Sabina Hossenfelder
https://www.youtube.com/watch?v=l3C_db2RjKo&t=18s

What does the universe expand into? Do we expand with it?

Do čeho se vesmír rozpíná? Rozšiřujeme to? aa 143

233 901 zhlédnutí
•29. 5. 2021

This video was sponsored by the Great Courses Plus. If the universe expands, what does it expand into? That’s one of the most frequent questions I get, followed by “Do we expand with the universe?” And “Could it be that the universe doesn’t expand but we shrink?”
* I will repeat my version in HDV: There is a space in front of the Big Bang = there is space-time 3 + 3D, which is Euclidean flat, infinite, there is no matter or field in it and time does not run in it and space does not expand. As a result of the rule = principle of alternating symmetries with asymmetries, there will be a "bang". (This is not an explosion, but a change from the previous state to the next state). The curvature of the space-time dimensions changes. In that infinite flat state of space-time before the Bang, the "" final location (our Universe) will occur, in which there will be the opposite extreme: the curvature of the dimensions will be extremely great. This final locality - boiling vacuum, foam of dimensions = plasma begins its genesis of state changes. There is an "unpacking" of those curvatures, ie the flow-flow of time starts, the "unpacking" of space starts. (it's similar to Guth's inflation). However, the curvatures in this foam of dimensions change so that (imagine the foam as a homogeneous mixture of black and white balls = minilocalite) the "white" localities are curved even more, they are packed in packages = ball and… and the black localities are unpacked, namely will be our intergalactic 3 + 3D space-time (with a predominance of gravitational curvature; but also there will be "frozen" three states of expansion of space-time dimensions into the form of three forces: weak, strong and electromagnetic). So: balls = wave packs (from that foam "peeled off as" clones ") will realize the elementary particles of matter (quarks, leptons, bosons; each topological shape = a different property;… subsequently in the genetic sequence of changes-changes of" wrapped dimensions "into atoms, molecules, into compounds, proteins). At the same time, "conglomerates" will present themselves as stars and galaxies. So this is a brief, really brief scenario of the development of "unpacking and collapsing" curvatures of dimensions of 3 + 3D space-time. Large-scale time-space expands in each "stop-time" from Bang´s differently than they "pack" in the microworld and then connect packages-balls of space-time dimensions. In the anti-world, the time dimension collapses into a ball in the "opposite" direction than here in our World. Today, even today on the Planck scales, it boils, the vacuum of dimensions boils there, ie "changes" of curvature changes, pairs of virtual particles are born there, etc. (particles and antiparticles have the opposite spin, ie curvature of the time dimension into a ball). + 3D is not symmetrical with respect to the mutual curvatures of the six dimensions… and also takes place differently in the time "stop-states" from big-bang. So from big-bang, time "runs" = the time dimension expands, and better said, all three time dimensions expand. When anyway? and when not ?, then the question. We know, for example, from STR that time dilates in the direction of the

motion of a body, but in the other two dimensions of time perpendicular to motion, time no longer dilates. This interpretation is certainly not complete. I will also mention the vision that after Bang there is a genesis of the structure of matter, mass structures = complexity sequence, but also a parallel "sequence of laws and rules" that "pay attention" to the reciprocity of matter "floating in expanding space-time". With the development of the "variety" of material structures, the "third sequence of phenomena" also develops, and that is the "properties" of matter (eg properties also include mass, spin, charge, then Pauli's principle, .. then later chemical properties, etc. etc. Each topological configuration of both the "package" and the conglomerates of packages is a state of "property", e.g. acid as it differs from bases and salts from them, etc., etc.). All this, the difference would never have occurred if matter had not been "invented" (by God's providence) from space-time precisely through the breathtaking "combination" possibilities of curving dimensions of 3 + 3 + parallel laws, which also arose gradually in accordance with configurations of elements of matter. Similarly, in pale blue, string theorists chant that: the properties of matter are "produced" by the "tinkling-vibration" of strings. Indeed, this is not yet a complete interpretation, only indications of the diversity that can only arise from "unpacking and collapsing the dimensions of space-time." At the end of this video, you'll know the answers. * It will not be an answer, but it will be an opinion, Mrs. Sabina or other physicists. I have to add my opinion. It is central to the vision of HDV. http://www.hypothesis-of-universe.com/docs/g/g_033.pdf ; http://www.hypothesis-of-universe.com/docs/aa/aa_147.pdf

