

Copernican relativity

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Abstract

In Schwarzschild solution of the gravitational field equation of Einstein's general relativity theory, the time lapse slows down as it is closer to the center of the gravitational field.

Since the speed C of light cannot be exceeded, the radial axis is distorted.

In vicinity of Black Hole, the radial axis is infinitely distorted.

Therefore, the light cannot escape from vicinity of Black Hole.

According to Copernican relativity, the closer to the center of the gravitational field, the faster the time and the slower the light speed.

Light propagates through the gravitational field changing the direction and the speed of the light.

Therefore, the radial axis is not distorted.

In vicinity of Black Hole, the time passes infinitely fast, and the light speed is almost zero.

In vicinity of Black Hole, the propagation direction of light is extremely bent, so the light cannot escape from the vicinity.

1. Gravitational field

The Earth m is moving at the speed U drawing a circle of radius R around the Sun M .

While time dt is elapsing on the Earth m , time dt' is elapsing in gravitational field space, and the Earth m is moving by distance Udt' .

According to special relativity theory, the following equation (1) holds.

$$C^2 dt^2 = C^2 dt'^2 - U^2 dt'^2 = (C^2 - U^2) dt'^2 \quad (1)$$

C : Coefficients of the speed of light and time on the Earth

U : Earth's orbital speed

dt' : Minute time elapsed in the gravitational field

dt : Minute time elapsed on the Earth

m : The mass of the Earth

M : The mass of the sun

R : Distance between the Earth and the Sun

dS^2 : World distance

The Earth m is a stationary space where only time dt passes, and the gravitational field is an inertial space.

World distance dS^2 in above equation (1) are as follows.

$$C'^2 = C^2 - U^2 \quad C^2 dt^2 = C'^2 dt'^2 \quad R' = R \quad dR' = dR \quad (2)$$

$$-dS^2 = C^2 dt^2 - dR^2 - R^2(d\theta^2 + \sin^2\theta d\phi^2) \quad (3)$$

$$= C'^2 dt'^2 - dR'^2 - R'^2(d\theta^2 + \sin^2\theta d\phi^2) \quad (4)$$

In the microscopic local space, the gravitational field is an inertial space, but in the grand scheme of things, it is a spherically symmetric acceleration space.

Due to its acceleration, light propagates through a spherically symmetrical gravitational field while changing the direction and the speed C' of light.

Therefore, the polar axes R' are not distorted.

In addition, the speed C of light is unchanged when measured both on Earth and in the gravitational field.

The speed of light in the gravitational field appears to be slower from the Earth because the time lapse dt' of the gravitational field is faster than the time lapse dt on the Earth.

Since the above is the exact opposite of Einstein's general theory of relativity, it can be said to be a Copernican theory of relativity.

World distance dS^2 of Einstein's gravitational field equation (Schwarzschild solution) is as follows.

$$-dS^2 = C^2 \left(1 - \frac{R_s}{R}\right) dt^2 - \frac{1}{\left(1 - \frac{R_s}{R}\right)} dR^2 - R^2(d\theta^2 + \sin^2\theta d\phi^2) \quad (5)$$

The above World distance dS^2 is expressed in the gravitational field polar coordinates as follows.

$$dt'^2 = \left(1 - \frac{Rs}{R}\right) dt^2 \quad dR'^2 = \frac{1}{\left(1 - \frac{Rs}{R}\right)} dR^2 = dR^2 + \frac{\frac{Rs}{R}}{\left(1 - \frac{Rs}{R}\right)} dR^2 \quad R'^2 = R^2 \quad (6)$$

$$-dS^2 = C^2 dt'^2 - dR'^2 - R'^2 (d\theta^2 + \sin^2\theta d\phi^2)$$

As shown by equation (6), the time lapse dt' of the gravitational field is slower than the time lapse dt of the rest space.

Since light cannot propagate beyond the speed C of light, the radial axis R' of the gravitational field must be distorted.

In other words, light propagates bending along the strain of the radial axis R' .

It is unclear whether the gravitational field makes light appear to bend because space is distorted, or whether space appears to be distorted because light propagates changing the direction and the speed C' in a gravitational field.

Here, Copernican relativity is developed.

