The Interpretation of the Hubble-Effect and of Human Vision Based on the Differentiated Structure of Space

Gerhard Dorda
Institute of Physics, University of Armed Forces Muenchen, Werner-Heisenberg-Weg 39, 85577 Neubiberg, Germany.
E-mail: physik@unibw.de

Based on the differentiated structure of space, observed by the Quantum-Hall-Effect, a comprehensive equation is presented for the description of the Hubble-Effect. This Hubble-Effect equation reflects the experimental observation showing a casual connection to the Hubble time T_{U} and thus to the cosmic length L_{U} and the cosmic mass M_{U}. The obtained results are substantiated by the cosmic background radiation and by the agreement of the derived data with the experimental data of the Milky Way. It is shown that the differentiated structure of space, used for the description of the Hubble-Effect, also refers to the process of human vision, dominating the observation.

1 Introduction

After the discovery of the Quantum-Hall-Effect (QHE) and the associated exceptional side effects [1], it proved to be necessary to re-evaluate many physical and biological phenomena, e.g. the interpretation of the Hubble-Effect (HE) and, of the basis of it, even the process of human vision, referring to the *differentiated structure of space*. The differentiated structure of the three-dimensional space was first observed at the analysis of the experimental data of the QHE, which was discovered in 1980 by K. von Klitzing based on MOS-field-effect transistors.

The QHE is the first experimental observation of *quantization in the macroscopic scale* in solid-state physics. Only gradually, the fundamental importance of this discovery and of all with this discovery connected spectacular experimental observations became apparent for the entire range of physics. In the first instance, it was the observation of the QHE on GaAs–$\mathrm{Al}_x\mathrm{Ga}_{(1-x)}$As heterostructures [2], presented by D. C. Tsui et al, which showed that this effect is generally valid for the whole solid-state physics. More detailed investigations of the experimental data revealed that the QHE is not only independent from atomic mass, but also from the strength of the electric current used, i.e. from frequency, i.e. from time, and also from the form of the sample with the considered QHE structure, i.e. from space [3].

Really, the state of QHE shows a spectacular simultaneity of $R_{xx} = h/ie^2 = 2.58128 \times 10^4/i\,\Omega$ *and* $R_{xx} = 0\,\Omega$ (i is the quantization number), measured between different contacts *at any place* of the QHE structure. This effect of the spatial independence of the observed simultaneity in resistivity is the background of the disclosed two-dimensionality of electromagnetism at the causal situation. Besides that, it should be emphasized that the simultaneity of the quantized resistivity shows that the three-dimensional state of electromagnetism can be clearly separated spatially in two independent conditions: On one side in a 2-D state, given by the simultaneity, and on the other side in a 1-D state, realized capacitively by the interaction of the electron charges. The experimental observation of the possibility to split up electromagnetism in a 2-D and a 1-D state will be described by the "differentiated structure of the space" [3]. Analyzing all these novel experimental insights allowed to deliver convincing physical answers, for example Lee Smolin's book *The Trouble with Physics* posed fundamental and unsolved questions [4], in particular also about the category of time [3].

The description of space and time, i.e. frequency, based on the QHE, leads to the notion that also open questions in astronomy and cosmology could be answered with the help of the observations of the QHE. This, for example, includes the question about cosmic expansion, which, on the basis of the interpretation of the Hubble-Effect (HE), generated a vivid discussion, leading to the unfolding of several cosmic models, but without final solutions [5, 6]. Therefore, in this work, it is attempted to explore the experimental data of the HE on the basis of the so-called differentiated structure of space [3].

2 The analysis of the Hubble-Effect (HE) with respect to the differentiated structure of space

The cosmic expansion model is based on the experimentally observed Hubble-law, given by [5]

$$\upsilon_{\mathrm{HE,y}} = \frac{R_{\mathrm{HE,y}}}{T_{\mathrm{U}}}\,. \tag{1}$$

Here in (1), $\upsilon_{\mathrm{HE,y}}$ is the velocity of a given galaxy, $R_{\mathrm{HE,y}}$ has the significance of a distance referred to a given galaxy and T_{U} is interpreted as the Hubble time, defining the so-called age of the cosmos (an assumption which requires the expansion of the cosmos). The index HE signifies the relation of the Hubble-Effect (HE) to the associated redshift of the observed radiation and the index y refers this redshift to the observed galaxy [5, 6].

