2.3 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.

Photons are always 4-dimensional subspaces :

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 in the 6-dimensional field-space means that its quantised angular momentum is equal to that of the universe; its effect takes place within the gravitational potential of the universe; and the pointer direction of its field exchange is dependent on the periodic formation 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.

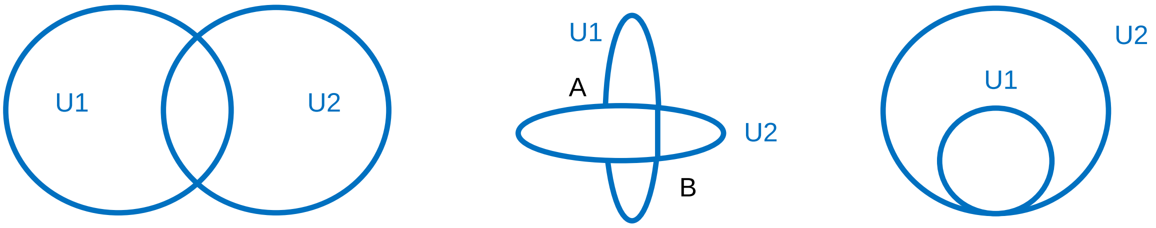

Figure 2.8: Possible arrangements of subspaces in the wave-field $F_{4\text{-}6}$

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:

$$c^2 = V_4^2 + V_5^2 \tag{2.27}$$

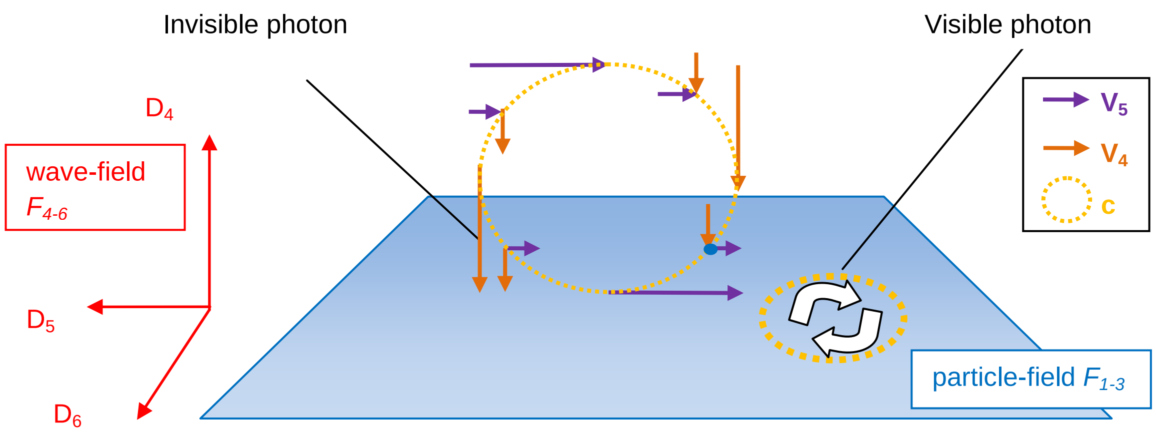

Figure 2.9: Left: orthogonal to the dimensional plane D_{56} an invisible photon with its rotation mechanism; right: parallel to the dimensional plane D_{56} a rotating visible photon

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**.

The following quantum principles are postulated for photons:

10) 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.

11) 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 $\overrightarrow{e_6}\,\mathrm{d}D_4\mathrm{d}D_5 = \overrightarrow{\mathrm{d}A} = D_{45}$ and always results in the maximum velocity $V_{max} = c$ in a vacuum with $299792458\,\frac{\text{m}}{\text{s}}$. The relationship applies:

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

12) 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.

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

14) 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.

15) 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:

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 $F_{1\text{-}3}$.

