

The limit of physics,..Science, Consciousness, and Free Will.

Emptiness or Incompleteness ?

An essay.

Abstract

A quick overview over different perspectives of the universe to search the limits of physics. **Uh mm! I guess this guy will lead us to incompleteness or just plain emptiness.**

About Science.

Science is the effort of discovering how the physical world **-universe-** works, in other words the effort of finding the rules that link causes with effects. That means, time and timing **-the concept of before and after-** is inherent to the process of science: we have some physical fact **-the cause-** , we wait some time so the rule applies, and then we have the effect. **-wow!**

Science as an effort of discovery, relies on empirical data. When trying to find rules that link causes with effects, science relies on rules **-formulas or statements-** that “predict” effects for given causes. This rules are believed true unless proven false by experience. All good rules should be falsifiable. **-If the rules are false, they can be more or less easily proven false with an experiment. Ha-ha, what about string theory, many worlds, multiverse, and many other good theories?**

Also, science and scientist rest on the belief that universe is basically deterministic. For any given set of causes, rules will always produce the same effect. **-Ha-ha! catch you, what about quantum mechanics?-** Even quantum mechanics which deal with probabilities in stead of “hard” numbers, establishes the relation “cause – effect”: one known **-known?-** set of possible “causes” **-particle positions and speeds-** can only lead to one minimum set of “effects” with probability 1.

If we believe in determinism, we, conscious beings, in the best of cases, are just “observers” of the film called: *“Universe: From the hot big bang to the cooling of all things”*. All phenomena is already established, from the past all the way to the future. What we call free will is just a dream **-we wish to have a film with a happy ending, but it will finish as it will any way , so we can only watch the movie.**

The limits of physics

With this scenario, with the universe being a movie and all phenomena already printed on the film, two questions arise: **-Did they arise because of some cause or did you want to think them?**

1. **“What’s the buzz about the limits of physics?...** Questions like: “What are the limits of

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physics' explanatory and predictive power?", What role do 'impossibility' principles or other limits play in foundational physics and cosmology?, and concepts like "sub-light-speed signaling", "Heisenberg uncertainty", "cosmic censorship", "the second law of thermodynamics", "the holographic principle", "computational limits", etcetera, refer only to "how we want or can see the movie".-Wow wow, now your using some terms stolen from the FQXi ESSAY CONTEST INTRODUCTION, you are not gonna make it any way-

2. **What should be written on an essay about the limits of physics?** What can be said about the limits of physics that is not already said and helps at least a little to the progress of science and our understanding of the universe? -You should have thought that half a page earlier.-

To try to answer the two questions, we should go back to science. If science is the effort of discovering how the physical world works, the effort of finding the rules that link causes with effects; then we, the beings that do science, are trying to represent in our "brains" and with our "mathematics" the world -universe- that is out there. After all, the rules that rule the universe are there whether we find them or not -Now , what if you are imagining everything? Remember Descartes.- We are trying to transform the movie to a different format, so we can play it in our head. -Why would you play it in your head?- And when we play the movie in our head we can fast forward or rewind, so we know, here and now, what will happen in the future and what happened in the past.

So, cause and effect is inherent to the process of science, which is no more and no less than the process of learning and thinking. One thing that can be said about science.

Now, does the phrase "the process of science is no more and no less than the process of learning and thinking" help at least a little to the progress of science? Not much. -Any way, what is the progress of science?- If a statement, or formula, does not help to predict future phenomena, it does not help to the progress of science. It must at least help to discover and explain the past. -Got it: The progress of science is the accumulation in time of statements and formulas that help predict the future and help to discover and explain the past here and now. But... have you answered your two questions?-

Summarizing:

1. The buzz about the limits of physics is because the limits of physics are exactly the same limits of the whole human process of learning and thinking. So whenever scientists do science, learn or think, in a way or other they are dealing with the limits of human knowledge.
2. Something that can be said about the limits of physics is that they are inherent to the process of science, learning and thinking, even if knowing this won't help much on predicting the future or discovering the past.

Didn't Feynman say that physics -science- is like sex, it some times produces some practical results but thats not the reason why we do it?

More about the limits of physics.

With the same metaphors:

1. universe being like a movie: an infinitely large set of already printed frames,
2. and science being the effort of transforming the movie to a different format so it can be played in the head of scientists,

what else can be said about the limits of physics?

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What we say about the limits of physics depends on how we see the movie, and each point of view, although partial, might be helpful to develop statements and formulas that contribute to the progress of science.

