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 dM($\alpha \rightarrow 0°$) and –dM($\alpha \rightarrow 180°$). 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.

Figure 7.5 illustrates this state.

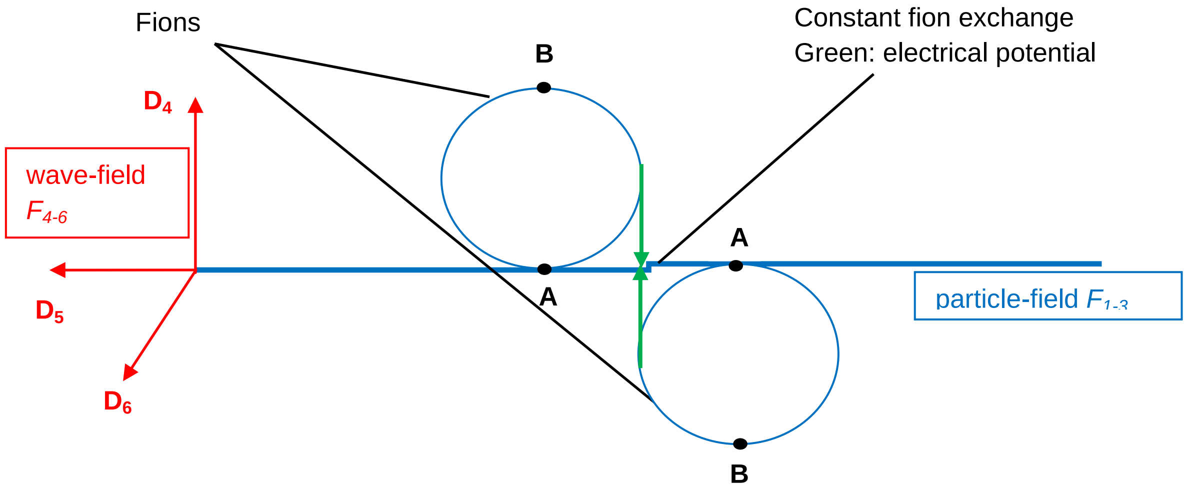

Figure 7.5: Black hole in the wave-field $F_{4\text{-}6}$

The gravitational potential between the fions oscillating above and below the dimension plane D_{56} corresponds to the mechanism of the photon field of the universe shortly after its birth.

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 fion pair will be referred to below as the black hole photon.

General limit at which particles develop black hole properties:

The limit begins exactly at the point where the wavelength λ of a particle is equal to its field radius R. The approach for calculating the field angle must correspond to the characteristics of the universe:

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

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

$h = \lambda_x\ r_x\ m\ k = \lambda_x^2\ m\ k = r_x^2\ m\ k$

$\underline{\underline{r_x = \lambda_x = 4{,}05\ 10^{-35}\ \mathrm{m}}}$

$\underline{\underline{\alpha = 2{,}65768\ 10^{-60\circ}}}$ → Gravitational potential of every black hole

Depending on the mass absorbed by the black hole, its wavelength becomes smaller and the field radius larger. The black hole grows with its field radius similarly to how the universe expands. However, its field angle α remains constant at approx. $2{,}65768\ 10^{-60\circ}$. A black hole only continues to grow with the external absorption of photons and particles. A universe, on the other hand, has a constant mass and a dynamic field radius that expands and contracts T-periodically.

Largest gravitational potential of a black hole:

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

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

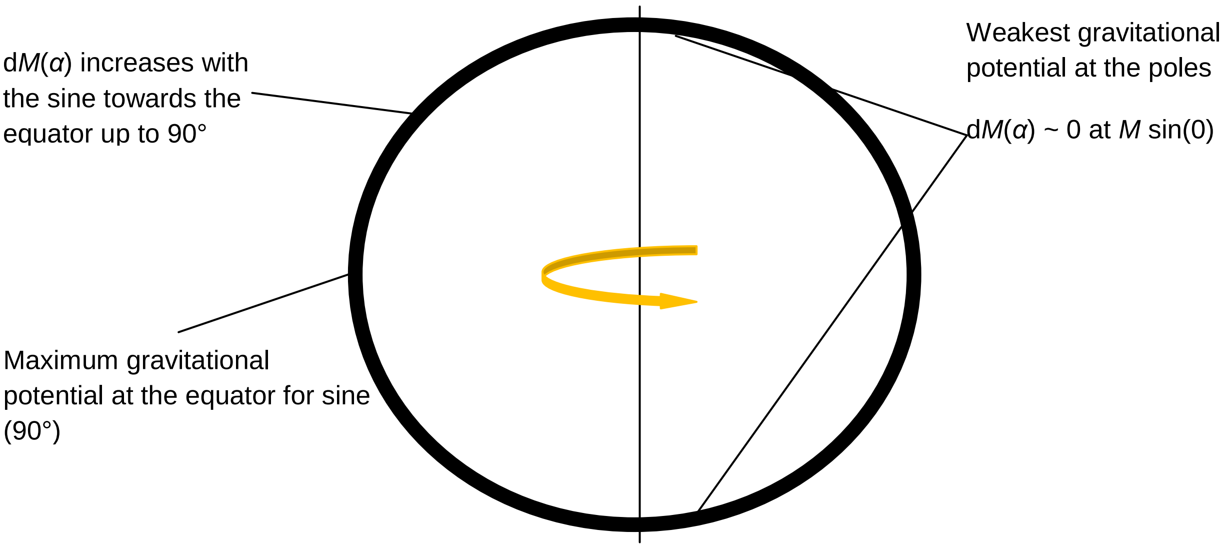

Figure 7.6: Gravitational potential along the surface of its spherical sector in the particle-field $F_{1\text{-}3}$

