Complementary Extensions of Physics: Absolute Time and Intrinsic Time

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Contents

1 Introduction

This paper examines two novel and logically coherent approaches in theoretical physics: the complementary standard model of relativity theory with an absolute time and a modified Schrödinger equation with a mass-dependent intrinsic time. Both concepts offer not only alternative perspectives on the nature of time, energy, and quantum mechanics but are also internally consistent and build upon established physical principles. The complementary standard model introduces an absolute time that is linked to a dynamic energy-mass relationship, while the modified Schrödinger equation postulates an intrinsic time that is derived from the mass of a system. These dual approaches extend the wave-particle duality in a way that is both mathematically consistent and physically plausible, inviting deeper reflection on the foundations of modern physics.

2 Wave-Particle Duality and its Extension

Classical quantum mechanics views light and matter as both waves and particles, depending on the type of experiment. This paper extends this duality by assuming that wave and particle properties do not only arise from the measurement process but are determined by a fundamental interaction with an intrinsic time structure. This intrinsic time arises from the mass of the considered object and directly influences the evolution of the system.

3 Complementary Standard Model of Relativity Theory

3.1 Introduction

This model is based on the assumption of an absolute time T_0 and a variable energy E as well as mass m. It presents an alternative view to the special theory of relativity (STR) by reinterpreting the role of time.

3.2 Basic Assumptions

1. Absolute time: T_0 is constant.
2. Constant speed of light: $c_0 \approx 3 \times 10^8\,\mathrm{m/s}$.
3. Variable energy: E is not fixed but dynamic.
4. Mass as a function of energy: $m = f(E)$.

3.3 Mathematical Formulation

The central energy relation is:

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

With the known relationship $E = mc_0^2$, it follows:

$$m = \frac{E}{c_0^2} = \frac{\hbar}{T_0 c_0^2}$$

From this, it follows that the mass m varies with E, while T_0 remains fixed.

3.4 Implications for the Standard Model

- The classical assumption of a fixed rest mass must be extended.
- The model could offer alternative explanations for quantum correlations.
- The interpretation of time in quantum field theory could be modified.

This theory represents a complementary perspective to established physics and offers new approaches for the unification of quantum mechanics and relativity theory.

4 Modified Schrödinger Equation with Intrinsic Time

In my work *Time as an Emergent Property in Quantum Mechanics* (March 23, 2025), the Schrödinger equation is extended to account for a mass-dependent time. The essential change is that the time t in the Schrödinger equation is replaced by an intrinsic time T that depends on the mass m of the quantum mechanical system. The intrinsic time T is defined as:

$$T = \frac{\hbar}{mc^2}$$

This leads to a modified Schrödinger equation, in which the time evolution of the system depends on its mass. The modified formula reads:

$$i\hbar \frac{\partial}{\partial (t/T)} \Psi = \hat{H} \Psi$$

Here, time t is scaled by the intrinsic time T, which means that the time evolution proceeds at different rates for different masses. For a system with a larger mass m, the intrinsic time T is shorter, leading to a faster time evolution, while for a system with a smaller mass m, the time evolution is slower.

5 Mathematical Comparison of Wave-Particle Duality and Time-Mass Duality

5.1 Wave-Particle Duality

5.1.1 Particle Description

The particle description of a quantum mechanical system focuses on localized mass/energy with a defined position:

- Particle of mass m with position $\vec{x}$
- Momentum $\vec{p} = m\vec{v}$
- Energy $E = \frac{1}{2}mv^2$ (non-relativistic) or $E = \gamma mc^2$ (relativistic)

5.1.2 Wave Description

The wave description focuses on the spatially extended wave function:

- Wave function $\Psi(\vec{x}, t)$
- De Broglie wavelength $\lambda = \frac{h}{p}$
- Wave vector $\vec{k} = \frac{\vec{p}}{\hbar}$
- Angular frequency $\omega = \frac{E}{\hbar}$

5.1.3 Mathematical Connection

The two descriptions are connected by the Fourier transform:

$$\Psi(\vec{x}) = \frac{1}{(2\pi\hbar)^{3/2}} \int \phi(\vec{p}) e^{i\vec{p}\cdot\vec{x}/\hbar} d^3p$$

$$\phi(\vec{p}) = \frac{1}{(2\pi\hbar)^{3/2}} \int \Psi(\vec{x}) e^{-i\vec{p}\cdot\vec{x}/\hbar} d^3x$$

Here, $\phi(\vec{p})$ is the wave function in momentum space.

5.2 Time-Mass Duality

5.2.1 Time Dilation Description (Standard Model)

- Variable time t with time dilation: $t' = \gamma t$
- Constant rest mass m_0
- Relativistic energy: $E = \gamma m_0 c^2$
- Time dilation factor: $\gamma = \frac{1}{\sqrt{1-v^2/c^2}}$

5.2.2 Mass Variation Description (this model)

- Absolute, constant time T_0
- Variable mass $m = \gamma m_0$
- Energy: $E = mc^2 = \frac{\hbar}{T}$
- Intrinsic time: $T = \frac{\hbar}{mc^2}$

5.2.3 Mathematical Connection

The connection between both descriptions can be expressed through the following transformations:

