Light in Deterministic and Synergetic Processes

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Abstract
The experimental foundations of the 'photon with structure and field' are reported in detail. With those basic facts are reported diffraction and interference as deterministic interaction of single-processes by change of direction or reflection - refraction. However, in induced emission in laser the dominant field synchronized by interaction the photon in 'status nascendi' in a synergetic process, for the photon is built up during the so called life-time.

I. The erection of photons with structure

Between spontaneous stimulation (with in value variable or oscillating dipole-moment) and emission in visible light go by about 10^{-8} sec. The frequency of this light amount to 10^{14} Hz, therefore between stimulation and emission intervened about 10^6 periods. Up to now the opinion of Bohr, Kramers and Slater [l] was destined that the photon in this time, designated as (average) life-time, is a 'virtual photon'. However, by Nieke [2] the photon is built up in this time, the photon is in 'status nascendi'. For this is to concede a structure of photon (what shall be self-evident since the year 1960) and not to persist in the dualism of wave and particle.

The alleged proof of light as wave by Fresnel (the slit limits a wave-font and every point of this wave-front becomes a starting-point of a new sphere-wave,) based by Nieke [3] and [4] on an inadmissible and wrong extrapolation of the formula of diffraction at hindrance with inner or inside, at slit with outer or outside diffraction-fringes (inside or outside of shadow-limits) for great distances to the distance nought. In short distances namely appear the inner diffraction fringes of slit, or outer of hindrance, which correspond to the diffraction figure of half-plane with the edges as half-planes. The experiments for it already Newton [5] III carried out with his diffraction experiments in observation 5 (bent light comes only from a small surroundings of edges) and observation 10 (diffraction at the triangular-slit with inner **and** outer diffraction fringes). But Newton could not give an explanation for diffraction with his light-particles, therefore the inadmissible and wrong extrapolation was used and with this could be simulated an explanation of diffraction.

By Heisenberg [6] the photon has a structure of lying side by side fermion and antifermion with spin and antispin. Nieke [2] interpreted vividly this as vortex-pair. For this Sommerfeld [7] and [8] had shown unconsciously that the Schrödinger-equation can be a formula of vortex-dynamics (Schrödinger-equation and formulas of vortex-dynamics only contain the first deviation to time and not the second).

For generation of a photon in the so called life-time is to induce an electromagnetic vortex in every half-period, they are to sum up and have to remain near the atom till their energy reach the known Einstein-equation

E = h f.

Then the photon with the frequency f is emitted.

So there is no quantum-jump and Schrödinger [9] was right, at which his waves are to interpret as eigen-frequencies. However, in vortex-dynamics vortices are viewed as infinite long vortex-filaments, in this direction vortex-dynamics is to complete.

II. Characteristics of the photon with structure and field

Broglie [10] demanded for light the dualism of wave and particle. Already Born [11] corrected wave in field. Mach [12] showed that diffraction and interference proved only the periodicity of light and not the wave, what is lightly to confirm. Than Nieke [13] had shown that bent light in a following diffraction behave differently from not influenced light, if the light comes from the diffraction at a half-plane or inner diffraction fringes at slit. For which already Fresnel [14] had shown experimentally that their intervals of diffraction-fringes do not grow linearly with distance as outer diffraction-fringes at slit, but weaker, in parallel incident light intervals grow proportional with the root of distance. So the photons can not run straightly and already Newton [5] deduced from the transformation of inner to outer fringes at slit that light-particles have to run eel-like. In the same paper Nieke [13] showed that with masked image of one double-slit nevertheless the diffraction-fringes of double-slit arise (but not the part of masked single-slit of diffraction-figure), if before the imagery-optic lay a way of about

decimetre. This was assessed that to the photon is returned already so many field to the photon, that the photon has the information of the other slit and carried out the belonging changes of directions.

By Nieke [2] the photon sends runningly, as in Huygens' principle, an electromagnetic field, but this field is not running spherical away, but normally returning to the photon as vortex-field. If the field is hindered unsymmetically, the photon with the structure of a vortex-pair has no more exactly the structure of a vortex-pair. Such a little asymmetric vortex-aggregate executes a turn, for instance by Sommerfeld [7], i.e. the photon suffers a change of direction. So Nieke [2] described diffraction at triangular-slit: in short distances returns to the in surroundings of edge passing photons only field which also passed near the edge (the from the edge masked field is missing), the photons suffer turns and show the inner diffraction-figure of slit. If the photons have covered a further way so return also field which have passed the whole slit, so the photons have information of the whole slit and execute change of directions following to the outer diffraction-fringes of slit.

