Physical conditions of space curvature

General relativity describes gravity as the curvature of space-time. The question arises: how does gravity curves space-time? In "Introduction to General Relativity" (p. 184), Bernard F. Schutz, discussing the transition from differential geometry to gravity, formulates the following postulate: "we must say how curvature is generated or determined by objects in spacetime." Unfortunately, this postulate has not been analysed and is rhetorical in nature.

The starting point for the analysis of how the curvature of space-time can be generated is the elastic deformation of macroscopic objects. It seems that the best analogy for the spatial axes (coordinates) of space-time are slender rods. For the time axis of space-time, however, it is difficult to find a macroscopic object whose elastic deformation could be an analogy for its curvature. If the concept of space coordinates is obvious, and the concept of length as a parameter describing space coordinates is also obvious, then time is not an obvious concept and requires definition. Hence, further analyses concern three-dimensional space, not space-time.

The deformation of a macroscopic object requires the action of a force on the deformed object. Bernard F. Schutz, discussing the principle of equivalence (p. 126), states: "we must have an idea of what force is." Unfortunately, here too there is no attempt to define force and the statement is rhetorical. Before it is possible to define force, we will use the concept of "factor causing deformation". The elasticity of space means that after the action of the factor causing deformation ceases, the space return to its undeformed state. Depending on how "applied" the deformation factor is, the deformed object can be compressed, stretched, twisted or bent. A deformation that is a curve can be induced by bending or compression. Elastic deformation caused by bending or compression applies to objects that are elastically rigid. To bend a slender rod, it is necessary to "apply" a deformation factor consisting of two "bending moments" or three "forces". In the case of bending, it is not possible to determine by macroscopic analogy what two "bending moments" or three "forces" could be and how two "bending moments" or three "forces" could be "applied" to space using gravity, regardless of how gravitational forces would be defined.

In compression, the curvature of a slender bar is its buckling. If the compression of space is local, then a local fragment of space may be compressed by the space surrounding it. The condition for local compression is a local disturbance (fluctuation) of the stiffness of space. A local stiffness disturbance causes the local stiffness of the space to be lower than the stiffness of the surrounding space. The space with disturbed stiffness does not balance the stiffness of the space surrounding it and the space with disturbed stiffness is compressed by the space surrounding it. We call such a space elementary space. The stiffness disorder may affect one axis, two axes, or all three axes. Elementary space can be compressed in one axis, in two axes, or in all three axes.

The amount of buckling is limited. When compressing a slender rod, the bending angle cannot exceed 180^0. The analogy to compressing a slender rod shows that the amount of space curvature is limited.

In the analysis of the physical conditions of space curvature, the limitation of the amount of space curvature is the only limitation imposed on the geometry of space and its mathematical description. This limitation is valid not only for curved space, but for any space deformed by local compression. The analysis of how limiting the amount of space deformation affects the mathematical description of space geometry goes beyond the scope of physical conditions of space curvature.

1. Space curvature parameters

The analysed three-dimensional space is described by three lengths perpendicular to each other. With three perpendicular lengths, the surface area and volume are also defined. The curvature of elementary space caused by compression causes elementary space to differ from the surrounding space in length, area, or volume.

The size of the space surrounding the elementary space causes the compression of the elementary space to cause a negligible curvature of the surrounding space. The space surrounding the elementary space, referred to as ambient space, can therefore be treated as uncurved space.

The parameters describing the curvature of the elementary space are either the ratio of the length, area or volume of the elementary space after curvature to the length, area or volume before curvature, or are the ratio of the difference of these parameters after curvature and before curvature to the parameter before curvature.

Two parameters are needed to describe the curvature of elementary space: a scalar parameter describing the amount of curvature and a vector parameter describing the direction of curvature. The scalar parameter is the change in the volume of space caused by compression. We define the change in the volume of space as the relative curvature (of space). The relative curvature (h) is equal to the relative change in volume

$$h = \frac{V}{V_0}$$

An uncurved space (h = 1) is called a flat space. The relative curvature of uncurved space h = 1 means that the relative curvature is the product of the relative curvature in each axis

$$h = 1 = 1 \times 1 \times 1 = h_x \times h_y \times h_z$$

The axes of space X, Y, Z are indistinguishable and the relative curvature in each curved axis is the same. For compressed space, the relative curvature is less than one. The amount of relative curvature in one axis, defined by the symbol s, is called the relative curvature constant.

$$h_i = s < 1$$

The vector parameter is the change in the length of space caused by compression. The change in the length of space is defined as linear curvature (of space). The linear curvature (f) is equal to the relative difference in length

$$f = \frac{\Delta l}{l_0}$$

For uncurved space, linear curvature has a value of zero (f = 0). For a compressed space, the linear curvature has a negative value.

