Some Insight into the outcome of Double-Slit-Experiments

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Abstract

The particle-interference-experiments, with the photons and electrons have clearly shown that they are always detected as localized 'particles'; and the density of their detections exhibit a pattern similar to the interference of waves. This experimental-observation is alternatively interpreted here, different from the current, 'probabilistic interpretation'. The 'particle' is first mathematically characterized as an 'impulse function' in space; and then Fourier-transformed into the wave-number-domain, as a wide band of constituent-waves as shown in the fig. 1&2. The 'particle' is an 'event' of constructive-superimposition of a wide band of 'pre-quantum-waves'. This 'event' occurs in space at regular distances; and at regular instances in time. In the particle-interference-experiments, they are the wide band of 'pre-quantum-waves which interfere physically. This physical interference of the pre-quantum-waves determines the position and time of emergence of the 'impulse in space' detectable as the 'particle'. In the real-world-situation, the 'pre-quantum-waves of a wide bandwidth arrive from all the directions, so the amplitude and phase of every constituent wave keep changing; so the place of constructive superimposition of all the spectral-components, keep varying unpredictably; and only the 'probability' of detection in a given volume is possible in practice. Thus, form the theoretical view-point, there are only the pre-quantum-waves; and 'particle' is a specific situation of constructive-superimposition of all the spectral-components of pre-quantum-waves; so there is no wave-particle-duality. The 'probabilistic-interpretation' is only a 'practical-limitation', detector being able to detect only the 'particle', and not the spectrum of constituent waves.

1. Introduction

The wave-particle-duality of the photons and the electrons; their complementarity; Max Borns probabilistic interpretation of quantum-mechanical waves; Einstein's dissatisfaction, expressed in the words: "God does not play dice"; Fynmann's alternative method of path-integral; Prof. David Bohm's proposal of 'implicit order'; …are well known to the readers. Einstein's statement that: " My constant brooding over the problem for more than two decades has brought me no closer to the answer, on the true nature of the photon. Some rascals think, they know; but they are deluding themselves." This statement shows the gravity of the puzzle.

This letter attempts so resolve this puzzle of wave-particle-duality. It starts with the experimentally observed fact that photons and electrons are always detected as 'whole', 'un-split' 'particles'. These 'particles' are always localized in a point-like space. So, they are mathematically characterized here as an impulse-function in space. This 'impulse-function', when Fourier-transformed, yields a wide band of waves, termed here as 'pre-quantum-waves', to

distinguish them from the de-Broglie's matter-waves, and the quantum-mechanical-waves. The 'particle' of light or matter is not a substance, it is an 'event' of constructive-superimposition of the wide band of 'pre-quantum-waves'. In the double-slit-experiments, they are the 'pre-quantum-waves' which interfere physically. The interference of a very wide band of 'pre-quantum-waves' emerging from two different slits cause a change in the place of constructive-superimposition of them, detectable as the 'particle'. Thus, from the theoretical insight emerging from this letter, we can say that there are only the 'pre-quantum-waves' which interfere physically; and there is no theoretical uncertainty at the fundamental level. Since our instruments can detect only the 'particles', whose place of emergence depends of superimposition of a very wide band of 'pre-quantum-waves' arriving at a point from all the directions, we are constrained to predict only the probability-density in a given volume-element.

2. Description

Since the 'particle' is always detected at a point-like place, it can be mathematically characterized as an impulse-function in space as shown in fig.1. Now we can Fourier-transform this impulse-function from the space-domain into the wave-number-domain, as shown in the bottom of the fig.1. This wide band of waves of the fig.1,(Bottom) imply that the 'particle' contains a very wide band of 'pre-quantum-waves'.