This interpretation is supported by Nieke [15] with his proof of reduction in frequency after diffraction which already Smekal [16] predicted.

Accordingly the diffraction-figure results from interaction of photon with structure with its field, if this field reaches its photon asymmetrical hindered. The property of periodicity of photon and field as result of vortex-structure caused the formation of fringes.

III. The interference angle-condition as deterministic single-process

Berge [17] extended the examination of the so called coherence-condition also to the side behind the slit, i.e. he considered true diffraction, however, he tried to interpret this with waves. Nieke [18] formulated the result that the divergence of light before diffraction (angle from diffraction-slit to limits of light-source or illumination-slit) is full transferred to the side of diffraction-figure as blur. A diffraction-figure is looking equally with conventional- or laser-source of illumination, if the participated frequencies are considered. To states of order resulted no hint, on which the designation coherence indicated. Therefore Nieke [18] suggested the designation 'interference angle-condition'.

Diffraction-figures show periodical distributions of photons. If the interference angle-condition not fulfilled, i.e. the angle to the illumination-slit is greater than the angle of neighbouring fringes, so the diffraction-figure turns blurred or washed out and no more it is evalutable. This is the state of disorder or chaos. To find out the chaos so is to fulfil the interference angle-condition, i.e. the angle out of light is coming, is to limit narrowly. That shows that it is a deterministic chaos and no problem of synergetics, as it seams to wave-theory.

IV. The diffraction as deterministic single-process

Newton [5] could not found diffraction with particles of light, for his mechanic knew no force in which results a deflection perpendicular to propagation direction. By Young [19] bent light started only from every edge, this was a step backward compared with Newton, for bent light indeed comes out of surroundings of edges (< 0.1 mm according to aperture). The assumption of interference of this edge-rays showed at double-slit and grating in large distances agreement with experiments. However, at slit Fresnel could not obtain agreement, as it is lightly to examine. An agreement tried Fresnel [14] to obtain with Huygens' principle, but that was, as in section I is described, only possible with an inadmissible and wrong extrapolation which lead to the sentence: 'The slit limits a wave-front and every point of this wave-front will be a starting-point of a new spherical wave'. Fresnel [14] had expressly confirmed, that he had satisfied that bent light comes only from the edge. But he had noticed that the area between the regions from which bent light is coming is not allowed to be covered, because the diffraction-figure of double-slit will arise. By the here advocated interpretation the field of bent photons is not allowed to be covered.

By Nieke [2] the change in direction takes place by interaction of photon with structure with its field, if the field returns asymmetrically hindered by laws of vortex-dynamics. So there is a deterministic process, for which it is necessary to know the locality i.e. the distance to the edge in which the photon and the field passed the slit-plane. Nieke [4] could prove a connection between place in the slit-image and the place in the diffraction-figure in a schlieren apparatus by Abbe with masking in the diffraction-figure in the plane of imagery-optics. In a schlieren-apparatus one double-stripe with a small dark interval in the place of every image of the edge in the slit-image (altogether < 0.1 mm) appears as image of a slit. He expressly pointed that with this is not determined the place in which the photon passed the slit-plane. By Nieke [3], [14], and [20] the shadow-sided bent light is displaced

shadow-sided, it seams to come from the slit-jaws. It is to assume that the small dark interval in the place of image of edge in the schlieren-apparatus is the trace of this light. It is not succeed to determine a place inside of one order, for then arises a noticeable additional diffraction, if it is not masked in a minimum. Nieke [4] and [21] showed that light, which passed the middle part of the slit, forms the zeroth order of the figure of diffraction, by the here advocated interpretation of interaction of the photons and their field.

Dirac [22] concluded from the fact that in diffraction and interference appears the same figure, if in each case only one photon could be in the apparatus; that every photon interferes only with itself.

A diffraction of photon appears, if the field of this photon is asymmetrically hindered in returning to its photon, at what every photon only interacted with its own field. The place in which the photon run through the slit and the manner in which the returning field is hindered, determines its place in the diffraction-figure. In the presented results exist no influence of phase, for instance in the slit-plane, but only for differences of phases of photon and field. Therefore the process of diffraction is a deterministic single-process. The periodic structure of diffraction-figure is visible only if the interference angle-condition is fulfilled.

