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SCIENZE DELLA RAPPRESENTAZIONE DELLO SPAZIO
Geometria proiettiva, Geometria descrittiva, Rilevamento, Fotogrammetria

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SPACE REPRESENTATION SCIENCES
Projective geometry, Descriptive geometry, Survey Photogrammetry

Palermo, Italia

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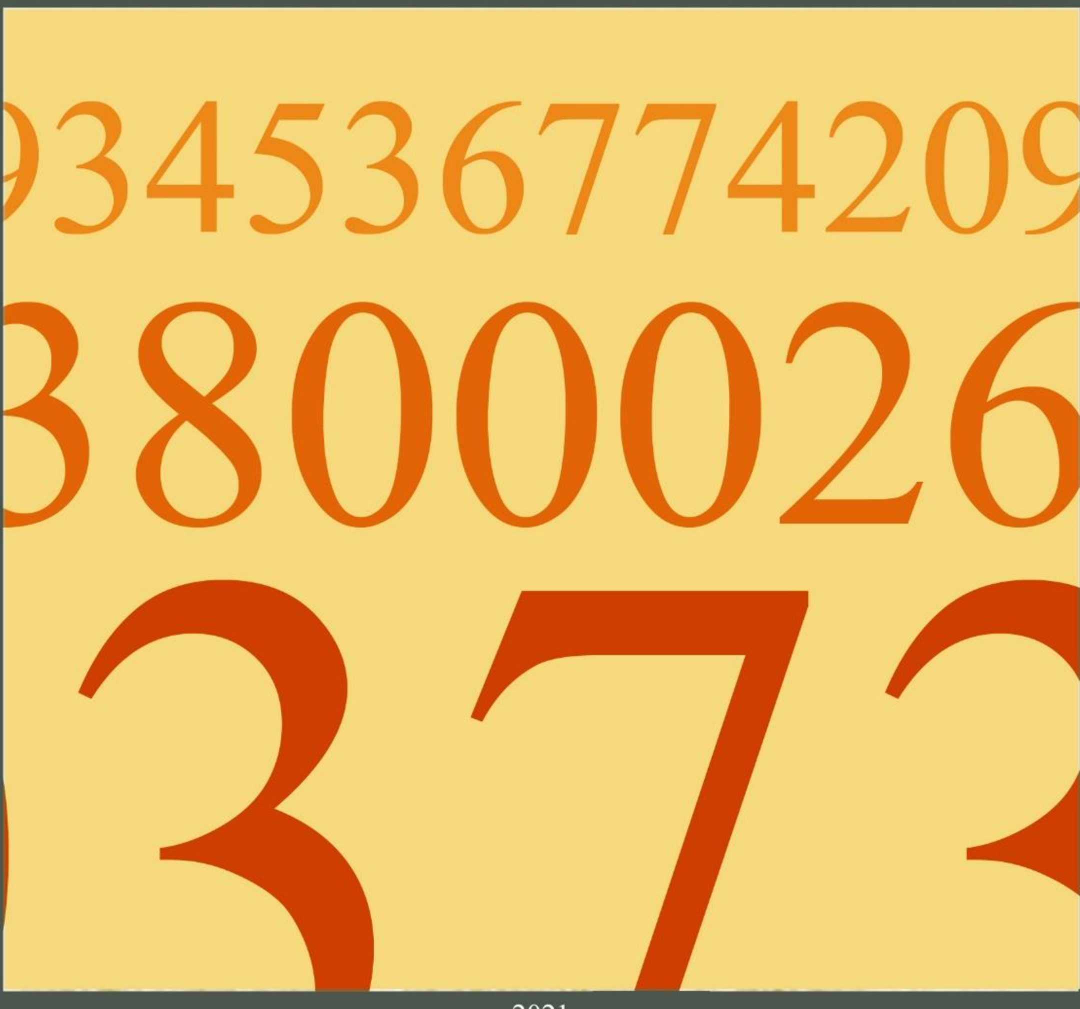
NUMBERS DESCRIBE THE FOURTH REAL DIMENSION OF THE SPACETIME



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NUMBERS DESCRIBE THE FOURTH REAL DIMENSION OF THE SPACETIME

The theory of the dimensions (1) describes the existence of nine real dimensions of the spacetime in which we live.

In particular, however, it should be remembered that the demonstration of the existence of the fourth dimension was already implicit a century ago in the theory of general relativity. Albert Einstein in fact demonstrated that three-dimensional spacetime bends, therefore expands or contracts, being a physical entity, not homogeneous or isotropic at all.

