The simulation of quantum optical processes

Preliminary remarks: When I sketched this design of optics in a digital space in 1988, Nick Bostrom's (2003) simulation hypothesis did not yet exist. Nevertheless, there were already precursors of this hypothesis in the various interpretations of quantum physics and computer theory: (Wikipedia "Origins of the simulation hypothesis can be found in the interpretations of quantum mechanics and considerations of numerous physicists and computer scientists, including Carl Friedrich von Weizsäcker, John Archibald Wheeler, Stephen Wolfram, Jürgen Schmidhuber and Gerard 't Hooft. [13] [14] [15] [16]
The hypothesis that the universe can be understood as a digital machine came to Konrad Zuse during a stay in Hinterstein in 1945/1946 [17] and was published by him in 1969 in the book *Rechnender Raum.* In it, he formalized his ideas on "computing space", building on Stanisław Marcin Ulam's work on cellular automata around 1940.")

At that time, the computing power of my PC was just enough to program the beginnings of a simulation in a 2D space. Today it is completely different.

At least this design was found quite interesting, even if it was a bit ahead of its time, as the following facsimile from the TU Stuttgart shows.

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Sehr geehrter Herr Dr. Nitsche,

für die Zustellung Ihres interessanten Beitrages "Ansätze zu einer Nichterlanger Optik" möchte ich mich herzlich bedanken. Ich finde diese Arbeit äußerst interessant und freue mich auch schon auf den angekündigten Vortrag an unserem Institut. Ich würde allerdings den Termin etwas nach hinten schieben, damit auch noch Studenten, die z.Zt. teilweise im Urlaub sind oder Praktika machen, zuhören können. Geeignet scheint mir November/Dezember 88, eventuell Januar 89.

Wie wird Ihre zukünftige Tätigkeit aussehen? Wir sind immer noch an einer allfälligen Zusammenarbeit interessiert.

Ich wünsche Ihnen noch viel Spaß an den weiteren Untersuchungen und freue mich auf unser nächstes Gespräch.

In der Zwischenzeit verbleibe ich

mit freundlichen Grüßen

Prof.Dr. H. Tiziani

There has yet to be an Elon Musk who was even sure: (Wikipedia: "Musk concludes: "If civilizations cease to progress, it may be due to a catastrophic event that wipes out a civilization." Hence his conclusion, "Either we create simulations that are indistinguishable from reality, or civilizations will cease to exist. " ")

I did not pursue this topic further and turned to the theory of gravitation. Einstein's model of gravity is elegant but less suitable for simulation. The singularities of this model are not suitable for a digital simulation.

The current draft has not been changed. If I still have time for it, I will try to implement it again.

Approaches to a Non-Continuum Optics

T E I L I

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T E I L II

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0. Introduction

> *"The question about the validity of the presuppositions of geometry on an infinitely small scale is connected with the question about the inner basis of the dimensional relations of space. In this question, which may well still be counted as part of the doctrine of space, the above remark is applied, namely, that in the case of a discrete manifold the principle of the dimensional relations is already contained in the concept of this manifold, but in the case of a continuous manifold it must be added from somewhere else. Thus either the real thing underlying the space must form a discrete manifold, or the ground of the dimensional relations must be sought outside, in binding forces acting upon it."*
> *B. Riemann, On the hypotheses underlying geometry.*

The experiences made in the mathematical modelling of physical processes since the development of computer technology make an abolition of the so-called "Erlangen physics" *(physics of the continuum)* seem conceivable. The physical manifold, whose homogeneity is expressed in the invariance of the combinations of field functions and their differential quotients and leads to the conservation law, is in most practical cases subjected to a quantization process determined by "step sizes" and "difference quotients". Quantities are counted, model bodies arise and decay in spatial elements with finite distances, forces act only in discrete spatial points. Thus, a development of physical thinking, as started by Felix Klein ("Vergleichende Betrachtungen über neuere geometrische Forschungen") and Emmy Noether ("Invariante Variationsprobleme") in Erlangen physics, seems to be complemented and extended by new forms of thinking. Ultrarelativistic interaction processes of fields, as they become possible from the indeterminacy relation, need not be expressed in the macroscopic mean of a given field. In macroscopic fields local fluctuations are of no importance and "pseudoquantized" numerical models of physical processes are quite reasonable.

In ultramicroscopic areas, however, it seems to me to be important to work with meaningful step sizes, differences and transitions in the mathematical models. I also believe that recent developments in computer technology, such as those represented by array processors, open up possibilities for modeling such physical processes without statistical averaging. Such "real-time modeling" could then penetrate to physical spaces that are difficult to access with existing models. An example would be the interaction of an "individual photon" with the "individual atoms" of a boundary layer. Modeling such processes seems to me to be important in the development of optical chips and computers, among other things. The study "Approaches to a Nichterlanger Optics" aims at showing possibilities for such a mathematical modelling. Since Nichterlanger (*quantized)* optics does not know any integral laws, and all processes are "countable" from the beginning, its development is bound to computational prerequisites. The study does not assume a "quantization of integral regularities", rather it attempts to derive the behavior of photons from a quantized space-time. Only an investigation of the behavior of a large number of photons can lead to the confirmation of a macroscopic integral regularity and thus contribute to the verification of Nichterlanger optics in the development stage. I would like to point out one more essential circumstance in the development of Nichterlanger optics: The models and principles can probably only be verified step by step (apart from basic approaches) with their computational realization.

1. Preliminary remarks on a Nichterlanger optic

Introductions to the field of imaging optics usually begin with an object, a luminous candle for example, being imaged through a converging lens onto a collecting plane.

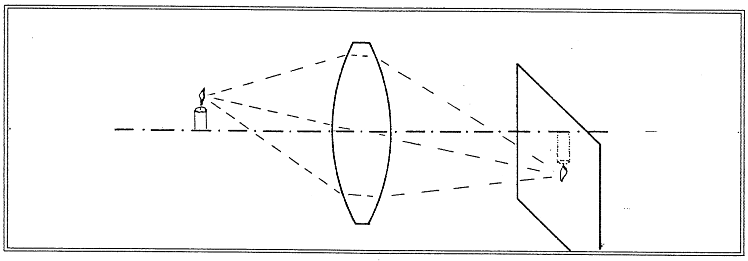


Bild 1 Geometrische Optik

A first hypothesis is made by saying: from each point of the object a bundle of light rays goes into the surrounding space. Part of this bundle of light is now concentrated by the converging lens onto the collecting screen, rays emanating from a point on the object intersecting near a point on the collecting screen.

A model of this appearance then looks like this:

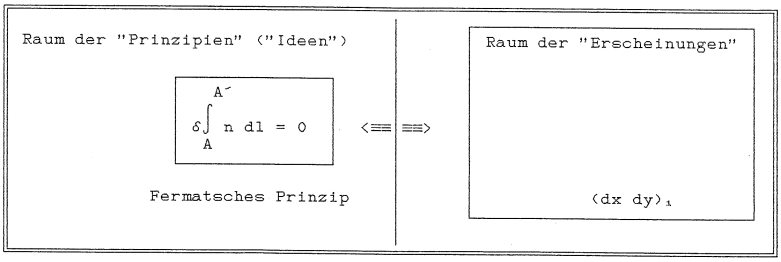


Bild 2 Wirkungsbereich des Fermatschen Prinzips in der Optik

A mapping of appearances into a space of principles takes place. In this concrete case the ray-optical image of an object is the "image" of Fermat's principle. Of course, as is well known from practice, Fermat's principle can be applied meaningfully only to areas in the optical image which are larger than a unit area given here as (dx dy). While on one side in the "space of principles" a simple basic principle is available, we have on the other side a still relatively large area for which this basic principle according to Fermat is valid with sufficient accuracy. If the requirements for accuracy are no longer sufficient, and one has to make statements about smaller areas than (dx dy)>1, the space of principles "expands" to the space of Maxwell's equations (Figure 3).

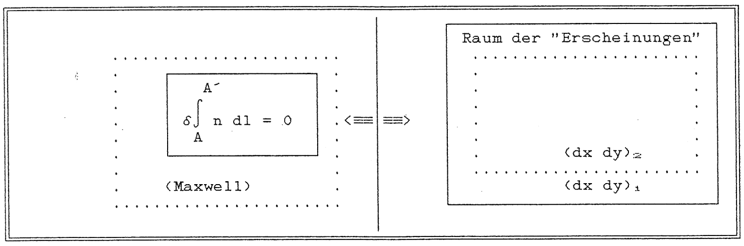


Bild 3 Wirkungsbereich der Wellenoptik

In between there are other principles, which all follow from the approximations of Maxwell's equations. A further extension of the space of principles is provided by quantum field theory and photon statistics (Fig. 4).

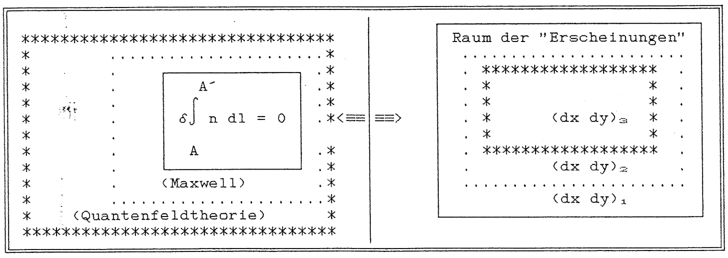


Bild 4 Wirkungsbereich der Quantenfeldoptik

The space $(dx\ dy)_3$ is now so small that fluctuations in the wave field and photon counts belong to the phenomena no longer accessible to the senses. In general, there is a reciprocal proportionality between the space of principles and the "resolvable" space of phenomena:

$$\Delta(P) \sim \frac{1}{(dx\ dy)}$$ P - Space of principles

The reciprocal "transformation" of spaces represents a primal principle of linkage, as it is applied in holography, among other things. Closely connected with this is the question of the infinity of the processes of reduction and enlargement and which tendencies can thus be derived from the phenomena of light. The starting point in geometrical optics was pseudo-points and pseudo-rays as the elements of an optical continuum. A progression to smaller areas in the space of phenomena leads to the fact that these points and rays cannot fall below certain spatial extensions. The solution for this is the continuum of wave surfaces from Maxwell's equations. But also this continuum decays in photon statistics to countable photons. This expresses another tendency in the hierarchy of levels of abstraction: In an optics in which the integral conditions of space determine the course of local processes, be it in general the propagation of light in vacuum or the propagation in interaction with matter, difficulties arise when ultramicroscopic interactions are considered. This is due to the fact that the integral conditions of space are based on a notion which regards infinity as the (imagined) result of the continued division of a finite quantity. In the case of the domains of optics accessible to the senses and their instrumental amplifications, this view has certainly proved its validity. The resistance encountered to an integral description in ultramicroscopic domains is accompanied by an increasing restlessness and agitation (fluctuation). Even a certain arbitrariness or freedom in the description of ultramicroscopic processes leads to a discrepancy between what is to be described materially and the ideas underlying the description. Therefore two ways seem conceivable, one is to assume that the laws of motion are in matter itself, in which case I can replace matter by its laws of motion, the other is to regard matter as a chaos of energy "organized and held together" by "principles" (such as photon, electron, etc.). The tendencies outlined above seem to lead to the latter case.

An "organized chaos" can be described globally by integral conditions, but locally all models based on any continuum fail. Based on transitions just sketched, one could easily conclude to a decay of photons, to a quantization now also of photons and to a "principle of photons" resp. elementary particles. If I consider smaller and smaller areas in the space of appearances, I come to more and more comprehensive and fundamental principles in the space of principles (in the direction of a perhaps existing original principle of matter.) The direction towards such an original principle also signals a temporal going back in evolution, which is to be considered elsewhere. A chaos structured by "principles of energy" as represented by photons and by "principles of matter" as represented, for example, by the electron, must allow for the diversity of the observable world through hierarchies of principles. An exemplary consideration for these problems, because itself without models and thus drawing from an original source, is provided by the ideas of ancient atomistics, which do not posit an infinite divisibility of matter, space, time, and motion as a postulate. If we consider the thoughts of ancient philosophers on time and space, we notice, besides the "vagueness" of their definitions, apparently contradictory views, which find their summary especially in the aporias of Zeno, and find their "overcoming" both in the geometry of Euclid and in the physics of Aristotle. Thus a continuum and a manageable infinity had been found for the first time, at least for antiquity.

But if one starts from the hypothesis that this contradictoriness is only the contradictoriness between microscopic and macroscopic observation, then in a kind of "glass bead game" an attempt can be ventured which constructs a system from a compilation of ancient concepts about space and time which is free of contradictions in itself.

Statements of ancient atomism:	**Philosoph:**
Platonic bodies	Plato
no infinite division of the substance	Democritus
Regeneration of the fabric in every point	Alexander of Aphrodisias
Isotachy (movement with equal speed)	Epicurus
Declination (spontaneous deviation)	Epicurus
no infinite division of time	Epicurus
Emergence and decay as a form of movement	Aristotle
excellent frame of reference, absolute motion	Aristotle

The assignment in the table is not one-to-one and does not claim to assign the statement to its original thinker. Also, the statements have been strongly shortened and rationalized, for example, Epicurus speaks for the microscopic area of "moments of time detectable by thought" as the smallest units of time, while for him macroscopic time consists of "moments of time detectable by sense perception". The energy momentum space described in Sections 2 and 3 can be derived from the above table. The representations from Nichterlanger optics contained in the following sections are often only to be understood as working theses and are often only presented to the extent that they allow a qualitative explanation of optical phenomena (sections 4. and 5.). I tried to explain many of these appearances briefly, so application of methods of Nichterlanger Optics becomes visible. Detailed statements are possible in most cases only by computer simulation. It can also not belong to the tasks of Nichterlanger Optics to try to solve the same problems as wave optics or quantum optics. Nonlanger optics has its justification where the statistical behaviour of a multitude of photons loses its sense (e.g. when the photon numbers are too small). A reasonable condition for Nichterlager optics seems to me to be the requirement that, for example, all phenomena of wave optics or quantum optics must be derivable as approximations from Nichterlanger optics. Only this precondition allows an exact determination of the parameters for the algorithms of Nichterlanger optics.

2. on the metric of the momentum space

2.1 Structure of the impulse space

"We can therefore consider matter as the region of space in which the field is extra dense...in this new physics there is no room for both field and matter, for the field is the only reality" Albert Einstein

As momentum space here is understood the quantization of space and time in the way that an energy momentum can only exist in one space-time cell. After an elementary time interval, this energy impulse disappears and then reappears in a neighbouring cell. The distance between two neighbouring cells is the elementary distance which cannot be further divided. The ratio of elementary distance to elementary time interval is the maximum possible speed of change of place or propagation of a pulse sequence and is equal to the speed of light c in vacuum.

The elementary space-time cells and the transmutations of the energy impulses form the foundations of a physical reality which, with the addition of principles or ideas ordering this chaos, determine the observable reality of our world. In momentum space, infinity as a result of the division of a finite quantity has finally lost its physical meaning. Furthermore, the classical assumption that events are determined by integral conditions at successive instants and points is violated. There is no metric which makes the difference of the coordinates of two points the vertices of a straight line. Instead of measuring, there is counting the cycles of emergence and decay of the energy impulses, i.e. the number of transmutations.

<u>Principles of description and provisional definitions:</u>

Def. 1: A space is formed by contiguous elementary cells.
Def. 2: A space has a one-dimensional structure, if to a unit cell exactly belong to two neighbors.
Def. 3: A space has an n - dimensional structure, if to a unit cell exactly n+1 non-identical neighbors belong to.
Def .4: A clock involves the transmutation of all energy pulses from one cell of space to a neighboring cell.
Def.5: The distance between two non-identical elementary cells is the smallest possible number of cycles for a transmutation from one cell to another (minimal principle).
Def.6: The angles between three non-identical elementary cells are determined by their distances.

Contrary to Einstein's quote above, in Nichterlanger physics there is only space and energy. Similar to a neon sign, which wanders over a fixed field of light bulbs, the energy impulses behave in space. The time between the extinguishing of an incandescent lamp and the lighting up of the neighbouring lamp is the smallest possible unit of time. The distance between neighbouring light bulbs is the smallest possible distance in space. Field quanta occur as the probable behavior of energy pulses in space cells. Only the possible transitions to neighbouring cells determine the nature of the field (macroscopically seen).

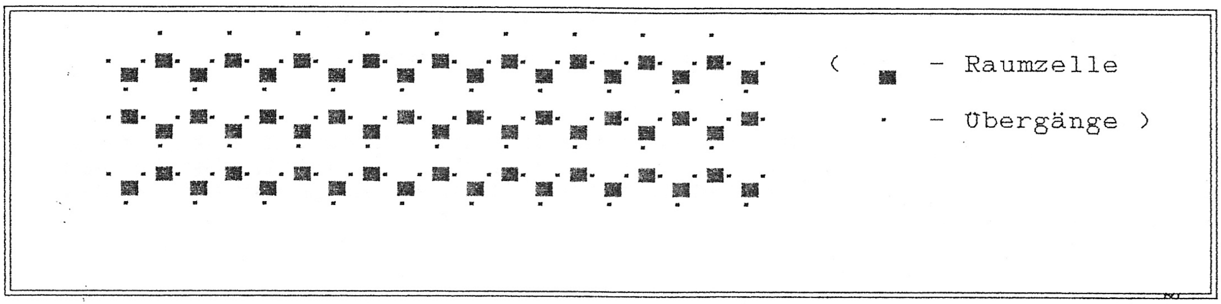


Bild 5 a Struktur eines zweidimensionalen Raumes

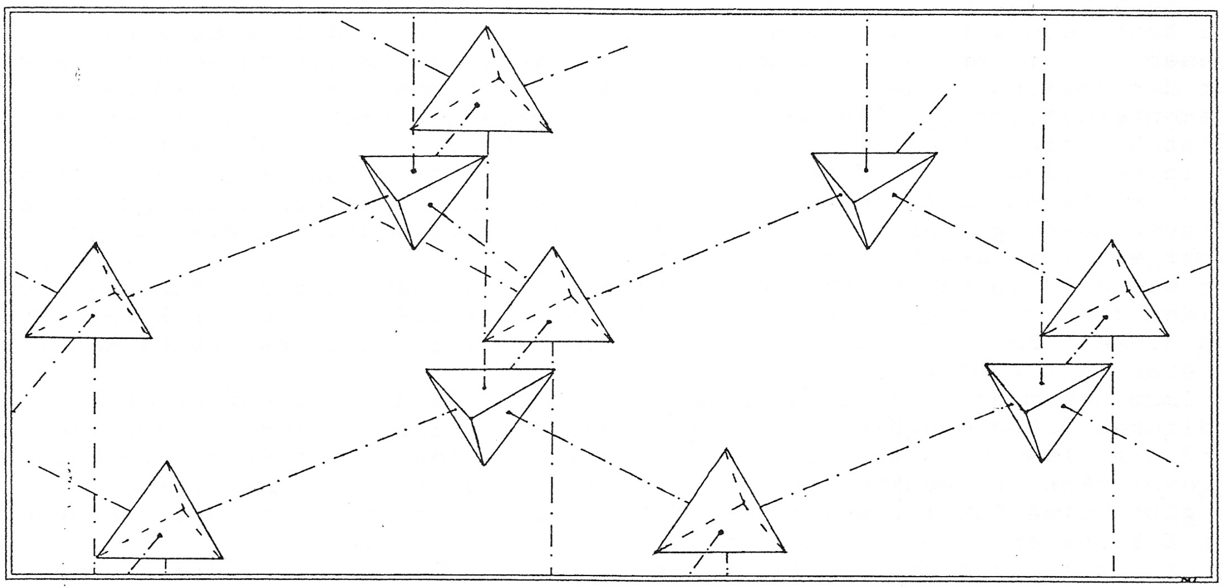


Bild 5 b Struktur eines dreidimensionalen Raumes (—·—·—Übergänge)

In the microstructure of the room is lost isotropy. Two space cells are always symmetrical to each other. This results in a mirror symmetry of the transitions from one space cell to the other.

