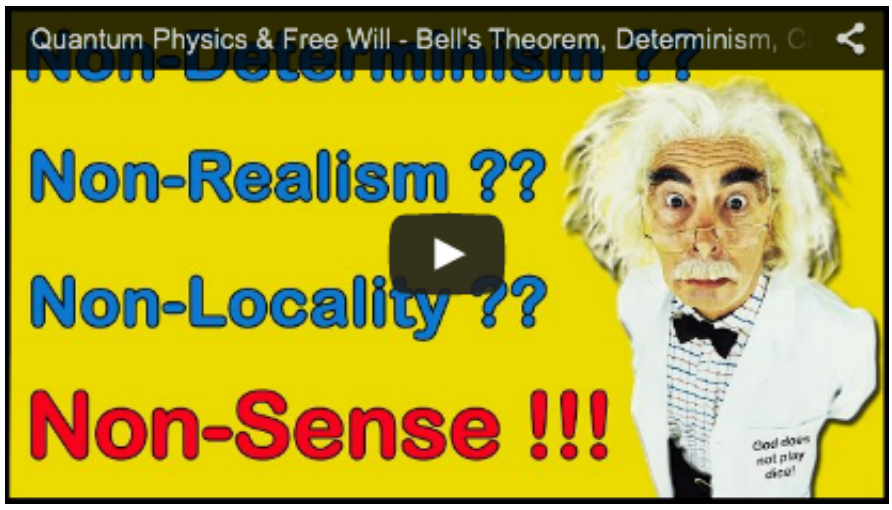
Quantum Physics and Free Will: Part One

Posted on January 28, 2015 by Dolors — 9 Comments ↓

Bell's Theorem, Determinism, Causality, Non-Locality, Realism, Free Will Axiom



Full Script:

Introduction:

I have been thinking of writing a script covering the topic of free will for a long long time. I don't remember having mentioned free will explicitly since my first video – in 2013 – where I discussed the nature of time. Finally, I have got round

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to doing it and I have to say that I am very excited about this video, not only because I am going to discuss the relationship between quantum mechanics and free will in a way that is hardly ever discussed in the popular media, but also because I am going to revisit the topics of time, causality and determinism – topics which I find fascinating. With this, I am hoping that some of the mind-boggling ideas which were introduced in that first video, will be here expanded and covered in much more detail. So let's get started, shall we?

Some of you may think that the idea that free will and quantum mechanics have anything to do with each other is ridiculous. That these two topics tend to be put together only in embarrassing, new-age, unscientific videos or articles. If you think like that, then I will take it as my job today to show you otherwise; I take it as my personal challenge to get you a little bit more informed on this matter.

Please be aware that I will cover some topics in this video, such as Bell's Theorem, which may be completely new for some of you. I'll do my best to discuss these ideas at a level that feels comfortable and engaging to everyone, no matter what you may or may not already know about quantum physics. And if – after watching this video – you are still hungry for more in-depth information, then you can refer to the links pointing to all the relevant articles, which are located right at the end of the written script for this video which, as usual, is available from my website. The direct link to the full script is right below this video, in the YouTube description area; really easy to find, you can't miss it.

A Popular Argument Against Free Will:

Ok, I am going to start with one of the most typical arguments against free will. It usually goes something like this:

All events occurring in the universe are necessitated by previous events, that is, temporal causality from past events to present events holds. In addition, the laws of physics apply to all physical systems, and since of course I am a physical system which is part of the universe too, my brain – which is involved in my decision making process – is subject to the

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same causal laws as everything else, hence it must be the case that my choice right now could only be the end result in this long chain of events that was initiated a very long time ago at the moment of the big bang. Therefore, the idea that I have choices – that I could have done otherwise in those same circumstances – can't possibly be true, hence free will must be an illusion.

Uncovering Some of the Assumptions:

Now, there are many assumptions in this argument worth analysing and discussing. But today, I will mostly examine two or three of these assumptions; the assumptions which I will then be able to relate to the very foundations of quantum mechanics. Remember that an assumption, axiom or postulate is our premise or starting point in an argument or theory, something which is assumed to be true and which doesn't need to be justified by scientific evidence. So what are these assumptions then?

