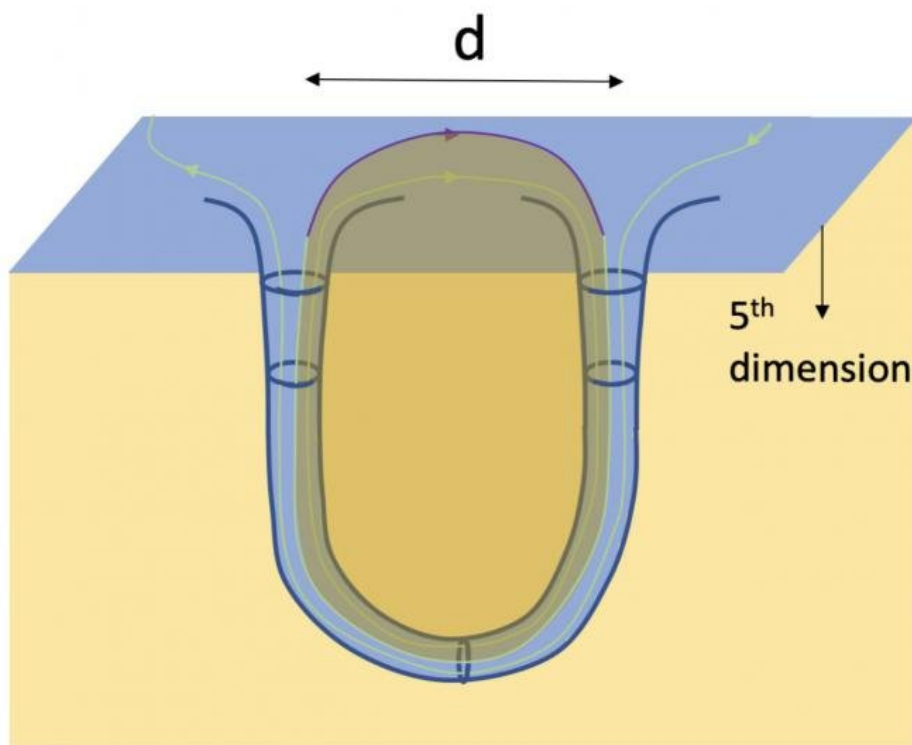


## A chance to travel in time through the emerging reality from hidden spaces

*From a new hypothesis arises the possibility of traveling in time, at least as observers, through a wormhole*

By **retimedia**



*A chance to travel in time through the emerging reality from hidden spaces*

A new work just published on [MDPI](#) shows and introduces some new interpretative aspects of the concept of "emerging space" as a geometric/topological approach in the cosmological field.

In the [theory of complexity](#), **emergent behavior** is the situation in which a complex system exhibits well-defined macroscopic properties, difficult to predict on the basis of the laws that govern its components taken individually, thus arising from the linear and non-linear interactions between the components themselves.

Although it is more easily found in systems of living organisms or social individuals or in economic systems, unlike a widespread belief today, the *emergence* also manifests itself in much more elementary contexts, such as particle physics and atomic physics.

It can also be defined as **the process of forming complex schemes starting from simpler rules**, and an example can be obtained by observing **John Conway's "The game of life"**, in which a few simple rules set for a few basic individuals can lead to very complex evolutions.

Despite the unpredictability of the emergent behavior, in a deterministic system, if it does not originate from the interaction of the environment, it is a direct consequence of the initial condition of the system.

Among the possible applications of this theory, including the possibility of considering a non-orientable **wormhole**, a **topological interpretation** is proposed, using a new approach, to *M-Theory* and *String Theory in 10 dimensions*.

Furthermore, some conclusions suggested by this new interpretation are presented and also some observations that consider a unifying approach between strings and dark matter. The approach shown in the document considers that **reality, as it appears to us, can be the "emerging" part of a more complex hidden structure**.

## Two mouth wormhole, Moebius strips and time travel

In essence, the article deals with a new geometric/topological approach in some areas of cosmology with some interesting consequences, albeit purely speculative, given the premises.