2.2 Effect propagation and principle of relativity

The speed of light is the only possible speed for the propagation of energy impulses. Since all observable elements of physical reality are composed of energy impulses, these, as will be explained further below, can also only move at the speed of light in the limiting case. From this, the macro relations of relativity can be derived. This is explained here by an example of the propagation of effects in a one-dimensional momentum space.

Two systems A, B, C and A', B', C' are considered. The system A,B,C is at rest, while the system A', B', C' is moving with a speed smaller than the speed of light. From A and A' respectively an impulse goes to the left and to the right and is "mirrored" at B and C and B' and C' respectively.

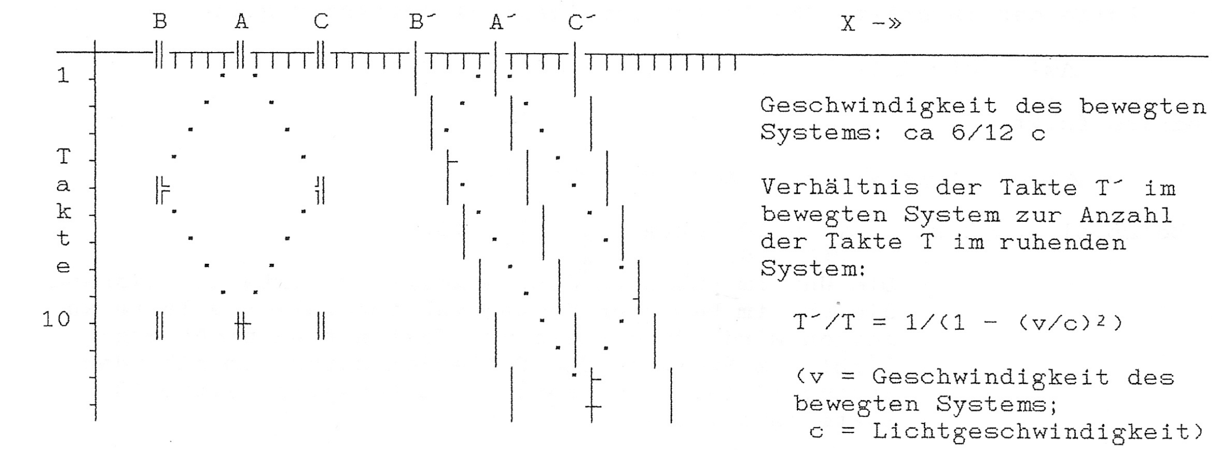


Bild 6 Signalausbreitung im ruhenden und bewegten System

It should be noted in this example that the "reflection" was idealized and thus does not exactly express the behavior of an energy pulse propagation, because the "reflecting surfaces" shown here are themselves composed of energy pulses. From a macroscopic point of view, the reflection represents a statistical process, which is closely connected with the concept of the transition probability introduced in the next section.

2.3 Own time calculation

The distance between the transmission, reflection and reception of a signal in the (absolutely) stationary and (absolutely) moving system can be expressed by

$\Delta s^2 = c^2 * \Delta t^2 - \Delta x^2$ (system at rest)

$\Delta s'^2 = c^2 * \Delta t'^2 - \Delta x'^2$ (moving system).

The Δ values can be expressed by counting the bars.

As can be seen from the example in 2.2, the following inequality applies

$\Delta s^2 \neq \Delta s'^2$

The signal propagation is different due to the absolute motion.
If one renounces the time measurement by counting the transmutation bars, one can demand:

$\Delta s^2 = \Delta s'^2$!

Which means as much as the introduction of a time, which is connected with a system. Such a calculation of proper time can be done according to Einstein's principle of relativity. During a small interval of time t the moving clock covers the distance Δx. Let the time it shows afterwards be Δt'.

In the coordinate system connected to it, the clock is at rest (x'= 0).

As a consequence of the invariance of the (four-dimensional) distance holds:

$\Delta s^2 = c^2 * \Delta t^2 - \Delta x^2 = c^2 * \Delta t'^2 = \Delta s'^2$

It follows that

$\Delta t' = \Delta t * \sqrt{} (1 - (\Delta x / (c^2 * \Delta t))^2)$

Example from 2.2:

Δt = l0 cycles T`= 13.3 T
Δt' = 8.7

The clock in the resting system shows 10 bars, while
the clock in the moving system will probably show 9 bars
will be. Fractions of bars are not possible.
The event of reflection lasts l0 clocks in the system at rest,
while in the moving system it takes 13 bars.

By the introduction of an absolute time and an excellent frame of reference, the macro-relations of relativity are preserved, but the micro-relations differ from it.

3. the concept of transition probability

Determinations:

The term transition probability is intended to mean the probability of transmutation into a neighboring cell.

In an n - dimensional space, there exist n + 1 transition probabilities.

The transition itself can be expressed in terms of a transmutation vector.

For the propagation of an energy pulse in a certain direction, an algorithm can be given which describes the transition probabilities of a space cell to the neighbouring cell.

Transmutation algorithm:

1: Determination of the current direction vector (*The direction vector can be constant or can result from principles in each room cell*)

2 : Determination of the transmutation vector (*The transmutation vector determines the real transition*)

3 : Transition to the neighbouring cell

4 : If the direction vector for the energy pulse in all adjacent room cells remains constant, this results in the new current Direction vector from the combination of transmutation vector and old direction vector.

5: Repetition of the algorithm

From the structure of the energy pulse space and the mirror symmetry of the transitions, the following general conditions can be given for the transmutations of the energy pulses:

directions R indicate in the microrange of the energy pulse space the direction of the transmutations for energy pulses whose macroscopic velocity is equal to the is the speed of light. For simplification, the direction can be divided into two vectors split.

$$R^{+} = \begin{vmatrix} a_1 \\ a_2 \\ . \\ a_n \end{vmatrix} \quad ; \quad R^{-} = \begin{vmatrix} b_1 \\ b_2 \\ . \\ b_n \end{vmatrix}$$

n -1 = Dimension des Energieimpulsraumes

a_i, b_i = Übergangswahrscheinlichkeiten

Es gilt:

$$\Sigma\, a_i = -\,\Sigma\, b_i = 1$$

(Normierung der Übergangswahrscheinlichkeiten)

Energy pulses moving macroscopically at a speed less than the speed of light can be described by gons of transition probabilities in their direction of propagation. (*In two-dimensional space by trigons, in three-dimensional space by tetragons and in four-dimensional space by pentagons*).

$$G^{+} = \begin{vmatrix} a_1 \\ a_2 \\ . \\ a_n \end{vmatrix} \quad ; \quad G^{-} = \begin{vmatrix} b_1 \\ b_2 \\ . \\ b_n \end{vmatrix}$$

Gone enthalten mindestens n + 1 von Null verschiedene Elemente.
Es gilt:

$\Sigma\ a_i = -\ \Sigma\ b_i = 1$ (Normierung der Übergangswahrscheinlichkeiten)

Die Gone lassen sich zu einem Richtungsvektor reduzieren:

$$R_g^{+} = \begin{vmatrix} s_1 \\ s_2 \\ . \\ s_n \end{vmatrix} \quad ; \quad R_g^{-} = \begin{vmatrix} t_1 \\ t_2 \\ . \\ t_n \end{vmatrix}$$

mit $s_i = a_i + b_i$ für $(a_i + b_i) > 0$ sonst $s_i = 0$

und $t_i = a_i + b_i$ für $(a_i + b_i) < 0$ sonst $t_i = 0$.

Es gilt: $\Sigma\ s_i = -\ \Sigma\ t_i < 1$

$$T = \begin{vmatrix} d_1 \\ d_2 \\ . \\ d_n \end{vmatrix} \qquad d_f = \pm 1 \quad \text{mit} \quad d_j = 0 \quad \text{für } j \neq f$$

The actual transitions from one space cell to another can be described by a transmutation T . This transmutation is the result of the transition probabilities and indicates the actual transition.

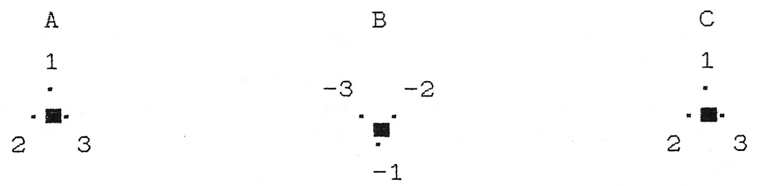
For the transmutation algorithm of directions can thus be written:

$R_i^{+} = {}_{i-1}^{+}R - T + R^{+}$ if $d_f = 1$

$R_i^{-} = {}_{i-1}^{-}R - T + R^{-}$ if $d_f = -1$

Example of the transmutation algorithm in a 2-dimensional space:

In the space cell A, let the direction vector R+ be (0.6, 0, 0.4), this direction should also be maintained in the following transitions. The transitions are marked by numbers. The corresponding vector R- has the values (0, -1, 0).



A » B $$\begin{vmatrix} .6 \\ 0 \\ .4 \end{vmatrix} - \begin{Vmatrix} 1 \\ 0 \\ 0 \end{Vmatrix} + \begin{vmatrix} .6 \\ 0 \\ .4 \end{vmatrix} = \begin{vmatrix} .2 \\ 0 \\ .8 \end{vmatrix}$$

B » C $$\begin{vmatrix} 0 \\ -1 \\ 0 \end{vmatrix} - \begin{Vmatrix} 0 \\ -1 \\ 0 \end{Vmatrix} + \begin{vmatrix} 0 \\ -1 \\ 0 \end{vmatrix} = \begin{vmatrix} 0 \\ -1 \\ 0 \end{vmatrix}$$

C » D $$\begin{vmatrix} .2 \\ 0 \\ .8 \end{vmatrix} - \begin{Vmatrix} 0 \\ 0 \\ 1 \end{Vmatrix} + \begin{vmatrix} .6 \\ 0 \\ .4 \end{vmatrix} = \begin{vmatrix} .8 \\ 0 \\ .2 \end{vmatrix}$$

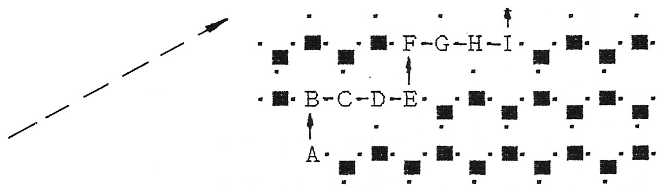


Bild 7 Weg mit der größten Wahrscheinlichkeit für den Energieimpuls aus obigem Beispiel.

4. principles of the type of material

A chaos of energy impulses initially passes through three conceivable stages in a "cooling process" or "condensation process". In a first stage, "heat bodies" are formed, which are more or less mutually delimited areas that affect the chaos as a whole. Structures and principles of these heat bodies have astronomical dimensions today and are not of interest here. In a second stage, a kind of coupling of energy impulses to each other takes place. Groups of energy impulses receive a direction of their transmutations. Thus they possess a higher "individual order" than the heat bodies. Since their principle is essentially based on the preservation of the transmutation direction, they form the radiating part of the universe. The condensation principles of this order are always called photons in the following. Photons do not possess a centre. A third level can be thought of as a combination of a center with a coupling of energy pulses. The transmutation direction of each energy pulse is oriented to a common center. A consequence of this is that the "imagined" centre cannot move with the same speed as the individual energy impulses. This centre gets the function of a centre of gravity. In the ancient atomistics this picture is compared with a flock of sheep, which, moving in itself, nevertheless changes its place as a whole (*Lucretius*). Principles from the type of matter refer to the spatial distribution of the transition probabilities and to the possible "packing densities" of the energy impulses connected with it, which in the most extreme case only allow the exchange of energy impulses with your neighbours.

4.1 Binding types and transition probabilities

It is probably not very fruitful to ask how a transmutation happens concretely. In this area of elementary processes it is important to investigate all possibilities of thought, since appearances cannot refer to sense perceptions in any way, thought alone forms the principles. A basic postulate, which limits the possibilities of thinking, but nevertheless seems reasonable to me as a hypothesis, is the requirement that only one energy impulse can be in a space cell at a time. Between energy-pulses and principles two possibilities of connection are conceivable. On the other hand, the energy pulses themselves cannot cause any changes in the transition probabilities in the neighbouring cells; in this case, the principles are "added from outside" (in the language of ancient atomistics, the dogs that hold the flock of sheep together would be the principles "added from outside").

If one considers a single energy pulse, the following possible states can be determined:

1. the neighbouring space cells do not contain an energy pulse
2. a neighbouring cell contains an energy pulse
3. two (or more) neighbouring cells contain an energy pulse
4. all neighbouring cells contain an energy pulse

Three cases will be considered here, which assume that the principles are added from outside and that the energy impulses only influence each other through their neighbourhood.

Case A:

If we first assume an equal distribution of transition probabilities, we can think of the following changes in local transition probabilities:

l. For the two-dimensional example, the energy pulses A and B each have a neighbor, C is without neighbors.

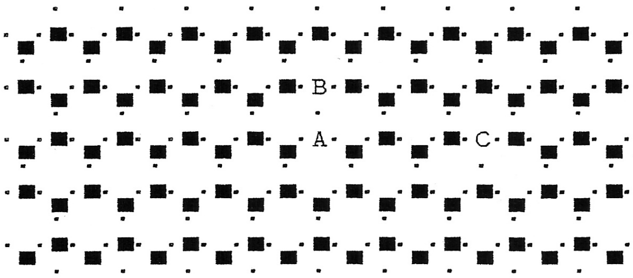
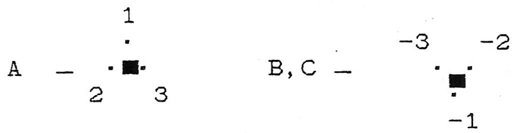


Bild 8a Lage dreier Energieimpulse im zweidimensionalen Energieimpulsraum

Die Übergangswahrscheinlichkeiten (ohne äußere Prinzipien) sehen wie folgt aus:



$$A = \begin{vmatrix} 0 \\ .5 \\ .5 \end{vmatrix} \qquad B = \begin{vmatrix} 0 \\ -.5 \\ -.5 \end{vmatrix} \qquad C = \begin{vmatrix} -.33 \\ -.33 \\ -.33 \end{vmatrix}$$

(The direction is determined in the 2D space shown: + transition upwards and left/right downwards; - downwards and left/right at the same height)

If one assumes in a further step that the energy pulses themselves already exert an effect on the neighboring cells with respect to the transition probabilities, the ratios shown in Fig. 8b result for the transition probabilities.

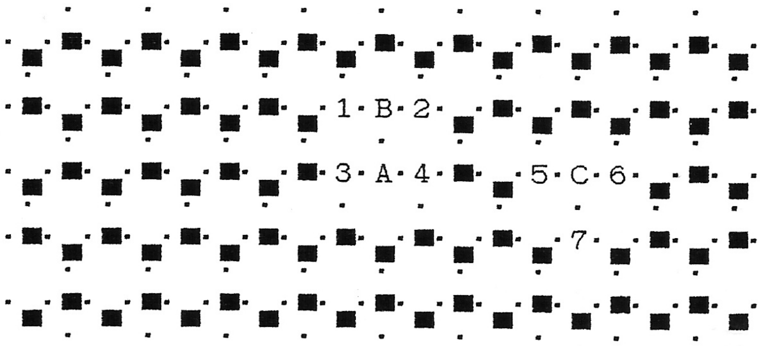
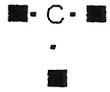
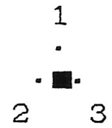
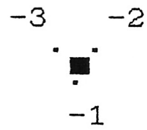


Bild 8b

As a benchmark for the following examples, it is assumed that the transition probabilities caused by an energy pulse in the neighboring cells each amount to one third, which is again divided between two transitions.



(1,2,5,6,7),A, — 

(3,4),B,C — 

$$(1) = \begin{vmatrix} .16 \\ .16 \\ 0 \end{vmatrix} \quad B = \begin{vmatrix} 0 \\ -.16 \\ -.16 \end{vmatrix} \quad (2) = \begin{vmatrix} .16 \\ 0 \\ .16 \end{vmatrix}$$

$$(3) = \begin{vmatrix} -.16 \\ 0 \\ -.16 \end{vmatrix} \quad A = \begin{vmatrix} 0 \\ .16 \\ .16 \end{vmatrix} \quad (4) = \begin{vmatrix} -.16 \\ -.16 \\ 0 \end{vmatrix}$$

$$(5) = \begin{vmatrix} .16 \\ .16 \\ 0 \end{vmatrix} \quad C = \begin{vmatrix} 0 \\ 0 \\ 0 \end{vmatrix} \quad (6) = \begin{vmatrix} .16 \\ 0 \\ .16 \end{vmatrix} \quad (7) = \begin{vmatrix} 0 \\ .16 \\ .16 \end{vmatrix}$$

The quality of the transition probabilities for A, B and C is preserved in this case.

2. for the two-dimensional example, the energy pulse A has two neighbors.

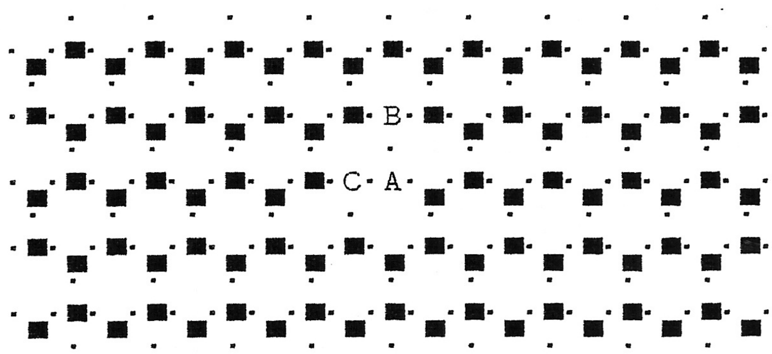
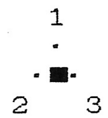
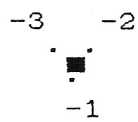


Bild 9a

The transition probabilities (without external principles) look like this:

A — 

B,C — 

$$A = \begin{vmatrix} 0 \\ 0 \\ 1 \end{vmatrix} \quad B = \begin{vmatrix} 0 \\ -.5 \\ -.5 \end{vmatrix} \quad C = \begin{vmatrix} -.5 \\ 0 \\ -.5 \end{vmatrix}$$

In this case, the dynamic behavior of the neighboring energy pulses is not taken into account. If regulations for the external transition probabilities are added, difficulties arise with larger packing densities of the energy pulses.

