

Unification Might Be Achievable by a Hypothesis of Instantaneous Time-Jumps during Photon and Graviton Interactions (A Brief Note)

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How to cite this paper: Tatum, E.T. (2022) Unification Might Be Achievable by a Hypothesis of Instantaneous Time-Jumps during Photon and Graviton Interactions (A Brief Note). *Journal of Modern Physics*, 13, 730-735.

<https://doi.org/10.4236/jmp.2022.135042>

Received: April 20, 2022

Accepted: May 24, 2022

Published: May 27, 2022

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Abstract

Quantum theory according to the Copenhagen interpretation holds that, when a quantum interaction is observed (*i.e.*, “measured”), the observer’s measuring devices temporarily become a part of the quantum system. Relativity theory holds that the event clock of the absorbed or emitted photon or graviton is frozen in time relative to all clocks outside the observed system. If we harmonize both theories, this would appear to imply that time continuity must be interrupted at each instant of observed photon or graviton interaction with matter. It is as if a segment of space-time is clipped out during each such observed interaction. If so, we must dispense with the notion of an absolutely smooth and continuous space-time and replace it with an observation-dependent, discontinuous, relativistic/quantum space-time. Mathematical physicists should be able to model this hypothesis (call it a “time-jump hypothesis”) and its inherent discontinuous space-time in their further efforts at unification.

Keywords

Time-Jump Hypothesis, Unification, Relativity Theory, Quantum Field Theory, Relativistic/Quantum Space-Time, Instantaneous Energy Transition, Quantum Measurement Problem, Quantum Non-Locality

1. Introduction and Background

Philosopher Bertrand Russell once made the following remark in reference to quantum physics: “... its chief philosophical importance is that it regards physical phenomena as possibly discontinuous. It suggests that, in an atom, a certain

state of affairs persists for a certain time, and then suddenly is replaced by a finitely different state of affairs. Continuity of motion, which had always been assumed, appears to have been a mere prejudice... I suspect that (quantum theory) will demand even more radical departures from the traditional doctrine of space and time than those demanded by the theory of relativity [1].”

Previous attempts at the unification of relativity theory and quantum theory have failed, largely because the integration of gravity into quantum theory introduces unmanageable “infinities” into the mathematical models. Nevertheless, both physical theories work sufficiently well on their respective scales that they are enormously useful.

It has long been a subject of debate as to whether relativity theory or quantum theory must be comprehensively revised so that unification can be achieved. However, it may also be that both theories only need a small adjustment for them to become harmonious. The purpose of this brief note is to introduce the concept of a “time-jump” and to show by analogy how it might be understood. The key to this new understanding is to realize that relativistic considerations at the quantum scale must imply that we discard the long-held notion of an absolutely smooth and continuous space-time.

2. A Film-Editing Analogy of Time-Jumping

Movie films of the early 20th century had a jumpy time quality because there was poor camera/projector mechanization in conjunction with hand-cranking. Once this technology had sufficiently improved, a director’s cut or editor’s cut could be used to manipulate the time experience by actively creating a jump forward in the chronology of a story. In the editing room, the film could be spliced in such a way that a segment of time in an otherwise continuous sequence could be removed. The effect at sufficient film speed was an instantaneous jump in time; in other words, a time-jump.

3. How Relativistic Time-Jumping Might Work in the Quantum Realm

One of the concepts of special relativity theory is that faster relative motion slows the “moving” clock. Einstein’s key conception was that, effectively, a photon’s clock is timeless (*i.e.*, it is frozen in time) with respect to the reference frame clock of any outsider. With general relativity theory, the same can also be said of the clock of a graviton or a clock embedded exactly on the event horizon of a black hole (as perceived by the observer at any distance outside the event horizon). To put it another way, the clock of any outside observer, moving at any relative speed (short of speed of light c), ticks infinitely fast with respect to a photon, graviton, or black hole horizon clock.

But here’s a key hypothetical point: the frozen clock of photon and graviton interactions pertains to the *entire* quantum frame (*i.e.*, “system” as defined by the Copenhagen interpretation). Any physical body, during the time of its emis-

sion or absorption of the energy of a photon or a graviton, is in the timeless reference frame of that speed-of-light particle. Thus, the emission or absorption of that relativistic energy is *instantaneous*. Furthermore, the same reference frame applies to the observer measuring devices during such an energy emission or absorption event. This is presumably how a quantum observation (*i.e.*, “measurement”) can be defined. Thus, the quantum observer sees the energy interaction as instantaneous. When such an event is perceived as instantaneous, that means that no time elapses on the observer’s clock during the event, and the space-time of the event can be represented as a finite point (*i.e.*, it has no space or time extension). When the observer is not observing (*i.e.*, not measuring) the quantum system, his own fast-ticking “outside” clock is his reference clock. This is perhaps why the “measurement problem” in quantum physics has been so perplexing. The relativistic concept of time-jumping, as described herein, wasn’t formally a part of the Copenhagen interpretation.

4. Discussion

Several interesting theories about photon/graviton interactions with matter have been recently proposed [2] [3] [4] [5]. However, to this author’s knowledge, recent and past theoretical work has not sufficiently explored the possibility of progress towards unification by incorporation of a relativistic instantaneous time-jump hypothesis into quantum theory.

The problem of unification could be somewhat analogous to viewing a pointillist painting from various distances. A sufficiently large separation between the viewer and the painting gives the impression of continuity in the landscape, whereas, a sufficiently short separation between the viewer and the painting gives the impression of discontinuity. Moreover, when the painting is sufficiently well-done, as in Seurat’s “A Sunday Afternoon on the Island of La Grande Jatte”, there is an intermediate distance which creates a certain level of cognitive dissonance, wherein one must inquire as to how something can appear to be both continuous and discontinuous at the same time. Nevertheless, the viewer can readily understand that this experience is merely one of clever illusion. Pointillism color theory, which was important to Seurat, is not germane to the present discussion.

