

Energy-Steps of Electrons in Magnetic Eigen-Field

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Abstract

The electron with its magnetic moment is shown as magnetic moment-sheet circulating round the nucleus. The Lorentz-force yields a force opposite to electrical attraction. This force stabilizes the path of electron and can cause the energy-steps of electron if the field of electron returns with right phase. Bohr could not consider the magnetic moment of electron because it was not yet discovered. When it was discovered, he had hasty committed himself that the atom is classic not calculable. The magnetic moment of the electron is not interpreted as magnetic dipole or virtual monopole but as magnetic 'vortex-propelling' which generates the magnetic vortex-field.

I. Quantization by Bohr

With the Einstein-Bohr-equation

$$\Delta E = E_1 - E_2 = h f \quad (1)$$

is established that from an energy-amount ΔE is building up a photon with the frequency f . Light is quantized it exists in light-quanta or photons.

Bohr started from the simplest case of atom, the hydrogen atom and limited his considerations in the beginning to circle-orbits. The classical description of equilibrium in attraction \mathbf{F} of positive nucleon, here $Z = 1$, and the negative electron with centrifugal-force \mathbf{F} of circle-motion with radius a and the circular-frequency ω yielded in the exhibition of Sommerfeld [1] :

$$|\mathbf{F}| = m a \omega^2 = e^2 / a^2 \quad (2)$$

Bohr added a quantum-theoretical condition which he interpreted as an impulse-moment of rotator, to get the frequency of the Balmer-series of hydrogen:

$$m a^2 \omega = n h / 2 \pi \quad (3)$$

From division of (2) in (3) ensues:

$$v = a \omega = 2 \pi e^2 / n h \quad (4)$$

Out of this condition was discussed that an electron can only move in quantized paths, in 'Bohr's orbits', where n is the quantum-number of orbit. But the frequencies, inferred out of equation (1): $\Delta E = h(f_1 - f_2)$ do not exist, because E_1 and E_2 are not transformed in a photon.

Sommerfeld [2] wrote 1922 to Einstein about wonderful numerical laws of line-combinations (translated): „All works, but it remains muddily in the deepest foundation. I can only promote technics of quanta, you have to make their philosophy.“

II. Consideration of magnetic eigen-fields

Bohr's statement in section I could show only formal steps in consequence of quantization. It is only an adaptation to Balmer-formula. Nieke [3] and [4] reported that the Copenhagen-interpretation is without basis for the disregard of Newton's diffraction experiments (transformation of inner to outer diffraction-fringes: light never can be a wave; localization of bent light near the surroundings of edge: diffraction can not be indeterministic but deterministic). Nieke [5] and [6] applied this to electrons.

So a new basis shall be to find, here the new trial: The consideration of all magnetic fields, the structure of elementary particles and their self-interaction with their returning field. Therefore two possibilities are examined: The magnetic field of round the nucleus circulating electron (as charge) and the magnetic moment of electron self.

III. The magnetic field of circulating electron with charge

The electron has in every case an electrical field and the moving electron produces a magnetical field. But the electron or atom is a stable and stationary particle, in stationary states the electron may not lose (inner) energy and therefore no field. For the electron is to demand: all field has to return to the electron. If an exchange of field take place between electron and nucleus, so has all the same to run over and back. The field of a static (or stationary) dipole in the distant-field falls with r^{-3} and no field is lost. Nieke [3] excluded a radiation of circulating electron because photons have the structure of

vortex-pairs and a circulating electron can not produce two opposite vortices. It is fact that a stationary circulating electron can not emit radiation with the structure of photons, and for that reason the electron can not fall in the nucleus. That is an important fact about which hitherto the theory silently shut the eyes; also for this reason the problem has to be new rolled up.

The circulating electron generates a magnetic field. The Lorentz-force as vector-product is standing perpendicular on velocity of electron and the self produced magnetic field.

$$\mathbf{F}_L = e |\mathbf{v} \times \mathbf{B}| = e |\mathbf{v}| |\mathbf{B}| \quad (5)$$

The velocity $|\mathbf{v}|$ of circulating electron is $a \omega$. The magnetic field of a circulating charge corresponds to a current. In centrum gets the field divided by plane:

$$\begin{aligned} \mathbf{B} &= \mu \mathbf{H} = \mu_0 e a \omega / 2 \pi a^2 = \mu_0 \omega e / 2 \pi a \\ |\mathbf{F}_L| &= e a \omega \mu_0 e \omega / 2 \pi a = \mu_0 e^2 \omega^2 / 2 \pi \end{aligned} \quad (6)$$