However, Einstein made no mention of the fact that expansion or contraction of the spacetime is possible thanks to the existence of the fourth dimension.

It is appropriate then to recall briefly the simple, fundamental theoretical development that leads to knowledge of the higher dimensions, in particular the fourth.

According to the theory of general relativity, the spacetime, space, as has been said, curves. An immediate important consequence that

Einstein did not draw from the curving of the spacetime was the impossibility of the existence of the stright line.

Spacetime is always incurvable, but if the straight line, open entity, existed, it could never curve and become a circumference, closed entity. So, what is the straight line? It is actually the maximum possible circumference with respect to the human observer, that is, with respect to our eye-brain system.

The concept of a straight line arises from the alignment of irradiating point sources that have coincident images on the retina, since the retinal receptor is unable to evaluate the curvature of the axis the sources belong to.

If the stright line is nothing more than a maximum circumference, then the one-dimensional spacetime s_1 is any maximum circunference.

The two-dimensional spacetime s_2 is any maximum spherical surface.

The three-dimensional spacetime s_3 is any maximum spherical volume.

We note that each dimension n allows the curving of the n-1-dimensional spacetime.

The curving of each n-1-dimensional spacetime covers the entire extension of the n-dimensional spacetime.

For example, the three-dimensional spacetime allows the curving of the two-dimensional spacetime, that is of the spherical surface.

The two-dimensional spacetime, changing radius, then curvature, covers the entire three-dimensional spherical volume. Obviously, the curving of the two-dimensional spacetime also causes the curving of the circumferences belonging to it.

Therefore the curvature of the three-dimensional space in the fourth dimension must cover the entire extension of the four-dimensional space, but it must also curve the spherical surfaces and the circumferences that belong to it.

So, what does it mean to curve the three-dimensional space into the fourth dimension?

It means to expand or contract it intrinsically, since in this way it changes the curvature of the spherical volumes, spherical surfaces and circumferences, which belong to it.

But this spacetime that curves, expands or contracts, is precisely the spacetime described by Einstein, a spacetime that extends into the fourth dimension.

It is easy to imagine the fourth dimension, because the magnification provided by the microscope or telescope simulates the reality that expands into the fourth dimension. The same expanding reality, the same magnification, is perceived by an observer contracting into the fourth dimension.

Our visual system also simulates the fourth dimension when we approach or move away from an object.

Moreover, let's remember that without the fourth dimension we would not even have light (1), vision and therefore we would not have knowledge.

Finally remember that the discovery of six other real dimensions, in addition to the first three recognized for millennia, shows how geometric concepts have a correspondence to physical reality beyond all expectations, so as to complete the fusion between geometry and physics started by Albert Einstein with the theory of relativity general (1).

Space is not what has been believed for millennia, although the three-dimensional representation, based on Euclid's axioms, is still sufficient for almost all human activities carried out on our planet, activities which do not affect the macrocosm and microcosm. The curved spacetime can and must be represented by a geometry that conforms to experience (1).

In general, the great physicist did not dwell on the important consequences of the curving, although in 1919, a few years after the birth of the theory of general relativity, the mathematician T. Kaluza pointed out that the theory of relativity predicted the existence of new dimensions.

Until then, the dimensions of the space in which we live had seemed three. On these the solid geometric structure of Euclid had been erected for millennia, a structure that had supported the magnificent buildings of science. Nobody had ever doubted the apparent three-dimensionality of the space and the existence of the stright lines.

Yet Kaluza thought that, since Einstein had described the force of gravity in terms of the warps and curvatures of the spacetime, then it was possible to use the same idea, the same model, with the other known force, the electromagnetic force.

There had to be a space-time that, by curving, generated the electromagnetic force.

The reasoning was absolutely unassailable, but a mystery remained that neither Einstein nor Kaluza could unravel. If the spacetime, still considered three-dimensional, described and generated gravity, then which spacetime described and generated the electromagnetic force?

There must have been other dimensions besides the three known. Where to find them? How to recognize them?

The years went by and the enigma seemed to have no solution, while the theory of relativity found experimental confirmation and was consolidated in the history of science.

Yet the solution of the enigma, at least as regards the fourth dimension,was printed in large letters in the very extension of the spacetime. Nobody realized that the fourth dimension was there, in front of the eyes, merged in that incurvable spacetime that had mistakenly been believed to have only three dimensions.

