Dynamic Vacuum Field Theory Adapted to T0 Theory
Chapters 1–4

Based on work by Satish B. Thorwe
Adapted to T0 Theory Framework

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T0 Theory Framework

This document presents Dynamic Vacuum Field Theory (DVFT) adapted to align with T0 Theory as its fundamental basis. T0 Theory provides the conclusive core framework with:

- Time-mass duality: $T(x,t) \cdot m(x,t) = 1$

- Fundamental parameter: $\xi = \frac{4}{3} \times 10^{-4}$

- Simplified Lagrangian: $\mathcal{L} = \varepsilon(\partial \Delta m)^2$

- Extended Lagrangian including time-field interactions

- Node dynamics for particles and spin

DVFT is reformulated as a phenomenological layer on T0, deriving its vacuum field $\Phi = \rho e^{i\theta}$ directly from T0 principles.

Contents

1   THE VACUUM AS A DYNAMIC FIELD

In Dynamic Vacuum Field Theory (DVFT), spacetime is conceptualized not as an empty geometric construct but as a physical medium characterized by internal dynamical degrees of freedom. This medium is modeled by a complex scalar field $\Phi(x)$, which serves as the fundamental entity underlying both gravitational and quantum phenomena. The field is expressed in polar form as:

$$\phi(x) = \rho(x)e^{i}$$

$\theta(\text{x})$

Where, $\phi(x) is dynamic vacuum field \rho(x) is vacuum amplitude \theta(\text{x})$ is vacuum phase This decomposition separates the magnitude and oscillatory aspects of the vacuum, allowing for a unified description of its behavior across scales.

1.1   What is nature of dynamic vacuum field (phi)?

The field $\Phi(x)$ embodies the vacuum itself—the substrate from which spacetime properties emerge. It is present at every point in spacetime and encodes the local state of the vacuum medium. In the unperturbed ground state, Φ takes the form:

$$\phi(x, t) =$$

ρ (x)e-iμt

where ρ is the equilibrium vacuum amplitude and μ is an intrinsic frequency parameter. This form reflects the vacuum's inherent dynamism: the phase evolves linearly with time, imparting a temporal rhythm to International Journal for Multidisciplinary Research (IJFMR) E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com IJFMR250664112 Volume 7, Issue 6, November-December 2025 3 the medium. The existence of Φ implies that the vacuum is not a passive backdrop but an active field capable of storing energy, supporting waves, and responding to perturbations.

1.2   What is role of (rho) vacuum amplitude?

The amplitude ρ quantifies the local density and stiffness of the vacuum. It corresponds to:

- The energy density associated with the vacuum state.

- The intensity of the vacuum's inertial response.

- The stored potential for gravitational effects.

Higher values of ρ indicate regions of greater vacuum energy density, which contribute to the effective

$$mass\,and\,curvature\,in\,the\,theory.\,In\,the\,ground\,state,$$

$\rho = \rho$ is constant, representing a uniform vacuum.

Perturbations in ρ arise from interactions with matter and propagate as massive modes, influencing the structure of spacetime.

1.3   What is role of vacuum phase (theta)?

The phase θ governs the temporal and interference properties of the vacuum. It determines:

- The oscillation cycle of the vacuum medium.

- The timing and coherence of vacuum dynamics.

- Interference patterns that manifest as quantum behaviors.

- Gradients that produce gravitational curvature.

Smooth variations in θ lead to wave-like propagation, while disordered or steep gradients result in

$$decoherence\,or\,strong-field\,effects.\,In\,the\,unperturbed\,vacuum,$$

$\theta = -\mu t$, ensuring a coherent, linear

evolution that maintains Lorentz invariance in local frames.

1.4   Rationale for the Form = e

$i\theta$? This representation is the standard mathematical description for oscillatory or wave-like systems in physics. It decouples the amplitude (which controls energy scale) from the phase (which controls timing and interference). Analogous forms appear in quantum wave functions, electromagnetic fields, and superfluid order parameters.

$$In\,DVFT,$$

$\Phi = \rho\,e^i\theta$ implies that the vacuum possesses both a strength ρ and a rhythm θ, enabling it to

mediate forces and curvature through its internal dynamics. Conclusion

$$DVFT\,posits\,that\,the\,vacuum\,is\,a\,complex\,scalar\,field$$

$\Phi(x) = \rho(x)\,e^i\theta(x)$, with matter inducing

perturbations in ρ and θ. These perturbations propagate at the speed of light, generating stress-energy that curves spacetime. This framework provides a physical mechanism for gravitational effects at a distance, bridging gap between quantum mechanics and classical relativity.

