The Necessity of Extending Standard Quantum Mechanics and Quantum Field Theory

Johann Pascher

March 27, 2025

Zusammenfassung

This work examines the conceptual limitations of standard quantum mechanics (QM) and quantum field theory (QFT) and proposes the time-mass duality with an intrinsic time field as an extension. By introducing $T(x) = \frac{\hbar}{\max(mc^2, \omega)}$, a connection between time and mass is established, overcoming the QM-QFT duality and providing a deterministic framework. The theory is supported by experimental predictions and cosmological implications.

Inhaltsverzeichnis

1 Introduction: Conceptual Limits of Established Theories

Standard quantum mechanics (QM) and quantum field theory (QFT) face limitations in integrating with General Relativity (GR) and in understanding time and mass. The T0 model offers a new perspective, as described in *From Time Dilation to Mass Variation: Mathematical Core Formulations of Time-Mass Duality Theory* [1].

1.1 Inherent Duality Between QM and QFT

- QM: Particle perspective [5].
- QFT: Field-based view.

1.2 Overinterpretation Due to Incomplete Theoretical Foundations

- Measurement problem [7].
- Nonlocality [6].

2 Asymmetric Treatment of Time and Space

2.1 Time as a Parameter vs. Space as an Operator

In standard quantum mechanics, time is treated as a parameter:

$$i\hbar\frac{\partial}{\partial t}\Psi(x,t) = \hat{H}\Psi(x,t) \tag{1}$$

Spatial coordinates, however, are described by operators, resulting in an asymmetric treatment of time and space.

3 Static Treatment of Mass

3.1 Mass as an Invariable Parameter

In the standard formulation, mass remains constant:

$$\hat{H} = \frac{\hat{p}^2}{2m} + V(\hat{x}) \tag{2}$$

This static treatment of mass limits the theory's flexibility and prevents a dynamic integration of mass and time.

4 The Concept of Intrinsic Time

Theorem 4.1 (Intrinsic Time)**.** *The intrinsic time is defined as:*

$$T(x) = \frac{\hbar}{\max(mc^2, \omega)} \tag{3}$$

This definition unifies the treatment of massive particles and photons. The modified Schrödinger equation is:

$$i\hbar T(x)\frac{\partial}{\partial t}\Psi + i\hbar\Psi\frac{\partial T(x)}{\partial t} = \hat{H}\Psi \tag{4}$$

This makes time evolution mass-dependent, enabling a more dynamic description.

5 Time-Mass Duality: A New Theoretical Framework

5.1 Complementary Models

- Standard Model: Constant mass, variable time.
- T0 Model: Absolute time, variable mass.

Time-mass duality offers an alternative perspective that transcends the limitations of traditional approaches.

6 Lagrangian Formulation

The total Lagrangian density of the T0 model is:

$$\mathcal{L}_{\text{Total}} = \mathcal{L}_{\text{Boson}} + \mathcal{L}_{\text{Fermion}} + \mathcal{L}_{\text{Higgs-T}} + \mathcal{L}_{\text{intrinsic}}, \quad \mathcal{L}_{\text{intrinsic}} = \frac{1}{2}\partial_\mu T(x)\partial^\mu T(x) - V(T(x)) \tag{5}$$

This approach integrates the dynamics of the intrinsic time field into existing field theories.

7 Implications for Fundamental Phenomena

7.1 Quantum Coherence and Decoherence

The decoherence rate becomes mass-dependent:

$$\Gamma_{\text{dec}} = \Gamma_0 \cdot \frac{mc^2}{\hbar} \tag{6}$$

Gravitation emerges as a property from gradients of the intrinsic time field:

$$\nabla T(x) = -\frac{\hbar}{m^2c^2}\nabla m \tag{7}$$

with the modified gravitational potential:

$$\Phi(r) = -\frac{GM}{r} + \kappa r, \quad \kappa \approx 4.8 \times 10^{-11}\,\mathrm{m\,s^{-2}} \tag{8}$$

8 Variable Mass as a Hidden Variable

8.1 Modified Quantum Dynamics

Time evolution can also be described by a variable mass:

$$i\hbar\frac{\partial}{\partial t}\Psi(x,t) = \hat{H}(m(t))\Psi(x,t) \tag{9}$$

This suggests that mass could act as a hidden variable explaining the apparent indeterminacy of quantum mechanics.

