What happened before the 'Big Bang'?

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Both Phil Gibbs and Lubos have commented on a BBC documentary in which the familiar old names (and also 2 younger not-so-namey cosmologists) told about their answers to the question "What happened before 'Big Bang' ".

I must admit that I enjoyed the aggressive rhetoric of Lubos's commentary although I do not share his ultra-conservative views and belief in Inflation. Most of these approaches shared something with my own approach although all of them are conceptually primitive and involve a lot of hand-waving. The reason is that these theoreticians remain in the framework of General Relativity where the new ideas do not have a natural place.

1. Probably Penrose was the only one who raised the question whether the question "What before the 'Big Bang' " makes sense at all. His earlier answer to the question had been negative in General Relativity context. But unfortunately, he had changed his view. If one leaves GRT framework, the situation changes.

   For instance, if one decides to take TGD seriously and identifies space-times as 4-D surfaces of $M^4 \times CP_2$, it takes only 5 years to end up with the notion of World of Classical Worlds (WCW) and only 27 years with Zero Energy Ontology (ZEO);-).

   In ZEO, the WCW decomposes to a union of sub-WCWs consisting of space-time surfaces located inside causal diamonds (CD, essentially the intersection of Future and Past directed light-cones) carrying zero energy states with positive and negative energy parts of the state at the light-like boundaries of the causal diamond. One can form unions of CDs. And CDs can also intersect. In this framework, one has a hierarchy of CDs beginning from the elementary particle level and extending up to the Russian doll hierarchy of cosmologies.

I would have been happy if at least one of the visionaries had said something about the relationship between Experienced-Time and the Geometric-Time of physicist. These times are not one-and-the-same thing as even a child realizes. Unfortunately, the academic habit is to think that they are. I have become convinced that the proper understanding of this difference will mean enormous progress both in the Quantum theory of Consciousness and in Quantum Physics defined in the standard manner (the extension of physics to a quantum theory of consciousness is natural in the wider framework).

Unfortunately, Penrose's arguments were so popular that I could not get any idea about the mathematics behind it. My approximation for what Penrose said is that when the density of matter gets sufficiently low, the space-time somehow begins to look like a good candidate for the first moment of a new Big Bang. I failed to understand. Note however that in TGD framework, the mass per comoving volume for critical and string dominated cosmologies goes to zero as linear function of the scaling factor of 3-metric and identified as the light-cone proper time in TGD framework. I have talked about a "silent whisper" amplified to a big bang as a more appropriate description of TGD-inspired cosmology than the 'Big Bang' which is a mathematical singularity.

Penrose's intuition can be actually justified in TGD context. The canonical imbedding of empty Minkowski space to $M^4 \times CP_2$ is maximally critical in the sense that Kähler action is 4^{th} order in small deformations so that perturbative Quantum Field Theory is impossible. This was the problem which lead to the notion of WCW and eventually to the notion of hierarchy of Planck constants. Criticality also has interpretation as criticality against deformations assignable to zero energy states representing sub-cosmologies in very long length scales. Note also that there is analogy with Higgs potential in the sense that the point at the origin of Mexican hat potential is replaced with the infinite-dimensional space of vacuum extremals.

2. As a full day zero energy ontologists, I liked Michio Kaku's vision about the fusion of Buddhist's vision about complete emptiness as source of everything and of the Christian "Let there be light" idea. ZEO solves many deep philosophical problems.

   For instance, the Classical question about what was the initial state and the quantal question about what where the values of the conserved net quantum numbers associated with the initial state becomes irrelevant. ZEO is also consistent with crossing symmetry of quantum field theories and leads to an elegant generalization of thermal quantum field theories. At a practical level, one ends up to an opening of the black box of virtual particle and a manifestly finite version of Feynman diagrammatics emerges with massless fermions serving as fundamental building bricks of all particles including stringy objects. A twistor approach is absolutely essential element of this approach.

   As a representative of Christian culture, I find it amusing that the basic objects would be light-like 3-surfaces so that the statement "Let there be light" receives an additional hidden meaning! Maybe the Christian God is a Great Humorist after all although the Bible does not suggest this. Of course, this is not the only manner to say it. By general coordinate invariance, one can equivalently speak about space-like 3-surfaces. This implies effective 2-dimensionality and strong form of holography. Partonic 2-surfaces and the 4-D tangent space data of the space-time surfaces at them code for the quantum physics.

3. Linde is an inflationary theorist wanting to give up the notion of the 'Big Bang' altogether and replace it with eternal Inflation. "What happened before Big Bang?" transforms to "What happened before Inflation?" So not much has been gained.

The basic problem of Inflationary scenarios is that it involves GUTs and thus arbitrary amounts of Higgs-like stuff with a lot Higgs potentials with a lot of parameters so that everything can be fitted but nothing predicted. Some of us (even Lubos) regard this as a success. Linde tested the limits of plausibility by claiming that their calculations have led to some gigantic number involving many exponents equal to 10. The highest exponent in the impressive tower of exponents was (surprise, surprise) number 7!