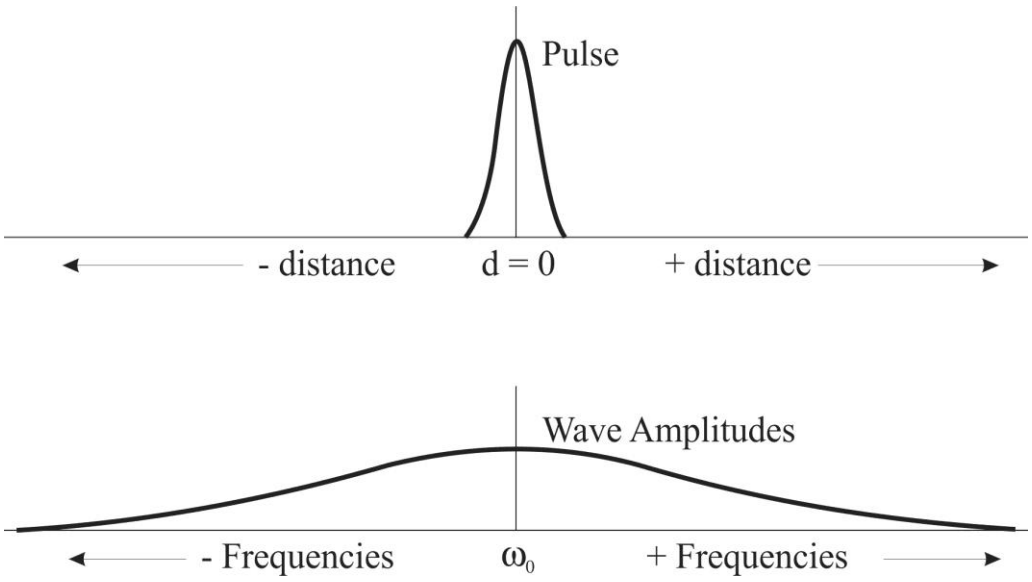
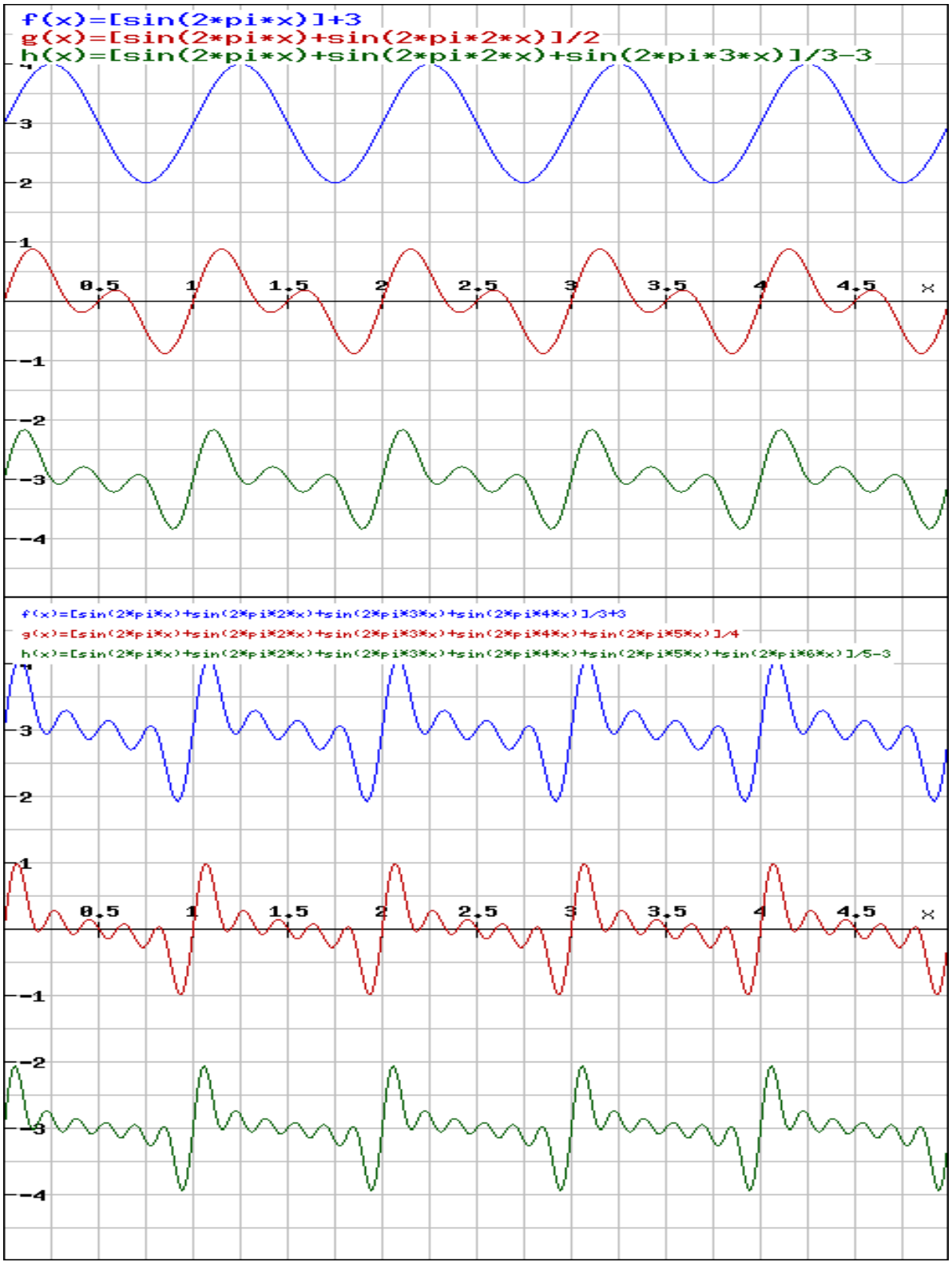