Well, to start with, the previous argument assumes that causal determinism is true and that it operates linearly from past to present to future. In other words, the argument assumes that any state or event I can think of in the history of the universe, including human action, is bound by causality in such a way that it is always uniquely determined by prior states associated with it; that is, each event is necessitated by previous events and conditions which belong to this causal chain. What all of this means is that I conceive myself as an entity which is the product of a long chain of causally connected, temporarily ordered events in a universe whose history must necessarily run linearly from past to present to future.

It means that I assume there is a real world out there which – throughout these 13.8 billion years that have elapsed since it came into being – has existed in just one particular state at each moment in time. Put another way, I am assuming that all the unique past events which I conceive as belonging to this long cause and effect chain did really occur at some point in time, and that all of these past events necessarily followed one another linearly until they ended up leading to this

particular moment in time, the present, which I am experiencing right now, when I am just about to make my choice. Past, present and future are all set in stone in this model.

What's more, notice that this argument also assumes that all those past events belonging this long chain – events which I visualise to be causally linked to my present choice – occurred completely independently of my awareness, perception, experience or knowledge of them. It assumes that my sense of I-am-ness has no agency whatsoever, that what I call "I" is simply a detached observer, that what I am doing right now is only the product of a fixed, external, objective, observer-independent existence; that all what I am doing right now is completely outside of my control, for the past has already happened and, in a sense, so has the present and the future, as all possible events are equally fixed since the beginning of time.

Since all the events in this chain are subject to this past-to-present-to-future linear cause and effect law – that is, they were necessitated by their previous causes – and since most of these past events have nothing to do with me, with my experience or knowledge of them – as after all they took place well before I was born – the question is: how could I possibly be said to be making any free choices right now? I had nothing to do with most of the past events which can be causally linked to my choice today, so I conclude that I simply could not have chosen otherwise, that my choice was necessitated by previous causes, causes which were completely outside of my control.

Changing our Starting Assumptions:

Ok, so now that I have exposed a few of the assumptions that are taken for granted in this popular argument against free will, I have a challenge for you today. I would like you to look at this scenario from a very different perspective. The ideas that I will present to you throughout this video will highlight the fact that the concepts of determinism, indeterminism, free will and causal order are intrinsically linked to each other but that the argument can in fact be turned completely upside down,

and that if we do so, the consequences are mind-boggling.

So what happens when we turn our previous argument upside down then? Given that both free will and absolute determinism seem to be unprovable, the idea is that, instead of starting by assuming determinism to be true – since there is no scientific or subjective evidence whatsoever that supports it – instead we start by making the assumption which we take for granted every single day of our lives and by which we live our lives accordingly. Yes, you guessed it, we start by assuming our own free will to be real – given our most profound experience of it – and then see where this leads us.

This means that, rather than starting by assuming that there is a deterministic, objective, agent-independent world out there which started 13.8 billion years ago, which can be modelled via a causally linear chain of events which runs from the distant past right through to this present moment in time, when I am about to make my choice, hence leading me to the conclusion that free will can only be an illusion; I instead start by assuming nothing but what feels obvious, intuitive and undeniable to me right now, as a result of my present subjective experience. That is, I start with the assumption that I am a conscious agent with the inherent capacity to make free choices, choices which are not uniquely determined by the past history of the universe.

As I will show you later in the video, turns out that this way of thinking not only has led science to experimentally test some of the most important theorems of all time, but that in fact it is precisely this important assumption that enables us to talk meaningfully about science in general. In addition, I will also discuss some fascinating ideas describing how the universe might work and what our place in it might be, showing that we don't need to be mere puppets going through the Universe's motions, but that we can indeed be very active participators in this huge, magnificent cosmic show.

