7.4 Description of Black Holes

The field radius has the property that no photon can escape once it reaches this field radius. In the particle model, the field radius is determined to be very small. Black holes (BH), on the other hand, have a particularly large field radius R_{BH} from which no photon can escape. This is also called the event horizon. The event horizon only begins to have an outward effect on an object when its field radius is greater than its own wavelength. This intersection between the field radius and the wavelength is shown, along with a particle structure that has exactly these properties. An indication of this is given **in Chapter 7.1** with the state of the universe at the location d$M(\alpha \rightarrow 0°)$. This is the location where a photon would be able to generate a field radius by occupying just enough volume with its own wavelength to oscillate within it. This would mean that a particle has been found whose wavelength is as small as possible, but still exists in the space-time of the universe.

The transformation of an object into a black hole:

The lower limit coincides exactly with the point where the wavelength λ of a field body is equal to the product of its field radius r and 2π. The approach used to calculate the field angle α corresponds to the characteristics of the universe:

$G = 6{,}67\ 10^{-11}\ \mathrm{N}\frac{\mathrm{m}^2}{\mathrm{kg}^2}$; $c = 299792458\ \frac{\mathrm{m}}{\mathrm{s}}$; $k_{Uni}\ M_{Uni} = 4{,}0396\ 10^{35}\ \frac{\mathrm{kg}}{\mathrm{s}}$;
$h = 6{,}626\ 10^{-34}$ Js ; $r_{BH} = 7421{,}5$ m

Equation (7.01) applies, in which the wavelength λ_x is equal to the field radius 2π r_x:

$h = \lambda\ r\ m\ k = 2\pi\ r_x^2\ m\ k$

$\underline{\underline{r_x = 1{,}616\ 10^{-35}\ \mathrm{m}}}$ → equals the Planck length

The maximum compression of a field body is reached at the volume radius r_x, beyond which it takes on black hole properties. Depending on the mass absorbed by the black hole, its wavelength will continue to shrink and its field radius will increase. A black hole continues to grow as it absorbs photons and particles from the outside. A universe, on the other hand, has a constant mass and a dynamic field radius $r(t)$ that expands and contracts in a T-periodic manner.

The contraction must result in the simplest possible particle structures that such a contraction can produce. **Figure 7.5** illustrates the state derived so far.

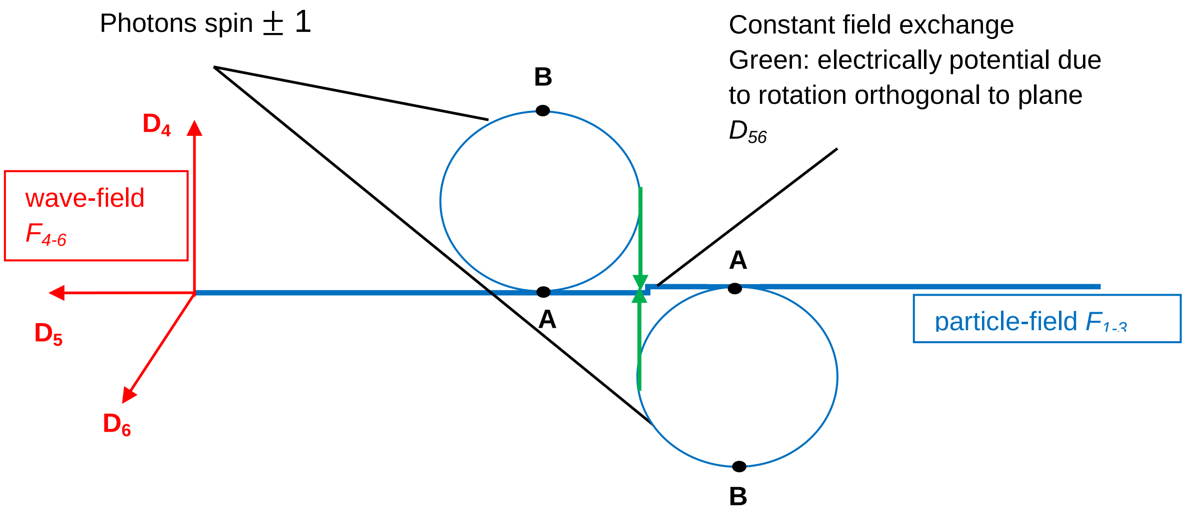

Figure 7.5: Black hole in the wave-field $F_{4\text{-}6}$, shaping parallel to D_{56}