2. Speed U

$$\text{The kinetic energy of the Earth } E = \frac{mU^2}{2}$$

The derivative of the Earth's kinetic energy E by its distance R from the Sun M is the force $F = \frac{mGM}{R^2}$ with which the Sun's gravitational field acts on the Earth m (the gravitational force of Newtonian mechanics).

$$\frac{dE}{dR} = F \quad \frac{d\left(\frac{mU^2}{2}\right)}{dR} = -F = -\frac{mGM}{R^2} \quad \frac{dU^2}{dR} = -\frac{2GM}{R^2}$$

If both sides of the above equation are integrated from distance R to infinity ∞ , the following equation (7) holds.

$$U^2 = \int_R^\infty \frac{dU^2}{dR} = -\int_R^\infty \frac{2GM}{R^2} = \frac{2GM}{R}$$

$$U^2 = \frac{2GM}{R} \quad (7)$$

Then equation (1) is rewritten as follows:

$$-dS^2 = C^2 dt^2 = \left(C^2 - \frac{2GM}{R}\right) dt'^2 \quad (8)$$

3. The speed C' of light in the gravitational field and the Schwarzschild radius R_s

The distance at which light propagates at the speed C' of light in any inertial space is the same in elapsed time dt' .

In other words, the following equation holds.

C' : The speed of light in inertial space (gravitational field)

$$C^2 dt^2 = C'^2 dt'^2$$

The speed C' of light in the gravitational field is as follows.

$$C'^2 = C^2 - \frac{2GM}{R} \quad (9)$$

When $C'^2 = 0$, $C^2 - \frac{2GM}{R} = 0$

$$R_s = \frac{2GM}{C^2} : \text{Schwarzschild radius} \quad (10)$$

4. Propagation of light in gravitational fields

First, as shown in Fig.1, light propagates orthogonally to a point at a distance R from the point mass M .

After that, the light reaches a position at a distance R'

from the point mass M as shown in Fig.1.

$$\delta = \theta - \omega > 0$$

Its position is rotated by an angle θ around the point mass M .

Light rotates in the direction of its propagation by an angle ω .

The speed of change $C' \left(\frac{d\omega}{dt'} \right)$ in the direction of propagation of light is equal to the acceleration $\frac{dU^2}{dR} \cos\delta$ of the gravitational field.

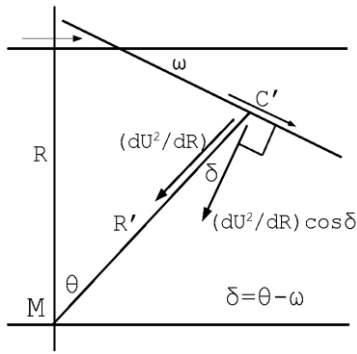


Fig.1

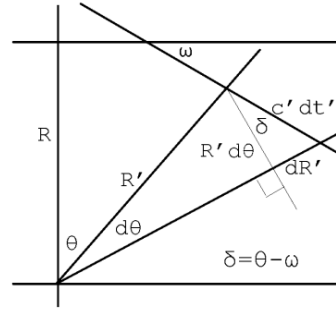


Fig.2

Then the following equation (11) holds.

$$C' \frac{d\omega}{dt'} = C' \left(\frac{d\omega}{d\theta} \right) \left(\frac{d\theta}{dt'} \right) = \frac{dU^2}{dR} \cos\delta \quad (11)$$

$$U^2 = \frac{2GM}{R} \quad (7)$$

As can be seen from Fig.2, the following equation holds.

$$\frac{d\theta}{dt'} = \frac{C' \cos\delta}{R'}$$

Using the above equation, equation (7) is rewritten as follows, and the following equation (8) holds.

$$\frac{d\omega}{dt'} = \left(\frac{d\omega}{d\theta}\right)\left(\frac{d\theta}{dt'}\right) = \left(\frac{d\omega}{d\theta}\right)\left(\frac{c' \cos\delta}{R'}\right) = \frac{2GM \cos\delta}{c' R'^2}$$

$$\frac{d\omega}{d\theta} = \frac{2GM}{c'^2 R'} \quad (12)$$

Using equation (7), the above equation (12) is rewritten into the following equation (13).

$$\frac{d\omega}{d\theta} = \frac{\frac{2GM}{c'^2 R'}}{\left(1 - \frac{2GM}{c'^2 R'}\right)}$$

$$Rs = \frac{2GM}{c^2}$$

$$\frac{d\omega}{d\theta} = \frac{\frac{Rs}{R'}}{\left(1 - \frac{Rs}{R'}\right)} \quad (13)$$

$$R' = \frac{R}{\cos\delta} \quad 2Rs < R$$

See Appendix 2 for the derivation of the above equation

5. Black hole

R of black holes BH_M satisfies the following equation.

