2.4 The Photon Model

The derived constants in **Chapter 2.2** suggest that the mechanism of the 7-dimensional theory of relativity is scalable to all matter. Thus, the representation of sine periodicity from cosmology with its wave behaviour is transferred to quanta in the microcosm. This chapter explains the photon model, which results exclusively from the relativistic framework conditions. This model overcomes the idea that elementary particles are point particles. Instead, they are a contracting and expanding hollow body oscillation consisting of superimposed harmonics. The simplest form of these harmonics corresponds to the photon. In addition to the dimension of time, a photon requires four spatial dimensions to describe its photon field. This quantised photon field and its harmonic form a subspace U for a 6-dimensional field vector, which also describes complex structures and networks of several photons.

<u>Photons are always 4-dimensional subspaces :</u>

A 6-dimensional space has a 5-dimensional surface. It can contain numerous of 4-dimensional subspaces U in the form of field bodies. The surface of such a 4-dimensional subspace U is 3-dimensional. A fourth spatial dimension is required to represent one or more such 4-dimensional rotation paths. The properties of real photons are attributed to these rotating field bodies.

a) The surface of a 4-dimensional hollow sphere is 3-dimensional. It takes four dimensions to map three 4-dimensional rotation paths.
b) The surface of a 5-dimensional hollow sphere is 4-dimensional. It takes five dimensions to map four 4-dimensional rotation paths.
c) The surface of a 6-dimensional hollow sphere is 5-dimensional. It takes six dimensions to map five 4-dimensional rotation paths.

For a photon, its 4-dimensional subspace within the 6-dimensional field space implies that

- its quantized angular momentum is equal to that of the universe
- its interaction takes place within the framework of the universe's gravitational potential
- the direction of its field exchange depends on the periodic structure of the universe.

Integration of a photon into the field-space:

The first challenge is to integrate an electromagnetic wave that follows a wave function into a reference system that takes into account the relationships shown in **Figure 1.5**. The relevant method is to represent a wave as a mathematically periodic rotation. With a relativistic rotational motion, the angular momentum L can be modelled for its relativistic inertial force. The angular momentum *L* has the unit Js for an effect. Within the framework of FSM, the mechanism of angular momentum in the macrocosm can be transferred to the angular momentum of the microcosm. This is because the photons must follow the angular momentum of the universe in accordance with the law of conservation of angular momentum. The original angular momentum remains the same, regardless of any additional energy. As the angular momentum of each photon must be maintained relative to the angular momentum of the universe during its own motion, space-time deforms the field-space at the location of the field. The greater the intrinsic motion of a photon in the form of a higher frequency, the more energy the photon must be based on.

Display options:

The following visualisation options for 4-dimensional subspaces U are conceivable. The appropriate illustration is used for each chapter.

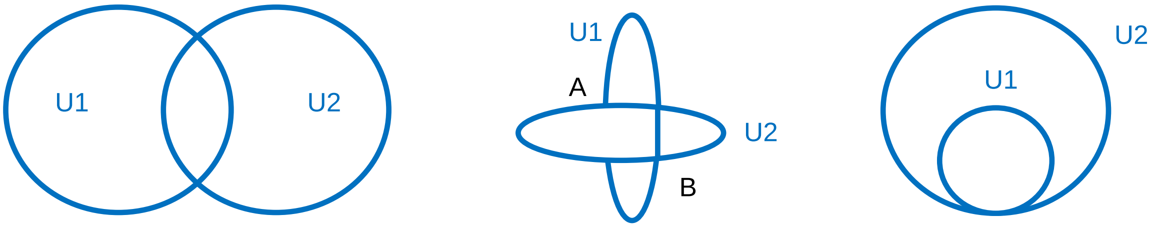

Figure 2.8: Possible arrangements of subspaces in the wave-field $F_{4\text{-}6}$

Now the photon is to be abstracted as an electromagnetic wave into a mathematical rotation in the wave-field $F_{4\text{-}6}$. **Figure 2.9** realises sine-periodically rotating photons, which are described according to the results of FSM-GTR.

The relativistic relationship applies to the field propagation velocity vectors V_4 and V_5:

$$c^2 = V_4^2 + V_5^2$$

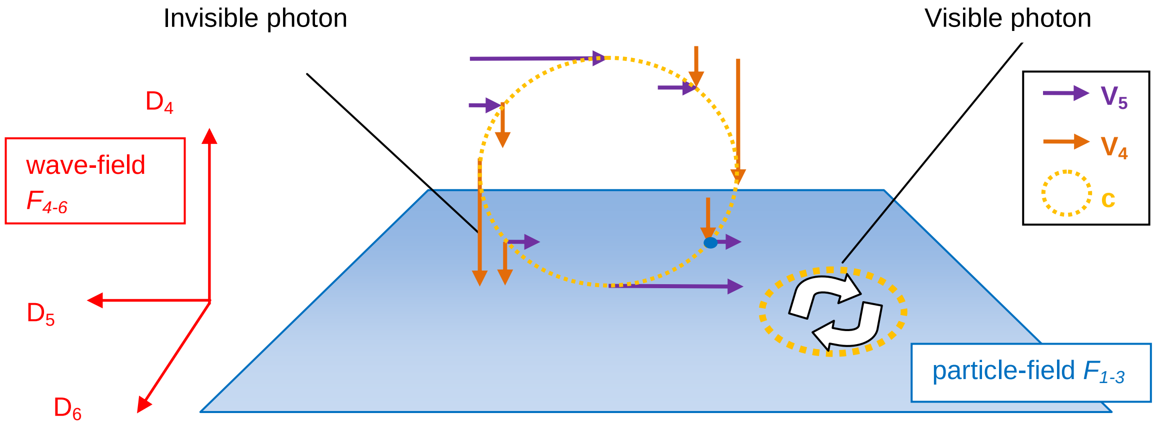

Figure 2.9: Left: orthogonal to the dimensional plane D_{56} an invisible photon with its rotation mechanism; right: parallel to the dimensional plane D_{56} a rotating visible photon

Figure 2.9 shows several capabilities of a photon at the same time. The current inertial state of a wave should be marked as a small blue dot. This always rotates along its prospective trajectory with the maximum speed $V_{max} = c = 299792458\,\frac{\text{m}}{\text{s}}$. The field propagation velocity vectors V_4 and V_5 in the wave-field $F_{4\text{-}6}$ change periodically during its path. With the periodic change of its field propagation velocities, its space-time behaviour changes dynamically during rotation. This periodic sequence of its inertial motion in the wave-field $F_{4\text{-}6}$ shown above will also transmit its gravitational force starting at the point of contact on the dimensional plane D_{56} in a sinusoidal or wave-like manner into the particle-field $F_{1\text{-}3}$. The gravitational wave in question is registered.

