



Lost in Math
How Beauty Leads Physics Astray
 Sabine Hossenfelder

English

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“No longer shall I sweat to teach
 What always lay beyond my reach
 I’ll know what makes the world revolve
 It’s inner mysteries resolved
 No more in empty words I reel
 creation’s wellsprings I reveal.”

In order to come closer to the ancient human goal "to recognize what makes the world revolve" Faust has entered into a pact with Mephisto; modern basic researchers must enter into a pact with donors and funding bodies.

According to Sabine Hossenfelder *) this leads nowadays to expensive dislocations in the “foundation of physics” research landscape, which only produced "zero results" for years with the LHC (Large Hadron Collider). Sabine Hossenfelder questions the construction of an even larger CERN LHC ring collider: What else can be discovered after having identified the Higgs particle? The foundation of physics standard model consists of 25 particles and has been unanimously confirmed and accepted. Since then, the LHC only produced zero-results so far. To better understand her thesis, the author first describes the problem and defines the current terms and criteria like the “beauty of equations” for the evaluation of new theories in the "foundation of physics".

What means “Beauty” of a theory?

According to physicists agreements “beauty” of a theory consists of three criteria: simplicity, technical naturalness and elegance; *simplicity* is characterized by using “simple laws” as input, *technical naturalness* means that in mathematical representations of the theory, numbers used in mathematical equations are allowed only to “be around 1” not too large, not too small and *elegance* means that the theory leads to interesting, unexpected insights.

Applying these criteria to the open questions of “foundation of physics” like super-symmetric particles”, string theory, dark matter and the search for unification (a “theory of everything”) of the

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Das Hässliche Universum
Warum unsere Suche nach Schönheit der
Physik in die Sackgasse führt
 Sabine Hossenfelder

Deutsch

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“Dass ich erkenne was die Welt
 Im innersten zusammenhält
 Schau alle Wirkenskraft und Samen
 und tu nicht mehr in Worten kramen.“

(JW Goethe, Fasut I)

four known forces, electromagnetic force, weak and strong nuclear forces and gravitational force, Sabine Hossenfelder claims that the building of just another larger LHC to follow up the current “beauty-theorem” according to the belief that “what we have not found so far to support the theory must become visible with the next higher magnitude of resolution of our measuring tools because our theory is full of beauty and therefore must be right ” is not the most promising way to find solutions for the problems and Hossenfelder justifies this by the many recent zero-result examples of the LHC and no progress in the relevant, abundant literature.

Now, with this approach the author stirs up a deeper discussion about the procedures and processes of approving and funding of such big projects, alluding that the research community is driven to promote fields which most of the involved physicists like – and maybe even have spent a lifetime working in this particular field, unable to admit that this particular approach does not lead any further. Hossenfelder calls this “cognitive and social distortion” leading to an endangerment of the “pure” scientific method. The result in the author’s opinion is, that originally supporting criteria such as “beauty of a theory” are promoted to serve as decisive criteria.

This of course triggered a lively, although valid discussion in the community because a lot of money and prestige is on stake.

In my opinion the great benefit of the book for the interested reader is that firstly he or she is thoroughly informed about the achievements, criteria and goals of “foundation of physics” i.e., what the taxpayers money is used for, and secondly, about the current status as of today on the questions of supersymmetry, quantification of gravitation, string theory, dark matter and where further research might be more promising without the next generation LHC.

Having worked for a long time in a "funding body"- environment, it is easy for me to understand the reasoning of Sabine Hossenfelder and I am convinced that the initiated discussion is necessary and hopefully leads to an intelligent return to the original goals of basic research and does not only continue with the principles "follow the money" or “publish or perish”.

Hossenfelder suggests in annex C “What can be done about it ”as a scientist, as a higher administrator, science policymaker, journal editor or representative of a funding body, as a science writer or member of the public among other things: Ask questions and be Critical!

A necessary book at the right time!

To conclude with a quotation I found in the book, closing the circle with the above Faust quotation: “The exceedingly beautiful system of the sun, planets and comets can only emerge from the advice and the domination of an intelligent being” (Johannes Kepler, 1726).

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