My Definition of a Free Choice:

But for now, I'd like to tackle a very important question first. What do I mean by a free choice? What exactly must the

choice be free from, you may wonder? Well, personally, by free choice I do not mean a choice which is not influenced at all by external events. We all know that there is no such thing as a completely isolated system or being which operates 100% independently (100% freely) from anything else. We are heavily influenced by our biology, our culture, our upbringing and so on…

Everything is interconnected, we are all interconnected, and that of course includes our own sense of self! What do I mean by this? Well, think about how this sense of self is actually deeply interconnected with what we personally reject as not self. For instance, we often tend to identify with our ego and forget that we are actually a lot more than that, that we are also our unconscious self, which includes our body's autonomic functions. Hence, this sense of self – which is aligned with our answers to the questions "who am I?" and "what is my relationship to the external world?" – plays a very important role when it comes to our discussion on the topic of free will.

Think about how the whole and its parts are deeply interconnected with each other, what the role of the part actually is in relationship to the whole, what degrees of freedom are available to the part as compared to the whole, and how we can make sense of free will by looking at reality from different perspectives, either the differentiated parts or the unified whole. Hopefully I can talk about this issue very soon, in a follow up video, where I would like to discuss free will and our sense of self, reductionism and holism, Libet's experiments, neuroscience's arguments against free will, and a few other related issues.

Ok, going back to the topic of this video and what I mean by a free choice; I mean a choice which is not uniquely determined by other past events which can be causally associated with it. So it is a free choice in the sense that, while I acknowledge that I may be influenced by external circumstances or past events, I still assume that I do have a certain degree of freedom, that I really do have a branching of possibilities arising in front of me, that I have something called a decision space. My choice is free in the sense that I am not at all pre-destined to choose what I choose, I am not uniquely or

exclusively determined to choose what I choose. And therefore, the profound and intuitive experience I have that I could have done otherwise is actually genuine, it corresponds to reality, it is not an illusion.

And so… the idea is that we take this concept of free will – as explained, free will in the sense of having freedom from exclusive or complete determination by external influences or past events – and we make free will one of the most important axioms of our existence. Note that this definition of free will is consistent with indeterminism and is also consistent with having a certain degree of self-determination, partial self-determination, but disregards the notion that we are isolated or separate agents with some sort of super-hero, exclusive self-determination powers, as certain libertarian free will definitions seem to imply. Remember, indeterminism does not necessarily entail absence of causation or absence of self-determination; in the same way, indeterminism does not entail a universe characterised by complete randomness.

What we are doing is acknowledging the obvious fact that we are not separate beings, that we are not totally immune to external or past influences. On the other hand, we make the important assumption that our choices are not uniquely determined by those influences and that there is in fact a branching of possibilities in front of us, an intrinsic indeterminacy in Nature which we can experience at the present moment, the only moment we can ever experience. By being aware of this branching of possibilities (consciously or unconsciously), we are then able to exert our freedom of choice, in line with our own intent or will.

Free Will as a Fundamental Axiom:

Free will becomes this way a fundamental aspect of reality, a fundamental axiom or postulate, a basic pillar upon which we can build our models of the world. Free will allows us to be true sources of novelty and creativity, for only a universe which displays a certain degree of randomness, which can spontaneously and non-deterministically come up with new possibilities, an arising of new information which coexists peacefully with its more stable and predictable patterns and

regularities, is a universe which can produce genuine novelty and creativity.

From the theory of evolution and our most innovative technological gadgets to the most creative pieces of art … Any process of creation – whether it is carried out by Nature through trial and error in the timespan of billions and billions of years, or whether it is carried out by Nature through us ,humans beings, in the timespan of a week – can only be made meaningful thanks to our intuitive understanding, our intuitive experience that Nature evolves by exercising its own freedom; that we are in fact part of Nature, that we are active participators and creators, that we are not just mere puppets following deterministic physical laws.

In other words, the meaningfulness of Nature's evolution, of our own process of evolution, of our creativity, of our scientific discoveries and our technological advances is derived from our deep understanding that Nature evolves freely, that we are part of Nature and hence we indeed possess a certain degree of freedom to make personal choices, to make mistakes and to learn from them, a certain degree of freedom to be part of this amazing cosmic creative process.

