Consideration of Magnetic Moment of Electron in Quantum Theories

Helmut Nieke

Abstract
In previous papers were shown that the consideration of magnetic moments delivered new aspects by introducing into spin and Bohr's atomic model. In this paper could be shown that with 'on electrons coupled magnetic current-tubes' in quantum-field theory as well as vivid consideration of magnetic moment of electron and Lorentz-force can give the same results. This shows that quantum-theory is necessary for completion. Einstein was right that he marked Heisenberg-Bohr's quantum theory as incomplete. General is shown that the designation of wave is to change for field, in light and also in matter.

I. Copenhagen interpretation

Copenhagen interpretation contains firstly the dualism of wave and particle. The dualism based on light as wave in diffraction experiments by Fresnel [1] and light as particle in light-electric effect from 1900. This was used in the form by Broglie [2] for light and broaden to matter.

In previous papers Nieke [3] and [4] showed with consideration of the diffraction experiments by Newton [5] and newer diffraction experiments, that light never can be a wave, as already Newton has asserted. (The ostensible proof of light as wave by Fresnel [1] based on an inadmissible and wrong extrapolation.) Therefore diffraction was described by Nieke [6] as change of direction as result of interaction of photons with their fields. Instead of dualism of wave and particles is to substitute: particle always with structure, instead of wave the field of particle, and dualism is to substitute by interaction of photon with its field. (Einstein demanded instead of dualism: fusion.)
Secondly Copenhagen interpretation maintains the indeterminism in quantum-processes. Newton [5] already had proved that bent light comes only out of the narrow surroundings of edge, therefore in diffraction can not be present an indeterminism. (Einstein: God do not dice.) Details by Nieke [4].

Against the dogma of indescriptness, which was concluded from indeterminism, already Schrödinger [7] has lodged contradiction. He wrote (translated): „From philosophical standpoint I should think a final decision in this sense as a complete lay down of arms. For we can not change arbitrarily the forms of thinking, and what we can not understand within the same, that can we understand not at all. There are such things - but I do not belief that the structure of atoms belonging to them."

II. The structure of photon by Heisenberg and that of electron

Heisenberg [8] concluded as structure of photon that the photon consists of side by side laying of fermion and antifermion with spin and antispin. In vortex-dynamics such an aggregate is designated as vortex-pair. It is essentially that with it Heisenberg gave up the spin as formal quantum-number and introduced the spin as spin-, rotation- or vortex-aggregate.

In simplest case pair-creation demands that one electron and one positron are converted into two gamma-quanta. Nieke [9] concluded out of the structure of photon by Heisenberg as electromagnetic vortex-pair with two opposite rotating vortices for electron and positron the reorganization of vortices to the structure of vortex-twin. For it electron and positron distinguish only in rotation-direction of both vortices in both vortices of equal direction of rotation in vortex-twin. By law of vortex-dynamics two vortices of equal rotation-direction have to rotate around each other in equal direction. Therefore the spin of electron and photon are composed of three elements. In electron of two rotations of equal electro-magnetic vortices in equal direction of rotation and the reciprocal rotation in equal direction of rotation around each other. In the photon out of two vortices of opposite vortices, the third element is the propagation with light-velocity. Corresponding to vortex-dynamics in rest the photon is instabil and the electron stabil.

Nieke [9] criticized that Pauli [10] designated the electron with 180° turned magnetic moment with the negative sign of spin, instead to reserve the negative sign for the opposite rotation. Nieke founded this that a right-screw can not turn into a left-screw by a 180° turning perpendicular to the axis. Pauli recognized rightly that spin could not be a simple rotation, but by Nieke [11] the spin can

be a vortex- or a rotation-aggregate. Pauli developed his theory 1925 after the discovery of magnetic moment of the electron. The positron was discovered just 1932, and Pauli did not correct his spin definition, what was unconditionally necessary. By Nieke [9] the dogma of indescriptness had at that an authoritative part. The indescriptive and formal definition of spin had far-reaching consequences, for example the β-process demanded an additional particle which was called neutrino. With the rotation (charge) opposite spin this particle is unnecessary.

For the spin of proton could be only partly found with hypothetical quarks, Düren [12] spoke of 'spin-riddle'. Therefore also in composite particles by no means all is cleared, further knowledges are necessary.