Over time, there has been multiple positions to see the universe, we will review some of them and try to see if we can find some new things to say. *Now, you should mention that you learned some of these points of view in the process of writing this essay and reading some of the other essays that participate in the contest which made you write this essay in the first place.*

Before going to the revision of some of the points of view on the universe, we should separate some concepts that are relevant.

1. **“Order of events”**. What is behind “cause – effect”, the before and after. We can say, a sequence of events is valid if one can be obtained from the previous by the application of the rules which govern the universe.
2. **“Ultimate Cause”** First cause, first event. If science is based on cause and effect, there should be a first cause, or beginning. For economic reasons some call the “Ultimate Cause” God. I will not be religious here, matter and energy can play that role if you wish, you can think on the pair -matter-energy- as just being. After all there is no answer to, Who created God? Another name for the “ultimate cause” could be “Big Bang”. *An obvious limit to science. Now, do we shave with Occam’s razor?.*

Note: For personal reasons and for the rest of this essay when I say God I refer to the ultimate knowledge, the search scientists do. In this thinking I follow Thomas Aquina, the ultimate purpose of humans is the search of God, that is knowledge *Yes, I know, you are the author of the essay so you rule in here.*

Block Universe

There are several equivalent points of view which we call block universe. Essentially the argument and the metaphor exposed are block universe based. The universe is a set of 3D frames (moments) arranged on a 4th dimension which is time. Time and space could be continuous or discrete. If we have block universe, determinism is an irrelevant consequence. All events **are**. God can see all of the frames at the very same time, just as we are able to see a line of several pictures of our last vacation over the table at the same time.

We have what is called “space-time”, with no major difference between the 3 space dimensions and the 4th, “time” dimension. There should be no reason why not to move on the 4th dimension, just as we move on the 3 space dimensions. *Wait, what is movement?* Although movement is a tricky concept here. *Just like politicians, some talking, no answer.*

Let's say we have a movie printed on a celluloid strip (film), we have a succession of frames, but what happens if we cut the frames with scissors: we could re-arrange the frames over a table. Of course is not like we could move the frames that form the block universe at random, there are rules, we can move the frames, but the frames that were together on the film, should stay together. Because we know

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(or at least feel) that time and space are sequential. If instead of a table, we can place the frames of the film over a sphere, or a cone, or a cylinder, or what ever, we can keep what was together, together and have different arrangements of the frames. Let's say we have one of such arrangements, we will find some frames that were very far apart on the film, are now together. Because of the rule with which the arrangement was made, we can always draw a line over the different frames to reconstruct the same succession we had on the film. Now, the question is: Given an arrangement of frames, does any line that links the frames define a valid **"order of events"**? By definition, this has to do with the rules that govern universe.

Determined Universe

If we believe that the first event in time was the "Big Bang", that it was the first "cause" and all subsequent events come from the application of the rules which govern the universe, then we will have a perfect succession of frames. If rules apply always the same way to the same set of events -frame-, it doesn't really matter if we are currently on a specific position of our strip of celluloid, and it doesn't matter that we can't move forward or backward at will. It doesn't even matter that the movie isn't really printed yet. It doesn't matter that future is not yet here. All frames are determined and God could see them all at a time. There is no much difference between a deterministic universe and block universe. The only difference is that we might not be able to move over time and the only order is a perfectly valid **"order of events"**. On the other hand, just like in block time, we have a fixed set of frames to our movie, and even if in reality frames can not be reordered, by reformatting the movie (in our brains and with our mathematics) we can re arrange the frames.

Global space-time, relative space-time.

If I ask for a definition of simultaneous events, with our metaphor, the definition is quite trivial. Any two events that "exist" on the same frame of our movie are simultaneous. Our whole movie is Global space-time.

The problem here is that there is no audience in this cinema. I mean, no one can watch the whole movie at a time, and in fact no one can watch a whole 3D frame. All of our observers -audience- are part of the movie. The bad thing is that no one read the script. *You mean, the observers are some characters in the movie, there is really no actors.*

Now, we can define simultaneous events as two events that are seen by an equidistant observer at the same time. This definition relies on the assumption that the speed of light is constant. Now we have the problem of defining distance. *Again leaving loose ends.* There is, to each observer, a perceived space-time. We call this "Relative space-time".

Relative space-time is the bubble in which each of us lives. We receive information about events around us through signals that travel at the best of cases at the speed of light, so we can receive information only about events that are away and in the past. Since we observers are part of the movie, we exist and live when and where we are on the movie. and we are only on the frame NOW. Even if we believe that the common first cause to all events is the "Big Bang", duration and distance from the Big Bang to an observer are different to each observer, *What if we all have the same clock and*

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measuring device? Relativity tell us each of observer has its own measuring frame for time and distance. Hey! isn't this a limit of physics? Two observers will never have an agreement.