I haven't made a video about this so far, because there are already lots of videos about it. But then I was thinking, if you keep asking, those other videos probably didn't answer the question. And why is that? I am guessing it may be because one can't really understand the answer without knowing at least a little bit about how Einstein's theory of general relativity works. (foto AE) Hi Albert. Today is all about you. So here's that little bit you need to know about General Relativity. First of all, Einstein used from special relativity that time is a dimension, (!) no skalar so we really live in a four dimensional space-time with one dimension of time and three dimensions of space.* I am convinced that there are more than one time dimension. No one has ever researched it before. Unfortunately, it is very depressing that a lot of "things" that are not obvious and observable at first glance, scientists declared them in equations and only then looked for them by observational or nuclear experiments… But this does not apply to time. They never explored it, either abstractly before the discovery of multidimensional reality, nor observationally without theory. Without general relativity, space-time is flat, like a sheet of paper. With general relativity, it can curve. But what is curvature? * For me, the key to understanding was the "hot potato principle" http://www.hypothesis-of-universe.com/docs/h/h_082.jpg , ie how (mathematically) linearity is made from nonlinearity, ie how "linear foam into nonlinear gravity "(!)… and he understood this from R. Feynman's explanation when he told the students at the blackboard: he took a wand-stick and started waving it, first slowly and then faster and faster and fastest…; asymmetry changes here in symmetry. Gravity is nonlinear and quantum linear mechanics. We "rape" the dish by cutting it into infinitesimal lines and then reassembling it one behind the other to "make" a straight line from the crooked dish - that's what Mr. Ullmann did. And these scams are used by mathematics for physics http://www.hypothesis-of-universe.com/docs/g/g_039.pdf . That's the key to understanding space-time. To see what it means for space-time to curve, let us start with the simplest example, a two-dimensional sphere, no time, just space. That image of a sphere is familiar to you, but really what you see isn't just the sphere. You see a sphere in a three dimensional space. That three dimensional space is called the "embedding space". The embedding space itself is flat, it doesn't have curvature. If you embed the sphere, you immediately see that it's curved. But that's NOT how it works in general relativity. In general relativity we are asking how we can find out what the curvature of space-time is, while living inside it. There's no outside. There's no embedding space. So, for the sphere that'd mean, we'd have to ask how'd we find out it's curved if we were living on the surface, maybe ants crawling around on it. One way to do it is to remember that in flat space the inner angles of triangles always sum to 180 degrees. In a curved space, that's no longer the case. An extreme example is to take a triangle that has a right angle at one of the poles of the sphere, goes down to the equator, and closes along the equator. This triangle has three right angles. They sum to 270 degrees. That just isn't possible in flat space. So if the ant measures those angles, it can tell it's crawling around on a sphere. There is another way that ant can figure out it's in a curved space. In flat space, the circumference of a circle is related to the radius by 2 Pi R, where R is the radius of the circle. But that relation too doesn't hold in a curved space. If our ant crawls a distance R from the pole of the sphere and you then goes around in a circle, the radius of the circle will be less than 2 Pi R. This means, measuring the circumference is another way to find out the surface is curved without knowing anything about the embedding space. * That's to think about. Whether we have a 3D space around us "insertion itself" without curvature and only we insert another 3D space with curved dimensions, ie in a flat 3D space another 3D non-flat-curved space "floats" for the realization of eg a triangle with 270 degrees of sum of angles. By the way, if you try these two methods for a cylinder instead of a sphere you'll get the same result as in flat space. And that's entirely correct. A cylinder has no intrinsic curvature. It's periodic in one direction, but it's internally flat. General Relativity now uses a higher dimensional generalization of this intrinsic curvature. So, the curvature of space-time is defined entirely in terms which are internal to the space-time. You don't need to know anything about the embedding pace. The space-time curvature shows up in Einstein's field equations in these quantities called R. Roughly speaking, to calculate those, you take all the angles of all possible triangles in all orientations at all points. From that you can construct an object called the curvature tensor that tells you exactly how space-time curves where, how strong, and into which direction. * That is, the tensor "discards" in that curved 3D space (floating in a flat) not in that basic flat in which there is no curvature. The things in Einstein's field equations are sums over that curvature tensor. * In equations, those things can only be abstract character shapes "made" in a 3D tensor CURVE space. There are no tensors in reality… we do not see tensors flying around us. That's the one important thing you need to know about General Relativity, the curvature of space-time can be defined and measured entirely inside of space-time. * Not like this. Within the flat 3D (3 + 3D) space-time, if we are to define "curvature", we must "add" another 3 + 3D space-time to it (in which curvature can "be" realized). These are considerations that need to be discussed in a broad forum of physicists. The other important thing is the word "relativity" in General Relativity. That means you are free to choose a coordinate system, * (crooked or crooked ??) and the choice of a coordinate system doesn't make any difference for the prediction of measurable quantities.* ? This needs a deep explanation. It's one of these things that sounds rather obvious in hindsight. Certainly if you make a prediction for a measurement and that prediction depends on an arbitrary choice you made in the calculation, like choosing a coordinate system, then that's no good. However, it took * ? This needs a deep explanation. Albert Einstein to convert that "obvious" insight into a scientific theory, first special relativity and then, general relativity. So with that background knowledge, let us then look at the first question. * My basic knowledge of special relativity is that "this mathematics, thus constructed mathematics" demonstrates the mutual rotation of systems, **a)** the system into which the Observer fits and **b)** the system that is connected to the test object-body, where this body moves relative to the Observer. Basic. What does the universe expand into? * And here it is standing - there are two possibilities on the table - two variants of the "on the thing" view. A) the flat infinite 3 + 3D space-time in front of the big-bang and "floats" in it B) the locality of the (finite) space-time of 3 + 3D curved dimensions, in which the curvature of individual dimensions pulsates from absurd curvature to zero curvature, a… and v which can change the curvature of all 6 dimensions individually, even in combinations. Thus, they are two time-spaces that identify in the "right" extreme position and "separate" in the opposite extreme position. The opposite extreme position is Big-bang where two time-spaces with opposite curvatures live "side by side". But even this is not entirely true, because after the big-bang, both time-spaces "live" in each other = the crooked cp "floats" in that non-crooked space-time. In the genesis of changes, only one space-time changes, the curvatures change in it. In the second, the curvature does not change. It doesn't expand into anything, it just expands. * More precisely: The universe (the crooked 3 + 3D space-time) EXPANDS… and it even expands inhomogeneously nonlinearly throughout the universe…, it expands all around us (it is evident on the Planck scales). The statement that the universe expands is, as any other statement that we make in general relativity, about the internal properties of space-time. It says, loosely speaking, that the space between galaxies stretches. * The variant of "expansion" would lead to the solution that "our Universe expands" into nothing "and would also lead to the creation of" new "points in space-time and also" from Nothing ". Think back of the sphere and imagine its radius increases. As we discussed, you can figure that out by making measurements on the surface of the sphere. You don't need to say anything about the embedding space surrounding the sphere. Now you may ask, but can we embed our 4 dimensional space-time in a higher dimensional flat space? The answer is yes. * Here we come to a common unified idea, a common supportive understanding of "one reality" (Today-today there are two realities: **a)** my HDV and **b)** the reality of physicists with their models). For me, in HDV, the higher dimensions are "good" for the realization of the artifact → matter. The balling of the basic dimensions 3 + 3D leads to the construction of 26 elementary particles of the standard model. http://www.hypothesis-of-universe.com/index.php?nav=ea And then it is clear that and how these conglomerate together into more complex states of matter.). We do not need extra dimensions to build all baryon matter, if we can abstractly justify the "division" of the space-time grid of 3 + 3D flat dimensions from the "other" grid also 3 + 3D dimensions of all curves, ie whether and how the **"crooked" grid "floats"** 3 + 3D in a 3 + 3D **grid "non-curved"** and… and how it is implemented. You can do that. It takes in general 10 dimensions. But you could indeed say the universe is expanding into that higher dimensional embedding space.* Or HDV where the crooked dimensions from the Bang from a boiling vacuum of space-time foam **unfold** However, the embedding space is by construction entirely unobservable, * O.K.!! We humans around us do not observe the basic grid-web-network of 3 + 3-dimensions of flat space-time in which the space-time of curved dimensions "floats" even though we even perceive those curvatures. which is why we have no rationale to say it's real. The scientifically sound statement is therefore that the universe ((our after big-bang universe everywhere and crooked in everything)) doesn't expand into anything. * O.K. Curved dimensions expand in the basic flat grid… Do we expand with the universe **?** * Why do you say that space expands with the universe ?? this is faulty logic. The 3 + 3D basic raster-subsoil does not expand, but in it the "floating" state of globally curved 3 + 3 space-time with galaxies, which are also multi-packages of curved dimensions, expand - you say expand. No, we don't. Indeed, it's not only that we don't expand, but galaxies don't expand either. It's because they are held together by their own gravitational pull. They are "gravitationally bound", as physicists say. The pull that comes from the expansion is just too weak.