The figures of the experimental HE in [5] and [6] show the so-called escape velocity $\upsilon_{\mathrm{HE,y}}$ in relation to the velocity of light c, meaning that (1) can be rewritten by use of c. As a result, we receive a form which defines the HE in relation to the so-called length of the cosmos, obtained by $L_U = T_U\, c$, and we may write

$$\frac{R_{HE,y}}{L_U} = \frac{\upsilon_{HE,y}}{c} \ . \tag{2}$$

The value of the redshift is usually specified by the number z_y, which means

$$z_y = \frac{\upsilon_{HE,y}}{c} \ . \tag{3}$$

Since the HE merely reflects the observation of light, i.e. photon energies, the number z_y may, in accordance with (1) and (2) and due to the c-standardization, be considered to be related to the limit of the light frequency f_C or to the limit of the light wavelength λ_C. As shown in Section 4, this is of fundamental importance for the interpretation of the HE.

The concept of an escape velocity $\upsilon_{HE,y}$, as stated in (1), must originate from the existence of a given position, e.g. from the place of observation, or in a general sense from any localized place in the cosmos, in order to have the possibility to speak of place in sense of the classic conception of velocity, a model, which so far has been crucial for the interpretation of the HE. The concept of a place requires the existence of localization related to atomic mass, i.e. to protons and neutrons, constituting a gravitationally induced localization which only can become real through an atomic solid-state structure.

Starting from these findings it can be shown that based on the experimental data of the QHE, which is independent of atomic mass, a novel form of velocity can be defined. This velocity is also given by the relation of length and frequency, but this specific form of velocity is merely deduced from the dualistic character of the electron, i.e. without any contribution of proton-neutron-mass related gravity. This specific i.e. structural space-time condition, which is identifiable in the QHE, reveals that the electron-related velocity is given by the relation of the category of length, reflected by the electron mass m_e, and the category of frequency, realized by two-dimensional electromagnetism, i.e. by the electron charge e. This length-frequency, i.e. length-time relation is, in spatial terms, always mutually perpendicular to each other, which is the background for the notion of three-dimensionality of space and also the background for the *freedom* of choice concerning the value of light velocity. As shown in [3, pp. 33–34,45,49–50], it therefore follows the possibility of differentiation between the one-dimensionality, i.e. 1-D, and the two-dimensionality, i.e. 2-D. These fundamental circumstances were characterized in summary as a differentiated three-dimensional spatial structure.

It is evident that this electron related form of velocity is given at light effects, i.e. given by λf (λ = wavelength, f = frequency). Thus, it can be assumed that this form of velocity is also displayed in the observation of the HE-galaxies, playing an essential key role in the here presented reinterpretation of the HE. Hence, unexpected statements about the HE-galaxies may be obtained when the Hubble-law, i.e. (1), and the model of the differentiated structure of space are applied to Kepler's third law.

3 The application of the Hubble-Effect to Kepler's third law

To begin with, it seems necessary to appropriately transform Kepler's third law. In doing so, we assume that due to the cosmological principle [6], Kepler's third law has general validity in the entire universe.

Kepler's third law is given by [3],

$$\left(\frac{T_{G,y}}{2\pi}\right)^2 = t_{G,y}^2 = \frac{R_{G,y}^3}{G\, M_{G,y}} \ , \tag{4}$$

whereby G in (4) is the gravitational constant, given by

$$G = c^2 \frac{L}{M} \ . \tag{5}$$

Eq. (4), in conformity with the MKSA- or MKS-system of units, represents a universal linkage of the category of length with the category of time, modified by the category of mass. $T_{G,y}$ in (4) is the so-called orbital period of the given solid-state celestial body (SSCB), which planets, suns and stars are to be counted as part of. $t_{G,y}$ in (4) is the so-called effective time, referred to the surface of the SSCB, $R_{G,y}$ is the distance to the center of the SSCB and $M_{G,y}$ its mass. The index G signifies the connection to the SSCBs. In (5), L bears the meaning of the Planck length, $L = 4.051 \times 10^{-35}$ m, and M represents the Planck mass, $M = 5.456 \times 10^{-8}$ kg [7]. By transforming (4), we receive the following form, being valid for all SSCBs