III. Magnetical moment of electron circulating round the nucleus

In 1913 Bohr started with the calculation of a atom-model according planet-motion. He could not consider the magnetic moment of electron because this was discovered first in 1925. As it was discovered, Bohr had committed himself that the atom is not to calculate classically, his calculations were not completed.

Nieke [11] considered in Bohr's atom-model also the magnetic moment of round the nucleus circulating electron, and additionally arising simultaneously the Lorentz-force. This magnetic field he designated as magnetic moment-sheet. The magnetic moment of electron adjusts so that it forms with the magnet-sheet (the field of charge of circulating electron) a ring in a magnet-field. The field of charge of circulating electron has either return to the electron or has to get from the positive charge of nucleus exact so much as it sends to the nucleus. In every case the field of magnetic moment as vortex-field has to return to the electron. Because the inner energy of electron is constant, only the kinetic energy is variable. In contrast: at the photon velocity is constant but energy and frequency variable (Compton-effect and diminution of frequency after diffraction by Nieke [13]).
Nieke [11] interpreted the field of magnetic moment of electron as magnetic 'vortex-propelling' and not as magnetic dipol or virtual monopol. If the electron has the structure of vortex-twin with two equal rotating vortices which rotate around each other in equal direction, so this aggregate seams not without torquemoment as a whole. But it is to remark that there are electromagnetic vortices and the magnetic vortex-propelling permits an equilibrium if electro-and vortex-dynamics are considered combined. The Lorentz-force, together with the magnetic moment-sheet and moving charge, generates a force against electrical attraction. This force stabilizes the path of electron, causes steps of energy for electrons through phase-right return of the field of magnetic moment, and prevent a plunge into nucleus. For the field has to return phase-right for stationary state, considering together with the structure, are resulting steps of energy, the quantum-states. Therefore it is unconditional necessary to respect the magnetic moment of electron in Bohr's atom-model.

The process of quantization is accordingly to imagine like this: circulating electrons do not radiate, for by Nieke [6] and [14] can not be formed a photon with the structure of a vortex-pair, however, they built up a field as magnetic moment-sheet. The field of electron, that of charge, and above all that of magnetic moment, have by Nieke [6] and [11] to return phase-right. There the stationary orbits result. Is an electron stimulated to an instable orbit with dipole-moment (that can not be a circular orbit), so a photon can be build up by back-transition to a stationary orbit. In the so called lifetime of state in amount of order 10^{-8} s, in 10^{6} periods at visible light, by Nieke [6] a photon could be build up in half-period rhythm. In this time the photon is in 'status nascendi' till it is erected and has the to frequency belonging energy. Is that reached so the photon comes off with velocity of light with the structure of vortex-pair, or surely more right, both vortices each other drive forward. For photons with structure there is necessary no quantum-jump.

IV. The Chern-Simons invariant

Chern and Simons [15] only reported about characteristic group-theories without hint to application. They point to Lie-groups (differentiable and rotating round a stationary point) and Weil-groups (ring- and fibre-structures), which permit an application to magnetic fields. As Chern-Simoms invariant is valid J = I(s) mod 1. Chern [16] reported about applications and so Rabbi and Soliani [17]. This statement was applied on symmetries of spectral-lines, the quantum-field theory, self-duality, many dimensions, vortices in magnetic field, polarization, relation to Schrödinger-equation, application to quantum-Hall-effect, anyonen and solitrons. Inferences of Chern-Simons invariant were denoted as Chern-Simons term or altogether as Chern-Simons theory.

This was possible for this group-theory offered a complete or least a more complete theory, however, the quantum-field-theory respected not sufficient vortex-fields because Bohr had respected no magnetic moment of electron too.

Einstein therefore was right when he designated Heisenberg-Bohr's quantum theory as an incomplete theory. Beside this the Copenhagen interpretation was built up on an inadmissible and wrong extrapolation, what is justified already in the first section.

V. Electrons with coupled magnetic stream-tubes

Weller [18] reported summary about magnetic stream-tubes, which are coupled as quasi-particles to electrons. The theoretical construction describes the Chern-Simons electro-dynamics, confer Dunne [19] with a fictitious magnetic field

$$\mathbf{B} = (\tilde{\mathbf{N}} \times \mathbf{A})_z = - m \, \Phi_0 \, \rho \, (x,y,t) \qquad (1)$$
$$\mathbf{A} = m \, \Phi_0 / 2 \, \pi \, r \qquad (2)$$

There is $\tilde{\mathbf{N}}$ a differential-operator, $\mathbf{A}$ vector-potential of magnetic stream-tube, Φ_0 stream-quanta, m their number, ρ their density. There are added path-integrals and vector-products with a magnet-field.

