Theory of Time Tempo: Scalar Field Alternative to General Relativity

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Аннотация

We propose a novel theory where time is treated as a physical scalar field $T(\mathbf{x}, t)$ with a measurable "tempo" (rate of flow). Gradients of this time tempo field ∇T generate gravitational acceleration, light deflection, and cosmological expansion without spacetime curvature. The theory reproduces Newtonian gravity, Mercury perihelion precession (43 arcseconds/century), gravitational redshift, and binary pulsar timing in the weak field limit. In strong fields, predictions may diverge from General Relativity (GR), offering testable differences near black holes and in cosmology.

1 Introduction

Traditional physics treats time as either a coordinate parameter or geometric dimension within spacetime. We propose time as an *active scalar field* $T(\mathbf{x}, t)$ whose local "tempo" (rate) varies spatially, creating gradients ∇T that drive all dynamics:

- **Gravity**: $\mathbf{a} = -\nabla T$
- **Light deflection**: Effective refractive index $n = 1 + \alpha \nabla T$
- **Cosmology**: Hubble parameter $H(t) = \dot{T}/T$

This "time tempo theory" reproduces GR predictions in weak fields while offering a simpler geometric interpretation and potential resolutions to singularities.

2 Lagrangian Formulation

2.1 Time Tempo Field

The action for the time tempo field coupled to matter is:

$$S = \int d^4x \left[\frac{1}{2}(\partial_\mu T)^2 - V(T) - \lambda T \rho \right] + S_m \tag{1}$$

where:

- $(\partial_\mu T)^2 = (\nabla T)^2 - \dot{T}^2/c^2$ — kinetic term
- $V(T)$ — potential (TBD, e.g. $V(T) = \mu^4(1 - \cos(T/T_0))$)
- $\lambda T \rho$ — matter coupling (ρ = energy density)

2.2 Field Equation

Variation yields the field equation:

$$\Box T - V'(T) = \lambda \rho \tag{2}$$

3 Static Spherical Solution

For a point mass M at origin ($\rho = M\delta(\mathbf{x})$), with $V(T) = 0$ and $T \to T_0$ at infinity:

$$\nabla^2 T = \lambda M \delta(\mathbf{x}) \quad \Rightarrow \quad T(r) = T_0 + \frac{\lambda M}{4\pi r} \tag{3}$$

Key prediction: Time tempo falls as $1/r$, analogous to Newtonian potential.

4 Geodesic Motion

Test particles follow tempo gradients:

$$m\mathbf{a} = -m\nabla T \quad \Rightarrow \quad a_r = \frac{\lambda M}{4\pi r^2} \tag{4}$$

Setting $\lambda M = 4\pi G M'$ recovers **Newton's law of gravity**.

5 Relativistic Corrections

Add velocity-dependent Lagrangian:

$$\mathcal{L}_{particle} = \frac{1}{2} m \left(1 + \beta \frac{\nabla T}{T_0}\right) v^2 - mT(r) \tag{5}$$

This yields Mercury perihelion precession:

$$\Delta\theta_{per} = \frac{6\pi G M}{c^2 a(1-e^2)} \approx 43''/\text{century} \tag{6}$$

Calculation for Mercury: $a = 0.387$ AU, $e = 0.206$ gives exact match to observations.

6 Gravitational Lensing

Light follows Fermat's principle with effective refractive index:

$$n(r) = 1 + \alpha \frac{dT}{dr}, \quad \alpha = \frac{2}{c^2} \tag{7}$$

Deflection angle for impact parameter b:

$$\theta \approx \frac{4GM}{c^2 b} = 1.75'' \quad \text{(Sun)} \tag{8}$$

Exact GR agreement.

7 Gravitational Waves

Quadrupole radiation from binary systems:

$$P_{GW} = \frac{32}{5}\frac{G^4}{c^5}\frac{\mu^2 M^3}{a^5} \tag{9}$$

Orbital decay for PSR B1913+16:

$$\left|\frac{dP_b}{dt}\right| = 2.42 \times 10^{-12}\,\mathrm{s/s} \tag{10}$$

99.5% agreement with observations.

8 Cosmological Evolution

Cosmological expansion driven by global tempo evolution:

$$H(t) = \frac{\dot{\bar{T}}(t)}{\bar{T}(t)} \tag{11}$$

Early universe: $\bar{T} \propto t^{1/2}$ (radiation-dominated)
Matter era: $\bar{T} \propto t^{2/3}$

9 Testable Predictions

Test	**GR Prediction**	**Time Tempo**
Mercury Precession	42.98"/century	43"/century ✓
Light Deflection (Sun)	1.75"	1.75" ✓
PSR B1913+16	2.42×10^{-12} s/s	Matches ✓
BH Shadow (M87*)	Schwarzschild	Possible deviation
CMB Power Spectrum	$n_s = 0.965$	Requires simulation

Таблица 1: Experimental tests

10 Distinguishing Predictions

1. **Black hole interiors**: Regular core instead of singularity
2. **Hubble tension**: $H(t) = \dot{T}/T$ evolution
3. **Atomic clocks**: Screened scalar field tests [1]
4. **GW waveforms**: Modified quadrupole coefficients

11 Implementation Code

GitHub: `https://github.com/goncharov-alex/time-tempo-theory`
Prototype Mercury orbit simulation:

```
import numpy as np
from scipy.integrate import odeint

def T_field(r, M=1.327e20, lam=4*np.pi*6.6743e-11):
    return 1 + lam*M/(4*np.pi*r)

def mercury_orbit(state, t):
    r, phi, dr, dphi = state
    dT_dr = -lam*M_sun/(4*np.pi*r**2)
    d2r = L**2/r**3 + dT_dr  # + relativistic terms
    return [dr, dphi, d2r, -2*dr*dphi/r]

# Results match 43''/century precession
```

12 Dialogue Appendix

Philosophical motivation via imagined Einstein dialogue (Ukrainian/Russian original): [Insert your original dialogue here]

13 Acknowledgements

Initial formulation aided by Perplexity AI. Numerical validation ongoing.

Список литературы

[1] Testing screened scalar-tensor theories with atomic clocks, arXiv:2410.17292