$$R = \gamma Rs \quad (1 < \gamma < 2)$$

See Appendix 5 for derivation of the following equation.

$$R' = R \cos\delta$$

Using the above equation, equation (9) is rewritten as follows:

$$\frac{d\omega}{d\theta} = \frac{\frac{Rs}{R \cos\delta}}{1 - \frac{Rs}{R \cos\delta}}$$

When $R = \gamma Rs$ ($1 < \gamma < 2$), the above equation (9) is rewritten as follows.

$$\frac{d\omega}{d\theta} = \frac{1}{\gamma \cos\delta - 1} > 1 \quad (14)$$

The above equation (14) shows that the trajectory of light is spiral-shaped.

In other words, light that enters a gravitational field within twice the Schwarzschild radius Rs cannot escape that gravitational field.

Therefore, when the mass radius R_M of the mass M (**see**

Appendix 7) is greater than the Schwarzschild radius R_s and less than twice its size, the mass M is a Black hole BH_M .

$$R_s < R_M < 2R_s \quad (11)$$

There is no celestial material M whose mass radius R_M is smaller than the Schwarzschild radius R_s .

Because when the radius of mass R_M is smaller than the Schwarzschild radius R_s , what is a space in which no physical quantities (space-time, light, matter, charge, etc.) can exist? and such a situation is physically impossible.

Therefore, when the mass radius R_M is about to become smaller than the Schwarzschild radius R_s , Black hole BH_M explodes, its mass M disperses, and the Black hole BH_M disappears.

Appendix 2

Referring to Figure 2, when $\theta - \omega > 0$, R' is obtained as follows.

$$\begin{aligned} \delta &= \theta - \omega \\ dR' &= C' dt' \sin \delta \\ \frac{d\theta}{dt'} &= \frac{C' \cos \delta}{R'} \\ \frac{dR'}{dt'} &= \frac{dR'}{d\theta} \frac{d\theta}{dt'} = C' \sin \delta \\ \frac{dR'}{d\theta} \frac{C' \cos \delta}{R'} &= C' \sin \delta \\ \frac{d(\log R')}{d\theta} &= \frac{\sin \delta}{\cos \delta} = - \frac{d(\log(\cos \delta))}{d\delta} \end{aligned}$$

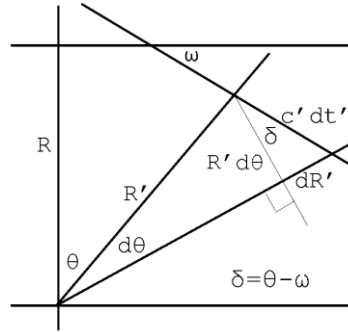


Fig. 2

If the left side of the above equation is integrated by $d\theta$ and the right side is integrated by $d\delta$, the following equation is established.

$$\log R' = -\log(\cos \delta) + \log A$$

A : constant of integration

$$R' \cos \delta = R' \cos(\theta - \omega) = A$$

When the light is perpendicular to the radial axis R , the following equation holds.

$$\theta = \omega = 0 \quad R' = R$$

Therefore, $R = A$

$$R' = \frac{R}{\cos \delta}$$

Appendix 3

μ particle life and mileage

Primary cosmic rays ν , which have very high energy, collide with atoms above the atmosphere to form high-energy (velocity) muons μ .

These muons μ are formed at high altitudes $6km$ and reach the ground.

Muons at rest decay into electrons (e^-) and neutrons (neutrinos γ_μ) over lifetime ($2.15 \times 10^{-6}sec$).

No particle can travel beyond the speed $C(3.0 \times 10^8m/s)$ of light.

Even if this muon μ travels at the speed C of light, its mileage is high $\tau \times C = 2.15 \times 10^{-6}sec \times 3.0 \times 10^8m/s = 645m$.

Therefore, muons μ decay while traveling from high altitudes and cannot reach the ground.

In order to reach the ground, the time lapse of a muon μ traveling at high speed must be smaller than the time lapse on the ground.

According to the special theory of relativity, the following equation holds.