It explains how, for this purpose, a special manifold called PNPD-manifold (*Partially Negative Dimensional Product manifold*) was used, a special type of *Einstein warped product manifold*, whose base-manifold (B) is a **Riemannian product** with precise characteristics and whose fiber-manifold (F) is a **derived-smooth manifold**, which allows a concept of "virtual" dimensions.

A PNPD-manifold (M), is a special type of Einstein warped product manifold, i.e. it is an Einstein manifold formed by the Riemannian product between two manifolds that we call B (base) and F (fiber), that is, as **Alexander Pigazzini, mathematician and computer scientist who deals with research in differential geometry, mainly in Riemannian geometry, for the Mathematical and Physical Science Foundation, a research company in Slagelse, Denmark and co-author of the study**, explains by email:

" $M = B \times F$ , whose metric  $g$  is given by  $g = g_B + f * g_F$  (with  $*$  I mean the product symbol, it would be " $f$  for  $g_F$ ", with  $g_B$  the metric of  $B$ , with  $g_F$  the metric of  $F$ , and  $f$  is a smooth and positive scalar function defined on  $B$ , which takes the name of warped function), but in which both the warped function  $f$  and the  $B$ -manifold (which in turn is a Riemannian product between two manifolds), must have very specific characteristics.

Finally F must be a derived smooth manifold of the type: *smooth manifold (N) + bundle of obstruction (E)*, which admits a concept of negative virtual dimension,  $dim(F) = dim(N) - rank(E)$ , that is  $rank(E) > dim(N)$ . This means that the dimension of M

will also be "virtual" because  $\dim(M) = \dim(B) + \dim(F)$ , and since  $\dim(F) < 0$ ,  $\dim(M)$  will be less than  $\dim(B)$ .

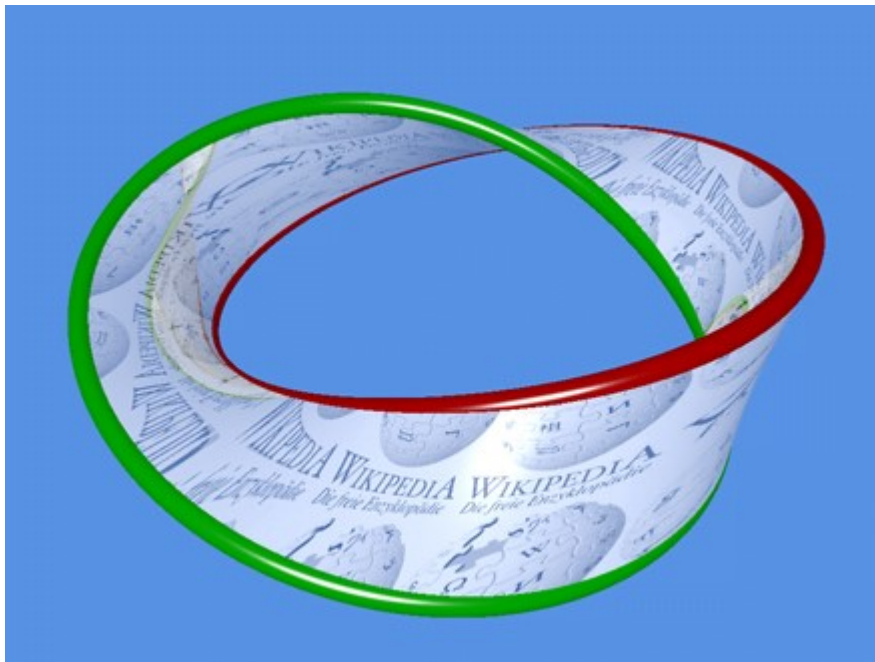
"From the speculative point of view, we consider that  $\dim(M) < \dim(B)$  is as if the "virtual" negative dimensions of F interacted (*linked*), to the dimensions of B, making appear (*through particular mathematical projections*) "virtually" M as a manifold with a number of dimensions smaller than those of B".

**Richard Pinčák**, *theoretical physicist who works for the Institute of Experimental Physics Slovak Academy of Sciences in Kosice, Slovak Republic and also a co-author of the study*, adds: "We therefore consider that in nature some dimensions of space-time or Bulk, by their intrinsic nature or by some initial situation, behave in such a way as to be able to mathematically describe them as "virtual" negative and this, therefore, implies an interaction, at the internal configuration, with the other dimensions that are present".