Depending on the directions of stiffness disturbance and the resulting directions of compression of the elementary space by the surrounding space, three types of elementary spaces are possible:

1. space curved in one axis $h_x = s$; $h_y = h_z = 1$; $h_1 = s$
2. space curved in two axes $h_x = h_y = s$; $h_z = 1$; $h_2 = s^2$
3. space curved in three axes $h_x = h_y = h_z = s$; $h_3 = s^3$

2. Physical interpretation of the local disruption of the rigidity of space

Local perturbation of stiffness causes that in the perturbed area referred to as elementary space, the stiffness of space is lower than in the undisturbed space referred to as ambient space, and the ambient space compresses elementary space. From the macroscopic analogy it can be concluded that the difference in linear curvature Δf caused by compression causes an opposite action called force (F)

$$F + \Delta f = 0$$

When the stiffness is lost, the elementary space is not curved and no forces act in it. The compression of the elementary space resulting from the difference in stiffness is the effect of the pressure difference. The pressure p corresponding to the stiffness of space is the dot product of the relative curvature h. The physical dimension of pressure is also the dimension of energy density. Hence, the loss of space stiffness is the result of pick up a certain amount of energy from space. While discussing the physical conditions of space curvature, it is not possible to answer the question of how energy is pick up from the elementary space.

The dot product of the relative curvature of elementary space as a remainder of the energy density is the inertial mass density.

$$\rho = \frac{m}{V} = h^2$$

The inertial mass density of elementary spaces is

1. space curved in one axis $\rho_1 = s^2$
2. space curved in two axes $\rho_2 = s^4$
3. space curved in three axes $\rho_3 = s^6$

At a certain value of the curvature of the elementary space, the force caused by the difference in linear curvature balances the difference in pressure between the surrounding space and the elementary space. The relative curvature constant s is equal to the relative curvature of the elementary space compressed in one axis, at which a force equal to the difference in linear curvature balances the pressure of the surrounding space.

2.1. Causes of movement in space

In a macroscopic object, compression causes movement outward from the object in a plane perpendicular to the direction of compression. The analogy of macroscopic compression shows that the compressed space moves in a plane perpendicular to the direction of compression. In space curved in one axis and space curved in two axes, there is an internal difference in linear curvature between the curved and uncurved axes, which causes the elementary space to move in the direction determined by the uncurved axes. A space curved in two axes moves in a progressive motion in a direction perpendicular to the compression plane. The movement direction is random. A space curved in one axis has two degrees of freedom of motion: progressive motion in a plane perpendicular to the direction of compression with a random direction and sense, and rotational motion with a random direction (L, R). In a space curved in three axes, there is no internal difference in linear curvature. Compression does not cause movement of space curved in three axes.

The movement of elementary space is the change in the position of the curvature of space relative to the surrounding space. Space is homogeneous and it is not possible to determine the position of elementary space in relation to the surrounding space. The position of an elementary space can only be determined relative to another elementary space. The motion of an elementary space determined relative to other elementary spaces is a relative motion.

Length (l) as the distance between two positions of the moving elementary space is a space parameter and does not depend on the motion of the elementary space. The motion parameter is a number describing the changes in the position of the elementary space. The number describing the changes in the position of the elementary space is proportional to the length of the movement. In continuous space, with continuous movement of the elementary space, the number of changes in the position of the elementary space is infinite and is not a motion parameter. In curved space length changes. Changing the length changes the value of the number describing the changes in the position of the elementary space. The number describing changes in the position of elementary space is proportional to the amount of space curvature. In uncurved space, the number describing changes in the position of elementary space is the smallest. The relative curvature (h) is inversely proportional to the curvature of space. For a curved space, the number describing the changes in the position of the elementary space is inversely proportional to the relative curvature of the space in which the movement of the elementary space takes place. The number describing changes in the position of the elementary space is called time t

$$t = \frac{1}{h} \times l$$

Time as a number describing the change in the position of elementary space describes the movement that has already taken place. The parameter describing the current movement of elementary space is velocity (v)

$$v = \frac{dl}{dt} = h$$

The movement of elementary space is not the movement of space as such. The movement of elementary space is the movement of the curvature of space, or more precisely, it is the movement of the change of the curvature of space.

