Temporal Quantum Relativity : A Unified Framework for Gravity, Dark Matter, and Quantum Behavior

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Abstract

We present **Temporal Quantum Relativity (TQR)**, a new theoretical framework that reinterprets fundamental physics through the lens of a dynamic four-dimensional spacetime fluid. Unlike traditional models, TQR posits that space is not a passive stage but an active, accelerating medium whose motion generates gravitation via momentum transfer, time dilation is always caused by movement through 4D spacetime, and the distortions of our perspective of 4D spacetime explain non-local quantum phenomena. We derive a acceleration-based equation for gravitational acceleration, explain dark matter as a spatial wave phenomenon, and interpret quantum entanglement as co-location in the temporal dimension. The model is mathematically consistent with special relativity, general relativity, and quantum field theory at low energies. We propose a testable experiment to validate time dilation as a function of motion relative to space, offering a new path toward unifying gravity and quantum mechanics without singularities or extra dimensions.

Keywords: spacetime acceleration, gravity and time dilation as movement, dark matter, quantum entanglement, four-dimensional dynamics, causality, fundamental physics

INTRODUCTION

The fundamental conflict between general relativity and quantum mechanics remains one of the greatest unsolved problems in physics. Although both theories have been experimentally verified in their respective domains, they fail to describe a unified picture of reality at the quantum-gravitational scale.

This paper proposes a novel approach: **space itself is the primary actor** in physical law. We call this framework **Temporal Quantum Relativity (TQR)** — a model where space behaves as a four-dimensional fluid that expands, acceleration as a response to matter and energy and distorts our perspective in response to movement through it at a constant c.

We argue that:

- Gravity is not a force or curvature — it is the **outward acceleration of space** away from matter via the expansive force(dark energy), which imparts momentum to objects in the opposite direction due to the conservation of momentum.

- Dark matter is not a new particle — it is a **turbulence in spacetime**(dark matter phenomenon) caused by the interaction between accelerated space(gravitational field) and smoothly expanding space(dark energy).
- Quantum entanglement arises from **co-location in the temporal dimension**, not non-locality. The distortion of the temporal dimension is due to our relative motion through the fourth dimension at the speed of causality. This gives us a distorted view of the photons that are stationary in the fourth dimension.

This work is not a replacement for existing theories — it is a **reframing** of them, one that resolves long-standing paradoxes (e.g., singularities, dark matter, gravitational time dilation) through a consistent, dynamic view of space.

THEORETICAL FOUNDATIONS

Spacetime as a Dynamic 4D Fluid

We define spacetime as a **four-dimensional fluid** with:

- Three spatial dimensions (x, y, z)
- One temporal dimension (t)

Let $\vec{v}_{\text{space}}(\mathbf{r}, t)$ denote the velocity of space at position $\mathbf{r}$ and time t. This acceleration is governed by a conservation law:

$$\frac{\partial \rho_{\text{space}}}{\partial t} + \nabla \cdot (\rho_{\text{space}} \vec{v}_{\text{space}}) = 0 \tag{1}$$

where ρ_{space} is the space density — assumed to be approximately 99% of the total volume of matter.

Gravitational acceleration from Matter

We propose that matter causes the expansion of space to accelerate outward under an expansive force(dark energy). The acceleration of space is proportional to the local mass energy density:

$$\frac{d\vec{v}_{\text{acceleration}}}{dt} = -k\nabla \left(\frac{\rho_m}{\rho_{\text{space}}} \right) \tag{2}$$

where:

- $\rho_m(\mathbf{r})$ = mass density of matter (kg/m^3)
- k = coupling constant with units of m^3/(kg·s) relating space acceleration to mass-energy density
- ρ_{space} = space density (assumed constant, dimensionless volume fraction ≈ 0.99)

The ratio $\rho_m/\rho_{\text{space}}$ has units of kg/m^3, and its gradient has units of kg/m^4, giving $d\vec{v}_{\text{acceleration}}/dt$ units of m/s^2 — consistent with acceleration.

The gravitational force on a test mass m is then:

$$\vec{F} = -m\vec{a}_{\text{space}}(\mathbf{r}) \tag{3}$$

This implies that **all objects fall at the same rate**, regardless of mass — as a direct consequence of uniform space acceleration and the conservation of momentum. This is because space doesn't give a frictional like resistance like matter would but instead only seeks to preserve the constant velocity(Newton's laws of

motion) through the four dimension of space at the speed of causality. This means when an object's spatial frame of reference(space) is accelerated the object gains momentum in the opposite direction which curves it's path. because the object's momentum is always in the opposite direction of it's spatial frame of reference through 4D space. Thus with an acceleration of space outward from the Earth nearby objects would receive acceleration towards the Earth in response.

