Essay

Universe from Nothing

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Abstract

The book "Universe from Nothing: Why There Is Something Rather than Nothing" by Lawrence Krauss has stimulated a lot of aggressive debate between philosophers and physicists and gained mediate attention. The basic criticism of philosophers is directed to the identification of "nothing" as vacuum state and it is easy to agree with the criticism. In this essay the purpose is not to consider this issue but go one level deeper and ask what existence could mean - an issue not often discussed in physics circles dominated by materialistic philosophy.

1 Introduction

The book A Universe from Nothing: Why There Is Something Rather than Nothing [2] by Lawrence Krauss has stimulated a lot of aggressive debate between Krauss and some philosphers and of course helped in gaining media attention.

Peter Woit wrote about the debate - not so much about the contents of the book - and regarded the book boring and dull. He sees this book as an end for multiverse mania: bad philosophy and bad physics. I tried to get an idea about what Krauss really says but failed: Woit's posting concentrates on the emotional side (the more negative the better;-)) as blog posting must do to maximize the number of readers.

Peter Woit [3] wrote also a second posting about the same theme. It was about Jim Holt's book Why Does the World Exist?: An Existential Detective Story [4]. Peter Woit found the book brilliant but again it remained unclear to me what Jim Holt really said!

Sean Carroll [5] has a posting about the book talking more about the contents of the book. This posting was much more informative: not just anecdotes and names but an attempt to analyze what is involved.

In the following I will not consider the question "Why There Is Something Rather than Nothing" since I regard it as pseudo question. The very fact that the question is made implies that something - the person who poses the question - exists. One could of course define "nothing" as vacuum state as physicists might do but with this definition the meaning of question changes completely from what it is for philosophers. Instead, I will consider the notion of existence from physics point of view and try to show how non-trivial implications the attempt to define this notion more precisely has.

2 What do we mean with "existence"?

The first challenge is to give meaning for the question "Why There Is Something Rather than Nothing". This process of giving meaning is of course highly subjective and I will discuss only my own approach. To my opinion the first step is to ask "What existence is?". Is there only single kind of existence or does existence come in several flavors? Indeed, several variants of existence seem to be possible. Material objects, mathematical structures, theories, conscious experiences, etc... It is difficult to see them as members of same category of existence.

This question was not made by Sean Carroll ,who equated all kinds of existence with material existence - irrespective of whether they become manifest as a reading in scale, as mathematical

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[2]http://www.amazon.com/Universe-Nothing-There-Something-Rather/dp/145162445X/

[3]ttp://www.math.columbia.edu/ woit/wordpress/?p=4672

[4]http://www.amazon.com/Why-Does-World-Exist-Existential/dp/0871404095

[5]http://blogs.discovermagazine.com/cosmicvariance/2012/04/28/a-universe-from-nothing/

formulas, or via emotional expressions. Carroll did not notice that already this assumption might lead to astray. Carroll did the same as most mainstream physicists would do and I am afraid that also Krauss makes the same error. I dare hope that philosophers criticizing Krauss have avoided this mistake: at least they made clear what they thought about the deph of philosophical thinking of physicists of this century.

Why Carroll might have done something very stupid?

1. The first point is that this vision- known as materialism in philosophy - suffers from serious difficulties. The basic implication is that consciousness is reduced to physical existence. Free will is only an illusion, all our intentions are illusions, ethics is illusion and moral rules rely on illusion. Everything was dictated in Big Bang at least in the statistical sense. Perhaps we should think twice before accepting this view.
2. Second point is that that one ends up with heavy difficulties in physics itself: quantum measurement theory is the black sheep of physics and it is not tactful to talk about quantum measurement theory in the coffee table of physicists. The problem is simply that that the non-determinism of state function reduction - necessary for the interpretation of experiments in Copenhagen interpretation - is in conflict with the determinism of Schrödinger equation. The basic problem does not disappear for other interpretations. How it is possible that the world is both deterministic and deterministic at the same time? There seems to be two causalities: could they relate to two different notions of time? Could the times for Schrödiner equation and state function reduction be different?

I have just demonstrated that when one speaks about ontology, sooner or later begin to talk about time. This is unavoidable. As inhabitants of everyday world we of course know that the experienced time is not same as the geometric time of physicists. But as professional physicists we have been painfully conditioned to identify these two times. Also Carroll as a physics professor makes this identification - and does not even realize what he is doing - and starts to speak about time evolution as Hamiltononian unitary evolution without a single world about the problems of quantum measurement theory.

With this background I am ready to state what the permanent readers of the blog could do themselves. In TGD Universe the notion of existence becomes much more many-faceted thing as in the usual ultranaive approach of materialistic physicist. There are many levels of ontology.

1. Basic division is to "physical"/"objective" existence and conscious existence. Physical states identified as their mathematial representations ("identified" is important!: I will discuss this later) correspond the "objective" existence. Physical states generalize the solutions of Schrödinger equations: they are not counterparts for time=constant snapshots of time evolutions but counterparts for entire time evolutions. Quantum jumps take between these so that state function reduction does not imply failure of determinism and one avoids the basic paradox. This however implies that one must assign subjective time to the quantum jumps and geometric time to the counterparts of evolution of Schrödinger equation. There are two times.

