravity and gauge fields suggests potential deviations from general relativity, particularly in strong gravitational fields107:1†source.
- **Discrete Space-Time Effects:** The quantized nature of gauge interactions in Heim's framework may lead to measurable effects in particle physics experiments at the Planck scale107:1†source.
- **Dark Matter and Dark Energy:** The additional gauge fields may contribute to explanations for dark matter and dark energy, providing a potential link between particle physics and cosmology107:1†source.

22.6 Conclusion

Heim's framework extends conventional gauge field structures by embedding them within a twelve-dimensional space, where interactions emerge naturally from the geometric properties of the metric tensor. The presence of an extended symmetry group G_X introduces additional interactions beyond the Standard Model, potentially explaining phenomena such as modified gravity, new force carriers, and quantum gravitational effects. Future experimental tests, including searches for deviations from known gauge couplings, could provide further validation for this theoretical approach107:1†source.

23 This Section is a reconstruction attempt of Slides from Illobrand von Ludwiger. This is a work in progress, but I wanted to include this as it holds some vital equations like the latest contrabary equation. First is an translation of the german original behind

The Compositive Fundamental Tensor (the "Correlator")

In R_6, there exist three subspaces:

$$R_3 = (x_1, x_2, x_3), \quad T_1 = x_4, \quad S_2 = (x_5, x_6).$$

In Heim's *Flächendifferenzenrechnung* (surface-difference calculus), one demands the superposition of two tensorial selectors. The metric fundamental tensor is formed by pairing off two partitional tensors belonging to the subspaces. If the coordinate groups $(y_1, y_2, y_3, x_4, x_5, y_6)$ are labeled by the indices $\mu, \nu = 3, 2, 1$, while $i, k, m = 1, 2, \ldots, 6$, then the "compositive fundamental tensor" is written as:

$$g_{ik}^{(m)*} = \sum_{\mu=1}^{3} \kappa_{ik}^{(\mu)} \sum_{\nu=1}^{3} \kappa_{ik}^{(\nu)} = \left(\kappa_{ik}^{(1)} + \kappa_{ik}^{(2)} + \kappa_{ik}^{(3)}\right)\left(\kappa_{ik}^{(1)} + \kappa_{ik}^{(2)} + \kappa_{ik}^{(3)}\right) = \sum_{\mu=1}^{3} g_{ik}^{(\mu)*},$$

where the partial tensors $\kappa_{ik}^{(\mu)}$ have the form:

$$\kappa_{ik}^{(1)} = \kappa_{ik}^{(1)}(y_1, y_2, y_3), \quad \kappa_{ik}^{(2)} = \kappa_{ik}^{(2)}(y_4), \quad \kappa_{ik}^{(3)} = \kappa_{ik}^{(3)}(y_1, y_2, y_3).$$

In other words, the total six-dimensional metric $g_{ik}^{(m)*}$ arises as a combinational or "compositive" construct, summing up the partial metrics $\kappa_{ik}^{(\mu)}$ from different coordinate blocks of the six-dimensional space.

The Unified Field-Strength Tensor According to Heim and Auerbach

English translation of the original German text:

"The union of electric and gravitational quantities, together with the abbreviated variables $\mathbf{G}, \mathbf{C}, \mathbf{j}$*, and* $\mathbf{p}$*, leads to the unified field-strength tensor* $\mathbf{T}$*."*

In the following, the combination of electrical and gravitational terms is expressed in these newly defined variables:

$$\mathbf{G} = \sqrt{\varepsilon_0}\,\mathbf{E} + \frac{\alpha}{\varepsilon_0}\,\mathbf{\Gamma}, \quad \mathbf{C} = \sqrt{\mu_0}\,\mathbf{H} + \sqrt{\beta}\,\mu,$$

$$\mathbf{j} = \sqrt{\mu_0}\,\mathbf{j}_{\mathrm{em}} + \sqrt{\beta}\,\mathbf{j}_{\mathrm{m}}, \quad \mathbf{p} = \sqrt{\mu_0}\,\mathbf{p}_{\mathrm{e}} + \sqrt{\beta}\,\mathbf{p}_{\mathrm{m}}.$$