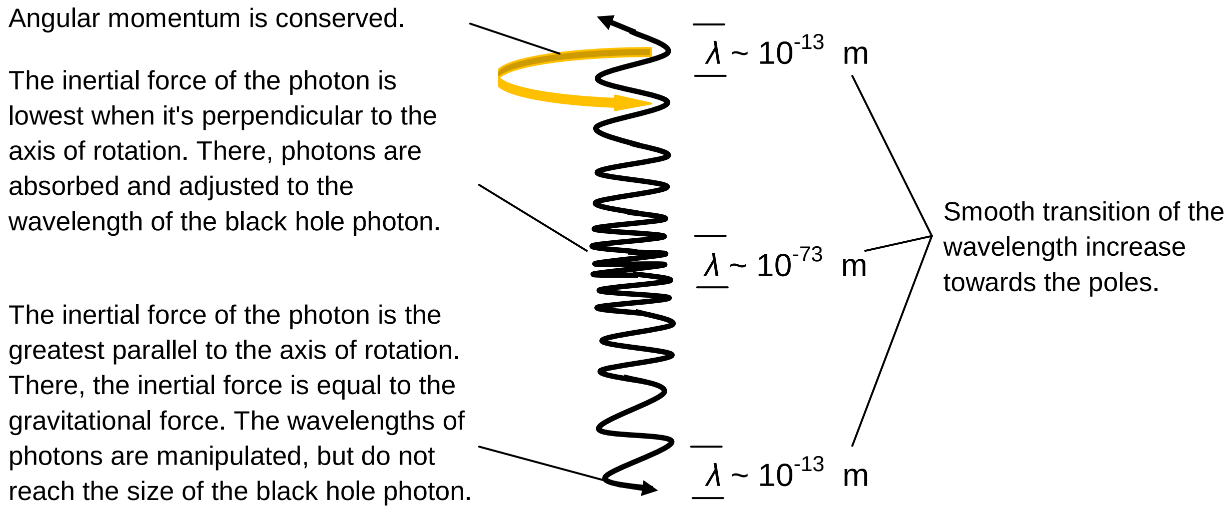

Figure 7.7: Behaviour of absorbed photons along the spherical sector of a black hole

A black hole is an extreme case. Its event horizon is its field radius, 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:

Calculation of the event horizon s of a black hole photon:

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

$$\underline{\underline{R_{BH} =}} \frac{G\,M_{BH}}{c^2} = \underline{\underline{7421{,}5\ \mathrm{m}}} \tag{7.24}$$

Alternatively with: $\frac{M_{obj}}{R_{obj}}$ = 1,34746 10^{27} $\frac{kg}{m}$ → Mass-area constant (2.26)

$$R_{BH} = \frac{10^{31}\,\mathrm{kg}}{1{,}34746\ 10^{27}\,\frac{\mathrm{kg}}{\mathrm{m}}} = 7421{,}5\ \mathrm{m} \tag{7.25}$$

Calculation of gravitational effect for different speeds < *c*:

$$R_{BH\_gravity\_range} = \frac{G\,M_{BH}}{V_3^2} \qquad \text{with: } \mathrm{V_3} \text{ – object velocity} \tag{7.26}$$

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

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

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

$$R_{BH\_gravity\_range} = \frac{G\,M_{BH}}{V_3^2} = 66700\ \mathrm{m}$$

Circular frequency - revolutions per second on the vertical axis:

$$k_{BH} = \sqrt{\frac{G\,M_{BH}}{R_{BH}^3}} \tag{7.27}$$

$\underline{\underline{k_{BH} = 40394{,}8\,\frac{1}{s}}}$ → 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: λ_{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:

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

b) 100 kg heavy object:

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

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:

$$R_{BH} = \frac{G\ M_{BH}}{c^2} = 7421{,}5\ \mathrm{m};\ M_{BH} = 10^{31}\ \mathrm{kg} \rightarrow \text{Mass of the black hole}$$

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

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

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

Comparison:

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

Cross-check:

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

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

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:

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

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

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

Compared to individual photons:

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

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

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

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

$\underline{\underline{n = \dfrac{M_{BH}}{M_{BH_{photon}}} = 1}}$ → 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 ion (136,6875 f_e), the electron and the proton are assumed to be absorbed by the black hole.

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

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

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)

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

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

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

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

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

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

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.

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

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

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:

$$n_{obj} = \frac{R_{BH+10} - R_{BH}}{R_{obj}} \qquad \text{mit: } n \in \mathrm{N} \tag{7.39}$$

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

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

Or:

$$n_{obj} \approx \frac{M_{BH+10} - M_{BH}}{M_{obj}} \tag{7.40}$$

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

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

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

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

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 forces in the universe with a gravitational potential of d$M(\alpha < 90°)$ prevail. When the space-time mechanical effects diminish with the expansion of the universe, the gravitational potential tends to decrease to the minimum value d$M(\alpha = 90°)$. 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 $\alpha = 90°$. 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.

Key insight from the black hole:

The essential insight is illustrated in **Figures 7.5 – 7.7**. The black hole photon consists of a fion pair with separate impulses, which are formed parallel to the fourth dimension. Between them lies a fixed gravitational potential of d$M(\alpha = 2{,}65768\ 10^{-60}°)$. 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.