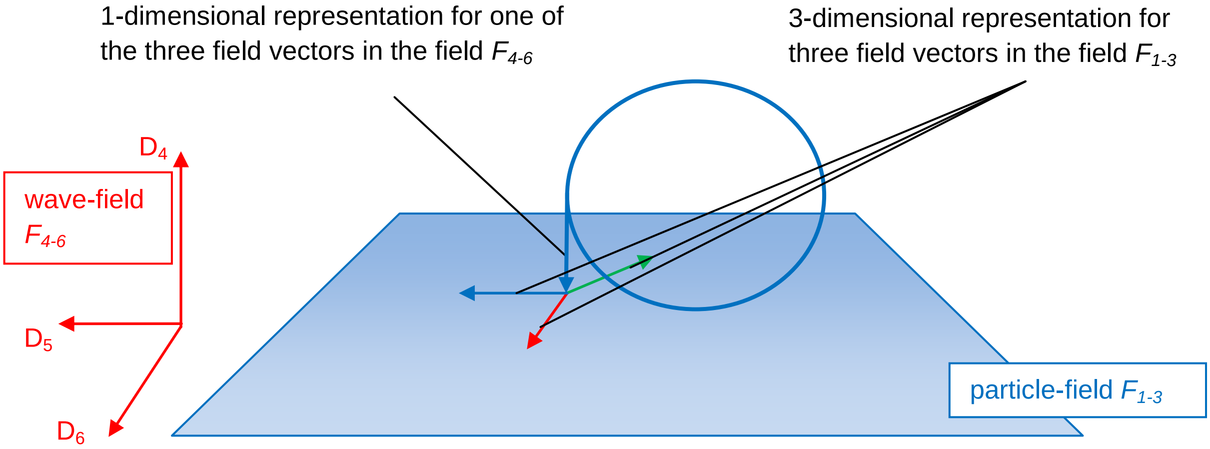

Figure 2.10: 4-dimensional representation of a subspace in the wave-field $F_{4\text{-}6}$

From the point of view of the particle-field $F_{1\text{-}3}$, this representation corresponds to the **wave character** of a photon.

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 $F_{4\text{-}6}$: $\boldsymbol{D_{14/24/34}}$.

Consideration of the field character of photons:

Although the depicted field body already exists with its 1-dimensional field component, it can only be perceived measurably if it emits fields into the particle-field $F_{1\text{-}3}$. This is only possible if part of the field vector lies in 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 charge parallel to the electrical potential of the photon 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 dimensional plane D_{45} generates a charge 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 recurring impulse for its wave maximum from the wave-field into the particle-field. This impulse 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 character** of a photon.

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_{1-3}

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

<u>The geometric propagation of a field in the particle-field behaves like a longitudinal wave, while its field body corresponds to a transverse wave.</u> The field forces mediated via the dimensional plane D_{56} are therefore perceived as a rigid body in the particle-field. The photon with its 2-dimensional momentum is only registered in the particle-field as a point particle, which in fact it is not. The **wave-particle-duality** of photons and particles in the particle-field F_{1-3} can be attributed to its self-interaction with its own 2-dimensional field in the dimensional plane D_{56} from the wave-field F_{4-6}.

<u>Note:</u> 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:

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

$$\text{with: } r(t) = R \sin(kt)\ ;\ k = \sqrt{\frac{G\, m_{obj}}{R^3}}\ ;\ Rk = c$$

$$\boxed{F(t) = m_{obj}\, R_{obj}\, k_{obj}^2 \sin(kt) = m_{obj}\, c\, k_{obj} \sin(kt)} \qquad (2.28)$$

$F(t)$ - relativistic force

m_{obj} - Object mass

R_{obj} - Field radius of the object

k_{obj} - Circular frequency of the object

c - Maximum speed $V_{max} = c$

The term $\sin(kt)$ in the force equation corresponds to the same mechanism as the formula (2.20) for the universe. The greatest effect of a mediation of the force $F(t)$ is achieved when this takes place in 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 (2.28) is replaced by the volume radius 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: $c = kR$.

The maximum energy transfer takes place during the phase of maximum expansion 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.

