PHYSICS AND LIMITS OF HUMAN THOUGHT

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Abstract

The essay aims at analyzing possibilities in physics, like – How much is the development of physics aided or hindered by the human thought process? Should we ever expect to understand the nature in its entirety? Is mathematics really the natural tool for a physicist or just a beautiful well-fit mind-nature analogy? Each question posed follows an explanation, and later an attempt to find answers. The essay will at times pose open-ended questions which are expected to help realize the limitations of human thought.

Introduction

All that physics is today, and will be tomorrow, is bound to the limitations of human thought. A scientific thought can be a conscious attempt at understanding nature, but deep down may contain assumptions, not necessarily imposed by nature itself. The relation between physics and human consciousness may never be fully answered (due to the fact that it is 'all in the brain'), but understanding the limitations of brain as a thought machine will help realize the ultimate possibilities in physics.

In the initial stage, this essay will describe human thought as a physical process, following the laws of this universe itself. The following part will attempt to analyze the relation between physics and mathematics. It will not be a rigorous treatment of equations in mathematical physics, but an attempt at analyzing the basic association between the two studies - an association that develops in the earliest stages of a student's life, and is carried to the most advanced levels. Thus, it is the 'nature of physics' that will be analyzed here, rather than the 'physics of nature'. The 'physics of nature' is the set of laws followed by entities in this universe (or its alterations), independent of whether such a study is done by us or not. The 'nature of physics' comprises the characteristics of the study done by us, and its current direction.

This essay is not a theological treatment of physics.

What is a human thought and limits of its applicability to physics?

A human thought is a signal exchanged and saved among neurons in the brain. Whatever be the physiological and chemical processes, the human thought is bound to the nature of the universe. Hence, thinking of processes that are outside this universe is difficult and mostly impossible. For example, a geometrical vision of a 4 or more– dimensional space is impossible for the brain. The best we can do is devising an analogy – usually a mathematical or diagrammatic representation, etc. Though series of marvelous experiments, and rigorous mathematical theories, will continue to expose the physical reality, it has to come down to a basic understanding in form of these brain signals. Humongous amount of experimental data is of no real use unless analyzed for results, and fit into a physical theory. Such a theory is a form of human thought. The ultimate quest of physics is to find a state of brain wherein all such theories are stored and every physical phenomenon explained or implied by it. This leads to an interesting point – Is such a state of brain achievable?

Here it is worth analyzing the role of mathematics in understanding and development of physics, which is as follows.

Is mathematics really the natural tool for a physicist or just a beautiful well-fit mind-nature analogy?

What is mathematics? A conventional answer is the study of numbers ergo of quantities, measurement, etc. Let us consider measurement of length, which is of fundamental importance to classical mechanics. We measure by associating a number to the entity. The magnitude depends on the relative scale.

4 units

A very fundamental question arises here – Is association of numbers to an entity a natural basis or just a human selection? For instance, do we really see numbers associated to physical entities – No. It does well fit into nature and produces significant results, but that is just what we hope and expect to. The existence of mathematics is not a demand of nature but a need of a scientific mind.

Let us consider the basic development of numbers. We associate symbols like 1, 2, etc. to quantities as single, double, etc. respectively. Everything, from basic mathematical operations to other numbers, is defined circularly. Can we expect circular definitions to provide a real absolute answer to the existence of the universe?! To remove these circular definitions, one has to absolutely define 'the first number' and 'the first operation'. An attempt always leads to fall into a circular definition or a symbol-language association. For illustration, let us try a natural number and a basic operation –

- One
    - Any number divided by itself
        - which number? (hence circular definition)
        - define division. (again a circular definition)
    - 1, single, first, etc. – (symbol-language association)
- Addition
    - 1 + 0 = 1
        - define 1, 0 (circular definition)

Hence 'the first number' cannot be defined absolutely, without defining 'the first operation' and vice-versa.

How much is the reliability on mathematics important for physics?

