

Quantum mechanics: *Continuation*

9. The particle - wave duality:

Some general remarks:

In the classical experiment photons - or electrons (or even atoms) are emitted from a source towards a screen with one or two slits. Behind there is a detecting screen. With one slit open, the quanta behave rather like "particles", with two slits open the detecting screen shows interference, the wave behaviour or property of the quanta.

There is always in second - or third - forth ... hand descriptions of these experiments too little information. Very seldom conditions is such as the dimensions of the slits in relation to wavelength, the distances between slits (and distances between emitting source and screens). One such fact is that X-rays needs "slits" as narrow as in crystal lattices to show the interference patterns.

Nor is anything mentioned about how the photons are quantified. How many wavelengths of light make a photon as a quantum? According to some information (oral, high school) one has made two-slit experiments which showed that there was no interference if single photons were emitted with a time delay representing circa 1 meter of a light beam. According to L. one gets an interference pattern even with "years" of delay between the single photons. This implies that we have to take all secondary information with a warning. L. also contradicts himself: On an early page (55, Swedish version) he points to the fact that an interference pattern only slowly is built up by a lot of photons, when single photons are emitted with delay. Later in the book (page 167) he says one single photon can show such a pattern. Probably only carelessness, but an essential one.

The so called classical physics originates from war and the reach of projectiles as bullets in Galilei's time. It seems quite natural that we have to leave this old, simple ballistic physics for interpretations of all underlying levels - and all the superposed ones as in biochemistry and life.

Two other general remarks:

- Physicists don't seem to make any explicit analysis in terms of changes in dimensional degrees. (?)
- They seem to neglect the empty (or vacant) space, ignoring its eventually essential role as collaborator. (By that also Dirac's hole theory and $E = - mc^2$). (?) Repeating what was said under point 5, part 1:

First there seems to be a mix up of two different kinds of duality:

We should distinguish between the particle-wave-duality and that operating in interference, even if the latter is said to characterize waves only. Waves are waves, even without any "interference".

Particle - Wave duality is not the same kind of complementary polarity, not poles of the same dimensional degree, said in terms of the model here. But the so called "interference" patterns on the detecting screen are: as polarizations between positive and "negative" energy hits.

Secondly, about the concept of "interference":

Could it possibly also be a mix up of two different processes in this concept?

Is it really right to interpret the striped patterns appearing with two open slits only in terms of the typical interference of waves, alternately amplifying and extinguishing each

other by the combination of their maxima and minima, as in texts about quantum mechanics?

If it's true as L says that even with "years" of delay between single, emitted quanta there appears an interference pattern, then obviously it seems as if quite another principle of polarization is acting too.

The particle-wave-duality first:

From aspects of the 5-dimensional model here we have in other chapters suggested the preliminary view that "particles" are characterized by inward direction, versus "waves", characterized by outward direction.

5 — 4 — 3 — 2 — 1 — 0/00
 particle <----- or 4a (vectors inwards), 3a (circular)
 -----> wave or 4b (vectors outwards), 3b (radial)

Could such a view help us understand the experiments?

There is a difference in the d-degree of propagation: A classical particle has a linear (1-dimensional) pathway. A light wave too, according to the usual "classical" view: propagating along straight lines if not curved by gravitation (or eventually by the slits if these are small enough to brake up a single wavelength?). But the light wave oscillates in 3 dimensions, which eventually effects the surrounding space. (Cf. the hypothesis about "side-waves" in file Additions to Electromagnetic waves)

Other waves, spread from a centre, propagates in 2-3 dimensions.

A particle could be perceived as with enclosed centre, with more of "impermeability" in opposition to a wave.

Hence, we should be able to look at particles as with more structure, less motion moments than waves, that is of a higher d-degree according to the model here.

Yet, this view doesn't agree with the way physicists illustrate and describe particle-like quanta as "wave packages", as consisting of only a certain, quantified number of wavelengths.

Photons as particle-like quanta of EM-waves seem to be identified as such in experiments where the direction is inwards: so in Einstein's interpretation of EM-waves hitting out electrons from atoms. So too in the fact that EM-waves can give birth to electron pairs near heavier atoms.

Note, this can happen when these heavier atoms can absorb some of the motional energy, as it is explained (right or wrong?) in some source. In terms of the dimension model: one motion moment less: implying more of built-in structure, a higher d-degree. (Cf. a braking, as negative acceleration - inwards, coupled with "mass".)

In these latter events we should also observe that the created quanta or "particles", the electron pairs, have opposite signs: e+/e-: e+ as Dirac's holes, out of "negative" energy, vacant space. This implies that the "surrounding" is used by the positive energy of the EM-wave, and that the wave gets transformed in complementary units like Yes or No, Particle - No particle and such opposites in these experiments.