In matrix form, the unified field-strength tensor $\mathbf{T}^{\mu\nu}$ can be written as:

$$\mathbf{T}^{\mu\nu} = \begin{pmatrix} 0 & C_x & -C_y & -i\,Q_x \\ -C_x & 0 & C_z & -i\,Q_y \\ C_y & -C_z & 0 & -i\,Q_z \\ i\,Q_x & i\,Q_y & i\,Q_z & 0 \end{pmatrix}.$$

Applying the relevant differential operators, we obtain the following field equations:

$$\nabla \cdot \mathbf{G} = c\,\rho, \quad \nabla \times \mathbf{G} = -\frac{1}{c}\frac{\partial \mathbf{C}}{\partial t},$$

$$\nabla \cdot \mathbf{C} = \omega\,\sqrt{\beta}\,\big(\rho_{\mathrm{m}} - \rho_{\mathrm{m0}}\big), \quad \nabla \times \mathbf{C} = \mathbf{j} + \frac{1}{c}\frac{\partial \mathbf{G}}{\partial t}.$$

Furthermore, we define

$$\beta = \frac{1}{\alpha\,c^2}.$$

Notes:

- $\mathbf{E}, \mathbf{H}$ denote the usual electric and magnetic field intensities.
- $\mathbf{\Gamma}, \mu$ are Heim's gravitational analogues, i.e. gravito-electric and gravito-magnetic field components.
- $\mathbf{j}_{\mathrm{em}}, \mathbf{j}_{\mathrm{m}}$ represent electromagnetic and mass currents, respectively.
- ε_0 and μ_0 are the vacuum permittivity and permeability.
- α and β are parameters connecting gravitational and electromagnetic couplings in Heim's formalism.
- ρ_{m0} is a reference mass density, and ω is a constant in the theory controlling how mass densities appear in the unified field equations.

Die einheitlichen Feldgleichungen

English translation:
The following field equations serve as a practical tool, for instance in generating magnetic fields by means of moving neutral mass fluxes $\mathbf{j}$.

German original:
"Die nachfolgenden Feldgleichungen dienen zur praktischen Anwendung, beispielsweise der Erzeugung von Magnetfeldern durch bewegte neutrale Massenströme $\mathbf{j}$*."*

$$\nabla \cdot \mathbf{E} = \frac{1}{\varepsilon_0}\,\rho_{\mathrm{e}}, \tag{92}$$

$$\nabla \cdot \mathbf{\Gamma} = \frac{1}{\alpha}\,\rho_{\mathrm{m}}, \tag{93}$$

$$\nabla \times \big[\mathbf{E} + \big(\tfrac{\alpha}{\varepsilon_0}\,\mathbf{\Gamma}\big)\big] = -\,\mu_0\,\frac{\partial}{\partial t}\big[\mathbf{H} + \big(\tfrac{\beta}{\mu_0}\,\mu\big)\big], \tag{94}$$

$$\nabla \cdot \mathbf{H} = 0, \tag{95}$$

$$\nabla \cdot \mu = c\,\big(\rho_{\mathrm{m}} - \rho_{\mathrm{m0}}\big), \tag{96}$$

$$\nabla \times \big[\mathbf{H} + \big(\tfrac{\beta}{\mu_0}\,\mu\big)\big] = \mathbf{j} + \frac{1}{c}\,\frac{\partial}{\partial t}\big[\mathbf{E} + \big(\tfrac{\alpha}{\varepsilon_0}\,\mathbf{\Gamma}\big)\big]. \tag{97}$$

The Contrabaric Effect

English Translation:

Taking the time derivative of the force density $\vec{\xi} = \frac{\mathrm{d}\eta}{\mathrm{d}V} = \nabla\,\eta$, it follows that

$$\vec{\xi} = \nabla\,\eta = \frac{1}{2}\,\frac{\mathrm{d}}{\mathrm{d}t}\big(\varepsilon_0\,\mathbf{E}^2 + \mu_0\,\mathbf{H}^2\big) = -\,\nabla\cdot(\mathbf{E}\times\mathbf{H}).$$