However, **Figure 2.9** shows even more. Depending on whether a photon rotates orthogonally to the dimensional plane D_{56} or not, it can be registered differently. Photons rotating in the wave-field $F_{4\text{-}6}$ parallel to the dimensional plane D_{56} continuously exchange their photon field with the particle-field $F_{1\text{-}3}$. In addition to the short and long wavelengths, these photons also contain frequencies visible to the eye. These photons are used in experiments to measure the speed of light. Such photons are part of the **registering matter** and should be summarised as **visible photons**. While the so-called **invisible photons** rotate in the wave-field $F_{4\text{-}6}$ orthogonally to the dimensional plane D_{56}, they can only transmit their photon field into the particle-field $F_{1\text{-}3}$ under certain conditions and periodically. Such invisible photons nevertheless exist even without direct registration by an observer and are assigned to the **hidden matter**.

Classification of dark matter:

According to FSM, dark matter is a form of hidden matter consisting of invisible, coupled photons or invisible complex particles. A deviation from the point of contact in the dimensional plane D_{56} reduces the coupling strength of matter with its interaction fields into the particle-field $F_{1\text{-}3}$. Despite coupling, dark matter may interact weakly or not at all with visible matter.

Classification of dark energy:

Dark energy consists of a collection of invisible photons that, in their evolution, have not reached the minimum coupling frequency (**Chapter 3.1**) required for interaction with other matter. These cannot (yet) interact with other matter.

Conclusion on matter:

Matter is not 'substance' in the conventional sense, but rather a geometric effect of a relativistic 6-dimensional field-space.

Quantum principles for photons formulated from the axioms:

1) Photons have fields in the wave-field $F_{4\text{-}6}$, which oscillate relativistically in space-time in a contracting and expanding manner, while these are abstracted macroscopically in the particle-field $F_{1\text{-}3}$ as field lines.

2) A field propagation velocity V_4 in the fourth dimension and the field propagation velocity V_5 in the fifth dimension together form a rotation matrix along the unit vector $\overrightarrow{e_6}$, which runs parallel to the dimensional plane $\overrightarrow{e_6}\, dD_4 dD_5 = \overrightarrow{dA} = D_{45}$ and always results in the maximum velocity $V_{max} = c$ in a vacuum with 299792458 $\frac{m}{s}$. The relationship applies:

$$c^2 = V_4^2 + V_5^2$$

3) The results of length contraction and time dilation reach the factor 1 exactly when the object velocity $V_3 = 0$. Accordingly, the state $V_4 = 0$ with $V_5 = c$ applies.

4) The object time t_{Obj} of a particle depends on its field propagation velocity V_5, which unfolds in the dimensional plane D_{56}.

5) The length of an emitted field line can be measured in a velocity diagram for all dimensions $D_{1\text{-}3}$ in the particle-field $F_{1\text{-}3}$ using the object time t_{obj} and its field propagation velocity V_5.

6) The common point of contact for photons, which mediates visible matter, lies exactly in the dimensional plane D_{56}, which is spanned between the fifth and sixth dimension. The common point of contact for hidden particles lies above or below the dimensional plane D_{56}.

Field body point of view:

The local field body is modeled by vector fields and gravitational fields. Under the condition that the volume radius R is much larger than the field radius r ($R >> r$), the vector fields and their scalar feedback determine the field body at the microcosmic level (**Chapter 2.2, Wave Equations, Point 11**). The dominant metric component is:

$$ds^2 \supset 2(A_\mu^a + \delta A_\mu^a)\, dy_a\, dx^\mu$$

Due to the spatially limiting 3-dimensional nature of the particle-field, a single field body in the particle-field $F_{1\text{-}3}$ can only exist in a maximum of 3 dimensions in all spatial directions. For each spatial direction D_1, D_2, D_3 in the particle-field $F_{1\text{-}3}$, only a single field vector remains for a 4-dimensional subspace U in the wave-field $F_{4\text{-}6}$, in which a field can propagate. This is represented in the wave-field $F_{4\text{-}6}$ as a 1-dimensional field vector for each of the spatial directions D_4, D_5, D_6. **Figure 2.10** uses a blue arrow to represent one of the three possible 4-dimensional subspaces. This shows a 6-dimensional field vector for the case where one dimension in the field $F_{4\text{-}6}$, e.g. in the fourth dimension, is omitted for three spatial directions of an object in the particle-field $F_{1\text{-}3}$.

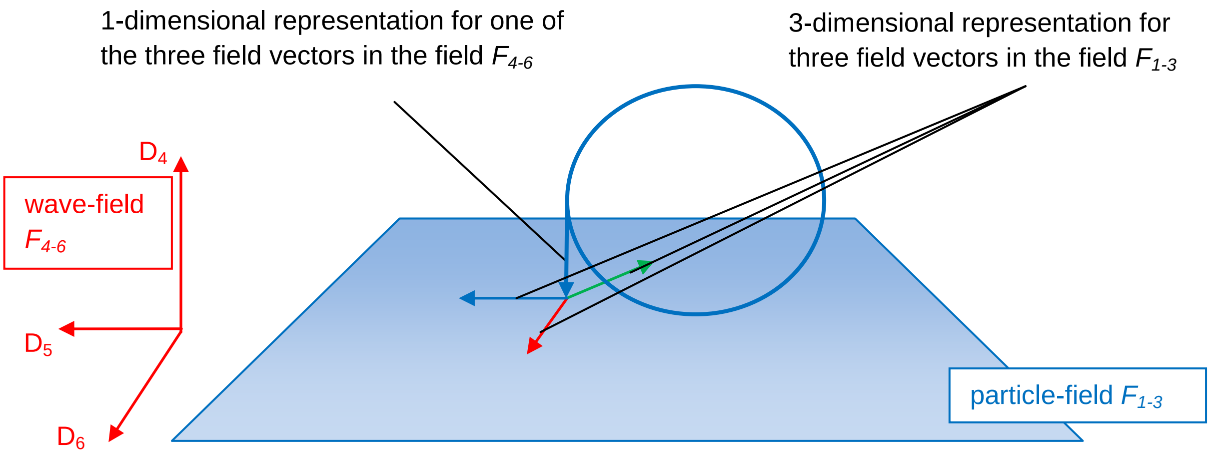

Figure 2.10: 4-dimensional representation of a subspace in the wave-field $F_{4\text{-}6}$

From the perspective of the particle-field $F_{1\text{-}3}$, this representation corresponds to the **wave nature** of a photon. Based in **Chapter 2.2, Wave Equations, Points 11 and 14**, this wave nature is described by the transverse wave.

For this field body, further 1-dimensional field vectors are conceivable for the fifth and sixth spatial directions in the field $F_{4\text{-}6}$. **Table 2.1** is intended to show the 6-dimensional field vector, which at the same time gives the object its 3-dimensional wave character. This vector describes initial information about how photons can rotate geometrically in space and how the field exchange with the particle-field $F_{1\text{-}3}$ works.

