

FERMI SOCIETY OF PHILOSOPHY

biweekly meetings and talks



mailing list:

philosophysociety@fnal.gov (through the listserv)

Genesis of a Pythagorean Universe Pt. I

Alexey and Lev Burov

Apr 7th

The laws of nature are discovered as specific mathematical structures. Why these structures and not other? Why are they mathematically beautiful? The talk reviews an original approach to these questions by the eponymous award-winning article; recently, it was published by Springer, together with all the winners of the 2015 contest of the Foundational Questions Institute.

Genesis of a Pythagorean Universe Pt. II

Alexey and Lev Burov

Apr 21st

Open discussion on Genesis of a Pythagorean Universe

Open

May 5th

MEETINGS ARE SCHEDULED EVERY OTHER THURSDAY,
12:00-1:00, REQ ROOM (WH4NW)

discussion: fermisocietyofphilosophy.wordpress.com

GENESIS OF A PYTHAGOREAN UNIVERSE

Alexey Burov* and Lev Burov[°]

*FNAL, Batavia, IL

[°]Scientific Humanities LLC, San Francisco, CA

<http://arxiv.org/abs/1411.7304>



FOUNDATIONAL QUESTIONS INSTITUTE

Physics and Mathematics
Contest Winners Announced
View and comment on the
"Trick or Truth: the
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EXPLORING THE
FOUNDATIONS AND
BOUNDARIES OF PHYSICS
AND COSMOLOGY

FQXi catalyzes, supports, and
disseminates research on

Disclaimer

The following was motivated by our
love of reason.

I will try my best to make our arguments clear
for the joy of sharing with those
who dare to think about ultimate questions.

Although it is not my concern as to
how convincing our arguments are,
I would be grateful for any responses
of those who made the effort to understand me.

ToE as the goal of physics

- Physics is looking for the laws of nature, the logical structure of the Universe.
- When the axioms of nature are all discovered, being logically unified into a single theory of everything (ToE), the task of fundamental science would be over.
- Although humanity does not have the ToE now, and may possibly never have it, many of its limit cases are already known.

Independently of incompleteness
of our knowledge of the ToE,

We may ask:

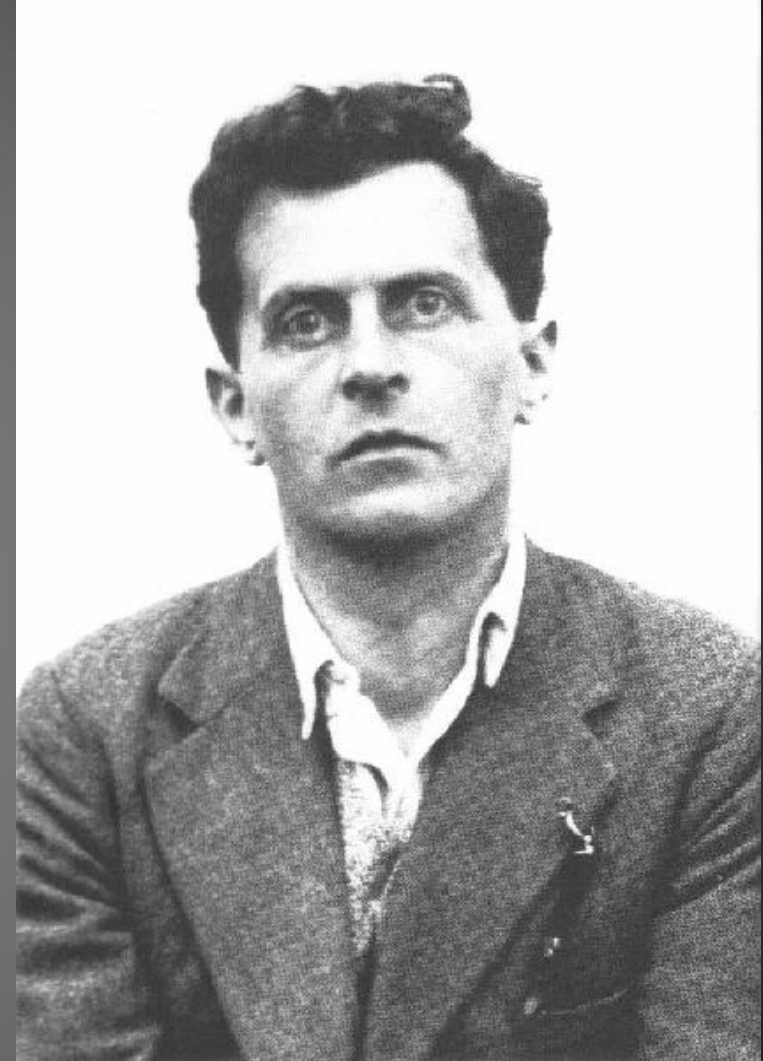
Why the laws are what they are?