From this, one obtains the so-called "contrabaric equation":

$$\vec{\xi} = \nabla\,\nabla\cdot(\mathbf{E}\times\mathbf{H}) = \frac{c\sqrt{\mu_0\,\varepsilon_0}}{2\pi\,\gamma^2}\,\frac{\mathrm{d}}{\mathrm{d}t}\,\nabla\!\left(\frac{1}{r^2}\Big[\sqrt{\varphi_\mathrm{e}} + r\,\frac{\mathrm{d}}{\mathrm{d}r}\,\sqrt{\varphi_\mathrm{e}}\Big]\right).$$

(Harasim et al. 1985). *Using the energy densities of the electric and gravitational fields, one can describe the electric charge in terms of the field mass. The energy differentials are given by*

$$\mathrm{d}E_\mathrm{e} = \mathrm{d}E = \mathrm{d}m\,c^2 = \frac{\partial E_\mathrm{r}}{\partial r}\,\mathrm{d}r + \frac{\partial E_\mathrm{e}}{\partial e}\,\mathrm{d}e = \frac{1}{4\pi\,\varepsilon_0}\left(-\frac{e^2}{r^2}\,\mathrm{d}r + \frac{2\,e}{r}\,\mathrm{d}e\right),$$

where ε_0 is the vacuum permittivity (Influenzkonstante) and e is the elementary charge. After some calculation, one arrives at an expression for the charge density η of the electromagnetic field:

$$\eta = \frac{\mathrm{d}e}{\mathrm{d}V} = \frac{1}{4\pi\,r^2}\,\frac{\mathrm{d}e}{\mathrm{d}r} = \frac{\sqrt{\beta}}{4\pi\,\gamma^2}\,\frac{1}{r^2}\,\frac{\mathrm{d}}{\mathrm{d}r}\big(r\sqrt{\varphi_\mathrm{e}}\big), \quad \textit{with} \quad e = \frac{2\,c\sqrt{\mu_0\,\varepsilon_0}}{\gamma^2}\,r\,\sqrt{\varphi_\mathrm{e}}.$$

Hence,

$$\eta = \frac{c\sqrt{\mu_0\,\varepsilon_0}}{2\pi\,\gamma^2\,r^2}\Big(\sqrt{\varphi_\mathrm{e}} + r\,\frac{\mathrm{d}}{\mathrm{d}r}\,\sqrt{\varphi_\mathrm{e}}\Big).$$

Taking the time derivative of the force density $\vec{\xi} = \frac{\mathrm{d}\eta}{\mathrm{d}V} = \nabla\,\eta$, it follows that

$$\vec{\xi} = \nabla\,\eta = \frac{1}{2}\,\frac{\mathrm{d}}{\mathrm{d}t}\big(\varepsilon_0\,\mathbf{E}^2 + \mu_0\,\mathbf{H}^2\big) = -\,\nabla\cdot(\mathbf{E}\times\mathbf{H}).$$

From this, one obtains the so-called "contrabaric equation":

$$\vec{\xi} = \nabla\,\nabla\cdot(\mathbf{E}\times\mathbf{H}) = \frac{c\sqrt{\mu_0\,\varepsilon_0}}{2\pi\,\gamma^2}\,\frac{\mathrm{d}}{\mathrm{d}t}\,\nabla\!\left(\frac{1}{r^2}\Big[\sqrt{\varphi_\mathrm{e}} + r\,\frac{\mathrm{d}}{\mathrm{d}r}\,\sqrt{\varphi_\mathrm{e}}\Big]\right).$$

(Harasim et al. 1985).

With the Substitutions

English Translation:
By introducing the following substitutions, Heim set up the so-called "contrabaric equation" in his first paper published in the journal *Flugkörper*:

$$\mathbf{G} = \frac{c\sqrt{\pi\,\varepsilon_0}}{2\pi\,\gamma^2}\,\frac{\mathrm{d}}{\mathrm{d}t}\,\nabla\!\left(\tfrac{1}{r^2}\,\sqrt{\varphi_\mathrm{e}}\right), \quad \mathbf{\Gamma} = \frac{c\sqrt{\pi\,\varepsilon_0}}{2\pi\,\gamma^2}\,\frac{\mathrm{d}}{\mathrm{d}t}\,\nabla\!\left(r\,\tfrac{\mathrm{d}}{\mathrm{d}r}\,\sqrt{\varphi_\mathrm{e}}\right),$$

$$\mathbf{F} = \mathbf{E}\times\mathbf{H}, \quad \mathbf{K} = \nabla\,\nabla\cdot = \mathrm{rot}\,\mathrm{rot} + \nabla\,\nabla\cdot = \mathrm{rot}\,\mathrm{rot} \quad \big(\text{since}\,\nabla\,\nabla\cdot(\mathbf{E}\times\mathbf{H}) = 0\big).$$