Dimensions / 4-dim. rotary tracks	1	2	3	4	5	6
1	X	X	X	X	/	/
2	X	X	X	/	X	/
3	X	X	X	/	/	X

Table 2.1: The three possible 6-dimensional field vectors for the 3-dimensional field body view in the particle-field $F_{1\text{-}3}$

"X" means that a 4-dimensional subspace U is spanned, while "/" means that no spatial direction is spanned for this dimension.

The six-digit field vector (1) can be labelled with the following indices as the **dimensional plane** between particle-field $F_{1\text{-}3}$ and wave-field $F_{4\text{-}6}$: $D_{14/24/34}$.

Consideration of the field effect of photons:

Although the field body shown already exists with its 1-dimensional field component, it can only be measured if this field is periodically emitted into the particle-field $F_{1\text{-}3}$. This works if a vector component of the field body touches the dimensional plane D_{56}, which runs parallel to the particle-field $F_{1\text{-}3}$, in order to exchange its field from the wave-field $F_{4\text{-}6}$. Another part of the field vector must run in the dimensional plane D_{45}, which generates a potential in the photon field asymmetrically parallel to the electric potential. Its maximum amplitude is transmitted as a static charge at the point of contact in the dimensional plane D_{56} into the particle-field.

This conflict is resolved by giving a field emission a rotating character, as shown in **Figure 2.10** - blue circle. A periodically recurring rotation in the D_{45} dimensional plane creates a potential in the photon field, while the dimensional plane D_{56} periodically enables the field exchange between wave-field $F_{4\text{-}6}$ and particle-field $F_{1\text{-}3}$. The corresponding field vectors in the wave-field $F_{4\text{-}6}$ must be expanded from a 1-dimensional to a 2-dimensional field component for a possible field exchange, while one spatial direction from the particle-field in the field $F_{1\text{-}3}$ is reduced for this purpose. The result is a 6-dimensional field vector that runs 2-dimensionally in the dimensional plane D_{45} in the wave-field $F_{4\text{-}6}$ and has a 2-dimensional wave character for each spatial direction in the particle-field $F_{1\text{-}3}$. Finally, there is a periodically field exchange for its wave maximum from the wave-field into the particle-field. This field exchange is referred to as the **matter pulse** in the course of this paper.

From the perspective of the particle-field $F_{1\text{-}3}$, this representation corresponds to the **momentum nature** of a photon. Based on the **mathematical principles** outlined in

points 12 and **14**, this momentum nature is described as a so-called longitudinal wave.

Table 2.2 shows the changes in the 4-dimensional subspace for each spatial direction.

Dimensions / 4-dim. rotary tracks	1	2	3	4	5	6
4	X	X	/	X	X	/
5	X	/	X	X	X	/
6	/	X	X	X	X	/

Table 2.2: The three possible 6-dimensional field vectors for a periodic 2-dimensional field exchange in the particle-field $F_{1\text{-}3}$

The six-digit vectors (4), (5), (6) rotate 2-dimensionally parallel to the **dimensional plane D_{45}**.

The geometric propagation of a field's momentum character behaves like an invisible longitudinal wave in the particle-field, while its field body corresponds to a visible transverse wave. The field forces mediated via the dimensional plane D_{56} are therefore perceived as a rigid body in the particle-field. The **wave-particle duality** of photons and particles in the particle-field $F_{1\text{-}3}$ can be attributed to their self-interaction with their own two-dimensional scalar, longitudinal field in the dimensional plane D_{56}, derived from the wave-field $F_{4\text{-}6}$. The duality is solved using the 7-dimensional field equations from **Point 9** and the wave equations from **Point 11** in **Chapter 2.2**.

Note: Wave-particle duality for visible photons

The visible photons, which are measured via a screen, have the field body representation of vectors two and three from **Table 2.1**, because these are already rotating parallel to the dimensional plane D_{56} according to **Figure 2.9** on the right. They can only be contracted by an additional field deformation in the form of a reduction of the field propagation velocity V_5. The rotation parallel to the dimensional plane D_{56} generates a constant gravitational force for its periodic inertial motion, which only interacts with its surroundings as a space-time quantum. A charge and thus an electric field to be mediated is ruled out, as there is no rotational component in the dimensional plane D_{45}.

In the double-slit experiment, the momentum behavior of a transmitted photon for the particle-field is determined by recording a point. The distribution of several of these points visualizes the sinusoidal periodic inertial motion of the transmitted photons from the wave-field.

Force equation of the photon:

The following applies to the maximum field force effect of a 4-dimensional subspace of the photon field in a sinusoidal-periodic contracted equation:

$$F(t) = m_{obj}\, a_5(t) = m_{obj}\, r''(t)$$

with: $r(t) = r \sin(kt)$; $k = \sqrt{\frac{G\,m}{r^3}}$; $r\,k = c$

$$F(t) = m_{obj}\, r_{obj}\, k_{obj}^2 \sin(kt) = m_{obj}\, c\, k_{obj} \sin(kt) \tag{2.178}$$

$F(t)$	- relativistic force
m_{obj}	- Object mass
r_{obj}	- Field radius of the object
k_{obj}	- Circular frequency of the object
c	- Maximum speed $V_{max} = c$

If the term $\frac{1}{\sin(kt)}$ is used according to formula (2.164), it describes the dynamic relativistic effect between the photon field and space-time. If the term $\sin(kt)$ is considered according to formula (2.172), the case for the deviation from the optimal orthogonal shape to the dimensional plane D_{56} is captured. The greatest effect of a force $F(t)$ is achieved when it occurs in the dimensional plane D_{56}. In **Chapter 2.2**, a deviation angle β was also introduced, which allows for a shift relative to the dimensional plane D_{56} and thus describes a transition between strong and weak interactions. The maximum effect of a force $F(t)$ is achieved when the field exchange occurs parallel to the dimensional plane D_{56}.

Note for cases where the wavelength is greater than the field radius:

To calculate the forces of objects that have a larger wavelength than their field radius, e.g. the Earth's gravitational field, the formula must be adapted. If an observer in the vicinity perceives the surface of a solid which increases the distance to its actual field radius r, the local deformation of space-time and consequently the acting surface gravity is reduced due to the increased distance. In such cases, the field radius r from formula (2.178) is replaced by the volume radius R of the object:

$$R = \frac{\lambda}{2\pi}$$

The angular frequency k is scaled accordingly to these ratios, as its torque has a larger volume radius in such cases. The maximum velocity $V_{max} = c$ must also be adapted to the cosmic circular velocity of the object. In this way, the surface gravity of any object whose wavelength is greater than its field radius' can be determined.