ToE as a problem of metaphysics

- Why is the world defined by **any mathematical structure at all**? Why is this structure so *simple* that it is **discoverable**?
- While it is thinkable for a universe to be structured by **any logically consistent system**, out of this infinite set of structures only one determines our universe. **Why this structure and not another?** Who or what singled it out and on what ground?
- In this way the **laws of nature become a problem**, though not in the usual physical context of searching them out, but **as something that requires its own explanation**. For that, we have to think about physics, looking at physics from outside of it; thus, we have to think meta-physically.

What can be the Terminus?

- The illusory nature of an explanation that does not go beyond natural laws was pointed out by **Ludwig Wittgenstein (1889-1951)** (“Tractatus”, 1922):
- “The whole modern conception of the world is founded on the illusion that the so-called laws of nature are the explanations of natural phenomena. Thus people today stop at the laws of nature, treating them as something inviolable, just as God and Fate were treated in past ages. And in fact both are right and both wrong: though the view of the ancients is clearer in so far as they have a clear and acknowledged **terminus**, while the modern system tries to make it look as if everything were explained.”



Ludwig Wittgenstein

1889-1951

Physics normally thinks bottom-up,
looking for more and more general theories.

Let's think top-down:

What, in principle, can be thought as the Terminus?

And what cannot?

Absurd as a Ground of Reason?

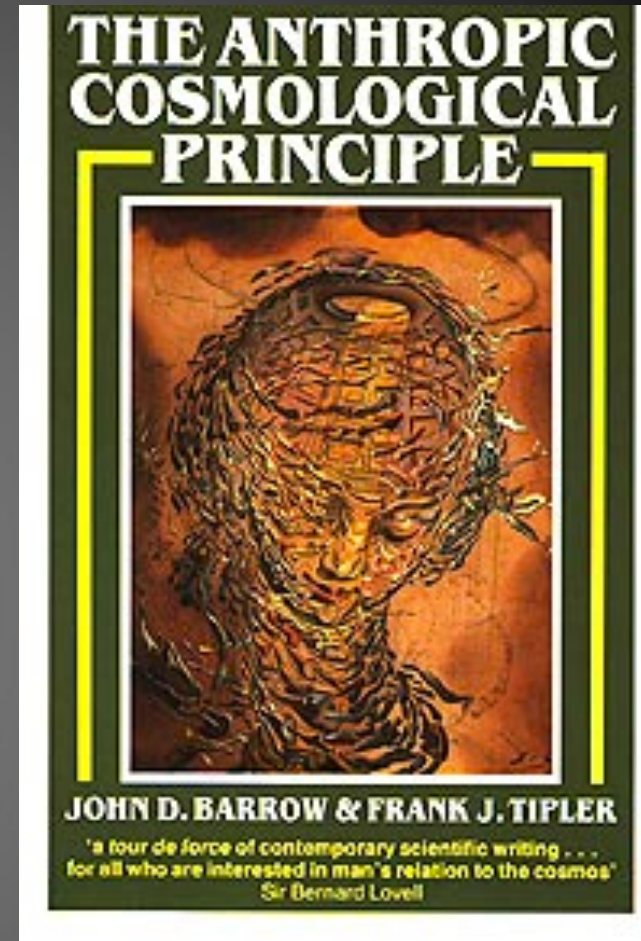
- One of the reactions to the problem of terminus is to deny the reasonableness of this questioning.
- Paul Davies: “If that is so [if it is unreasonable to ask], then the unified theory—the very basis for all physical reality—itself exists for no reason at all. Anything that exists reasonlessly is by definition absurd. So we are asked to accept that the mighty edifice of scientific rationality—indeed, the very mathematical order of the universe—is ultimately rooted in absurdity!”
- In other words, such superstition **destroys the meaning and value** of fundamental science by undermining the importance of reason, subjected by this belief to the absurd.
- What reasonable answers can there be concerning the **source of the laws of nature**? Is there any way of *choosing* or rejecting one or another?

Before any attempt to explain the laws of nature,
let's first ponder on what they are.

Are they specific in any respect?

The Fine Tuning

- “The laws of science, as we know them at present, contain many fundamental numbers, like the size of the electric charge of the electron [fine structure constant] and the ratio of the masses of the proton and the electron. ... The remarkable fact is that the values of these numbers seem to have been very finely adjusted to make possible the development of life.” (S. Hawking)



- “There is now broad agreement among physicists and cosmologists that the universe is in several respects ‘fine-tuned’ for life.” (P. Davies)

The Structural Tuning

- The laws of nature are **very special mathematically**: they are expressed by reasonable and simple mathematical forms, at the same time allowing rich life-friendly family of solutions, i.e. they are *beautiful*.
- These forms cover a huge range of parameters with extraordinary precision, which excludes them being a mere fitting or an artifact.
- *E. Wigner*: "...the mathematical formulation of the physicist's often crude experience leads in an uncanny number of cases to an amazingly accurate description of a large class of phenomena. This shows that the mathematical language has more to commend it than being the only language which we can speak; it shows that it is, in a very real sense, the correct language...", *The Unreasonable Effectiveness of Mathematics in the Natural Sciences*, 1960.