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

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

$$E(\Delta s) = \frac{1}{2}\,m_{obj}\,R_{obj}^2\,k_{obj}^2\,\{[k_{obj}\,T - \cos(kT)\,\sin(kT)]\} \qquad (2.29)$$

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

Derivation variant 1:

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

$$\boxed{\begin{aligned} E &= m_{Obj}\,R_{obj}^2\,k_{obj}^2 \\ E &= m_{obj}\,c^2 \end{aligned}}$$

mit: $c^2 = R^2\,k^2$

(2.30)

Derivation variant 2:

In the event that $E(S)$ is given with distances $S \gg \Delta s = c\,T$, then the following applies for countless integrals over the distance Δs, which correspond to the wavelength λ of photons:

with: $S = n\,\Delta s \quad n \in \mathrm{N} \quad S \gg \Delta s$ applies: $-\cos(kT)\,\sin(kT) = 1$

$$E(S) = n\,E(\Delta s) = \frac{1}{2}\,n\,m_{obj}\,R_{obj}^{2}\,k_{obj}^{2}\,[k_{obj}\,T\,]$$

$$E(S) = n\,E(\Delta s) = \frac{1}{2}\,n\,m_{obj}\,R_{obj}^{2}\,\left(\sqrt{\frac{G\,m_{obj}}{R_{obj}^{3}}}\right)^{2}\,[k_{obj}\,T\,] \qquad \text{with: } k = \sqrt{\frac{G\,M}{R^{3}}}$$

$$E(S) = n\,E(\Delta s) = \frac{1}{2}\,n\,m_{obj}\,R_{obj}^{2}\,\frac{G\,m_{obj}}{R_{obj}^{3}}\,[k_{obj}\,T\,]$$

$$E(S) = n\,E(\Delta s) = \frac{1}{2}\,n\,m_{obj}\,\frac{G\,m_{obj}}{R_{obj}}\,[k_{obj}\,T\,]$$

$$E(S) = n\,E(\Delta s) = \frac{1}{2}\,n\,\frac{G\,m_{obj}}{R_{obj}}\,[k_{obj}\,m_{obj}]\,\frac{\lambda_{obj}}{c} \qquad \text{with: } T = \frac{\lambda}{c}$$

$$E(S) = n\,E(\Delta s) = \frac{1}{2}\,n\,\frac{\cancel{G\,m_{obj}}}{\cancel{G\,m_{obj}}}\,c^{2}\,[k_{obj}\,m_{obj}]\,\frac{\lambda_{obj}}{c} \qquad \text{with: } R = \frac{G\,M}{c^{2}}$$

$$E(S) = n\,E(\Delta s) = \frac{1}{2}\,n\,c\,[k_{obj}\,m_{obj}]\,\lambda_{obj}$$

$$E(S) = n\,E(\Delta s) = \pi\;n\,c\,[k_{obj}\,m_{obj}]\,R_{obj} \qquad \text{with: } R = \frac{\lambda}{2\pi}$$

The mean value of all half wave movements with respect to the particle-field $F_{1\text{-}3}$ with division π provides:

$$E(S) = n\,E(\Delta s) = c\,k_{obj}\,m_{obj}\,R_{obj} \qquad \text{for } n = \frac{S}{\Delta s} = 1$$

$$\boxed{\begin{aligned} &E = R_{obj}\,m_{obj}\,k_{obj}\,\mathrm{c} \\ &E = m_{obj}\,R_{obj}^{2}\,k_{obj}^{2} = m_{obj}\,c^{2} \\ &E = m_{obj}\,G\,\{m_{obj}\,k_{obj}\}\,\frac{1}{c} \end{aligned}}$$

with: $c = k\,R$

(2.31) — $E = m_{obj}\,R_{obj}^{2}\,k_{obj}^{2} = m_{obj}\,c^{2}$

(2.32) — $E = m_{obj}\,G\,\{m_{obj}\,k_{obj}\}\,\frac{1}{c}$

$$\boxed{E = \frac{\lambda_{obj}}{\lambda_{obj}} R_{obj}\, m_{obj}\, k_{obj}\, c = h\, f_{obj}} \qquad [E] = \mathrm{J} \tag{2.33}$$

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

$$\mathbf{h = \lambda_{obj}\, R_{obj}\, m_{obj}\, k_{obj} = \lambda_{obj}\, m_{obj}\, c} \qquad [h] = \mathrm{Js} \tag{2.34}$$

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.