$$\frac{\upsilon_{G,y}^2}{c^2} = \frac{L}{R_{G,y,1-D}} \frac{M_{G,y}}{M} \ , \tag{6}$$

whereby

$$\upsilon_{G,y} = \frac{R_{G,y,2-D}}{t_{G,y}} \ . \tag{7}$$

In (6), the left-hand side represents the electromagnetic effect, i.e. an effect reflecting spatial two-dimensionality, and the right-hand side reflects a distance related, i.e. a one-dimensionality related gravitational effect.

Here, in (6) and (7), the findings from the Quantum-Hall-Effect (QHE) about the possibility of the differentiated space is used, according to which the three-dimensional space, in case of it being structured, can be considered partitioned, and that [3]:

1. in a one-dimensional space, described by the 1-D state, covered by $R_{G,y,1-D}$, and
2. in a two-dimensional space, described by the 2-D state, ascertainable by $R_{G,y,2-D}^2$.

Attention should be paid to the fact that the one-dimensional gravitational distance $R_{G,y,1-D}$ of the SSCBs, as given in (6), could be described by the number $a_{G,y}$, which due to the reference to one-dimensionality was termed gravitational number. In [3, see p. 14], it is given by

$$R_{G,y,1-D} = a_{G,y}\, \lambda_{G,y}\,. \tag{8}$$

Here, $\lambda_{G,y}$ is a one-dimensional reference length, defined by

$$\lambda_{G,y} = M_{G,y} \frac{L}{M}\,. \tag{9}$$

It is easily recognizable that in accordance with (4) – (8), this reference length $\lambda_{G,y}$ signifies the connection between the category length and the atomic mass related gravitation.

When discussing (6), it is of importance to consider that the Planck relation L/M in (5) and (9) possess, due to the cosmological principle, validity for the entire being in the cosmos. Therefore, as an extension of L/M, we may write

$$\frac{L}{M} = \frac{\lambda_{G,y}}{M_{G,y}} = \frac{L_U}{M_U}\,, \tag{10}$$

which is a consequence of the general validity of Kepler's third law. Here in (10), $\lambda_{G,y}$ stands for the reference length of the SSCB and $M_{G,y}$ for its related mass. Furthermore, L_U and M_U are the limit length L_U and the limit mass M_U of the cosmos, introduced by means of (1) and (2), i.e. by means of the HE.

The masses $M_{G,y}$ in (4), (6), and (9) are effective as homogeneity parameters. As will be shown, the state of homogeneity can be related to two different structures in the cosmos, which, in the three-dimensional cosmic space, are identifiable by their dot-like centered unity. These two forms are:

1. Celestial bodies which consist of solid state, i.e. SSCBs, and which can, by means of Kepler's third law, be very well described as spherical structures, given by interwoven gravitational-electromagnetic structures ([3], page 44). All planets, suns and stars are to be counted as part of this. With regard to (4), the boundary condition for the homogeneity of the SSCB is the equality $R_{G,y,1-D} = \sqrt{R^2_{G,y,2-D}}$, which enables dynamics, i.e. the category of time, to be revealed in Section 4.
2. Celestial bodies whose existence only is observable with the aid of optical methods, i.e. with the aid of eyesight and technically with the aid of optical absorption methods. This includes galaxies, theoretically ascertained by (1) and (2) of the HE. These cosmic structures are not given by a coherent, gravitational-electromagnetic interwoven state, but they are to be considered a free, i.e. dynamic cluster of different SSCBs, which, as part of above all electromagnetic interactions, form by the so-called "black hole" a homogeneous, i.e. dot-like centered unity. Due to the free cluster of SSCBs, which show only insignificant gravitational interaction, the possibility of creating the category of time by means of galaxies does not exist. Hence, we are able to clarify the boundary condition for the homogeneity of the HE-galaxies only in Section 5.