As a minimally entangled spin-0 photon, the rotating field body would be capable of rotating at the maximum speed $V_{max} = c$. The configuration takes on structures similar to dark energy, orthogonal to the D_{56} dimensional plane.

The two sub-photons are electrically attracted to one another. Their orthogonal orientation relative to the D_{56} dimensional plane prevents a classical approach and, consequently, an annihilation reaction. Externally, this structure behaves like a neutral but internally polarized object. Both sub-photons are in a stable, entangled equilibrium. However, the internal structure cannot be measured due to the event horizon.

The compact geometry transitions into a complex topology with a high number of windings n and possibly $g \geq 1$. The object possesses high topological stability due to its Chern classes, but is close to the transition to evaporation.

The entire mass is stored as pure rotational energy of the photons. The potential $V(\phi_n)_{\text{dark}}$ reaches its maximum value. The object emits extremely intense radiation (similar to Hawking radiation) because the oscillation $[\cos(kt + \beta)]$ becomes very high-energy during compression.

This representation has the simplest 1:1 coupling between particle-field and wave-field, which is not adversely affected by the complexity associated with larger particles. This spin-0 photon pair will be referred to below as the **black hole photon**.

External angular momentum:

Astronomically, a black hole is identified, for example, by its event horizon radius r when it causes a gravitational lensing effect or gravitational redshift. This structure has a high mass. Consequently, the measurable portion of the angular momentum is dominated by the term in the formula (2.197).

$$L_{ø\_particle\text{-}field\_BH} = \sqrt{G\, M_{BH}^3\, r_{BH}} + \frac{h}{2\pi} \qquad \text{with: } \frac{h}{2\pi} \approx 0$$

Largest gravitational potential of a black hole:

$$F_{BH} = \frac{G\,M\,m}{r_{BH}^2} \sin(\alpha)$$ The maximum gravitational potential is at 90° at the equator.

The lowest gravitational potential is at 0° to the axis of rotation.