One of the first scientific inventions of the primitive man was counting. Since physics is the study of physical nature, and mathematics is one of the oldest scientific tools, an association between the two follows almost subconsciously within the brain. Mathematics is the language of physics. The reasons of its selection are accuracy and simplicity, but also attributed to lack of a substitute. Often a physicist cannot rely only on plain equations, however concise. The 3 basic tools a theoretical physicist relies on are –

- mathematics,
- natural language, and
- imagination

These together form a scientific theory. Since common natural languages are inherently ambiguous, and imagination is abstract and non-universal, mathematics is the only option for

universality. This asks for an analysis of the current direction of physics. A new experimental school of thought in physics – that is both scientific and universal, yet keeps imagination on the same level of importance as mathematics, may help in breaking new grounds.

Let us consider a simple binary digital computer. It works on 2 different types of signal – on and off, or 1 and 0. Here, the computer does not really work on definitions of the numbers 1 and 0, but on the distinction between a high and low signal. Hence again mathematics is a convenience not a necessity.

Importance of imagination to physics

Imagination is simply abstract, yet powerful. As Einstein said [1]-

> Imagination is more important than knowledge …

It is by observation that a physicist notes a result, but it is by imagination that the results are made to fit into a model. For example, the clubbing of space and time, into a spacetime fabric in general relativity, is primarily an idea (imagination). Imagination is a sub-process of the human thought system. Since the human thought system is bound to this universe and based on its physical processes (as described earlier), it is irrational to expect imagination of a view outside the current set of physical laws. We can only imagine the results of the current theories and its derivatives or distortions.

For example, considering only in the realm of classical mechanics, gravity is attractive. So a scientific mind can imagine the following –

- What if gravity was/is repulsive?
- What if gravity was essentially zero or did not exist?

and many more already posed. Here it is worth pointing that a scientific inference is a sub-set of imagination.

This leads to an interesting point – Is every physical phenomenon we can imagine possible in nature (maybe not in this universe), and, can we imagine every physical phenomenon? Let me illustrate this with an example – since the brain signals are bound by laws of physics, an imagination of a particle travelling with speed greater than light is not possible. This suggests an evidence of the limits of imagination by a human brain. A neuroscientist may propose an experiment to measure the maximum speed of a human thought process.

Should we ever expect to understand the nature in its entirety?

Let us assume that a complete explanation of all the processes in this universe exists. This means that we can formulate a theory for it, however, concise or detailed. If a human brain has capacity enough to learn all these theories, given a sufficient amount of time, this theory can exist as a series or aggregation of these brain signals.

Now let us consider a hypothetical system that does not follow the laws of this universe. The fundamental question that arises here is – Can we expect its laws to follow the present mathematics? What if the mathematics of measurement does not hold there? Let me illustrate this as follows -

What does a hypothetical non-measurable universe imply? An example, though semi-rational, is that one cannot associate a single real number to a conventional property (say length), and neither to its probability of falling within a certain finite interval of magnitude. This may lead the entire classical physics to darkness. The reason is the intertwining between mathematics and physics in the current universe, and hence our brains, that make mathematics a compulsion for physics.

The above example does not intend to underplay mathematics in physics, but to expose the limitations of its applications to physics.

In Conclusion

If theoretical physics keeps moving with the basic subconscious association between physics and mathematics, the results obtained for this universe - its statics and dynamics, will one day be completely explained, hopefully. But, if this basic association is allowed to go unquestioned, the development of physics will be analogous to casting a giant iron ball. Each new discovery or theory, will add a new layer to our understanding, but this giant ball will have a fine hair-type void at its centre – the void about the unexplained lower end of mathematics.

In this process, as and when the association between physics (or nature) and mathematics is examined rationally, a better understanding of both the subjects can be achieved. In this regard, I cannot help but add a beautiful thought [2] –

> Mathematics is like the ocean — rough, boisterous and fearful on the surface, but having precious pearls and gems of the purest ray serene at the bottom.[1]
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> - Swami Rama Tirtha

The studies of physics and mathematics are an extension of the human mind and its consciousness - interrelated in our theories, but yet not necessarily related physically. A bold interrogation about their association will only lead to a higher truth.

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[1] There are variations of this quotation in different texts, which differ only grammatically as "... of the bottom." instead of "… at the bottom.". The quote is used in its essence.

References

[1] Albert Einstein, in "What Life Means to Einstein : An Interview by George Sylvester Viereck" in *The Saturday Evening Post* (26 October 1929)

[2] Graph Theory with Applications By C. Vasudev (ISBN 812241737X)