The velocity proportional to the relative curvature is the velocity at which the change in curvature propagates through space.

The curvature of elementary space is perpendicular to the direction of motion. In a plane perpendicular to the direction of movement of elementary space, the change in the curvature of space caused by the movement of elementary space propagates in the form of a spherical change in the curvature of space. A spherical change in the curvature of space is inversely proportional to the square of the distance from the place of change.

The movement of space curved in two axes causes a spherical change in the curvature of space in two axes perpendicular to the direction of movement.

The movement of space curved in one axis causes a spherical change in the curvature of space in one axis perpendicular to the direction of movement. The curvature of spherical space changes the curvature of space in one axis to rotate according the rotation of the curvature in that axis. Due to the rotation of the curvature, the spherical change in the curvature of space in one axis is sinusoidally variable.

Spherical change in the curvature of space add up. The sinusoidal nature of the spherical change in space curvature in one axis means that the summation result depends on the rotation frequency of the space curvature and the rotation phase of the space curvature. As a result of summing spherical change in the curvature of space in one axis, wave phenomena such as interference, resonance or polarization may occur. The summation of spherical change in the curvature of space in two axes does not produce any wave phenomena.

2.2. Kinematic interpretation of interaction at a distance

The time of motion of the elementary space is inversely proportional to the relative curvature of the surrounding space in which the motion takes place. If a moving elementary space is within the range of a spherical change in space curvature produced by another moving elementary space, the relative curvature of the surrounding space on the side of the source of the spherical change in space curvature will have a smaller value than on the opposite side, and the movement time of this elementary space will be longer from the side of the source of the spherical change in the curvature of space than from the opposite side. The difference in the time of movement of the side of elementary space directed towards the source of the spherical change in the curvature of space and the opposite side will cause an additional movement of elementary space in the direction of the difference in time of movement, and the elementary space will move in a centripetal motion relative to the source of the spherical change in the curvature of space. Elementary space, which moves centripetally relative to the source of the spherical change in the curvature of space, is in turn the source of the spherical change in the curvature of space for the elementary space relative to which it performs centripetal motion. Both elementary spaces will move centripetally towards each other. In the reference frame of any elementary space, there will be an attractive interaction between both elementary spaces, inversely proportional to the square of the distance between the attracting elementary spaces.

The mathematical description of the probability of occurrence of wave phenomena concerns the quantum properties of the interaction on the distance between spaces curved in one axis. In a space curved in three axes, there is no internal difference of linear deformation. Space curved in three axes does not move relative to the surrounding space. There is no interaction on the distance between spaces curved in three axes.

2.3. Kinematic interpretation of direct interaction

Elementary spaces can collide with each other. On the side of collision with the second elementary space, the motion time is clearly longer than the motion time of the opposite side. The difference in motion time causes the colliding elementary spaces to move centripetally towards each other and may superposition. The superposition of elementary spaces on each other is not the superimposition of one space on another, but is the summation of the curvature of the spaces of the superimposed elementary spaces. In directions in which the elementary spaces are not curved, the superposition of elementary spaces does not produce any change in space.

The sum of the curvature of space of the colliding elementary spaces may be greater than the maximum curvature of space in some direction. In such a situation, the difference in the linear curvature of the maximum curvature and the sum of the linear curvature of the colliding elementary spaces has a negative value and the centrifugal force prevents the superimposition of the colliding elementary spaces. The colliding elementary spaces then move relative to each other on their external surfaces.

The curvature of space curved in three axes is greatest. If the curvature of the space curved in three axes Z is smaller than the maximum curvature T_{max}, and the sum of the curvature of the space curved in three axes Z and the space curved in one axis X is greater than the maximum curvature T_{max}

$$Z < T_{max} < Z + X$$

then the elementary space, colliding with the space curved in three axes, will move centripetally on the outer surface of the space curved in three axes.

The movement time of the space curved in one axis colliding with the space curved in three axes on the surface side of the space curved in three axes is clearly longer than on the opposite side. The difference in the movement time of the space curved in one axis causes the space curved in one axis to stretch on the surface of the space curved in three axes at the equatorial position. Differences in rotational time cause the space curved in one axis to be stretched perpendicular to the equatorial position. The resultant stretching of space curved in one axis on the surface of triaxial space is oblique to the equatorial position, and space curved in one axis slides off the surface of triaxial space.