To clearly show the difference between the SSCBs and the galaxies, (6) must be adapted to (1) and (2). Based on (6) and (10), we may write

$$\left(\frac{v_{HE,y}}{c}\right)^2 = \frac{L_U}{R_{HE,y,1-D}} \frac{M_{HE,y}}{M_U}\,, \tag{11}$$

whereby $v_{HE,y}$ is given by

$$v_{HE,y} = \frac{R_{HE,y,2-D}}{T_U}\,. \tag{12}$$

$M_{HE,y}$ signifies the mass related to the given galaxy. The distances $R_{HE,y,1-D}$ and $R_{HE,y,2-D}$ in (11) and (12) are, according to the cosmological principle, to be interpreted as characteristic distances, i.e. lengths, of the given galaxy.

In conformity with (6) and (11), the fundamental difference between the SSCBs and the HE-galaxies should become above all apparent by means of the different definitions of $v_{G,y}$, (7), and of $v_{HE,y}$, (12). Thus, this difference is discussed in the following sections.

4 The difference between solid-state celestial bodies (SSCBs) and HE-galaxies

When comparing the velocities $v_{G,y}$ and $v_{HE,y}$, we proceed that both $R_{G,y,2-D}$, the distance of the given solid-state celestial body (SSCB), and $R_{HE,y,2-D}$, the distance of the given galaxy, are to be considered their distinctive characteristic. In doing so, the cosmological principle is to be heeded, stating that in the cosmos there is no center and consequently no defined position [6]. Moreover, the fundamental difference between the time statements $t_{G,y}$ and T_U, given in (4) and (1), has to be taken into account since it points out that, as (4) and (6) show, the time $t_{G,y}$ is one of the characteristic parameters of any given SSCB, whereas the time T_U, being valid for all HE-galaxies, is solely a cosmic constant. From Kepler's third law, (4) and (6), it results that the time $t_{G,y}$ is given by

$$t_{G,y} = \sqrt{a_{G,y}}\, \frac{R_{G,y,2-D}}{c}\,, \tag{13}$$

whereby $a_{G,y}$ is the SSCB related gravitational number, defined in (8). Thus, considering (6), (7), and (13), the solid-state celestial body is characterized not only by the mass $M_{G,y}$ and the radius $R_{G,y}$, but also by the SSCB related category of time $t_{G,y}$.

In contrast to $v_{G,y}$, the velocity $v_{HE,y}$ can experimentally only be experienced by optical means, in fact with aid of the light i.e. photon energies, emitted by the given galaxy. This energy spreads from the galaxy with the velocity of light and is registered by the eye or by appropriate appliances (telescopes) via absorption. Since the respective galaxies distinguish from each other by the emitted light i.e. photon energy, it is physically permitted, in compliance with the observed value of the so-called redshift z_y, to ascribe an appropriate frequency f_y to the observed galaxy, which reflects the energy hf_y. That means, the in (2) presented relation $v_{HE,y}/c$ can be replaced by an appropriate frequency or wavelength relation, and we may write

$$z_y = \frac{hf_y}{hf_C} = \frac{hc/\lambda_y}{hc/\lambda_C} = \frac{\lambda_C}{\lambda_y} . \tag{14}$$

It then again follows that the HE can be described by means of an equation of light

$$\lambda_y f_y = \lambda_C f_C = c , \tag{15}$$

which inter alia reflects the fact that the frequency, in localized form known as the category of time, is an expression of pure electromagnetism [3].

Here in (14) and (15), f_y is the given galaxy related frequency or λ_y wavelength, whereas f_C is the Compton frequency and λ_C the Compton wavelength. In (14), z_y is, unlike in the classic Doppler-effect model, not valued as a difference from wavelengths, but as a direct information about the observed galaxy state, given by f_y or λ_y, respectively. Thus, (14) and (15) determine the state of the HE-galaxies. Hence, instead of interpreting $v_{HE,y}$ mechanically as an escape velocity of the galaxies, it proves to be physically acceptable, with regard to (14) and (15), to replace the concept of the classical velocity with the frequency or wavelength relation given by (14) and to describe the redshift as a light wave radiation, which reflects the heat radiation laws, i.e. Wien's displacement law. That means, it is postulated that any HE-galaxy emits radiation in the form of photon energy as a result of its homogeneity.

