

TUNNELING EFFECT MECHANISM IN THE RADIO RECEIVER HYPOTHESIS {RRH} AND FURTHER INTERPRETATION IN [UBR] MODEL***Lie Chun Pong**

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Abstract

The tunneling effect was discovered by Physicists Leonid Mandelstam and Mikhail Leontovich in the late 1920s, but the mechanism behind it is puzzling in many aspects, such as why it occurs and where to begin understanding it. In our research paper, we will discuss the phenomenon of the tunneling effect, and we will utilize the [UBR] model as experimental support to back our Radio Receiver Hypothesis {RRh}. This will allow us to postulate the tunneling effect phenomenon in a specific quantum state. This is the spot where we will demonstrate the linear tunneling effect mechanism behind and further interpret this research radio receiver assumption.

Keywords: Tunneling effect, Tunneling effect mechanism, Tunneling effect mechanism behind, Radio Receiver Hypothesis {RRh}, [UBR] model.

INTRODUCTION

Quantum tunneling, also known as the tunneling effect, is a phenomenon in quantum mechanics where particles can pass through energy barriers that they theoretically shouldn't be able to cross based on classical physics. Classical physics predicts that particles lacking enough energy will be completely reflected by such barriers. However, quantum mechanics shows that particles have a finite chance to "tunnel" through due to their wave-like nature, as described by the Schrödinger equation. This occurs because the wavefunction maintains a nonzero amplitude inside and beyond the barrier, resulting in a small but definite transmission probability [1]. The tunneling effect is essential for explaining phenomena like alpha decay in nuclear physics, where alpha particles leave the nucleus even though they lack enough kinetic energy to pass the nuclear potential barrier through classical means. It also forms the basis for technologies such as tunnel diodes and scanning tunneling microscopes (STM), which utilize the tunneling probability's dependence on barrier width at an atomic scale [2]. The likelihood of barrier penetration depends exponentially on the barrier's height and width, as well as the particle's energy. When particle energies are higher or barriers are narrower, tunneling probability increases considerably, leading to nonlinear effects like substantially reduced radioactive half-lives for some isotopes [3].

LITERATURE REVIEW

The tunneling effect, also known as quantum tunneling, was first understood theoretically in the late 1920s. Physicists Leonid Mandelstam and Mikhail Leontovich, who published their findings in 1928, were among the earliest to discover tunneling phenomena independently. The idea was expanded by George Gamow, and separately by Ronald Gurney and Edward Condon, who used tunneling to mathematically explain alpha decay in the same year.

The first experimental demonstration of electron tunneling in solids was performed by Leo Esaki in 1957, who observed tunneling in semiconductors and developed tunnel diodes. Following Esaki's work, Ivar Giaever experimentally demonstrated tunneling in superconductors in 1960. Then, Brian D. Josephson theoretically predicted new tunneling phenomena in superconductors in 1962, known as the Josephson effects. For their pioneering work on tunneling in solids, Esaki, Giaever, and Josephson were awarded the Nobel Prize in Physics in 1973. Recent findings in 2025 include the Unveiling Under-the-Barrier Electron Dynamics in Strong Field Tunneling [UBR] experiment, developed by Scientists, Tsendsuren Khurelbaatar, Michael Klaiber, Suren Sukiasyan, Karen Z. Hatsagortsyan, Christoph H. Keitel, and Dong Eon Kim [4]. They have interpreted UBR in the context of strong field action. Their findings can support our Radio Receiver Hypothesis {RRh}.

METHODOLOGY

This research paper utilizes the Google Scholar academic search engine and Research Gate to systematically find and examine relevant scholarly literature to support our theoretical framework and hypotheses. This comprehensive literature review aims to establish a strong foundational context rooted in peer-reviewed physics studies, thereby enhancing the rigor and credibility of our theoretical concepts.

Discussion and Insight

The [UBR] model potentially offers a semi-quantitative explanation of quantum tunneling phenomena, where an electron interacts with a potential barrier, such as a crystalline wall, resulting in an exchange of energy that enables the electron to surmount classically forbidden regions. Nevertheless, we posit that, from a fundamental physics perspective, the process by which the electron transitions from an external to internal region or vice versa must strictly conform to the Law of Conservation of Energy. Consequently, this suggests that while the [UBR] model provides a partial

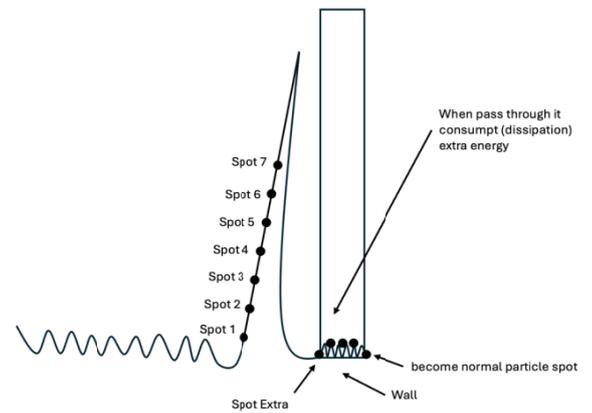
understanding of the tunneling mechanism, it does not account for the complete dynamical constraints dictated by quantum mechanics and energy conservation principles. Therefore, the [UBR] model can be considered a theoretically valid depiction of the phenomenon; however, it is only partially corrected, indicating that it requires additional refinement and validation against empirical data to achieve a comprehensive and accurate description. This limitation suggests that the model captures some essential aspects of the underlying physics but does not yet fully account for all the relevant interactions and variables involved.