C : Speed of light (speed of light in stationary space)

v : Muon μ velocity

dt' : Time elapsed on the ground

dt : Elapsed time of muon μ

τ : Life expectancy of muon μ

dS^2 : World distance

$$-dS^2 = C^2\tau^2 = C^2dt'^2 - v^2dt'^2 \quad vdt' = 6km$$

Based on the above equation, the muon μ reached the ground from high altitude $6km$ at a speed ($\cong 2.771 \times 10^8 m/s$) close to light speed C and collapsed.

Appendix 4

The energy of the point mass M

The acceleration of the gravitational field of the point mass M is U^2 differentiated by dR and is as follows.

$$\frac{dU^2}{dR} = \frac{d\left(\frac{2GM}{R}\right)}{dR} = -\frac{2GM}{R^2}$$

The above acceleration acts on the small mass dM at a distance R from the point mass M .

The force F acting on the small mass dM are as follows.

$$F = \frac{2GM}{R^2} dM$$

The energy dE when a force F acts on the small mass dM over distance dR is:

$$dE = FdR$$

The following energy E_{dM} are required to transport the small mass dM from the Schwarzschild radius R_s to infinity.

$$R_s = \frac{2GM}{C^2}$$

$$E_{dM} = \int dE = \int_{R_s}^{\infty} FdR = \int_{R_s}^{\infty} \frac{2GMdM}{R^2} dR = \frac{2GMdM}{R_s} = C^2dM$$

As described above, the energy E_{dM} is the energy required to transport the small mass dM from the Schwarzschild radius R_s to infinity and does not depend on the point mass M .

Then, the following equation holds.

E_M : The energy of the point mass M

$$E_M = \int E_{dM} = \int_0^M C^2dM = MC^2$$

Therefore, E_M is the energy of the point mass M .

補足 5

When $R = \gamma R_s (1 < \gamma < 2)$, $R' = R \cos \delta$

$$-\delta = \theta - \omega$$

$$\frac{dR'}{R' d\theta} = -\tan \delta = -\frac{\sin \delta}{\cos \delta}$$

$$\frac{dR'}{d\theta} \frac{\cos \delta}{R'} = -\sin \delta$$

$$\frac{d(\log R')}{d\theta} = -\frac{\sin \delta}{\cos \delta} = \frac{d(\log(\cos \delta))}{d\delta}$$

$$\log R' = \log(\cos \delta) + \log A$$

$\log A$: constant of integration

$$R' = A \cos \delta, \quad \theta = \omega = 0, \quad R' = R = A$$

$$R' = R \cos \delta = \gamma R_s (\cos \delta)$$

Using the above equation, equation (9) is rewritten as follows:

$$\frac{d\omega}{d\theta} = \frac{\frac{R_s}{R'}}{1 - \left(\frac{R_s}{R'}\right)} \quad (9)$$

$$\begin{aligned} \frac{d\omega}{d\theta} &= \frac{\frac{R_s}{R \cos \delta}}{1 - \left(\frac{R_s}{R \cos \delta}\right)} \\ &= \frac{\frac{1}{\gamma \cos \delta}}{1 - \frac{1}{\gamma \cos \delta}} \end{aligned}$$

$$= \frac{1}{\gamma \cos \delta - 1} > 0$$

$$\frac{d\delta}{d\theta} = \frac{d\omega}{d\theta} - 1 = \frac{2 - \gamma \cos \delta}{\gamma \cos \delta - 1}$$

$$(2 - \gamma \cos \delta) > 0$$

$$= (2 - \gamma \cos \delta) \frac{d\omega}{d\theta} > 0$$

$$\frac{d\omega}{d\theta} - 1 > 0$$

$$\frac{d\omega}{d\theta} > 1$$

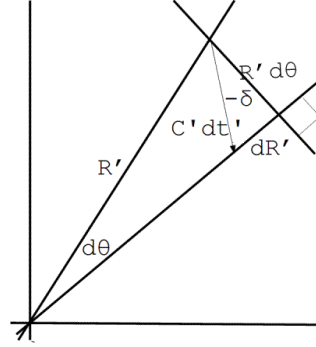


Fig.3

補足 6

The propagation direction of light propagating around the Sun M is bent as shown in Fig. 4.