5 The equation of the Hubble-Effect

Starting the analysis of this novel description of the HE, above all it must be emphasized that the existence of the parameter of the HE galaxies, given by T_U, attests the validity of Kepler's third law for the whole cosmos, i.e. the form of the gravitational constant (5), and also the extension of L/M, presented in (10). Thus it is – from a physical point of view – legitimate to use the (4), (5), and (10) as basic equations for the further analysis of (11), at which we take the form $R_{HE,y,1-D}$ in place of $\lambda_{G,y}$ of (9). Furthermore, it appears absolute necessary for the description of the HE to apply the model of the differentiated structure of the space to (11). This requirement indicates to formulate (11) in a particular form, reflecting this spatial differentiation. It can be achieved by a completion of (11) by the factor z_y^2, hence formulating

$$\left(\frac{v_{HE,y}}{c}\right)^2 = \frac{L_U\, z_y^2}{R_{HE,y,1-D}} \frac{M_{HE,y}}{M_U} . \tag{16}$$

Really, it should be considered, the experimental HE data shows that the factor z_y is causally related to the distance $R_{HE,y,2-D}$, as it was on the basis of (2) and (3) expressed by (12). Thus, to be in accordance with the required differentiation of the HE-state from the usual three-dimensionality into the one-dimensionality and the two-dimensionality, we have to conclude that the factor z_y^2 must be related to the 1-D related distance $R_{HE,y,1-D}$, to ensure the causality at the whole HE-state. Evidently, these requirements are realized by means of (16).

Taking into consideration all the presented experimental data and the related conclusions, given in Sections 2 – 4, we are able to present the solution of the whole HE state, and that in form of a comprehensive, generally valid equation, given by

$$\begin{aligned} R_{HE,y,1-D} &= z_y\, R_{HE,y,2-D} = z_y^2\, L_U \\ &= z_y^x\, M_{HE,y} = z_y^{x+2}\, M_U , \end{aligned} \tag{17}$$

at which z_y^x is given by

$$z_y^x = \frac{L}{M} = \frac{R_{HE,y,1-D}}{M_{HE,y}} = \frac{L_U}{M_U} = 7.426 \times 10^{-28}\ \mathrm{m\,kg^{-1}} . \tag{18}$$

Equation (17) shows that with respect to (2) it is possible to formulate the relations

$$R_{HE,y,2-D} = z_y\, L_U , \tag{19}$$

as well as

$$R_{HE,y,1-D} = z_y\, R_{HE,y,2-D} \tag{20}$$

and

$$M_{HE,y} = z_y^2\, M_U . \tag{21}$$

Furthermore, on the basis of (16), it becomes evident that the difference between the SSCBs and the state of HE-galaxies is simply describable by the factor z_y , which is, according to (6), for the SSCBs without exception given by $z_y = 1$.

The numerical value of (18) results from the experimentally explored gravitational constant [4] $G = 6.6738 \times 10^{-11}$ $\mathrm{m^3kg^{-1}s^{-2}}$, using (5). It demonstrates the value z_y^x to be a natural constant. Besides, it should also be emphasized that (18) is therefore significant for our model, as it discloses the functional background of the homogeneity of the HE galaxies.

The validity of (17) and (18), and thus of (19) – (21), can be verified using both the knowledge of the cosmic background radiation and the known experimental data of the Milky Way, since according to our model the Milky Way galaxy is assessed to be a homogeneous galaxy.

6 The analysis of the cosmic background radiation with respect to the Milky Way galaxy radiation

At first, when analyzing (17) and (18), which describe the state of all HE galaxies, it must be pointed out that in the spatially differentiated state, as it is the case for the optical observation of the HE galaxies, only the electron related electromagnetic variability is ascertained, so that a specific proton-neutron one-dimensional mass-effect cannot be observed at this effect by experiment. Thus to solve this problem, the observation of the cosmic background radiation is considered. It shows that this radiation, represented by the temperature $T_{\text{cosm}} = 2.73\,^\circ\text{K}$, is the result of the interaction of hydrogen atoms, extended over the whole cosmos, see [5] and [12].