Hence, Heim established in that work the equation

$$\mathbf{K}\,;\,\mathbf{F} = \mathbf{G} + \mathbf{\Gamma}, \quad \text{i.e.} = \mathrm{rot}\,\mathrm{rot}\,\big(\mathbf{E}\times\mathbf{H}\big).$$

Heim's Metronization of Geometry

English Translation:
Heim developed a conceptual scheme for the *"Metronisierung"* (discretization) of geometry, in which space is subdivided into the smallest possible units, called "metrons." This metronization forms the foundation of his theory of microphysical structures.

The metronization approach provides a bridge between the continuous spacetime of general relativity and the discrete nature of quantum mechanics. According to Heim, space is not infinitely divisible but instead consists of fundamental area elements on the order of the square of the Planck length.

Original German Text and Equations

Über die Energiedichten der elektrischen und gravitativen Felder lässt sich die elektrische Ladung durch die Feldmasse beschreiben. Die Energie-Differenziale sind

$$\mathrm{d}E_\mathrm{e} = \mathrm{d}E = \mathrm{d}m\,c^2 = \frac{\partial E_\mathrm{r}}{\partial r}\,\mathrm{d}r + \frac{\partial E_\mathrm{e}}{\partial e}\,\mathrm{d}e = \frac{1}{4\pi\,\varepsilon_0}\Big(-\frac{e^2}{r^2}\,\mathrm{d}r + \frac{2e}{r}\,\mathrm{d}e\Big). \tag{98}$$

... *(rest of German content as above)*

Original German Text with Equations

$$m(r) = m_0 + \mu_e \quad (\mu_e = \textit{Feldmasse}), \tag{99}$$

$$\textit{Gravitationsfeldstärke}\;\mathbf{\Gamma} = \textit{grad}\,\varphi = \gamma\Big(\frac{1}{r}\,\frac{\partial m}{\partial r} \;-\; \frac{m}{r^2}\Big), \tag{100}$$

The Geometrization of Physics

2.1 Eigenvalue Equations in the Microscopic Domain

English Translation:
Einstein (General Relativity, GR) held that the gravitational field is the spacetime structure of Riemannian geometry, with the field source as a phenomenological quantity. Heim's view is that the entirety of all possible interactions follows Riemannian geometry in the microscopic domain, according to the quantum principle.

The Christoffel symbols (which describe forces) become tensors in the microscopic regime, i.e. $\Gamma^i_{jk} \to \kappa^i_{jk}$. The Ricci tensor (the trace of the curvature tensor) in GR, $R_{ik} = R^l_{i\,l\,k}$, is proportional to the energy-density tensor T_{ik}, namely $R_{ik} = \alpha\,(T_{ik} - \frac{1}{2}\,g_{ik}\,T)$.

In the microscopic domain, the phenomenological portion of the field transitions to

$$\alpha\left(T_{ik} - \tfrac{1}{2}\,g_{ik}\,T\right) \;\to\; \lambda_p(k,m)\,\psi^{(p)}_{ik}, \quad \text{while the structural part} \quad R_{ik} \;\to\; \kappa^l_{ik}.$$

Here we introduce the nonlinear operator C_p. Instead of the GR field equations, one obtains a system of nonlinear eigenvalue equations describing metric structure levels in the microscopic regime:

$$C_p\,\kappa^l_{ik} \;=\; \lambda_p(k,m)\,\psi^{(p)}_{ik}.$$

Since the terms $\lambda_p(k,m)\,\psi^{(p)}_{ik}$ are equivalent to phenomenological energy densities, all 64 eigenvalue spectra must be components of a tensor (because $p, k, m = 1, \ldots, 4$ means $4^3 = 64$). Due to algebraic symmetries, 28 of those eigenvalue spectra vanish. Hence, a tensor with 6×6 row and column vectors defines a 6-dimensional space.