In this way, we make free will a fundamental axiom within science too. You think this is crazy or unscientific? Well, all scientific theories start from a few basic assumptions, assumptions which aren't always stated explicitly. We start from a set of axioms or postulates and we then build our models of the world from there. Would you be surprised if I told you that the observer's free will is already an assumption which is used as a fundamental axiom in one of the most important scientific theories of all time?

Yes, I am talking about Quantum Mechanics. In this part of the video, I am going to do my best to explain in simple terms how free will and quantum mechanics are intimately related. Not only that, but I will show you how the observer's free will has become of the most important axioms in the foundations of Quantum Mechanics

Quantum Physics and Free Will:

Quantum theory is a deterministic theory when it comes to describing Nature in the absence of observation, in the absence of measurement. On the other hand, quantum theory becomes a probabilistic theory when it comes to describing the outcomes of our observations. It is in this sense a non-deterministic theory, in that the particular outcomes of individual measurements arise not deterministically, but probabilistically, from a fuzzy world of possibilities. This indeterminacy is not due to us lacking precision or predictive power; in quantum mechanics, indeterminacy is considered to be intrinsic to Nature.

However – and here is the key – when we, as observers, as experimenters, conduct an experiment in quantum mechanics, we actually need to make very important choices about what questions we are going to ask Nature. For instance, before we make a measurement, we need to choose what questions we are going to ask related to the properties of the particles we are studying. How Nature responds to our questions, that is, the outcome that is presented to us as the answer, depends entirely on our previous choice as to what questions we decided to ask.

You may think, all right, there is nothing new there… Well, turns out the issue goes a lot deeper than it seems, because in fact, Nature's response to our questions is correlated to our choice of question even when we set up an experiment in such a way that this dependence would be classically forbidden, according to the principle of local realism.

I will discuss some fascinating examples in a bit when I talk about Bell's theorem, and also towards the end of the video when I talk about the link between free choices and past history. Turns out there are experiments which show that our free choices in the present can be causally linked to the creation of past histories of the universe! It has been shown that certain events which we would ordinarily think of as events that must have already occurred in the past, can indeed remain undetermined until we ask Nature a relevant question; by making our free choice, we then proceed to obtain the answer from Nature as we make our measurement, at which point certain past events can suddenly come to live. More on this later.

Origin of the Free Choice Discussion in Quantum Physics:

What is most relevant now to our free will discussion is that, in order for quantum theory to make sense, and arguably for the whole of science to make sense, we are always assuming, implicitly or explicitly, that this choice we are making is in fact a free choice. But how is this free choice defined in the context of quantum theory then?

Well, there seems to be a variety of ways in which this free choice has been defined within the context of quantum physics, but the assumption is certainly always there, implicitly or explicitly, and it is usually defined in line with indeterminism. From the quantum measurement problem to Bell's theorem, and more recently the Conway-Kochen Free Will Theorem, the crucial issue of whether the experimenter's choices are free or not plays a fundamental role in quantum theory.

Bell's Definition of a Free Choice:

For instance, physicist John Bell, when he formulated his famous theorem about 50 years ago – arguably one of the most important scientific theorems of all time – he made the free choice of the experimenter one of the axioms of his theorem. He considered the experimenter's choice to be completely free when that choice could only be correlated to variables in its causal future, but not its causal past.

In his own words, here is Bell's criterion for a variable to be free*: "For me this means that the values of such variables have implications only in their future light cones",* in "Free Variables and local causality", Chapter 12, Speakable and Unspeakable in Quantum Mechanics

Hence, if a variable is to be chosen freely, according to Bell's definition, it means that the variable can only be correlated with events in its future light cone.

Note that this is actually a very strong statement, as in the case of a human being, it means that no information accessible to the experimenter related to his own past cone

can be assumed to have a causal influence on his present choice.