Thus when we value the cosmic background radiation as a heat radiation effect, given by the displacement law of Wien, obtaining $z_T = \lambda_C/\lambda_{\text{cosm}} = T_{\text{cosm}}\,\lambda_C/(3.40\times10^{-3})$ [3, part III] and assess this value with respect to the heat radiation factor of the Milky Way, given by $z_{\text{MW}} = \lambda_C/\lambda_{\text{MW}}$, evidently this z_T value has to be modified by the relation m_p/m_e, corresponding to the temperature relation $T_{\text{MW}}/T_{\text{cosm}}$. Here m_p is the mass of the proton, m_e the mass of the electron and T_{MW} has reference to z_{MW}. In other words, the factor of modification m_p/m_e represents the energetic difference between the cosmic background radiation, being a result of the interaction of hydrogen atoms, and the radiation of the localized, i.e. spatially differentiated electromagnetism of the HE galaxies.

Using the HE-related (9) and (10), as well as the (17) and (20), and assuming that the heat radiation factor of the Milky Way is identical with the cosmic background radiation factor z_T, then we obtain the following relationship

$$R_{\text{HE,MW,2-D}} = \frac{3.4\times10^{-3}}{T_{\text{cosm}}\,\lambda_C}\,\frac{m_e}{m_p}\,\frac{L_U}{M_U}\,M_{\text{HE,MW}} = 2.08\times10^{-22}\,M_{\text{HE,MW}}\,. \tag{22}$$

Here, in place of the Milky Way radiation factor z_{MW}, the assumed identity of z_{MW} to z_T was used, resulting in

$$z_{\text{MW}} = z_T = \frac{T_{\text{cosm}}\,\lambda_C}{3.4\times10^{-3}}\,\frac{m_p}{m_e} = 3.58\times10^{-6}\,. \tag{23}$$

At (23), T_{cosm} was replaced with the background radiation value $T_{\text{cosm}} = 2.73\,^\circ\text{K}$, and the causal relation $\lambda_{\max}T = 3.40\times10^{-3}$, i.e. Wien's displacement law, was used for λT. When we use the Hubble time $T_U = 4.32\times10^{17}$ s, reflecting a Hubble constant of $H_o = 71.4\,\text{km}\,\text{s}^{-1}\text{Mpc}^{-1}$, lastly obtained from the Hubble telescope, we obtain a cosmic length $L_U = c\,T_U = 1.30\times10^{26}$ m, and by means of (10) a cosmic mass $M_U = 1.74\times10^{53}$ kg.

Finally, by means of (19) – (23), for the Milky Way we obtain the values

$$R_{\text{HE,MW,2-D}} = z_{\text{MW}}\,L_U = 15.05\,\text{kpc} = 4.63\times10^{20}\text{ m}\,,$$
$$M_{\text{HE,MW}} = z_{\text{MW}}^2\,M_U = 1.12\times10^{12}\text{ solar masses} = 2.23\times10^{42}\text{ kg}\,. \tag{24}$$

Considering these results with respect to the experimentally observed data of the Milky Way, given in [6] by the approximate values of the radius $R_{\text{HE,MW,2-D}} = 15\,\text{kpc} = 4.6\times10^{20}$ m and of the mass $M_{\text{HE,MW}} = 10^{12}$ solar masses $= 2\times10^{42}$ kg, we assess for the radius a factor of inaccuracy of only 3 %, and for the mass $M_{\text{HE,MW}}$ of only 12%. This finding, especially the agreement of the order of magnitude of both $R_{\text{HE,MW,2-D}}$ and $M_{\text{HE,MW}}$, is very important, as it convincingly demonstrates that (17) and (18) can be assessed as a novel, physically justified description of the Hubble-effect.

