Theoretical Innovation in Higher Education: Vectorization of Light Speed and Momentum—A New Approach to Resolving the Contradictions between Quantum Mechanics and Relativity

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Abstract: The proposal of the momentum formula based on the vectorization of light speed provides a completely new theoretical path for resolving the long-standing contradictions between quantum mechanics and special relativity. This momentum formula not only allows for a reinterpretation of the motion of particles under high-energy conditions but also offers new perspectives on the unification of fundamental forces within the framework of unified field theory. This paper derives the momentum formula for light speed vectorization in detail, analyzes its differences from the traditional relativistic momentum formula, and explores its physical significance in terms of energy relationships and particle behavior

Keywords: Vectorized Light Speed; Momentum Redefinition; Quantum Mechanics; Special Relativity; Unified Field Theory; High-Energy Physics

1. Introduction

The speed of light occupies a central position in modern physics, particularly in special relativity, where the speed of light c is regarded as the ultimate speed limit in the universe, remaining constant in a vacuum. Although quantum field theory to some extent combines relativity with quantum mechanics, significant theoretical challenges remain when attempting to unify the four fundamental forces (gravity, electromagnetic force, strong nuclear force, and weak nuclear force). For instance, quantum gravity theories have not yet successfully incorporated gravity into the description of quantum fields, and the traditional momentum formula struggles to explain certain observational phenomena under extreme conditions. Therefore, seeking a new definition of momentum that satisfies the requirements of special relativity while being compatible with the fundamental principles of quantum mechanics is an important topic in contemporary physics research.

2. Overview of Research team's Vectorized Light Speed Hypothesis

Based on this hypothesis, Research team proposed a new momentum formula: $\vec{p} = m(\vec{c} - \vec{v})$. In this formula, $\vec{c}$ represents the vectorized speed of light, and $\vec{v}$ is the velocity of the object. This formula implies that momentum is not solely a function of the object's velocity but is also closely related

to changes in the direction of light speed. The physical significance lies in the possibility that variations in the direction of light speed could influence the motion characteristics of objects in space, providing a new way to interpret the behavior of high-energy particles in strong gravitational fields.

Research team's formula aims to offer a new pathway for resolving the inconsistencies between quantum mechanics and special relativity. If this momentum formula can be validated experimentally, it has the potential to play a significant role in the study of unified field theory, offering new perspectives on the interactions among the four fundamental forces. Although this theory currently faces many mathematical and experimental challenges, its innovative approach undoubtedly opens new avenues for research in theoretical physics.

3. Derivation of the Vectorized Light Speed Momentum Formula

3.1 Mathematical Foundation

To derive the vectorized light speed momentum formula $\vec{p} = m(\vec{c} - \vec{v})$ proposed by Research team, we first need to clarify several key assumptions and definitions:

3.1.1 Vectorized Light Speed Hypothesis

In traditional special relativity, the speed of light c is defined as a scalar constant with a fixed magnitude $c \approx 3 \times 10^8 m/s$. However, Research team's theory posits that the speed of light can be represented as a vector $\vec{c}$. In this framework, the magnitude of the speed of light remains constant, but its direction can change in a given reference frame. Formally, the vectorized light speed can be expressed as $\vec{c} = c\hat{n}$, where $\hat{n}$ is a unit direction vector.

3.1.2 Definition of Momentum

Based on this hypothesis, Research team proposed the following momentum formula: $\vec{p} = m(\vec{c} - \vec{v})$, where m is the relativistic mass of the object, and $\vec{v}$ is the velocity of the object relative to a given reference frame.

3.1.3 Derivation Process

The derivation of this momentum formula can be broken down into the following steps:

1. First, define the rate of change of momentum under the framework of vectorized light speed:
$$\frac{d\vec{p}}{dt} = \frac{d}{dt}\,[m(\vec{c} - \vec{v})]$$
2. Assume that the mass mmm remains constant, i.e., $dm/dt = 0$ then the rate of change of momentum can be expanded as:
$$\frac{d\vec{p}}{dt} = m(\frac{d\vec{c}}{dt} - \frac{d\vec{v}}{dt})$$
3. In classical mechanics and relativity, the acceleration $\vec{a}$ of an object is defined as the rate of change of velocity, thus we have:
$$\vec{F} = m\vec{a} = -m\frac{d\vec{c}}{dt}$$

where $\vec{F}$ is the external force. It can be observed that when the direction of light speed changes, this change has a direct impact on the momentum of the object.

3.1.4 Mathematical Consistency

Under the vectorized light speed hypothesis, the mathematical consistency of the formula $\vec{p} = m(\vec{c} - \vec{v})$ primarily depends on how the vectorized speed of light $\vec{c}$ is treated. To ensure self-consistency, it must be assumed that the rate of change $d\vec{c}/dt$ in the direction of the speed of light $\vec{c}$ occurs under the influence of specific physical fields (such as electromagnetic or gravitational fields). This assumption allows the momentum formula to remain valid under the influence of different fields.

3.2 Derivation of the Energy Relationship under the New Momentum Formula

Based on Research team's momentum formula $\vec{p} = m(\vec{c} - \vec{v})$, we can further derive the energy relationship and explore its impact on the classical mass-energy equation $E^2 = mc^2$.

3.2.1 Relationship Between Momentum and Energy

In traditional relativity, the relationship between energy and momentum is given by: $E^2 = (pc)^2 + (m_0c^2)^2$, where m_0 is the rest mass, and $\vec{p}$ is the relativistic momentum.

3.2.2 Energy Expression Based on the New Formula

For Research team's formula, a new energy relationship can be derived as follows:

Let E be the total energy of the object, then we have:

$$E = \sqrt{(\vec{p} \bullet \vec{c})^2 + (m_0c^2)^2}$$

Under the vectorized light speed hypothesis, the expression for energy may exhibit a dependence on changes in the direction of light speed.

4. Conclusion

The momentum formula based on the vectorization of light speed is expected to play a more significant role in future physics research. Despite facing challenges, this theory provides a valuable opportunity for us to reevaluate the fundamental laws of physics and our current cosmological views. Should these investigations yield breakthroughs, they will undoubtedly have a profound impact on both theoretical and experimental physics.

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