Consequences for Photons out of Newton’s Diffraction Experiments

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Abstract

With the proof of localization of bent light in the narrow surroundings of edge in dependence on angle of observation by Newton was already shown, that Heisenberg's uncertainty relation can not be applicable for diffraction at slit. Out of Newton's diffraction experiments and their continuations the structure of photon as electromagnetic vortex-pair with field was inferred. For photons with this structure the Einstein-Podolsky-Rosen paradox is without object. It is discussed: spontane-, collecting-, Hertz's dipole-, and stimulated- emission. The life-time is interpreted as time for building up a photon with structure.

I. Newton's diffraction experiments

Newton [1] reported in the third book of his opticks about diffraction experiments. Here is interesting the observation 10, where Newton showed the diffraction at triangular-slit that in short distances and large slit-widths inner diffraction-fringes appear, which correspond to diffraction at half-plane with the edges as half-planes. First in larger distances the known outer diffraction-fringes appear of which intervals are constant and grow reciprocal to slit-width.

Then observation 5 of Newton [1] III is of interest, where Newton showed that shadow-side of an edge bent light is visible as a fine light-line (already known as Grimaldi's luminous edge) which became so smaller so sideways he observed. According to that bent light only comes out of a small surroundings of every edge. Newton [1] III query 1 inferred that light will be bend widest which passes the edge nearest.

Fresnel [2] could calculate border-line cases for great distances with the Fourier-theorem. The formula for slit was extrapolated inadmissible and wrong to the slit itself and so he got an incorrect conception of diffraction. Already Newton had shown what happen truly in this sphere of extrapolation, but Newton was disregarded.

The transformation of inner to outer diffraction-fringes and also the locality of bent light in small surroundings of edges could not be explain neither with punctiform light-particles nor with waves and therefore text book authors off about 1850 did not report about that. So resulted an incomplete and misleading description in diffraction as Nieke [3] and [4] discussed.

Since about 1960 elementary-particles could have a structure. For the structure of photons as work-hypothesis Nieke [5] combined the structure of linear polarized photon as electromagnetic vortex-pair with a field which is forming a part of photon.

From the photon with structure by Nieke [5] starts running, favoured in front, an electromagnetic field which normally returns to its photon (like Huygen's principle but with running back vortex-field). If the returning field is asymmetrically hindered, so the photon has no more exact the structure of a vortex-pair, but that of two vortices with opposite rotation and no more the exact same vortex-strength. According to vortex-dynamics this former vortex-pair executes a swinging as change of direction (for example by Sommerfeld [6]). The result is an interpretation of diffraction as deflection of photons.

II. Heisenberg's uncertainty-relation with photons with structure

For a mass-point or a particle which is representative as mass-point there would do two statements: That of locality and impulse or another pair of canonical conjugated variables. Also the uncertainty-relation by Heisenberg [7] used these statements. Nieke [3] showed that the out of uncertainty-relation calculated values do not agree with measurements, they can not agree because already Newton [1] had established that bent light only comes out of a small surrounding of every edge. Newton [1] III query 3 inferred out of diffraction at the triangular-slit with first inner and then outer fringes, that light has to run eel-likely. Fresnel [2] established experimentally that intervals of diffraction-fringes of half-plane grow with parallel incident light only proportional to the root of distance. Nieke [3] and [4] showed that shadow-side bent light has to be shadow-side displaced for it seamsto come from the slit-jaws. Bent photons can run after diffraction also not rectilinear as proved by all these experiments. Here these both statements, locality and impulse, do not be suffice, for a definite alteration of direction or impulse immediate after diffraction does not exist. First in large distances, when outer diffraction-fringes are formed, which intervals grow linear with distance, then photons are again to mark by two statements for they run rectilinearly, but then uncertainty-relation is without interest.

Therefore Heisenberg's uncertainty-relation presupposes that particles are representative as mass-points, and this must not be necessary for particles with structure. This is the argument that Heisenberg's uncertainty-relation does not be applicable in diffraction.

By Schrödinger [8] for measurement of velocity were just always two measurements necessary, after that the problem of uncertainty at one place does not exist.

Besides photons, also electrons, atoms etc. show the quality of diffraction cf. for example Carnal and Mlynek [9]. So could be supposed also here diffraction as self inter-action of atom with structure and its own field.

III. The Einstein-Podolsky-Rosen paradox

By Einstein, Podolsky a. Rosen [10] follows the emission of pairs of photons from the conservation of angular-momentum. With photons without structure and the spin 1 at that time there existed no other possibility for that. With acceptance of photons with structure out of two parts with opposite spin escapes the acceptance of emission of a pair of photons, for one photon out of two parts with opposite spin has already the right symmetry. At dipole-radiation in section 7 both parts originate one after another in successive half-periods; or at spontane emission in section 5 by collecting-emission during lifetime. Therefore in temporal average opposite angular moments compensate another during the emission-process. But it would be mislead to speak of a spin zero, for both opposite angular-moments effect stabilization of polarization as gyro-compass. The negative results of experiments in examine of Einstein-Podolsky-Rosen's paradox for example by Clauser, Horne, Shimony a. Holt [11] are to expect withthe model of photons with structure. Also the conclusion on non-existence of hidden parameters is inadmissible, for they are not to expect here.

