





# A Book on Bíases of Physics



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### Moira and Eileithyia for Genesis on the laws

First, the laws are endowed with a peculiar mathematical beauty, uniting in themselves formal simplicity, richness of solutions and one or another kind of symmetry, often as if suggesting itself as a hypothesis to a mind gifted with intuition. This special beauty is sometimes called **elegance** of the laws of nature. Thus, elegance has a decisive significance to a birth of a hypothesis, the most mysterious part of discovery.

Secondly, the same elegant mathematical law captures a tremendous range of parameters (distances, time intervals, energies, etc.), at that with a fantastic precision, up to twelve digits. This quality of the laws can be called universality.

Finally, the laws happen to be friendly to life's appearing and developing up to intellect; following the established terminology, this quality can be called anthropic.

The combined presence of these three qualities allowed for their discovery by great minds, and for that reason, it seems that the most appropriate term, uniting all three, is **discoverability**. A universe whose laws satisfy the **Discoverability Principle** (DP) of being *elegant, universal and anthropic* we suggested to call **Pythagorean**.

It could be even that the laws of our universe constitute the simplest possible set, compatible with the DP. The only so far available explanation of this amazing quality of the laws is that they come from the highest mind that created our universe able to not only be inhabited by intelligent beings but cosmically cognized by them.

A.&L. Burov, https://pythagoreanuniverse.com/

#### From the Preface to LiM

...The experiments didn't reveal anything new [anything fundamental predicted within last 40 years]. What failed physicists wasn't their math; it was their choice of math. They believed that Mother Nature was elegant, simple, and kind about providing clues. They thought they could hear her whisper when they were talking to themselves. Now Nature spoke, and she said nothing, loud and clear. Theoretical physics is the stereotypical math-heavy, hard-tounderstand discipline. But for a book about math, this book contains very little math. Strip away equations and technical terms and physics becomes a quest for meaning—a quest that has taken an unexpected turn. Whatever laws of nature govern our universe, they're not what physicists thought they were. They're not what I thought they were. Lost in Math is the story of how aesthetic judgment drives contemporary research. It is my own story, a reflection on the use of what I was taught. But it is also the story of many other physicists who struggle with the same tension: we believe the laws of nature are beautiful, but is not believing something a scientist must not do? (Preface)



b. 1976

### Darwinism and Quantum Gravity

Why should the laws of nature care what I find beautiful? Such a connection between me and the universe seems very mystical, very romantic, very not me.

"The sense of beauty of a physical theory must be something hardwired in our brain and not a social construct. It is something that touches some internal chord," he [Gian-Francesco Giudice, head of CERN theory dept] says. "When you stumble on a beautiful theory you have the same emotional reaction that you feel in front of a piece of art."

It's not that I don't know what he is talking about; I don't know why it matters. I doubt my sense of beauty is a reliable guide to uncovering fundamental laws of nature, laws that dictate the behavior of entities that I have no direct sensory awareness of, never had, and never will have. For it to be hardwired in my brain, it ought to have been beneficial during natural selection. But what evolutionary advantage has there ever been to understanding quantum gravity?





#### Beauty as a Delusion

In our search for new ideas, beauty plays many roles. It's a guide, a reward, a motivation. It is also a systematic bias...

Werner Heisenberg, one of the founders of quantum mechanics, boldly believed that beauty has a grasp on truth: "If nature leads us to mathematical forms of great simplicity and beauty we cannot help thinking that they are 'true,' that they reveal a genuine feature of nature." As his wife recalls:

One moonlit night, we walked over the Hainberg Mountain, and he was completely enthralled by the visions he had, trying to explain his newest discovery to me. He talked about the miracle of symmetry as the original archetype of creation, about harmony, about the beauty of simplicity, and its inner truth.

Beware the moonlight walks with theoretical physicists—sometimes enthusiasm gets the better of us. (LiM)

[AB: read e.g. E. Wigner, "Unreasonable Effectiveness of Mathematics"]





# What makes a theory beautiful?

Weinberg continues: "I wouldn't be in a hurry to set clear requirements for what a good theory has to be. But I can certainly tell you what a better theory has to be. A theory better than the standard model would be one that makes it inevitable that you have six rather than eight or four quarks and leptons. There are many things in the standard model that seem arbitrary, and a better theory would be one that makes these things less arbitrary, or not arbitrary at all."



b. 1933

SH to FW: "And why should this sense of beauty be relevant for the laws of nature?"

"I think it's the other way round," Frank [Wilczek] says. "Humans do better in life if they have an accurate model of nature, if their concepts fit the way things actually behave. So evolution rewards that kind of feeling that being correct gives you, and that's the sense of beauty. It's something we want to keep doing; it's what we find attractive. So explanations that are successful become attractive. And over the centuries people have found patterns in what the ideas that work are. So we've learned to see them as beautiful." (LiM)



## Mother of all biases

Biases: social and cognitive. See also at

http://backreaction.blogspot.com/2019/03/science-has-problem-here-is-how-you-can.html

"Then there is the mother of all biases, the bias blind spot—the insistence that we certainly are not biased. It's the reason my colleagues only laugh when I tell them biases are a problem, and why they dismiss my "social arguments," believing they are not relevant to scientific discourse. But the existence of these biases has been confirmed in countless studies. And there is no indication whatsoever that intelligence protects against them; research studies have found no links between cognitive ability and thinking biases.

Math keeps us honest, I told you. It prevents us from lying to ourselves and to each other. You can be wrong with math, but you can't lie. And it's true—you can't lie with math. But it greatly aids obfuscation.

I am biased."

## Questions Sabine does not ask

A bias is not an opinion, not even unreasonable opinion. A bias is an opinion you never try to examine seriously enough, as serious as you could. Biases are associated with blind spots, with overlooked, inconvenient, avoided questions and taboos.

SH admits that she is biased, and she points to her old belief in the beauty as the bias.

However, she never asks such key questions as:

- Why the belief in mathematical beauty was so effective in history of physics? Why the universe is comprehensible to such a significant degree?
- In our efforts to understand the universe better, is it possible at all to dispense with the belief in the mathematical beauty of not yet discovered laws?
- What is the value of the fundamental science—for the scientists and for humanity?
- There are old answers to these questions, shared by the fathers of physics; all the answers are pointing to God. There are no atheistic answers. Does it mean that God exists?

# Paul Davies on the "Party Line"



Where do the laws "come from"?

The laws exist reasonlessly They must be accepted as a brute fact Their origin is beyond the scope of science Asking "why those laws" is not a scientific question and is to be strongly discouraged!

"There is a chain of explanations concerning things that happen in the universe, which ultimately reaches to the fundamental laws of nature and stops...at the end of the day the laws are what they are...that's okay. I'm happy to take the universe just as we find it."

Sean Carroll

https://www.youtube.com/watch?v=pj7POKgkJTs 19:30

Lecture as part of the conference VARCOSMOFUN'16

To be continued...