If we also consider an effect of the energy impulses on the neighbouring cells, the following picture emerges:

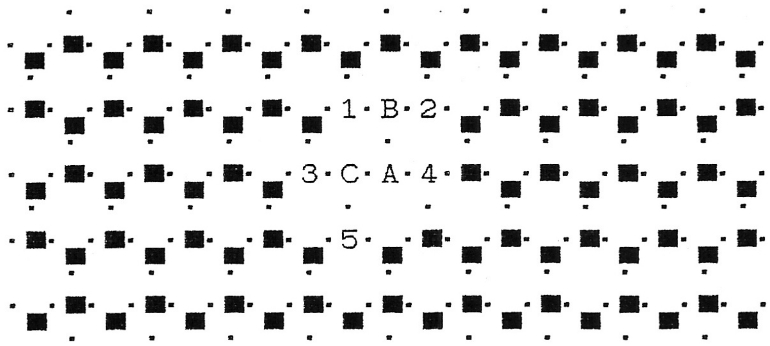
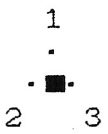
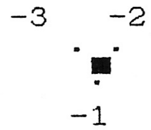


Figure 9b

(1,2,3,5),A, — 

(4),B,C — 

$$(1) = \begin{vmatrix} .16 \\ .16 \\ 0 \end{vmatrix} \qquad B = \begin{vmatrix} 0 \\ -.16 \\ -.16 \end{vmatrix} \qquad (2) = \begin{vmatrix} .16 \\ 0 \\ .16 \end{vmatrix}$$

$$(3) = \begin{vmatrix} .16 \\ .16 \\ 0 \end{vmatrix} \qquad A = \begin{vmatrix} .16 \\ .16 \\ .33 \end{vmatrix} \qquad (4) = \begin{vmatrix} -.16 \\ -.16 \\ 0 \end{vmatrix}$$

$$(5) = \begin{vmatrix} 0 \\ .16 \\ .16 \end{vmatrix} \qquad C = \begin{vmatrix} -.16 \\ 0 \\ -.16 \end{vmatrix}$$

The quality of the transitions no longer shows a match for the energy pulse A.

<u>Case B:</u>

If one assumes that the energy pulses have to change their spatial cell in every clock cycle (this seems to make sense in terms of a basic principle), then other local transition probabilities can be given.

For the two-dimensional example, the energy pulse A has two neighbors.

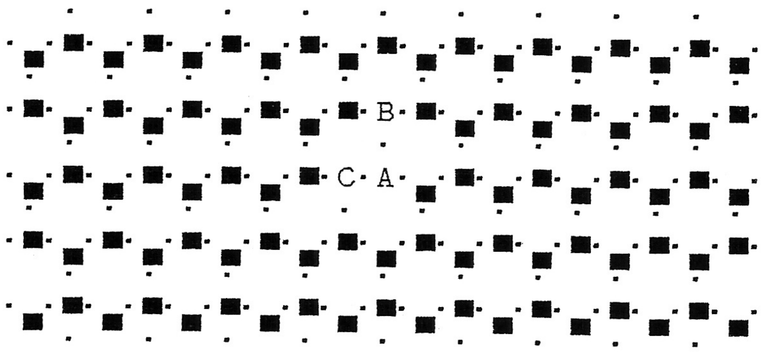
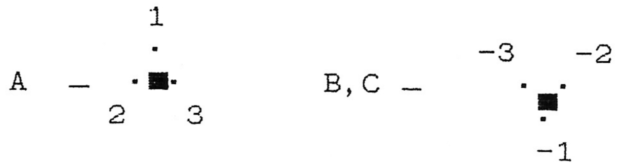


Bild 10

The transition probabilities (without external principles) look like this:



$$A = \begin{vmatrix} .33 \\ .33 \\ .33 \end{vmatrix} \qquad B = \begin{vmatrix} 0 \\ -.5 \\ -.5 \end{vmatrix} \qquad C = \begin{vmatrix} -.5 \\ 0 \\ -.5 \end{vmatrix}$$

With this distribution of the transition probabilities, it is excluded that both the energy pulse C and B can simultaneously transmute into the space cell in which the energy pulse A is still located at the moment. A comparison with the transition probabilities caused in the neighboring cells (to Fig. 9b) also shows here that the quality is not preserved.

<u>Case C:</u>

In this case, the possibilities for even greater packing densities are being investigated.

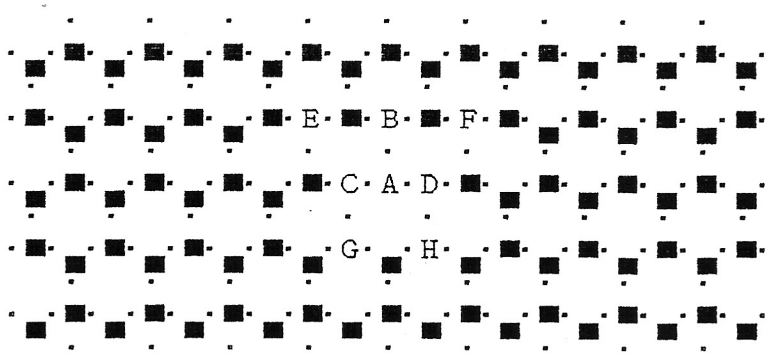
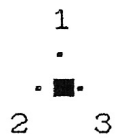
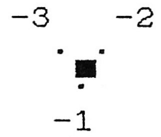


Bild 11 a

The transition probabilities (without external principles) look like this:

A,G,H —


B,C,D,E,F —


$$A = \begin{vmatrix} \mathbf{VA} \\ 0 \\ 0 \end{vmatrix} \quad B = \begin{vmatrix} \mathbf{VB} \\ 0 \\ 0 \end{vmatrix} \quad C = \begin{vmatrix} -1 \\ 0 \\ 0 \end{vmatrix} \quad D = \begin{vmatrix} -1 \\ 0 \\ 0 \end{vmatrix}$$

$$E = \begin{vmatrix} 0 \\ 0 \\ -1 \end{vmatrix} \quad F = \begin{vmatrix} 0 \\ -1 \\ 0 \end{vmatrix} \quad G = \begin{vmatrix} .5 \\ .5 \\ 0 \end{vmatrix} \quad H = \begin{vmatrix} .5 \\ 0 \\ .5 \end{vmatrix}$$

(**VA = 1, VB = -1** - "virtuelle" Übergänge)

If a space cell lies in the probability range of all neighboring energıeıpulses, then in case B problems arise for those energy pulses P whose neighboring cells all lie in the probability range of some energy pulse. In this case, certain packing densities of energy pulses are not possible (VB would be zero in this case). This difficulty does not occur if in such cases two energy pulses exchange their space cells. Such exchange transitions allow for maximum packing density. At the same time, new conditions appear in the exchange transitions, which can be regarded as coupling or binding of two energy pulses.

The extent to which these packing densities and types of bonding support the strong and weak interaction forces of the elementary particles will not be investigated here.

The electromagnetic interactions are external principles and cannot be derived from the algorithms of the local behaviour of the energy pulses. The same is true for the gravitational forces.

If we also consider the conceivable influence of an energy pulse on the neighbouring cells, the following picture emerges:

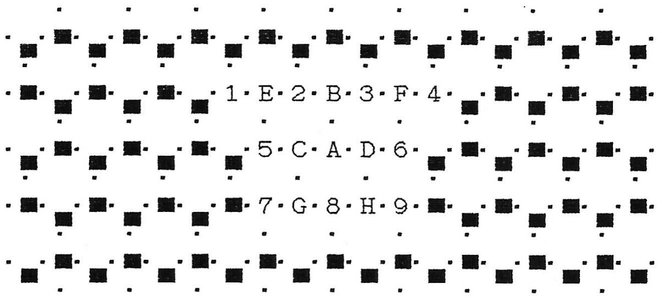
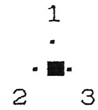
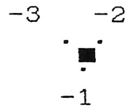


Bild 11 b

(1,2,3,4,5,6),A,G,H —



(7,8,9),E,B,F,C,D —



$$(1)=\begin{vmatrix}.16\\.16\\0\end{vmatrix}\quad (2)=\begin{vmatrix}.33\\.16\\.16\end{vmatrix}\quad (3)=\begin{vmatrix}.33\\.16\\.16\end{vmatrix}\quad (4)=\begin{vmatrix}.16\\0\\.16\end{vmatrix}$$

$$(5)=\begin{vmatrix}.16\\.33\\.16\end{vmatrix}\quad (6)=\begin{vmatrix}.16\\.16\\.33\end{vmatrix}\quad (7)=\begin{vmatrix}-.16\\0\\-.16\end{vmatrix}\quad (8)=\begin{vmatrix}-.33\\-.16\\-.16\end{vmatrix}$$

$$(9)=\begin{vmatrix}0\\-.16\\-.16\end{vmatrix}\quad A=\begin{vmatrix}.33\\.33\\.33\end{vmatrix}\quad B=\begin{vmatrix}0\\-.16\\-.16\end{vmatrix}\quad C=\begin{vmatrix}-.16\\-.16\\-.33\end{vmatrix}$$

$$D=\begin{vmatrix}-.16\\-.33\\-.16\end{vmatrix}\quad E=\begin{vmatrix}0\\0\\0\end{vmatrix}\quad F=\begin{vmatrix}0\\0\\0\end{vmatrix}\quad G=\begin{vmatrix}0\\.16\\.16\end{vmatrix}$$

$$G=\begin{vmatrix}0\\.16\\.16\end{vmatrix}$$

A comparison with the transition probabilities to figure 11a also shows no correspondence of qualities here. A hierarchy of principles is also conceivable, which already grants the energy impulses themselves a greater effect on their neighboring cells. As an example of this, a principle for energy impulses is considered in the following, which induces transition probabilities for the immediate neighbouring cells, which are directed towards their own cell, but have a repulsive effect on more distant cells.

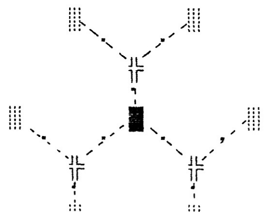


Bild 12 █ – Raumzelle mit Energieimpuls

╬ – Übergangswahrscheinlichkeit auf den Energieimpuls gerichtet

⁞⁞⁞ – Übergangswahrscheinlichkeit vom Energieimpuls weg gerichtet (Werte für diese Beispiel: ╬ = .33 , ⁞⁞⁞ = .16 sind willkürlich gewählt)

Ein Verband von 4 Energieimpulsen ergibt folgende Verteilung der Übergangswahrscheinlichkeiten:

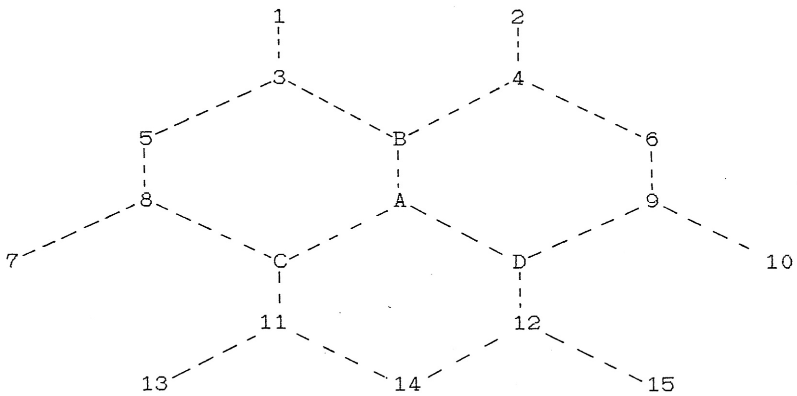


Bild 13 Verband von vier Energieimpulsen

$(1) = \begin{vmatrix} 0 \\ -.08 \end{vmatrix}$ $(2) = \begin{vmatrix} 0 \\ -.08 \end{vmatrix}$ $(3) = \begin{vmatrix} 0 \\ 0 \end{vmatrix}$ $(4) = \begin{vmatrix} 0 \\ .16 \end{vmatrix}$

$(5) = \begin{vmatrix} -.08 \\ -.08 \\ -.16 \end{vmatrix}$ $(6) = \begin{vmatrix} -.08 \\ -.16 \\ -.08 \end{vmatrix}$ $(7) = \begin{vmatrix} -.08 \\ 0 \\ -.08 \end{vmatrix}$ $(8) = \begin{vmatrix} 0 \\ 0 \\ .16 \end{vmatrix}$

$(9) = \begin{vmatrix} 0 \\ .16 \\ 0 \end{vmatrix}$ $(10) = \begin{vmatrix} -.08 \\ -.08 \\ 0 \end{vmatrix}$ $(11) = \begin{vmatrix} .16 \\ 0 \\ 0 \end{vmatrix}$ $(12) = \begin{vmatrix} .16 \\ 0 \\ 0 \end{vmatrix}$

$(13) = \begin{vmatrix} -.08 \\ 0 \\ -.08 \end{vmatrix}$ $(14) = \begin{vmatrix} -.16 \\ -.08 \\ -.08 \end{vmatrix}$ $(15) = \begin{vmatrix} 0 \\ -.08 \\ -.08 \end{vmatrix}$

$A = \begin{vmatrix} .33 \\ .33 \\ .33 \end{vmatrix}$ $B = \begin{vmatrix} 0 \\ 0 \\ 0 \end{vmatrix}$ $C = \begin{vmatrix} 0 \\ 0 \\ 0 \end{vmatrix}$ $D = \begin{vmatrix} 0 \\ 0 \\ 0 \end{vmatrix}$

This system of the four energy impulses is not yet stable with the assumptions made, it is only intended to demonstrate the emerging diversity that can result from algorithms once chosen. The assumptions made on this level must, in combination with higher principles, which however always can only unfold their effect over larger numbers of energy impulses, be available as a basic structure from the molecule over crystal structures up to more complex systems. If one brings the idea of evolution into the considerations, it is conceivable that the appearance of light represents a less complex structure of energy impulses than, for example, the electron is. An obvious hypothesis is that light in its basic structure consists of "condensations of energy impulses", which have a surface character (like the example above). Material condensations of energy-pulses then could carry space-character (associations of at least five energy-pulses) in their basic structure.

At this point it must be pointed out once again that the statements made here are only models of thought that have been set up with the aim of explaining the phenomena accessible to the senses (and their instrumental extensions) without contradiction.

4.2 The wave character of moving matter

According to de Broglie's idea, every material system can be assigned an "inner periodic motion". The frequency $\nu_0$determined from Einstein's mass-energy relation E = m*c ^{2}and Planck's relation E = h*ν. For a material system at rest applies:

$$\nu_0 = \frac{c^2}{h} \cdot m_0 .$$

There exists a direct proportionality between the internal frequency ν_0 and the rest mass m of$_0$ a material system. A quantization of this continuum would assume the following structure:

$$\nu_0 = \Sigma\ \nu_i = \frac{c^2}{h} \cdot \Sigma\ m_i \quad \text{mit} \quad m_0 = \Sigma\ m_i$$

(m_i = "Ruhemasse" eines Energieimpulses)

In Nichterlanger physics, such "quantization" can only be an approximation. Discrete frequencies are not possible.

The starting point is not a quantization of integral regularities, but the integral regularities are derived from Nichterlanger physics. The following three tables serve as a comparison between Erlangen physics and Nichterlanger physics:

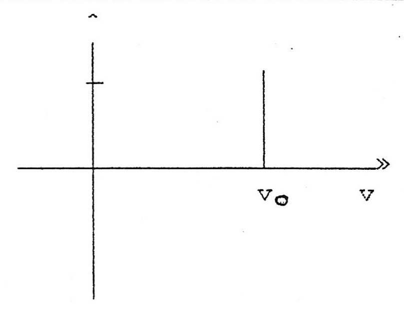
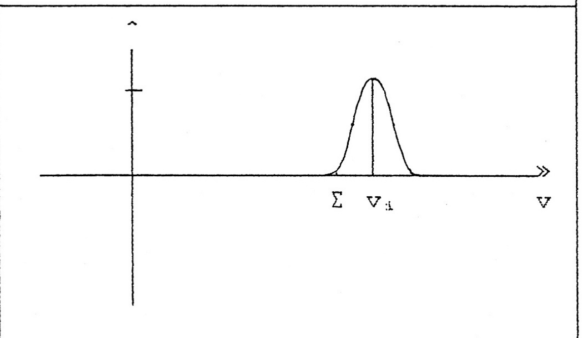
	Erlanger Physik	Nichterlanger Physik
Frequenzraum		

Tabelle 1: Vergleich der "Inneren periodischen Bewegungen"

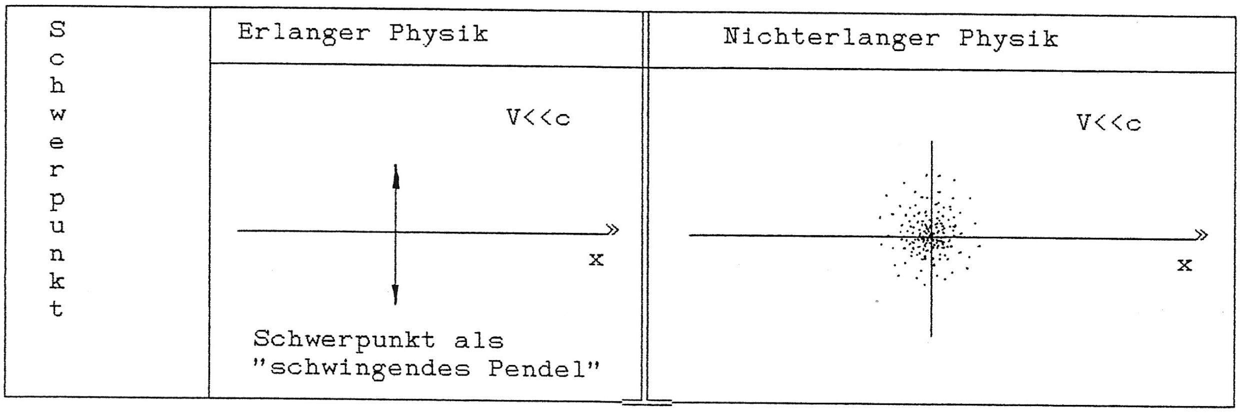


Tabelle 2: Vergleich des Verhaltens der Massenschwerpunkte

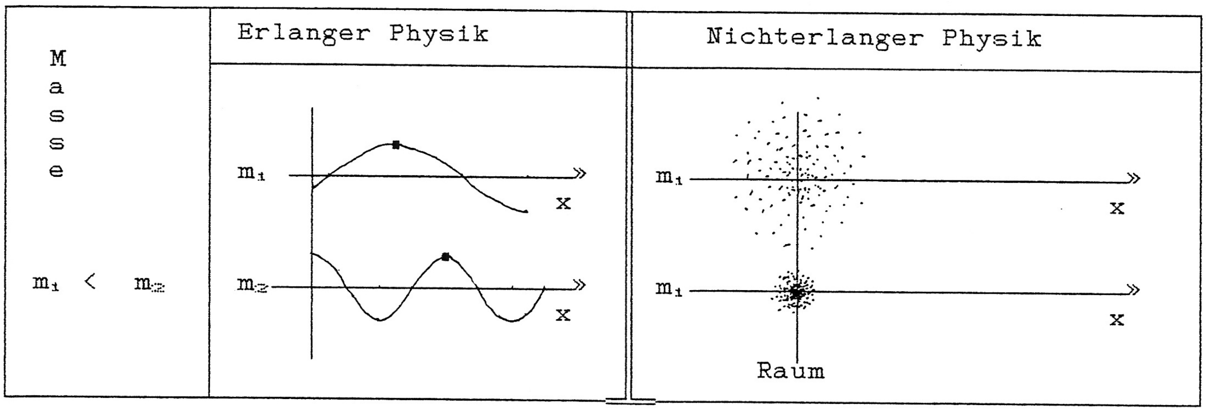


Tabelle 3: Vergleich zweier unterschiedlich schwerer Massensysteme

The occurrence of a "frequency wash" in Nichterlanger physics is the result of the chaotic behavior of the energy pulses.