Mechanism behind

Our assumption is that the underlying mechanism is that the electron exists as a wave, but when measured such as in our postulate by turning on a radio (whether you listen to it or not) the wave collapses into a localized point, concentrating a large amount of wave energy into a small area. This could give the electron additional energy. In other words, if our hypothesis is correct, we believe that this extra particle energy comes from the wave transforming into a spot point, which concentrates wave energy at the electron's location. In our Radio Receiver Measurement Hypothesis {RRh} Model, this process is related to the action of turning on a radio, representing a measurement event from the electron's perspective. As the wave collapses into a particle, the electron gains extra power. Consider an illustrative example: according to our postulate, when a radio frequency electromagnetic wave interacts with the receiver, the underlying quantum particles electrons exhibit wave-particle duality. Specifically, the incident radio photon induces electron excitations, causing them to behave as discrete particles during detection. This phenomenon underscores the wave-particle duality inherent in quantum electrodynamics, where the electromagnetic field interacts with charged fermions, resulting in observable particle-like behavior during the measurement process. When we listen to the radio on one side of a wall, the electron will exhibit particle-like behavior. When conducting a thought our experiment where a radio signal is received on one side of a partition wall, the scenario can be likened to a measurement process at the quantum scale from the perspective of an electron. According to quantum measurement theory, the act of detecting a classical electromagnetic wave such as radio frequency radiation induces a collapse of the electron's wave function, leading to a localized particle-like behavior on the other side of the barrier. This analogy draws parallels with the wave-particle duality principle in quantum mechanics, highlighting how the interaction with a classical field can induce a transition from a delocalized quantum state to a localized, particle-like state, akin to the behavior observed in quantum measurement devices.

Innovative {RRh} Tunneling Effect Interpretation

But when we turn on our radio, it's as if we are measuring it (from the electron perspective), whether or not we hear the signal. In other words, when we turn on the radio, on the other side, the electron wave collapses at a point, absorbing all the energy of the wave, and then it becomes a dot that passes through the wall with extra energy. But when the electron passes through the wall, it uses up some of that extra energy during the process. In the end, the electron remains the same as it was at the source the radio so the input equals the output.



$$\sum Spot1 + Spot2 \dots Spot7 = Spot Extra$$

Figure 1. The Tunneling effect mechanism in Radio Receiver Concept (energy consumption)

We modify it and refer to it as a [UBR]C model, incorporating consumption theory, which serves as an extended interpretative model of the [UBR-C] model.

That is to say, it captures the electromotive force of the left wave and converts it into a tunneling particle. During the tunneling process, the excess energy of this potential is used up and becomes the same as that of a regular electron. The process repeats continually, serving as the connecting particle for transmission.

That is, [UBR]C does interact with Wall, but it also interacts with waves and becomes (a spot of particles) (extra power particles).

Insight:

Borrowing Space-Time Creating Extra Energy

The reason is that space actually creates time. When the electron travels into the tunnel, from its perspective, space-time is compressed. This means the electron must be accelerated, creating additional energy before and during the entry process. However, while traveling, it will consume and dissipate energy, so in the end, it will be in the same form as a particle. Our further explanation approach in expressing the concept of Borrowed space and borrowed time generate extra energy. This can be explained because time is compressed, which leads to acceleration, so extra energy is generated to penetrate the Wall.

Entanglement in super-linear tunneling

Jump to quantum annealing. Under the tunneling effect, quantum annealing gains new energy; however, part of this energy is consumed during tunneling. During rapid mass-to-energy conversion, the energy of the wave point formed in the outer wall equals the energy that escapes. Due to time and space considerations when entering, particles of light and electrons are forced to accelerate and undergo we so call an "super-linear tunneling" $\sqrt{\quad}$. As a result, before entering, the wave behaves like a particle. The acceleration generates extra energy, but this energy is also used up during tunneling, so the particle's energy before entry and after exit remains the same (equally likely).

Tunneling Effect Equation

When,

$$\begin{aligned}\Delta \int \lambda e^+ &\cong \Delta e^{++} \\ \Delta \lambda \partial e^+ &\cong \Delta e^{++} \\ \Delta \lambda e^+ &\cong \Delta \lambda e^+\end{aligned}$$

Innovative super-linear tunneling Effect Equation

So, $e^+ = AT\&T$ during the Tunneling Process

A , refer to accelerate with respect to Time

T , refer to the transformation with respect to acceleration

$\&$, refer to $\sqrt{\quad}$

T , refer to transformation

So, our explanation of the tunneling effect can be further interpreted as a so-called faster-than-light action, when the electron passes through the wall process in {RRh}, and at the finish line, it becomes a normal electron particle.

Black-hole theory in Hawking radiation

Our Radio Receiver Hypothesis {RRh} will further explain the black-hole theory in Hawking radiation. In the information paradox, we can interpret it through our Radio Receiver Hypothesis {RRh}, since there is an energy transformation in a specific spacetime moment. During the tunneling effect, it might cause an entanglement phenomenon, which means it occurs whether or not you are listening to the radio.

However, when you turn on the receiver (radio), the electron wave state will collapse. And enter into a Jump to quantum annealing. Under the tunneling effect, quantum annealing gains new energy; however, part of this energy is consumed during tunneling. During rapid mass-to-energy conversion, the energy of the wave point formed in the outer space equals the energy that escapes.

Conclusion

This research paper offers new insights into the tunneling effect. By introducing our innovative radio receiver hypothesis approach {RRh}, we hope to bridge the gap between quantum physics and classical physics. With our new model, we aim to further clarify the quantum jump annealing process, which may help explain the phenomenon of quantum entanglement in superposition. We hope this research can contribute to the field of physics and benefit the mankind.

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