Guadagni [20] wrote: „The result of (the magnetic field of Chern-Simons vacuum expectation) has a simple physical interpretation. The exponent in the expression contains the circulation along one closed path, say C_1, of the magnetic field generated by the second wire. This quantity is precisely the energy gain ε of an imaginary magnetic monopol moving along C_1, in the presence of the magnetic field generated by C_2. For each „winding" of the magnetic monopole around C_2,

the energy increases by a definite amount which, in our units, is given by $\varepsilon = -2 \, e_1 \, e_2 \, (2 \, \pi \, / \, k)$. For arbitrary non-intersecting closed paths C_1 and C_2 the value of the expression (called the Gauss integral) is an integer representing exactly how many times C_1 'winds' C_2". That is with an imaginary monopol what in section 3 was explained with the magnetic moment of electron in form of the magnetic moment-sheet. But the electron has neither an imaginary monopol nor a real magnetic dipole, but by Nieke [11] a magnetic vortex-propelling which generates the magnetic moment. From Lorentz-force on the moving electron and magnetic moment-sheet, which field returns as vortex-field to the electron, follows:

$$\mathbf{F}_L = e \, (\mathbf{v} \times \mathbf{B}) = e \, (\, |\mathbf{v}| \; |\mathbf{B}| \,). \qquad (3)$$

For $\tilde{\mathbf{N}}$ is a geometric alteration, so thus corresponds with the velocity $\mathbf{v}$, and the vector-potential $\mathbf{A}$ of magnetic stream-tube with the magnetic field $\mathbf{B}$ of magnetic moment-sheet, which magnet-field results on circulating electron the Lorentz-force. With different means, formal with quasi-particle and virtual monopole and physical descriptive, here is described the same: the effect of magnetic moment of electron. Here is manifested the disadvantage of indescriptive description, because the real physical process is veiled.

It is to test, if the consideration of magnetic moment of electron and Lorentz-force is sufficient to get the experimental values in Bohr's atom-model.

IV. Ehrenhaft's experiments about trajectories of small proof-sample

Ehrenhaft [21] poured dusty proof-samples out of the differentest materials in gases or in vacuum, illuminated only for observation or intensive, and observed in dark field their trajectories in electric, magnetic or gravitation fields. There he observed photo-, electro-, magneto- and gravitatio-phorese. Besides the trajectories which he expected, he observed positive and negative effects, rotations and screw-paths. Although enormous lot of experiments he could not gave an uniform description. For explanation he supposed magnetic monopols which are already discussed in this time by Dirac. In every case from these experiments follow, that it must give least one fundamental appearance, which is not respected hitherto.

Proposition for explanation (besides the here discussed appearances): the centre of gravity, electric charge, magnetic dipole, and gravitation must not fall together in composed particle.

VII. Comparisation of light- with atom-beam

Carnal a. Mlynek [22] showed Young's double-slit experiment with helium-atoms (entrance slit 2 µm, double-slit 8 µm and 1 µm slit-width). For every helium-atom can pass only one slit, so also here is to suppose an interaction of atoms with their field. Staudemann a. o. [23] showed already inferences with neutrons.

In addition is to remark that light keeps normally fixedly its polarization direction, what is to reduce by Nieke [6] on the structure of photon as vortex-pair, which harmonize with a gyro compass. This constance of direction of polarization is to find in material beam not so marked, they are easily disturbable.

Because light never can be a wave, so this is not to suppose for matter all the more. It is uncontested that every elementary-particle and every atom has a field that is to take seriously. The establishment of Mach from light is to transfer to matter: 'All diffraction and interference experiments prove only their periodicity and not the wave.' Certain it is no continuous field as by a resting charge and so the field can have a phase-shift to the particle. Therefore also here is effective no guidance-wave, but a guidance-field or better an interaction-field with them the atom interacts by asymmetry or phase-shift. As by photons this interaction is to found with vortex-dynamics.