Bell's Theorem and its Philosophical Implications:

So what does Bell's theorem state and why is it so important? Bell's theorem states that no local realistic explanation of quantum mechanical predictions is possible in which the experimenter has a freedom to choose between different measurement settings. John Bell proved mathematically that certain quantum correlations, unlike all other known correlations in the Universe, violate realism, locality or freedom of choice.

For experiments on pairs of entangled particles, Bell realized that quantum theory predicted a kind of correlation between the outcomes in two well-separated laboratories which seemed to be profoundly mysterious. The philosophical implications of Bell's theorem are astonishing: either one must abandon the view that reality exists prior to and independently of observations, abandon our everyday notions of space-time and causality, or abandon the experimenter's freedom of choice.

To give you an idea of what Bell's theorem and Bell's inequalities are all about, imagine you have two experimenters who are space-like separated, which in this context, it essentially means that their laboratories are separated by such a distance that no information can travel from one to the other within a pre-stipulated period of time without moving faster than the speed of light.

Each of the experimenters is assumed to be free to choose at the last moment what question they are going to ask Nature. For simplicity, let's say they are free to choose what kind of experiment or measurement they are going to do, this one or that one. Quantum theory had already predicted the counterintuitive result that the outcome appearing in one laboratory would actually be interconnected with the choice made at the last moment by the experimenter in the other laboratory. In other words, the choice of what to measure in one laboratory was predicted to instantaneously influence the

outcome for later measurements in the other laboratory, which could in principle be located very far away, at another galaxy for instance.

Causality & Non-Locality: Spooky Action at a Distance or Reality Beyond Space-Time?

This prediction seemed absolutely crazy, because there was no time for the information to travel through space-time from one region to the other according to the known laws of physics, so how could the outcome of one experiment in one region possibly be correlated to such a high degree with the choice made in the other region by the other experimenter? This is what is called a violation of the principle of locality, where the assumption that causal influences can only occur locally is violated. Causality is at the core of what Bell's theorem is all about, although it must be said that one can dispute that this kind of interconnectedness between events could be called causal at all, as it seems to occur entirely outside our space-time, therefore rendering our traditional concept of causality completely meaningless.

Physicist Nicolas Gisin and his colleagues performed experiments in 2008 showing that, if these spooky influences were to be conceived as some sort of hidden type of communication between particles taking place in space-time, then they must be travelling at a minimum 100,000 times the speed of light (Nature, vol 454, p. 861); but this hidden type of communication is ruled out by most physicists, including Gisin himself. He concludes that there is no spooky action at a distance as such, because the notions of spatial distance or time-ordering become meaningless here; he thinks that the dimensions of reality we seem to live in, space-time, cannot possibly contain the explanation for this fundamental type of influence or interconnection. "There is no story in space and time that tells us how the correlations happen", he says. "There must exist some reality outside of space-time."

For all intents and purposes, we usually talk about this type of interconnection as instantaneous influences, since there is no way for us to explain them in terms of causation taking place within space-time. Einstein's theory of relativity does not allow

for information to travel faster than the speed of light within the fabric of space-time, so we can either talk about influences that occur outside space-time, that transcend space-time, or alternatively, we can talk about a type of interconnectedness in Nature which reveals the fact that space-time is not fundamental, but emerges from a deeper reality where non-separability is the norm, where everything is one, space ceases to exist and causal order and linearity in time – the way we classically understand them – are not fundamental either.

Experimental Confirmation of Violation of Bell's Inequalities. Locality, Realism, Freedom of Choice:

Numerous experiments have been performed over the years since Bell formulated his original theorem, and always, without failure, quantum theory has been proven right. *[Correction! Quantum theory's predictions have been shown to be right. However, strictly speaking, we do NOT say that quantum theory has been proven right, we say that it has not been falsified.]* The results of all experimental tests of Bell's inequalities performed to date indicate that – since the equalities are violated – we need to completely let go of one or more of the assumptions in Bell's theorem: locality, realism or freedom of choice. Violation of local realism indicates that we need to let go of what physicists call local hidden-variable theories, which are theories that some physicists think could explain reality better than quantum mechanics, theories that would still cling onto our classical assumptions of locality or realism. On the other hand, if the freedom of choice axiom was the culprit, then this would mean that we need to let go of our idea of free will and instead view Nature as a super-deterministic machine.