A system of energy pulses is organized by a principle whose appearance also changes its structure for different numbers of energy pulses. The transition probabilities change as a function of the distance from a center. This center is generally not identical with the "center of gravity" of the energy pulses.

Qualitatively, the following behavior can be given for the transition probabilities for two mass systems with different numbers of energy pulses:

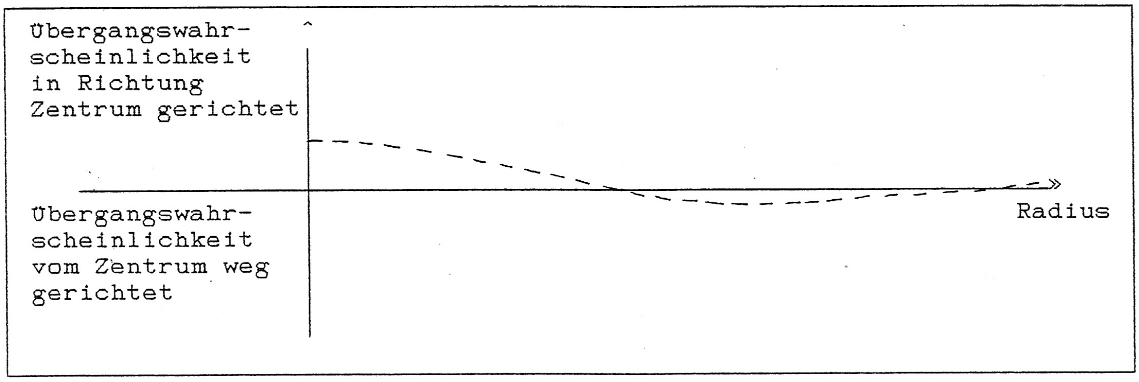


Bild 13 Verteilung der Übergangswahrscheilichkeiten für ein System von Energieimpulsen der Ruhemasse m_1.
Es sei $m_1 < m_2$.

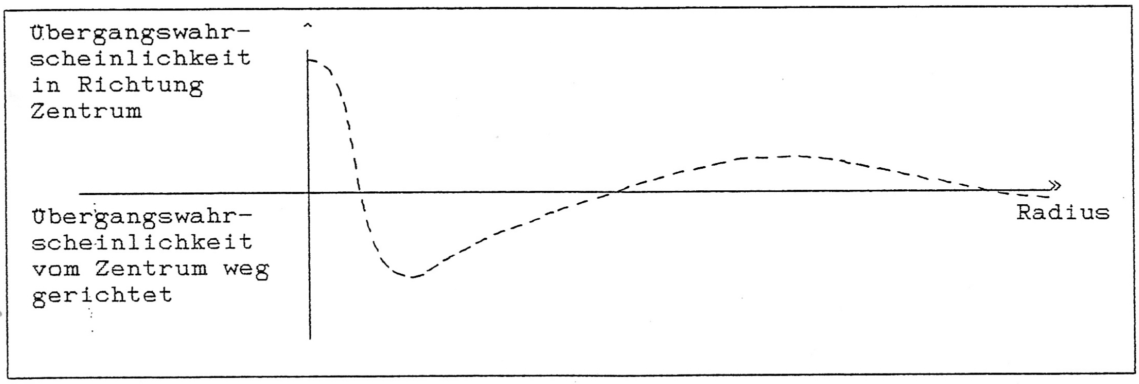


Bild 14 Verteilung der Übergangswahrscheilichkeiten für ein System von Energieimpulsen der Ruhemasse m_2.
Es sei $m_2 > m_1$.

4.3 Principles of electron shells

Radiation in general, and the associated principles of photons, are phenomena of the following processes:

a) Oscillation of free electrons
b) Oscillation of the atoms
c) electrons change their probable residence in the atom
d) Electrons are shot with high energy against the atomic nucleus

Of optical interest in the model of the atom are first the electron shells and their interactions with the photons. These principles are of fundamental importance for the processes b), c) and d).

In Nichterlanger physics elementary particles are to be equated with principles, which "manage" energy impulses. Basic principle of all elementary particles and therefore of the material matter is a "centralistic principle" , which is responsible among other things for the fact that it behaves sluggishly towards light (as a union of "energy impulses of the same direction"). Matter in this sense is created out of captured energy impulses and their centralistic administration.

The principles of elementary particles, which can be regarded here as rules for transition probabilities, must be derived from the behaviour of elementary particles. How far then, for example, the atomic nucleus results from the superposition of the principles of protons and neutrons, shall not be further investigated here.

Starting point here are at first following hypotheses about principles of electron, positron, neutron and proton:

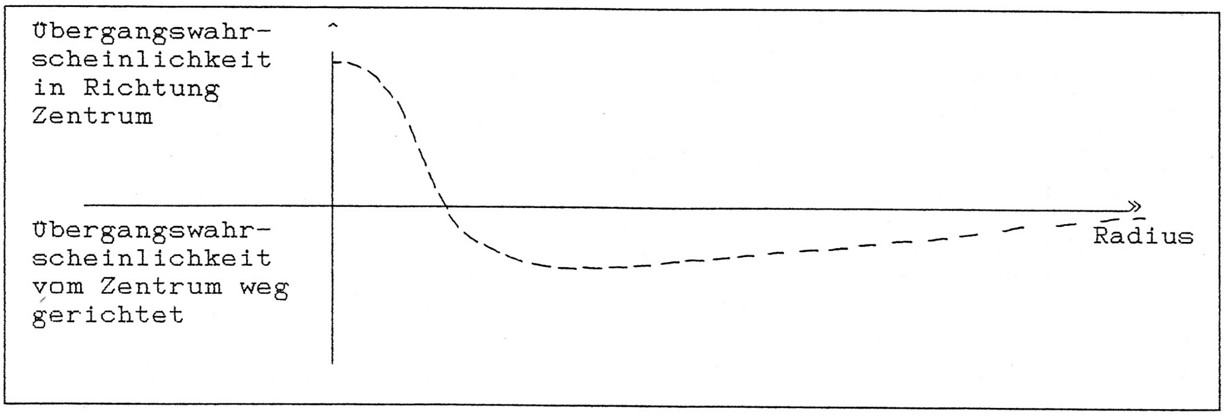


Bild 15 Verteilung der Übergangswahrscheinlichkeiten für ein Elektron (Die Übergangswahrscheinlichkeiten beziehen sich sowohl auf die "eingefangenen" Energieimpulse als auch auf "freie" Energieimpulse anderer zentralistisch organisierter Energieimpulse außerhalb des Zentrums des Elektrons).

The repulsive effect of two electrons results from the change of the transition probabilities in the respective centers (Fig. 15).

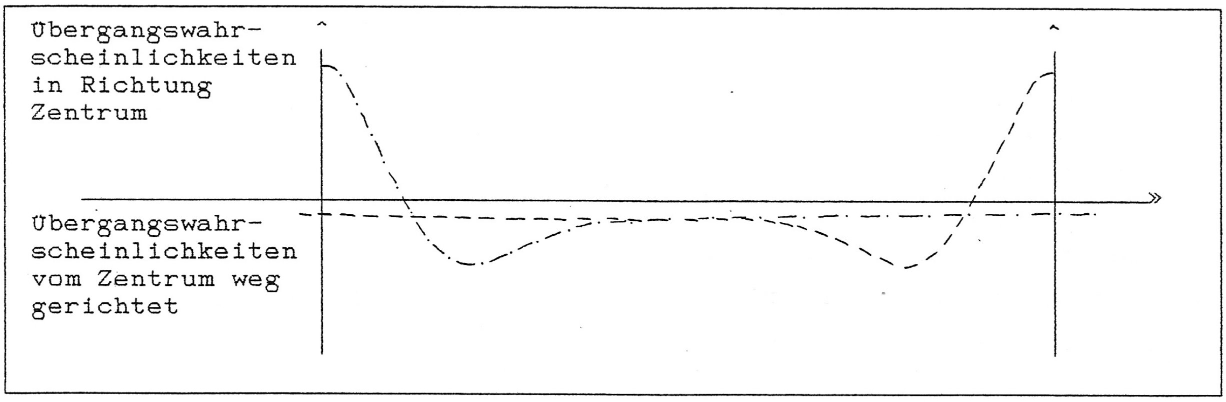


Bild 16 Entstehung der abstoßenden Wirkung zweier Elektronen

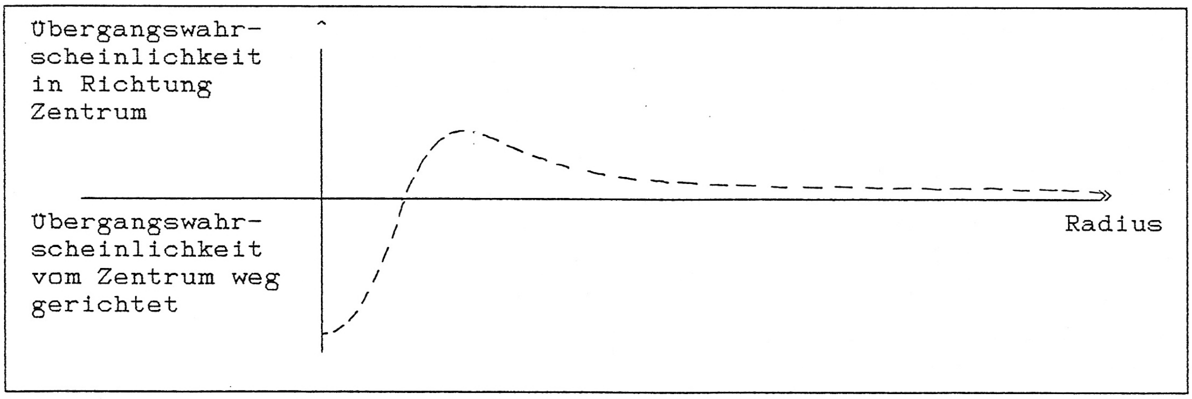


Bild 17 Übergangswahrscheinlichkeiten für ein Positron

The transition probabilities behave as mirror images of those of the electron. In the case of the electron, the energy impulses are concentrated at a central point. For the principle of the positron given in figure 15, the energy impulses concentrate in a sphere, albeit a small one. (A basic principle: mapping a structure concentrated around a point onto a sphere). A meeting of electron and positron leads to a cancellation of the two centralistic (and thus materialistic) principles. The energy impulses become free and leave the place of meeting as two energetic photons. A neutron has no transition probabilities essentially beyond the nuclear region; it behaves neutrally to other particles. Beyond that, however, it is subject to the transition probabilities of other particles that have transition probabilities beyond the nuclear region. However, the forces that occur here are weaker (Figure 18).

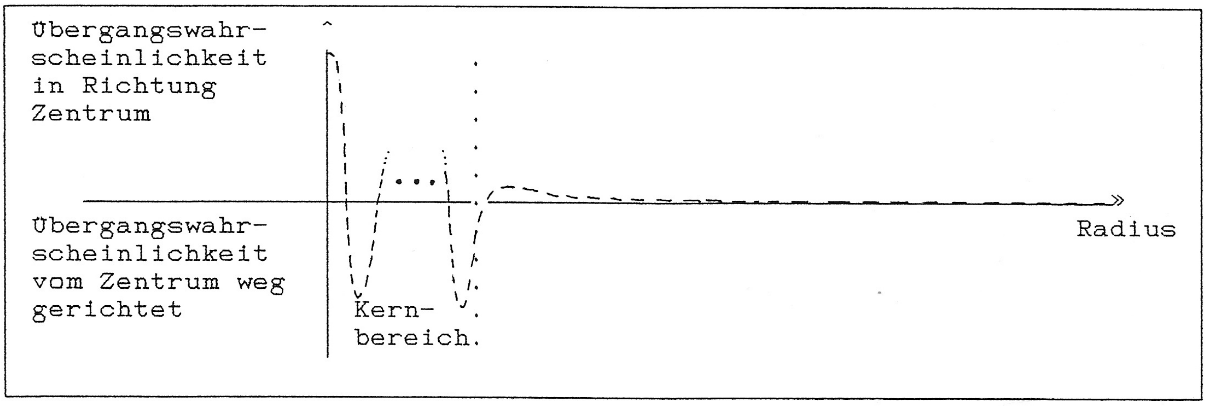


Bild 18 Übergangswahrscheinlichkeiten für ein Neutron

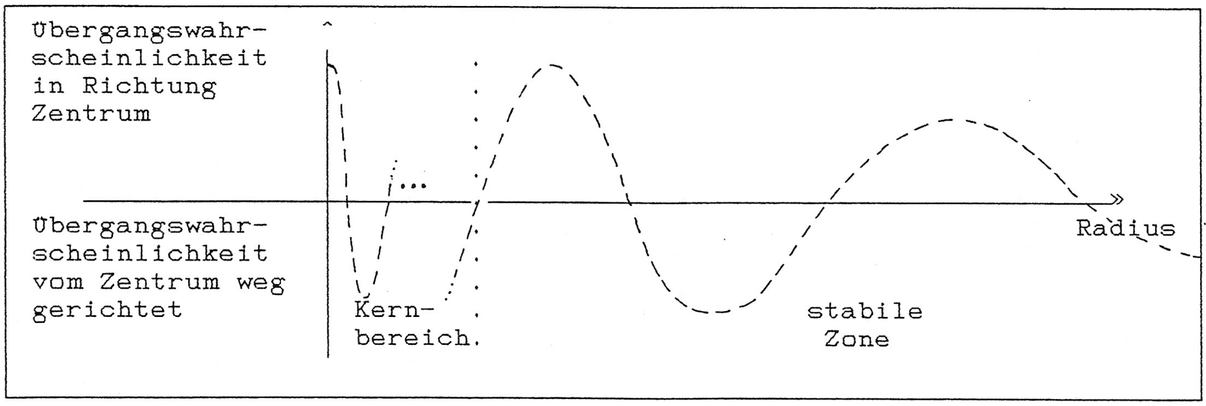


Bild 19 Übergangswahrscheinlichkeiten für ein Proton

In stable equilibrium, energy pulses are located at the distances from the center where the transition probabilities are directed against each other.

The principle of the proton is suitable to hold energy impulses and also electrons in discrete distances from the center. The starting point of each energy absorption of a proton or atom in general is connected with a collecting of energy impulses, these can have become free by dissolution of a photon and only give an impulse to the atom (increase of temperature of a body or gas) or by temporary invasion in a sphere claimed by an electron push this into a higher orbit.

Unlike the electron, the energy pulses of a photon do not form a center in this sphere.

The emission of a photon occurs after a stable sphere around the atom has reached its capacity of energy pulses. Due to the asymmetry in the electron's sphere of residence, the electron strives to resume the orbit closer to the nucleus after leaving the energy pulses closed as a photon.

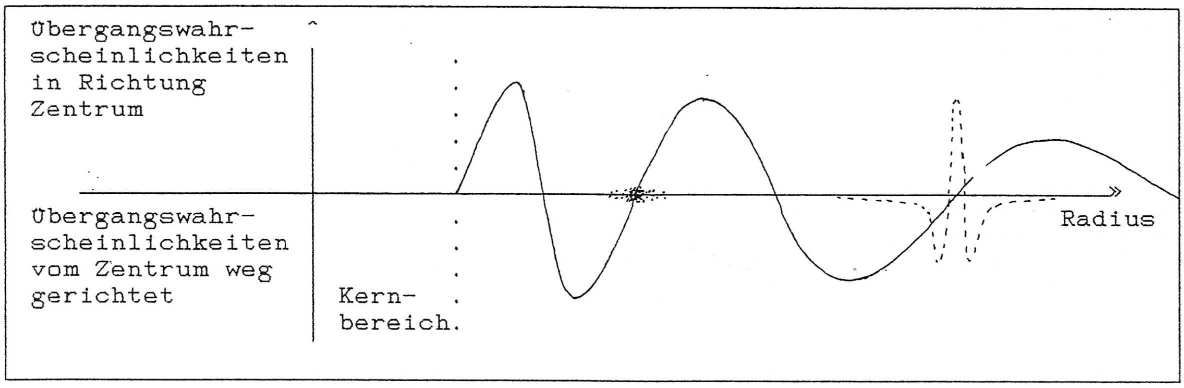


Bild 20 Übergangswahrscheinlichkeiten eines Protons mit Energieimpulsen und einem Elektron in stabilen Sphären.
(———— Übergangswahrscheinlichkeiten des Protons
------- Übergangswahrscheinlichkeiten des Elektrons)

Forces exerted on each other by two atoms arise from superposition of the outer zones of transition probabilities. At the same time, transition zones are created for the exchange of electrons in molecular bonds. One of the ways in which atoms can bond is by moving towards each other. This movement can occur by dissolving "heat photons" and capturing these energy pulses. Such a process increases the kinetic energy of the atom. At the same time, a binding of two atoms in the outer stable spheres of the transition probabilities releases energy impulses, which can then leave the atomic bond as heat photons or also light photons.

A separation of two atoms can then take place again by capturing light or heat photons, which by filling up the stable spheres of the transition probabilities push the atoms apart (in connection also with a pushing away of the electrons). Since the transition probabilities behave like a damped wave with increasing distance from the nucleus, the outer stable spheres of the transition probabilities have smaller capacities for receiving energy pulses. This, in conjunction with the relative changes in the distances of the atomic nuclei, the interpenetration of the outer spheres and the changes in capacity for energy pulse absorption caused by the interpenetration, ideally leads to the spectral energy distribution of the black body.

Figure 20 schematically shows two connected atoms. As can be seen from sections l and 2 (Figs. 21 and 22), preferential regions arise where the transition from one atom to the other becomes very probable.

The spheres of concrete atoms are shaped by the composition of the atomic nuclei, which then also gives rise to the chemical properties of the elements.