The Sections 2–6 have shown that the novel HE model is based on the QHE-observation about the differentiated structure of the 3-dimensional space. The application of the differentiated space structure on the gravitational constant G , (5), shows that c^2 is related to electromagnetism, in the case of the HE-galaxy to the 2-D state, represented by the $R_{\text{HE,y,2-D}}$ distance, whereas L/M refers to the gravity of the HE-galaxies, i.e. to the 1-D state, represented by the $R_{\text{HE,y,1-D}}$ distance, which is in this situation in a causal connection to the mass $M_{\text{HE,y}}$. The HE-circumstance, described by (16) – (18) and thus by (20), shows that the connection between the distances $R_{\text{HE,y,2-D}}$ and $R_{\text{HE,y,1-D}}$ is given by the factor z_y.

These results are confirmed by the agreement of the calculated data with the experimental data of the Milky Way and support also the conception, formulated by (10), that the relation $R_{\text{HE,y,(1-D)}}/M_{\text{HE,y}}$ of *any* HE galaxy is always identical with the L/M-relation.

7 The description of human vision on the basis of the differentiated structure of space

A particular confirmation of the value z_{MW} is obtained by considering the general limitation of vision. Seen in this connection, it should be pointed out that not only that of human eyes, but also the vision of all animals breaks off at the wavelength $\lambda_y = 6.8\times10^2$ nm [13]. This particular observation manifests the rightness of the identity between the limiting value of the wavelength of visible light and the specific wavelength of the radiation of the Milky Way $\lambda_{\text{MW}} = 6.79\times10^2$ nm.

A further very interesting observation about the process of seeing is obtainable, when we become aware of the connection between human vision and the differentiated structure of space. As disclosed extensively in *The Feynman Lectures on Physics* [13], human vision is the result of processing of two signals, independently given on the one side by the rod cells, and on the other side by the uvula cells. In this textbook, it is shown that the rod cells yield signals at the twilight, i.e. signals without any colored light absorption, whereas the uvulas show signals solely by means of colorful light.

This biological differentiation reflects in an absolute manner the physical model of spatial differentiation between gravitation and electromagnetism, suggesting that the rod-signals represent the 1-D related gravitational interaction, whereas the uvula-signals the 2-D related electromagnetic interaction.

Thus it is physically acceptable to suggest the biological structure of human eyes to be the consequence of the effect of the discussed existence of the differentiated structure of space, given outside of masses. Consequently we can state that this interesting biological differentiation between rods and uvulas reflects the spatial differentiation between the 1-D state and the 2-D state, showing that the differentiated structure of space is the particular mediator of these effects.

Considering these circumstances, it becomes evident that due to the existence of the differentiated structure of space, the human eyes become the main processing not only of the perceptibility of solids and thus of the observation in general, but also, simply by the absorption of particular quanta of light, of the perceptibility of stars and galaxies, and attain therefore, together with the help of telescopes, the possibility to discover the HE and the related equations (16), (17) and (18).

8 Concluding findings

In the cosmos, there are two forms of homogeneous structures: Solid-state celestial bodies (SSCBs) and HE-galaxies (HE). Homogeneous solid-state celestial bodies consist of electromagnetic-gravitational interwoven structures, which can be described by Kepler's third law. This law shows that the SSCBs can not only be characterized by mass and radius, but also by the category time, whose lapse is dependent on the strength of gravity of the given SSCB [3].

In contrast, the existence of HE-galaxies is solely observable by means of optical signals, i.e. by eyes and/or by technical methods, using telescopes. Here, signals undisturbed by atmospheric absorption are required, which correspond to the state of a differentiated three-dimensional space. Incidentally, in this connection it should be emphasized that the Pythagorean theorem, considered in conjunction with the three-body problem, entirely corresponds to this differentiated three-dimensional space model. Therefore, it should be pointed out that the application of the differentiated structure of space to the optical signals of galaxies leads, with analyzing the HE, to (16) – (18). In addition, it was demonstrated that the validity of (17) and (18) can be established by the cosmic background radiation, and what is more, by the excellent agreement of the deduced data of mass and radius of the Milky Way with the corresponding values.

The presented new model of the Hubble-effect, which is based on the black-body radiation, shows – according to the *experimental*, generally valid disclosures of the Quantum-Hall-Effect (QHE) – that the so-called HE-velocity $v_{\text{HE,y}}$ is a pure electron effect. Therefore it has been stated that, according to the differentiated structure of space, the frequency, i.e. the category time, should not be considered an absolute basic magnitude, but an electromagnetic 2-D state, which becomes localized, i.e. observable only in connection with the existence of masses. Therefore, as generally known – and also being in agreement with the differentiated space model – time can be observed only in a causal relation to the 1-D length state [4]. This conclusion follows from (4) and (8) and has been manifested by experimental data of the lapse of time, in particular described in [3] by (26).