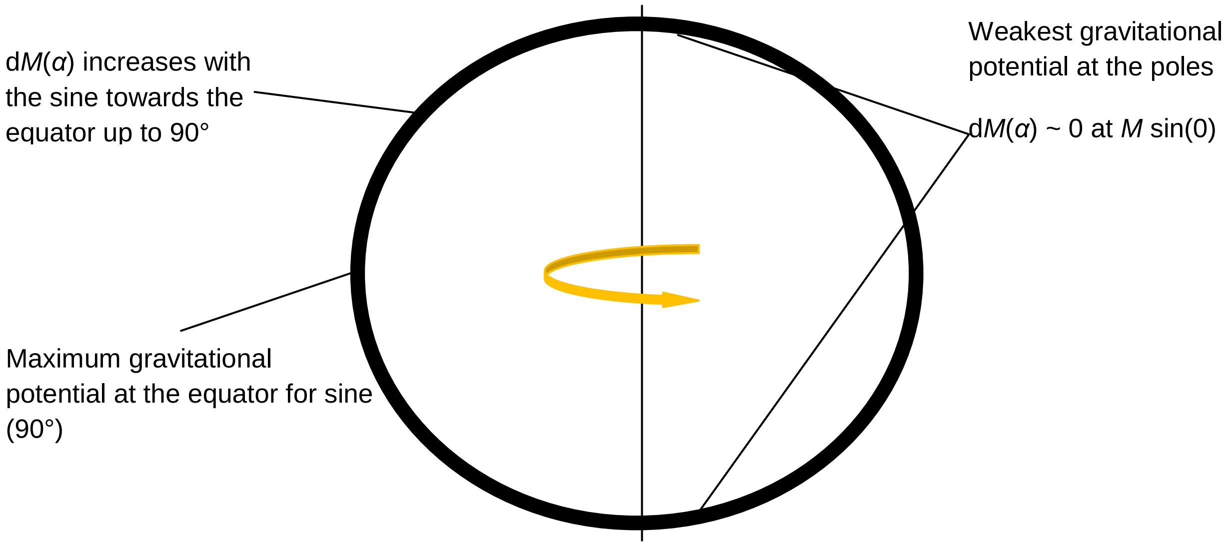

Figure 7.6: Gravitational potential along the surface of its spherical sector in the particle-field $F_{1\text{-}3}$

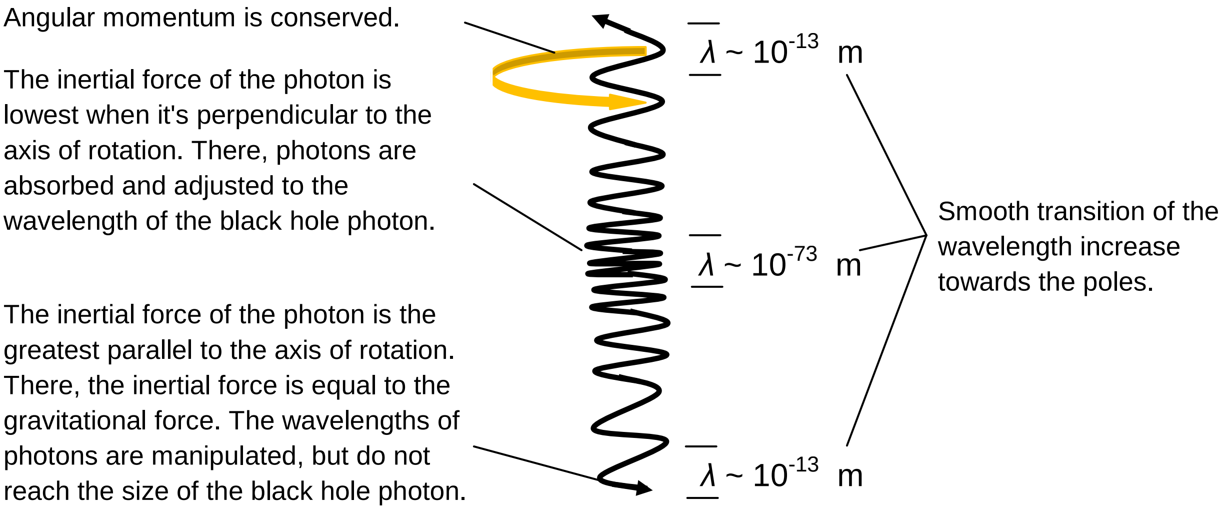

Figure 7.7: Behaviour of absorbed photons along the spherical sector of a black hole

A black hole is an extreme case. Its event horizon is its field radius *r*, beyond which photons cannot escape. Outside the field radius, a corona of photons can be seen, which largest parallel to the axis of rotation appears. According to the sine function, the inertial force of an object counteracting an external gravitational force is described mechanically along a hollow sphere. The inertial force is lowest at right angles to the axis of rotation, while it increases towards the poles until photons can no longer be attracted at the exact location of the axis of rotation. There, high-energy photons can be created that have already begun to adjust their wavelength to the black hole. Thermal radiation or gamma bursts possibly arise through such a process.