The movement time of the space curved in two axes colliding with space curved in three axes on the surface side of the space curved in three axes is clearly longer than on the opposite side. The difference in the movement time of the space curved in two axes causes the space curved in two axes to stretch on the surface of the space curved in three axes at the equatorial position. After colliding with the space curved in three axes, the space curved in two axes creates a rotating ring at the equatorial position on the surface of the space curved in three axes.

The movement time of the space curved in one axis colliding with the rotating ring of the space curved in two axes on the side in contact with the ring is clearly greater than on the opposite side. The difference in the movement time of the space curved in one axis causes the space curved in one axis to stretch within the ring of the space curved in two axes. The difference of the rotation time increases the amount of superimposed of space curved in one axis on the ring of space curved in two axes. After colliding with a ring of space curved in two axes, the space curved in two axes forms a rotating ring superimposed on the rotating ring of space curved in two axes.

The movement time of the places of the ring of space curved in two axes with the superimposed curved space in one axis is greater than the movement time of the places of the ring of space curved in two axes in the ambient space. Increasing the movement time of the space curved in two axes ring sites with the superimposed space curved in one axis ring stretch the space curved in two axes ring circumferentially, which increases the radius of centripetal movement on the space curved in three axes surface. A ring of space curved in two axes with a superimposed ring oof space curved in one axis in it has a larger diameter than a space curved in two axes ring (without a space curved in one axis ring superimposed on it).

For an elementary space moving in translation, the curvature of space is perpendicular to the direction of translation. The extension of elementary space into a rotating ring changes the spatial location of the curvature of space. In the reference system of the ring rotation axis, the position of the curvature of the space of the rotating ring can be described by the following components: radial, axial and circumferential. There are three possible types of rotating rings, differing in the number of components needed to describe the position of the curvature of space.

The individual components of the curvature of the rotating ring do not differ from each other and the relative curvature in one axis of the rotating ring is the resultant of the components and is

$$h_p = \sqrt{n} \times s$$

The relative curvature for the rotating rings is

1. ring of space curved in one axis $h_{p1} = h_p \times 1 \times 1 = \sqrt{n} \times s$
2. ring of space curved in two axes $h_{p2} = h_p \times h_p \times 1 = n \times s^2$

2.3.1. Kinematic interpretation of the sign of a ring of space curved in one axis

If the cross-section of the ring of space curved in one axis is smaller than the cross-section of the ring of space curved in two axes, the ring of space curved in one axis will not be in contact with the surface of the space curved in three axes and the rotational movement of the ring of space curved in one axis will be independent from the rotational movement of a ring of space curved in two axes. Randomly, the rotations of the space curved in one axis ring and the space curved in two axes ring will be consistent or opposite.

With opposite rotations, the time of one complete revolution of the ring of space curved in one axis will be longer than with consistent rotations. The time of movement depends on the curvature of the space in which the movement takes place. The difference in the time of movement during consistent and opposite rotations shows that the curvature of the superimposed spaces - the ring of space curved in two axes and the ring of space curved in one axis - is greater for opposite rotations than for consistent rotations. The curvature of the space of superimposed elementary spaces adds up. With a longer movement time (opposite rotations), the curvature of space is the sum of the space curved in two axes and one axis. With shorter movement time (consistent rotations), the curvature of space is the difference in the space curved in two axes and one axis. With opposite rotations, the curvature of space in one axis is greater than the space curved in two axes. With consistent rotations, the curvature of space in one axis is smaller than the space curved in two axes.

With consistent rotations, we assign a positive sign to the ring of space curved in one axis. With opposite rotations, we assign a negative sign to the ring of space curved in one axis. The spherical change in the curvature of space generated by a rotating ring of space curved in one axis is the difference between the spherical change in the curvature of space generated by the rotating rings of biaxial curved space and space curved in one axis, and the spherical change in the curvature of space generated by the rotating ring of space itself curved in two axes. With a positive sign assigned to a ring of space curved in one axis, the difference is inversely proportional to the square of the distance from the source. The curvature of space transmitted by a positive spherical change in the curvature of space decreases. With a negative sign assigned to a ring of space curved in one axis, the difference is inversely proportional to the square of the distance from the negatively signed source. The curvature of space conveyed by a negative spherical change in the curvature of space increases.