The Compositive Fundamental Tensor (Correlator)

English Translation:
According to Heim, only 36 components have physical significance. According to Dröscher, the previously empty spots also have meaning, so that, starting with the original $64 = 8 \times 8$ components, he postulates an 8-dimensional hyper-space.

In R_6, one finds three subspaces: $R_3 = (x_1, x_2, x_3)$, $T_1 = x_4$, $S_2 = (x_5, x_6)$.

In Heim's so-called *Flächendifferenzenrechnung* (surface-difference calculus), the superposition of two tensorial selectors is prescribed. The metric fundamental tensor is built from two partial tensors of these subspaces. Labeling the coordinate groups $\left(y_1, y_2, y_3, x_4, x_5, y_6\right)$ with indices $\mu, \nu = 3, 2, 1$, and letting $i, k, m = 1, 2, \ldots, 6$, then the *compositive fundamental tensor* can be written:

$$g^{(m)*}_{ik} \;=\; \sum_{\mu=1}^{3} \kappa^{(\mu)}_{ik} \sum_{\nu=1}^{3} \kappa^{(\nu)}_{ik} \;=\; \left(\kappa^{(1)}_{ik} + \kappa^{(2)}_{ik} + \kappa^{(3)}_{ik}\right)\left(\kappa^{(1)}_{ik} + \kappa^{(2)}_{ik} + \kappa^{(3)}_{ik}\right) \;=\; \sum_{\mu=1}^{3} g^{(\mu)*}_{ik},$$

in conjunction with the partial tensors $\kappa^{(\mu)}_{ik}$:

$$\kappa^{(1)}_{ik} = \kappa^{(1)}_{ik}\left(y_1, y_2, y_3\right), \quad \kappa^{(2)}_{ik} = \kappa^{(2)}_{ik}\left(y_4\right), \quad \kappa^{(3)}_{ik} = \kappa^{(3)}_{ik}\left(y_1, y_2, y_3\right).$$

Poissongleichung für die Feldmassendichte $\rho(r)$: (101)

$$\rho(r) = \Delta\varphi = div\, grad\, \varphi = \gamma\Big(\frac{\partial^2}{\partial r^2} + \frac{2}{r}\frac{\partial}{\partial r}\Big)\frac{m}{r}. \quad (102)$$

und nicht

$$\rho(r) = \gamma\Big(\frac{\partial^2}{\partial r^2} + \frac{2}{r}\frac{\partial}{\partial r} + \frac{1}{r^2}\Big)\,\frac{m}{r}. \quad (103)$$

Die Ausbreitung gravitativer Feldstörungen erfolgt mit Lichtgeschwindigkeit c (und nicht mit $4/3\,c$). Postulieren zweier 4-dimensionaler Räume R_4 und R_{4c} ist nicht erforderlich.

Verallgemeinerter Ausdruck für das Gravitationspotenzial nach Heim: (104)

$$\varphi = 4\,\frac{\gamma\, M(r)}{r}\Big(1 - \frac{r}{R}\Big)^2 \quad mit\ R = \frac{h^2}{8\pi\,\alpha\,\gamma^2\,m_0},\ m_0$$

(105)

Korrigierte Gravitationsfeldstärke nach Grüner (2009): (106)

$$\frac{d\varphi(r)}{dr}\,\varphi = -\,\frac{\gamma\, M(r)}{r}\Big(1 - \big(\tfrac{r}{R}\big)^2\Big). \quad (107)$$

Damit "gute Ergebnisse" für die Abschätzung der "Dunklen Energie" (Grüner).

Der einheitliche Feldstärketensor nach Heim und Auerbach

Die Vereinigung von elektrischen und gravitativen Größen führt mit den Kürzungen G, C, j und p auf den einheitlichen Feldstärketensor T:

$$\mathbf{G} = \sqrt{\varepsilon_0}\mathbf{E} + \frac{\alpha}{\varepsilon_0}\mathbf{\Gamma} \tag{108}$$

$$\mathbf{C} = \sqrt{\mu_0}\mathbf{H} + \sqrt{\beta}\mu \tag{109}$$

$$\mathbf{j} = \sqrt{\mu_0}\mathbf{j}_{em} + \sqrt{\beta}\mathbf{j}_m \tag{110}$$