Photons as the quanta of light belong to the so-called "carrier of forces" and also the other "carriers" use presumably the Vacant Space for their existence. A carrier between protons as the π -meson use anti-quarks from antimatter. We can note here that "forces"

as vector fields in this model represent d-degree 4, in principal "all"-directed, inwards /outwards.

If this view on particle-like quanta as of one d-degree higher should be valid, we could ask: What in the structure of the particle gets transformed to motion in a d-degree jump towards a lower d-degree? One guess is that it concerns the M-field in some way, the M-field interpreted as a pole connected with Vacant Space and inward direction on some levels in this model.

The concept "wave packages" doesn't express the inversion moment of directions in the structure between particle and wave character that we here presume, a kind of inside out turning: an into the particle incorporated M-component for instance, replaced by the use of exterior "vacant space" in the wave.

With the assumption that particle-like character implies a higher d-degree, the particle could also represent a kind of secondary "superposition". a superposition of E- and M-components for example (in photons, electrons, atoms...) as equivalent with "Yes" or "No", positive or "negative" energy forms... (Compare "Mass - Vacant Space" out of 4-dimensional vector fields.)

(Compare too "double messages" from parents as one kind of superpositions, which built into child can make the child enclosed into itself and lock its activity.)

Some physicists has thought about an eventual "resonance" between the 2 possible outcomes of a "collapsed" superposition (which L. brushes aside as a new mystery).

It shouldn't be more mysterious however than the immediate coupling (or "resonance" between electric and magnetic components (E- and M-fields) in a wave or the like.

A "collapsing" y-axis immediate defines both the outer poles +/- infinity of an x-axis in a 2-dimensional co-ordinate system, as immediate as a 0-pole, a point, defines an anti-centre, a 00-pole, expressed in terms of this model. (However, physicists don't like "probabilities" higher than 1 (!) and specially not the probability of wave-functions raising to infinities, so they have to keep themselves inside a unity circle?)

Hence, if a particle-like quantum is characterized by inward directed "fields", is it then quite right, as the physicists do, to ask which of 2 open slits the "quantum" has passed? The direction of emitted quanta is outwards, and perhaps that implies a change in the structure to a wavelike spreading which we never can detect, while all registration concerns "incoming" quanta?

A wavelike spread of the energies could theoretically mean that both slits are reached simultaneously. We could possibly imagine a "photon" or an electron divided into halves - as along the +/--halves of an x-axis*, "interfering" on the other side of the slits, recombined to single units when hitting the detector screen, but still it's hard to think of whole atoms in that way. (Only conservatism?)

* Compare how electrons sometimes are divided like that in illustrations of some orbitals in e-shells, as half loops around the halves (+/-) of the co-ordinate axes. Perhaps there could exist a coupling with the 2-slits phenomenon?

If we really separates the question about "interference", why couldn't we just think that an emitted "particle" takes sometimes this way, sometimes that way, when two slits are open? It shouldn't matter then that one destroys the "interference" by a measurement just behind the slits.

In the efforts to answer such a question about which way the quantum has passed, keeping to the idea of a particle, - and non-locality, a physicist like Feynman has talked about the particle taking "all ways" through the room. That is a 3-dimensional way. While another one (Hawking?) has used the metaphor of a globe where all directions straight outwards from the North pole lead to the South pole - a 2-dimensional spread or propagation.

With the concepts in the model here we could imagine an outward directed vector field (pole 4b) activated when a quantum is emitted from the source: the source or the quantum getting the role of a centre (pole 0). As said before, we could think of a 3-dimensional particle with 1-dimensional motion as a whole 4-dimensional system, activating the level of vector fields.

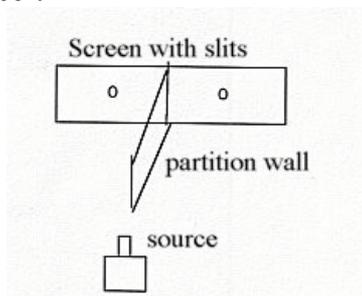
We could perhaps think of this field as similar to a balloon: One slit in the first screen in the experiments should get the role of a prick in the balloon: all its inner energy should gather (to a "point") and "leak out" that way.

Is it then the vector field or an "individualised photon", particle-like through the inward direction towards the slit as a centre - that escapes that way?

With two open slits in the screen, there would of course be two ways for escape of the energy, and two radial vector fields on the other side.

Of course we have to believe too that a volume of energy has an enclosing border or surface of some kind.

Has there been made any experiments with a partition wall between the slits towards the emitting source ?



Or with a rounded screen with the slits?

Another question about experiments:

If one photon was "shot" straight through one slit in the screen, and should take only a straight 1-dimensional way through the room towards this slit as as we are used to think that a ray of light does: then if we placed our eye or a detector on this side of the screen (before passage) and just a little bit beside it, we should not be hit by it or able to detect it - should we?

With all these thoughts on ("guiding"?) vector fields, quanta taking "all ways" through the room , balloons etc., the question seems to remain why the energy packages transforms to only one point on the detecting screen behind.