Consciousness and Quantum Mechanics

We observers, receive signals from away and past events around us. Senses, intelligence, memory etcetera allow us to reformat those signals and represent events and “perceive” objects, causes and effects. Consciousness make us perceive ourselves and the rest of the universe, as parts and as wholes. To be conscious implies putting together many events of the past and predicting some future events in a single moment. There is no science with out consciousness.

When we look to the basic pieces which compose matter in our movie *our universe*, we see they behave weird. Scientists have empirically demonstrated that basic pieces of matter and light some times behave like waves, and some times behave like particles. In fact they are both. This produces a simple, but catastrophic, effect. We can never know the exact speed and the exact position of the basic components of matter . *Sure, that is weird!* It is called “Heisenberg uncertainty”. *Hey! isn't this another limit of physics?*

Since scientists can not know the exact position and speed of a basic piece of matter, they calculate only the probabilities of a particle to be in certain areas at certain speed. They call it wave function. This could sound little knowledge, but quantum mechanics has had more impact in science than any other theory. It has been around for more or less a hundred years now and it has had great predictions. *Right, shut up and calculate!*

What the wave function means is still being discussed, as mentioned it can be interpreted as the probability for a particle to be at certain areas at certain speed -wave functions are always a set of several values, possibly an infinite number of values- wave functions can also be interpreted as the actual particle. Then, when a scientist measures the position or speed of a particle, we call wave function collapse, because in stead of having several “possible places” for the particle to be at, we have just one. In quantum mechanics, a conscious being doing measurements actually changes what is being measured. Scientist do not agree on the wave function meaning and neither they agree on what happens when a measurement is done by a conscious being.

Consciousness, physics and Gödel

And, what's consciousness ? We have said that consciousness allows to perceive ourselves, along with the rest of the universe. And we have also said that we, the observers, are part of the movie. So we have a strange kind of movie, a movie that sees itself.

A mathematician named Kurt Gödel, *And don't forget to say mathematicians are more like philosophers, they do not care about experiments.* demonstrated that any mathematical formalism that includes arithmetic is self referent, it can speak about itself. In that way he constructed a self referencing statement which can not be proven false, nor it can be proven true. So we say, *any formalism that includes arithmetic is incomplete because it has statements that can not be true nor false. I see were you are going. now I can predict the future. Could it be possible that since the universe is self referencing...* Could it be that the universe is incomplete since the universe is self referencing through

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consciousness? And then what does it mean that the universe is incomplete? At least we humans know about ourselves and about the universe, we are conscious, but we can not explain how consciousness works.

An incomplete universe, in the sense Gödel incompleteness theorem, means that there are perfectly valid objects or events which will never come to existence. That, as far as I can see, is what we have. So don't need to worry about the multiverse and other things, they might be valid, but the universe might not have produced them. **Sorry, Murphy says that a perfectly valid BAD thing that can happen will happen...**

Most physics theories, at least contain arithmetic, so they are necessarily incomplete. That means that there are some physics statements that can not be true nor false -they are undecidable- with such a theory.

If the physics statements which are undecidable in a theory refer to *EXISTING* physical objects, phenomena or events; then we have an incomplete theory.

All physics theories used today are incomplete. For every theory there are existing physical objects and phenomena which can not be explained.

Information, complexity, Buddha and physics

Again with our movie.

We want to reformat the movie to play it in our head and with our mathematics, and then fast forward or rewind at will. -then we could predict the future and completely explain the past. The thing is we have not found the right reformatting rule.

How should the right reformatting rule be?

To fit all the information of the universe in our head, since our head is smaller than the universe, we need to loose information. We have some helpful devices to store some more information, and loose less on the reformatting: computers, books, etcetera. Still we have to loose a lot of information, but it is fair to have tools. **A question here. You just said the process of learning is a process of losing information, isn't that the 2nd law of thermodynamics?**

For certain events, the physics theories we have are perfectly right, actually for every day life, we have the theories we need. The reformatting rule for the behavior of the pool balls on the pool table are completely right. Here we have the complexity problem. If we have enough balls on the pool table there will be not enough computational power to predict the behavior of the balls. We will not reformat the movie fast enough. What we do is just wait and see. **Great thing we do not predict the results of sports,...**

So we have two problems to reformat our movie : (1) we have to loose a lot of information and (2) we have the complexity issue.