However today the theory of dimensions (1) describes the fourth, fifth and sixth dimensions, responsible for the electromagnetic force, and the seventh, eighth and ninth dimensions, responsible for the nuclear forces.

This difficulty in discovering the presence of all dimensions of spacetime, this consequent permanence of a spacetime insufficient to explain all the forces of nature, would have created serious damage to science, that is, it would have allowed the detachment of the physical model of the macrocosm, which established itself with the theory of general relativity, from the physical model of the microcosm, which had in parallel established itself with quantum physics.

All this would have prevented the formulation of a single model of the known physical reality.

It is correct, however, to point out at this point that the difficulty in revealing the presence of other dimensions, beyond the three most obvious, was not only physicists. Before the last century, for millennia, physicists had blindly trusted geometrical studies, which had never expressed any doubts about the existence of only three dimensions.

Yet a clear clue could have made the mathematicians of any time suspicious in evaluating the dimensions of the space. The numbers, which reflected the existence of the plurality of the known bodies, from ancient times provided for the possibility of an unlimited sequence of digits. Was this sequence compatible with a three-dimensional space or did it imply the existence of other dimensions?

No one in so many centuries seems to have ever conceived this strange and perhaps inconceivable question. The certainty of three-dimensionality was in fact a very solid basis, due to the experimental evidence continually manifested in every human action that required the measurement of the space.

Not even the idea of infinity of the most recent centuries had shaken this basis on which science had developed for so long.

The numbers and the fourth dimension

Now let's see if even the numbers have a correspondence with the real dimensions of the spacetime. We still formulate the question that mathematicians have ignored for millennia.

Is an unlimited sequence of digits compatible with a three-dimensional space or does it imply the existence of other dimensions?

Is it possible, that is, to carry out operations, such as division or multiplication, in the three-dimensional spacetime with an however large sequence of digits?

To answer this question, let's suppose we split a segment of line AB into an integer n of parts p. As n increases, the length of p obviously decreases. The number n can be as large as you want, but it is always a finite integer.

In fact, if we could divide the segment into infinite parts, these would have zero size, because if they had non-zero size, this, multiplied to infinity, would not return us the original finite segment.

Then let's divide the segment into a finite number of parts.

The subdivision of segment AB assumes the presence of an observer. In fact the length of segment AB does not have an absolute value, but has a value relative to the size of the observer.

The experience allows to affirm the *principle of relativity of the spacetime*, which can be enunciated as follows: *the largeness of the spacetime is relative to the largeness of the observer*.

Compared to an microbe, the segment AB has a significantly larger size than that it has compared to the human observer. Also compared to a child, the segment AB has a larger size than that it has compared to an adult. For this reason, the environments, objects or animals known in childhood appear to us and are, when we are adults, of smaller dimensions than those present in our memories.

The expansion of the spacetime, which occurs when passing from the human observer to the microbe observer, provides new details ,provides new details, new information, like an imaginary photography that, by enlarging, can proportionally increase its resolution, without ever becoming grainy.

Once the largeness of the observer is fixed, there is a value of n, which we could call n_l, so that the part p, resulting from the subdivision, is so small that it is no longer observable.

In the case of humans, the value of n_l is reached when p falls below the resolving power of the eyes

Yet the value of the number n can theoretically grow without any limit.

To proceed in the subdivision by means of values of n beyond the limit nl of the observable, it would therefore be necessary that the segment AB to curve, expand intrinsically in the fourth dimension or, which is the same, for the observer to contract intrinsically in the fourth dimension. That is, it would be necessary that every part, every particle, every portion of space-time of the observer to contract.

As we are not able to shrink in the fourth dimension and become smaller than an insect or a microbe, we have created optical instruments, such as microscopes, which simulate, as it has been said, the effects of reality that expands in the fourth dimension.

Numbers therefore in their unlimited extension have always testified to the existence of the fourth dimension.

According to some mathematicians of the last century, geometry was independent of correspondence to reality and seemed to resolve itself into pure abstraction.

Recently, the discoveries about the real dimensions that shape the reality of the spacetime show that these are by no means abstract.

Now we realize, as we might have expected, that even the numerical representation of reality, sister of the geometric representation, conforms to the reality in which we exist.

NOTE

1 Giuseppe M. Catalano, Ten real dimensions of the spacetime, International Institute for Advanced Studies of Space Representation Sciences, Palermo 2017.

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