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

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

$$m_{obj}\, k_{obj} = M_{Uni}\, k_{Uni} = \text{constant} = 4{,}0396\; 10^{35}\, \frac{\mathrm{kg}}{\mathrm{s}} \tag{2.35}$$

$$R_{obj}\, k_{obj} = R_{Uni}\, k_{Uni} = \text{constant} = 299792458\, \frac{\mathrm{m}}{\mathrm{s}} \tag{2.36}$$

$$\frac{M_{Uni}}{R_{Uni}} = \frac{m_{obj}}{R_{obj}} = \text{constant} = 1{,}34746\; 10^{27}\, \frac{\mathrm{kg}}{\mathrm{m}} \tag{2.37}$$

$$\lambda_{obj}\, R_{obj}\, m_{obj}\, k_{obj} = \lambda_{Uni}\, R_{Uni}\, m_{Uni}\, k_{Uni} = \text{constant} = 6{,}626\; 10^{-34}\; \mathrm{Js} \tag{2.38}$$

$$c^2 = \frac{G\, M_{Uni}}{R_{Uni}} = \frac{G\, m_{obj}}{R_{obj}} \tag{2.39}$$

$$c = \sqrt[3]{G\, M_{Uni}\, k_{Uni}} = R_{Uni}\, k_{Uni} \rightarrow c = \sqrt[3]{G\, m_{obj}\, k_{obj}} = R_{obj}\, k_{obj} \tag{2.40}$$

Here is a specific example:

$$\boxed{m_{obj} = \frac{h\,c^2}{G\,\{m_{obj}\,k_{obj}\}\,\lambda_{obj}} = \frac{h}{c\,\lambda_{obj}} = \frac{h\,f_{obj}}{c^2}} \qquad (2.41)$$

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

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

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

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

$\underline{\underline{m_{pho} = 4{,}004\ 10^{-36}\ \text{kg}}}$

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

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.

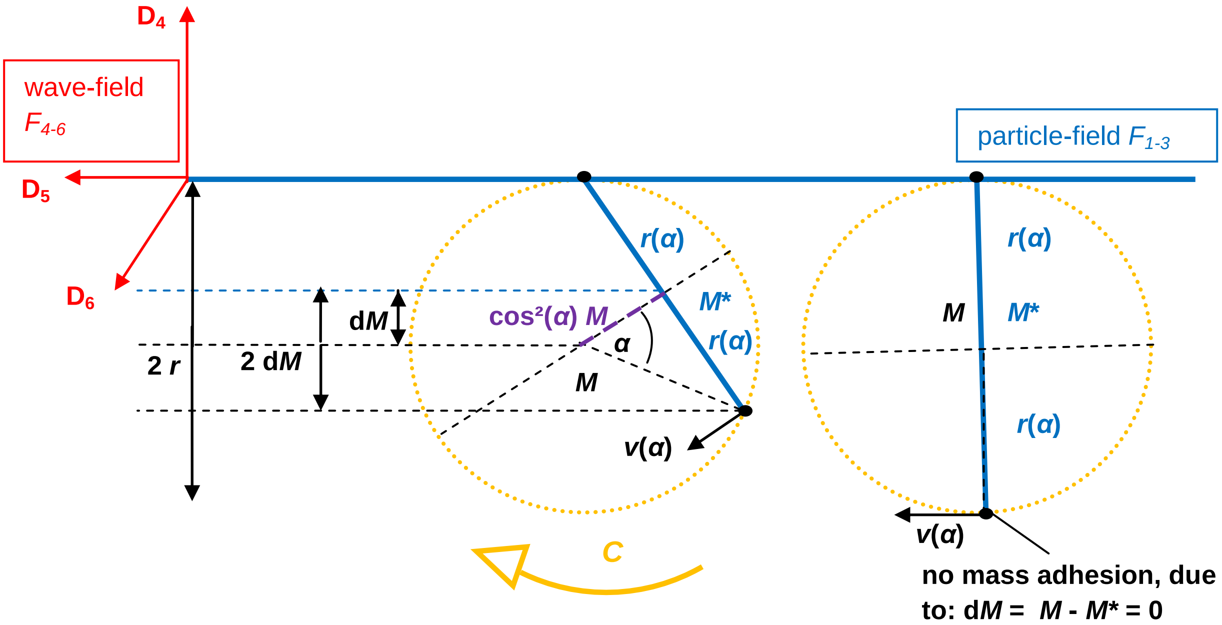

Figure 2.11: Dependencies of the radius $r(\alpha)$, the velocity $v(\alpha)$ of the subspace U with the gravitational potential d$M(\alpha)$ over a period T