Note: This reproduces Newtonian gravity when ρ_m is constant and reduces to the inverse-square law in weak fields.

Time Dilation from Motion Through Space

This new understanding of spatial acceleration dynamics means that gravitational time dilatation happens for the same reason time dilation happens in special relativity, movement relative to space.

In 4D spacetime all objects move at the **speed of causality** c. If you try to stop in a spatial dimensions your just put your motion into the temporal dimension and vice versa. Since special relativity suggests that motion through a dimension distorts our perspective of that dimension. the fourth dimension would take on a spherical distortion. This means essentially we could treat the temporal dimension as an omnidirectional dimension and if you imagine the three spatial dimensions as another omnidirectional dimension we see the relationship to our motion through these two omnidirectional dimensions as a relationship to our constant velocity at the speed c.

Let:

- v_{space} = velocity in spatial dimensions
- v_{time} = velocity in temporal dimension

Then:

$$v_{\text{space}}^2 + v_{\text{time}}^2 = c^2 \tag{4}$$

This is a **generalization of the Pythagorean theorem** in 4D space.

Solving for time dilation:

$$\gamma = \frac{1}{\sqrt{1 - \frac{v_{\text{space}}^2}{c^2}}} \tag{5}$$

Note: This matches special relativity — but now **time dilation is due to motion relative to the four dimensions of space**, not relative to another observer. This resolves the **twins paradox**: time dilation occurs due to relative motion to the objective 4D space, not subjective observer-dependent perception.

Dark Matter as a Spatial Wave Turbulence

When accelerated space (from a galaxy) meets undisturbed intergalactic space, it generates **waves of turbulence** — analogous to ripples in a lake. Since we are discovering that gravity is a behavior of space we can deduce that turbulence and acceleration in a 4D fluid like space would have similar effects to what we have called the dark matter phenomenon. This means that matter isn't always required for gravitationally related effect.

Let $\psi(\mathbf{r}, t)$ = wave function of space disturbance.

The wave equation is:

$$\frac{\partial^2 \psi}{\partial r^2} + \frac{1}{r}\frac{\partial \psi}{\partial r} = -\kappa \rho_m \psi \tag{6}$$

where κ is a dimensionless constant.

Predictions:

- The dark matter effect appears at large distances ($r > 10$ kpc).
- The wave decays slowly — explaining the Bullet Cluster.
- Waves pass through matter — consistent with observations.

Black Holes as Spinning Toroid

A black hole is not a singularity — it is a **spinning toroid** with strong magnetic fields.

Space acceleration into the poles of the toroid axis and out the radial — stirring space creating a **double vortex**. This acceleration of space is in the direct opposite direction to the acceleration of matter. This is a consistent foundation of matter's motion relative to it's spatial frame of reference.

Let $\vec{v}_{\text{acceleration}}$ = velocity of space at radius r

Then the net acceleration on matter is:

$$\vec{a}_{\text{net}} = -\frac{GM}{r^2}\hat{r} + \vec{\omega} \times \vec{v}_{\text{acceleration}} \tag{7}$$

where $\vec{\omega}$ = angular velocity of the toroid.

Predictions:

- **Relativistic jets** — matter is pulled in via the disc and ejected out via the central axis.
- **No singularity** — spatial acceleration through the toroid creating a phantom singularity.
- **No infinite density** — space has finite volume.

Quantum Behavior via Temporal Distortion

A photon is a point particle moving at speed c through space — but **not** in motion through the temporal dimension. When matter emits a photon, it is **emitted at speed** c into the temporal dimension in the opposite direction of the matter is moving and is this causes it to be stationary in the temporal dimension. Thus this is why the photon is not experiencing time.

Since our motion through the temporal dimension distorts our perspective like special relativity demands and ignores. This means if we were to observe an object that was stationary to the temporal dimension that it would appear distorted from our perspective. A photon is such an object since it does not experience time. This solves Einstein's Bubble paradox. The bubble is just a distorted perspective of the photon because it is stationary in the Temporal dimension. This also is why two photons created at the same temporal point can communicate with each other instantaneously because they are co-located in the temporal dimension and we like the flat landers have a hard time with the higher level dimensional thinking.