Bell [24] considered guidance-wave for impossible, what he established with formulations of wave-function and separates of measurement. According to him with guidance-wave should be founded only differences to quantum-conception and the word was abused. He mentioned Born but remarked not that Born already had corrected wave in field.

In coherence is standing the problem of hidden parameter, what is discussed for example by Bell [25]. He considered the proof of v. Neumann not valid but hidden parameter only interesting to unsophisticated minds. If one starts from the inadmissible and wrong extrapolation of the only for large distances valid formula for diffraction at slit, so he can not decide this question. Experimental already Newton [5] had shown with shadow-side diffraction at edge, that here the obvious parameter is the distance to edge in which the particle of light has passed the edge. Nieke [4] had shown in a schlieren-apparatus the connection of order of diffraction and the both localities in the image of slit. If one considers a wide light-bundle, then are to give natural only statistical statements, but for the individual process have to be present obvious parameters. So already Schrödinger [26] showed the compton-effect as impact-process with excentric impact as obvious parameter.

VIII. The field

From the field only the effects are known. With resting particles: to show the electric field is to bring in an electric charge, to show a magnetic field is to bring in a magnetic dipole, and for a gravitation field a mass. With moving particles are further possibility but that is here not to discuss.

The influence of magnetic moment was also demonstrated by Bohm [27] and Aharonov-Casher- effect [28], at which they spoke of influence of quantum-potential what also is compared with the Ψ-field of Schrödinger-equation. By Aharonov- Bohm [29] the effect still appeared, if the field is else not detectable. Also Zeiske a. o. [30] reported about that.

Also if a particle has no charge, the moving particle with magnetic moment will be diverted, what is sometimes comprehended as canonical impulse:

$$\mathbf{p} = m\,\mathbf{v} + \mathbf{m}\mathbf{x}\,\mathbf{E} \tag{4}$$

Therefore the integral over vector-product of magnetical moment μ by electric field E (or magnetic field M) corresponds to equation (1) or (3). Boz, Fainberg a. Pak [31] connected Aharonov-Bohm scattering formal with Chern-Simons theory conventional by means of S-matrix and Feynman-diagram.

The photon interfered or interacted with its field as Dirac's interference of photon with itself. But: in the laser-radiation interferes a photon also with a photon of the same phase and mode. As other extreme, in high radiation density, the non-linear optics appears: photons inter-acting obviously then direct together.

What it 'is', real a field is unknown, but such it has to give. Out of Hertz's dipole-radiation and the light-electric effect is to conclude that the photon forms a field-, energy-, or vortex-aggregate. Out of pair-formation is to conclude that also the electron represented a field-aggregate with other structure. This would correspond with Hund [32]: 'matter as field', but this book is written before 1960, where a structure of elementary-particle were not acknowledged.

IX. Conclusion

As already described in section I, the Copenhagen interpretation is by consideration of Newton's diffraction experiments without physical basis. Out of these and newer experiments is deduced that also the foundation of the whole quantum-theory is to inspect.

The consideration of magnetic moment of electron demands the definition of spin instead of formal magnetic spin-quantum numbers to replace by spin- or better vortex-aggregates. Therefore the structure of vortex-pair for photon and the structure of vortex-twin for electron are offered.

Quantum-electro-dynamics has instead of second quantization to consider the building of photons within the so called life-time. Here is to calculate really the magnetic moment of electron circulating round the nucleus and not to interpret formal as coupled magnetic stream-sheet.