Energy equation for the photon:

Energy is defined as the sum of all forces that have occurred over the distance Δs:

$$E(\Delta s) = \int_0^{\Delta s} F(t,s)\mathrm{d}s$$

➔ $F(t, s)$ specifies the force $F(t)$ depending on its position in space

At the location of the minimum Lorentz transformation of the universe, a photon propagates at the maximum speed $V_5 = c$. If a certain path $\Delta s = c\,\Delta t$ or $\mathrm{d}s = c\,\mathrm{d}t$ corresponds to the path $\Delta s = c\,T$ travelled by a photon with a period length T, the following applies: $c = k\,r$.

The maximum energy transfer takes place during the phase of maximum elongation in 2 dimensions in the subspaces in the wave-field $F_{4\text{-}6}$ on the dimensional plane D_{56}. With regard to the 3-dimensional rotation in the particle-field $F_{1\text{-}3}$, the photons oscillate with a sine wave. A further factor $\sin(kt)$ from the original orientation axis must be applied for this.

$$E(\Delta s) = \int_0^{\Delta s} F(t,s)\sin(kt)\,\mathrm{d}s = \int_0^{T} c\,F(t)\sin(kt)\,\mathrm{d}t = \int_0^{T} m_{obj}\,r_{obj}^2\,k_{obj}^3\ \sin^2(kt)\,\mathrm{d}t$$

$$E(\Delta s) = \frac{1}{2k}\,m_{obj}\,r_{obj}^2\,k_{obj}^3\,\{[k_{obj}\,T - \cos(kT)\,\sin(kT)]\}$$

$$E(\Delta s) = \frac{1}{2}\,m_{obj}\,r_{obj}^2\,k_{obj}^2\,\{[k_{obj}\,T - \cos(kT)\,\sin(kT)]\} \tag{2.179}$$

$k_{obj}\,T$	- component of the angular momentum
$\cos(kT)\,\sin(kT)$	- component of the electromagnetic oscillation

The mean value of all half wave movements of an electromagnetic oscillation provides with: $\frac{1}{2}\,[k_{obj}\,T - \cos(kT)\,\sin(kT)] = 1$

$$E = m_{Obj}\,r_{obj}^2\,k_{obj}^2 \qquad \text{with: } c^2 = r^2 k^2 \qquad [E] = \mathrm{J} \tag{2.180}$$

$$E = m_{obj}\,c^2 \tag{2.181}$$

$$E = m_{obj}\,G\,\{m_{obj}\,k_{obj}\}\,\frac{1}{c} \tag{2.182}$$

$$E = r_{obj}\,m_{obj}\,k_{obj}\,c \tag{2.183}$$

$$E = \frac{\lambda_{obj}}{\lambda_{obj}} r_{obj}\, m_{obj}\, k_{obj}\, c = h\, f_{obj} \tag{2.184}$$

Formula for Planck's quantum of action *h*:

$$h = \lambda_{obj}\, r_{obj}\, m_{obj}\, k_{obj} = \lambda_{obj}\, m_{obj}\, c \qquad [h] = Js \tag{2.185}$$

E	- Energy	m_{obj}	- Object mass
h	- Planck's quantum of action	r_{obj}	- Field radius of the object
G	- Gravitational constant	k_{obj}	- Circular frequency of the object
f_{obj}	- Object frequency	c	- Maximum speed
λ_{obj}	- Wavelength of the object		

The index "*Uni*" for universe can be exchanged with the parameters of the index "*Obj*" for object as long as the universal relationships between the mass *M*, the field radius *r* and the angular frequency *k* are maintained.

$$M_{Uni} \rightarrow m_{obj}\ ;\ r_{Uni} = \frac{G\, M_{Uni}}{c^2} \rightarrow r_{Obj} = \frac{G\, m_{obj}}{c^2}\ ;$$

$$k_{Uni} = \sqrt{\frac{G\, M_{Uni}}{r_{Uni}^{3}}} \rightarrow k_{Obj} = \sqrt{\frac{G\, m_{obj}}{r_{obj}^{3}}}$$

$$m_{obj}\, k_{obj} = M_{Uni}\, k_{Uni} = \text{constant} = 4{,}0396\ 10^{35}\ \frac{kg}{s} \tag{2.186}$$

$$r_{obj}\, k_{obj} = r_{Uni}\, k_{Uni} = \text{constant} = 299792458\ \frac{m}{s} \tag{2.187}$$

$$\frac{M_{Uni}}{r_{Uni}} = \frac{m_{obj}}{r_{obj}} = \text{constant} = 1{,}34746\ 10^{27}\ \frac{kg}{m} \tag{2.188}$$

$$\lambda_{obj}\, r_{obj}\, m_{obj}\, k_{obj} = \lambda_{Uni}\, r_{Uni}\, m_{Uni}\, k_{Uni} = \text{constant} = 6{,}626\ 10^{-34}\ Js \tag{2.189}$$

$$c^2 = \frac{G\, M_{Uni}}{r_{Uni}} = \frac{G\, m_{obj}}{r_{obj}} \tag{2.190}$$

$$c = \sqrt[3]{G\, M_{Uni}\, k_{Uni}} = r_{Uni}\, k_{Uni} \rightarrow c = \sqrt[3]{G\, m_{obj}\, k_{obj}} = r_{obj}\, k_{obj} \tag{2.191}$$

Here is a specific example:

$$m_{obj} = \frac{h\, c^2}{G\, \{m_{obj}\, k_{obj}\}\, \lambda_{obj}} = \frac{h}{c\, \lambda_{obj}} = \frac{h\, f_{obj}}{c^2} \tag{2.192}$$

h = 6,626 10^{-34} Js; c = 299792458 $\frac{m}{s}$; $m_{obj}\,k_{obj} = \sqrt{\frac{(c^2)^3}{(G)^2}}$ = 4,0396 10^{35} $\frac{kg}{s}$;

G = 6,67 10^{-11} $N\frac{m^2}{kg^2}$;

$E_{pho} = h\,f_{pho}$ = 3,6 10^{-19} J → f = 5,431 10^{14} Hz; λ = 552 nm

$$m_{pho} = \frac{6{,}626\ 10^{-34}\ \mathrm{Js} \cdot \left(\sqrt[3]{6{,}67\ 10^{-11}\mathrm{N}\frac{\mathrm{m}^2}{\mathrm{kg}^2} \cdot 4{,}0396\ 10^{35}\frac{\mathrm{kg}}{\mathrm{s}}}\right)^2}{6{,}67\ 10^{-11}\ \mathrm{N}\frac{\mathrm{m}^2}{\mathrm{kg}^2} \cdot 4{,}0396\ 10^{35}\frac{\mathrm{kg}}{\mathrm{s}} \cdot 552\ \mathrm{nm}}$$

m_{pho} = 4,004 10^{-36} kg

Counter sample: $m_{pho} = \frac{3{,}6\ 10^{-19}\ \mathrm{J}}{c^2}$ = 4,004 10^{-36} kg