The net effect of the instantaneous time-jump process described in this note is that its observer will never see an intermediate phase in the energy absorption. A photon-absorbing electron, in the temporary quantum system including its observer, effectively jumps instantaneously between atomic orbitals and can never be observed to be between them. It is as if there is no space-time distance between atomic orbitals during such energy transitions. Effectively, a space-time segment has been spliced out by the timeless photon or graviton clock. A similar instantaneous time-jumping process might also explain quantum non-locality between entangled quantum particles at great distances, so long as the emission/absorption messenger is absorbed and emitted by the intervening vacuum.

Distance as well as time is effectively eliminated, as if by a wormhole in space-time. Perhaps this sort of exchange is also a key to understanding dark energy within the vacuum, as recently theorized [6].

The following figures represent notions of energy transition by a seemingly smoothly-continuous process of energy absorption (**Figure 1**) and by a discontinuous process of quantum energy absorption (**Figure 2**). It may be helpful to imagine two different ways of representing the energy absorption of a body falling in a gravitational field. On the largest scale (**Figure 1**), the body appears to show a smoothly-continuous increase of energy. On the quantum scale (**Figure 2**), however, the body's energy gain is shown as representing instantaneous jumps in energy by graviton interactions at each time-jump. In an analogy to pointillism, both representations can be seen as useful, depending upon the scale needed at a given time. However, the greater and finer detail is obviously found in quantum **Figure 2**.

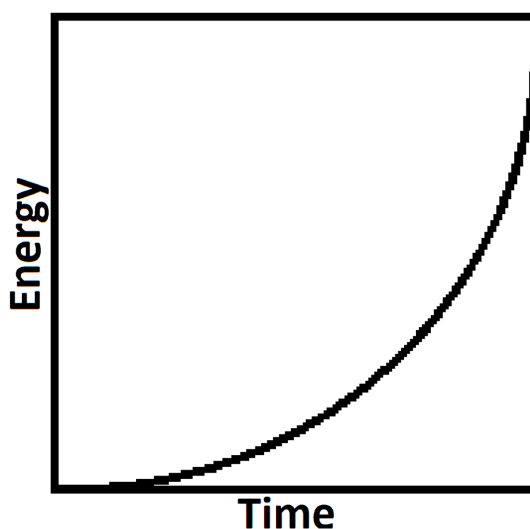


Figure 1. Classical energy transitions for a falling body.

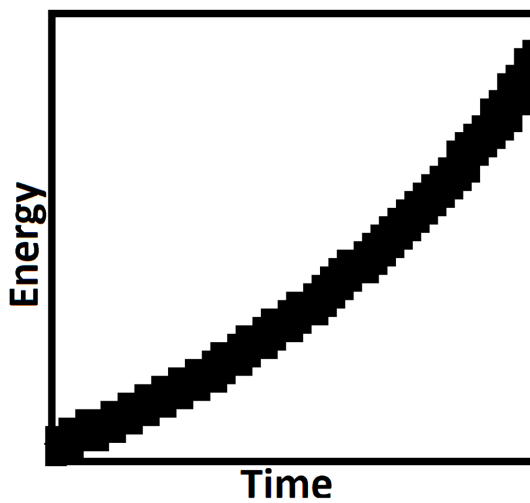


Figure 2. Quantum (graviton) energy transitions for a falling body.

With respect to this presentation, it is crucial to note that quantum time-jumps in **Figure 2** are vertical (*i.e.*, having infinite slopes) because energy absorptions of gravitons are relativistically instantaneous. Perhaps, this correlates in some simplified way with the “infinities” found in previous attempts at unification. A rigid assumption of smoothly-continuous space-time will not allow for a notion of instantaneous events.

5. Conclusion and Summary

The present work is in the spirit of prior efforts to assist in unifying relativity with quantum theory. To our knowledge, the novelty of the present work is that the possibility of progress towards unification by incorporation of an instantaneous time-jump hypothesis has not been sufficiently explored. Future work is recommended along the lines of continuing to insert relativistic concepts of time and space into quantum theory.

The instantaneous energy jumps of the quantum world, wherein the energy-absorbing or energy-emitting particles are never found at an intermediate energy level (such as between atomic orbitals or within intervening space-time), might only be explainable by relativity, as discussed. One can think of the time clock of a photon or graviton as being frozen with respect to the infinitely fast-moving clock of the outsider. The particle absorbing or emitting a photon or graviton, as well as the observer measuring their energy transition, becomes temporarily part of the quantum system under observation and “sees” the event as instantaneous by the system’s photon or graviton clock. Not only does a relativistic time-jump integration into quantum theory possibly alleviate the “infinities” problem in prior attempts at unification, it might also help us to better understand the instantaneous and space-eliminating nature of quantum non-locality, and the mystery of dark energy within the vacuum. If this time-jump hypothesis is correct, we must relinquish the long-held notion of an absolutely smooth and continuous space-time and replace it with an observation-dependent, discontinuous, relativistic/quantum space-time.

Dedications and Acknowledgements

This note is dedicated to Stephen Hawking and Roger Penrose for their groundbreaking work on black holes and their possible application to cosmology. Dr. Tatum sincerely thanks U.V.S. Seshavatharam for his co-authorship of the seminal Flat Space Cosmology papers and some of the more recent FSC publications. He also thanks Dr. Rudolph Schild of the Harvard-Smithsonian Center for Astrophysics for his past support and encouragement.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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