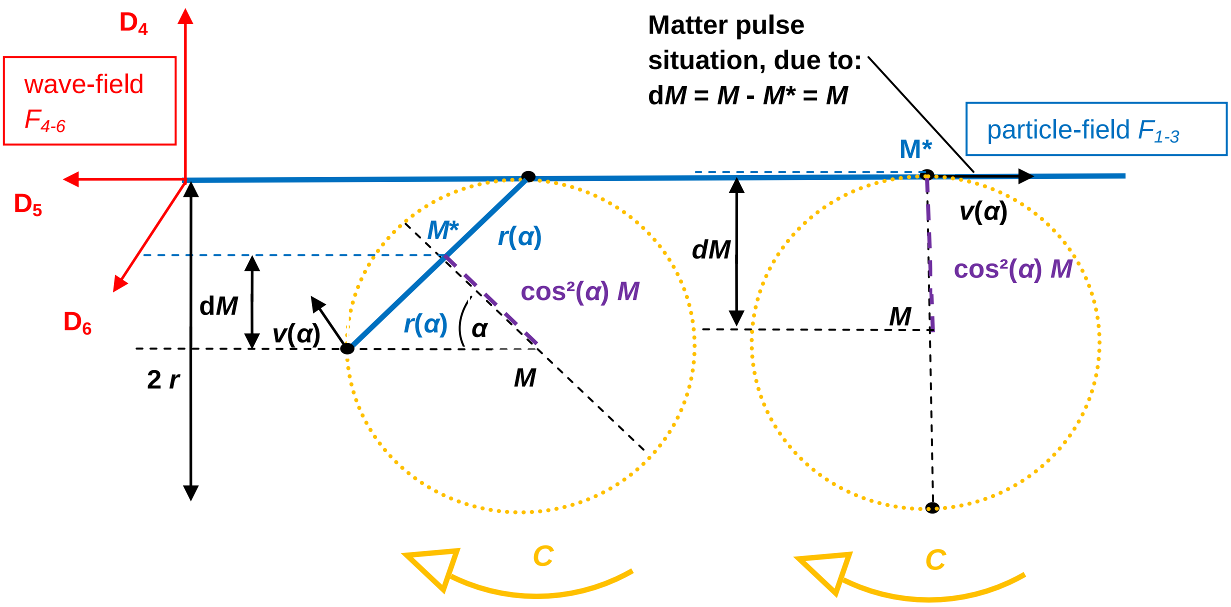

Figure 2.12: Course of a rotation

$v(\alpha) = c \sin(\alpha)$ $\quad r(\alpha) = R \sin(\alpha)$ $\quad \alpha = kt$ $\quad k = \text{const.}$ $\quad T \, \varepsilon \, (0; T)$

T = period length of a rotating photon

The classical approach to angular momentum continues to apply in all relativistic states.

Classical approach: $L = m\, v\, \mathrm{r}$ (2.42)

The subspace U has a radius $r(\alpha)$, which rotates at a speed $v(\alpha)$ around an axis through the centre with the inertial mass M^*. The length with respect to the inertial mass M^* must be multiplied by 2 to represent the length $2r(\alpha)$. The angle α only assumes a maximum angle of 45° during rotation. The inertial mass M^* can therefore have a minimum mass of 0 or a maximum mass *of* M. dM can be represented trigonometrically by $M\cos^2(\alpha)$. The product 2π is required so that $r(\alpha)$ can be mapped as the surface radius. The approach for the angular momentum with α-dependence is as follows:

$$dL(\alpha) = 2 \cdot 2\pi\, dM(\alpha)\, v(\alpha)\, r(\alpha)\, d\alpha$$

$$L(\alpha) = 4\pi \int_0^{\alpha} m_{obj} \cos^2(\alpha)\, v(\alpha)\, r(\alpha)\, d\alpha$$

with: $0 \le \alpha \le 45°$

$$L(\alpha) = 4\pi\, m_{obj}\, v(\alpha)\, r(\alpha) \int_0^{\frac{\pi}{4};\, 45°} \cos^2(\alpha)\, d\alpha = 4\pi\, m_{obj}\, v(\alpha)\, r(\alpha)\, \{[\frac{1}{2}\alpha + \frac{1}{4}\sin(2\alpha)\,]\}_0^{\frac{\pi}{4};\, 45°}$$

