Interference-Induced Particle-Wave Theory [Letter]

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(Abstract 1.1)

We propose a theory based on wave-particle duality and many of the principles of the Double Slit Experiment; Mostly the destructive interfering part. Continuous interference reduces the wave amplitudes to atomic scales, explaining particle-like behaviour without having the wavefunction collapse. Our "Parent Wave" model suggests that particles are localized manifestations of underlying waves.

(Introduction 1.2)

Our theory revolves around the measurement barrier not being real, but rather there just being a "made-up" world that we have, called the Quantum World. Electrons and Photons, which are the main focus of our theory, behave consistently across both the quantum and real worlds. In both domains, their wave-like properties persist through continuous destructive interference, reducing to atomic scales without requiring wavefunction collapse.

Keywords: Destructive Interference; Wave-Like Properties; Parent Wave

Objectives: (1.3)

- To propose a theory that can also support other theories such as Many Worlds Interpretation.
- To introduce "Parent Wave as a new variable to the scientific community"

Methodology: (1.4)

- Our theory is made from being inspired by many of the key experiments/theories of the Quantum Physics world.
- Our theory lies on the basics of wave interference, how constructive and destructive interference can cause a wave to get a whole another form.
- Assistance in mathematical equations provided by AI's and other Physicists.

Parent Wave (1.5)

When waves interfere destructively, they combine to form a wave with a smaller amplitude. This wave, when reduced to the size of atoms, is called, "the Parent Wave". The P.W can generate new waves, which also interfere and reduce in size. This process is continued by the new P. W's also being made. This explains how waves like Light-Waves and Electrons can appear as particles without collapsing the wavefunction.

- **Generation**

1. Parent Wave generates successive waves due to its wave-like nature.
2. These generated waves interact and destructively interfere to match the Parent Wave's scale, making it a loop/cycle of a kind. If 2 waves A_1 and A_2 interfere, the resultant amplitude will be:

$$\mathbf{A_{result} = \sqrt{([A_1^2 + A_2^2 + 2A_1A_2\cos(\Delta\phi)])}}$$ [Click here to see the Derivation]

Where Δφ is the phase difference.

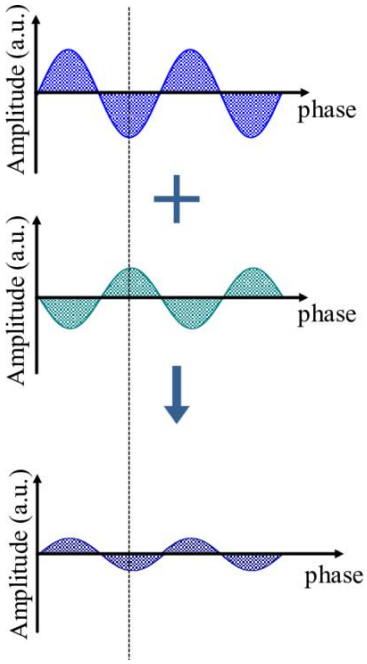
- **Interference and Reduction**

1. With each step of interference, the amplitude is reduced by a factor *k*.

$$A_{result} = k^n A$$ [Click here to see the Derivation]

Where *k*, is the reduction factor, *n*, is the no. of interferences and A_{result} is the resulting amplitude after the destructive interference

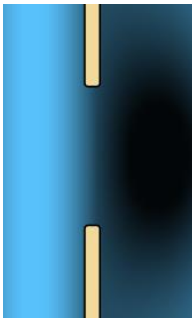
2. This continuous process explains the quantum behaviour of particles as waves.



[img. 1- Destructive Interference shown; Constructive interferences' part of the img. cropped (edit)]

Double Slit Experiment (1.6)

The Double Slit Experiment [1] also shows destructive interference. It has shown the interference pattern which is directly related to our theory. In the observations of the Double Slit Experiment, the wave was said to be in superposition. But according to us, it was everywhere at the same time, without being in superposition. The wave sent to the screen was our Parent Wave, and when it generated more waves, they destructively interfered with each other, to create the pattern.



[img 2- The origin of Parent wave according to our theory]

The Intensity '*I*' at a point on the screen can be described by:

$$I = I_0 \left(cos \frac{\pi d \sin \theta}{\lambda} \right) \text{^} 2$$

Comparison to other theories (1.7)

theory also supports the theory made by Hugh Everett, Many Worlds which says that the wavefunction doesn't collapse but rather splits into different branches, which are different universes. This could be said for our theory as well; As those waves, when destructively interfering with each other, generate new waves (Done by P. Ws). That could show that every new wave created, is a branch of a different universe.

Conclusion (1.8)

The proposed "Parent Wave" model offers a new perspective on wave-particle duality, suggesting that particles arise from the continuous interference of underlying waves. While experimental verification is currently challenging, this theory presents a potential framework for understanding quantum phenomena without involving the wavefunction's collapse, just like the Many Worlds interpretation

We anticipate that the "Parent Wave" concept will stimulate further theoretical and experimental researches. Advances in experimental techniques and theoretical understanding may ultimately lead to an evaluation of this model.

Summary of the theory:

- The Wavefunction doesn't collapse but rather the waves are destructively interfered by other waves, causing their amplitudes to be reduced to the size of atoms, therefore making them LOOK like particles.
- The wave generating newer waves is known as, the "Parent Wave".
- This theory does support the proposal of Hugh Evrett, of MWI.

Appendix (1.9)

Derivations:

[a]: $\mathbf{A_{result} = \sqrt{([A_1^2 + A_2^2 + 2A_1A_2\cos(\Delta\phi)])}}$

This equation is derived from the principle of superposition for two interfering waves. Breakdown of it:

1. When two waves A_1 and A_2 interfere, the resultant amplitude, A_{result} depends on their individual amplitudes and the phase difference ($\Delta\phi$) between them.
2. Using the low of cosines for vector addition, the resultant amplitude is:

$$\boldsymbol{A_{result} = \sqrt{([A_1^2 + A_2^2 + 2A_1A_2\cos(\Delta\phi)])}}$$

[b]: $\boldsymbol{A_{result} = k^nA}$

Suppose we have a wave with initial Amplitude ***A.*** After each destructive interference, the amplitude is reduced by a factor *k*.

1. After the first interference, the amplitude A_1 is:
$$A_1 = kA$$
2. After the second interference, the amplitude A_2 *is:*
$$A_2 = kA_1 = k(kA) = k^2A$$
3. After the third interference, the amplitude A_3 is:
$$A_3 = kA_2 = k(k^2A) = k^3A$$

Continuing this process for *n* interferences, the amplitude A_n is:

$$A_n = k^nA$$

References (1.10)

[1]: Vaidman, Lev, "Many-Worlds Interpretation of Quantum Mechanics", *The Stanford Encyclopedia of Philosophy* (Fall 2021 Edition), Edward N. Zalta (ed.),

URL = <https://plato.stanford.edu/archives/fall2021/entries/qm-manyworlds/>.

Img. 1 - Gao, Shuai. (2019). A combined theoretical and experimental analysis on performance and functionality of printed dielectric mirrors.

URL = https://www.researchgate.net/publication/338146983_A_combined_theoretical_and_experimental_analysis_on_performance_and_functionality_of_printed_dielectric_mirrors

Edit: Constructive interferences' part of the image was cropped.

Img. 2: Simulation by PhET Interactive Simulations, University of Colorado Boulder, licensed under [https://creativecommons.org/licenses/by/4.0/]; [https://phet.colorado.edu/]