2.3.2. Dependence of the impact of a spherical change in the curvature of space on the sign

If the rotating positive ring of space curved in one axis is within the range of a positive spherical change in space curvature, the relative curvature of the surrounding space on the side of the source of the positive spherical change in space curvature will have a smaller value than on the opposite side, and the movement time of the positive ring of space curved in of one axis will be longer on the side of the source of the positive spherical change in the curvature of space than on the opposite side. The difference in the movement time of the side of the positive ring of the curved space in one axis directed to the source of the positive spherical change in the curvature of space and the opposite side will cause an additional movement of the positive ring of the curved space in one axis in the direction of the difference in the time of movement, and the positive ring of the curved space in one axis will move with centripetal to the source of the positive spherical change in the curvature of space.

Changing the sign of a ring of space curved in one axis changes the sign of the motion time difference. A positive ring of space curved in one axis within the range of a negative spherical change in the curvature of space in one axis will move in a centrifugal motion relative to the source of the negative spherical change in the curvature of space. A negative ring of space curved in one axis within the range of a negative spherical change in the curvature of space in one axis will move in a centripetal motion relative to the source of the negative spherical change in the curvature of space. A negative ring of space curved in one axis that is within the range of a positive spherical change in the curvature of space in one axis will move in a centrifugal motion relative to the source of the positive spherical change in the curvature of space.

2.3.3. Movement of curved space in three axes

The movement of space curved in three axes can be caused by the direct interaction of another elementary space. If, as a result of the direct interaction of another elementary space, the three-axial space is deformed asymmetrically, then a force equal to the difference in linear deformations will cause the curved space to move in three axes.

After colliding with the space curved in three axes, the space curved in two axes creates a ring of space curved in two axes on the surface of the space curved in three axes, rotating in the equatorial position. The interaction of the ring of space curved in two axes with the spherical change in the curvature of space in two axes slides the ring of space curved in two axes off the surface of space curved in three axes.

If three rings of space curved in two axes rotate on the surface of a space curved in three axes, then as a result of the mutual interaction between the rings in the places where the rings superimposed, the axes of rotation of the rings will be mutually perpendicular and the impact of the spherical change in the curvature of space in two axes will not slide the rings off surface of space curved in three axes. The difference in the time of movement of the rings of space curved in two axes from the side of the source of the spherical change in space curvature and the opposite side deforms the rings. The deformation of the rings of a space curved in two axes deforms a space curved in three axes. A force equal to the difference in linear deformations causes the movement of space curved in three axes.

In centripetal motion, the peripheral component is proportional to the radius of motion, and the radial component is inversely proportional to the radius of motion. The radius of centripetal movement of a ring of space curved in two axes caused by the interaction of a spherical change in the curvature of space in two axes is comparable to the distance between the rings interacting with each other. The radial component of the centripetal movement of the ring of space curved in two axes and the attractive interaction of the spherical change in the curvature of space in two axes on a space curved in three axes are negligibly small.

2.3.3.1. The movement of space curved in three axes caused by a spherical change in the curvature of space in one axis

A ring of space curved in one axis superimposed on a ring of space curved in two axes does not touch the space curved in three axes. The deformation of the ring of space curved in one axis caused by the interaction with the spherical change in the curvature of space in one axis is the deformation of the ring of space curved in two axes with the opposite sign. The deformation (of the opposite sign) of a ring of space curved in two axes deforms the space curved in three axes. The force equal to the difference in linear deformations of space curved in three axes has the opposite sign to the force acting on the ring of space curved in one axis. With the consistent signs of the ring of space curved in one axis and the spherical change in the curvature of space in one axis, three-axis space performs centripetal movement. With opposite signs of the ring of space curved in one axis and the spherical change in the curvature of space in one axis, three-axis space performs centrifugal movement.

The radius of centripetal (centrifugal) movement of a ring of space curved in one axis caused by the interaction of a spherical change in the curvature of space in one axis is comparable to the distance between the rings interacting with each other. The radial component of the centripetal motion of a ring of space curved in one axis is negligibly small. The radius of centrifugal (centripetal) movement of the ring of space curved in two axes caused by the interaction of the spherical change in the curvature of space in one axis on the ring of space curved in one axis is comparable to the size of the ring of space curved in two axes. The peripheral component of the centrifugal (centripetal) motion of the ring of space curved in two axes is negligibly small.