$$L(\alpha) = 4\pi\, m_{obj}\, v(\alpha)\, r(\alpha)\, \{[\frac{1}{2}\frac{\pi}{4} + \frac{1}{4}\sin(2 \cdot 45°)\,] - [\frac{1}{2} \cdot 0 + \frac{1}{4}\sin(2 \cdot 0)\,]\}$$

$$\boxed{L(\alpha) = 4\pi\, m_{obj}\, v(\alpha)\, r(\alpha)\, (\frac{\pi + 2}{8}) = 2\pi\, m_{obj}\, v(\alpha)\, r(\alpha)\, (\frac{\pi + 2}{4})} \quad (2.43)$$

→ Angular momentum of a rotating photon in the wave-field at an any location with field angle α

The mean value of the angular momentum with division $\frac{\pi}{4}$ provides:

$$\boxed{L(\alpha)_{\varnothing} = 2\pi\, m_{obj}\, v(\alpha)\, r(\alpha)\, (\frac{4\pi + 8}{4\pi}) = 2\pi\, m_{obj}\, v(\alpha)\, r(\alpha)\, (\frac{\pi + 2}{\pi})} \quad (2.44)$$

→ Average angular momentum in the wave-field with the following dependencies: $v(\alpha) \sim r(\alpha) \sim \sin(\alpha)$

The subspace U rotates in relation to the particle-field with its sinusoidal periodicity orthogonal to the dimensional plane D_{56}. The maximum momentum transfer takes place during the phase of maximum expansion of the subspaces. For this purpose, the angular momentum with respect to the particle-field must be added in proportion to a further factor $\sin(\alpha)$ from the original orientation axis.

$$L_{\text{particle-field}}(\alpha) = 2\pi\, m_{obj}\, r\, c \left(\frac{\pi+2}{\pi}\right) \int_0^{\alpha} \sin^3(\alpha)\, d\alpha \qquad \text{with: } 0 \leq \alpha \leq 45°$$

$$L_{\text{particle-field}}(\alpha) = 2\pi\, m_{obj}\, r\, c \left(\frac{\pi+2}{\pi}\right) \left\{\left[\frac{1}{3}\cos^3(\alpha) - \cos(\alpha)\right]\right\}_0^{45°}$$

$$L_{\text{particle-field}}(\alpha) = 2\pi\, m_{obj}\, r\, c \left(\frac{\pi+2}{\pi}\right) \left\{\left[\frac{1}{3}\cos^3(45°) - \cos(45°)\right] - \left[\frac{1}{3}\cos^3(0) - \cos(0)\right]\right\}$$

$$L_{\text{particle-field}}(\alpha) = 2\pi\, m_{obj}\, r\, c \left(\frac{\pi+2}{\pi}\right) 0{,}077411\ldots$$

The mean value of the angular momentum in relation to the particle-field with division $\frac{\pi}{4}$:

$$L_{ø\_\,\text{particle-field}} \approx 2\pi\, m_{obj}\, r\, c \left(\frac{\pi+2}{\pi}\right) \frac{\pi}{4}\, 0{,}077411\ldots$$

$$L_{ø\_\,\text{particle-field}} \approx 2\pi\, m_{obj}\, r\, c\, \frac{1}{2\pi} \qquad \text{with: } r = \frac{\lambda}{2\pi};\ \lambda \sim \frac{1}{m_{obj}}$$

$$\boxed{L_{ø\_\,\text{particle-field}} = m_{obj}\, \lambda_{obj}\, c\, \frac{1}{2\pi} = m_{obj}\, \lambda_{obj}\, k_{obj}\, R_{obj}\, \frac{1}{2\pi} = \frac{h}{2\pi}} \qquad (2.45)$$

Comparison: (2.34)

$L_{ø\_\,\text{particle-field}}$ - 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

→ Average angular momentum in the particle-field

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

Cross-check the above derivation:

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

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

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

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

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 **matter pulse** in **Figure 2.12** is marked with

$$P = m_{obj}\,c \qquad [P] = \mathrm{kg}\frac{\mathrm{m}}{\mathrm{s}} \qquad (2.46)$$

and is located at the point of contact in the dimensional plane D_{56}. The mass is transmitted sinusoidally into the particle-field. All interaction fields are exchanged with the momentum and the space-time deformation is registered via the gravitational force.