Eugene Wigner
(1902-1995)

Dual Tuning

- For today, our scale of scientific cognition is described by an enormous dimensionless parameter $\sim 10^{45}$; that big is the ratio of the sizes of the largest object of physics, the universe, $\sim 10^{26}\text{m}$, to the smallest ones, the top quark and the Higgs boson, corresponding to $\sim 10^{-19}\text{m}$.
- It is important that the same laws precisely work for the entire range of these **45 orders**, both for the Universe en grand and for its tiny elements, fundamental particles.
- Thus, the **laws of nature are tuned in two senses**: they are both elegant and anthropic. The tuning is *both* structural and fine.
- Now we are coming back to the question of the *terminus*.

A pure scientific approach

- Who or what tuned the universe so specially?
- A pure scientific approach requires finding an objective answer: not “somebody” but “something” as the cause of tuning.
- This “something” can only be a pure accident, the totality of Chaos, Nothingness.
- This leads to an idea of all thinkable universes to exist (Nozik, Lewis), or each mathematical structure is realized as the theory of everything of some universe in the multiverse (Tegmark).
- So cosmogenesis is suggested to be considered as *chaosogenesis* (CG).



Max Tegmark suggested his own solution to the “embarrassing” question: **“mathematical democracy”**

“If the ToE [theory of everything] exists and is one day discovered, then **an embarrassing** question remains, as emphasized by John Archibald Wheeler: Why these particular equations, not others? Could there really be a fundamental, unexplained ontological asymmetry built into the very heart of reality, splitting mathematical structures into two classes, those with and without physical existence? After all, a mathematical structure is not “created” and doesn’t exist “somewhere”. It just exists. As a way out of this philosophical conundrum, I have suggested that complete **mathematical democracy holds**: that mathematical existence and physical existence are equivalent, so that all mathematical structures have the same ontological status.” (“**The Mathematical Universe**”, Foundations of Physics, 2007)

Is it possible though that laws
so specific are purely accidental?

Weak Anthropic Principle (WAP)

- WAP: In the infinite multiverse, only those universes can be observed where observers can appear, which selects a narrow class of fine-tuned universes.
- The fine tuning apparently receives a scientific explanation: Although in the infinite megaverse only a tiny portion of universes is fine-tuned for life and consciousness, the probability for any observer to see the universe as fine-tuned is 100%.
- Nothing seemingly contradicts the assumption that our universe is a random representative of WAP-selected subset of the full-blown multiverse, but is that really so? Does the universe indeed have no clear signature excluding any possibility of it having been **randomly** selected from this totality of all possible mathematical structures? **Is the concept of CG irrefutable by any thinkable observation?**
- Apparently, it is considered as irrefutable by some leading experts.

Is Tegmark's Hypothesis Irrefutable?

For instance, **Brian Greene** clearly says that:

“I draw the line at ideas that have no possibility of being confronted meaningfully by experiment or observation, not because of human frailty or technological hurdles, but because of the proposals' inherent nature. Of the multiverses we've considered, only the full-blown version of the Ultimate Multiverse falls into this netherland. If absolutely every possible universe is included, then no matter what we measure or observe, the Ultimate Multiverse [i.e. Tegmark's] will nod and embrace our result.” (“The Hidden Reality: Parallel Universes and the Deep Laws of the Cosmos”, 2011)

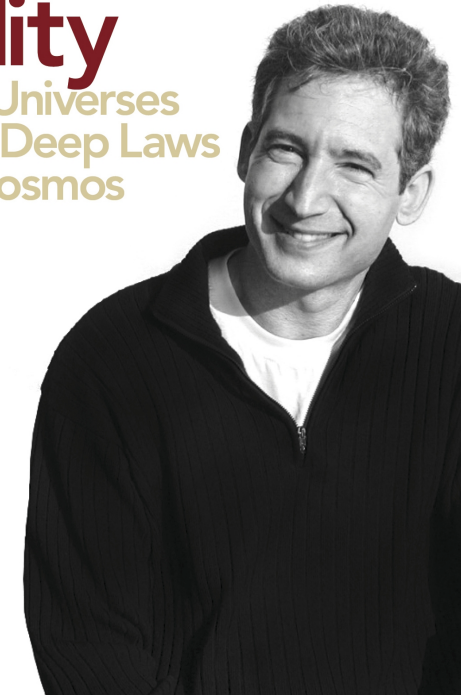
Contrary to B. Greene, we are showing that Tegmark's hypothesis runs counter to certain observations, so it fails, and fails as a scientific theory.



'If extraterrestrials land tomorrow and demand to know what the human mind is capable of accomplishing . . . hand them a copy of this book' THE NEW YORK TIMES BOOK REVIEW

Brian Greene The Hidden Reality

Parallel Universes
and the Deep Laws
of the Cosmos



To be continued Apr 21 2016