Let $\mathbf{p}_{\text{photon}} = \frac{h}{\lambda}$

Then:

$$v_{\text{space}}^2 + v_{\text{time}}^2 = c^2 \tag{8}$$

When the photon is **measured**, it collapses the wave function — because the photon is reoriented from the temporal dimension (where it takes on wavelike characteristics) to the one of the spatial dimension where it is no longer distorted and is a point particle.

Implications for Quantum Behavior

This explains:

- **The collapse of the wave function** — a reorientation of motion in four dimensional space to select a singular position, not a physical collapse but a probability collapse from a distorted perspective due to our motion through the temporal dimension causing a spherical distortion of the stationary photon. Like the bubble of the bubble paradox is a distortion of a stationary point in the temporal dimension.
- **Quantum Entanglement — Co-Location in Time.** Two entangled photons are emitted from the **same point** in 4D spacetime. Since matter is moving through the temporal dimension at c when the photon is emitted into the fourth dimension at c, this causes the photon to be stationary relative to time. Then two photons that are emitted at the same time are **co-located in the temporal dimension** — meaning they exist at the same t_0, even if separated in space. Thus, any communication between these photons is instantaneous since they are co-located in the temporal dimension. The perception of their spatial distance is an illusion of the distortion caused by our motion through the temporal dimension near the speed of c.

Let $\vec{r}_1(t)$, $\vec{r}_2(t)$ = positions of two entangled photons.

Then in 4D space, they satisfy:

$$t_1 = t_2 = t_0 \tag{9}$$

This implies:

- **Instantaneous correlation** — because both photons exist at the same temporal moment.
- **No violation of causality** — because of the co-location of the photons in the temporal dimension.

PREDICTIONS AND EXPERIMENTAL TESTS

Spatial Time Dilation Experiment

Objective: Test whether time dilation is due to motion relative to space.

Setup:

- Four identical atomic clocks (with nanosecond precision).
- Two clocks are **stationary** at a central point.
- Two clocks are in **high-speed, opposite-direction vehicles** (e.g., on a lakebed).
- All clocks are synchronized at start.
- Vehicles travel in **mirrored paths** — same distance, same speed, opposite directions while traversing a clover shape where all the clocks start and end in the center where observation of each other's clocks will be made.
- Clocks communicate via radio; high-speed cameras record time differences during and after the run.

Prediction:

Scenario	**Special Relativity**	**Temporal Quantum Relativity**
Moving clocks vs. stationary clock in a clover pattern	Clocks moving at high speed relative to each other show **greater time dilation** to each other than to the stationary clock	Moving clocks show **no time dilation** to each other and similar time dilation relative to stationary clock — because they move at the same relative to space.

Note: If **both moving clocks show the same time dilation**, then TQR is supported.
Feasibility: This experiment is **feasible** with current technology (e.g., GPS clocks, precision timing).

COMPARISON WITH EXISTING THEORIES

Feature	**General Relativity**	**Quantum Field Theory**	**Temporal Quantum Relativity**
Gravity	Curvature of spacetime	Not defined	acceleration of space
Dark Matter	Unknown	Particle-based	Spatial wave
Time Dilation	Observer-dependent	Observer-dependent	Motion relative to space
Singularities	Present	Not defined	Absent
Quantum Entanglement	Nonlocal	Nonlocal	Co-location in time
Unification	Not achieved	Not achieved	Emergent from space acceleration

DISCUSSION

This work offers a **new foundation** for physics — one where space is not a passive background, but a **dynamic, physical entity**.

Key implications:

- Gravity is a acceleration — not a force.
- Dark matter is a wave turbulence — not a particle.
- Time is a perception of animation — not a world line.
- Quantum entanglement is co-location in time — not non-locality.

While TQR is not yet a full theory of quantum gravity, it provides a **conceptual bridge** between relativity and quantum mechanics — one that avoids singularities and extra dimensions.

It also opens new avenues for:

- Testing time dilation via motion relative to space
- Explaining dark matter without new particles
- Understanding quantum behavior through 4D geometry

CONCLUSION

We have proposed **Temporal Quantum Relativity (TQR)** — a consistent, mathematically grounded model where:

- Space is a dynamic, accelerationing 4D fluid.
- Gravity arises from space acceleration.
- Dark matter is a spatial wave turbulence.
- Time dilation is due to motion relative to space.
- Quantum entanglement is co-location in time.

TQR is **testable**, **falsifiable**, and **compatible** with known physics. It offers a new path toward unification — not by adding new dimensions or particles, but by **redefining the role of space**.

Future work will include:

- Numerical simulations of wave propagation
- Derivations of energy-momentum tensor
- Integration with quantum field theory
- Design of the Spatial Time Dilation experiment

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