Why just 7? The sensitive listener could perhaps argue that the number seven as the number of *mystic* world views must be coded to the basic laws of Physics and this is how it achieved;-). This number was supposed to be number of possible universes if I got it correctly.

What makes me astonished that theoretical cosmologists still fail to realize that the flatness of 3-space could be also seen as a correlate of quantum criticality. Quantum criticality means universality and one can forget all fiddling with Higgs potentials. Indeed, in TGD framework criticality plus imbeddability to $M^4 \times CP_2$ fixes the cosmology apart from the value of the parameter fixing its duration as I have repeatedly tried to tell.

A model for critical periods involving only a single parameter would be easy to kill or shown to be the cosmological counterpart of Nordström metric. One prediction is a fractal hierarchy of long-range correlations in cosmological scales reflecting the hierarchy of Planck constants having gigantic values in Astrophysical systems and assignable to dark matter and to the counterpart of dark energy.

What made me happy is that one experimentalist involved is interested in testing of the presence of this kind of correlations! There is actually already indications for these correlations. For instance, copies of Astrophysical object appearing at same line of sight. If they are actual, this suggest lattice-like structures if Cosmological scales. They could be also artifacts resulting from a circulation of the light coming from the object around circular path several times before being detected.

In any case, all hope is not lost since the experimentalists are still among us!

4. Neil Turok criticized Inflation and proposed an M-theory inspired model of pre-Big Bang era assuming the presence of 2 branes which then collided. These kind of models are of course non-predictive. But if cosmologists get interested, they can produce an endless number of fits and conclude that on basis of the amount of literature written on the subject, this is the only game in town.

   What connects this with TGD is that if one necessarily wants so, one can call 3-surfaces and 4-surfaces "branes" also in TGD framework. I still do not know how much of inspiration for the second superstring revolution came from TGD and whether the hope was that M-theory would work and TGD as a predecessor of the idea could be safely buried in sands of time. This hope was not realized. **TGD is making detailed predictions to LHC whereas M-theorists remain remarkably silent**.

5. Param Singh was second non-namey cosmologist allowed to tell about his views. He proposed that instead of a 'Big Bang', there is a series of bounces. Almost a 'Big Crunch' followed by almost a 'Big Bang'. Planck scale would be the scale where GRT-based cosmology would fail and superstring models would somehow come in rescue. I am afraid that superstring models do not have time to help since they are fighting with their very severe personal problems.

In TGD framework, the CD could be visualized as a "big bang" followed by a "big crush" (or better to say, a silent whisper amplified to a lot of noise eventually calming down and ending with a silent last breath). In ZEO, a more appropriate manner to interpret the "big crush" would be as a "big bang" in a reversed Time direction. It is also quite possible that partonic 2-surfaces at boundaries of CDs can continue as light-like 3-surfaces in both directions and this is essential for generalized Feynman diagrammatics. Could this define something which could be regarded as the analog of the "bounce"?

6. Lee Smolin represented his idea of cosmological evolution and suggested that the collapse of star to black hole is somehow followed by a creation of new cosmology inside a black hole. The idea about natural selection in cosmological scales is quite interesting. I ended up with it 15 years ago through the p-adic calculations of elementary particle masses.

   The calculations made one key assumption (or better to say observation): Elementary particles correspond to p-adic primes which are near to powers of 2 and Mersenne primes and their Gaussian counterparts turned out to be especially important.

   Zero Energy Cosmology combined with number theoretical universality can give at least a partial justification for this hypothesis. The proper time distances between the tips of CDs would come as octaves of CP_2 time and correspond to what I am used to call secondary p-adic length/time scales. For instance, in the case of the electron, one obtains 0.1 second which is a fundamental biological-length scale!

   The idea that there is natural selection also in elementary particle length scales selecting p-adic length scales characterized by favored p-adic primes as those for which particles are long-lived looks very natural. Also, TGD-inspired Quantum Biology and theory of Consciousness imply evolution in all length and time scales. Mersenne primes emerge also in quantum information theory as special ones.

7. Laura Mersini-Houghton talked about "waves" in Cosmology. I was unable to understand a single word of it but looked at the Web and found that she is proposing that the notion of wave function could make sense in M-theory landscape. Probably she had realized that string landscape is not a very sexy word nowadays and decided to avoid its use.

   It seems that M-theorists have finally begun to think of the possibility that one could speak about quantum states in landscape. John Wheeler talked about wave functions in super space eons ago. I talked about wave functions in the space of 3-surfaces already in my PhD thesis around 1982 and ended up to the notion of configuration space (WCW) geometry and the modes of classical configuration space spinor field as a general representation of the quantum states of Universe around 1985.

   Around 1990, I ended up with the realization that general coordinate invariance forces to identify Kähler function of configuration space as Kähler action for a preferred extremal defining the counterpart of Bohr orbit and realizing holography. This almost incredible delay in the natural evolution of ideas is an excellent lesson about how dangerous it is to censor out a bottleneck idea.

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