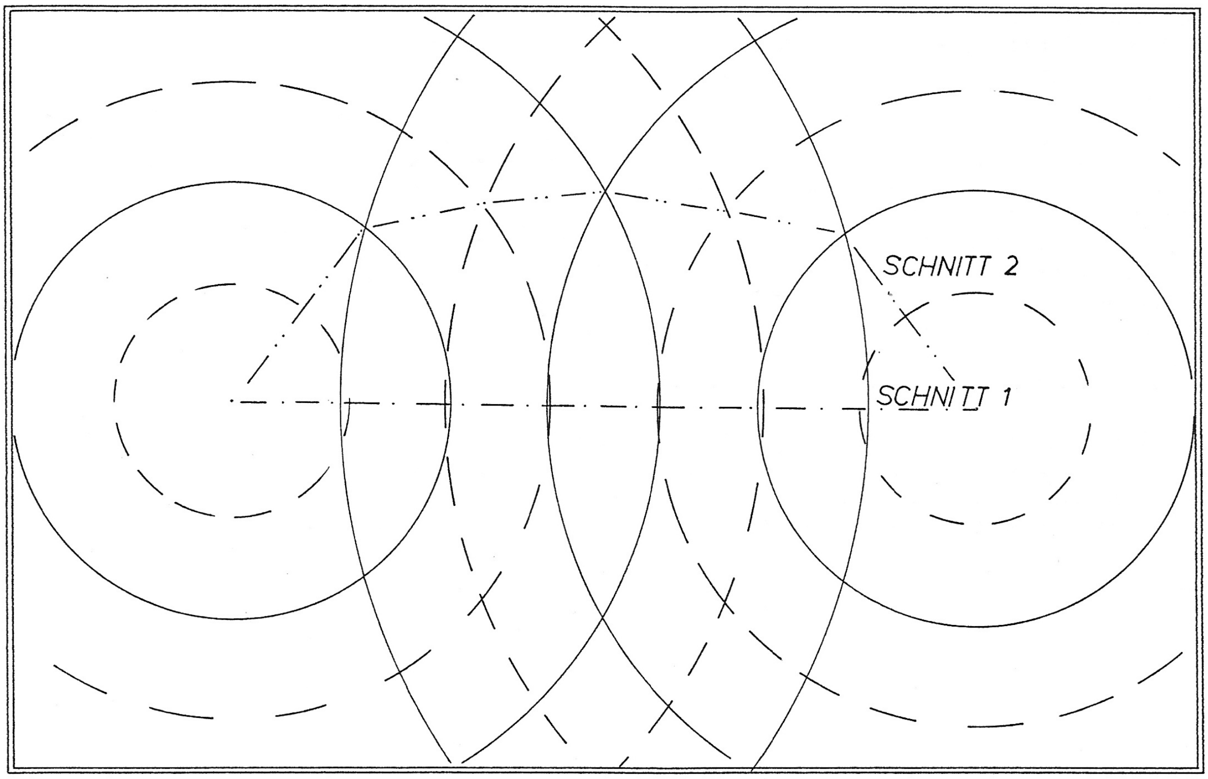


Bild 21 Schematische Darstellung der Verbindung zweier Atome über die Sphären der Übergangwahrscheinlichkeiten. Der Atomkern ist zur Vereinfachung der Zeichnung als Punkt angenommen worden.
———— stabile Zonen
--------- labile Zonen

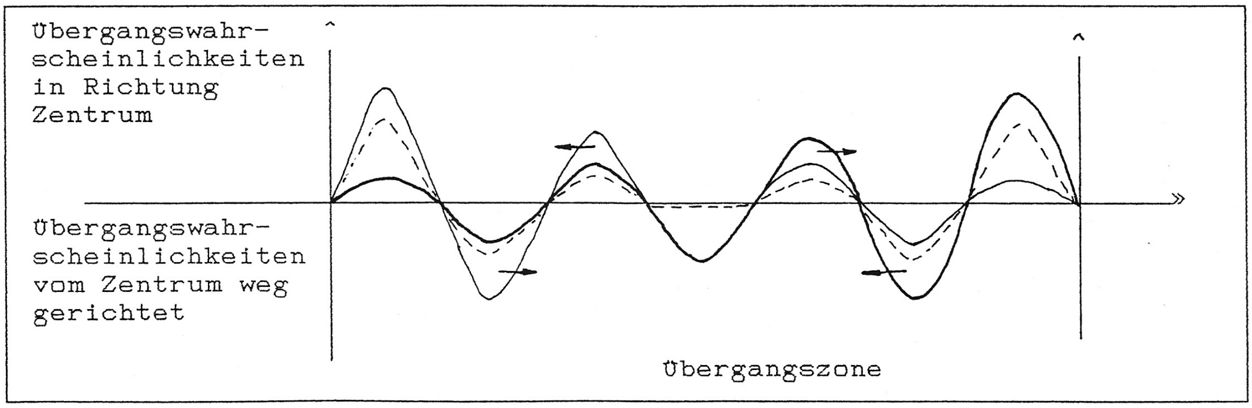


Bild 22 Übergangswahrscheinlichkeiten für zwei Atome; Schnitt 1 in Bild 20. In der Mitte zwischen beiden Atomen heben sich die Übergangswahrscheinlichkeiten auf und Elektronenübergänge sind sehr wahrscheinlich.
------- resultierende Übergangswahrscheinlichkeit, bezogen auf das jeweilige linke oder rechte Zentrum (von der Mitte aus betrachtet).

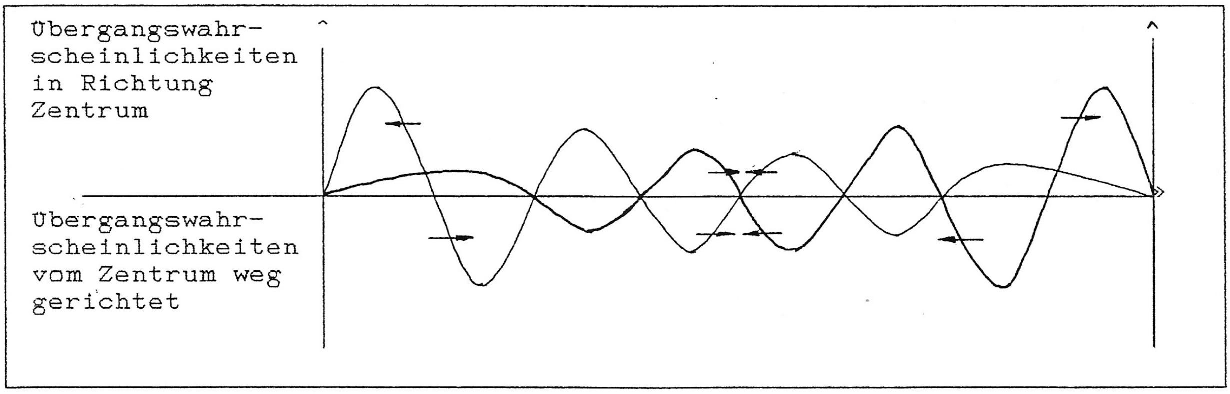


Bild 23 Übergangswahrscheinlichkeiten für zwei Atome; Schnitt 2 in Bild 20. Zur Vereinfachung der Darstellung wurde der Maßstab aus Bild 20 nicht beibehalten.
In diesem Schnitt treten keine Übergangszonen auf.

5. photon type principles

A photon is in media because of its expansion constantly in contact with a large number of atoms. The question, which must be asked here, is the one about the atom, with which now the photon interacts, e.g. in the external light-electric effect. According to the prerequisites to the Nichterlanger physics, no statistical statements may be made here.

Random events do not occur at the photon-atom level in Nichterlanger physics. The level of random events lies here with the energy pulses.

The photons represent in the framework of the Nichterlanger physics principles of energy impulses which do not form a centre.

The principle of photons can be characterized by the following points:

a) All energy impulses of a photon are subject to a direction vector. (The energy impulses of the material matter are subjected to gons).

b) The energy pulses of a photon form a lattice, which macroscopically corresponds to a "wavy elastic band".

c) The number of energy pulses per photon is directly proportional to the frequency. The packing density of the energy pulses increases with their number. (From this, the permeability of the photons to different media can be derived) I

d) If obstacles occur in the direction of an energy pulse, the direction cannot be maintained. For the energy impulse in interaction with the obstacle then transition gons (para. 3) appear. In order to keep the association, all other energy impulses of the neighbourhood have to get transition gons, too. Macroscopically, the velocity of the photon becomes smaller than the velocity of light in vacuum. If the obstacles are equally distributed, only a decrease of the velocity occurs.

e) If the energy pulses in the photon are densely packed (high-energy photons, e.g. gamma radiation), or if the obstacle is a principle with extended and strong changes of the local transition probabilities, then the association of the energy pulses in the photon can be disturbed so strongly that a part of the energy pulses leaves the association. In this case, no transition gons are possible for parts of the association. The remaining energy impulses form a new association.

f) At lower packing densities of the energy impulses in the photon, the "trapping" of an energy impulse does not lead to the destruction of the association and to the formation of a new association. Transition gons are formed which allow all energy pulses to follow the captured energy pulse or basic structure. (e.g. absorption of a photon in the shell of an atom).

5.1 Transition probabilities and wave character

Stable associations of energy pulses, which have the character of areas, can be built up from groups of three. Figure 24 shows an example of the smallest possible group of three.

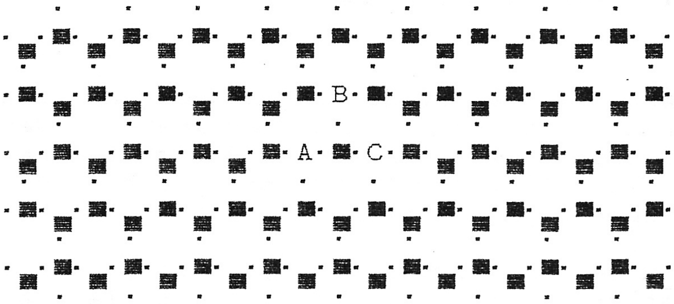


Bild 24

In den folgenden Bildern 25a,b,c sind Takte für die Übergänge der einzelnen Energieimpulse dargestellt.

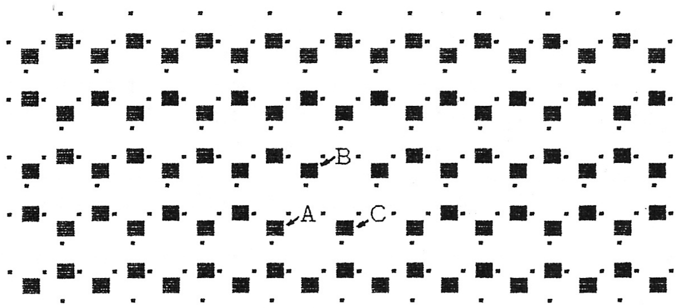


Bild 25a

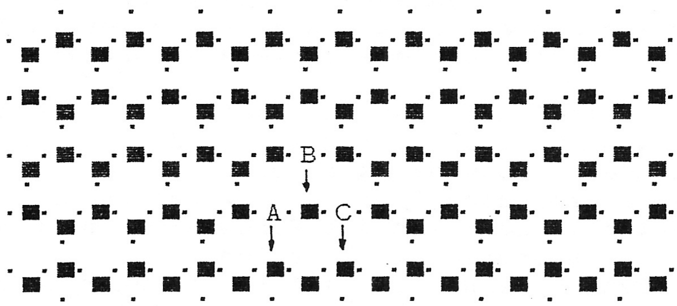


Bild 25b

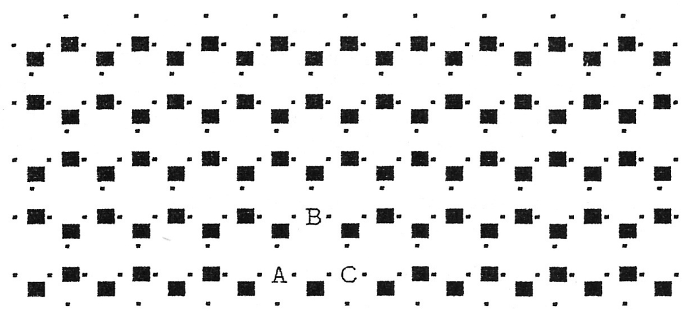


Bild 25c

Die "Abstände" zwischen den Energieimpulsen bleiben erhalten. Aus dieser stabilen Grundstruktur lassen sich über Hierarchien größere Flächen bilden. Ein Beispiel dafür ist in Bild 26 zu sehen.

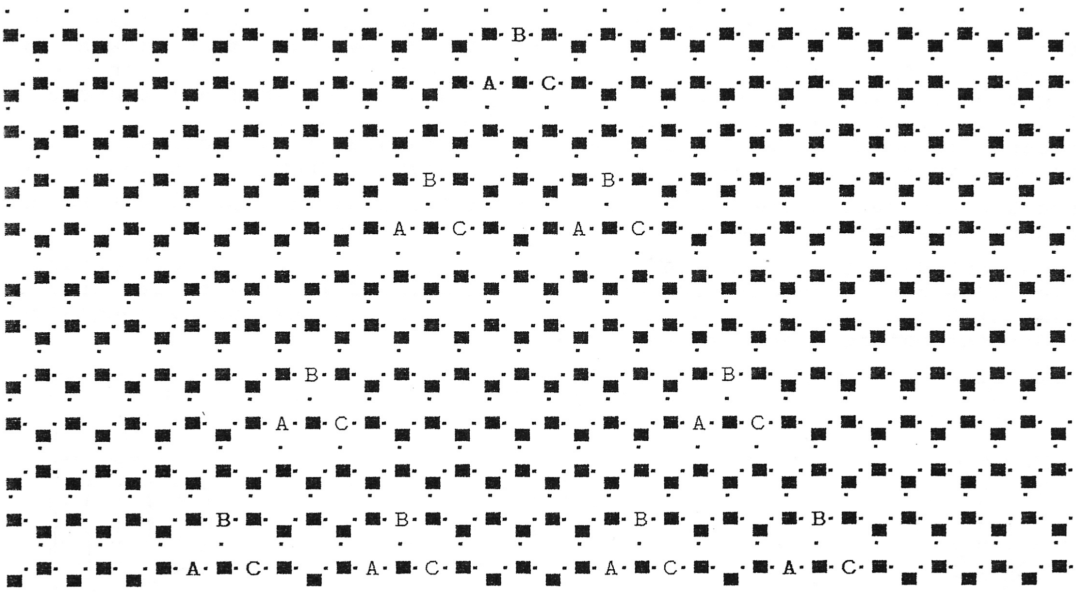


Bild 26 Flächenartige Struktur mit hierarchischem Aufbau

Die Stabilität eines aus solchen hierarchischen Unterstrukturen aufgebauten Verbandes ist dann gewährleistet, wenn die durch die Nachbarstrukturen bewirkten Übergangswahrscheinlichkeiten eine stabile Gleichgewichtslage erzeugen (Bild 27). Dargestellt sind die Zonen maximaler Stabilität der Übergangswahrscheinlichkeiten 1. und 2. Ordnung.

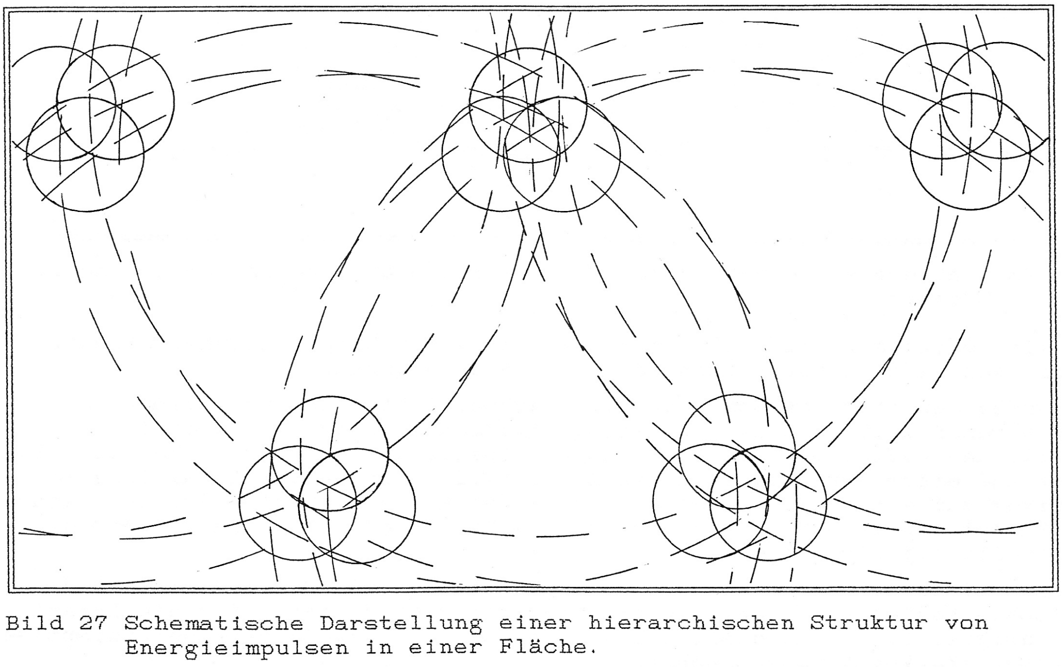


Bild 27 Schematische Darstellung einer hierarchischen Struktur von Energieimpulsen in einer Fläche.

If the basic structure is a plane-like structure of energy pulses, then the superordinate structure also bears a plane-like character, although it is conceivable that the change of the transition probabilities by the energy pulses has a spherical character. A perpendicular section through Fig. 27

shows (Fig. 28) that there are particularly stable zones for the neighboring structures in the horizontal direction. But such zones also appear in parallel planes above and below.

Macroscopically, the occupation of the parallel planes indicates an increase in the amplitude of the light.

From the nature of the stable zones, the macroscopically observable wavelength or frequency is also conceivable. The local variation of the curvature of these light surfaces is also to be seen in a close connection to the packing density of the basic structure elements.

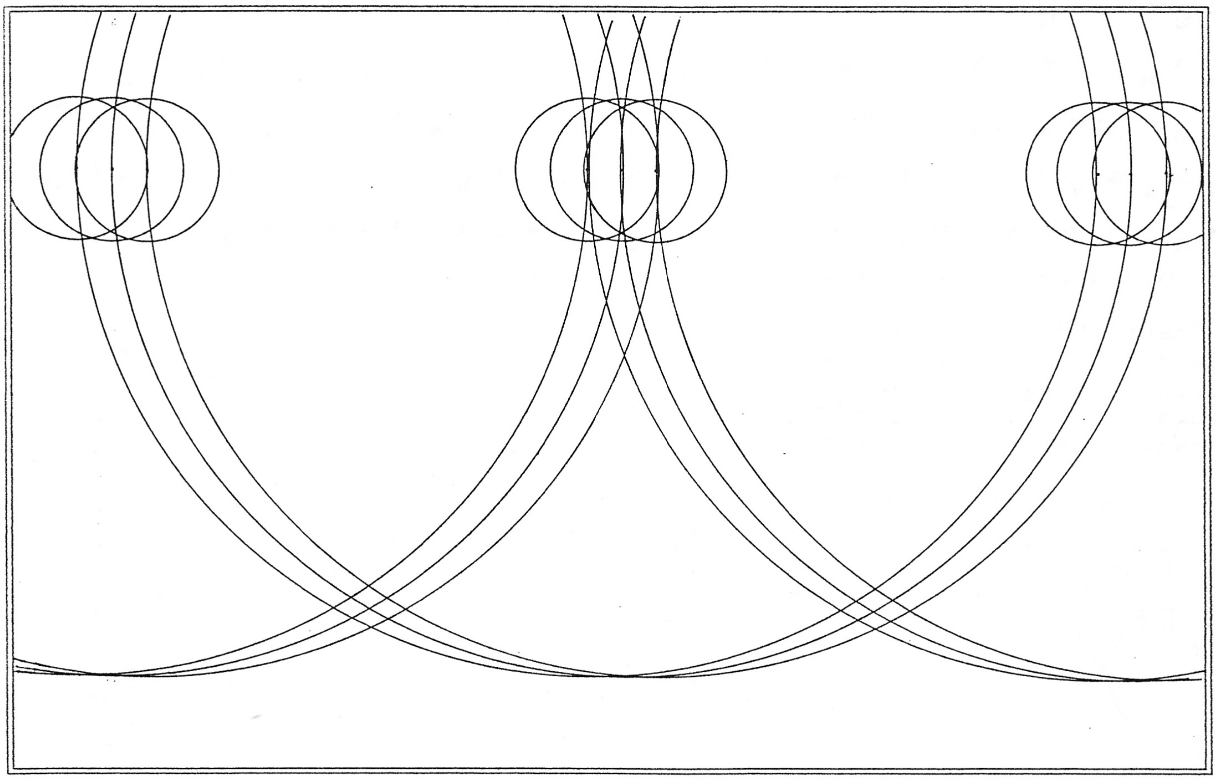


Bild 28 senkrechter Schnitt durch Bild 27 mit Stabilitätszonen 1. und 2. Ordnung.