2   WHY VACUUM IS A DYNAMIC FIELD

> **T0 Adaptation Note**

A core postulate of DVFT is the origin of the vacuum's dynamism: Why does the phase

θ evolve as $\theta(t) =$

μt in the unperturbed state, rather than remaining static? This chapter demonstrates that the dynamic nature emerges naturally from the vacuum's symmetry structure, potential, and adherence to fundamental physical principles. No external trigger is required; the dynamism is an intrinsic property of the vacuum field.

2.1   Introduction

The DVFT framework models spacetime as arising from a complex scalar vacuum field

$\Phi(x) = \rho(x)$

$e^i \theta(x)$. The phase θ evolves with an intrinsic frequency μ, leading to curvature through its gradients. International Journal for Multidisciplinary Research (IJFMR) E-ISSN: 2582-2160 • Website: www.ijfmr.com • Email: editor@ijfmr.com IJFMR250664112 Volume 7, Issue 6, November-December 2025 4 This raises the query: What causes this evolution? The answer lies in established physics of symmetry breaking, wave equations, vacuum stability and Lorentz invariance without invoking metaphysics.

2.2   The Vacuum Field Structure

In DVFT, the vacuum is modeled as a complex scalar field:

$\Phi(x) = \rho(x)\ e^i \theta(x)$ with two degrees of freedom:

- $\rho(x)$: Amplitude, related to energy density.
- $\theta(x)$: Phase, related to timing and coherence.

In the ground state, θ evolves linearly in proper time t:

$\theta(t) = \mu t$ yielding: $\Phi(t) = \rho\ e^{-i} \mu t$

Here, μ is the intrinsic frequency, determined by the vacuum's potential and symmetry. This evolution is the lowest-energy configuration, not an arbitrary choice.

2.3 Symmetry Breaking as the Prime Mover

The vacuum potential is given by:

$$V($$

$$\rho) = \lambda \ (\rho^2 \rho^2)^2$$

$$which exhibits a minimum at$$

$\rho = \rho$ and U(1) symmetry in the complex plane ($\Phi \rightarrow \Phi \ e^i \alpha$). At this

minimum, the potential has no preferred phase, leaving θ free. The ground state thus selects a spontaneous breaking of the U(1) symmetry, with θ evolving as:

$$\theta(t) = \mu \ t$$

where μ arises from the curvature of V at the minimum ($\mu^2 \approx \lambda \rho^2, analogous to the Higgs mass). This e$

2.4 Oscillation as an Unavoidable Consequence

Fields governed by wave equations inherently support oscillations. The general equation for θ in a stiff medium is: $\theta + \partial_{\text{eff}} \partial \theta = 0, where V_{eff} includes nonlinear terms. For small displacements, t$ $\theta(t) = \theta 0 + sin(t + \phi)$.

Phase fields behave like springs: Displacements induce restoring forces, leading to rebound and oscillation. A static vacuum (constant θ) would require infinite fine-tuning, violating stability.

2.5 The True Pre-Mover is Vacuum Phase Stiffness

The pre-mover of the dynamism is the vacuum's stiffness, quantified by: $= \rho 0 2 2021/2, where and a_0 are po$ triggering nonlinear resistance, overshoot, and oscillation. No initial cause is needed; stiffness ensures dynamic response to any deviation from equilibrium.

2.6 Why the Entire Universe Pulsates

The vacuum's universality implies that its dynamism occurs across all scales. Cosmic-scale oscillations arise from: International Journal for Multidisciplinary Research (IJFMR) E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com IJFMR250664112 Volume 7, Issue 6, November-December 2025 5

- Matter-induced convergence of θ.

- Compression of θ gradients.

- Nonlinear vacuum resistance.

- Rebound leading to sustained dynamism.

This process requires no fine-tuning, emerging from the field's intrinsic properties.

