Introduction to DD-Theory© and Radial Field: A Unified Framework for Dark Matter, Dark Energy, and Ordinary Matter

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Abstract

Albert Einstein's General Relativity revolutionized our understanding of gravity by describing it as the curvature of spacetime caused by mass and energy. However, cosmological observations indicate that ordinary matter constitutes only a fraction of the universe's composition. Dark matter and dark energy make up approximately 26.8% and 68.3% of the universe, respectively. This thesis proposes a new theoretical framework that extends beyond Einstein's and Newton's concepts, focusing on the interactions between dark matter, dark energy, and the radial field as the fundamental drivers of spacetime dynamics. The DD-Theory© introduces a novel description of cosmic dynamics, integrating these elements into a comprehensive model.

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1 Introduction

The understanding of the universe and its fundamental components has significantly evolved over the last century. Despite technological and theoretical advancements, the nature of dark matter and dark energy remains one of the greatest mysteries in modern physics. These components, which constitute about 95% of the total energy density of the universe, challenge current physical theories and suggest the need for new models and paradigms. The Dark Dynamics Theory (DD-Theory©) is proposed as an ambitious extension of existing theories to incorporate these unexplained phenomena into a unified theoretical framework, alongside the concept of a Radial Field that defines space itself.

1.1 Context and Motivation

This work is rooted in the discovery that the universe is undergoing accelerated expansion, a phenomenon that cannot be fully explained by traditional theories such as Einstein's General Relativity or Newtonian gravity. Additionally, anomalies in galaxy rotation and cosmic mass distribution provide further evidence of the presence of dark matter. These observations raise fundamental questions about the completeness of current physical theories and the existence of incomprehensible phenomena. DD-Theory© aims to address these challenges with a new theoretical approach that does not rely on Einstein's or Newton's traditional concepts.

1.2 Limits of Previous Theories

Traditional theories such as General Relativity and Newtonian gravity have been effective in explaining local phenomena and planetary-scale interactions. However, they fail to explain large-scale cosmological anomalies, such as accelerated expansion and dark matter distribution. Additionally, General Relativity, which is based on the curvature of spacetime, struggles to coherently incorporate dark matter and dark energy without adding ad hoc components.

1.3 Objectives and Relevance

The objectives of DD-Theory© are to provide a mathematically coherent and physically plausible model that incorporates the effects of dark matter and dark energy into a new field theory. This model not only seeks to explain existing observational data but also to predict new effects that could be tested through future astronomical observations and cosmological experiments. The relevance of this work extends beyond theoretical physics, influencing cosmology, astrophysics, and potentially new technologies based on an innovative understanding of gravitational forces and the fundamental properties of the universe.

2 Fundamentals of DD-Theory and the Radial Field

DD-Theory© posits that the universe is fundamentally composed of three entities: dark matter, dark energy, and the radial field. These elements define the structure and dynamics of the field.

2.1 Dark Matter and Dark Energy

Dark matter forms the structural backbone of the field and interacts gravitationally with visible matter and dark energy. Dark energy, on the other hand, is understood as the driving force behind the universe's accelerated expansion. Within the DD-Theory© framework, dark energy manifests in various forms, influencing the universe in different ways.

2.2 Radial Field as the Foundation of Space

The radial field redefines space not as an independent entity but as a field that emanates from every point in the universe. This field influences the behavior of matter and energy, defining the dynamic structure of the universe and fundamental interactions.

2.3 Relationship between DD-Theory and Radial Field Theory

While DD-Theory© provides a global view of the universe's dynamics, the Radial Field Theory offers a more detailed description of local interactions involving ordinary matter. Radial Field Theory explores how fundamental forces manifest on a local scale and how dark matter acts as a containing structure for the field.

3 A New Field Theory: Total Action and Field Equations

Within the DD-Theory© framework, the Total Action describes the interaction between dark matter, dark energy, and ordinary matter, each of which modulates the dynamics of the field in distinct ways.

3.1 Total Action and Field Equations

The Total Action can be expressed as:

$$S_{\text{total}} = \int d^4x \, (\mathcal{L}_{\text{dm}} + \mathcal{L}_{\phi} + \mathcal{L}_{\text{ord}} + \mathcal{L}_{\text{int}} + \mathcal{L}_{\text{radial}})$$

Where:

- $\mathcal{L}_{\text{dm}}$ is the Lagrangian density for dark matter, describing its contribution to the structure of the field.
- $\mathcal{L}_{\phi}$ is the Lagrangian density for the scalar field ϕ representing dark energy, influencing cosmic dynamics.
- $\mathcal{L}_{\text{ord}}$ is the Lagrangian density for ordinary matter, reflecting its contribution to the radial field dynamics.
- $\mathcal{L}_{\text{int}}$ describes the interaction between dark matter and dark energy.
- $\mathcal{L}_{\text{radial}}$ is the Lagrangian density for the radial field, which represents space itself.