A calculation example:

$G = 6{,}67\ 10^{-11}\ \mathrm{N}\frac{\mathrm{m}^2}{\mathrm{kg}^2}$; M_{BH} = 5 times the mass of the Sun = 10^{31} kg ; $c = 299792458\ \frac{\mathrm{m}}{\mathrm{s}}$

Event horizon of this black hole photon:

$$\underline{\underline{r_{BH}}} = \frac{G\,M_{BH}}{c^2} = \underline{\underline{7421{,}5\ \mathrm{m}}} \qquad (7.23)$$

Alternatively with: $\frac{M_{obj}}{r_{obj}} = 1{,}34746\ 10^{27}\ \frac{\mathrm{kg}}{\mathrm{m}}$ → Mass-area constant (2.176)

$$r_{BH} = \frac{10^{31}\,\mathrm{kg}}{1{,}34746\ 10^{27}\ \frac{\mathrm{kg}}{\mathrm{m}}} = 7421{,}5\ \mathrm{m} \qquad (7.24)$$

Field angle for this black hole:

$$\alpha_{BH} = \sin^{-1}\left(\frac{1{,}616\ 10^{-35}\ \mathrm{m}}{7421{,}5\ \mathrm{m}}\right) \qquad (7.25)$$

$\underline{\underline{\alpha_{BH} \approx 1{,}2476\ 10^{-37\circ}}}$ → equivalent field angle of this black hole

External angular momentum:

$$L_{ø\_particle\text{-}field\_BH} = \sqrt{G\,M_{BH}^3\,r_{BH}}$$

$$\underline{\underline{L_{ø\_particle\text{-}field\_BH} = 2{,}22\ 10^{43}}}\ \frac{\mathrm{kg\ m}^2}{\mathrm{s}}$$

Gravitational effect for different speeds < *c*:

$$r_{BH\_gravity\_range} = \frac{G\,M_{BH}}{V_3^2} \qquad \text{with: } V_3 \text{ – object velocity} \qquad (7.26)$$

Range in the event that an object is accelerated to a speed of 400 $\frac{\mathrm{m}}{\mathrm{s}}$:

$$r_{BH\_gravity\_range} = \frac{G\,M_{BH}}{V_3^2} = 4{,}17\ 10^{15}\ \mathrm{m} \triangleq 0{,}44\ \mathrm{LY}$$

Range in the event that an object is accelerated to a speed of 100000000 $\frac{\text{m}}{\text{s}}$:

$$r_{BH\_gravity\_range} = \frac{G\ M_{BH}}{V_3{}^2} = 66700\ \text{m}$$

Circular frequency - revolutions per second on the vertical axis:

$$k_{BH} = \sqrt{\frac{G\ M_{BH}}{r_{BH}{}^3}} \qquad (7.27)$$

$\underline{\underline{k_{BH} = 40394{,}8\ \frac{1}{\text{s}}}}$ → Turns per second of the black hole

When a black hole grows, its circular frequency k_{BH} decreases. In contrast, the circular frequency k_{Uni} of the universe remains constant due to its expanding nature.

Gravitational force of the black hole on a) a photon and b) an everyday object at the event horizon:

a) Photon: $\lambda_{pho} = 552$ nm; $m_{pho} = 4{,}004\ 10^{-36}$ kg

$$F_{BH} = \frac{G\ M_{BH}\ m_{pho}}{r_{BH}{}^2}\ \sin(\alpha) \qquad (7.28)$$

With sin(α = 90°) = 1 at the location of the strongest gravitational potential:

$$\underline{\underline{F_{BH}}} = \frac{G\ M_{BH}\ m_{pho}}{r_{BH}{}^2} = \underline{\underline{4{,}849^{-23}\ \text{N}}}$$

b) 100 kg heavy object:

$$\underline{\underline{F_{BH}}} = \frac{G\ M_{BH}\ m_{100kg\_obj}}{r_{BH}{}^2} = \underline{\underline{1{,}2\ 10^{15}\ \text{N}}} \qquad (7.29)$$

Wavelength of the black hole photon:

The following relationship between the field radius r_{BH} and its circular frequency k_{BH} is now known and can be applied to this black hole:

$$r_{BH} = \frac{G\ M_{BH}}{c^2} = 7421{,}5\ \text{m};\ M_{BH} = 10^{31}\ \text{kg}$$

$$k_{BH} = \sqrt{\frac{G\ M_{BH}}{r_{BH}{}^3}} = 40394{,}8\ \frac{1}{\text{s}};\ h = 6{,}626\ 10^{-34}\ \text{Js}$$

$$\lambda_{BH} = \frac{h\ c^2}{G\ M_{BH}{}^2\ k_{BH}} \qquad (7.30)$$

$\lambda_{BH} = 2{,}21\ 10^{-73}$ m → Wavelength of the black hole photon

Comparison:

a) The universe has a wavelength of $\lambda_{Uni} = 1{,}87862\ 10^{-96}$ m
b) Visible photons have wavelengths in the order of 552 nm

Cross-check:

$$h = M_{BH}\, \lambda_{BH}\, c = 10^{31}\ \text{kg} \cdot 2{,}21\ 10^{-73}\ \text{m} \cdot 299782458\ \frac{\text{m}}{\text{s}}$$

$$h = 6{,}625\ 10^{-34}\ \text{Js} \approx 6{,}626\ 10^{-34}\ \text{Js}$$

Increases: M_{BH} → decreases: λ_{BH} → $h = M_{BH}\, \lambda_{BH}\, c$ = const. → **Planck's act. quantum**

Photons or particles of other wavelengths are reduced to the wavelength of the black hole photon by the force of gravity. The density of the black hole continues to increase with mass, while its wavelength becomes smaller and smaller and space-time continues to deform.

A formal verification of the wavelength λ_{BH} is now performed using the classical calculation:

Energy of a photon inside the black hole:

$$E_{BH,photon} = \frac{1}{\lambda_{BH}}\, h\, c = 8{,}988\ 10^{47}\,\text{J} \tag{7.31}$$

Conversion to eV by division by $1{,}602\ 10^{-19}$ J provides:

$$E_{BH,photon} = 5{,}61\ 10^{66}\ \text{eV}$$

Compared to individual photons:

$\lambda_{pho} = 552$ nm with: $m_{photon} = \dfrac{3{,}6\ 10^{-19}\ \text{J}}{(299792458\ \frac{\text{m}}{\text{s}})^2} = 4{,}004\ 10^{-36}$ kg

$E_{pho\_552nm} = \dfrac{1}{\lambda_{pho}}\, h\, c = 3{,}6\ 10^{-19}$ J $E_{pho\_552nm} = 2{,}246$ eV

Mass of a photon in a black hole:

Mass verification from the derived $E = m\, c^2$ formula:

$$E_{BH,photon} = M_{BH,photon}\, c^2 = 8{,}988\ 10^{47}\ \text{J} \quad \text{(result from above)} \tag{7.32}$$

$$\underline{\underline{M_{BH,photon}}} = \frac{E_{BH_{photonen}}}{c^2} = \frac{8{,}988\ 10^{47}\ \text{J}}{(299792458\ \frac{\text{m}}{\text{s}})^2} = \underline{\underline{1{,}0001\ 10^{31}\ \text{kg}}} \sim 10^{31}\ \text{kg} = M_{BH}$$

Number of superimposed photons in the black hole:

$M_{BH} = 10^{31}$ kg ; $M_{BH\_photon} = 10^{31}$ kg; Number n of photons ; n ε N

$$\underline{\underline{n}} = \frac{M_{BH}}{M_{BH_{photon}}} = \underline{\underline{1}}$$

→ simple verification of the wavelength λ_{BH}: there is only one photon in the black hole

Growing properties of the event horizon with the inclusion of different particles:

When a particle hits a black hole and merges with it, the black hole grows in proportion to the particle absorbed. For example, the photon (552 nm), an exchange fion (136,6875 f_e), the electron and the proton are assumed to be absorbed by the black hole.