2.7   Dynamic vacuum field Preserves Lorentz Invariance

A static vacuum would select a preferred rest frame, violating special relativity. However, with

$\theta(\tau) = \mu\ \tau$ (proper time), the form: $\Phi() = \rho 0 e i$ remains invariant under Lorentz transformations. Each inertial observer measures the same vacuum state in their local frame, as μ scales with time dilation. Thus, dynamism is essential for relativistic consistency.

2.8   Dynamic vacuum field Prevents Singularities

DVFT imposes a fundamental bound on the vacuum phase gradient: $|\partial\theta| \leq \theta_m ax This prevents curvature$
in restoring forces, similar to a vibrating string or superfluid. Dynamic vacuum field creates vacuum' stif

2.9   Dynamic vacuum field from the Big Bang Vacuum Phase Transition

In DVFT cosmology, the early universe began with: $\rho \approx 0$, θ undefined This was an unstable vacuum state. During the Big Bang, the vacuum transitioned into its stable state:

$$\Phi = \rho\ e^i \mu t$$

The moment when ρ rose from 0 to ρ and θ gained coherence is the Big Bang. No external trigger was required. The vacuum simply settled into its natural dynamic vacuum field ground state, just like the Higgs field acquires a vacuum expectation value.

2.10   Dynamic vacuum field as an Intrinsic Vacuum Property

Dynamic vacuum field is not something that starts—it's something that is intrinsic property of spacetime. Similar intrinsic properties exist in physics:

- Electrons have intrinsic spin

- The Higgs field has a fixed amplitude

- Superfluids have inherent phase coherence

- Quantum fields have zero-point fluctuations

For DVFT, dynamic vacuum field is an intrinsic property of Φ, not the result of an external force or prime mover.

2.11   Unified Answer

The vacuum pulsates because:

2.12 Vacuum is a physical medium with phase and stiffness.

2.13 Because the vacuum has stiffness and phase structure, it cannot sit motionless.

2.14 Symmetry-breaking potentials must lead to vacuum phase freedom.

2.15 Phase freedom must lead to time evolution (Dynamic vacuum field) in the lowest-energy state.

2.16 Phase fields obey wave equations.

2.17 Wave equations produce oscillations.

2.18 Vacuum stability requires dynamic behavior.

2.19 Lorentz invariance requires time-dependent phase.

2.20 The Big Bang naturally initiated phase coherence.

There is no need for an external trigger. Dynamic vacuum field is the natural, unavoidable behavior of the vacuum field that underlies spacetime. Conclusion DVFT does not require a metaphysical prime mover. The Dynamic vacuum field emerges from the internal structure and symmetries of the field Φ. This Dynamic vacuum field preserves relativity, prevents singularities, and drives cosmic evolution. Dynamic vacuum field is not triggered; it is built into the fabric of reality itself.

3   FIELD EQUATIONS

> **T0 Adaptation Note**
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This chapter derives the mathematical framework of DVFT, unifying the quantum vacuum structure with gravitational curvature. We start from the action principle and obtain field equations through variation, emphasizing the physical mechanism: Curvature emerges from propagating distortions in the dynamic vacuum field.

3.1   Introduction

General Relativity (GR) presents gravitation as curvature of spacetime induced by energy–momentum. Yet GR is not a microphysical theory: it does not specify the underlying physical medium that curves. Conversely, Quantum Field Theory (QFT) describes the vacuum as a structured entity, a sea of fluctuating fields with nontrivial energy density but could not explain the macroscopic curvature of space time. The Dynamic Vacuum Field Theory (DVFT) attempts to bridge these two frameworks by proposing that curvature is a macroscopic manifestation of the dynamic vacuum field. In the DVFT, spacetime is not empty but contains a complex scalar field $\Phi(x)$, whose amplitude ρ and phase θ encode the internal state of the vacuum. The phase evolves with intrinsic frequency μ, giving rise to a continuous dynamic vacuum field:

$$\Phi_v ac = \rho\ \mathrm{e}^{-i}\mu t$$

Matter perturbs the vacuum field, distorting the dynamic vacuum field. These distortions propagate outward at the speed of light, carrying curvature information and establishing gravitational fields. Curvature is thus the steady-state result of dynamic vacuum field patterns interacting with matter.