"Interference" patterns:

Interference is not inherent in the definition of waves.

Interference patterns need 2 open slits in the screen to appear, which eventually implies

- 2 sources of complementary forms of energy,
- plus the conditions: same energy source, and coherence (L).

This is another kind of a polarizing principle, acting between similar "poles" or sources - but still acting complementarily.

As said above: If the statement of L. is true that one gets an "interference" pattern even with "years" of delay between single, emitted quanta when the slits are open, then it is hard to explain this pattern as an interference between waves only, alternately amplifying and extinguishing each other by the interaction of maxima and minima, as one does in texts about quantum mechanics?

Yet, if we imagine the single quantum (inward form) transformed to a wave (outward form), according to views above, and the wave passing through both slits as $\pm \frac{1}{2}$ or something, we *could* get interference by that single entity. In that case we have to imagine that this interference in some way prepares the detecting screen as surface with a virtual striped pattern as a kind of guide lines, in spite of it hitting just one dot on the screen. A preparation below a threshold value? Potentially activates the other detectors on the screen?

(One could perhaps compare with the nervous system, with amplitude modulation inwards towards the nerve cell, and threshold values that have to be reached before the nerve cell reacts with a frequency modulated signal outwards?)

But should such an effect remain with years of intervals?

Another question concerns the look of the striped "interference" pattern: These light and dark, parallel bands (according to illustrations): are they really the pattern that for instance interfering sea waves (or sine waves) give?

Obviously the polarization giving the "interference" patterns in these experiments works transversal, orthogonal or "circular" in relation to the directions of radiation or pathways of quanta.

Couldn't we suspect that there is another polarization principle acting too here, the more fundamental polarizing principle, acting complementarily also on superposed levels, as in biochemistry, biology and social structures ?

There is a multiplicity of similar phenomena on higher levels among objects which behave according to classical physics - while they lack "coherence" in their inner details as L. describes it. (In this description L's view is that of an assembly, while we here think "the whole" comes first.) Just to mention a few examples:

We have the polarizations in the nervous system in the general opposition between the systems of inhibition and stimulation, sharpening the contrast. One single example is inhibition signals around activated receptors in the organ of hearing.

There are layers in air above earth and in ocean currents with polarization in contrasting temperatures. So too, one says, in cosmic clouds where heat and cold areas can get separated, apparently in opposition to traditional views on the spread of temperature.

Among living organism there are such things as arrangements of upwards and downwards leading ducts in plants. Among "classical objects" as human beings there is the grouping phenomenon, as between lion families, creating "preserves", where the operating force is expressed as "attraction and repulsion".

Kinds of "interference patterns" ?

In pure geometries:

2 opens slits as centres define a line. This line gets polarized into "motions to and from each other" according to the model here. That could be in forms of "negative" and positive energy, giving the striped patterns.

In terms of this 5-dimensional model we have the complementary poles inwards / outwards, mass / vacant space, E- / M-fields etc., or just directions +/- of a co-ordinate axis from a centre.

Density, suggested as the only physical quality in d-degree step $5 \rightarrow 4$ implies 1 d-degree branched off: (as the "line" between the two open slits?), which polarized to "d-degree 0/00" gives "motions to and from each other".

(If each 1-dimensional component of a d-degree is possible to analyse in pure motions (in agreement with first postulates), then also the transversal or circular one of pole 3a in this model: implying a density wave of that geometry too. Compare perhaps the hypothesis about "side-waves" here and possible changes of the values of "negative" energy of empty space.)

Two open slits in the screen is needed to get an "interference" pattern:

Reflect eventually upon this metaphor:

2 persons as similar centres talking with one another:

One listens; ears on the side of the head.

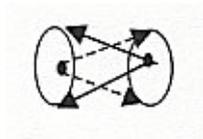
The other talks, activity from the mouth, from the centre of the head.

Then interchanging roles.

Centre and anti-centre as 0- and 00-poles in a consecutive process.

The root of the talking is vector fields, but the radiation takes the form of more or less individual quanta as words.

The persons illustrate two opposite gradients into one another.

**Two other questions** about the particle - wave duality:

What happens in the slits, if they are small enough to brake a single wavelength and not give room enough for its whole amplitude and the necessary counterdirection from empty space which it eventually needs?

Perhaps changes of roles between the complementary factors making up the wave or quantum?

Which physical effect makes the "wave function" collapse when a measurement behind a slit is made?

As said earlier (point 6 in part 1), something have to effect the measurement apparatus and this effect should reasonably have a countereffect (as a recoil) on the measured something, which could disturb the coherence, the necessary condition for "interference". (Newton's law about force and counterforce.).

Or, if in the discussion between two persons above, a third person, say a professional physicist like Bohr, interrupts, surely the discussion will "collapse" between the two perhaps equally silly and "coherent" persons - continuing eventually along a new line between discussing partners of different origin.

*