$$\mathbf{p} = \sqrt{\mu_0}\mathbf{p}_e + \sqrt{\beta}\mathbf{p}_m \tag{111}$$

$$\mathbf{T}^{\mu\nu} = \begin{pmatrix} 0 & C_x & -C_y & -iQ_x \\ -C_x & 0 & C_z & -iQ_y \\ C_y & -C_z & 0 & -iQ_z \\ iQ_x & iQ_y & iQ_z & 0 \end{pmatrix} \tag{112}$$

$$\nabla \cdot \mathbf{G} = c\rho \tag{113}$$

$$\nabla \times \mathbf{G} = -\frac{1}{c}\frac{\partial \mathbf{C}}{\partial t} \tag{114}$$

$$\nabla \cdot \mathbf{C} = \omega\sqrt{\beta}(\rho_m - \rho_{m0}) \tag{115}$$

$$\nabla \times \mathbf{C} = \mathbf{j} + \frac{1}{c}\frac{\partial \mathbf{G}}{\partial t} \tag{116}$$

$$\beta = \frac{1}{\alpha c^2} \tag{117}$$

Die einheitlichen Feldgleichungen

Die nachfolgenden Feldgleichungen dienen zur praktischen Anwendung, beispielsweise der Erzeugung von Magnetfeldern durch bewegte neutrale Massenströme j:

$$\nabla \cdot \mathbf{E} = \frac{1}{\varepsilon_0}\rho_e \tag{118}$$

$$\nabla \cdot \mathbf{\Gamma} = \frac{1}{\alpha}\rho_m \tag{119}$$

$$\nabla \times \left[\mathbf{E} + \left(\frac{\alpha}{\varepsilon_0}\mathbf{\Gamma}\right)\right] = -\mu_0 \frac{\partial}{\partial t}\left[\mathbf{H} + \left(\frac{\beta}{\mu_0}\mu\right)\right] \tag{120}$$

$$\nabla \cdot \mathbf{H} = 0 \tag{121}$$

$$\nabla \cdot \mu = c(\rho_m - \rho_{m0}) \tag{122}$$

$$\nabla \times \left[\mathbf{H} + \left(\frac{\beta}{\mu_0}\mu\right)\right] = \mathbf{j} + \frac{1}{c}\frac{\partial}{\partial t}\left[\mathbf{E} + \left(\frac{\alpha}{\varepsilon_0}\mathbf{\Gamma}\right)\right] \tag{123}$$

Die Quelle der Gravitation ist eine Elementarmasse mit Radius $\mathbf{r}_0$

$$m(r) = m_0 + \mu_e \quad (\mu_e = \mathit{Feldmasse}) \tag{124}$$

$$\mathit{Gravitationsfeldstärke}\ \mathbf{\Gamma} = \mathit{grad}\,\varphi = \gamma\left(\frac{1}{r}\frac{\partial m}{\partial r} - \frac{m}{r^2}\right) \tag{125}$$

Poissongleichung für die Feldmassendichte $\rho(r)$: (126)

$$\rho(r) = \Delta\varphi = \mathit{div\ grad}\ \varphi = \gamma\left(\frac{\partial^2}{\partial r^2} + \frac{2}{r}\frac{\partial}{\partial r}\right)\frac{m}{r} \tag{127}$$

und nicht

$$\rho(r) = \gamma\left(\frac{\partial^2}{\partial r^2} + \frac{2}{r}\frac{\partial}{\partial r} + \frac{1}{r^2}\right)\frac{m}{r} \tag{128}$$

Die Ausbreitung gravitativer Feldstörungen erfolgt mit Lichtgeschwindigkeit c (und nicht mit 4/3 c). Postulieren zweier 4-dimensionaler Räume R_4 und R_{4c} ist nicht erforderlich.