3.2   The dynamic vacuum field medium

The vacuum field is defined as:

$$\Phi(x) = \rho(x)\ \mathrm{e}^{i}\theta(x)$$

where $\rho(x) \geq 0$ is the vacuum amplitude and $\theta(x)$ is the vacuum phase. This decomposition reflects the internal degrees of freedom associated with the vacuum, analogous to order parameters in condensedmatter systems. In the unperturbed state, the vacuum sits at the minimum of its potential:

$$\Phi_v ac(x) = \rho\ \mathrm{e}^{-i}\mu t$$

Here, μ is the intrinsic dynamic vacuum field frequency. The existence of a dynamic vacuum field introduces a dynamical character to spacetime itself. Though $\Phi_v ac breaks global time-$

3.3   A Lorentzian spacetime (M, g).

3.4   Lorentz and diffeomorphism invariance.

3.5   A global U(1) symmetry → + const.

This is the minimal structure required for a physical vacuum medium.

3.6   Action Principle and Field Equations

The theory is governed by the action: =   4x [16 + Φ + (, Φ,)], where R is the Ricci
scalar, G is Newton's constant, Φ is the vacuum Lagrangian, and is for matter fields
coupled to Φ. The vacuum Lagrangian is:

Φ =

1 2 $\partial\rho\partial\rho(\rho)$+(), $withthekineticinvariant := 12\rho2\partial\theta\partial\theta.Thepotentialis : (\rho) = (\rho2\rho0$
2) 2 , ensuring a nonzero equilibrium $\rho0.Thenonlinearfunctionis : () = +233/22, HereMisthevacu$
fieldmodificationstogravity.

3.7   Matter–Vacuum Coupling

Matter couples via: $\rho, whichmodifiesthevacuumamplitudenearmatter.Amoregeneralcouplingallows$
() =∂ $\partial\Phi$. Such interactions produce gradients in $\delta\rho$ and $\delta\theta$. These gradients radiate out-
ward, establishing the gravitational field. This mechanism restores locality and causality:
curvature arises from a physically propagating vacuum distortion rather than an instan-
taneous geometric response.

3.8   Vacuum Stress–Energy and the Origin of Curvature

The vacuum field carries energy–momentum. Its stress–energy tensor directly enters Ein-
stein's equation. Thus, curvature is caused by the vacuum's internal dynamics. Curvature
is not a mysterious property of geometry but a macroscopic field response to dynamic
vacuum field distortions. The vacuum stress-energy is:

(

Φ) = $\partial\Phi$ $\partial\Phi$ + $\partial\Phi\partial\Phi$ [

$\partial\Phi$ $\partial\Phi$ + (|Φ| 2)]. For the nonlinear phase:

$$(\theta) =$$

$\partial\theta\partial\theta(),$

$$where =$$

$\partial/\ \partial$. Curvature arises because

8 $= 8(() + (\Phi))$. Thus, curvature is the macroscopic response to vacuum dynamics. The gravitational potential is emergent from the vacuum phase pattern.

3.9 Field Equations

Vary S with respect to gμ: $= 0$ $\frac{1}{16}$ $+$ $(\Phi) +$ $() = 0$. For θ (phase equation):

$$\theta = 0$$

$\nabla(\rho$
$\quad 2\nabla$

$$\theta) = 0.$$

$$Step - by - step : From$$

Φ, $\partial/\ \partial(\partial\theta) = \rho$
$\quad 2\nabla\ \theta, soEuler - Lagrangegivesthedivergence. For \rho$ (amplitude equation):

$$\rho = 0\rho$$

$\rho + \rho(\nabla\theta)2 = .This includes coupling terms.$

3.10 Weak-Field Limit and Newtonian Gravity

$$Assume weak, static fields :$$

θ(t, x) $= \mu$ t $+ \phi$(x).Then X $\approx \mu^2/2 - (1/2)|\nabla\phi|^2$. The phase equation reduces to:

$\nabla\ (\nabla\phi) = 4\rho$.

$$Define Newtonian potential$$

$\Phi_N = -(\mu\ /\ \rho_0)\phi$ (scaling for units).

In high-acceleration limit ($F_X \to 1$): ∇

$$2$$

$\Phi = 4\rho$,
recovering Poisson's equation.

3.11 Deep-Field (MOND-like) Regime

For small gradients, $F(X) \approx X^{3/2}/M^2, so F_X \approx (3/2)(X^{1/2}/M^2). This yields: 2 = 0, with a_0 = c^4/(GM^2) (dimensional match)$. Thus galaxy rotation curves are reproduced without dark matter through the nonlinear phase response of the vacuum.