Fig.1: A 'particle' mathematically represented as a 'pulse-function' (top); and its frequency-domain-representation (bottom).

If we want to convert this wide band of waves back to the impulse, then we will have to constructively-add all the spectral-components of the wide band, having a specific phase-relationship, as shown in the figures below:


f(x)=[sin(2*pi*x)]+3
g(x)=[sin(2*pi*x)+sin(2*pi*2*x)]/2
h(x)=[sin(2*pi*x)+sin(2*pi*2*x)+sin(2*pi*3*x)]/3-3
f(x)=[sin(2*pi*x)+sin(2*pi*2*x)+sin(2*pi*3*x)+sin(2*pi*4*x)]/3+3
g(x)=[sin(2*pi*x)+sin(2*pi*2*x)+sin(2*pi*3*x)+sin(2*pi*4*x)+sin(2*pi*5*x)]/4
h(x)=[sin(2*pi*x)+sin(2*pi*2*x)+sin(2*pi*3*x)+sin(2*pi*4*x)+sin(2*pi*5*x)+sin(2*pi*6*x)]/5-3
x

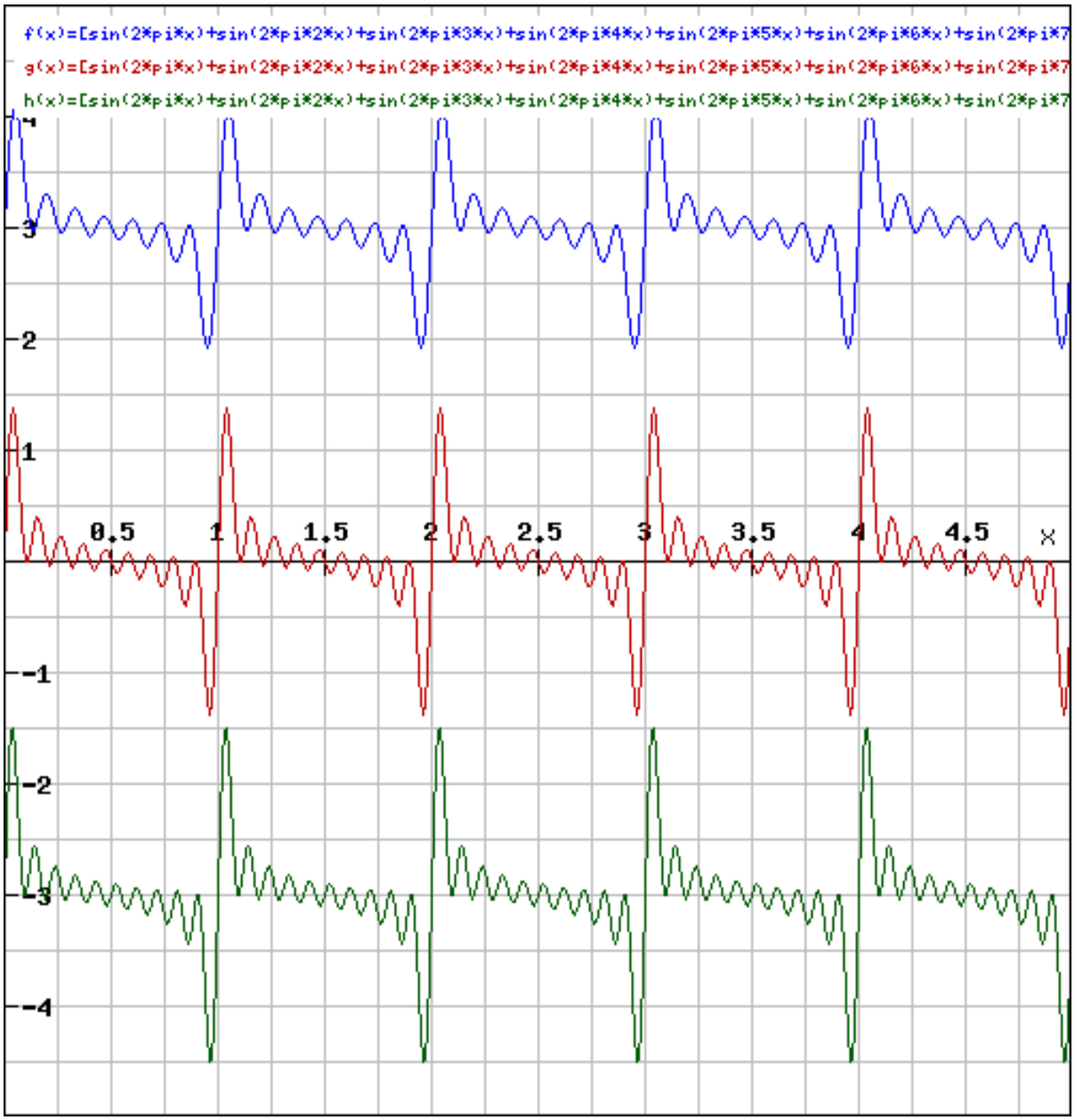


Fig.2: Figure showing ‘waves’ becoming 'particles': As we add more and more higher-harmonics to the fundamental-wave, they go on getting localized, like the ‘particles’.

This implies that the ‘particle’ of light or matter is an ‘event’ of constructive-superimposition of a very wide band of ‘pre-quantum-waves’. So when this wide band of waves is passed through two near-by slits, the output waves from both the slits will experience ‘interference’, and both the slits will behave as if they are the point-sources of waves; spreading waves in all the radial directions. Due to the interference of the two sets of wideband-waves from the two slits the place of constructive-superimposition of all the spectral-components keep changing. Fortunately, a regular pattern of dark and light bands of detections emerged in the double-slit experiments,

though this regular-pattern was a ‘secondary-effect’. It helped us to infer some wave-aspect involved in the detections of ‘particles’.

With the help of the above-mentioned characterization of the ‘particle’ as an impulse-function in space; and its Fourier-transform containing a very wade band of pre-quantum-waves, we now get some insight into the “wave-particle-duality” puzzling the minds of great scientists for so many decades.