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

The 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 of the circular rotation with sin(kt) shifts into the dimensional plane D_{45}, resulting in an elliptical path. The increased surface area represents the additional energy required to perform this work. The surface distance of an object in relation to the hollow sphere model of the field-space increases accordingly according to **Figure 2.4** with:

$$\frac{c^2}{c^2 - V_4^2} = \frac{1}{\sin^2(kt)}$$

This factor corresponds to the relativistic increase in energy during a space-time deformation relative to an inertial system. **Figure 2.13** shows the mechanism for an object.

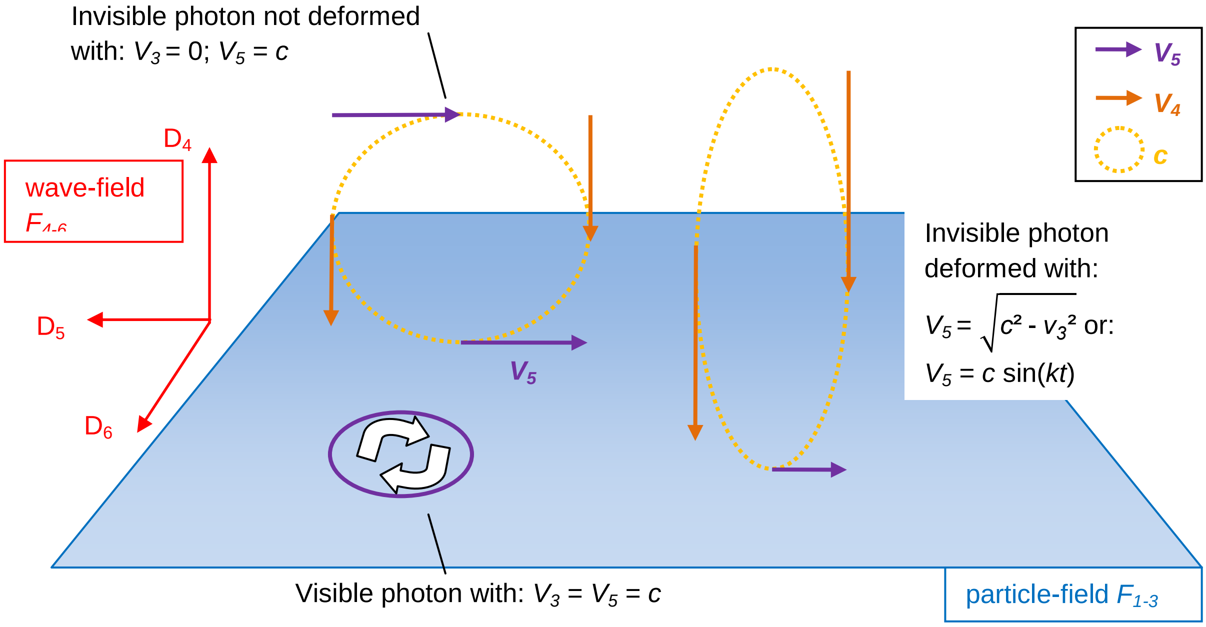

Figure 2.13: Top left: the invisible photon at rest $V_3 = 0$, $V_5 = c$; bottom: the visible photon $V_3 = V_5 = c$; right: the invisible photon in motion $V_3 \rightarrow c$; $V_5 \rightarrow 0$

Since the rotation always takes place with the invariant value for the orbital speed with c and the constant angular frequency k, the object time t_{Obj} passes more slowly over the longer rotation path.

One of the consequences of this is that the matter pulse (**Figure 2.12 right**) with $P = m_{obj}\, c$ slows down relative to normal time t and is therefore measured at larger time intervals. The following applies to the relativistic observation of the matter pulse with a normalised object mass m_{obj} :

$$P = m_{obj} \sqrt{\frac{c^2}{\sin^2(kt)}}$$

$$\boxed{P = m_{obj} \frac{c}{\sin(kt)} = m_{obj} \frac{c^2}{V_5}} \qquad (2.47)$$

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.