Findings:

- → The ratio of the mass M to the size of the angular frequency k is confirmed.
- → The oscillation of the photon behaves like the oscillation of the universe.
- → Confirmation: the mass is proportional to its frequency: $M \sim f$

Angular momentum $L_{rotation}$ of photons in the wave-field and particle-field:

The mechanism of an oscillating invisible photon, which rotates orthogonally to the dimensional plane D_{56}, is analysed below. In this case, the relativistic state is represented by the Lorentz factor 1. The radius R is derived from the wavelength λ of the photon in the wave-field dimensions. Not to be confused with the field radius r, this describes the event horizon of an electromagnetic wave. According to equation (2.91), the relationship between mass, frequency, and rotational modulation is as follows

$$m_{pho} = \frac{n\,h}{2\pi\,c\,R_{pho}}\cos(kt+\beta) \rightarrow m_{pho}(t) = \frac{h\,f_{pho}\cos(kt+\beta)}{c^2}$$

It can be seen that only the amplitude of the mass is transferred to the particle-field $F_{1\text{-}3}$ during the oscillation. The mass transfer consists of the compact components of the FSM's momentum-energy tensor.

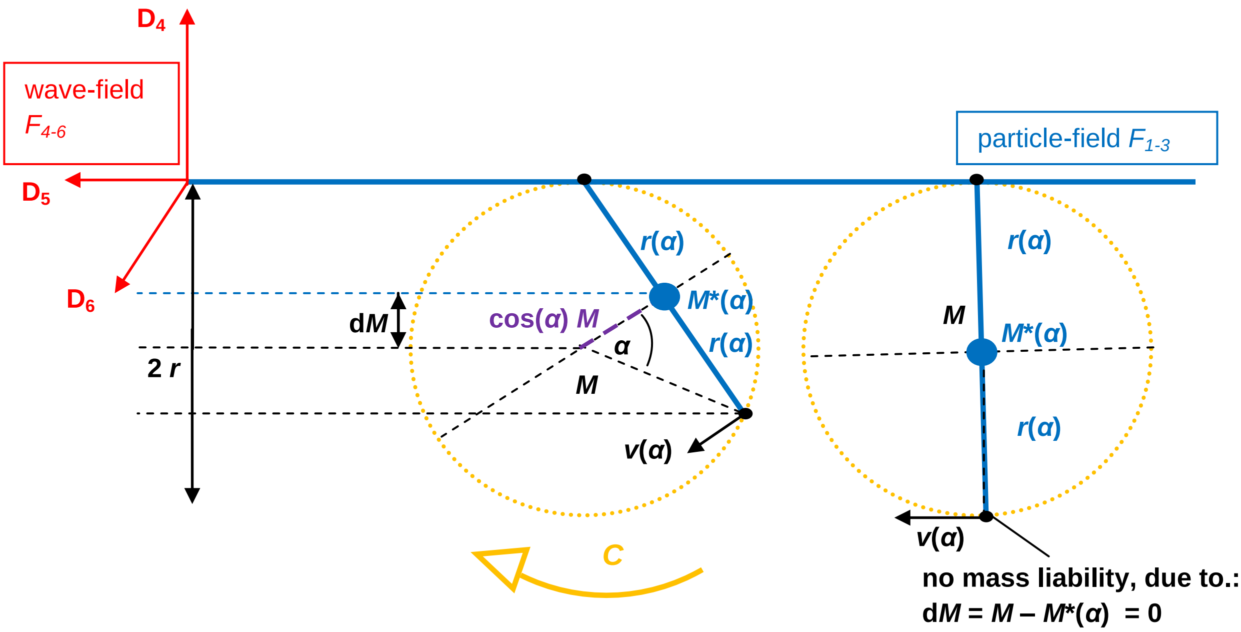

Figure 2.11: Dependencies of the radius *r*(*α*) and velocity *v*(*α*) of the subspace U on the inertial mass *M(*α*) over a period *T***

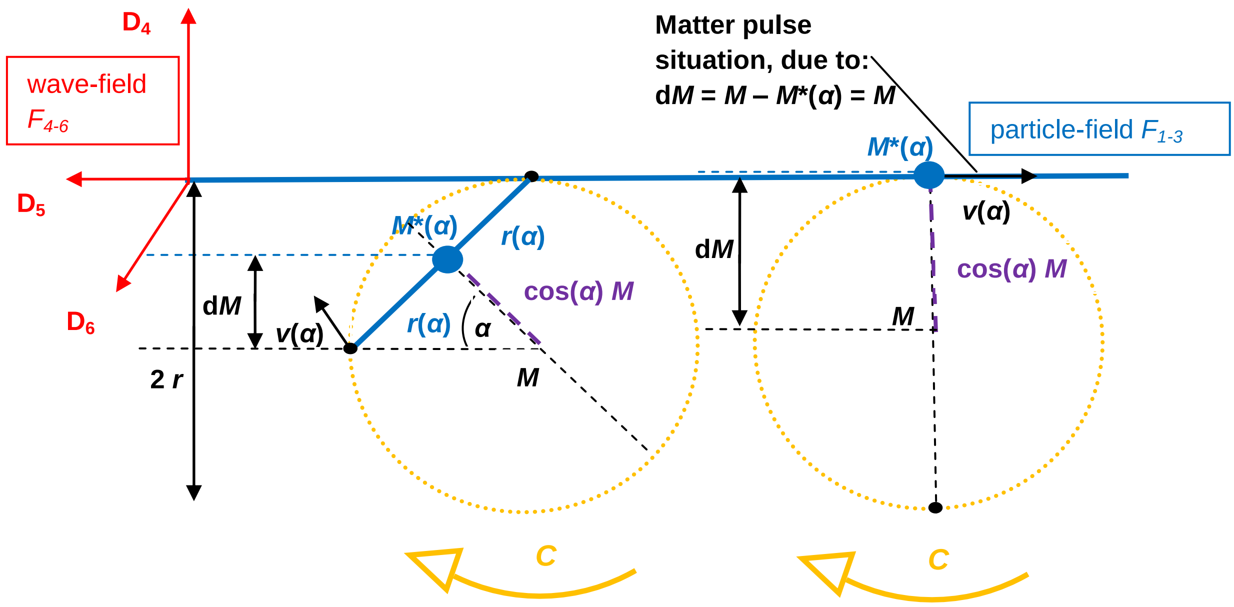

Figure 2.12: Course of a rotation

$v(\alpha) = c \sin(\alpha)$ $r(\alpha) = R \sin(\alpha)$ $\alpha = kt$ $k = \text{constant}$ $\lambda = 2\pi R$

$dM = M - M^*(\alpha)$ $M^*(\alpha) = \sin(\alpha)\, M$

The classical approach to angular momentum continues to apply under all relativistic conditions because there is no force in the universe that could change it from outside.