The same goes for solar systems and planet. And atoms are held together by much stronger forces, (higher curvature of dimensions) so atoms in intergalactic space also don't expand. It's only the space between them that expands. How do we know that the universe expands and it's not that we shrink? Well, to some extent that's a matter of convention. . http://www.hypothesis-of-universe.com/docs/c/c_262.jpg Remember that Einstein says you are free to choose whatever coordinate system you like. So you can use a coordinate system that has yardsticks which expand at exactly the same rate as the universe. * That is, when I identify the Observer with a photon, with a system connected to a photon. If you use those, you'd conclude the universe doesn't expand in those coordinates. O.K. You can indeed do that. However, those coordinates have no good physical interpretation. That's because they will mix space with time. So in those coordinates, you can't stand still. Whenever you move forward in time, you also move sideward in space. That's weird and it's why we don't use those coordinates. The statement that the universe expands is really a statement about certain types of observations, notably the redshift of light from distant galaxies, but also a number of other measurements. And those statements are entirely independent on just what coordinates you chose to describe them. However, explaining them by saying the universe expands in this particular coordinate system is an intuitive interpretation. So, the two most important things you need to know to make sense of General Relativity is first that the curvature of space-time can be defined and measured entirely within space-time. An embedding space is unnecessary. And second, you are free to choose whatever coordinate system you like. It doesn't change the physics. In summary: General Relativity tells us that the universe doesn't expand into anything, we don't expand with it, and while you could say that the universe doesn't expand but we shrink that interpretation doesn't make a lot of physical sense. This video was sponsored by The Great Courses Plus I like to learn new things, and while YouTube is really useful for little nuggets of wisdom, it's not particularly good for structured learning. When it comes to structured learning, * ← I will omit / postpone the commentary on this whole passage that has been said for now.

 Thanks for watching, see you next week.

JN, kom 04.07.2021 + english 27.08.2021