In Fig. 29 an example is given for the construction of a hierarchical structure by stability zones of different order. The size of the stable zones and the packing density of the energy pulses contribute significantly to the propagation properties of photons in material media. If a light wave with relatively large stable zones and a low packing density (e.g. light waves in the millimetre range) impinges on an optically dense medium, individual basic structures of energy pulses can "bypass" individual obstacles without breaking up the association of the light wave. Macroscopically, the transmittance of optical media can be derived from these properties, as a statistical process describing the number of "resolved" (and thus e.g. energy pulses captured by an atom) photons per path.

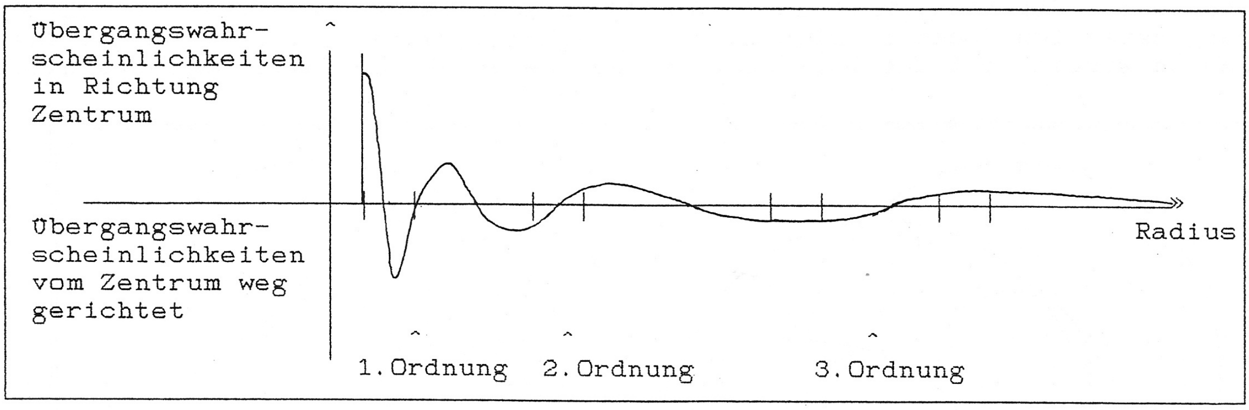


Bild 29 Übergangswahrscheinlichkeiten in Zonen verschiedener Ordnung. Das Bild kann qualitativ mit einem Schnitt entlang einer Kante in Bild 26 verglichen werden.

The surface structure of the photons macroscopically causes the polarization properties of the light waves. The sinusoidal wave structure arises in the interaction of the labile and stable zones of 2nd order for the transition probability. Figures 30 a and 30 b show this interaction schematically. The pictures show a section through the wavy surface of the photon.

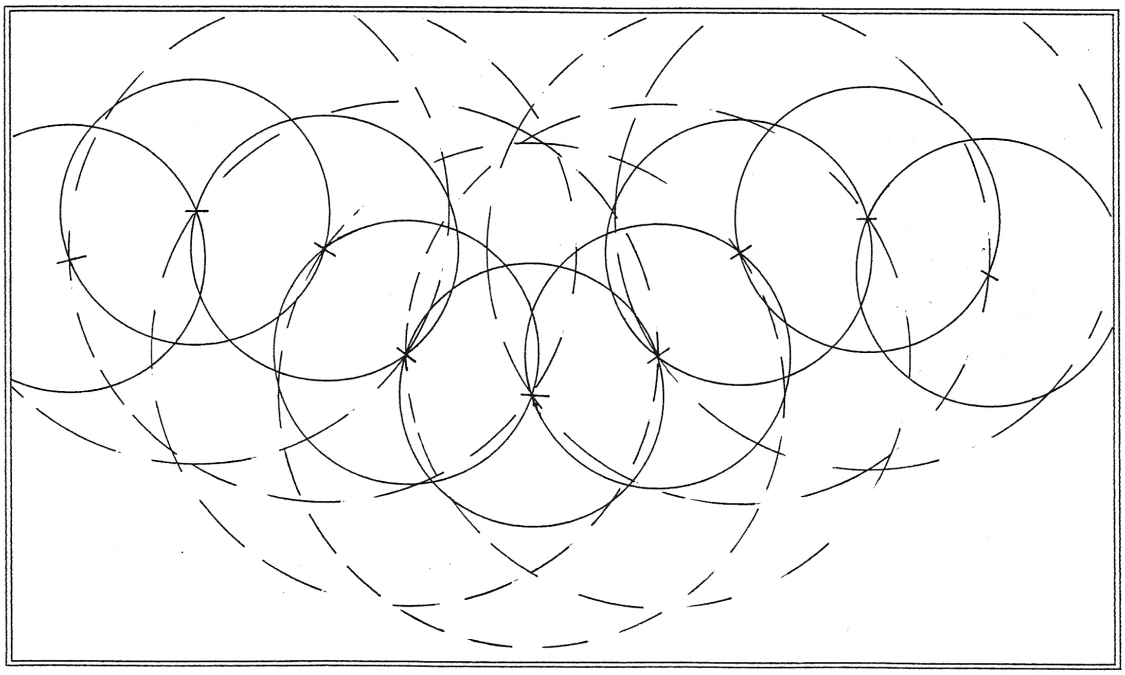


Bild 30 a Schematische Darstellung der Entstehung der "Welligkeit" eines Photons. Die Grundstrukturen der Energieimpulse sind zur Vereinfachung als Punkte dargestellt. Im Bild sind nur die stabilen Zonen für die Übergangswahrscheinlichkeiten 1. und 2. Ordnung dargestellt.

A centre is formed by two 1st and two 2nd orders. The still existing ambiguity of picture 30 a is cleared up by the consideration of the unstable zones in picture 30 b. If no further influences act on the photon, the ripple of a free photon is very probable

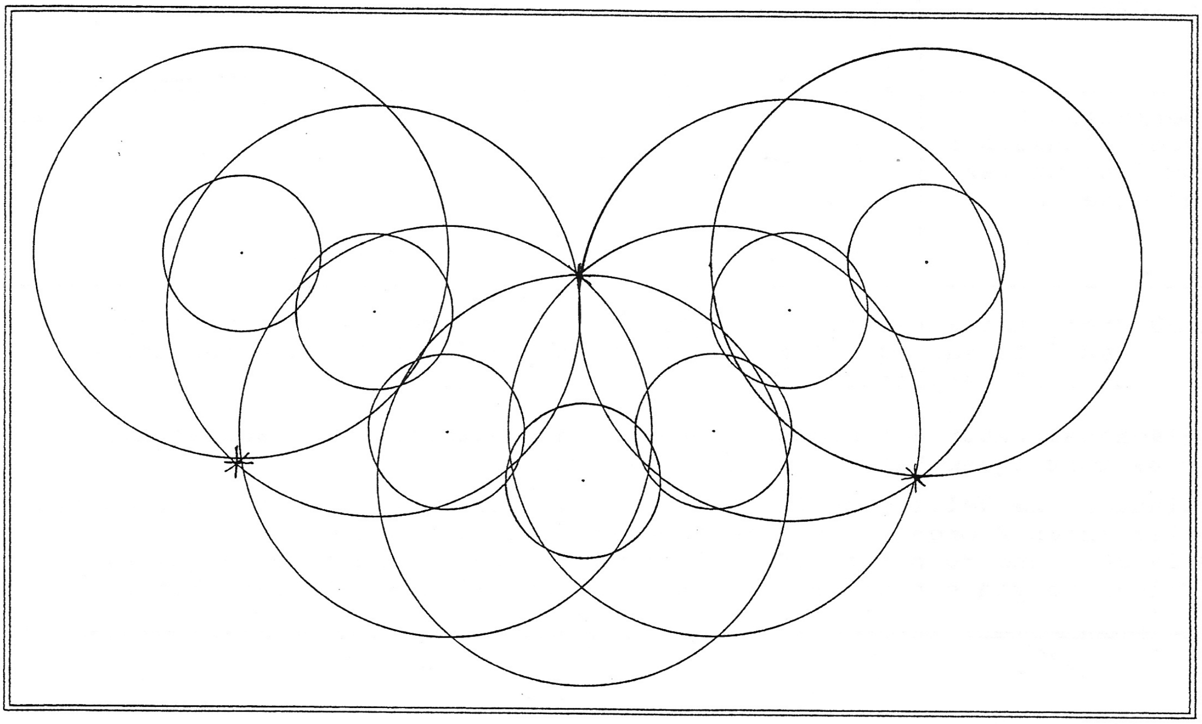


Bild 30 b Schematische Darstellung der Entstehung der "Welligkeit" eines Photons. Die Grundstrukturen der Energieimpulse sind zur Vereinfachung als Punkte dargestellt. Im Bild sind nur die <u>labilen</u> Zonen für die Übergangswahrscheinlichkeiten 1. und 2. Ordnung dargestellt.

⁎ – starke Überlagerung der labilen Zonen.

Das in den weiteren Betrachtungen verwendete Modell eines Photons ist zusammenfassend in den Bildern 31 a und 31 b dargestellt.

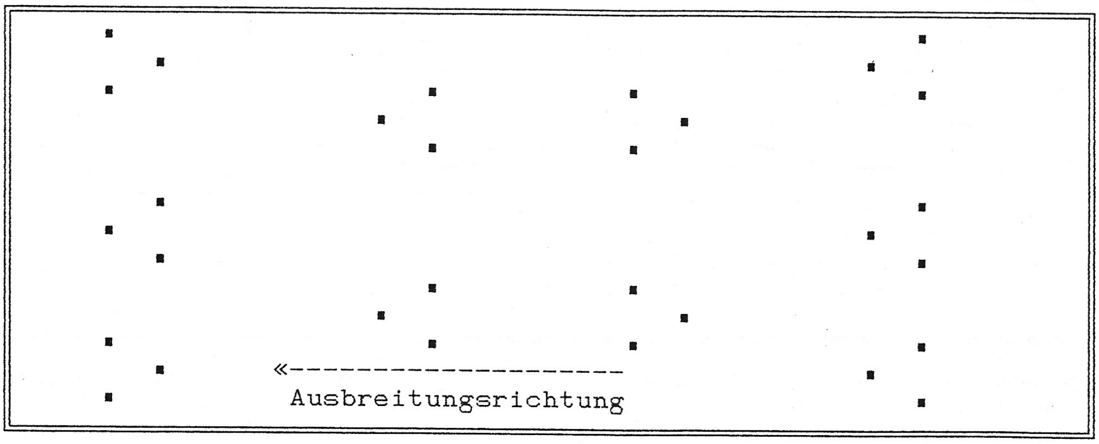


Bild 31 a Darstellung eines Photons in der Ebene seiner Ausbreitung.

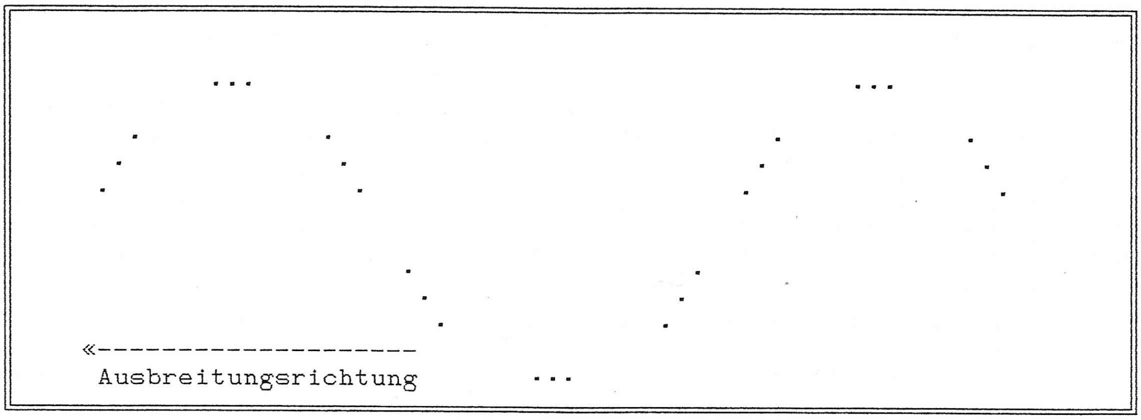


Bild 31 b Darstellung eines Photons senkrecht zur Ebene seiner Ausbreitung.
··· symbolische Darstellung einer Grundstruktur.

5.2 Examples of light propagation in matter

5.2.1 Group and phase velocity, absorption

A photon propagating in media will always interact with principles of matter type. However, the photons of visible light are of a relatively low packing density, so that an "evasion" of the basic structures of the photon is possible over large numbers of cycles. Delays of single basic elements cause changes of transition probabilities at neighbouring basic elements, which altogether leads to a delay of velocity of the whole group of basic elements.

Figure 32b schematically illustrates the effect of deceleration of a basic element.

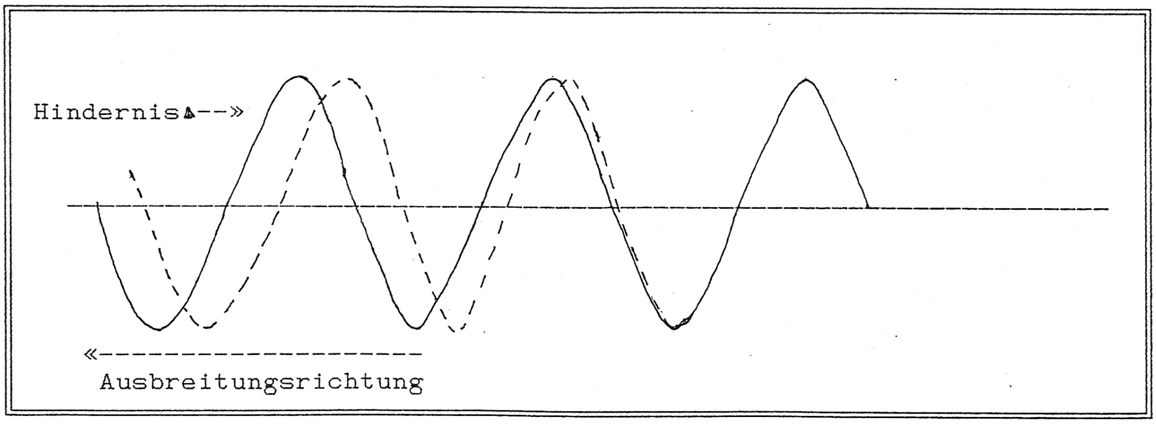


Bild 32 b Schematische Darstellung der Wirkung eines lokalen Hindernisses auf die Ausbreitung eines Photons.
——— unbehinderte Ausbreitung
------ Photon nach der Verzögerung

The obstacle in Fig. 32 leads to a "snaking motion" of the photon and thus to a divergence of group and phase velocity. The tracking of a single obstacle (e.g. an atom for visible light) is macroscopically not detectable. Only the interaction with a multitude of atoms leads to the macroscopically observable appearance of the refractive index of an optical medium.

From the algorithms for the transition probabilities it is also easy to read that the passage of a photon through a crystal leads to a special effect on the photon. The "area character of the photon" alone, which corresponds macroscopically to polarization, leads to different group velocities.

For photons of the visible light, a free electron represents a bigger obstacle, than an atom. In the atom, the transition-probabilities are more "damped", than in the electron, whose influence of the environment (electrical forces) reaches further and therefore can dissolve photons of certain packing densities and hierarchical structures (visible light). The dispersed energy impulses, which mostly still remain in their basic structure of 1st order, distribute themselves, and thus their momentum, to the atoms of the environment and also to the electron. The atoms for their part oscillate more strongly in their "network of transition probabilities" (process of absorption).

5.2.2 Refraction

If photons move in media, their propagation is essentially determined by gons and not by direction vectors.

The "appearance" of the gone, averaged over a large number of beats, changes depending on whether the medium is optically denser or thinner. If one interprets the gon as a "probability volume", there is a relationship between the macroscopic velocity of the energy pulse and this probability volume.

The appearance of refraction is a macroscopic effect, which is to be represented here with a "semi-macroscopic" approach. In picture 33 the transition of a photon from an optically thinner into an optically denser medium is shown qualitatively; the interface is considered macroscopically and assumed to be a plane.(The algorithm for the propagation of a photon works at this point with different atoms).