Classical approach: $L = m\, v\, r$ (2.193)

The subspace U has a radius $r(\alpha)$, that rotates at a speed $v(\alpha)$ around an axis through the centre with the inertial mass $M^*(\alpha)$. The length relative to the inertial mass $M^*(\alpha)$ must be multiplied by 2 to represent the length for $2r(\alpha)$. The angle α can only assumes a maximum of 90° during rotation. For a complete period, the integral of the outward and return paths must be taken into account. A factor of 2 must be considered for this. The inertial mass $M^*(\alpha)$ is at its maximum at 0° relative to the object's mass M. $M^*(\alpha)$ can be described trigonometrically as $M \sin(\alpha)$ and can be regarded as a periodic deviation from the original object mass. The subspace U rotates relative to the particle-field with its sinusoidal periodicity orthogonal to the dimensional plane D_{56}. The maximum momentum transfer is achieved during the phase of maximum elongation of the subspaces. For this purpose, the angular momentum relative to the particle-field, as defined by the metric, must be added to an additional factor cos(α) from the original orientation axis.

The approach for angular momentum with α-dependence is ultimately:

$$dL(\alpha) = 2 \cdot 2\, M^*(\alpha)\, v(\alpha)\, r(\alpha) \cos(\alpha)\, d\alpha \qquad (2.194)$$

$$dL(\alpha) = 4 \int_0^{\alpha} m_{obj}\, R\, c \cos(\alpha) \sin^3(\alpha)\, d\alpha$$

$$dL(\alpha) = 4\, m_{obj}\, R\, c \int_0^{\frac{\pi}{2};\, 90°} \cos(\alpha) \sin^3(\alpha)\, d\alpha \qquad \text{with: } 0 \le \alpha \le 90°$$

$$L(\alpha) = 4\, m_{obj}\, R\, c \left[\frac{\sin(\alpha)^4}{4}\right]_0^{\frac{\pi}{2};\, 90°}$$

$$L(\alpha) = 4\, m_{obj}\, R\, c \left[\frac{\sin(90°)^4}{4} - \frac{\sin(0°)^4}{4}\right]$$

$$L_{ø\_\,particle\text{-}field} = m_{obj} \frac{\lambda}{2\pi} c \qquad \text{with: } R = \frac{\lambda}{2\pi}$$

$$L_{ø\_\,particle\text{-}field} = m_{obj}\, \lambda_{obj}\, c \frac{1}{2\pi} = m_{obj}\, \lambda_{obj}\, k_{obj}\, r_{obj} \frac{1}{2\pi} = \frac{h}{2\pi} \qquad \text{Comparison: (2.185) (2.195)}$$

$L_{ø\_\,particle\text{-}field}$ - average angular momentum in the particle-field

h	- Planck's quantum of action	r_{obj}	- Field radius of the object
λ_{obj}	- Wavelength of the object	k_{obj}	- Circular frequency of the object
m_{obj}	- Object mass	c	- Maximum velocity

→ **Planck's quantum of action *h*** for the particle-field

Cross-check the above derivation:

with: λ_{photon} = 552 nm; c = 299792458 $\frac{\text{m}}{\text{s}}$; m_{photon} = 4,004 10^{-36} kg; E_{photon} = 3,6 10^{-19} J

$r_{pho} = \frac{G\, m_{pho}}{c^2}$ = 2,9715 10^{-63} m; $k_{pho} = \sqrt{\frac{G\, m_{pho}}{r_{pho}{}^3}}$ = 1,0089 10^{71} $\frac{1}{\text{s}}$

$\underline{\underline{h =}}$ 4,004 10^{-36} kg · 552 nm · 299792458 $\frac{\text{m}}{\text{s}}$ = $\underline{\underline{6{,}626\ 10^{-34}\ \text{Js}}}$

or: $\underline{\underline{h =}}$ 4,004 10^{-36} kg · 552 nm · 1,0089 10^{71} $\frac{1}{\text{s}}$ · 2,9715 10^{-63} m ≈ $\underline{\underline{6{,}626\ 10^{-34}\ \text{Js}}}$

Comparison of Planck's quantum of action from the literature: h = 6,626 10^{-34} Js

Planck's constant *h* describes the proportional effect of a photon on its surroundings with a fixed linear increase in energy as a function of frequency. The FSM derives Planck's constant h for the particle-field via the product of the mass M, the wavelength λ and the maximum field propagation velocity c; or alternatively via the product of the mass M, the angular frequency k, the wavelength λ and the field radius r. Planck's constant h can be regarded as an invariant reference quantity with h = 6,626 10^{-34} Js because there is no external force for the universe and its photon field that could change its angular momentum.

Note: for angular momentum with $L = \frac{h}{2\pi}$

The mathematically represented angular momentum of a photon corresponds to a sinusoidal periodic sequence as contraction and expansion of its 6-dimensional hollow body.

The location of the **matter pulse** shown on the **right in Figure 2.12** is given by

$$dM = M - M^*(\alpha) = M \tag{2.196}$$

at the point of contact in the dimensional plane D_{56}. The mass is transmitted sinusoidally into the particle-field.

Macroscopic vs. microscopic angular momentum:

$L_{ø\_\ particle\text{-}field} = L_{ø\_\ macrocosmic} + L_{ø\_\ microcosmic}$, a fluid transition of dominance

$$L_{ø\_\ particle\text{-}field\ \_photon} = \sqrt{G\, M^3\, r} + \frac{h}{2\pi} \tag{2.197}$$

$$L_{ø\_\ particle\text{-}field\ \_n\_fions} = \sqrt{G\, M^3\, r} + \sqrt{\sum_0^n \left(\frac{h}{4\pi}\right)_n^2} \tag{2.198}$$

Relativistic energy increase – space-time effect on accelerated objects:

According to formula (1:11), the relativistic trigonometric relationship applies to an object without vectorial proper motion in particle-field $F_{1\text{-}3}$:

$$c^2 = (c\sin(kt))^2 + (c\cos(kt))^2 = V_4^2 + V_5^2$$

$$\sin(kt) = \sqrt{1 - \cos(kt)^2} \qquad (2.199)$$

In the case of a vectorial proper motion V_3 in the particle-field $F_{1\text{-}3}$, an object such as an invisible photon in **Figure 2.13 on the right** experiences an increased field propagation velocity V_4 in the wave-field $F_{4\text{-}6}$, while the field propagation velocity V_5 decreases relativistically.