"In the case  $\dim(M) = \dim(B) + \dim(F) = 0$ , then M virtually appears a point-like manifold, that is zero-dimensional, as a point that has dimension zero, resulting therefore "invisible", without dimension".

"The latter case is therefore linked to the "invisible connection" of the wormhole, that is a PNDP-manifold virtually point-like, dimensionless, therefore not perceptible (*due to the interactions between dimensions*), but which still connects the two "mouths" of the wormhole".

Now let's consider that the point-like PNDP-manifold is non-orientable like the [Möbius strip](#), and that a particle enters the wormhole. The particle travels through the wormhole and at the exit it travels the point-like PNDP-manifold (*"hooked" to the wormhole mouths*) which appears, therefore, as an "invisible" Möbius strip.



*The tunnel from mouth to mouth of a wormhole might resemble a Möbius strip*

**If the wormhole were configured, for example, by placing the "mouths" one near a black hole or bringing the other to a high speed, the time of these two openings will no longer be the same with the direct consequence that one will**

**travel from a moment to another, so we could hypothesize that the "mouth" at the exit is in the past compared to the incoming one.**

In this case, the path prepared by the PNDP-manifold is such that if it were an oriented strip, that is NOT a Möbius strip, **the time travel from the "exit" to the "entrance" in the "mouth" would be such that the particle would return to the mouth of entry exactly at the same moment in which it left, then it would retrace its past step-by-step until it "sees" itself ready to undertake the journey on the entrance "mouth" of the wormhole.**

In reality, the hypothesis used in the study is that the PNDP-manifold is a Möbius strip, and this would mean that the particle would return to the entrance of the "mouth", but on the opposite side of the strip, so it would not return to the exact point in which is about to enter the wormhole, that is from which it started, to do this it would have to retrace the strip again and finally it would find itself exactly in the same point and instant in time in which it started (finally on the correct side of the strip).

To return to the same instant in which it started, but completing two turns, the time of the space-time "configured" as a point-like PNDP-manifold by Möbius strip, will flow more slowly than the non-Möbius version.

**Therefore the particle will retrace its past at a slower temporal scan (compared to a hypothetical external observer) and, being along a point-like manifold, it will not be able to interact with the episodes that make up its past, because it is translated into an "invisible" space-time.**

In short, to use simple and understandable words to most people, if a wormhole were configured for example by placing the "mouths" one near a black hole or bringing the other to a high speed, **the time of these two openings will no longer be the same, with the direct consequence that we will travel from one moment to another, so we could hypothesize that the "mouth" at the exit is in the past compared to the entrance one.**

Considering the possibility of connecting the two "mouths" with a point-like PNDP-manifold, we would obtain that the particle would retrace its past until it returns to the "mouth" of entry exactly at the same time it left, so it would retrace its past step-to-step up to "see" itself ready to undertake the journey on the wormhole's entrance "mouth", but it will in no way be able to interact with any moment of its past, being in an "invisible" space-time. The hypothesis from which this work starts, in essence, makes us imagine that we can travel in time but only as observers unable to manipulate events, so it will not be able to alter the past, but only retrace it. Farewell to the idea of the "[grandfather paradox](#)", it would not be possible in any way to achieve it.

In this context, an approach based on string theory gains more emphasis, and here the innovative aspect lies in the **possibility that a string emerges from the interaction between particular dimensions of space** .

In fact, the study **assumes** that some dimensions of space-time, by their intrinsic nature or by some initial situation, behave in such a way as to be able to mathematically describe them as "*virtual*" negative and this (in the approach used), implies interactions, at the internal configuration, with the other dimensions that are present.

This interaction, also considered from an energetic point of view, also introduces a new concept of *"hidden"* dimension, in fact, always according to this approach, strings cannot vibrate in those *"interacting"* dimensions, and therefore in a certain sense they remain *"invisible"*.

The interaction can therefore be interpreted as a point-like manifold on which a non-interacting space "emerges" (*"emergent space"*).

Overall, the topological approach proves to be very versatile and the idea of considering new energies of interaction, which can alter the space-time structure, could also be a new point of view in the study of some still unclear phenomena.