3.2 Details of the Lagrangians

1. **Dark Matter Lagrangian** ($\mathcal{L}_{\text{dm}}$):

$$\mathcal{L}_{\text{dm}} = -\frac{1}{4}F_{\mu\nu}F^{\mu\nu} + \frac{1}{2}m^2 A_{\mu}A^{\mu}$$

- $F_{\mu\nu}$ is the field tensor of dark matter A_{μ}. - m is the mass associated with the dark matter field.

2. **Scalar Field Lagrangian** ($\mathcal{L}_{\phi}$):

$$\mathcal{L}_{\phi} = \frac{1}{2}\nabla_{\mu}\phi\nabla^{\mu}\phi - V(\phi)$$

- $\nabla_{\mu}\phi$ represents the covariant derivative of the scalar field ϕ. - $V(\phi)$ is the potential of the scalar field.

3. **Ordinary Matter and Radial Field Lagrangian** ($\mathcal{L}_{\text{ord}}$):

$$\mathcal{L}_{\text{ord}} = \frac{1}{2}\rho_{\text{ord}}u^{\mu}u_{\mu} - \frac{1}{2}g_{\mu\nu}T^{\mu\nu}_{\text{ord}}$$

- ρ_{ord} is the energy density of ordinary matter. - $T^{\mu\nu}_{\text{ord}}$ is the energy-momentum tensor of ordinary matter.

4. **Interaction Lagrangian** ($\mathcal{L}_{\text{int}}$):

$$\mathcal{L}_{\text{int}} = \lambda \phi A_\mu A^\mu$$

- λ is the coupling constant between the scalar field ϕ and the dark matter A_μ.

5. **Radial Field Lagrangian** ($\mathcal{L}_{\text{radial}}$):

$$\mathcal{L}_{\text{radial}} = \frac{1}{2}(\nabla_\mu \psi)(\nabla^\mu \psi) - \frac{1}{2}V(\psi)$$

- $\nabla_\mu \psi$ represents the covariant derivative of the radial field ψ.

3.3 Derived Field Equations

The field equations are derived by varying the total action with respect to the involved fields. The variation of the action with respect to the metric $g_{\mu\nu}$ leads to new field equations that describe the dynamic structure of the radial field and its interaction with ordinary and dark matter.

For example, for dark matter, varying with respect to A_μ yields:

$$\nabla^\mu F_{\mu\nu} = J_\nu$$

This expresses the behavior of dark matter, where J_ν represents the current associated with dark matter.

3.4 Final Equation of the Theory

The final equation that describes the interaction between dark matter, ordinary matter, dark energy, and the radial field is:

$$R_{\mu\nu} = \Xi^{(\text{Conversi})}_{\mu\nu} = \alpha T^{\text{dm}}_{\mu\nu} + \beta T^{\text{ord}}_{\mu\nu} + \gamma I_{\mu\nu}(\phi)$$

4 Radial Field Dynamics: Formula and Explanation

The dynamics of the radial field are described by the following equation:

$$U_{\mu\nu} = \sum_i \left(\frac{\alpha_i M_{\mu\nu}^{(i)}}{r_i^2} \right) + \epsilon I_{\mu\nu}(\phi) + \lambda F_{\mu\nu}$$

4.1 Explanation of the Terms

- $\alpha_i M_{\mu\nu}^{(i)} / r_i^2$: represents the contribution of ordinary matter to the radial field.
- $\epsilon I_{\mu\nu}(\phi)$: describes the influence of the scalar field ϕ (dark energy) on the radial field.
- $\lambda F_{\mu\nu}$: represents the contribution of other fields, such as electromagnetic fields, interacting with the radial field.

4.2 Mathematical Development

To derive the full equations, let's take the following steps:

1. **Term** $\sum_i \left(\frac{\alpha_i M_{\mu\nu}^{(i)}}{r_i^2} \right)$:

$$M_{\mu\nu}^{(i)} = \rho_i u_\mu u_\nu + p_i (g_{\mu\nu} + u_\mu u_\nu)$$

This term describes the energy-momentum tensor of ordinary matter with an inverse square dependence on the radial distance r_i.