To accept as basis-radius of hydrogen-atom $r_H = 0.5 \cdot 10^{-10} \text{ m}$ up to $0.53 \cdot 10^{-10} \text{ m}$, and calculate ω out of equation (2), where (2) is to read in SI- system

$$|\mathbf{F}| = m a \omega^2 = e^2 / \epsilon_0 a^2 \quad \text{therefore} \quad (2')$$

$$\omega^2 = e^2 / \epsilon_0 m a^3$$

$$\omega^2 = 2,56 \cdot 10^{-38} (\text{As})^2 / 8,9 \cdot 10^{-12} (\text{As/Vm}) 9,1 \cdot 10^{-31} (\text{kg}) 0,15 \cdot 10^{-30} (\text{m}^3)$$

$$\omega^2 = 2,1 \cdot 10^{34} \text{ s}^{-2}$$

$$\omega = 1,45 \cdot 10^{17} \text{ s}^{-1} \quad (7)$$

With it results for (6) the Lorentz-force:

$$\begin{aligned} |\mathbf{F}_L| &= 1,26 \cdot 10^{-6} (\text{Vs/Am}) 2,56 \cdot 10^{-38} (\text{A}^2 \text{ s}^2) 2,1 \cdot 10^{34} (\text{s}^{-2}) / 2 \pi \\ |\mathbf{F}_L| &= 1,08 \cdot 10^{-10} (\text{N}) \end{aligned} \quad (8)$$

That is to compare with either the right side of equation (2'), therefore with the electrical attraction of electron.

$$\begin{aligned} |\mathbf{F}_A| &= e^2 / \epsilon_0 a^2 \\ |\mathbf{F}_A| &= 2,56 \cdot 10^{-38} (\text{As})^2 / 8,9 \cdot 10^{-12} (\text{As/Vm}) 0,28 \cdot 10^{-20} (\text{m}^2) \\ |\mathbf{F}_A| &= 1,03 \cdot 10^{-6} \text{ N} \end{aligned} \quad (9)$$

Or with the left side of (2'), the centrifugal-force:

$$\begin{aligned} |\mathbf{F}_Z| &= e a \omega^2 \\ |\mathbf{F}_Z| &= 9,1 \cdot 10^{-31} (\text{kg}) 0,53 \cdot 10^{-10} (\text{m}) 2,1 \cdot 10^{34} (\text{s}^{-2}) \\ |\mathbf{F}_Z| &= 1,01 \cdot 10^{-6} \text{ N} \end{aligned} \quad (10)$$

That means that the Lorentz-force with magnetic-field produced through circulating charge is small opposite to forces of attraction or centrifugal-force. The Lorentz-force is here to neglect. But of interest is the direction of this force, it lies in direction of attraction and opposite to centrifugal-force.

IV. The magnetic field of circulating electron with magnetic moment

In 1913 Bohr began with calculation of the atom corresponding the planet-model, he could not consider the magnetic moment of electron for yet it was not discovered. As it was discovered in the year 1925, Bohr already had committed himself that the atom is classic not calculable. Indeterminism and indescriptness in quantum processes were propagated as principle of modern physics. In section III is shown that the magnetic field of circulating electron gives no noticeable improvement. Because since 1925 the magnetic moment of electron was not respected, so this is to recover now.

The electron has a magnetic moment in size of Bohr's magneton μ_B . But for Lorentz-force is to use the magnetic induction \mathbf{B} and the field of a magnetic dipole is not to state without specific acceptances. Then this magnetic dipole is not standing motionless but circulates in rhythm of ω . Hitherto this field was not taken in consideration. Chew [7] made self-interaction able to science, actions of magnetic moment as magnetic field in Lorentz-force to charge of electron are self-interactions. Question: Does the magnetic moment work direct on itself moreover? (Therefore also without charge of electron). Experiments with circulating (possibly charged) magnetic dipole are not easy and the extrapolation to atomic dimension is insecure.

The field of circulating charge in section 3 was small but it is to suppose that the electron with its magnetic moment obtains the opposite direction so that Lorentz-force here has the direction of centrifugal-force and opposite the electrical attraction.