The motion sequence of the circular rotation shifts into the dimensional plane D_{45}, resulting in an elliptical trajectory. The total rotational path for one period does not increase. The increasing vectorial component of the rotational path parallel to the fourth dimension reduces the field propagation speed from $V_5 = c$ to $V_5 < c$ and triggers a relativistic time dilation t_{Obj} relative to the nominal time t. This results in a longer period duration, until a complete oscillation period with a maximum orbital velocity of c has been completed. Compared to a less deformed space-time, the perception of time dilation t_{Obj} is possible. The resulting time dilation requires additional energy, which this work performs.

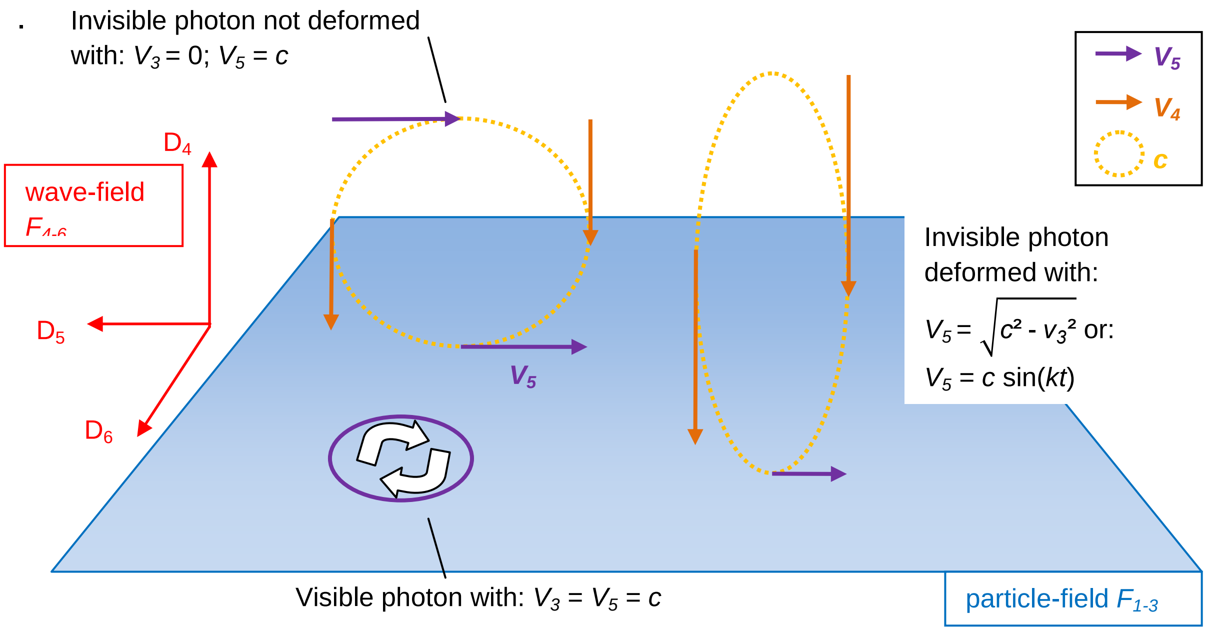

Figure 2.13: Top left: the invisible photon at rest $V_3 = 0$, $V_5 = c$; bottom: the visible photon $V_3 = V_5 = c$; right: the invisible photon in motion $V_3 \rightarrow c$; $V_5 \rightarrow 0$

Space-time has the freedom to deform depending on the elliptical rotation path so that a balance is restored against the space-time mechanical effects (**Figure 2.14**).

For a space-time deformation, the gravitational force is thus represented as a balancing force that requires additional work.

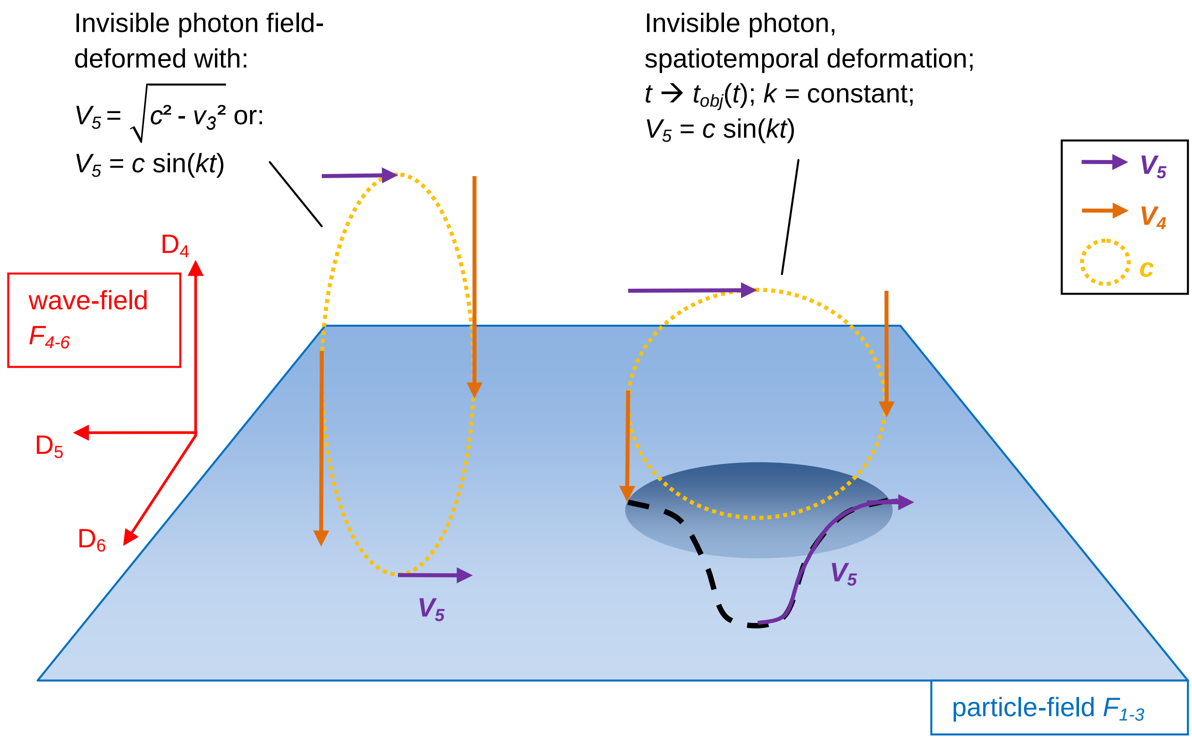

Figure 2.14: Two possible ways of visualising a space-time deformation with its field deformation

<u>Derivation variant 1 – (*r*):</u>

Nominal energy:

$E_0 = m\, c^2$ with: $c^2 = \frac{G\,M}{r}$

$E_0 = \frac{G\,m^2}{r}$

Relativistic energy:

$E(t) = \frac{G\,m^2}{r(t)}$ with: $r(t) = r \sin(kt)$

$E(t) = \frac{G\,m^2}{r \sin(kt)}$ with: $r = \frac{G\,M}{c^2}$

General: $E(t) = m\, c^2 \frac{1}{\sin(kt)}$; Special: $E(t) = m\, c^2 \frac{c}{V_5}\, mc^2 \frac{1}{\sin(\alpha)}$; See also (2.101)

Derivation variant 2 – (t):

For an individual object movement, the force equation is used, which describes the dynamic relativistic field effect between the subspace U and the photon field of the universe:

$$F_{gravity}(t) = m_{Obj}\, r_{obj}\, k_{obj}^2 \frac{1}{\sin(kt)}$$

$$E(\Delta s) = \int_0^{\Delta s} F(t,s) \sin(kt)\, \mathrm{d}s$$

$$E(\Delta t) = \int_0^{Tobj} c\, F(t) \sin(kt)\, \mathrm{d}t = \int_0^{Tobj} m_{obj}\, c\, r_{obj}\, k_{obj}^2\, \mathrm{d}t$$

with: $r\, k = c$; $t_{obj} = \frac{c}{V_5}\, t = \frac{t}{\sin(kt)}$

$$E(\Delta t) = m\, c^2\, k_{obj} \frac{T}{\sin(kt)}$$

For a complete period T, an oscillation with the circular frequency k_{obj} is completed.

$$E(t) = m\, c^2 \frac{1}{\sin(kt)}$$

Derivation variant 3 – (λ), sees the derivation according to equation (2.92):

$$E_0 = m\, c^2 = \frac{h}{2\pi\, c\, R} \qquad \text{with: } 2\pi\, R = \lambda$$

Pure relativistic without periodic perturbation with cos(kt = 0° + β = 0°):

A relativistic contraction of its wavelength in the direction of motion produces a blue shift at the source given by: $\lambda \sin(\alpha)$

$$m(t) = \frac{h}{c\, \lambda} \frac{1}{\sin(\alpha)} = \frac{h}{c\, \lambda} \frac{c}{V_5} \qquad (2.92)$$

Substitute and generalize using (kt) = α provides:

$$E(t) = E(t) = m\, c^2 \frac{1}{\sin(kt)}$$

One consequence of this result is that the matter pulse (**Figure 2.12, right**) is also slowed down relative to the nominal time t and is thus measured at greater time intervals.

For the relativistic consideration of the imulse with a normalized object mass m_{obj}, the same extent of the space-time effect applies:

General: $P(t) = m_{obj} \frac{V_4}{\sin(kt)}$ Special: $P(t) = m_{obj}\, V_4 \frac{c}{V_5} = m_{obj} \frac{V_4}{\sin(\alpha)}$ (2.104)

Note: In contrast to an invisible photon, a visible photon does not have a field propagation velocity V_4 and is therefore not capable of additionally deforming a space segment beyond the Lorentz transformation by a factor of 1 alone.

From the perspective of the inertial system, a so-called gravitational redshift occurs as soon as an electromagnetic wave moves out of a field-deformed space.

$$\lambda_{obj}(t) = \frac{\lambda_{obj}}{\sin(kt)} \quad \text{(gravitational redshift)} \quad \text{with } \alpha = kt \text{ (general)} \qquad (2.200)$$

$$\lambda_{obj}(t) = \lambda_{obj} \sin(kt) \quad \text{(gravitational blue shift)}$$

$$P = m_{obj} \frac{V_4}{\sin(kt)} = m_{obj}\, V_4 \frac{c}{V_5}$$

$$E_{obj}(t) = h\, f_{obj} \frac{1}{\sin(kt)} = m_{obj}\, c^2 \frac{1}{\sin(kt)} \qquad (2.201)$$

$$E_{obj}(t) = m_{obj}\, c^2 \frac{1}{\sin(\alpha = 90°)} \qquad \text{for } V_5 = c;\ V_4 = 0$$

$$E_{obj}(t) = m_{obj}\, c^2 \frac{1}{\sin(0 < \alpha < 90°)} \qquad \text{for } V_5 \rightarrow 0;\ V_4 \rightarrow c$$

A rest mass consists, in total, of several superimposed harmonics in the form of relativistic fields that are in resonance with one another at the point of field exchange. An additional kinetic energy exerts a mechanical effect by causing a longer vectorial path for its relativistic fields in the fourth dimension. Restoring forces following a periodically recurring interaction can also extend the vectorial path parallel to the fourth dimension. Within its existing oscillation (kt) at rest, this leads to additional time dilation and a contraction of its field parallel to the fifth dimension < 1 (see **Figure 2.13, right**). Although the mass appears heavier, only the relativistic fields are deformed along their phase. The additional contraction work performed is ultimately determined by Lorentz invariance for the **Relativistic Energy Gain** precisely via the measurable field deformation with a dynamically contracted field propagation velocity V_5. This expands the classical understanding of **Energy-Mass Equivalence**.

In the field-space model, energy-mass equivalence holds only if the global Lorentz factor is 1. In the case of a relativistic energy gain due to global curvature, an additional gravitational and electric potential is introduced, which extends this equivalence through its global influence. Taking into account a **Relativistic, Global**

Energy Gain, the classical energy-mass equivalence is extended to the so-called **Energy-Space-Time Equivalence**.

Results for the photon model and response to the hypothesis:

The **FSM-GTR** for the 6-dimensional field-space describes the space-time-mechanical effects for both cosmology and the microcosm. Scaling becomes possible only when photons propagate parallel to the dimensional plane D_{56}. It follows that field propagation is slowed down by field deformation. The speed of light for photons is thus determined by the field propagation speed V_5. This confirms the thesis from **Chapter 1** that the speed of light does not have a fixed maximum value, but must be considered relative to the maximum speed $V_{max} = c$. Furthermore, it becomes apparent that relativistic oscillations can be excellently described mathematically using trigonometry. For example, an oscillation ensures a periodically dynamic barrier as a restoring force to stabilize a system from collapse in extreme cases. Furthermore, it is possible for the photon field to define a relativistic, cosmic location for the inertial system. Thus, for any specified physics, a purely geometric relationship between energy and space-time applies. In this model, this relationship is also called **energy-space-time equivalence**.

The geometry of the wave-field allows relativistic effects to be transferred to the microcosm. The present photon model is a purely relativistic representation of space-time, whose geometry describes the state of matter. The FSM derives matter as an emergent product of relativistic fields from the natural space-time geometry. Depending on their geometric position in the wave-field, this model distinguishes between visible and invisible photons or matter. It also provides an explanation for wave-particle duality. The photon model offers an alternative derivation of the equations of force, energy, and momentum compared to the classical model.

Chapter 3 uses the electron and particle model to confirm the geometric conditions of the 6-dimensional field-space by providing a general formula for the mass and frequency of all particles. The theoretical results are then compared with experimental measurements. Finally, the predictions verify the FSM model.