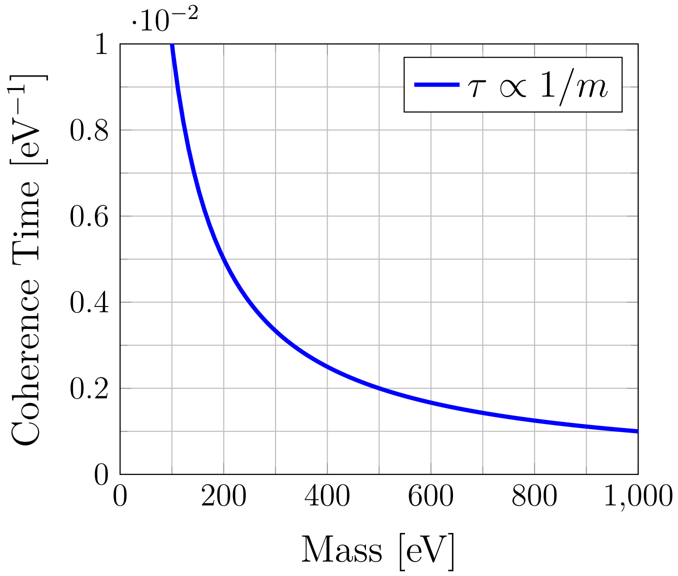

Abbildung 1: Mass-dependent coherence time in the T0 model.

9 Cosmological Implications

The T0 model has far-reaching cosmological implications:

- Redshift: $1 + z = e^{\alpha d}$, $\alpha \approx 2.3 \times 10^{-18}\,\mathrm{m}^{-1}$ [1].
- Gravitational Potential: $\Phi(r) = -\frac{GM}{r} + \kappa r$, $\kappa \approx 4.8 \times 10^{-11}\,\mathrm{m\,s}^{-2}$ [1].
- Wavelength Dependence: $z(\lambda) = z_0(1 + \beta_\mathrm{T} \ln(\lambda/\lambda_0))$, where $\beta_\mathrm{T}^\mathrm{SI} \approx 0.008$ in SI units and $\beta_\mathrm{T}^\mathrm{nat} = 1$ in natural units [2].

10 Conclusion

The T0 model extends standard quantum mechanics and quantum field theory by introducing time-mass duality and the intrinsic time field. It provides a deterministic framework that overcomes the traditional QM-QFT duality and is supported by experimental predictions such as mass-dependent coherence times and cosmological effects. This extension could represent a significant step toward a more unified theory of physics, integrating quantum mechanics and gravitation.

Literatur

[1] Pascher, J. (2025). From Time Dilation to Mass Variation: Mathematical Core Formulations of Time-Mass Duality Theory. March 29, 2025.

[2] Pascher, J. (2025). Time-Mass Duality Theory (T0 Model): Derivation of Parameters κ, α, and β. April 4, 2025.

[3] Einstein, A. (1905). *Does the Inertia of a Body Depend Upon Its Energy Content?*. *Annalen der Physik*, 323(13), 639-641.

[4] Planck, M. (1901). *On the Law of Energy Distribution in the Normal Spectrum*. *Annalen der Physik*, 309(3), 553-563.

[5] Schrödinger, E. (1926). *An Undulatory Theory of the Mechanics of Atoms and Molecules. Physical Review*, 28(6), 1049-1070.

[6] Bell, J. S. (1964). *On the Einstein-Podolsky-Rosen Paradox. Physics*, 1(3), 195-200.

[7] Einstein, A., Podolsky, B., Rosen, N. (1935). *Can Quantum-Mechanical Description of Physical Reality Be Considered Complete?. Physical Review*, 47(10), 777-780.