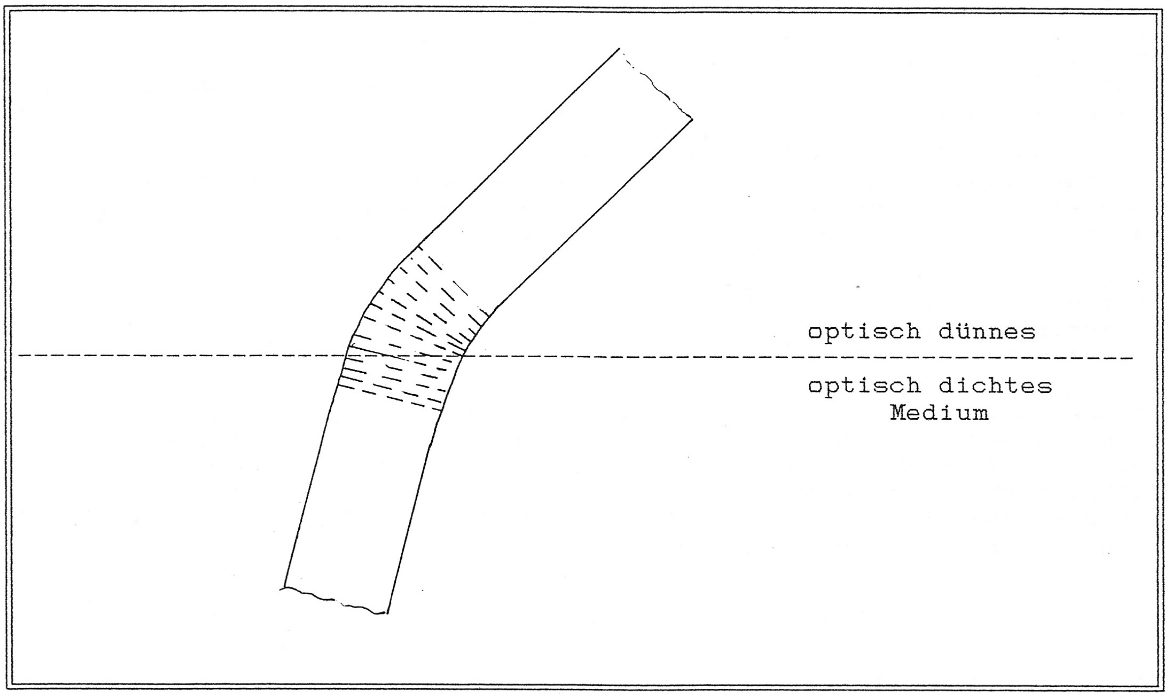


Bild 33 a Verhalten eines parallel zur Einfallsebene polarisierten Photons

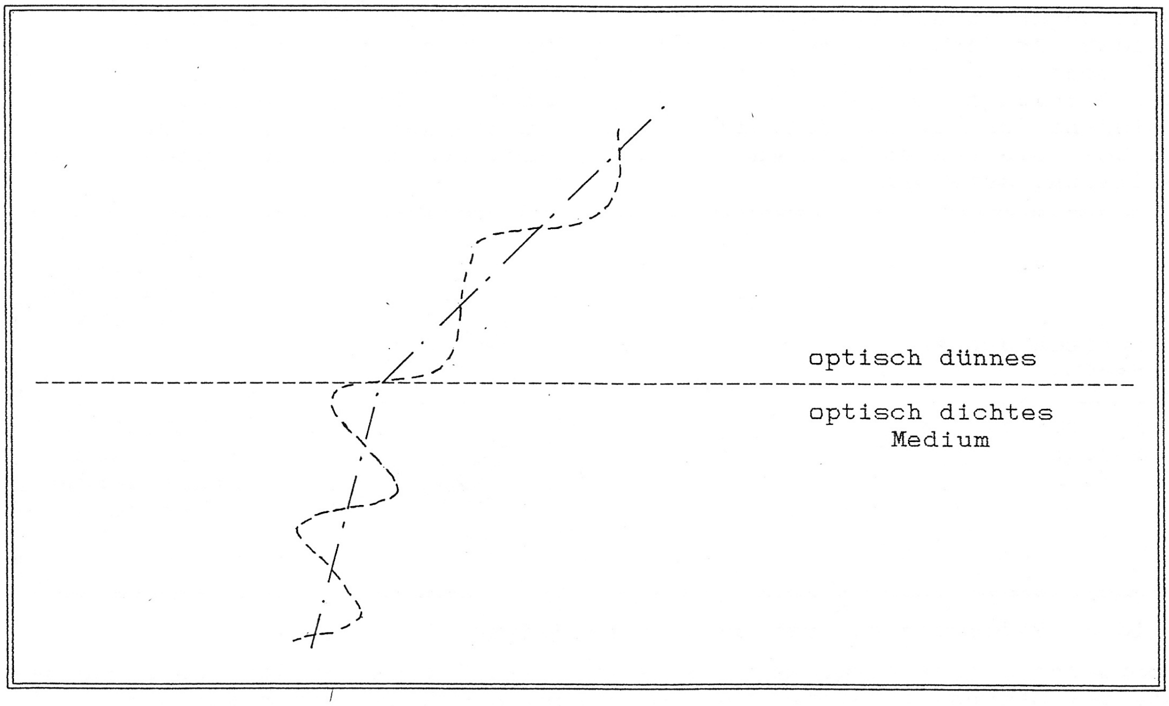


Bild 33 b Verhalten eines senkrecht zur Einfallsebene polarisierten Photons

Without mathematical modelling of this process the transition in picture 33 b is more difficult to imagine than in picture 33 a. Already from these only qualitatively describing pictures can be concluded the different behaviour (reflectivity) of two perpendicularly polarized photons. The macroscopic continuity conditions for the electric and magnetic field strength appear here as a condition for the preservation of the hierarchical structure of the energy pulses. This condition need not be required; it follows from the nature of the atoms in the boundary layer. The scattering at a rough surface can be modeled for a single photon. The only thing that matters here is the extent of the photon in relation to the irregularities of the interface. Since large wavelengths also have a large extension due to the associated hierarchical structure (with low packing density), only changes over larger interfacial areas are relevant for large wavelengths. Local perturbations of the interface area have an effect for large wavelengths only in local perturbations of the photon. There is a dependence between the wavelength of the photons and the "frequency spectrum of the interface roughness".

5.2.3 Reflection at the optically denser medium

From a macroscopic point of view, the reflection at a boundary layer represents a statistical process. If a photon with its foremost basic elements hits an optically denser medium, the first elements can get transition gons for some clocks, which are opposite to the previous propagation direction. If a majority is found, the association forms a new direction (the disturbances are so small that the association is not broken up), the resulting directions formed from the "random directions" of the first transition gons have a dominating effect on the subsequent basic elements of the energy pulses (Fig. 34). The real relationships can only be captured by mathematical modelling.

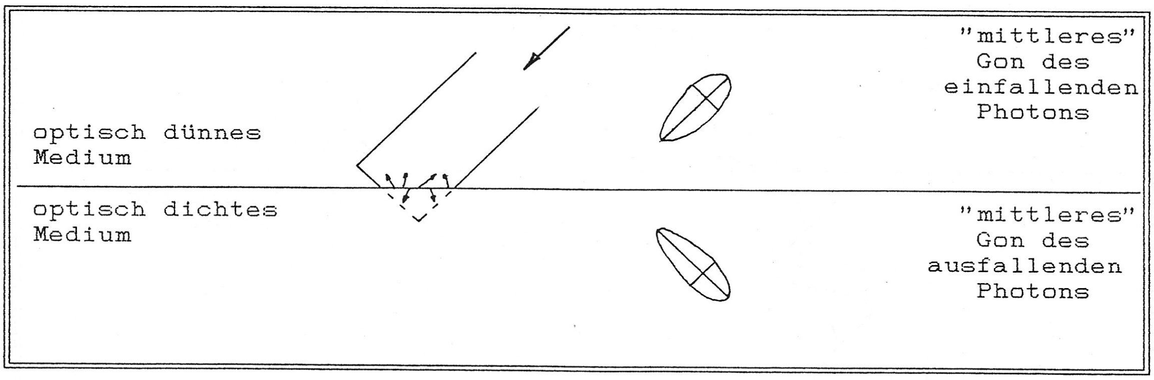


Bild 34 Reflexion am optisch dichten Medium

The optical density of a medium depends for a photon on the size and density of the perturbations (atoms) and the angle at which these perturbations appear to the photon in its propagation. In Fig. 35 a summary of reflection and refraction at the optically denser medium is shown by the "resulting mean gons".

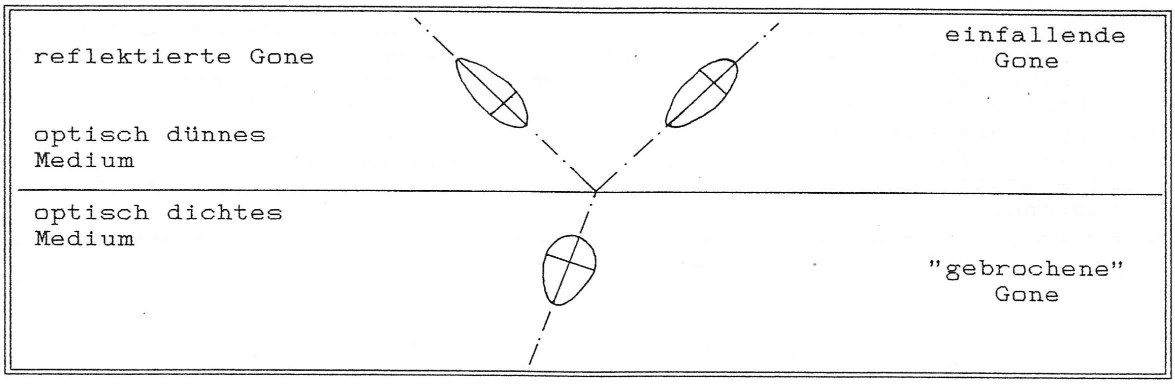


Bild 35 Reflexion und Refraktion am optisch dichteren Medium

5.2.4 Total reflection and reflection at the optically thinner medium

The reflection at the optically thinner medium is different from the reflection at the optically denser medium. The higher velocity in the optically thinner medium and the retention of some energy pulses in the optically denser medium leads to a "re-immersion" of the photon into the denser medium Figure 36).

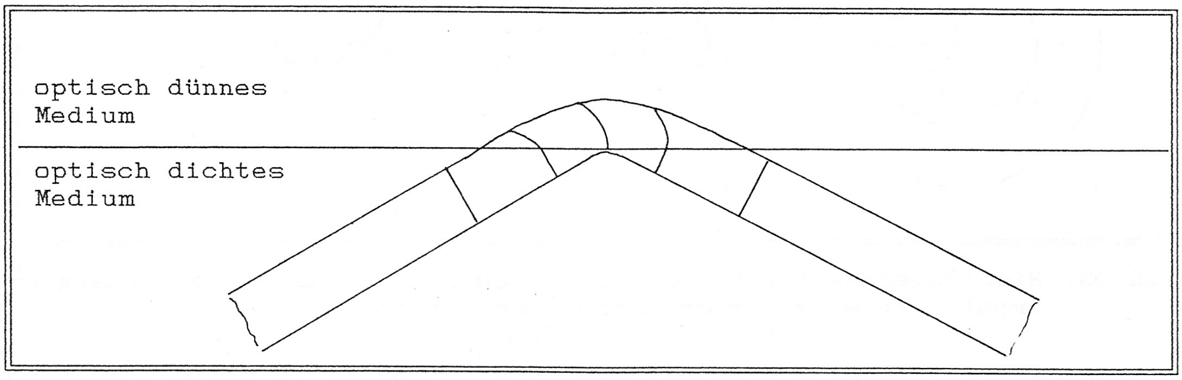


Bild 36 Schematische Darstellung der Totalreflexion

Important here is especially the fact that the photon penetrates into the other medium (problems of fiber optics). From the measurement of this process, estimates can be made about the transverse expansion of the photon.

In Figure 37, similar to Figure 35, the "mean gons" for reflection and refraction from the optically thinner medium are shown. Outside the angular range for total reflection, the transition gons of the first energy pulses when the photon contacts the optically thinner medium are of importance. Decisive for the reflection or refraction are the "majority ratios" of the "remaining" energy pulses. If too much energy impulses remain at the beginning of the contact, then the photon is reflected, because of the preservation of the association. The reflection at the optically thinner medium shows some peculiarities, which can be represented here only schematically.

In Fig. 38 it is shown, without taking into account the dynamic conditions during the propagation of the photon in the medium, that the stable spheres for the transition probabilities allow a "reversal" of the photon under certain circumstances.

Macroscopically, viewed in Euclidean three-dimensional space (as an approximation of energy momentum space), the intersection of the 1st and 2nd order spheres is a circle. These ratios also allow the photon to be spatially rotated when certain orders of obstacles exist, or when certain orders of transition probabilities act (electric and magnetic fields). In the simplified two-dimensional representation, only two possible stable points or areas exist here for the next basic element of the photon.

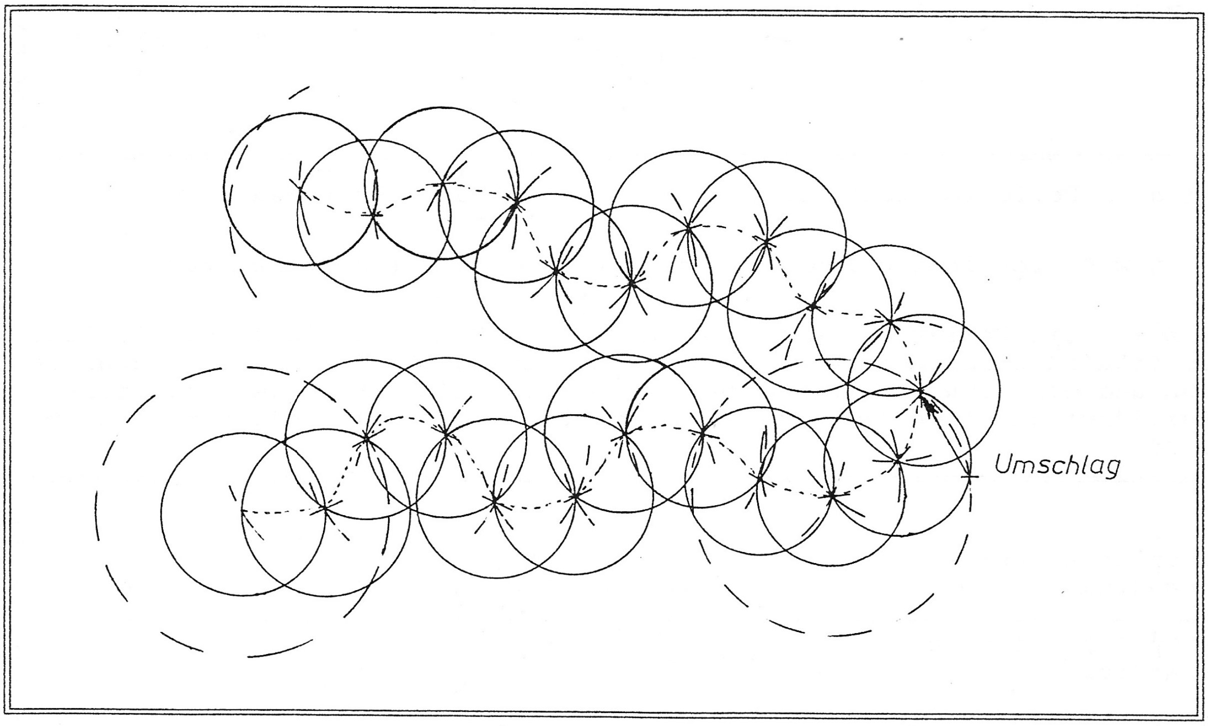


Bild 38 Richtungsänderung eines Photons durch Fluktuation der Energie-impulse in einen anderen stabilen Bereich.

In Figure 38, the reflection at the optically thinner medium is shown schematically simplified. When a photon is reflected at the optically thinner medium depends on the concrete conditions at the boundary layer. Roughly speaking, the ratio of the basic elements already leading and those still lagging behind is of essential importance. The reflectance is the statistical average of the behaviour of a large number of photons.

Figure 39 does not take into account the "meandering motion" of the photon in the medium.

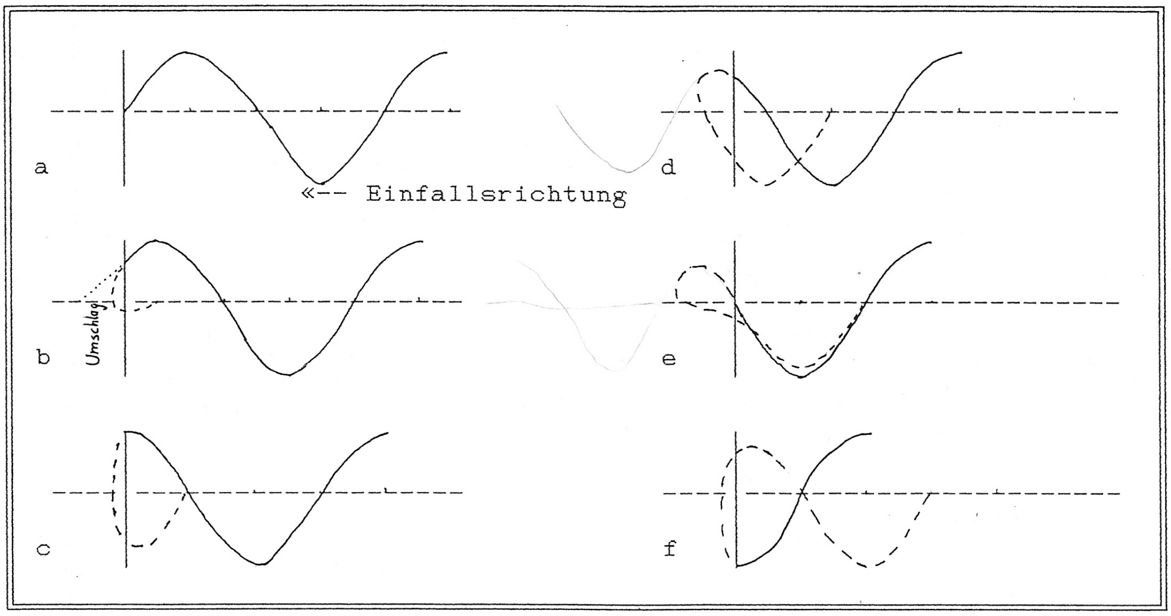


Bild 39 Richtungsänderung eines Photons am optisch dünneren Medium.
——— einfallendes Photon
------ reflektiertes Photon

5.2.5 Interference of photons

Two essential basic quantities of the macroscopic phenomenon of interference are the amplitude and the relative phase of two light waves. The amplitude of a macroscopic light wave can be thought of as originating from the number of photons in the same phase. The relative phase of the light wave is also the relative phase of two groups of photons with the same group phase.

To illustrate the processes to which photons are subjected in interference processes, the conditions at a boundary layer are to be qualitatively represented here as an example.

The conditions at the boundary layer are complicated, because there are no analytical relations as in wave optics. In Fig. 40, a photon (1) is shown in solid lines, which impinges on an optically denser medium from the top right of the drawing. This photon can overcome the boundary layer, or it can be reflected. Both possibilities are shown in figure 40.

The photon (2) drawn in broken lines hits the interface to the thinner medium from the lower right. This photon can also overcome the boundary layer or be reflected. To simplify the illustration, no wavelength and direction changes between the two media are taken into account. Looking at the transition probabilities at the interfaces, it can be read that the conditions for a reflection of photon (2) are unfavorable, due to photon (1) arriving in the same phase.

It should be noted that, contrary to the simplified representation in Fig. 40, there are always spatial regions around the "corrugated surfaces of the photons" which are shaped in their transition probabilities by the photon. The reflection (reversal) of photon (2) is disturbed by photon (1). At the same time the photon (2) favours a reflection of the photon (1).

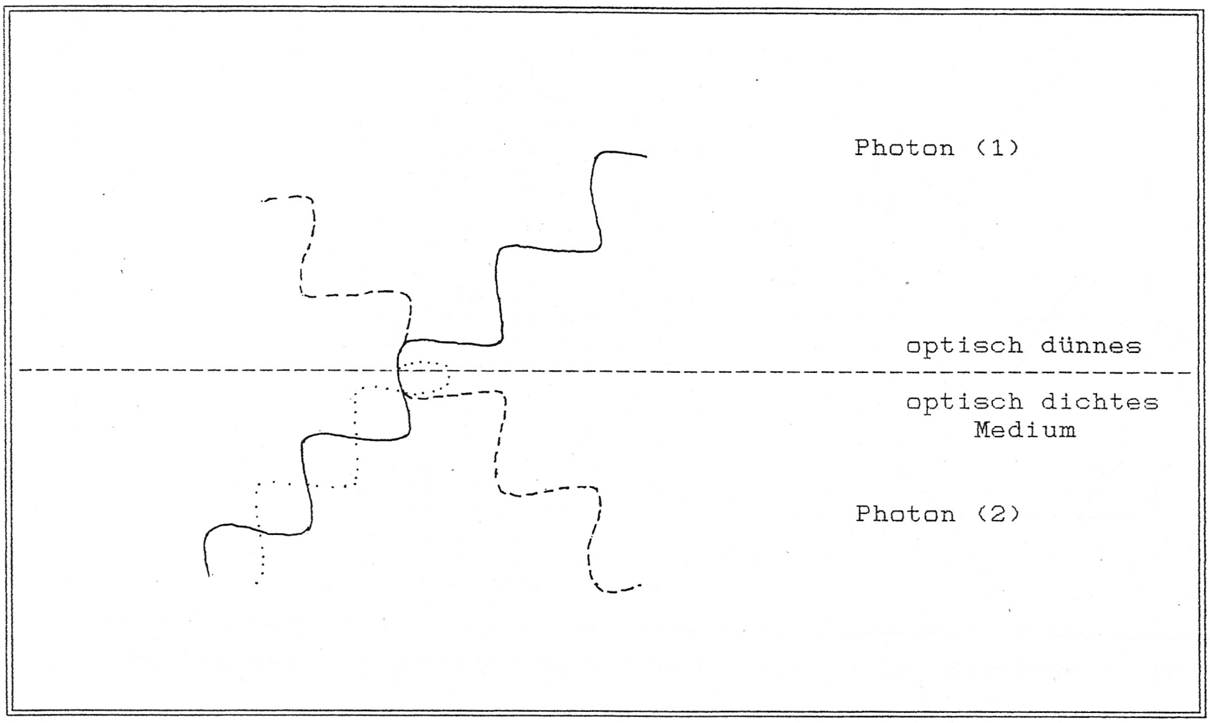


Bild 40 Interferenzerscheinungen von Photonen an Grenzflächen.
—— Photon (1), ---- Photon (2), ... "Umkehr" des Photons (2)

Summarizing, there is a large probability (for the phase ratios shown in the drawing) that photon (1) will be reflected and photon (2) will pass into the thinner medium. In this view, there is no extinction or amplification of a photon, only the probability ratios for reflection and transmission change. Extinction effects of classical wave optics appear in Nichterlanger optics as displacement effects.