For calculation of magnetic induction B is used the following approach. As basis serve the sentence: The strength of a pole ϕ is proportional to the magnetic flux which it sends in the outside-space of the magnet.

$$|\mathbf{B}| = \phi / 2 F \text{ (Vs m)} \quad \text{with } F \text{ as plane} = \pi r^2.$$

Magnetic moment $\mu = \phi l$ (Vs m)~ with l = pole-interval = dipole-length. This conventional split up is later called in question, but for testing the order of Lorentz-force it should be retained

$$|\mathbf{B}| = \mu_B / 2 \pi r^2 l \quad (11)$$

Bohr's magneton $\mu_B = 1.15 \cdot 10^{-29}$ (Vs m). The pole-interval is certain smaller than the radius of electron, which is stated on $r_E = 2.8 \cdot 10^{-15}$ m. With it the Lorentz-force gives by (6) if r is set as radius of hydrogen-atom a :

$$|\mathbf{F}_L| = e a \omega \mu_B / a^2 2 \pi l = e \omega \mu_B / 2 \pi a l \quad (12)$$

To get a survey about l with $|\mathbf{F}|$ out of (9) F_A or (10) F_Z

$$l = 1,6 \cdot 10^{-19} \text{ (A s)} / 145 \cdot 10^{17} \text{ (s}^{-1}\text{)} \cdot 1,15 \cdot 10^{-29} \text{ (Vs m)} / 2\pi \cdot 10^{-6} \text{ N} \quad (13)$$

$$= 0,85 \cdot 10^{-15} \text{ m.}$$

The dipole-interval shows the right order. The Lorentz-force can have the order of F_Z in (2). Instead of (2) were to set:

$$|\mathbf{F}| = m a \omega^2 + e \omega \mu_B / 2 \pi a l = e^2 / a^2 \quad (14)$$

With it were to find new quantum-conditions for a ω and a ω^2 . That should be no solution but a suggestion.

But it is not necessary that in an electron is present a north-and a south-pole, therefore a dipole, for to generate a magnetical vortex-field will do a magnetic vortex drive, as proposal the designation magnetic 'vortex-propelling'. Nieke [5] concluded out of the possibility of pair-formation for electron and positron the structure of vortex-twin. This electromagnetic vortex-twin has to cause the magnetic vortex-propelling and, as secondary product the electric charge, ever direction of rotation positive or negative. For magnetism is preponderant resulting in aligned magnetic moments of electrons, so one wishes to generalize this. Microscopically magnetism is caused by aligned vortex-propellings and only macroscopically this range of vortex-propellings is to interpret as dipole.

A current which revolves round a plane, or a charge revolving round a nucleus, generates a magnetic field what is designated as magnet-sheet or magnetic double-layer. This is used in section III. With consideration of magnetic moment of circulating electron is shown in section IV that also the magnetic moment generates a magnetic field, which exerts with the Lorentz-force an effect on electrons. This magnetic field should be designed as 'magnetic moment-sheet'.

Sommerfeld [8] wrote to that (translated): „The question, in order to which it points in last end, is that if besides the Coulomb-force still interactions intervene between proton and electron of the sort as they are to observe in nuclear physics.“ Sommerfeld had so the right presentiment, but also after 1925 a self-interaction was not cognizable in that time.

The consideration of magnetic moment of circulating electron as magnetic moment-sheet causes as counter-force to electrical attractive power, besides centrifugal-force, additional with Lorentz-force a stabilisation of the orbit of electron and gives new conditions.

V. Emission of light from the electron in the atom-formation

Light-emission of accelerated or retarded moving electrons is discussed by Nieke [6]

In atom-formation light will be only emitted if an electron is stimulated and one in amount variable dipole-moment is present. But in sections III and IV that is not present there and the stationary circulating electron can not radiate a photon, what is already discussed.

Simulation requires an absorption of light, impact of electron, or thermic impact. That is possible only in a limited sphere of frequency or velocity respectively. Is an electron stimulated by an impact process with sufficient energy, the electron can leave the atom-formation (impact-ionisation). If the energy of impact does not suffice for ionisation, so is a circular-path no more possible. Or else how were built an in amount variable dipole-moment? An exact ellipsis-path is not certain for the Lorentz-force (14) increases only with a ω . An additional precession is not to exclude.

According to the Balmer-formula there are possible for emission only special values of frequency or energy. The stimulation determines the possible energy-degree. The from the dipole-moment induced field build up a photon, afterward the field of electron has to return with right phase,

for being stationary. This is to establish through the structure of electron by Nieke [6] or the zitterbewegung (jiggling motion) by Schrödinger [9]. Therefore with the demand of stimulation and phase-right returning of field, steps of energy are to establish like Bohr explained this formal with equation (3) and (4). First when the periodic changing dipole-moment is discharged by radiation or impact-loss, then again a circle-orbit of electron is possible.

