A CONJECTURED MULTIVERSE STRING COSMOLOGY IN 26 DIMENSIONS by Richard Ruquist

ABSTRACT

Vafa's (11+1) F theory is extended by means of Bars' 2T holographic theory to yield a 14d Multiverse theory that permeates the brane of a 12d Universe in which both the Universe and the Multiverse have (3+1) spacetimes.

Given the 2d toroidal compactification of F theory, we conjecture that the Multiverse has a 4d Cartesian compactification that is filled with 3D+T spacetime via the standard 6d elliptic Calabi-Yau compactification, as in both M and F theory. The result is exemplified using supermassive black hole cosmology.

INTRODUCTION

Given that supermassive black holes in the galaxies of our Universe and all other existing universes may spawn baby universes that flow into the Multiverse, as originally proposed by Lee Smolin in his 1997 book, The Life of the Cosmos[1], we argue that a 26d reality is required. This reality is split between a 14d Multiverse and 12d universes. The Multiverse permeates the brane of our 12d Universe (and all other universes). However, only a 12d GUT field is recreated in supermassive-black-hole singularities at the centers of galaxies in each universe consistent with Brookhaven experiments[2] at near Big-Bang conditions and matter in the brane of the Universe only distorts the spacetime of the Universe so 3D orbital stability is maintained.

The 12d Superstring F-theory[3] of Harvard's Physics Professor Cumrun Vafa is a guide for the required compactification of the 14d Multiverse Superstring Theory. Based on the initial 2d compactification in F-theory of a toroidal fibration (or put simply, a grid), we conjecture that in a Multiverse Theory there is an initial 4d compactification into a Cartesian grid. Thereafter or concurrently 6d compactifications fill both the torus and the Cartesian grid with 3D+T spacetimes. Note well that the fibers that make up the 2d or 4d grids and the 6d compact elliptic Calabi-Yau fourfolds at the junctions of each grid are all at or below the Planck scale and therefore constitute an invisible, undetectable subspace.

USC Physics Professor Itzhak Bars' 2T 13d S-theory[4] combines his holographic 2T Physics with Witten's 1T 11d M-theory. We presume that 2T physics may also be combined with (11+1) F Theory and in addition that it can be done with an additional three large dimensions. The result connects the spacetime of the Universe to the spacetime of the Multiverse. In the Multiverse the 3D+T dimensions of the grid are likely to be infinite. But the 3D'+T' spacetime of our Universe is finite.

BACKGROUND

The existence of a Multiverse, in which our Universe and presumably many others are embedded as 3D branes, is inferred from two recent bodies of work in high energy theoretical physics that go beyond the standard model SM in order to solve some SM problems (e.g., the hierarchy and the cosmological constant).

The first is the 1999 work in string phenomenology[5] by Lisa Randall and Raman Sundrum which has expanded into well over a 100 papers since then, mainly devoted to the search for 'Large Extra Dimensions' at the LHC. Here is the abstract of one review[6] of these papers, "Large and infinite extra dimensions" by V. A. Rubakov:

"The emphasis in the development of theories with more than three spatial dimensions has recently shifted towards "brane world" picture, which assumes that ordinary matter (with possible exceptions of gravitons and other, hypothetical- particles which interact very weakly with matter) is trapped to a three-dimensional sub-manifold --- brane --- embedded in a fundamental multi-dimensional space. In the brane world scenario, extra dimensions may be large, and even infinite; they may have effects, directly observable in current or forthcoming experiments. On the basis of simple field-theoretic models, various ideas in this direction are exposed at a non-expert level."

The second inference comes from the TWO-TIME PHYSICS investigations of Itzhak Bars and his students at USC. Quoting from his USC bio[7]:

"According to the body of work in 2T-physics, there is more to space-time than can be garnered with 1T-physics. 2T-physics introduces additional one space and one time dimensions, which can coexist with the familiar 3+1 dimensions as well as extra space dimensions of tiny sizes known as Kaluza-Klein-type dimensions, but the new ones have very different properties. First of all, the extra 1+1 dimensions in 2T-physics are not small. However, there are gauge symmetries that effectively reduce 2T-physics in 4+2 dimensions to 1T-physics in 3+1 dimensions without any Kaluza-Klein remnants. The reduction is not unique because there is an infinite variety of 3+1 embeddings in 4+2 dimensions"