Other interference phenomena are briefly discussed in Section 5.2.7.

5.2.6 Light in electric and magnetic fields

In Nichterlanger optics there are no special fields. The different field qualities are different qualities of distributions of transition probabilities, which can be described by different orders (Fig. 41)

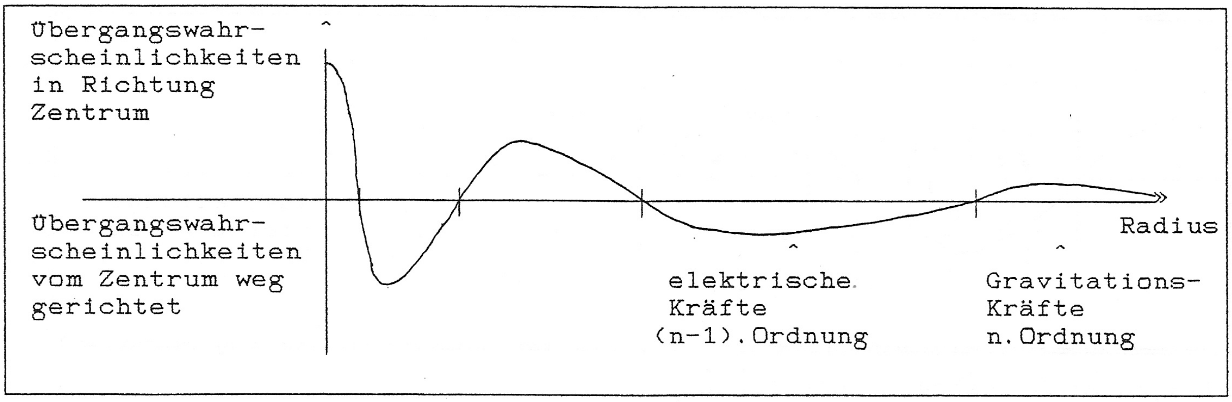


Bild 41 Schematische Darstellung von verschiedenen Kräften als Feld der Übergangswahrscheinlichkeiten

An electric field, for example, results from the superposition of the transition probabilities of free electrons. If one observes the motion of an electron (Fig. 42), there is a change in the transition probabilities of the surroundings of its orbit. If there are energy impulses or principles of these energy impulses in the vicinity of this orbit, a vortex formation occurs, since these also influence each other by their transition probabilities.

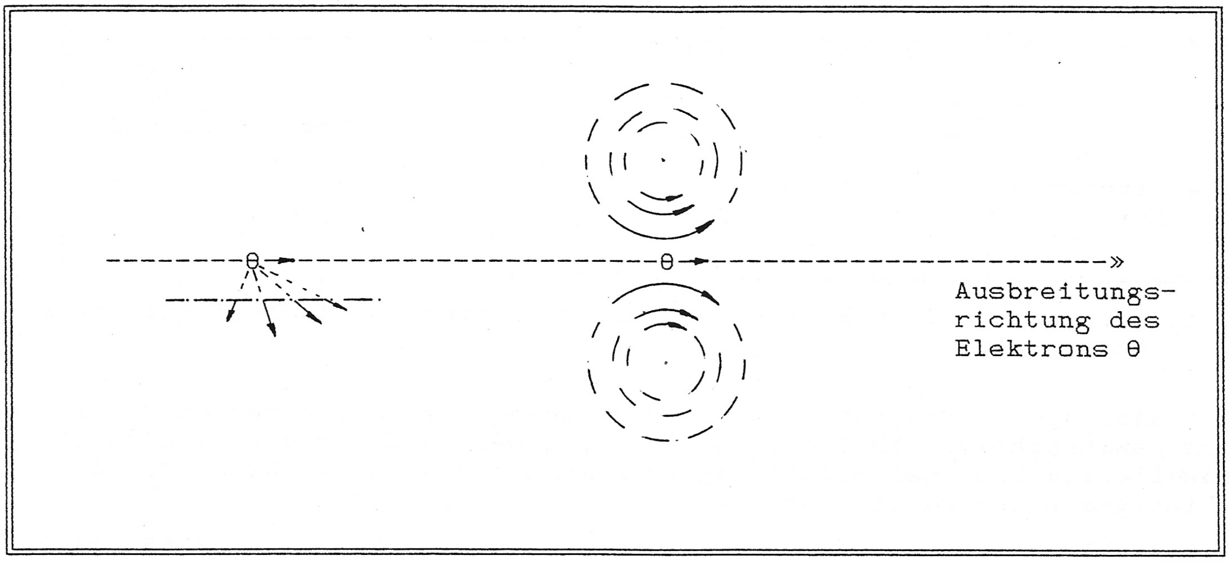


Figure 41 Trajectory of an electron and effects of transition probabilities on the environment.

A propagating photon has a similar effect on its surroundings (Fig. 43).

A magnetic field appears in Nichterlanger optics as a vortex field of transition probabilities. Such a vortex field is e.g. able to rotate the plane of polarization of light (Faraday effect).

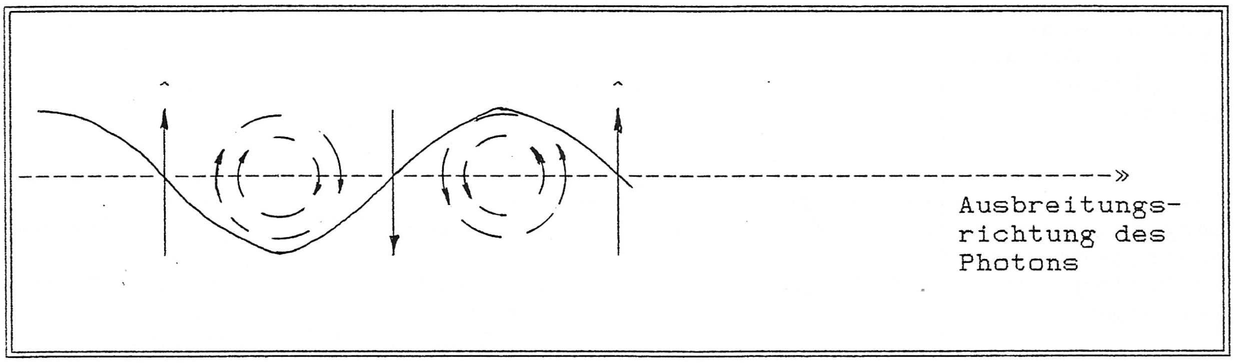


Bild 43 Sich ausbreitendes Photon
——— Fläche oder "Netz" der Energieimpulse des Photons
------- Wirkung auf "Probekörper" der Umgebung

According to these methods, the propagation of photons of large wavelengths (radio wave photons) can also be explained (Fig. 44).

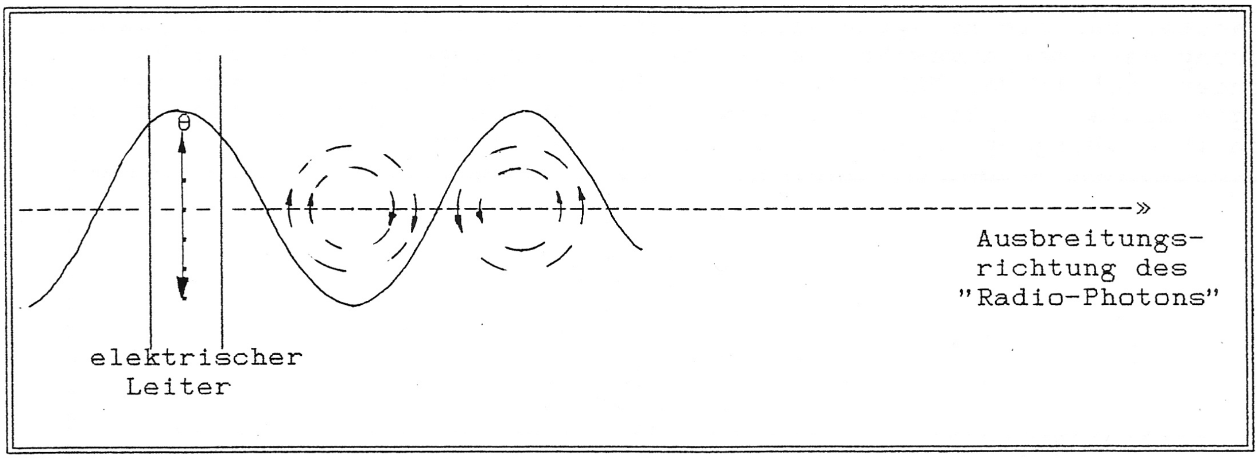


Bild 44 Schwingung eines Elektrons in einem Leiter und Ausbreitung einer Radiowelle.

Electrons moving "back and forth" in wires create vortices of transition probabilities, and furthermore, energy pulses are compressed by the "shock wave surfaces" of electrons into "thin webs" that propagate at the speed of light.

At this point it must be pointed out that the electrons themselves transport energy pulses due to their principle (see also section 5.3.1).

Energy is always bound to the energy impulses in the Nichterlanger physics. Electrons can only be accelerated by receiving energy pulses, they also release their energy by releasing energy pulses.

In Figure 44, the electrons could be compared to "shallow shells" filled with peas rolling back and forth. A few of these peas roll over the edge when the electron is forced to reverse its direction and some fall into the next "electron shell", some of the energy impulses are absorbed by the atoms (heating the wire) and some are pushed away by the moving electron, condensed and cross-linked to form the radio photon. So these processes can be represented vividly, but unfortunately not very scientifically. A mathematical modelling of these processes is very complex, because no closed analytical functions can be given and only the algorithms described in this paper can be applied.

5.2.7 Diffraction of photons

Diffraction is a statistical process describing the interaction of a multitude of photons at the interface of two different media, where the angles of incidence to the interface are large. For the interaction it is immaterial whether the interface separates a strongly and a weakly absorbing medium, or whether it is the diffraction at a phase edge. The depth of penetration considered in a strongly absorbing medium is small and only of importance if differently polarized light is to be examined. Therefore the relations shown in fig. 45 are also only more of principle.

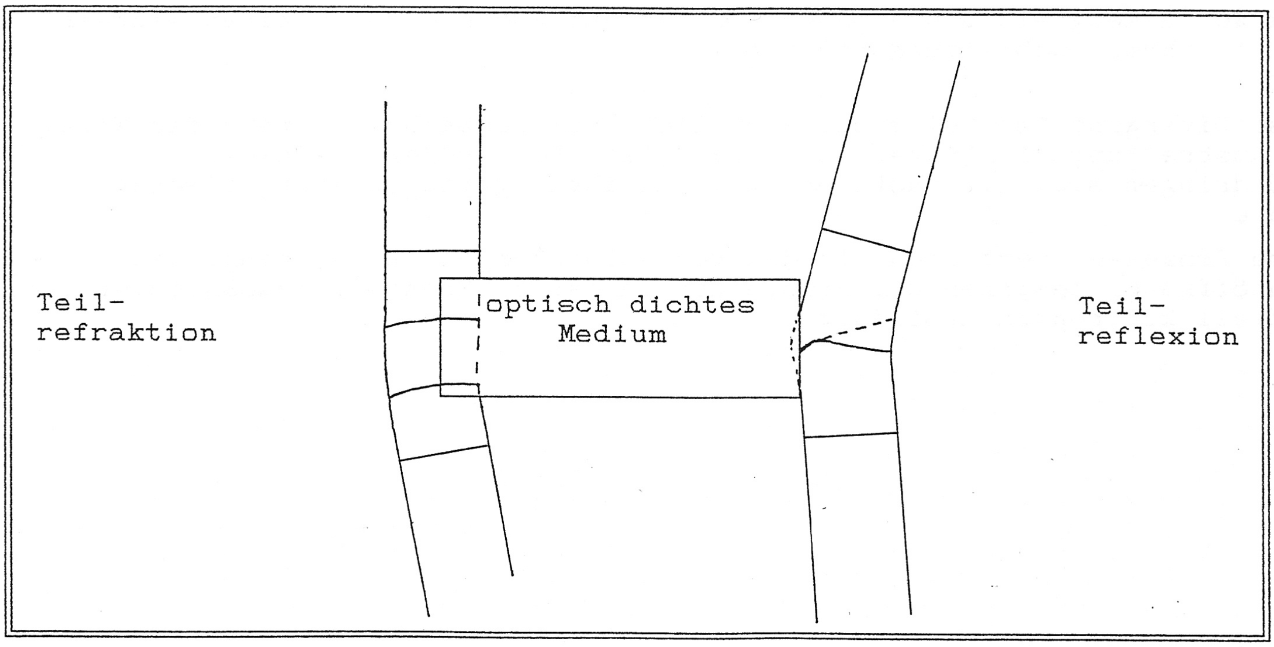


Bild 45 Prinzipielle Darstellung der Beugung an Grenzflächen.

From the disturbances at the edge, which cause a scattering of the photons by penetration and reflection processes, the phenomena of the divergence of the photon stream are to be distinguished. The divergence of the entire, relatively thin photon bundle results from the mutual influence of the photons. The interaction of the photons with each other is determined at low photon densities by the number of cycles their encounter lasts.

Phased photon pairs are more stable than phase-shifted ones. Phase-shifted photon pairs diverge.

This divergence is only observable in visible light if the angle of the propagation directions is very small. At larger angles, the photons penetrate each other due to their low energetic density.

These processes, combined with the interactions in the diffractive light aperture, give rise to the phenomena of coherent, incoherent and partially coherent imaging.

5.3 Examples of the interaction of photons with matter

5.3.1 Photon and electron

For the interaction of energetic photons with free electrons, a model can be given that is based on the relation

$$E_{ph} = h \cdot \Sigma \nu_i \qquad i = 1,2,..N$$

E_{ph} = Energie des Photons

basiert. Es erfolgt ein Übergang von Energie vom Photon auf das Elektron:

$$E_{ph} \Rightarrow E_{ph} - h \cdot \Sigma \nu_j \qquad j = 1,2,..M;\ M<N$$

$$E_{el} \Rightarrow E_{el} + h \cdot \Sigma \nu_j \quad .$$

E_{el} = Energie des Elektrons

The transition of energy takes place in the form of energy pulses. The in this case relatively energetic and compact photon partially overcomes the sphere of transition probabilities leading away from the center of the electron.

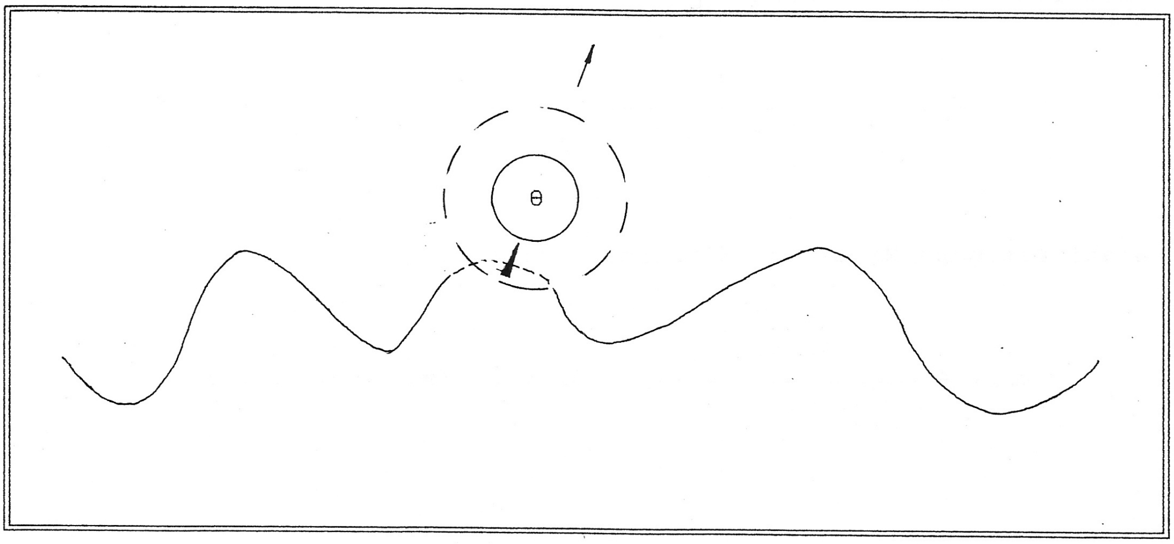


Bild 47 Übergang von Energieimpulsen eines Photons auf ein Elektron

From the relativistic law of conservation of energy it follows for an electron at rest:

$$(m_{el} + \theta \Sigma \nu_j)\, c^2 = \frac{m_{rel} \cdot c^2}{\sqrt{(1 - (V^2_{rel}/c^2))}}$$

The same applies to the law of conservation of momentum

$$c \cdot \theta \Sigma\ v_j = \frac{m_{rel} \cdot V_{rel}}{\surd(1 - (V^2_{rel}/c^2))}$$

(m_{rel} = relativistische Masse des Elektrons
V_{rel} = relativistische Geschwindigkeit des Elektrons
$\theta = h/c^2$ mit h = Plancksches Wirkungsquantum)

The influence of the photon on the angular momentum of the electron is not considered here for the sake of simplicity, this corresponds to the case where the energy pulses passing to the electron produce angular momentum which cancel out in the sum. The relativistic velocity after the interaction with the photon follows from the conservation laws to:

$$V_{rel} = \frac{c}{1 + (m_{el}/(\theta \Sigma\ v_j))}$$

$$m_{rel} = \frac{c \cdot \theta \Sigma\ v_j}{V_{rel}} \surd\ (1 - (\theta \Sigma\ v_j)^2/(m_{el} + \theta \Sigma\ v_j)^2)$$

The relativistic mass of the electron follows to:

The results refer to the energy balance only, directional changes are not considered.

If the jequivalent mass loss m^-_{ph} of the photon is used instead of the quantized frequencies, the above relations can be written in a simplified way:

$$\frac{V_{rel}}{c} = \frac{1}{1 + M} \qquad \text{mit} \quad M = m_{el}/\bar{m}_{ph}$$

$$\frac{m_{rel}}{m_{el}} = (1 + 1/M) \cdot \sqrt{(1 - (\bar{m}_{ph})^2/(m_{el} + \bar{m}_{ph})^2)}$$

Example: If the equivalent mass of the photon's energy pulses captured by the electron is equal to the "rest mass" of its energy pulses, then the relativistic velocity of the electron can be at most c/2. The relativistic mass of the electron for this example is then:

$$m_{rel} = m_{el} \cdot \sqrt{3} \qquad (\text{für } M = 1).$$

6. literature

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