Verallgemeinerter Ausdruck für das Gravitationspotenzial nach Heim: (129)

$$\varphi = 4\frac{\gamma M(r)}{r}\left(1 - \frac{r}{R}\right)^2 \quad \mathit{mit}\ R = \frac{h^2}{8\pi\alpha\gamma^2 m_0},\ m_0 = \mathit{Elementarmasse},\ \alpha = \frac{1}{4\pi\gamma} \tag{130}$$

Korrigierte Gravitationsfeldstärke nach Grüner (2009): (131)

$$\frac{d\varphi(r)}{dr}\varphi = -\frac{\gamma M(r)}{r}\left(1 - \left(\frac{r}{R}\right)^2\right) \tag{132}$$

Damit "gute Ergebnisse" für die Abschätzung der "Dunklen Energie" (Grüner)

Der kontrabarische Effekt

Über die Energiedichten der elektrischen und gravitativen Felder lässt sich die elektrische Ladung durch die Feldmasse beschreiben. Die Energie-Differenziale sind

$$dE_e = dE = dmc^2 = \frac{\partial E_r}{\partial r} dr + \frac{\partial E_e}{\partial e} de = \frac{1}{4\pi\varepsilon_0}\left(-\frac{e^2}{r^2} dr + \frac{2e}{r} de\right) \tag{133}$$

(mit ε_0 = Influenzkonstante und e = Elementarladung). Nach einiger Rechnung folgt für die Ladungsdichte des elektromagnetischen Feldes

$$\eta = \frac{de}{dV} = \frac{1}{4\pi r^2}\frac{de}{dr} = \frac{\sqrt{\beta}}{4\pi\gamma^2}\frac{1}{r^2}\frac{d}{dr}(r\sqrt{\varphi_e}), \quad mit \quad e = \frac{2c\sqrt{\mu_0\varepsilon_0}}{\gamma^2} r\sqrt{\varphi_e} \tag{134}$$

$$\eta = \frac{c\sqrt{\mu_0\varepsilon_0}}{2\pi\gamma^2 r^2}\left(\sqrt{\varphi_e} + r\frac{d}{dr}\sqrt{\varphi_e}\right) \tag{135}$$

Mit der zeitlichen Änderung der Kraftdichte $\vec{\xi} = \frac{d\eta}{dV} = grad\ \eta$:

$$\vec{\xi} = grad\ \eta = \frac{1}{2}\frac{d}{dt}(\varepsilon_0 \mathbf{E}^2 + \mu_0 \mathbf{H}^2) = -div(\mathbf{E} \times \mathbf{H}) \tag{136}$$

ergibt sich damit die

Kontrabarische Gleichung:

$$\vec{\xi} = grad\ div(\mathbf{E} \times \mathbf{H}) = \frac{c\sqrt{\mu_0\varepsilon_0}}{2\pi\gamma^2}\frac{d}{dt} grad\left(\frac{1}{r^2}(\sqrt{\varphi_e} + r\frac{d}{dr}\sqrt{\varphi_e})\right) \tag{137}$$

(Harasim et al. 1985)

Mit den Substitutionen

$$\mathbf{G} = \frac{c\sqrt{\pi\varepsilon_0}}{2\pi\gamma^2}\frac{d}{dt}grad\left(\frac{1}{r^2}\sqrt{\varphi_e}\right), \quad \mathbf{\Gamma} = \frac{c\sqrt{\pi\varepsilon_0}}{2\pi\gamma^2}\frac{d}{dt}grad\left(r\frac{d}{dr}\sqrt{\varphi_e}\right) \tag{138}$$

$$\mathbf{F} = \mathbf{E} \times \mathbf{H} \quad \textit{und den Operatoren} \tag{139}$$

$$\mathbf{K} = grad\ div = rot\ rot + div\ grad = rot\ rot \quad \textit{(wegen div grad}(\mathbf{E} \times \mathbf{H}) = 0\textit{)} \tag{140}$$

hatte Heim in seinem ersten Aufsatz im Flugkörper" die kontrabarische Gleichung angegeben:

$$\mathbf{K}; \mathbf{F} = \mathbf{G} + \mathbf{\Gamma}, \quad also = rot\ rot(\mathbf{E} \times \mathbf{H}) \tag{141}$$

Heims Metronisierung der Geometrie

Heim entwickelte ein Konzept zur Metronisierung (Diskretisierung) der Geometrie, bei dem der Raum in kleinste Einheiten, sogenannte Metrone, unterteilt wird. Diese Metronisierung bildet die Grundlage für seine Theorie der Strukturen im Mikrobereich.

Die Metronisierung stellt eine Verbindung zwischen der kontinuierlichen Raumzeit der Allgemeinen Relativitätstheorie und der diskreten Natur der Quantenmechanik her. Nach Heim ist der Raum nicht beliebig teilbar, sondern besteht aus elementaren Flächenelementen mit der Größe des Quadrats der Planck-Länge.