IV. The mechanical model

On a rotating-disk or revolving-chair it is possible to bring two peg-tops so in opposite rotation that the moments of forces are compensated. Simplest the peg-tops are ordered symmetrically to the axis and one touches in the spokes suitable. If the forces and moments are compensated so should be compensated in symmetrical case also its reactions. For the angular-moments of peg-tops are opposite equal so remains the rotating-disk in rest. In a space-vehicle the moments have to compensate relative to centre of gravity.

However, the model is mechanically possible. In contrast, a photon is no mechanical vortex-pair but it should be an electromagnetic vortex-pair and their electrical and vortex peculiarities are to respect. It is not useful this mechanical model to execute farther, it will do to show that this leads to no contradiction.

V. Spontaneous emission at atomic processes

By presupposition that length of dipole is less to wave-length so was found for its emission during one period

$$S = 4\,\pi^3 f^3 M^3 / 3\,\varepsilon_0 c^3 \qquad (1)$$

Planck [12] applied this on the harmonious oscillator at atomic emission processes. With $f = k_D / m)$, $M_0 = e\, l_0$ and $E_A = k_D\, l^2_0 / 2$, where e and m are charge and mass of an electron he obtained:

$$S = 8\,\pi^3 f\, e^3\, E_A / 3\,\varepsilon_0 c^3 m. \qquad (2)$$

Should be emitted pro period one elementary-quantum so has to be $S = h\, f$. Then the excitation energy E_A was calculated to

$$E_A > 6.7\ 10^{-14}\ \text{Ws} = 4.2\ 10^5\ \text{eV}. \qquad (3)$$

An excitation energy would be necessary which suits to the gamma-radiation. Therefore Planck [12] demanded a damping of radiation with that in every period is emitting only little. This was consistent with the wave hypothesis but not with the quantum hypothesis. There is experimentally found a life-time or residence-time in an order of magnitude of 10^{-8} s and at hitherto interpretation then the full quantum of energy should be emitted indeterministically.

For photons with structure this fact can be described more detailed according vortex-dynamics. In every half-period of field-alteration one electromagnetic impulse or vortex is induced. This remains near the atom and rotate round the common centre of gravity. In the right rhythm consecutive vortices of respective equal sense of rotation can be increased up till the energy h f is reached. First with the energy h f, the photon is emittable. This mechanism could be called periodical collecting emission which is to compare with the increasing build-up of a torsional oscillation. The quantum-jump, which was vehemently combated by Schrödinger [13], should be avoidable so.

According the life-time results as that time which is necessary to transform the excitation energy over oscillating energy into electromagnetic vortex energy h f. The collecting emission would declare the statistical and nevertheless deterministic character of life-time if vortex energy below a specific h f_n can be staying not emittable near the atom. This energy, which has to remain conserved, will be bring in relation with the virtual photon e.g. Georgi [14]. From a virtual field of radiation already Slater [15] spoke, and from virtual oscillator Bohr, Kramers a. Slater [16]. Virtual particles are hitherto used as transition-particles (formal or hypothetical inter-products between annihilation- and creation-operator) in processes of elementary-particles e. g. in the Feynman-diagrams.
If in the moment of excitation still vortex energy is existing so a shorter time is possible for emission of one light-quantum. On the other hand the excitation energy has to be available all the time of life-time, therefore thermal impacts should not diminish this energy. At luminescence excitation thermally impacts cause so during life-time or time of collecting the 'temperature quenching'. With the hypothesis, that every light-quantum consists of a vortex-pair, is succeeded automatically that electrons on stationary orbits can not emit light, because two vortices of opposite sense of rotation can not be induced. In the process of collecting-emission this is not to name virtual photon but as photon in 'status nascendi'.

Here an experiment at high-frequency is conceivable for examination of this process. At frequencies of millimetre wavelength, where it is mechanical possible to produce a dipole, and a quantum is provable in a maser-amplifier, the dipole is to operate with so small energy that only one quantum was emitting during every period. If this supplied energy will be halved, so one quantum should be emitted only in every second period.

VI. Statistical collecting emission

According to this model it is not necessary to excite periodically a dipole but also impact dipole moments can cause electromagnetic vortices. Should be formed a photon with structure during one impact time so this is most improbable because the necessary high excitation energy as reported in formula (3). If a periodical collecting emission is possible a statistical collecting emission could be supposed too. By Landau a. Lifschitz [17] the actual frequency of vortex-pair should be resulting from the impact at the zero-passages of D or dD/dt. A farther impact can lengthen or shorten the time between the zero passages. If energy of impact together with energy existing by statistical collection is sufficient for emission, so one photon is able to be emitted as a quantum of light, otherwise the oscillation or vortex energy remains at the atom. Because spaces of time and magnitude of dipole-moments are different at thermally impacts so it is possible to originate a continuous spectrum.