Thus Bars might extend his 13d S Theory[8] from 1 to 3 extra space dimensions and apply it to F-theory to support the inference of our Universe being a 3D brane embedded in a larger 3D Multiverse space. He has responded to a query regarding the number of extra space dimensions:

"Yes, my theory admits any number of space dimensions. Limits on that number emerge from structures such as string theory, as you seem to be well aware of." I. Bars (January 23, 2008)

Additionally, there are holographic properties of this model also from the work of Bars. To quote again from the USC bio:

"Similarly, even though according to 2T-physics a unique dynamical system in 4+2 dimensions generates a large variety of 1-time "shadows"', 1T-physics presents these "shadows" in 3+1 dimensional space-times as different dynamical systems in terms of different Hamiltonians (different times)….In this way 1T-physics misses the underlying relationship between the "shadows" as well as the underlying properties (e.g. symmetries) of the higher dimensional space-time. Actually, it turns out that each "shadow" is a holographic image that retains all the information of the d+2 structure."

So string phenomenology and more directly Two Time Physics may extrapolate to the notion of two (3D+T) spacetimes. Susskind's original 26d closed-string theory had two time dimensions, as well as particles with imaginary mass, for which it was rejected. However to obtain a 26d Multiverse theory 2T Physics must be applied to Vafa's 12d F-theory where the 26d are split into 12d for the brane of the Universe and 14d for the Multiverse. One ambiguity is that F Theory is sometimes said to be (11+1) and at other times (10+2). That is, some references claim F Theory contains two time dimensions. We obviously require the (11+1) version.

TOP-DOWN 26d STRING THEORY

It seems that Vafa's 1T 12d theory may be extended by Bars' 2T physics to get a 1T 12d Universe along with a 1T 14d Multiverse. The mathematical details of the relationships between M-theory, F-theory, S-theory and Multiverse theory are outside the scope of this paper. As an aside, it is interesting that Vafa named his superstring theory F-theory where the F stands for Father, under the consideration that the M in Witten's superstring theory stands for Mother. We presume that the S in Bars' 13d theory then stands for Son. And so a Bars-type 14d superstring theory would be called D-theory where the D stands for Daughter. Also it is a convenient oversimplification to picture compactification as resulting in a grid of wires connecting junctions. Consider the following simple model:

The original superstring theories were in 10 dimensions (10d) which is the most basic form of string theory. In such theories, 6d of the 10d are COMPACTIFIED. That is, 6d dimensions shrink down to the Planck scale or less, as 3D space dimensions INFLATE in the Big Bang and one dimension remains time T'. The inflated dimensions are referred to as (3+1) spacetime. In 11d M-theory, the extra dimension just allows all 10d string theories plus 11d point-particle quantum gravity to be duals. (Duality just means it's the same physics in a different approximation, like the wave-particle duality.)

But in F-THEORY, two dimensions are compactified into a torus before or perhaps coincident with the 6d compactification. That leaves 14d for the Multiverse. A conjecture is that all of the dimensions of the Multiverse are also compactified except for three Space and one Time Dimension. If so, then 10d dimensions form a fine mesh screen or matrix in the Multiverse. But if the creation of the Multiverse is like that of a universe; that is, 6d compactify as 3D inflate; then 4d may have compactified beforehand into a fine-mesh grid at or below the Planck scale.

Occam's razor suggests that the 4d grid is Cartesian containing three space coordinates and one time-like coordinate into which the 6d compactification provides for 3 expanded Mspace Dimensions. The Multiverse Compact Manifold is presumed to exist at only a single time T which is the same time T' as in each universe, i.e., T=T'. Such a Multiverse grid and spacetime are likely infinite in the Time Dimension.

To summarize, reality may consist of 24 space-like dimensions of which all but 6 Space Dimensions have compactified into essentially two zero-volume matrices of wires and their junctions at or below the Planck scale. A similar 6d matrix called the Compact Manifold CM in string physics exists in both Mspace and Uspace. We shall refer to each individual junction as a compact manifold[9], the triple intersection points of seven-branes in 6d geometry.

26d STRING COSMOLOGY

From a 26 dimensional primordial UNIFIED FIELD where all dimensions may be of uniform size, we conjecture that the 14d Multiverse is first created within the unified field by the compactification of 10d, the expansion of 3D and somehow the creation of time T.

One possibility is the compactification of an additional 8d, (perhaps along with the 10d compactification), to make a 3D' core universe. The unified field could do this many times to make many universes which propagate out into the Multiverse.

