“De Broglie Frequency removes wave-particle-duality”

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11.1.1. Wave-particle duality for particles and locality of superposition effects between particle beams

Albeit generated through some nonlinear physical processes, the harmonic undulations of particles of internal energy E have been captured by Schrodinger for free particles as:

$$\exp(-iEt/\hbar) = \exp[-i2\pi\ ({}^{in.}f)t]; \quad \text{where } E = h\ ({}^{in.}f) \tag{11.19}$$

If we assume that a stable particle of energy E exists as some form of 3D structural oscillation of the CTF of a resonant frequency $({}^{in.}f)$. Then we have particles as localized harmonic oscillations of specific amplitude-gradient of the CTF. Schrodinger’s expression, $\exp(-iEt/\hbar) = \exp[-i2\pi\ ({}^{in.}f)t]$, represents a real physical undulation. It does not represent either a plane wave, or “*an abstract mathematical probability amplitude*”. The “*Hidden Parameter*” is this physical frequency of oscillation already built into QM formalism. The phase of this oscillation becomes a critically important parameter when more than one particle tries to exchange energy on to the same quantum mechanical particle needing a discrete amount of energy to undergo QM allowed transition.

We can now re-write the Eq.11.18, using Eq.11.19, in terms of rest-frequency ratio of particles-to-electrons as:

$${}^{in.}_{p}f = {}^{in.}_{el.}f\,(2\alpha)^{-1}l \tag{11.20}$$

The internal frequency for an electron can be computed from $E = h({}^{in.}f)$ as ${}^{in.}_{el.}f \approx 1.23 < 20 >$. This also appears to be in the range of highest frequency gamma rays that can be converted into electron-positron pair while being scattered by some nucleon. For CTF, this appears to be the possible boundary between linearly push-able gamma-wave-frequency and localized nonlinear self-looped-frequency of electron and positrons.

One can now appreciate that the heuristic concept of de Broglie wave or *pilot wave* is not necessary to understand why harmonic phases embedded in Schrodinger’s ψ plays such a vital role in all of quantum mechanics. Since ψ represents the stimulation of a particle (in complex representation) for a single quantum transition, and $\psi^*\psi$ represents energy transfer as a real-number for a single event (a quadratic process). Further, there is a very brief *quantum compatibility sensing interval* built into the mathematical step $\psi^*\psi$ [1.49; see also Ch.3]. During this time interval, all other ever-present and randomly passing-by particles and waves also try to share their energy by inducing their own stimulations on to the same particle, making ψ statistically dependent upon the background fluctuations. These background fluctuations can rarely match the QM resonance in strength and induce the QM-compatible strong linear undulations; but they can still perturb the stimulation process and share minute amounts of energies. Since we can never track and quantify these innumerable background stimulants, all QM formalisms will always have to remain statistical forever. This is, of course, already built into the current QM formalism as the step of taking ensemble average $< \psi^*\psi >$ [1.49].

We know that stable elementary particles remain stable even when they are accelerated to reasonably high velocities with high kinetic energy. Hence, their acquired, continuously variable, kinetic energy, most likely, have some separate manifestation than interfering with the internal 3D oscillations of CTF of energy $({}^{in}E) = h({}^{in.}f)$, which is at the root of its stability as a particle. More research would be needed to delineate this point. The particle’s internal 3D oscillations, as a stable unit, are tied to all the various tension components built into CTF. Let us then postulate that stable particle oscillators can assume another kind of simpler 3D harmonic oscillation of frequency, ${}^{k}f$, associated with its acquiring translational kinetic energy as, ${}^{k}E = m\mathrm{v}^2/2$. Or,

$$ {}^{k}E = m\mathrm{v}^2 / 2 = h\ ({}^{k}f) \tag{11.22} $$

Then, we can create a *fictitious* wavelength parameter ${}^{k}\lambda$ using the logic that the particle travels a distance ${}^{k}\lambda = \mathrm{v}\ ({}^{k}f^{-1})$ while completing one cycle of its *kinetic oscillation* for a given velocity, which facilitates the kinetic movement through CTF, initiated by some force gradient in the CTF.