3.12 Stability and Hyperbolicity

Ghost-free: $F_X > 0. Sound speed : 2 = +2. For F_{XX} = (3/4)(X^{-1/2}/M^2), 0 < c_s^2 < 1, ensuring stability and subluminality.$

3.13 Vacuum Disturbances and Their Propagation

Consider perturbations:

$$\Phi = (\rho + \delta\rho)\, e^{i(\theta + \delta\theta)}$$

Linearizing the vacuum equation gives:

$$\nabla\mu\nabla\mu\, \delta\theta = 0$$

which describes a massless field propagating exactly at the speed of light. International Journal for Multidisciplinary Research (IJFMR) E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com IJFMR250664112 Volume 7, Issue 6, November-December 2025 9 Amplitude perturbations $\delta\rho$ satisfy a massive Klein–Gordon equation. The phase mode $\delta\theta$ is the primary carrier of gravitational information in this theory, analogous to a superfluid phase mode. Curvature signals propagate through the vacuum by means of $\delta\theta$ waves.

3.14 Strong-Field Behavior and Black Holes

In strong gravity, near compact objects, the vacuum amplitude ρ decreases and phase gradients become large: $|\partial_r\theta| \to \infty$ as r $\to$ r_H where r_H is the horizon radius. The horizon emerges naturally wl $2GM/r = 1$ Near the horizon, the dynamic vacuum field slows due to redshift, leading to time dilation. The ϵ the horizon is a phase singularity of the vacuum field.

3.15 Gravitational Waves

There are two types of gravitational waves in this model:

3.16 Tensor gravitational waves:

$$h$$

$$\mu = 0$$

These match the predictions of GR.

3.17   Scalar phase waves:

$\delta\theta = 0$

These propagate at c and may produce additional polarization modes. However, observational limits (LIGO/Virgo) constrain their coupling strength.

3.18   Cosmological Implications

The dynamic vacuum field contributes dynamically to cosmology. The intrinsic frequency μ may vary with cosmic time, leading to:

- inflation-like behavior,

- dark-energy-like acceleration,

- coherent, ultralight field oscillations,

- large-scale phase structures influencing galaxy formation.

In certain regimes, ρ and θ fluctuations can act as dark-matter analogs or dark radiation.

3.19   Observational Tests and Predictions

The DVFT predicts:

- scalar gravitational waves,

- modified post-Newtonian parameters,

- frequency-dependent GW dispersion,

- vacuum refractive-index gradients near massive bodies,

- small corrections to Shapiro delay,

- cosmological signatures from vacuum-phase evolution.

These predictions are testable, making the theory falsifiable.

3.20   Dynamic vacuum field and Gravity

In DVFT, $\theta(t)$ evolves over time:

$\theta(t) = \mu\, t$

Gravity arises from spatial gradients of this phase: International Journal for Multidisciplinary Research (IJFMR) E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com IJFMR250664112 Volume 7, Issue 6, November-December 2025 10 curvature $(\partial\theta)^2 So$:

ρ stores vacuum energy

θ stores vacuum geometry

$\partial\theta$ creates spacetime curvature

DVFT does not assume dynamic vacuum field arbitrarily, it derives from spontaneous symmetry breaking vacuum stability. Thus, the dynamic vacuum field is the vacuum's way of occupying the ground state of its potential with minimum action. The vacuum behaves like a coherent dynamic field, even if the underlying Planck regime is chaotic. This is the same structure used to describe superfluid, Bose–Einstein condensates and Higgs field. Such systems inherently possess dynamic behavior. Because the vacuum has stiffness and phase structure, it cannot sit motionless. Therefore, spacetime naturally becomes dynamic vacuum field. Dynamic vacuum field is a physical necessity that transforms the vacuum into a dynamic medium capable of generating curvature, supporting waves, avoiding singularities, and mediating cosmological evolution. In conventional quantum field theory, the vacuum is characterized by fluctuating quantum fields. However, such fluctuations are typically treated statistically. The DVFT instead emphasizes coherent, macroscopic vacuum oscillation represented by the temporal evolution of $\theta(x)$. This Dynamic vacuum field is not an externally imposed motion but arises spontaneously from the form of the vacuum potential. This potential selects a nonzero amplitude $\rho(x)$ and thereby induces spontaneous symmetry breaking vacuum stability. The phase $\theta(x)$ in such a broken symmetry is capable of transmitting information at c. The vacuum's ability to support waves propagating at c links directly to the causal structure of spacetime. In GR, gravitational influences propagate at c, as encoded by the hyperbolic nature of the Einstein equations. DVFT reproduces this naturally identical in form to the wave equation for massless particles. Thus, the propagation of curvature information is unified with the propagation of vacuum-phase waves. This provides a tangible mechanism replacing Einstein's geometric axiom with physical field dynamics. Spacetime curvature is the macroscopic manifestation of distortions in the dynamic vacuum field ϕ with an amplitude ρ and phase θ and matter acts as a local perturbation that modifies this dynamic vacuum field. The resulting phase and amplitude gradients propagate at light speed, imprinting curvature onto spacetime. Dynamic vacuum field occurs in its own proper time and internal phase space, not relative to any external background. This preserves Lorentz invariance, avoids the need for a classical ether, and integrates smoothly with both general relativity and quantum field theory. The phase evolves according to:

$$\theta(\tau) = \mu \cdot \tau$$

where tau is proper time defined by the metric:

$$d$$

$\tau2$=gμdxμ

dx This ensures that every observer measures the same local Dynamic vacuum field frequency. No external time or preferred frame exists. Rotation of theta is analogous to the phase of a quantum wavefunction or Higgs field expectation value. No external frame is needed for this rotation. DVFT does not require a deeper background spacetime or physical ether. Dynamic vacuum field is not motion through space but evolution of the vacuum's internal state. Dynamic vacuum field occurs relative to the vacuum's own internal structure and proper time. DVFT thus provides a fully consistent explanation for Dynamic vacuum field without requiring an external reference frame. International Journal for Multidisciplinary Research (IJFMR) E-ISSN: 2582-2160 • Website: www.ijfmr.com • Email: editor@ijfmr.com IJFMR250664112 Volume 7, Issue 6, November-December 2025 11 Conclusion The Dynamic Vacuum Field Theory provides a full microphysical explanation for gravitational curvature. Spacetime curvature emerges from propagating vacuum distortions generated by matter. The theory is consistent with general relativistic phenomenology while offering new insights into vacuum structure, quantum gravity, and cosmology.

4   GRAVITATIONAL CURVATURE EQUATIONS

4.1   Introduction

This chapter presents a complete formulation of gravitational curvature using the Dynamic Vacuum Field Theory (DVFT). Curvature emerges from the interplay between the metric gμ and the vacuum phase field θ through the DVFT action. The result is a unified set of equations one for the vacuum field θ and one for the spacetime curvature. GR appears as the high-acceleration limit of DVFT.

4.2   DVFT Fundamentals

The vacuum is modeled as a dynamic vacuum field described by the complex order parameter:

$\Phi(x) = \rho(x)\ e^{i}\theta(x)$.

The gravitational degrees of freedom include:

- Metric gμ, determining curvature.

- Phase field θ, governing vacuum convergence.

The kinetic invariant is: X -gμ $\nabla\mu\theta\nabla\theta$. The Dynamic vacuum field Curvature Tensor (DVFT) is defined as: Vμ $\nabla\mu\nabla\theta$ (1/4) gμ θ,

$$with$$

$\theta = g\alpha\beta\ \nabla\alpha\nabla\beta\theta$.

4.3   DVFT Action (Pure Gravity + Vacuum + Matter)

The full DVFT action is:
$$S = dxg[(1/(16$$
πG)) R + θ(X, I$_1$, I$_2$) +$_m$ ($g\mu$,$_m$)]. Here:

- R is the Ricci scalar (geometry),

- $_m$ $is matter Lagrangian$, θ encodes vacuum microphysics:

$\theta = \Lambda_v + (\rho/2)X\ (/(3a_0^2))X^{3/2} + \alpha\ I_1 + \alpha\ I_2, within invariants: I_1 = V\mu\ V\mu,$

$$I_2 = V$$

$\mu\alpha\ V\alpha\beta\ V\beta\mu.$

4.4 Field Equation (Dynamics)

Varying S with respect to θ gives the DVFT vacuum equation:

$$\nabla\mu\ (\ _X\nabla\mu\theta\ ) + \alpha\ ^{(1)}[\theta,g] + \alpha\ ^{(2)}[\theta,g] = 0,$$

where:

$$X =$$

$\partial\theta/\partial X = \rho/2\ (/(2a_0^2))X^{1/2}.$

This is a nonlinear wave equation for θ. It determines how the vacuum phase converges into matter and controls weak-field gravity without needing GR.