By the interaction of a spherical change of space curved in one axis on a ring of space curved in one axis the peripheral component of the centrifugal (centripetal) movement of the curved space in three axes depends on the component of the circumferential movement of the ring of space curved in one axis, and the radial component of the centrifugal (centripetal) movement of the curved space in three axes depends on the radial component of the movement of the ring of space curved in two axes, and the attractive (repulsive) interaction of the spherical change in the curvature of space in one axis on a space curved in three axes is very large.

The interaction of a spherical change in the curvature of space in one axis on a space curved in three axes is many orders greater than the interaction of a spherical change in the curvature of space in two axes on a space curved in three axes.

2.3.4. The shape of space curved in three axes

Space curved in three axes has the shape of a ball. Superimposing three perpendicular rotating rings of space curved in three axes on the surfaces of space curved in three axes creates a structure similar to a ball with central symmetry. The ring of space curved in two axes with the ring of space curved in one axis superimposed on it has a larger diameter than the ring of space curved in two axes without the ring of space curved in one axis superimposed. Superimposition of three perpendicular rotating space rings on the surfaces of the space curved in three axes curved in two axes with rings of space rotating inside them, curved in one axis, creates a sphere-like structure with central symmetry and a larger diameter.

Superimposing three rings of space curved in two axes with different diameters to the surface of the space curved in three axes changes the shape of the space curved in three axes from a sphere to an ellipsoid of revolution. Only one ring of space curved in two axes then has a circular shape. The two remaining rings of space curved in two axes have an elliptical shape.

A structure with one ring of space curved in two axes with a superimposed ring of space curved in one axis has a shape similar to an oblate ellipsoid of revolution. A structure with two rings of space curved in two axes with superimposed rings of space curved in one axis has a shape similar to an elongated rotational ellipsoid. Changing the shape of a spherical space curved in three axes from a sphere to an ellipsoid of revolution does not change the volume of the space curved in three axes. For a space curved in three axes in the shape of an oblate ellipsoid of revolution, we obtain the relationship

$$\frac{4}{3} \times \pi \times a^2 \times b = \frac{4}{3} \times \pi \times R^3$$

In an oblate ellipsoid of revolution, a circular ring of space curved in two axes with a superimposed ring space curved in one axis of larger diameter deforms the circular rings of space curved in two axes without superimposed rings of space curved in one axis of smaller diameter into an elliptical shape. In an elliptical section, space curved in three axes is compressed in the shorter semi-axis of the ellipse. Increasing the curvature of space in the shorter semi-axis of the ellipse reduces the curvature of space in the longer semi-axis. The sum of the linear curvature in the shorter and longer semi-axes of an ellipse of space curved in three axes in the shape of an oblate ellipsoid of revolution is equal to zero

$$\frac{a-R}{R} + \frac{b-R}{R} = 0$$

For an oblate ellipsoid of revolution, we obtain the equation

$$\left(\frac{a}{b}\right)^3 - 5 \times \left(\frac{a}{b}\right)^2 + 3 \times \frac{a}{b} + 1 = 0$$

The ratio of the longer half-shaft to the shorter half-shaft is:

$$\frac{a}{b} = \sqrt{5} + 2$$

With a spherical shape of space curved in three axes, the relative curvature in each axis is equal to the relative curvature constant

$$\frac{R}{R_0} = s$$

Differences in linear curvature in individual axes of space curved in three axes in the shape of an ellipsoid of revolution reduce the value of the relative curvature in the direction of shorter semi-axis of the ellipse and increase the value of the relative curvature in the direction of longer semi-axis of the ellipse to a value equal to one.

$$1 = \frac{R_0}{R_0} = \frac{R}{R_0} \times \frac{R_0}{R} = s \times \frac{R_0}{R}$$