$$ ({}^{k}\lambda)({}^{k}f) = \mathrm{v} \ \Rightarrow\ ({}^{k}\lambda) = \mathrm{v} / ({}^{k}f) = h\mathrm{v}/(m\mathrm{v}^2 / 2) = 2h / p \tag{11.23} $$

Note that our heuristic derivation gets, ${}^{k}\lambda = 2h / p$, instead of ${}^{k}\lambda = h / p$ derived by de Broglie [11.32,11.33]. The reason behind separating ${}^{k}f$ from ${}^{in.}f$ can be appreciated from the fact that a particle with zero velocity (momentum) cannot represent itself with infinitely long wavelength parameter ${}^{k}\lambda$. It becomes infinity when the kinetic energy (velocity) becomes zero. Thus, de Broglie ${}^{k}\lambda$ is a non-physical parameter. But our proposed ${}^{k}f$ tends to zero just as the kinetic energy tends to zero: ${}^{k}E = m\mathrm{v}^2 / 2 = h\ ({}^{k}f)$. We will now use this proposition to explain the phase-dependent superposition effects due to superposition of phase-steady (mono-velocity) particle beams.

Since particle-particle interactions are also driven by two steps, phase sensitive complex field-field stimulations as ψ, followed by energy exchange through the recipe $\psi^*\psi$, we can now appreciate superposition effects due to particle beams as *localized interactions* between harmonically oscillating multiple particles arriving simultaneously and stimulating the same detecting molecule and all of them trying to transfer some of their energy, which would mathematically appear to be like a phase dependent interactions, or a superposition effect. The sharing of the quantity of the kinetic energy between any interacting particles is guided by the type of interaction. If the particle (detector) is being stimulated, is a resonant quantum entity, it will fill up its *quantum cup* by accepting the necessary amount of energy from all the donor stimulators present simultaneously as per QM recipe.

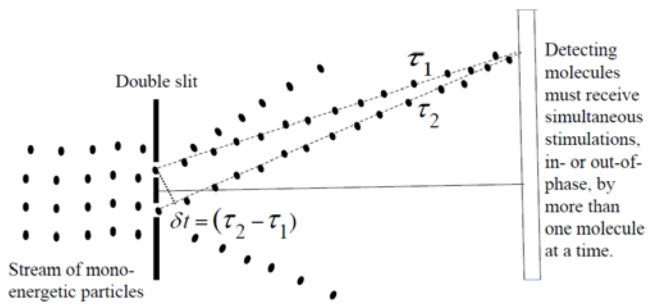


Figure 11.5..Understanding two-slit particle-beam superposition effect as due to multiple particles arriving in-phase and out of phase at different locations and correspondingly triggering very strong and very weak and phase-dependent energy transfer to detecting molecules. The detecting molecules absorb energy according to the QM recipe, square modulus of the sum of all the simultaneous stimulations it experiences.

