

# On a Deterministic Universe and Constructed Reality

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## INTRODUCTION

If the universe is deterministic, does that not lead to the future being pre-determined? Does the future “already” exist? How is free will to be reconciled with determinism? The solution to these problems is already contained within the definitions of a deterministic universe.

What is the universe? Let it be defined as all that exists. Then, by definition, there is nothing outside the universe. Anything that exists must be considered a part of the universe.

What is determinism? Let it be defined as a requirement that effects have a cause strictly defined by the laws of nature.

## DEMONS

Following the successes of classical mechanics in providing a model for a deterministic universe, Pierre Simon Laplace proposed that an intellect, called Laplace’s demon by later commentators, that had full knowledge of universe would be able to calculate everything about the past and about the future. [1]

Suppose instead of the universe, Laplace’s demon was studying a closed system within the universe that followed deterministic classical mechanics exactly. Perhaps the demon would be able to model the system exactly. However, the demon would not be able to model the universe. For Laplace’s demon to model the universe, it would require the demon to have knowledge of itself as part of the universe. This leads to inevitable self-referential paradoxes: the demon in calculating the universe’s future would be calculating the future of its own calculation of the future, an endless loop.

## DICE

Quantum mechanics as commonly understood is believed to restore indeterminacy to the universe. Take a spin  $\frac{1}{2}$  particle that can be in an up state or a down state, and allow the particle to enter a superposition of the two states. When the particle is measured, it can only be found in an up state or down state, but the result cannot be known until the measurement occurs, only modeled as a probability.

Is this actually in contradiction to determinism? In the Copenhagen interpretation, the particle was in a superposition and was not in an up or down state prior to measurement. It was the act of measurement that compelled the particle to enter either the up state or down state. [2] Causal determinism then is still present, if perhaps in a vaguer way in that there is no way to determine if the state of a specific measurement will be up or down, only that it will be one or the other with a certain probability.

The Copenhagen interpretation asserts that quantum mechanics is complete, and therefore the indeterminacy is a feature of the universe. Alternative interpretations propose that quantum mechanics is incomplete, and that additional information unavailable to quantum mechanics, a “hidden variable,” could determine the result exactly. The Bohmian interpretation of quantum mechanics provides one such “hidden variable” theory by postulating a universal guiding equation that contains within it all the other information in the universe. A criticism of the Bohmian interpretation is that this additional information is non-local, but John Bell demonstrated that quantum mechanics is itself already a non-local theory in his Inequality Theorem. [3]

The non-local hidden variable is the information that would be available to Laplace’s demon but not to us. It is non-local because it is the universe itself.

## DISCUSSION

The information on the state of the whole universe exists in the form of the universe itself. All things within the universe have their respective properties, which exist. However, the totality of this information is not accessible from within the universe, as to allow this information to be accessible would lead to self-referential paradoxes.

If the universe is universal, then there is nothing outside the universe, then there is no view of the universe from outside the universe. Therefore, the totality of information of the universe, not being within the universe, does not exist.

Suppose that a computer calculates that  $1 + 1 = 2$ . From an outside perspective, one can know that the result of the calculation of  $1 + 1$  will result in 2. But from the inside perspective, the computer cannot know what the result will be prior to making the calculation. The 1 and 1 do exist within the computer, as does the mathematical rule that allows one to predict that  $1 + 1 = 2$ , but the 2 does not exist within the computer until it is calculated.

The future is the universe observing itself, completely deterministic and yet also undetermined. The universe in calculating its future simultaneously creates its own future. The universe constructs itself.

## REFERENCES

[1] Laplace, Pierre Simon, *A Philosophical Essay on Probabilities*, translated into English from the original French 6th ed. by Truscott, F.W. and Emory, F.L., Dover Publications, New York, 1951.

[2] Griffiths, David J. *Introduction to Quantum Mechanics*, 2<sup>nd</sup> Edition. Upper Saddle River, NJ: Pearson Prentice Hall, 2005.

[3] Bell, J. S. “On the Einstein Podolsky Rosen Paradox,” *Physics*, **1** (3): 195-200, 1964.