Finally, the importance of the differentiated structure of space in nature has been further made evident by the analysis of human vision, showing that the difference of the function of the uvula cells and the rod cells reflects the separateness of the 2-D and 1-D spatial state of seeing, an effect, being in accordance with the description of the Hubble-Effect. This observation is of extraordinary importance, as the process of seeing is the main background of the human observation of all being. As will be shown in a next paper, this important conclusion can be additionally substantiated by the physical description of the process of hearing [14, 15].

Acknowledgements

The author is indebted to *Prof. Walter Hansch*, University of Armed Forces, Muenchen, for the support of this subject and for his critical comments to several statements of this paper. He would also like to thank *Torsten Sulima* for the scientific-technical assistance, *Alexander Hirler* for the extensive completion of the paper for printable publication and *Franz Wittmann*, Technical University, Muenchen, for his cooperation to select the proper journal for publication. Finally, the author expresses many thanks to *Klara Kirschner* for the translation of the text into English.

Received on December 5, 2019

References

1. von Klitzing K., Dorda G. and Pepper M. New method for high-accuracy determination of fine-structure constant based on quantized Hall resistance. *Phys. Rev. Lett.*, 1980, v. 45, 494–497.
2. Tsui D. C., Störmer H. L. and Gossard A. C. *Phys. Rev. Lett.*, 1982, v. 48, 1559–1561.
3. Dorda G. Die Struktur von Raum und Zeit und die Interpretation der Wärme. Cuvillier Verlag, Göttingen, ISBN 978-3-7369-9388-4, eISBN 978-3-7369-8388-5, 2016.
4. Smolin L. The Trouble with Physics. Houghton Mifflin Company, New York, 2006. In German: Die Zukunft der Physik. Deutsche Verlags-Anstalt, München, 2009, pp. 344–346.
5. Silk J. A short history of the universe. *Scientific American Library*, W. H. Freeman and Company, New York, 1994. In German: Die Geschichte des Kosmos. Spektrum, Berlin, 1996, pp. 34–42.
6. Bernhard H., Lindner K. and Schukowski M. Wissensspeicher Astronomie. Volk und Wissen Verlag, Berlin, ISBN 3-06-081705-7, 1995.
7. Kostro L. De Broglie waves and natural units. In: van der Merwe A. and Garuccio A., eds. Waves and particles in light and matter. Plenum Press, New York, 1994, 345.
8. Gerthsen C. and Vogel H. Physik. Springer-Verlag, Berlin, 1993, pp. 570–571.
9. Hausamann D. and Further J. Einstein und die Satellitennavigation, In: Einsteins Relativitätstheorien, Deutsches Museum. Deutsches Museum-Verlag, München, 2005, pp. 24–34.
10. Pound R. V. and Rebka G. A. *Phys. Rev. Lett.*, 1960, v. 4, 337–341.

11. Bublath J. Geheimnisse unseres Universums – Zeitreisen, Quantenwelten, Weltformel. Droemer Verlag, München, 1999, ch. 10, pp. 114–115.
12. Fritzsch H. Vom Urknall zum Zerfall. In: Serie Piper SP518, R.Piper & Co. Verlag, München, 1987, pp. 255–256, 283.
13. Feynman R. P., Leighton R. B. and Sands M. The Feynman Lectures on Physics, Vol. 1. California Institute of Technology, 1963, ch. 35–36. In German: Vorlesungen über Physik, Band 1. Oldenbourg Verlag, München, 1987, pp. 477–505.
14. Fletcher H. and Munson W. A. Loudness, its definition, measurement and calculation. *J. Acoust. Soc. Am.*, 1933, v. 5, 82.
15. Dorda G. Die Interpretation des Schalls auf der Basis der differenzierten Struktur des drei-dimensionalen Raumes. University of the Armed Forces, Muenchen, Germany, to be published.