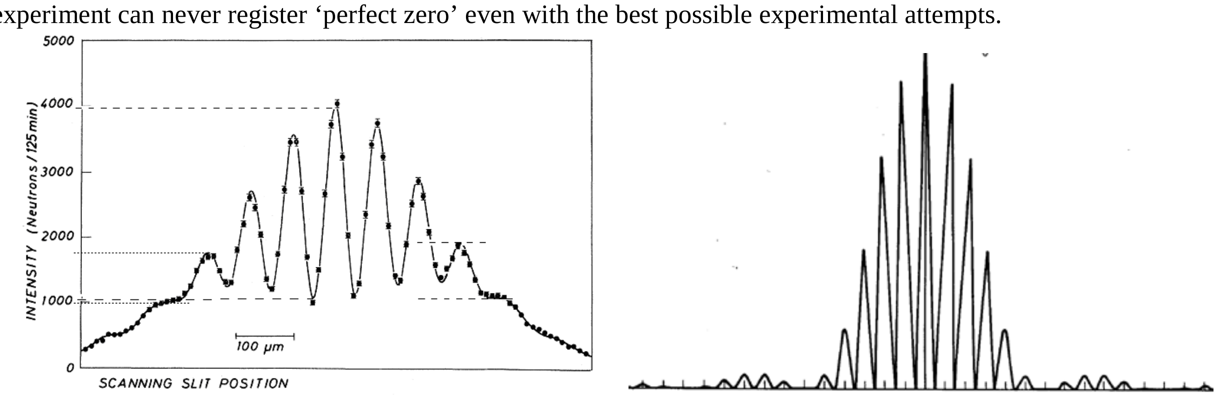
As depicted in Fig.11.5, mono-energetic particles with velocity v and corresponding kinetic frequency ${}^{k}f$, arrive at location P in the detectors surface with distinctly two different phase information, $\exp[i2\pi({}^{k}f)t]$ and $\exp[i2\pi({}^{k}f)(t+\tau)]$, due to their distinctly different propagation path dely. If χ is the linear response characteristic of the detecting molecules and the same molecule (or their assembly) experience two stimulations, $\psi_{1,2} = \chi \exp[i2\pi\, {}^{k}f t_{1,2}]$, then the spatial distribution of energy transfer and consequent transformation experienced (fringes registered) by the detector would be given by:

$$ D(\tau) = \left|\chi\psi_1 + \chi\psi_2\right|^2 = \left|\chi e^{i2\pi\, {}^{k}ft} + \chi e^{i2\pi\, {}^{k}f(t+\tau)}\right|^2 = 2\chi^2[1 + \cos 2\pi({}^{k}f)\tau] \tag{11.24} $$

The absorbed energy comes from both the stimulating particles $\psi_{1,2} = \chi \exp[i2\pi\, {}^{k} f t_{1,2}]$; QM formalism of Eq.11.24 clearly implicates this. Trajectories of the individual particles are not mysteriously re-directed by some unknown force to create the fringes. The two different stimulating phases $\chi \exp[i2\pi({}^{k} f)t_{1,2}]$ are two causal signals brought by two real particles arriving simultaneously to stimulate the same detecting molecule at P. They have travelled different distances, $\tau = (r_2 - r_1) / \mathrm{v}$, where r_2 and r_1 are two distances to the same detector at the point P from the two slits.

If our postulate is correct that phase sensitive superposition effect generated by particle beams is due to particles acquiring harmonic oscillation ${}^{k} f$ due to velocity v, then it may not be impossible to generate same kind of superposition fringes by sending two different kinds of particle beams having the identical kinetic frequency through the two slits. Then the detecting particle will experience two distinctly different and causal *amplitude stimulations* $\chi_{1,2} \exp[i2\pi({}^{k} f)t_{1,2}]$ and absorb energy accordingly producing fringes of visibility less than that one can get using same kind of particle. This would clearly establish that the postulate, *single-particle-interference*, is not a causality-congruent hypothesis. We should underscore again that the detecting molecule must be a resonant energy absorber, which first experiences amplitude-amplitude stimulation and then extracts energy from all the stimulating fields (particles). This, of course, is already built into Eq.11.24; which is mathematically similar to light-detector stimulation.