If the absolute zero-point is reached through radiation or refrigeration, so the kinetic energy of atoms is going to zero. But still then electromagnetic vortex energy could be existing, which can not be emitted at absolute zero less than ever. According to this hypothesis this energy would be the zero-point energy or a part of them.

Experiments laid before to prove this model of zero-point energy. For the lamb-shift at hydrogen by Lamb and Retherford [18] was concluded a virtual field of radiation. James a. Brindley [19] had proved an influence of zero-point energy with X-rays interferences.

VII. Emission of a dipole by Hertz

At the emission by atomic processes only the limited energy of excitation is available and so ever excitation uppermost only one quantum would be emitted. On the contrary at Hertz's dipole radiation the stream source provides running for excitation and many quanta are able to be emitted ever period.

In emission of electromagnetic radiation in the region of high-frequency for explanation is used now as ever the model of radiation of a dipole which Hertz [20] gave 1889. Maxwell's equations are not directly suited for calculation. Here Hertz's mathematical artifice helped with introduction of Hertz's vector or a help-vector which are defined by a curl-expression. A physical interpretation of Hertz's vector was not given but this statement marked unequivocally a vortex field.

According to Hertz's concept the energy in the space is unlaced as field-lines in every half-period. According to his calculations and drawings closed field lines are formed and in the next half-period are formed opposite field-lines. To remain in agreement with the presentations of that time he subsequently brought in the wave-concept.

That electromagnetic radiation is quantized, this is valid without doubt today, the proof was lead to always lower frequency. So Hertz's dipole-radiation should consist of quanta too. Formal the drawing of field-lines can be subdivided in fields of single-fields because the divide-lines run from neighbour-field in opposite direction, that additional field compensates there. A physical description is still not possible, the stability of photons with structure could bring a hint.

Hertz [20] wrote (translated): „While we tried to explain the observation with Maxwell's theory, it is not succeeded to us to remove all difficulties. Nevertheless. the completeness with this theory reproduced the greatest part of the appearances permit to consider this a not to be contemptuous performance." To this is to notice that the difficulties appeared in the sphere of distance of the transition from he near-field of the dipole with a r^{-3} dependence of distance to the far-field with r^{-2} therefore there where is to suppose the formation of quanta.

As long as in high-frequency-sphere we can not prove a single photon as quantum, so only an indirect proof is possible. If the transmitter of a dipole is carried on only with one half-period (and this signal is repeated because measure-technics with an interval of any periods), so is to proof if this signal is to receive in the near- and in the far-field which is demonstrable with a cathode-ray tube which is synchronized with the transmitter. This experiment is to repeat with 1 period, 1 1/2 periods and 2 periods et cetera. According to the model above is to expect in far-field by one half-period no signal but in one full period. What in 1 1/2 period would be emitted is only to decide experimentally.

VIII. Stimulated emission

In the stimulated emission a second photon is loosen by prime photon, then both photons run jointly. If during life-time the photon is building up, that the energy is collected which belongs to frequency, So the field of the prime photon stimulates the second photon in the same rhythm in phase and mode. According to the proposition by Kapitza and Dirac [21], Schwarz [22] could shown diffraction figures with an electron beam interior of a laser perpendicular to the axis of laser. For that the laser beam can be considered as 'light-crystal'. With atoms completed this Gould [23]. Without beam-splitter with two lasers Magyar and Mandel [24] found interferences if the lasers were sufficiently stabilized in mode and phase. Hereby Richter, Brunner a. Paul [25] concluded that photons can not only interfere with itself but also with photons which harmonize in mode and phase. This is in agreement with the model of photon with structure and field.

Nieke [5] and this paper introduced the interpretation of photon establishing by steps from swinging energy of excitation with dipole moment to electromagnetic energy of vortex as photon with the structure of vortex-pair. This interpretation is supported by experiments with one-atom laser. Rempe [26] reported summarily about this: The natural life-time is influenced also by surroundings of the atom; suppressions and amplifications appear in dependence of distance of mirror; interaction with the reflected image appears not only foremost the photon is ready but before.

IX. The field of light

Nieke [3] and [4] verified that Newton was right with his statement: 'never light can be a wave', for he had proved this with the transition of inner to outer diffraction-fringes at slit and the localization of bent light in surroundings of edges. By Nieke [5] the photon with structure has an electromagnetic field as part of the photon. This field is to prove in photo-effects, and this field shows also effects by change of direction of its photon. The effects of field former was denoted as wave-quality. This is also a contribution to Genz [27] who considered the vacant space.

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