Die Geometrisierung der Physik

2.1 Eigenwertgleichungen im Mikrobereich

Einstein (ART): Das Gravitationsfeld ist die raumzeitliche Struktur der Riemann-Geometrie. Die Feldquelle ist eine phänomenologische Größe.

Heim: die Gesamtheit aller möglichen Wechselwirkungen folgt der Riemannschen Geometrie im Mikrobereich nach dem Quantenprinzip.

Die Christoffelsymbole, die Kräfte beschreiben, werden zu Tensoren im Mikrobereich: $\Gamma^i_{jk} \to \kappa^i_{jk}$. *Der Ricci-Tensor (Spur des Krümmungstensors) der ART* $R_{ik} = R^l_{ilk}$ *ist dem Energiedichte-Tensor* T_{ik} *proportional:* $R_{ik} = \alpha(T_{ik} - \frac{1}{2}g_{ik}T)$.

Im Mikrobereich geht der phänomenologische Feldanteil über in

$$\alpha(T_{ik} - \frac{1}{2}g_{ik}T) \to \lambda_p(k,m)\psi^{(p)}_{ik} \quad \textit{und der Strukturteil in} \quad R_{ik} \to \kappa^l_{ik} \tag{142}$$

Mit dem nichtlinearen Operator C_p. *Anstelle der Feldgleichungen der ART erhält man ein System nichtlinearer Eigenwertgleichungen das metrische Strukturstufen im Mikrobereich beschreibt:*

$$C_p\kappa^l_{ik} = \lambda_p(k,m)\psi^{(p)}_{ik} \tag{143}$$

Da die $\lambda_p(k,m)\psi^{(p)}_{ik}$ *phänomenologischen Energiedichten äquivalent sind, müssen die 64 Eigenwertspektren Komponenten eines Tensors sein (wegen p, k, m = 1,...,4 ist* $4^3 = 64$*). Wegen algebraischer Symmetrien bleiben 28 Eigenwertspektren leer. Ein Tensor mit 6 x 6 Reihen- bzw. Spaltenvektoren definiert einen 6-dimensionalen Raum.*

Der kompositive Fundamentaltensor (Korrelator)

Nach Heim haben nur die 36 Komponenten eine physikalische Bedeutung. Nach Dröscher kommt den leeren Stellen auch eine Bedeutung zu, so dass er mit den ursprünglichen 64 = 8 x 8 Komponenten einen 8-dimensionalen Hyperraum postuliert.

Im R_6 gibt es die 3 Unterräume $R_3 = (x_1, x_2, x_3)$, $T_1 = x_4$, $S_2 = (x_5, x_6)$.

In Heims Flächendifferenzenrechnung wird die Superposition zweier tensorieller Selektoren gefordert. Der metrische Fundamentaltensor wird gebildet aus jeweils zwei partiellen Tensoren der Unterräume. Werden die Koordinatengruppen $(y_1, y_2, y_3, X_4, X_5, y_6)$ mit den Ziffern $\mu, \nu = 3, 2, 1$ benannt, mit i, k, m = 1, 2,...,6, dann lautet der kompositive Fundamentaltensor:

$$g_{ik}^{(m)*} = \sum_{\mu=1}^{3} \kappa_{ik}^{(\mu)} \sum_{\nu=1}^{3} \kappa_{ik}^{(\nu)} = (\kappa_{ik}^{(1)} + \kappa_{ik}^{(2)} + \kappa_{ik}^{(3)})(\kappa_{ik}^{(1)} + \kappa_{ik}^{(2)} + \kappa_{ik}^{(3)}) = \sum_{\mu=1}^{3} g_{ik}^{(\mu)*} \tag{144}$$

mit den Partialtensoren $\kappa_{ik}^{(\mu)}$:

$$\kappa_{ik}^{(1)} = \kappa_{ik}^{(1)}(y_1, y_2, y_3) \tag{145}$$

$$\kappa_{ik}^{(2)} = \kappa_{ik}^{(2)}(y_4) \tag{146}$$

$$\kappa_{ik}^{(3)} = \kappa_{ik}^{(3)}(y_1, y_2, y_3) \tag{147}$$