

A Very Short Story of What is to Come

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Abstract:

The short essay presented here as the goal of trying to point what is the main objective of physic and to address the question on whether it will reach its goal, and how. It is presented as an essay, not a technical paper.

Introduction

For as long as I remember, I always wonder how the world around me works. I always sought answer from my teachers, friends, colleague and professor. Unfortunately, I never received a satisfactory answer. That is the main reason I decided to study in mathematics-physics. I believed that I could do my share in the description of the universe.

Such reasoning is not rare among the physical science student. The vast majority of them believe that physics will ultimately explain everything. But is it the case? Is that the goal of the physical science? How does the physical science evolve? The answer to those question leads to the more fundamental one: what is ultimately possible in physics?

In the present short essay, I will expose my view on the answer to that question. On a first part, I will present what is physics in my opinion. Then, I will describe the way I understand the evolution of physical concept. Finally, a sort of answer to the big question will be presented. It is not an answer on exactly what can be done, because if it was, it would mean that we know it. It will merely be a projection of what is to come.

What is Physic?

It is a good idea, before starting to foresee what is to come, to remember what exactly the science of physics is. One has to recall that for the majority of people, physics is a collection of meaningless equations derived by a group of weird persons. Unfortunately, from what is sometime taught in high school or college, it is almost true. So, is that really what physics is about? Of course not! (Except maybe for the weird persons...)

The main objective of the science call physics is to study the foundation of Nature, or, as one can say, the knowing of the world around us. More specifically, physics is, at its own basis, the comprehension of the mechanics of the universe. Hence, there are no mathematics in the foundation of physics, simply a description and an understanding of the universe in which we dwells.

Now for the mathematics. Since the understanding of the mechanics of the world is what was sought (and still is...), some experiments were to be design. Experiments give results. Results were to be analysed. Predictions were to be made from the analysis. In order to do such predictions, rigorous thinking was needed and thus the introduction of mathematics. Hence, the mathematics only served as a language in which to describe the physical science.

Now, to answer the question upraised by the title of the present section, here is a succinct definition of physics:

The science of Physics is the science in which people are trying to understand and describe in a mathematical manner how the universe in which we live in (and perhaps other) works.

Evolution of Ideas

The second step in trying to define what is ultimately possible with physics is to draw a picture of the evolution of physical concept. Therefore, it will become possible to extrapolate onto the future of science. Now, since the study of the history of science is just a hobby of mine, I will stick to what I think are the most important change of paradigm in science (as would say Thomas Kuhn [1]), or what can be thought of the concept of rewiring (as would Leonard Susskind say [2]).

Let us first introduce the Ancient world, with the Egyptians and the Greeks. It is to say that those cultures developed what is called classical geometry [3]. The way they used geometry helped them to picture the world around them. However, a very simple mathematical theorem changed in a great manner their understanding of the world. The famous Pythagorean theorem. Before it was known, the Greeks saw the mathematical and physical world made of rational number only. For example, π was rational. Now the problem came with the square roots of 2, which is an irrational. The legend tells that the first mathematician who announced the result to the world outside Pythagorean School got killed by his fellow mathematicians! Science was hard in those days... Hence, one can thus say that the notion of irrational number is one of the first ever paradigm change in history (it is to note that the notion of zero came later, see for example Seife [4]).

Then the Dark Ages arrived (at least for Europe). It is good to know that Asian and Arabic cultures kept alive what was known and developed it. This paves the way to the Renaissance where, in my opinion, modern science really began. Of course, I am taking about Newton's law of gravitations, based on the previous work of Copernicus and Galileo (and Kepler, and Brahe, ...)[5]. The paradigm change took place on two separate levels. First, gravitation was explained from the comparison of the mass of the object studied. Such formulas explained in a very good manner the moving of the object in the Solar System. Then, the development of Calculus (actually, Newton developed the Fluxion, and Leibniz modern calculus). Those two aspects, when taken together, led the physical science to the point where, by the end of the XIX century, some physicist told their student to quit physic because there was nothing left to discover!

But some problems were left unresolved. At the beginning of the XX century, after more than 200 years of classical physics, two remarkable paradigm shifts appeared in a very short time (in thirty years, according to Gamow [6]). Those two paradigm change are, as you are expected, general relativity (space-time) and quantum mechanics (uncertainty). The development of those two theories enabled the physical science to overcome the unresolved problem put forward at the end of the XIX century.

Now, for the present day, it is too early in history to be sure that there has been a paradigm shift in the last few years. Some unresolved problems are present but it is unsure whether the actual theory will be able to explain what is observed. Perhaps some change is needed. Those changes might come in the form of Holographic Principle [2, 7], String Theory [2, 8, 9] or Non-Commutative Geometry [10, 11], for example. I have excluded the theory of everything [12] since it is not a new concept.

One can conclude this section by the following statement:

The evolution of the physical science is a continuous phenomenon with, occasionally, some discrete understanding leap, called paradigm shift.

What is to Come, Ultimately?

Now the big question. What is ultimately possible with physics? The answer comes when summarizing the two previous sections. On a first part, the physical science exists primarily to understand the working mechanism of the universe, on all possible scale. From cosmology to particles physics, from biophysics to material science, physics goal remain the same.

In the last few years, a lot of remarkable developments have been made in all domains of physic. The very large majority of such developments have been made with the use of accepted paradigm of science: principle underlying quantum mechanics, general relativity, classical mechanics... Even if some problem occurs in the understanding of some used phenomenon, a variation of the known physics will be proposed to overcome the problems, without changing the foundation. Now, one day, the physical science will come to a point were a paradigm change will be needed. One cannot say when it will happen, but it will.

After such change, a lot of new concept will be developed. The new paradigm will be developed to the point where a new one is needed. This process will occur as long as the ultimate goal of physic is reached: the understanding of the working mechanism of the universe.

So as what is *ultimately* possible in physic, the answer should be the understanding of the manner Nature works. There is no doubt that if humanity continues to develop itself as a society (peaceful one hopefully), with time, a very long time I fear, humans will be able to comprehend the way the universe is working.

However, there is a limit. Physics is not metaphysics, nor philosophy. The physical science describes nature in a mathematical manner, in order to understand the way it works. It has no pretention in knowing the “raison d’être” of the universe. So, even if physics will ultimately be able to correctly describe in a mathematical manner the surrounding universe, it will never answer the following question: why are we here?

Conclusion

I will conclude this short essay with a single statement:

There is still an enormous amount of thing related to the physical world that human minds don't even have a clue exist, so never quit studying physic.

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