   In this framework the talk about the beginning of the Universe and what was before the Big Bang becomes nonsense. One can speak about boundaries of space-time surfaces but they have little to do with the beginning and end which are notions natural in the case of experienced time.
2. One can divide the objective existence into two sub-categories. Quantum existence (quantum states as mathematical objects) and classical existence having space-time surfaces as its mathematical representation. Classical determimism fails in its standard form but generalizes, and classical physics ceases to be an approximation and becomes exact part of quantum theory as Bohr orbitology implies by General Coordinate Invariance alone. We have ended up with tripartimism instead of monistic materialism.
3. One can divide the geometric existence on sub-existences based on ordinary physics obeying real topology and various p-adic physics obeying p-adic topology. p-Adic space-time sheets serve as space-time correlates for cognition and intentionality whereas real space-time sheets are correlates for what we call matter.

4. Zero energy ontology (ZEO) represents also a new element. Physical states are replaced with zero energy states formed by pairs of positive and negative energy states at the boundaries of causal diamond (CD) and correspond in the standard ontology to physical events formed by pairs of initial and final states. Conservations laws hold true only in the scale characterizing given CD. Inside given CD classical conservation laws are exact. This allows to understand why the failure of classical conservation in cosmic scales is consistent with Poincare invariance.

   In this framework Schrödinger equation is only a starting point from which one generalizes. The notion of Hamiltonian evolution seen by Carroll as something very deep is not natural in relativistic context and becomes non-sensical in p-adic context. Only the initial and final states of evolution defining the zero energy state are relevant in accordance with strong form of holography. U-matrix, M-matrix and S-matrix become the key notions in ZEO.

5. A very important point is that there is no need to distinguish between physical objects and their mathematical description (as quantum states in Hilbert space of some short). Physical object is its mathematical description. This allows to circumvent the question "But what about theories: do also theories exist physically or in some other sense?". Quantum state is theory about physical state and physicist and mathematician exists in quantum jumps between them. Physical worlds define the Platonia of the mathematician and conscious existence is hopping around in this Platonia: from zero energy state to a new one. And ZEO allows all possible jumps! Could physicist or mathematician wish anything better;-)!

This list of items shows how dramatically the situation changes when one realizes that the materialistic dogma is just an assumption and in conflict with what we have known experimentally for almost century.

3 Could physical existence be unique?

The identification of physical (or "objective") existence as mathematical existence raises the question whether physics could be unique from the requirement that the mathematical description with which it is identical exists. In finite-dimensional case this is certainly not the case. Given finite-D manifold allows infinite number of different geometries. In infinite-dimensional case the situation changes dramatically. One possible additional condition is that the physics in question is maximally rich in structure besides existing mathematically! Quantum criticality has been my own phrasing for this principle and the motivation comes that at criticality long range fluctuations set on and the system has fractal structure and is indeed extremely richly structured.

This does not yet say much about what are the basic objects of this possibly existing infinite-dimensional space. One can however generalize Einstein's "Classical physics as space-time geometry" program to "Quantum physics as infinite dimensional geometry of world of classical worlds (WCW)" program. Classical worlds are identified as space-time surfaces since also the finite-dimensional classical version of the program must be realized. What is new is "surface": Einstein did not consider space-time as a surface but as an abstract 4-manifold and this led to the failure of the geometrization program. Sub-manifold geometry is however much richer than manifold geometry and gives excellent hopes about the geometrization of electro-weak and color interactions besides gravitation.

If one assumes that space-time as basic objects are surfaces of some dimension in some higher-dimensional space, one can ask whether it is possible for WCW to have a geometry. If one requires geometrization of quantum physics, this geometry must be Kähler. This is a highly non-trivial condition. The simplest spaces of this kind are loop spaces relating closely to string models: their Kähler geometry is unique from the existence of Riemann connection. This geometry has also maximal possible symmetries defined by Kac-Moody algebra, which looks very physical. The mere mathematical existence implies maximal symmetries and maximally beatiful world!

Loops are 1-dimensional but for higher-dimensional objects the mathematical constrains are much more stringent as the divergence difficulties of QFTs have painfully taught us. General Coordinate Invariance emerges as an additional powerful constraint and symmetries related to conformal symmetry generalizing from 2-D case to symmetries of 3-D light-like surfaces turns out to be the key to the construction. The requirement of maximal symmetry realized by conformal invariance leads to correct space-time dimension and also dictates that imbedding space has $M^4 \times S$ decomposition

with light-cone boundaries also possess huge conformal symmetries giving rise to additional infinite-D symmetries.

There are excellent reasons to believe that WCW geometry is unique. The existence would be guaranteed by a reduction to generalized number theory: $M^4 \times CP_2$ forced by standard model symmetries becomes the unique choice if one requires that classical number fields are essential part of the theory. "Physics as infinite-D geometry" and "Physics as Generalized Number Theory" would be the basic principles and would imply consistency with standard model symmetries.