1. Time coordinate transformation:

$$\frac{dt}{dt_0} = \frac{m_0}{m} = \frac{1}{\gamma}$$

2. Equivalent formulation of time evolution:
   - Standard model: $i\hbar\frac{\partial}{\partial t}\Psi = \hat{H}\Psi$
   - This model: $i\hbar\frac{\partial}{\partial(t/T)}\Psi = \hat{H}\Psi$
3. Transformation between descriptions:
   - If $t' = \gamma t$ (time dilation) in the standard model
   - Then $m' = \gamma m_0$ (mass variation) in this model
   - With $T' = \frac{\hbar}{m'c^2} = \frac{T_0}{\gamma}$

5.3 Parallels Between the Dualisms

1. **Complementarity**:
   - Wave-particle: Position ($\vec{x}$) and momentum ($\vec{p}$) are complementary observables
   - Time-mass: Time (t or T) and energy/mass (E or m) are complementary quantities

2. **Uncertainty Relations**:
   - Wave-particle: $\Delta x \Delta p \geq \frac{\hbar}{2}$
   - Time-mass: $\Delta t \Delta E \geq \frac{\hbar}{2}$ or $\Delta T \Delta m \geq \frac{\hbar}{2c^2}$

3. **Transformations**:
   - Wave-particle: Fourier transformation between position and momentum space
   - Time-mass: Lorentz transformation (standard model) or mass-variation transformation (this model)

5.4 Mathematical Structure of the Duality

In both cases, we can understand the duality as a transformation between complementary representations of the same physical system:

- **Wave-particle:**
  $\mathcal{F} : \Psi(\vec{x}) \to \phi(\vec{p})$
  Where $\mathcal{F}$ is the Fourier transformation operator.

- **Time-mass (in this model):**
  $\mathcal{L} : (T_0, m_0) \to (T, m)$
  Where $\mathcal{L}$ represents a modified Lorentz transformation that causes mass variation instead of time dilation, with:
  $m = \gamma m_0$
  $T = \frac{T_0}{\gamma}$

The invariance in both dualisms is shown in:

- Wave-particle: $|\Psi|^2 dx = |\phi|^2 dp$ (probability conservation)
- Time-mass: $m_0 c^2 T_0 = mc^2 T = \hbar$ (energy-time product)

6 Conclusion

This paper presents two innovative approaches to extending physical theories: the complementary standard model of relativity theory with absolute time and the modified Schrödinger equation with mass-dependent intrinsic time. Both models offer new perspectives on the nature of time, energy, and quantum mechanics and illustrate their inner coherence and complementarity through mathematical comparison with the wave-particle duality. A central objection to the concept of absolute time, however, is that we directly measure time and time dilation represents an observable reality, as seen in GPS corrections, muon decay, or light travel time measurements with photons. This objection requires in-depth consideration, as it challenges the foundation of the proposed models.

In the standard model of special relativity, time dilation ($t' = \gamma t$) is interpreted as a real change of time, confirmed by precise measurements. For example, GPS satellites show a time shift of about $38\,\mu$s per day, and muons have a longer lifetime in motion. Photon measurements, such as light travel time ($t = \frac{d}{c_0}$), also seem to support time as a variable quantity, as the measured time differences agree with the Lorentz transformation. However, the proposed T_0 model with absolute time and variable mass ($m = \gamma m_0$) offers an alternative interpretation, which I examine in detail in my work *A Model with Absolute Time and Variable Energy: A Detailed Investigation of the Foundations* (March 24, 2025), particularly in the section "Foundations of Time Measurement." There, I show that time measurements are made indirectly via frequencies ($f = \frac{E}{h}$), which are linked to energy ($E = mc_0^2$) and thus mass. In the standard model, this is interpreted as time dilation, while in the T_0 model, the same measurement reflects a change in mass with constant time.

This dualistic approach also extends to photon measurements. The light travel time could be interpreted as energy loss (E-variation) instead of time variation, since photons travel at c_0 in both models and their frequency ($\nu = \frac{E}{h}$) depends on energy. For example, a redshift in the T_0 model could be explained as E- or m-loss instead of time dilation. Crucially, however, all measurements – whether with matter particles (muons, GPS) or photons (light travel time, Doppler effect) – implicitly allow both interpretations. The mathematical equivalence between $t' = \gamma t$ (standard model) and $m' = \gamma m_0$ (this model) shows that the observable results are identical, regardless of whether we consider time or mass as variable. This means that photon measurements do not solve the problem of distinction but reinforce the duality: we cannot unambiguously determine whether time dilation or mass variation is the "more real" description, as both models equally explain the data.

The core problem lies in the fact that our measurement methods – whether through clocks, frequency spectra, or light travel time – always presuppose an operational definition of time that is linked to energy and mass ($E = hf = mc_0^2$). This link makes the distinction between the models experimentally challenging, as every measurement can be interpreted dualistically. The objection that time dilation is real because we measure time is thus not refuted but placed in an interpretive context: the reality of time dilation depends on the chosen perspective, not on the measurements themselves. In my further work *A Model with Absolute Time and Variable Energy* (March 24, 2025), particularly in the sections "Foundations of Time Measurement" and "Experimental Verification," I discuss this interpretive dualism in detail and suggest approaches on how future experiments might possibly uncover differences between the models. Similarly, in *Extensions of Quantum Mechanics through Intrinsic Time* (March 24, 2025), the role of intrinsic time as an emergent property is further explored. Until such distinctions are experimentally possible, the models presented here remain complementary perspectives that extend the flexibility and depth of physical description.