2. **Term** $\epsilon I_{\mu\nu}(\phi)$

$$I_{\mu\nu}(\phi) = \nabla_\mu \phi \nabla_\nu \phi - \frac{1}{2} g_{\mu\nu} \left(\nabla^\lambda \phi \nabla_\lambda \phi + 2V(\phi) \right)$$

Deriving the equation of motion for ϕ from the action:

$$\Box \phi = \frac{dV(\phi)}{d\phi}$$

3. **Term**$\lambda F_{\mu\nu}$

$$F_{\mu\nu} = \nabla_\mu A_\nu - \nabla_\nu A_\mu$$

The equation of motion for this term is:

$$\nabla^\mu F_{\mu\nu} = J_\nu$$

where J_ν represents the current associated with the fields involved.

Final Equation Summing all contributions, we obtain:

$$U_{\mu\nu} = \sum i \left(\frac{\alpha_i M_{\mu\nu}^{(i)}}{r_i^2} \right) + \epsilon I_{\mu\nu}(\phi) + \lambda F_{\mu\nu}$$

5 Cosmological and Astrophysical Implications

5.1 5.1 Radial Field Influence on Cosmic Structure

The radial field plays a crucial role in shaping the distribution of matter and energy throughout the universe. According to DD-Theory©, the radial field defines the very structure of space, with ordinary matter, dark matter, and dark energy interacting through it. Unlike traditional theories that describe spacetime as a separate entity, the radial field is integral to the dynamics of matter and energy.

In cosmic structures such as galaxies, clusters, and superclusters, the radial field guides the movement and distribution of matter. Ordinary matter, which experiences gravitational forces, is also influenced by the properties of the radial field. Dark matter, which is more directly coupled to the radial field, provides the necessary "scaffolding" for visible structures by anchoring the radial field's behavior on large scales.

The formation of cosmic voids, filaments, and other large-scale structures is a direct consequence of the radial field's influence. Galaxies and clusters form at points where the radial field is compressed or concentrated, while voids appear where the radial field is less intense. Observations of the cosmic web, such as those made through large-scale galaxy surveys, can offer insights into how well the DD-Theory© and its radial field predictions align with reality.

5.2 5.2 Dark Matter and Dark Energy Dynamics

The interaction between dark matter, dark energy, and the radial field defines the overall dynamics of the universe in the DD-Theory© framework. Dark matter serves as the backbone of cosmic structures, shaping the large-scale arrangement of galaxies and clusters. Its gravitational influence on the radial field stabilizes the distribution of matter in these regions.

Meanwhile, dark energy functions as a repulsive force, pushing matter apart and driving the accelerated expansion of the universe. Within the context of DD-Theory©, dark energy is modeled as a scalar field that acts on the radial field. Its interaction with dark matter creates a dynamic balance between attraction (dark matter) and repulsion (dark energy), which ultimately influences the rate of cosmic expansion.

The dynamics of dark matter and dark energy within the radial field provide a unified framework for explaining cosmic evolution. The radial field mediates these interactions, balancing the gravitational collapse of structures (due to dark matter) with the repulsive expansion driven by dark energy. This interplay could be observed through phenomena like galaxy formation, the large-scale distribution of matter, and the rate of cosmic expansion. Observational data from the cosmic microwave background (CMB), galaxy redshift surveys, and gravitational lensing could serve as key tools for testing these predictions.

5.3 5.3 Black Holes as Radial Field Collapse

Black holes are regions where the radial field collapses to its maximum density. In DD-Theory©, black holes are not simply singularities in spacetime, as described by General Relativity, but rather represent points of extreme compression within the radial field. As matter is drawn into a black hole, the radial field intensifies, reaching a point where ordinary matter cannot exist.

The collapse of the radial field within a black hole leads to conditions of extreme density and energy. However, unlike traditional descriptions of black holes, where spacetime itself is bent beyond recognition, DD-Theory© suggests that the radial field is what undergoes the dramatic transformation. The region within a black hole is dominated by the effects of the radial field and dark matter, which defines the boundaries of the event horizon.

Black hole growth, radiation, and even Hawking-like radiation can be reinterpreted within this framework. As matter interacts with the radial field at the edge of a black hole, extreme conditions create emissions similar to Hawking radiation, though driven by the radial field dynamics rather than purely quantum effects. Observations of gravitational waves, black hole mergers, and high-energy phenomena around black holes could serve as tests for this new interpretation of black hole physics within the DD-Theory© framework.