R : Radius around the sun

M : The mass of the sun

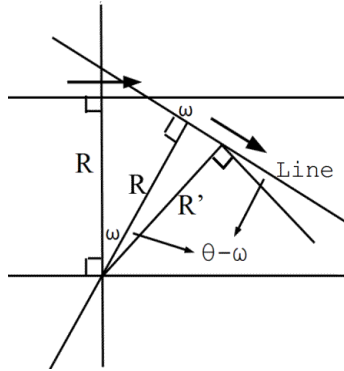


Fig.4

ω_p : The angle at which the light propagating R around the sun M is bent

$R_s (= \frac{2GM}{c^2})$: Schwarzschild radius of the Sun M

$R_s \ll R$ $\omega \ll \theta$ $\delta = \theta - \omega \cong \theta$

$R' = R / \cos \delta$: See **Appendix 2**

$$\frac{d\omega}{d\theta} = \frac{R_s \left(\frac{\cos \delta}{R} \right)}{1 - R_s \left(\frac{\cos \delta}{R} \right)} \cong \frac{R_s}{R} \cos \theta$$

$$\omega_p = \int d\omega \cong \int_{-\pi/2}^{\pi/2} \frac{R_s}{R} \cos \theta d\theta$$

$$= \frac{R_s}{R} \left(\sin \left(\frac{\pi}{2} \right) - \sin \left(-\frac{\pi}{2} \right) \right)$$

$$\omega_p = \frac{2R_s}{R} = \frac{4GM}{c^2 R}$$

Appendix 6

The mass M and mass radius R_M of Black hole BH_M
I Given the radial density ρ/r of the mass M , the mass radius R_M is larger than the Schwarzschild radius R_s .
 Therefore, Black holes cannot exist.

If the radial density of the mass M is the radial radius ρ/r^3 , then the mass radius R_M is smaller than the Schwarzschild radius R_S .

Therefore, there are no ordinary stars.

ρ : Mass density

ρ_M : Density coefficient

R_M : Mass radius

ρ_S : Density coefficient at mass radius $R_M = R_S$

R_S : Schwarzschild radius

r : Distance from the center of mass M

II The mass density ρ is assumed as follows.

$$\rho = \frac{\rho_M}{r^2}$$

$$M = \int_0^{R_M} 4\pi r^2 \rho dr = \int_0^{R_M} 4\pi \rho_M dr = 4\pi \rho_M R_M$$

Since the Schwarzschild radius R_S does not exceed the mass radius R_M , the following equation holds.

$$R_S = \frac{2GM}{c^2} = \frac{8\pi G}{c^2} \rho_M R_M$$

$$\rho_S = \frac{c^2}{8\pi G} = \frac{\rho_M R_M}{R_S}$$

$$\rho_S R_S = \rho_M R_M = 4\pi M$$

As mentioned above, the density coefficient ρ_S is a constant $\frac{c^2}{8\pi G}$ that does not depend on the Schwarzschild radius R_S or the mass radius R_M .

Since the mass radius R_M of Black hole BH_M is greater than the Schwarzschild radius R_S and less than twice as large, the following inequality holds.

$$\frac{c^2}{16\pi G} < \rho_M < \rho_S = \frac{c^2}{8\pi G}$$

When the density coefficient ρ_M exceeds $\rho_S = \frac{c^2}{8\pi G}$, Black hole BH_M explodes and ceases to be Black hole.

In addition, if the density coefficient ρ_M is less than or

less $\frac{c^2}{16\pi G}$, it is an ordinary star.

III A star ($2R_S < R_M$) with density coefficient ρ_M is considered to be Black hole BH_M as follows.

$$\rho_M > \frac{c^2}{16\pi G}$$

The mass M_S within the radius R_S of the star creates a gravitational field (acceleration) outside the radius R_S .

The gravitational field acts as a force that causes the mass outside the radius R_S to contract to the center of gravity.

As a result, the mass radius R_M decreases, but the density coefficient ρ_M increases in inverse proportion.

Since the mass M_S in the radius R_S increases, the contraction force becomes even larger.

The mass M_S within the radius R_S increases and the contractile force continues to increase.

When the mass is highly contracted to high temperature and pressure, nuclear fusion occurs due to further contraction.

Since nuclear fusion takes time, the mass radius R_M does not decrease in a short time even if the contractile force is applied.

Stars shine due to this nuclear fusion.

When the radius R_M of mass is reduced to less than twice Schwarzschild radius R_S by nuclear fusion, the star becomes Black hole BH_M .

However, not all stars become Black hole BH_M .

This is thought to be because nuclear fusion causes the star to release mass and the density coefficient ρ_M of the star becomes smaller than $\frac{c^2}{16\pi G}$.

It should be noted that even nuclear fusion cannot be sustained by the sun.

R_s : シュバルツシルト半径
 R_M : 質量半径