The periodicity of light, that is the frequency of photons, by interaction of photon with its field determines as deterministic process, pendent on phase-difference of photon and field, a periodical diffraction-figure by change of direction. Here also seams that in wave-theory to be a synergetic process.

V. The interference as deterministic single-process

It shall be viewed here only the interferences with light from conventional light-sources or laser-light, which interfered behind a beam-splitter. In the here advocated view divides a beam-splitter (reflection-refraction, semi-reflecting mirror, double imagery, partmasking, scattering) the photon from a part of its field.

Newton [23] gave as reason for the interference-rings at the plate-pair that the light-particles have 'fits' (real fits and no attacks) as periodical dispositions to refraction or reflection. This seems indeed the only possible interpretation, for all arrangements for interferences of equal thickness by Nieke [24] in a schlieren apparatus shows no lighten. Therefore there is no change of direction, there only remains the change of the parts of reflection and refraction. An extinguish eliminates for both outputs of Newton's plate-pair and Mach-Zehender's interferometer are as positive and negative, it is only varied between refraction and reflection. It remains only Newton's interpretation, which in the here advocated model is interpreted by interaction of photon with its field which steers the parts of reflection and refraction according to difference of phase. This showed already Wiener 1890 in his famous experiment, however, he interpreted this as 'standing-wave.'

At interferences of equal slope (e.g. Lummer-Gehrcke plate) appears in a schlieren-apparatus a lighten, here is to accept a change of direction of light, and the interference-figure is to interpret as in diffraction, about as at gratings

In consideration of interference as deterministic single-process is to add in appearance of Newton's rings that the interaction of photon with its field also can vary the part of reflection and refraction corresponding the difference of phase.

VI. The induced emission as problem of synergetic in lasers

Haken [25], [26] and [27] treated light in the laser as wave. The sections before have shown, that now it is necessary to try an interpretation with light consisting of light-quanta.
In stimulated emission shall be triggered a nearly ready photon by an other photon and both with equal frequency and phase move commonly then the way one behind the other. Kapitza a. Dirac [28] suggested to examine this with electron-rays perpendicular to the laser, what Schwarz [29] executed. The laser-light was designated as 'light-crystal', the photon have the distance of one wave-length (better called as identity-space) or a multiple.

After spontaneous stimulation through light or electron-impact, by both mirrors at the end of tube or laser-crystal, is selected one (or several) frequency and mode, which has got through by fitting conditions of phase. As known the laser-threshold has to be fulfilled. The laser-threshold decides if the process runs out deterministic or synergetic. In building up of photons is to expect by the first section and Nieke [30] that a photon in 'status nascendi' is influenced from the dominant field, by Haken this is named 'enslaved'. Hints for this gave experiments with the one-atom laser, reported by Rempe [31].

According to this the natural lifetime is influenced by surroundings, suppress and amplification arise in dependence on distance from mirror. The atom steps in interaction with its mirror image, and that not only if the photon is ready.

Dirac [22] founded the interference of photon only with itself. Richter, Brunner a. Paul [32] concluded that in laser-light a photon can interfere also with a photon if it has the same frequency and mode. For this Magyar a. Mandel [33] observed interferences without stream-splitter, if both lasers are sufficiently stabilized in mode and phase. The photon in 'status nascendi' is stationary, apart from heat-movement of atoms, on the other hand the ready photon with given phase is running with velocity of light preferably in direction of laser-axis.

Nieke [34] supposed according results by Hanbury-Brown a. Twiss [35] also in thermic light-sources a (small) share in stimulated emission.

VII. Results

The spontaneous emission permits only the interaction of every photon with its field, designated as self-interaction. This is a deterministic interaction dependent on phase-dependent return of field to its photon as change of direction or influence on reflection or refraction.

The induced emission causes a state- of order of photons. The field of every photon can interact with every photon of equal frequency and mode, also with photons in 'status nascendi'. This could be named as synergetic interaction. Source of synergetics is the synchronize of photons in 'status nascendi' by the dominant field and so a light-crystal can arise.

In non-linear optics, at very high density of photons, is a to suppose an interaction of photons with each other. This accords to a general interaction with many new effects, synergetic effects too.

One could say, that is no news: With order of diffraction-fringes, differences of phases, and of orders of radiation, this was formal to explain. That is only partially right, but now this can be founded. 1st. With the change of direction of photons, 2nd: With the periodical influence on parts of reflection and refraction, 3rd: In lasers by synchronisation of photons in 'status nascendi'. Only the last is a process of synergetics.

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