5.4 Gravity

In DD-Theory©, gravity is not simply a force resulting from the curvature of spacetime, as described in General Relativity, but is seen as the outcome of the interaction between ordinary matter fields. Every particle or cluster of particles intrinsically has its own field, which extends into the surrounding space and interacts with other fields. When two ordinary matter fields overlap or meet, an attractive force is generated: gravity.

This force is a reaction to the relationship between the fields themselves, where a stronger field exerts a greater influence on the other, creating an attraction that manifests as gravity. The intensity of this interaction decreases with the distance from the center of the particle, but its effect extends throughout the universe. Thus, gravity is the result of the coalescence and interaction of ordinary matter fields on a cosmic scale.

5.5 The Vision of the Universe

The universe, according to DD-Theory©, is a dynamic system in which different types of energy and matter interact to form the complex structure we observe. Dark matter represents the supporting structure of the universe, somewhat like a plastic balloon, which forms the "container" within which all cosmic dynamics occur. Dark energy, on the other hand, is the pressure that expands this container, inflating the balloon and causing the accelerated expansion of the universe.

Within this structure, energy condenses into particles of ordinary matter, which in turn group together into clusters such as stars, planets, and galaxies. These clusters interact with each other through their gravitational fields and other fundamental forces, creating a complex network of interactions that give rise to phenomena such as gravity, stellar explosions, black hole collapses, and galaxy collisions.

The universe is not homogeneous; it is characterized by an irregular distribution of energy, temperature, fields, and matter. These elements constantly interact, generating the evolutionary processes we observe, such as the birth and death of stars, the formation of black holes, and the constant expansion of space.

6 Mathematical Foundations

6.1 Riemannian Geometry and Tensors

Riemannian geometry is fundamental to describing curved spacetime and fields in many modern physical theories, including DD-Theory© and Radial Field Theory. In the context of differential geometry, the metric tensor $g_{\mu\nu}$ describes the geometric structure of spacetime or the radial field, defining distances between points and determining the curvature of space.

The Riemann curvature tensor $R^{\rho}_{\sigma\mu\nu}$ is a key quantity that describes how spacetime or the radial field curves in response to the presence of matter or energy. This tensor is constructed from the covariant derivative of the metric tensor and allows us to calculate geometric effects such as the expansion or collapse of the field. Riemannian curvature is what allows DD-Theory© to model not only ordinary matter but also the influences of dark matter and dark energy.

In our theory, the tensor $U_{\mu\nu}$ has a structure similar to the Ricci tensor, derived from the Riemann tensor, and describes the dynamics of the radial field and the curvature induced by ordinary matter, dark matter, and dark energy.

6.2 Covariant Derivatives and Christoffel Symbols

Christoffel symbols $\Gamma^{\lambda}_{\mu\nu}$ are essential for defining the covariant derivative of a tensor. They describe how vectors or tensors change as they are transported along curves in the field. In our context, the covariant derivative is crucial for calculating the behavior of fields in a curved spacetime or radial field.

The tensor $I_{\mu\nu}(\phi)$, which describes the influence of the scalar field ϕ (dark energy) in the radial field, is defined using the covariant derivative:

$$I_{\mu\nu}(\phi) = \nabla_\mu \phi \nabla_\nu \phi - \frac{1}{2} g_{\mu\nu} \left(\nabla^\lambda \phi \nabla_\lambda \phi + 2V(\phi) \right)$$

Where the covariant derivative $\nabla_\mu \phi$ is defined as:

$$\nabla_\mu \phi = \partial_\mu \phi - \Gamma^{\lambda}_{\mu\nu} \phi$$

This ensures that the field equations remain consistent even in the presence of non-trivial curvatures of the radial field or spacetime.

6.3 Calculus of Variations and Ricci Tensor

The calculus of variations is a crucial tool for deriving the equations of motion in theoretical physics. In DD-Theory©, we vary the total action S, which includes contributions from ordinary matter, dark matter, dark energy, and the radial field, with respect to the metric $g_{\mu\nu}$. The action is given by:

$$S_{\text{total}} = \int d^4x \sqrt{-g} \left(\mathcal{L}_{\text{dm}} + \mathcal{L}_\phi + \mathcal{L}_{\text{ord}} + \mathcal{L}_{\text{int}} + \mathcal{L}_{\text{radial}} \right)$$

For example, by varying this action with respect to the metric $g_{\mu\nu}$, we obtain the field equation for the Ricci tensor:

$$R_{\mu\nu} - \frac{1}{2}g_{\mu\nu}R = \frac{8\pi G}{c^4}T_{\mu\nu}$$

This is analogous to Einstein's equation in General Relativity, but in DD-Theory© and Radial Field Theory, this equation is modified to include the influence of dark matter and dark energy. Variation with respect to the fields A_μ and ϕ produces the respective equations for dark matter and dark energy.