OR, each resulting universe could contain a mechanism that recreates a 12d GUT field (that can create universes but not the Multiverse) which is consistent with the inferred observation[10] of an upper mass limit of the supermassive black holes at the center of galaxies in our Universe.

If the primordial 26d unified field were a supermassive black hole we might characterize First Creation as the result of inflation and compactification of 14 dimensions of the 26d, e.g.,

26d primordial black hole -> T + 3D(Mspace) + 4d(grid) + 6d(manifold) + 12d (black holes)

where the 12d black holes are carried along in the expansion of 3D Mspace.

In a Second Creation the 12d black holes then generate universes.

12d black hole -> T' + 3D'(Uspace) + 2d(grid) + 6d(junctions)

Universes then make their own 12d black holes that generate more universes as suggested by Smolin.

MICROSTATE CONSIDERATIONS

There is enough phase space (microstates) in a 12d black hole to fill a new universe, i.e., for Planck-volume equality to fill 3 dimensions of space within the Universe:

$(l/p)^N=(L/p)^3$, we get $L/p=(l/p)^{N/3}$,

where N is the number of space dimensions in the black hole, l is the extent of the black hole singularity, L is the extent of the Universe and p is the Planck scale.

Then supposing the size in Planck units of a supermassive black hole singularity is $l/p=10^{36}$, or 100 meters, we get for the scale of the Universe, $L/p=10^{12N}$. The observable universe[11] is 3×10^{80} cubic meters and so the number of Planck volumes in it is $(L/p)^3=10^{180}$ or $L/p=10^{60}$ for which N=5. The actual universe is of course much larger than the observable universe. But since N can be as large as 9 (not counting the 2d grid or the time dimension) 100 meter 12d black hole singularities could provide for universes where $L/p =10^{111}$.

A 10 cm 12d singularity provides for $L/p=10^{99}$. So despite the gross uncertainty of our guesses for singularity and universe size, our conclusion that 12d black holes are adequate seems robust. That they contain only GUT fields is consistent with experiments at Brookhaven[2]. Deriving the number of microstates from 2D and (N-1)D holographic surfaces is even more robust.

DISCUSSION

In this cosmology the Multiverse is a 4D spacetime that seemingly has always existed, wherein time seems to instantaneous within a pre-ordained infinite coordinate-like grid whose function is outside the scope of this discussion. Gravity exists in the Multiverse and spacetime distortion exists in the Universe (as demonstrated by metamaterial experiments[12]). Matter and the gauge forces (the strong and weak force and the electromagnetic force) only exist in the Universe. Gauge forces being closed strings are relatively free. Spacetime distortion in the brane of each universe is not free. So gravity is decoupled from the gauge forces as in F-theory. This cosmology may be falsified if gravitons are detected.

Based on a string theory prediction of a "perfect liquid" (a BEC of quarks and gluons) at both near-absolute-zero and near-big-bang temperatures (and their subsequent observation[2]), wherein each matter-particle is attached to a string, we conjecture that every particle of matter in our Universe is connected to the Compact Manifold by means of a string. That suggests how the Compact Manifold may control all matter-particle interactions. It follows that the Compact Manifold of the Universe may provide the vacuum Zero Point Energy ZPE and its virtual particles, and that the connecting strings may be the location of quantum wave functions.

References:

[1] http://en.wikipedia.org/wiki/The_Life_of_the_Cosmos

[2] www.sciencenews.org/view/feature/id/42632/title/Strings_Link_the_Ultracold_with_the_Superhot

[3] http://arxiv.org/PS_cache/hep-th/pdf/9602/9602022v1.pdf

[4] http://arxiv.org/PS_cache/hep-th/pdf/9904/9904063v1.pdf

[5] http://arxiv.org/PS_cache/hep-ph/pdf/9905/9905221v1.pdf

[6] http://arxiv.org/PS_cache/hep-ph/pdf/0104/0104152v2.pdf

[7] http://physics.usc.edu/~bars/

[8] http://arxiv.org/PS_cache/hep-th/pdf/9904/9904063v1.pdf

[9] http://arxiv.org/PS_cache/arxiv/pdf/0910/0910.2955v1.pdf

[10] http://www.sciencedaily.com/releases/2008/09/080909095133.htm

[11] http://arxiv.org/PS_cache/arxiv/pdf/0909/0909.3983v1.pdf

[12] http://www.physorg.com/news174893601.html