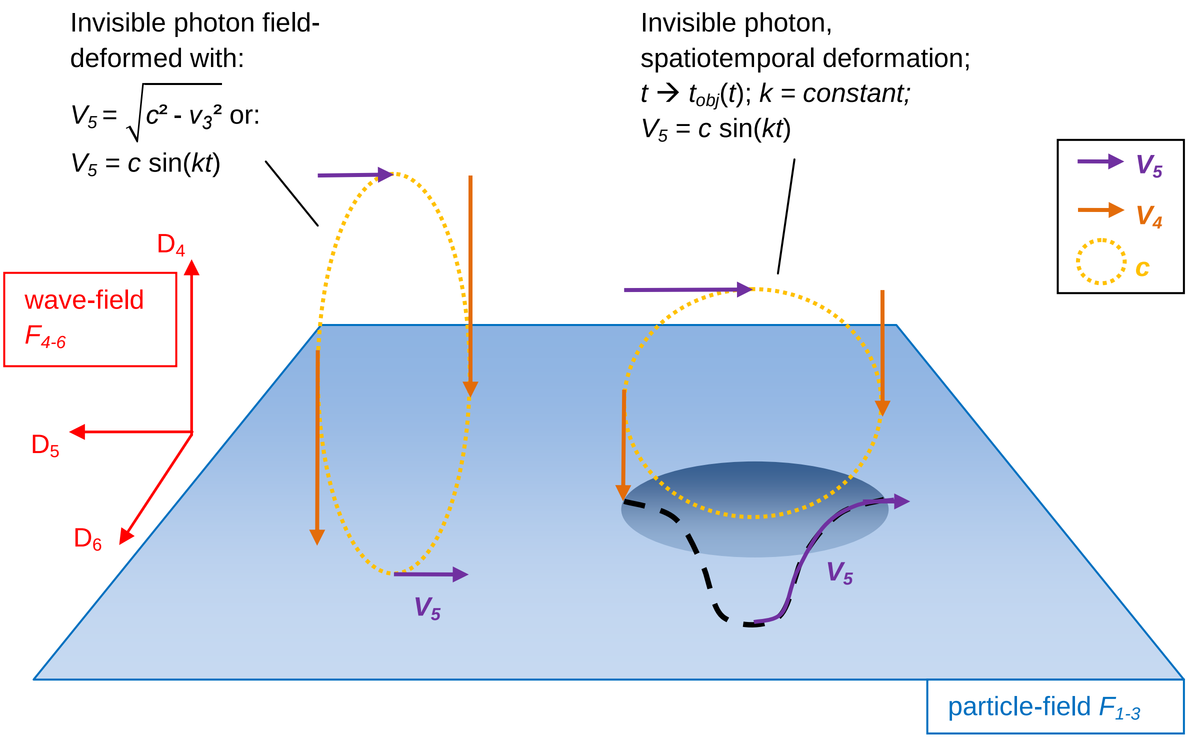

Figure 2.14: Two possible ways of visualising a space-time deformation with its field deformation

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.

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.

$$\lambda_{obj}(t) = \frac{\lambda_{obj}}{\sin(kt)} \qquad \text{(gravitational redshift)} \qquad \text{with } \alpha = kt \text{ (general)} \tag{2.48}$$

$$P = m_{obj}\,\frac{c^2}{V_5} = m_{obj}\,\frac{c}{\sin(kt)}$$

$$E_{obj}(t) = h\,f\,\frac{1}{\sin^2(kt)} = m_{obj}\,c^2\,\frac{1}{\sin^2(kt)} \tag{2.49}$$

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

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

Result for the photon model:

The **FSM-GTR** for the 6-dimensional field-space describes the space-time mechanical effects for both cosmology and the microcosm. This confirms the thesis from **Chapter 1** that trigonometry can be used to describe space-time mechanical effects. The relativistic relationship to the cosmic inertial system was defined for the photon field, which fills the entire cosmic space. Thus, for any given physics, a purely geometric relationship between energy and space-time applies. In this model, the relationship was also called energy-space-time equivalence. Due to the general geometry of the wave-field, the relativistic relationships can be transferred to the microcosm. The photon model is therefore a purely relativistic representation of space-time, which describes the state of matter with its geometry. Depending on the 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. This photon model provides an alternative derivation for the force, energy, and momentum equations 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.