$\frac{R_0}{R}$ determines the relative reduction in compression of a space curved in three axes to an uncurved state when changing shape from a sphere to an ellipsoid of revolution. The curvature of a space curved in three axes in an elliptical cross-section varies in two axes and depends on the square of the ratio of the longer semi-axis of the ellipse to the shorter semi-axis of the ellipse. The change in the shape of a space curved in three axes into a rotational ellipsoid takes place in two elliptical sections perpendicular to each other. The relative reduction in compression longer semi-axis of the ellipse of a space curved in three axes to an uncurved state is the sum of the change in shape in both elliptical sections

$$\frac{R_0}{R} = \left(\frac{a}{b}\right)^2 + \left(\frac{a}{b}\right)^2$$

The relative curvature constant is

$$s = \frac{9 - 4 \times \sqrt{5}}{2}$$

2.3.4.1. The size of a spherical space curved in three axes

The formation of a ring of space curved in two axes on the surface of the space curved in three axes results from the difference in the movement time of the part of the space curved in two axes touching the space curved in three axes and the part moving on the opposite side. The speed of movement of a ring of space curved in two axes on the surface of space curved in three axes is equal to the relative curvature of space curved in three axes

$$v = s^3$$

The maximum value of centripetal acceleration with which space curved in two axes can move on the surface of space curved in three axes is equal to one. The minimum radius of the surface of a space curved in three axes for a rotating space curved in two axes with the smallest inertia is

$$R = \frac{v^2}{a_r} = \frac{{s^3}^2}{1} = s^6 = \left(\frac{9 - 4 \times \sqrt{5}}{2}\right)^6 = 4{,}68 \times 10^{-10}$$

The radius of space curved in three axes is related to the centripetal acceleration of the ring rotating on the surface of space curved in three axes and is proportional to the inertial mass density of the ring

$$R = k \times \rho_p$$

Let's calculate the proportionality coefficient for n=1

$$R = k \times \rho_{yp} = k \times n^2 \times s^4 = k \times s^4 = s^6 \qquad k = s^2$$

The radius of the space curved in three axes for the rings of space curved in two axes without the superimposed rings space curved in one axis is

$$R_2 = n^2 \times s^6 \qquad R_{21} = 4{,}68 \times 10^{-10} \quad R_{22} = 6{,}62 \times 10^{-10} \quad R_{23} = 8{,}1 \times 10^{-10}$$

The radius of space curved in three axes for the rings of space curved in two axes with the rings of space curved in one axis superimposed is

$R_1 = n \times s^4$ $R_{11} = 6{,}03 \times 10^{-7}$ $R_{12} = 8{,}52 \times 10^{-7}$ $R_{13} = 1{,}04 \times 10^{-6}$

In natural units, the elementary spaces are many times smaller than the Planck length.

2.3.5. Inertia of rings of space curved in two axes and in one axis

Space curved in two axes, forming a ring, is kinematically stretched from the unit value (√n) to the value of the full circumference (2×π). In the plane perpendicular to the direction of kinematically stretching, the circumference of the ring of space curved in two axes decreases to a unit value. The ring of space curved in two axes is a toroid with a radius ($R=R_n + r$) and a circular cross-section with radius (r). The ratio of the cross-sectional radius of the ring to the radius of centripetal movement is the inverse of the stretching

$$\frac{r}{R} = \frac{\sqrt{n}}{2\times\pi}$$

The volume of the three rings of space curved in two axes (without the superimposed rings of space curved in one axis) is

$$V_{p2} = \frac{3}{2} \times \left(1 + \frac{\sqrt{n}}{2\times\pi}\right) \times n^7 \times s^{18} = 1{,}54 \times 10^{-28} \times \left(1 + \frac{\sqrt{n}}{2\times\pi}\right) \times n^7$$

The inertia of the three rings of space curved in two axes (without the superimposed rings of space curved in one axis) is

$$M_{p2} = \frac{3}{2} \times \left(1 + \frac{\sqrt{n}}{2\times\pi}\right) \times n^9 \times s^{22} = 9{,}27 \times 10^{-35} \times \left(1 + \frac{\sqrt{n}}{2\times\pi}\right) \times n^9$$

$$M_{p21} = 1{,}07 \times 10^{-34} \quad M_{p22} = 5{,}81 \times 10^{-32} \quad M_{p2} = 2{,}33 \times 10^{-30}$$

Creating a ring of space curved in two axes kinematically stretches the space curved in two axes to a value of 2π. The subsequent kinematically stretching of the curved space in two axes caused by the superposition of a ring of curved space in one axis is described by the change in the cross-sectional area of the ring caused by the kinematically stretching of the ring. Kinematically stretching a biaxial space ring by superimposing a ring space curved in one axis reduces the cross-sectional area of the space curved in two axes ring to a unit value

$$\frac{\pi\times r_{yx}^2}{\pi\times r_y^2} = \frac{\sqrt{n}}{\pi}$$

The cross-sectional area of the ring of space curved in one axis is smaller than the cross-sectional area of the ring of space curved in two axes and is a unit fraction of the cross-sectional area of the ring of space curved in two axes.