6.4 Lagrangian Mechanics

The Lagrangian formalism is a fundamental approach to theoretical physics, allowing us to derive field equations and the motion of physical systems through the principle of least action. For each field in DD-Theory©, there is a Lagrangian that describes its dynamics. For example, the Lagrangian for the scalar field ϕ, which represents dark energy, is given by:

$$\mathcal{L}_\phi = \frac{1}{2}\nabla_\mu\phi\nabla^\mu\phi - V(\phi)$$

Variation of the action with respect to ϕ leads to the equation of motion for the scalar field:

$$\Box\phi = \frac{dV(\phi)}{d\phi}$$

where $\Box = \nabla_\mu\nabla^\mu$ is the d'Alembertian operator, which describes the propagation of waves in the scalar field in a curved spacetime or field.

Similarly, the electromagnetic tensor $F_{\mu\nu}$ has its own Lagrangian, and Maxwell's equations are derived from it through the Lagrangian formalism:

$$\mathcal{L}_{\text{em}} = -\frac{1}{4}F_{\mu\nu}F^{\mu\nu}$$

Varying the action with respect to the potential A_μ gives Maxwell's equation:

$$\nabla_\mu F^{\mu\nu} = J^\nu$$

Each component of the theory is thus well described by the Lagrangian formalism, which allows for a consistent description of the interactions between ordinary matter, dark matter, and dark energy.

7 Predictions and Practical Applications

7.1 Theory Predictions and Observational Verifications

The DD-Theory© provides testable predictions in several key areas of cosmology and astrophysics. One major prediction concerns the distribution of dark matter, which, according to the theory, forms the structural backbone of the universe. This distribution can be observed through gravitational lensing effects and the anomalous rotation curves of galaxies.

In addition, the theory offers insights into the accelerated expansion of the universe. The Radial Field and its interaction with dark energy provide a framework for understanding cosmic acceleration without invoking the cosmological constant. Observational data from redshift surveys and the cosmic microwave background radiation (CMB) can be used to verify this prediction.

Black hole dynamics are another critical area where DD-Theory© diverges from traditional models. According to this theory, black holes represent collapsed regions of the radial field rather than mere spacetime singularities. Observational evidence from gravitational wave detectors and high-energy astrophysical phenomena can help test these predictions.

7.2 Future Experiments

Future experiments and observations will be crucial for empirically validating DD-Theory©. Large-scale astronomical observations, such as those conducted by the James Webb Space Telescope (JWST) and the Square Kilometre Array (SKA), may offer new data on the distribution of dark matter and the behavior of distant galaxies, which could provide support for the theory.

Cosmological simulations will play a key role in testing how the theory's predictions about the formation of large-scale structures match current observations. These simulations can also explore how the Radial Field influences galaxy formation, black hole growth, and the expansion of the universe.

On a smaller scale, precision measurements of gravitational interactions in laboratories on Earth or space missions, such as the planned LISA (Laser Interferometer Space Antenna) for gravitational waves, may help detect subtle deviations predicted by the theory. These could offer new insights into the nature of dark energy and its role in the dynamics of the universe.

8 Conclusion and Future Directions

8.1 Summary of Findings

DD-Theory© represents a significant advancement in understanding cosmic dynamics by integrating dark matter, dark energy, and the radial field into a unified theoretical framework.

8.2 Future Work

Future research will focus on empirical validation of the theory through astronomical observations and simulations. Additionally, potential extensions of the theory could explore the inclusion of torsion and spin, as suggested by Cartan's geometry, and a deeper integration with quantum field theories. This project is open source and hosted on GitLab at:
(SSH): `git@gitlab.com:ddtheory.com-group/DDtheory.com.git`
or
(HTTPS): `https://gitlab.com/ddtheory.com-group/DDtheory.com.git`
where researchers and contributors are encouraged to participate in refining the structure of the formula. Contributions can be made by following the guidelines provided in the **README.md** file and other documentation available on the GitLab repository. For further information or to discuss collaboration, you can reach out via email at: **support@ddtheory.com**. More details about the project can be found on the website at `https://ddtheory.com`. The collaboration aims to foster a collective effort in advancing the understanding and application of DD-Theory©, and all contributions are welcome.