$$k_{BH} = \sqrt{\frac{G\,M_{BH}}{r_{BH}{}^3}} = 40394{,}8\,\frac{1}{s}\ ;\ r_{BH} = \frac{G\,M_{BH}}{c^2} = 7421{,}5\text{ m}\ ;\ h = 6{,}626\ 10^{-34}\text{ Js}\ ;$$

$$G = 6{,}67\ 10^{-11}\,\text{N}\frac{\text{m}^2}{\text{kg}^2}\ ;\ M_{BH} = 5\text{ times the mass of the Sun} = 10^{31}\text{ kg};\ c = 299792458\,\frac{\text{m}}{\text{s}}\ ;$$

f_e = 123,56 Exa Hz = 1,2356 10^{20} Hz ; f_{proton} = 1845,28 f_e ; f_{fion} = 136,6875 f_e ;

f_{pho} = 5,43 10^{14} Hz (λ_{pho} = 552 nm)

$$\lambda_{fion} = \frac{c}{136{,}6875\,f_e} = \frac{299792458\,\frac{\text{m}}{\text{s}}}{136{,}6875\cdot 1{,}2356\ 10^{20}\text{ Hz}} = 1{,}775\ 10^{-14}\text{ m} \qquad (7.33)$$

λ_{proton} = 1,315 10^{-15} m $\qquad$ λ_e = 2,4263 10^{-12} m $\qquad$ λ_{pho} = 5,52 10^{-7} m

$$m_{obj} = \frac{1}{2}\,(\text{BC}\ (\text{CC})^3)^n\cdot\text{PC}\cdot\text{Dimfactor}\cdot M_e \qquad (7.34)$$

Alternative mass determination:

$$m_{fion} = \frac{h\,c^2}{G\,M_{BH}\,k_{BH}\,\lambda_{fion}} = 1{,}2467\ 10^{-28}\text{ kg} \qquad (7.35)$$

m_{proton} = 1,683 10^{-27} kg $\qquad$ M_e = 9,12 10^{-31} kg $\qquad$ m_{pho} = 4,004 10^{-36} kg

$$\underline{\underline{r_{fion}}} = \frac{G\,M_{fion}}{c^2} = \underline{\underline{9{,}25\ 10^{-56}\text{ m}}} \qquad (7.36)$$

$\underline{\underline{r_{proton} = 1{,}25\ 10^{-54}\text{ m}}}$ $\qquad$ $\underline{\underline{r_e = 6{,}75\ 10^{-58}\text{ m}}}$ $\qquad$ $\underline{\underline{r_{pho} = 2{,}97\ 10^{-63}\text{ m}}}$

$$k_{fion} = \sqrt{\frac{G\,m_{fion}}{r_{fion}{}^3}} = \frac{c^3}{G\,M_{fion}} = 3{,}24\ 10^{63}\,\frac{1}{s} \qquad \text{(for information)} \qquad (7.37)$$

$k_{proton} = 2{,}4\ 10^{62}\,\frac{1}{s}$ $\qquad$ $k_e = 4{,}43\ 10^{65}\,\frac{1}{s}$ $\qquad$ $k_{pho} = 1{,}01\ 10^{71}\,\frac{1}{s}$

By absorbing these wavelengths, the above-mentioned particles contribute proportionally to the growth of the black hole.