$$\frac{\pi\times r_x^2}{\pi\times r_{yx}^2} = \frac{\sqrt{n}}{\pi}$$

The volume of three rings of space curved in one axis is

$$V_{p1} = \frac{3}{2\times\pi^2} \times \left(1 + \frac{n^{\frac{3}{4}}}{\pi^{\frac{3}{2}}} - \frac{n}{2\times\pi^2}\right) \times n^6 \times s^{12} = 3{,}33 \times 10^{-20}\left(1 + \frac{n^{\frac{3}{4}}}{\pi^{\frac{3}{2}}} - \frac{n}{2\times\pi^2}\right) \times n^6$$

The inertia of three rings of space curved in one axis is

$$M_{p1} = \frac{3}{2\times\pi^2} \times \left(1 + \frac{n^{\frac{3}{4}}}{\pi^{\frac{3}{2}}} - \frac{n}{2\times\pi^2}\right) \times n^7 \times s^{14} = 2{,}58 \times 10^{-23}\left(1 + \frac{n^{\frac{3}{4}}}{\pi^{\frac{3}{2}}} - \frac{n}{2\times\pi^2}\right) \times n^7$$

$$M_{p11} = 2{,}92 \times 10^{-23} \quad M_{p12} = 3{,}97 \times 10^{-21} \quad M_1 = 7{,}11 \times 10^{-20}$$

In natural units, the inertia of three rings of space curved in one axis is comparable to the inertia of electrons (electron, muon, tau).

3. Conclusions

Taking into account physical conditions, the curvature of space is buckling. Buckling is the deformation of a region of space with reduced pressure, referred to as elementary space, compressed by the surrounding space.

The conclusions resulting from the analyses performed concern not only buckling, but any type of spatial deformation caused by local compression. These conclusions do not depend on how we mathematically describe the geometry of space.

The compression of elementary space in two axes or in one axis is the cause of the movement of elementary space. The time of movement (and speed) depend on the amount of curvature of space, and the difference in time of movement (and speed) explains the causes of the attractive interaction between elementary spaces.

The amount of space curvature as buckling is limited. Attempting to exceed the maximum amount of curvature by superimposed spherical change in the curvature of space changes the sign of the interaction from attractive to repulsive, which prevents the amount of space curvature from increasing beyond the maximum value. Relative curvature is inversely proportional to the curvature of space and the maximum value of space curvature corresponds to the minimum value of relative curvature. From the condition of creating structures based on space curved in three axes

$$((Z < T_{max} < Z + X) \rightarrow (\frac{1}{s^3} < \frac{1}{h_{min}} < \frac{1}{s^3} + \frac{1}{s}) \ < T_{max} < Z + X)$$

it follows that the minimum value of the relative curvature h_{min} is within the limits

$$2,1617 \times 10^{-5} < h_{min} < 2,1634 \times 10^{-5}$$

Since the propagation speed of the change in curvature in space is proportional to the relative curvature, with a very small but finite minimum value of relative curvature there is no surface through which the movement of the change in space curvature in any direction would not be possible. This means that the surface referred to as event horizons and the object referred to as a black hole are mathematical objects whose creation in real physical space is impossible.

Taking into account the properties of spherical changes in the curvature of space caused by the movement of elementary spaces, the gravitational field corresponds to a spherical change in the curvature of space in two axes, and the electromagnetic field corresponds to the sum (positive sign) or difference (negative sign) of the spherical change in the curvature of space in two axes and one axis.

Structures composed of space curved in three axes and three rings of space curved in two axes correspond to the properties of neutrinos. Structures composed of space curved in three axes and three rings of space curved in two axes with superimposed rings of space curved in one axis correspond to the properties of electrons.

The sign of the electric charge is the sign of the sum or difference of the curvature of space of superimposed rings of space curved in two axes and one axis, not the sign of the curvature of space.

The elementary charge is equal to three relative curvature constants, and the theoretical value of the fine structure constant is

$$\propto = e^2 = (3 \times s)^2 = \left(3 \times \frac{9 - 4 \times \sqrt{5}}{2}\right)^2 = \frac{1}{143}$$