Let us review the situation more critically. To bring back hard causality, we have posited that stable single indivisible particles, while propagating in a force-free region, cannot distribute their arrivals in some well-defined patterns, which we can be modeled analytically as due to two distinctly different physical path delays [1.26]. Simultaneous stimulation of the same detecting molecule by two or more particles is critical for in-phase or out-of-phase excitation is behind the generation of superposition effects due to particle beams. This is because, unlike EM waves, individual particles are not divisible and cannot diffractively divide as a classical coherent wave front does. Therefore, the only possible way to explain the phase driven superposition effect generated by detectors is to assume that a detecting particle must have a finite time of interaction to get stimulated before any quantum transition takes place. During this very short interaction period, if two exciting particles with opposite phases (of internal undulations) are superposed on a detecting particle, the detecting particle cannot be stimulated just as it happens when two EM undulations of opposite phases cannot stimulate a photo detecting molecule. What does this mean to fringe quality in particle-particle superposition experiments? Since most particles arrive with enough energy to be detected by the detecting particles, the “bright fringe” peaks will have relatively more “clicks” than the dark fringe minima. For dark fringe minima to remain ‘zero’ after a prolonged exposure, the stimulating particles must always arrive in even numbers with opposite phases to keep the detector particle from registering them at all. This is statistically almost impossible. In other words, our analysis implies that the minima in a two-slit particle diffraction experiment can never register ‘perfect zero’ even with the best possible experimental attempts.



(a) (b)

Figure 11.6. (a): A classic double slit neutron diffraction pattern by Zeilinger et al [Fig.7 in ref.11.34] as presented earlier [1.26]. Note that the visibility of the fringes even at the center of the pattern is barely 0.6 which indicates the detection (arrival of) a

large number of neutrons at the null regions. We explain this as arrival of some random single neutrons besides simultaneous arrival of even number of neutrons with opposite phases. The phase we hypothesize is due to some actual internal sinusoidal undulations of the particles that dictate interactions capability with the detectors. The opposite phases required to generate the null fringes is not due to de Broglie *Pilot Waves.* (b): For the sake of comparison, we have copied a theoretical double-slit pattern of unit visibility, when one uses phase-steady optical beam [11.35].

$$\mathbb{V} = (I_{\max} - I_{\min}) / (I_{\max} + I_{\min}) \tag{11.25}$$

So, we are copying here in Fig.11.6, the classic two-slit neutron diffraction pattern by Zeilinger et. al. [11.34] as modified in Fig.7 of ref. [1.26]. The visibility of the cosine fringes, instead of being unity, it is steeply degrading with the angle starting from the center to the edge. Even at the center the visibility is only 0.6, far below unity. In the middle (3rd fringe from the center), the visibility is between 0.27 and 0.32. It is practically zero at larger angles even where the accumulated count is close to 300. In an optical two-slit experiment, one can easily register unit visibility fringes, shown for comparison in Fig.11.6b.

Another way to validate our proposed explanation for superposition effect due to particle beams would be as follows. Assume we are using a mono-energetic beam of Rb atoms through a two-slit system. The far-field detection plane contains a thick high-resolution photographic plate. The arrangement is such that the development of the photographic plate will show black and white fringes as predicted. The next question is as follows. Are the bright lines (the zeros of the fringe pattern in the photographic negative) completely free of Rb atoms? We suggest that this plate be illuminated by 780nm laser beam to generate resonant fluorescent spontaneous emission which can be recorded as a one-to-one quantitative image. Our prediction is that the distribution of Rb fluorescent intensity will resemble approximately the superposition of two slightly displaced Gaussian beams as classical *bullet* theory would predict.

Thus, by imposing interaction process visualization epistemology and assuming particles as 3D localized undulations, we find that QM has more realities built into it than the Copenhagen Interpretation has allowed us to imagine. Our hypothesis, particles as 3D localized oscillators, safely removes the *wave-particle duality* for particles; just as we have established for photon wave packets in Ch.10. Superposition effects due to EM wave beams and particle beams are two distinctly different but causal phenomena. The commonality derives from the detectors being quantum mechanical. The measured superposition effects are generated by resonant detectors due to phase-dependent joint stimulations induced by more than one physical beam. Detectors with different intrinsic properties will generate different types of superposition pattern for the same set of beams. The quantumness observed in the data is due to the quantum mechanical energy absorption properties of the detectors used. Superposition of radio waves on an LCR-detecting circuit does not show any quantumness.