References
[1]   A. J. Fresnel, Oeuvres complétes 1. Paris 1866;
        Abhandlungen über die Beugung des Lichtes. Ostwalds Klassiker Nr. 215, Engelmann, Leipzig
        1926.
[2]   L. de Broglie, J. Phys. Radium **8** (1927) 225-241.
[3]   H. Nieke, Newtons Beugungsexperimente und ihre Weiterführung. Halle 1997, Comp. Print 1,
        Arbeit 1
        (Vorhanden in vielen deutschen Universitätsbibliotheken);
        Newton's Diffraction Experiments and their Continuation. Halle 1997, comp. print 3, paper 1
         (Available in some university libraries).
[4]   As [3], paper 2.
[5]   I. Newton, Opticks, or a Treatise of the Reflexions, Refractions, Inflexions and Colours of
        Light. London 1704;
        Opera quae exstant omnis, Tom IV. London 1782;
        Optics. Reprint, Bruxelles 1966;
        Optik II + III, Übers. W. Abendroth,
        Ostwald's Klassiker Nr. 97, Engelmann, Leipzig 1898;
        Neuauflage Bd. 96/97, Vieweg, Braunschweig 1983.
        Optique, Trac. J. P. Marat 1787; Reproduction Bourgois, Paris 1989.
[6]   As [3], paper 12.
[7]   E. Schrödinger, Ann. Physik IV **81** (1926) 109.
[8]   W. Heisenberg, Introduction to Unifom Field Theory of Elementary Particles. Interscience, New
        York 1966;
        Einführung in die einheitliche Feldtheorie der Elementarteilchen. Hirzel, Stuttgart 1967, S. 116.
[9]   As [3], paper 14.
[10]   W, Pauli, Aufsätze und Vorträge über Physik und Erkenntnistheorie. Vieweg, Braunschweig
        1961, S. 120-146 (Nobelvortrag 1946);
        Z. Physik **31** (1925) 373, 765.
        Collected and Selected Papers. New York 1964.
[11]   As [3], paper 17.
[12]   M. Düren, Phys. BI. **52** (1996) Nr.3, 243-6;
        Desy Hermes 95 - 02 (1995).
[13]   As [3], paper 6.
[14]   As [3], paper 13.
[15]   S.-S. Chern a. J. Simons, Proc. Nat. Acad. Sci. USA. **68** (1971) 791;
        Ann. of Math. **99** (1974) 48-69
        S.-S. Chern, Selected Papers Vol. 1. Springer, New York, ... 1980. paper 103 p. 444-465.
[16]   S.-S. Chern, Complex Manifolds without Potential Theory. Second edition, Universaltext,
        Springer, Berlin u.a. 1995, § 7, p.148-154 u. 157.
[17]   C. Rebbi a. G. Soliani, Solitons and Particle Physics. World Scientific, Singapore 1985.
[18]   W. Weller, Phys. BI. **52** (1996) 121-4.
[19]   G. Dunne, Self-Dual Cern-Simons Theories. Lecture Notes Physics M 36 Springer, Berlin 1995.
[20]   E. Guadagnini, The Link Invariants of the Chern-Simons Field Theory. De Gruyter, Berlin
        1993, p. 5
[21]   F. Ehrenhaft, Acta physica austrica **4** (1951) 461-88; **5** (1952) 12-29.
[22]   O. Carnal u. J. Mlynek, Phys. Bl. **47** (1991) Nr. 5, 379-81; Phys. Rev. Lett. **66** (1991) Nr. 21,
        2689-96.
[23]   J. L. Staudenmann, S. A. Werner, R. Colelia a. A. W. Overhauser, Phys. Rev. A **21** (1980)
        1419-38.

[24]   J. S. Bell, Speakable and unspeakable in quantum mechanics. Cambridge Univ. Press Cambridge a. o. 1987. Nr. 17 p. 159-168; Foundations of Physics **12** (1982) 989-99.

[25]   As [24] Nr. 1, p. 1-13, Nr. 4, p. 29-39;
Rev. Mod. Phys. **38** (1966) 447-52
In German: M. Baumann u. R. U. Sexl, Deutungen der Quantentheorie. Vieweg, Braunschweig/Wiesbaden 1987, S. 193-205.

[26]   E. Schrödinger, Ann. Physik (4) **82** (1927) 257.

[27]   D. Bohm, Phys. Rev. **85** (1952) 166-179.

[28]   Y. Aharonova, a. A. Casher, Phys, Rev. Lett. **53** (1984) 319.

[29]   Y. Aharonov a. D. Bohm, Phys. Rev. **115** (1959) 485;
Y. Imry u. R. A. Web, Spectrum d. Wiss. 1989 Juni 88-95.
Sc. Am. (USA) 1989, April 36.

[29]   Y. Aharonov a. A. Casher, Phys. Rev. Lett. **53** (1984) 319.

[30]   K. Zeiske, G. Zinner, F. Riehle u. J. Helmcke, Phys. Bl. **51** (1995) Nr. 12, 1188-9; Appl. Phys. B **60** (1995) 205.

[31]   M. Boz, V. Fainberg, N. K.Pak, Ann. Phys. N.Y. **246** (1996) 374.

[32]   F. Hund, Materie als Feld. Springer, Berlin, Göttingen, Heidelberg 1954.