A calculation example illustrates the ratios of how many particles are required for a 10% increase.

$$r_{BH+10\%} = \frac{G\,(M_{BH} + 0{,}1\,M_{BH})}{c^2} \qquad (7.38)$$

$$r_{BH+10\%} = 8163{,}5 \text{ m}$$

Increase in the field radius with a 10% increase in the energy of the black hole:

$$\frac{r_{BH+10\%}}{r_{BH}} - 1 = \frac{8163{,}5 \text{ m}}{7421{,}5 \text{ m}} - 1 \approx 10\ \%$$

Addition of number n of particles, corresponding to a 10% increase in energy in a black hole with a mass of 10^{31} kg:

$$n_{obj} = \frac{r_{BH+10} - r_{BH}}{r_{obj}} \qquad \text{with: } n\ \varepsilon\ \mathrm{N} \qquad (7.39)$$

$$\underline{\underline{n_{pho} = \frac{8163{,}5 \text{ m} - 7421{,}5 \text{ m}}{2{,}97\ 10^{-63} \text{ m}} = 2{,}5\ 10^{65}}}$$

$\underline{\underline{n_{proton} = 5{,}94\ 10^{56}}}$ $\underline{\underline{n_{e} = 1{,}1\ 10^{60}}}$ $\underline{\underline{n_{fion} = 8{,}02\ 10^{57}}}$

Or:

$$n_{obj} \approx \frac{M_{BH+10} - M_{BH}}{M_{obj}} \qquad (7.40)$$

$$n_{pho} \approx \frac{M_{BH+10} - M_{BH}}{M_{pho}} = \frac{0{,}1\ 10^{31}\text{kg}}{4{,}004\ 10^{-36} \text{ kg}} = 2{,}5\ 10^{65}$$

$$n_{proton} \approx \frac{M_{BH+10} - M_{BH}}{M_{proton}} = \frac{0{,}1\ 10^{31}\text{kg}}{1{,}683\ 10^{-27} \text{ kg}} = 5{,}94\ 10^{56}$$

$$n_{e} \approx \frac{M_{BH+10} - M_{BH}}{M_{e}} = \frac{0{,}1\ 10^{31}\text{kg}}{9{,}12\ 10^{-31} \text{ kg}} = 1{,}1\ 10^{60}$$

$$n_{fion} \approx \frac{M_{BH+10} - M_{BH}}{M_{fion}} = \frac{0{,}1\ 10^{31}\text{kg}}{1{,}2467\ 10^{-28} \text{ kg}} = 8{,}02\ 10^{57}$$

For the event horizon to increase by 10%, the black hole with an initial mass of 10^{31} kg needs to absorb $2{,}5\ 10^{65}$ photons.

End of life of a black hole:

A black hole remains stable as long as the attractive global forces in the universe with a gravitational potential of dM(α < 90°) prevail. When the space-time mechanical effects diminish with the expansion of the universe, the gravitational potential tends to decrease to the minimum value dM(α = 90°). At this point, the black hole photon is forced to transform into a visible photon. This is due to the position of its 2-dimensional rotation between the dimensional planes D_{45} and $D_{56,}$ in which the space-time deformation shifts to the dimensional plane D_{56} with α = 90°. In this situation, it no longer requires any additional potential forces to exchange with itself. The point is reached where it makes sense energetically to break the connection with such a concentration of mass. The black hole decomposes. With the repulsive forces of the universe coming into play, such celestial bodies are dissolved again and the total energy density is brought into spatial equilibrium.

Information is not lost when such objects disintegrate. For an object trapped inside a black hole, the time spent there would last only an instant. The reason lies in time dilation. Due to time dilation, time appears to pass almost infinitely quickly for that object. The time it takes for a black hole to disintegrate is not perceived as a continuous process, but is experienced as instantaneous by the observer. The information is released again.

Key insight from the black hole:

The essential insight is illustrated in **Figures 7.5 – 7.7**. The black-hole photon consists of a pair of spin-0 photons with separate momenta that are oriented parallel to the fourth dimension. Between them lies a gravitational potential of dM(α_{BH}). The black hole photon interacts in the particle-field $F_{1\text{-}3}$ with its own 2-dimensional field vectors from the wave-field $F_{4\text{-}6}$. Due to the fact that the field radius is greater than its wavelength, the black hole photon has the ability to absorb matter of any larger wavelength. A black hole has a growing character, while the universe has an expanding character.