Nieke [4] discussed the spontane emission in the life-time of this state which can conduce to an emission of one photon. There field-lines are abscised as Hertz [10] described and Nieke [6] discussed in detail. In every half-period opposite directed field-lines abscise till the energy $h f$ is collected as photon in 'status nascendi'. Then a photon is originated which run away with light-velocity.

The doublet-structure of spectra of hydrogen could be explained if not only at one phase-state of returning field leads to stability but two. The usual interpretation is that by the positive and negative spin-adjust, therefore the inversion of magnetic moment of the electron. By Nieke [5] this do not be admissible for this has to be reserved for right- and left-spin and moreover here the direction is settled with the magnetic moment-sheet

VI. Discussion

The radius of electrons r_e was calculated out of push- and scattering-experiments. The magnetic moment of electrons was determined by the Stern-Gerlach effect in an inhomogen magnetic-field; that is valid as a reliable value. The radius of hydrogen was found in similar size with thermodynamic methods.

The calculation show that self-interaction by magnetic field of magnetic moment of electron in union with Lorentz-force and returning field can effect the different steps or levels of electrons. For the field has to return with right phase, so result periodical states. The periodicity and with it the energy-steps are resulting out of structure of electron, sort of motion and the velocity of electron round the nucleus

Here is to quote Popper [11] (translated): „In so far the causal-meta-physics is in their results many more fruitfully than an indeterministic meta-physics, as advocated by Heisenberg, we see indeed that Heisenberg's formulations have affected lamely on research. Our examination let to recognize that even obvious connections will be disregarded, if us is hammered in always that the search for such connections were 'senseless'."

By Nieke [5] was quoted Stark as a defender of the annular electron. There and also here the annular electron was not confirmed, but several magnetic moment-sheets presume no more that every electron has to revolve round the atom-nucleus as centre. In symmetrical arrangement is also possible a position outside the magnetic moment-sheets. So the tetrahedral positions of electrons in carbon, as Stark supposed, are no more to exclude. The magnetic moment-sheets of the four valence-electrons of carbon can be so arranged indeed. The estimation of Kossel, that for this is necessary a new force, can be confirmed. The new force is here presented as consideration of magnetic moment of electrons, interaction of eigen-field and Lorentz-force.

Therefore for electrons is not to assume a dipole with north and south pole but for magnetic moment is to assume a magnetic vortex propelling. By Nieke [5] the electron has the structure of electromagnetic vortex twin and this had to generate magnetic vortex propelling and charge. Ever direction of rotation the charge is positive or negative. This introuction could be describable with a combined and extended vortex- and electro-dynamics.

References

- [1] A. Sommerfeld, *Atombau und Spektrallinien*. Bd. I, Vieweg, Braunschweig 1960, 2. Kap. § 4, S. 92.
Atomic Structure and Spectral Lines. Methuse, London 1923, 1930, 1934.
- [2] Ed. A. Hermann, A. Einstein und A. Sommerfeld: Briefwechsel. Stuttgart 1968.
- [3] H. Nieke, *Newtons Beugungsexperimente und ihre Weiterführung*. Halle 1997, Comp. Print 1, Arbeit 12.
(vorhanden in vielen deutschen Universitätsbibliotheken);
Newton's Diffraction Experiments and their Continuation. Halle 1997, comp. print 2, paper 12.
(Available in some university libraries).
- [4] As [3], paper 13.
- [5] As [3], paper 14.
- [6] As [3], paper 16.
- [7] As [1], Bd. II, S. 280.
- [8] F. Chew, *Science* **161** (1968) 160; *Physics Today* **23** (1970) 23.
- [9] E. Schrödinger, *Preuß. Akad. Wiss. Berlin mat.-nat. Kl.* (1930) 462.
- [10] H. Hertz, *Ann. Physik (III)* **36** (1889) 1;
Ges. Werke, Bd. 1. Barth, Leipzig 1892.
Electric waves. Transl. D. E. Jones, Macmillan, London 1893.
- [11] K. Popper, *Logik der Forschung*. 9. Aufl. Mohr, Tübingen 989, S. 196.
Hrsg. E. Botcher: *Die Einheit der Gesellschaftswiss.* Bd. 4;
The Logic of scientific discovery. (1935); 2nd Ed. London, New York: Basic Books 1959.