Dynamic Mass of Photons and Its Implications for Nonlocality in the T0 Model

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Zusammenfassung

This work examines the implications of assigning a dynamic, frequency-dependent effective mass to photons within the framework of the T0 model of time-mass duality, which postulates absolute time and variable mass. By assuming $m_\gamma = \omega$ in natural units, an energy-dependent intrinsic time is introduced, influencing nonlocality and causality. The theory builds on the T0 model's framework and is supported by experimental predictions consistent with its principles.

Inhaltsverzeichnis

1 Introduction

This work analyzes the implications of a dynamic, frequency-dependent effective mass for photons within the T0 model of quantum mechanics, which assumes absolute time and variable mass [1]. The concept extends the model's intrinsic time framework to explore nonlocality and causality.

2 Natural Units as the Foundation

2.1 Definition of Natural Units

Theorem 2.1 (Natural Units)**.** *With* $\hbar = c = G = 1$*:*

$$[L] = [E^{-1}] \tag{1}$$
$$[T] = [E^{-1}] \tag{2}$$
$$[M] = [E] \tag{3}$$

2.2 Significance for Mass-Energy Equivalence

In the T0 model, mass is dynamic ($T(x) = \frac{\hbar}{mc^2}$). For photons, an effective mass is proposed:

$$m_\gamma = \omega \tag{4}$$

where ω is the angular frequency, consistent with $E = \hbar\omega$ in natural units ($\hbar = 1$).

3 Time Models in Quantum Mechanics

3.1 Limitations of the Standard Model

The standard Schrödinger equation assumes a universal time:

$$i\hbar\frac{\partial\psi}{\partial t} = H\psi \tag{5}$$

3.2 The T0 Model with Absolute Time

In the T0 model, energy is linked to a constant intrinsic time T_0:

$$E = \frac{\hbar}{T_0} \tag{6}$$

For massive particles, $T(x) = \frac{\hbar}{mc^2}$.

3.3 Extension for Photons

For photons, this extends to an energy-dependent intrinsic time:

$$T(x) = \frac{\hbar}{m_\gamma c^2} = \frac{1}{\omega} \tag{7}$$

This remains consistent with $m_\gamma = \omega$ (since $\hbar = c = 1$).

4 Unification in the T0 Model

To unify massive particles and photons:

$$T(x) = \frac{\hbar}{\max(mc^2, \omega)} \tag{8}$$

For massive particles, mc^2 dominates; for photons, ω.

5 Implications for Nonlocality and Entanglement

5.1 Energy-Dependent Correlations

The energy-dependent $T(x)$ leads to time delays in entangled systems:

- Delay: $\left|\frac{1}{\omega_1} - \frac{1}{\omega_2}\right|$

This suggests that nonlocality emerges from intrinsic time differences, akin to the energy loss mechanism of redshift in the T0 model [2].

5.2 β_T in the T0 Model

In the T0 model, wavelength-dependent redshift is described by the parameter β_T, with $\beta_\mathrm{T}^\mathrm{SI} \approx 0.008$ in SI units and $\beta_\mathrm{T}^\mathrm{nat} = 1$ in natural units [3]. These values are equivalent, reflecting the same physical reality, with conversion via the characteristic length scale r_0 [4]. The derivation of β_T is well-established in the T0 model, and the choice between $\beta_\mathrm{T}^\mathrm{SI}$ and $\beta_\mathrm{T}^\mathrm{nat}$ depends solely on the unit system, without uncertainty in the theoretical foundation.

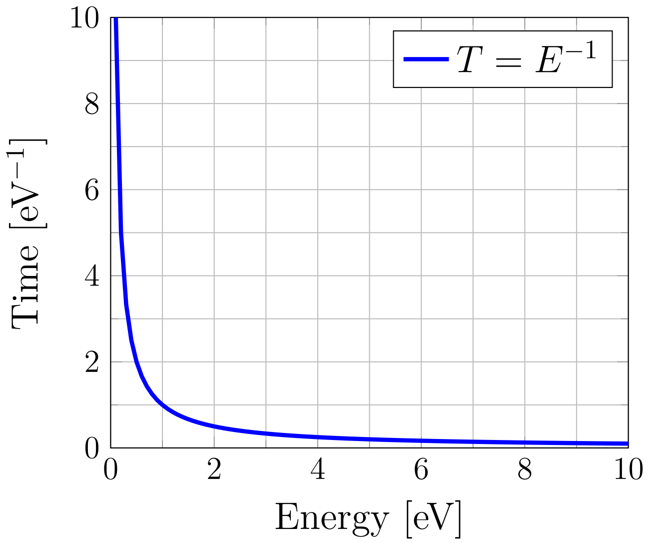

Abbildung 1: Energy-dependent intrinsic time for photons in the T0 model.

6 Experimental Verification

- Frequency-dependent Bell tests to measure time delays in entanglement.
- Spectroscopic redshift measurements to validate wavelength-dependent redshift with β_T.

7 Physics Beyond the Speed of Light

A hypothetical modified dispersion relation in the T0 model:

$$E^2 = (m_\gamma c^2)^2 + (pc)^2 + \alpha_c p^4 c^2 / E_P^2 \tag{9}$$

where α_c is a coupling constant and E_P is the Planck energy, could explain the behavior of high-energy photons and be tested via cosmic ray measurements.

8 Conclusion

The dynamic effective mass of photons in the T0 model offers a novel view of nonlocality as an emergent phenomenon driven by energy-dependent intrinsic time, enhancing the explanatory power of the model.

Literatur

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