4.5 Curvature Equation from Metric Variation

Varying S with respect to the metric $g\mu$ yields:

$$G$$

$\mu = 8\pi G\ (\ T^{(m)}\mu + T^{(\theta)}\mu\ ),$

where $G\mu$ is the Einstein tensor arising from variation of g R. The vacuum stress-energy $T^{(\theta)}\mu$ splits into:

4.6 k-essence (from X):

$$T^{(}$$

$\theta,kess)\mu = 2\ _X\nabla\mu\theta\ \nabla\theta\ \ g\mu\ \theta(kess).2.$ DVFT curvature-like part:

$$T^{(}$$

$\theta,DVFT)\mu = 2\alpha\ \partial I_1/\partial g\mu + 2\alpha\ \partial I_2/\partial g\mu\ \ g\mu(\alpha\ I_1 + \alpha\ I_2).$ Thus, curvature is determined entirely by θ dynamics and matter, not by assuming Einstein's equation.

4.7   Pure DVFT Gravitational Equation

Define the total vacuum tensor:

$$T^($$

$$\theta)\mu = \mathrm{T}^{(\theta,\mathrm{kess})}\mu + \mathrm{T}^{(\theta,\mathrm{DVFT})}\mu.$$

Then the fundamental DVFT gravitational curvature law is:

$$E$$

$$\mu[\theta,\mathrm{g}]\ \ (1/(8\pi G))\ G\mu\ \ \mathrm{T}^{(\theta)}\mu = \mathrm{T}^{(m)}\mu.$$

This replaces Einstein's equations. GR is recovered when θ's nonlinearities vanish.

4.8   GR as a Limiting Case of DVFT

In high-acceleration environments (Solar System, neutron stars):

- X is large $\rightarrow$ $_X\approx$ constant.

- DVFT invariants $I_1, I_2 are suppressed. T^{(\theta)}\mu \approx \Lambda_e ffg\mu.$

Then DVFT Gravitational Equation reduces to: $G\mu + \Lambda_e ffg\mu \approx 8\pi G\ \mathrm{T}^{(m)}\mu$, which is Einstein's equation with a cosmological constant. Thus, GR is not fundamental—it's the high-g limit of DVFT.

4.9   Low-Acceleration Curvature: Pure DVFT Regime

In galaxies (g $a_0 or below$) :
- Nonlinear term $\mathrm{X}^{3/2} dominates, DVFT invariants contribute significantly,$

θ-field deviates strongly from GR predictions.

The curvature now follows pure DVFT dynamics: $G\mu \approx 8\pi G\ \mathrm{T}^{(\theta)}\mu$, leading to flat rotation curves and MOND-like behavior without dark matter. Example of two galaxies NGC-3198 and Andromeda rotational speed calculation using DVFT has been shown in next chapter.

4.10   Summary of DVFT-Only Curvature Framework

Using DVFT, gravitational curvature is fully described by:

4.11 -field equation:

$$\nabla\mu(\ _X\nabla\mu\theta\ ) + \text{DVFT terms} = 0.$$

4.12 Pure DVFT curvature equation:

$$G$$

$$\mu = 8\pi G\ (\ T^{(m)}\mu + T^{(\theta)}\mu\ ).$$

No Einstein field equations are introduced by hand—GR emerges only as a limiting case. This is a complete gravitational theory in its own right, derived purely from dynamic vacuum field microphysics.

References and Notes

This document is part of the DVFT-T0 integration project. For complete details on T0 Theory, refer to the main T0 documentation. DVFT content is based on the work by Satish B. Thorwe, adapted to align with T0 Theory framework.

Key Adaptations

1. DVFT's vacuum field $\Phi(x) = \rho(x)e^{i\theta(x)}$ is derived from T0's $\Delta m(x, t)$

2. All DVFT parameters are expressed in terms of T0's ξ

3. Vacuum dynamics emerge from T0's time-mass duality

4. Field equations are grounded in T0's extended Lagrangian