Letting go of realism means we need to abandon the idea that physical reality exists prior to and independently of our observation, while letting go of locality means that we need to get used to the fact that, somehow, Nature seems to display a fundamental level of interconnectedness, a kind of non-local sharing of information that utterly defies our everyday notions of causality, space and time. While non-locality and non-realism correspond to well-developed interpretations of quantum mechanics, non-freedom of choice is another beast

altogether. I think that falsifying either free will or absolute determinism on scientific grounds is impossible; nevertheless, closing the existing loopholes would drastically reduce the likelihood that we live in such a super-deterministic world.

Notice that the important aspect about Bell's theorem which is relevant to our discussion about free will is that, for us to be able to make sense of the results we obtain from our quantum mechanics experiments, it is absolutely necessary to be able to speak meaningfully of what the result of our experiments would have been, had different choices been made by the experimenters. However, in an absolutely deterministic world, where every single event is set in stone from the moment of the big bang, even the questions the experimenters ask must be predetermined by the laws of physics, and we can no longer speak meaningfully about the possibility of having different outcomes, since no matter what choice we make, this choice, as well as the outcome, would be uniquely pre-determined beforehand. It is clear that, in such a scenario, not only our humanity but also the validity of all of science comes into question.

The Super-deterministic Universe – A Cosmic Conspiracy:

In Bell's own words, 'Suppose the world is super-deterministic, with not just inanimate nature running on behind-the-scenes clockwork, but with our behavior, including our belief that we are free to choose to do one experiment rather than another, absolutely predetermined, including the "decision" by the experimenter to carry out one set of measurements rather than another. Then there is no need for a faster-than-light signal to tell particle A what measurement has been carried out on particle B, because the universe, including particle A, already "knows" what that measurement, and its outcome, will be'.

The paradoxical idea behind super-determinism, as John Bell liked to call it, is that in such a scenario Nature would somehow deterministically conspire to make our experiments consistent with the view that quantum theory is true, that the world is indeterministic, non-local and observer-dependent at

the core. In other words, we would be living in an absolutely deterministic world where Nature would always conspire beforehand to make the results of our quantum mechanical experiments consistent with an idea of the world which is in fact incorrect! Confused… or… horrified… yet?

Physicist Anton Zeilinger couldn't describe the situation better. He states: "We always implicitly assume the freedom of the experimentalist… This fundamental assumption is essential to doing science. If this were not true, then, I suggest, it would make no sense at all to ask Nature questions in an experiment, since then Nature could determine what our questions are, and that could guide our questions such that we arrive at a false picture of Nature."

Violation of Leggett & Leggett-Garg Inequalities:

Anton Zeilinger is a distinguished quantum physicist who has pioneered numerous conceptual and experimental contributions to the foundations of quantum mechanics. Over the years, he has been involved in several quantum mechanical experiments to test Bell's inequalities as well as another kind of inequalities called Leggett's and Leggett-Garg inequalities. The results of his experimental tests have shown complete agreement with quantum theory. Whereas the violation of Bell's inequalities is generally associated with the falsification of locality but not necessarily realism, the violation of Leggett's inequalities is generally associated with the falsification of realism. The violation of Leggett-Garg's inequalities is associated with the falsification of macro-realism which, in broad terms, means that we even need to question whether the moon is actually there in the absence of observation.

What this means is that the experimental confirmation of the violation of Bell's inequalities together with the experimental confirmation of the violation of Leggett and Leggett-Garg inequalities seems to indicate that we need to completely abandon both locality and realism, including macro-realism! And if we are not happy with that because we feel safer clinging onto our 19^{th} century classical notions of reality, which are more in line with a local realistic picture of Nature,

we are then left with no other option than to completely deny our freedom of choice and the idea of agency so that we can model Nature as a conspiring super-deterministic machine, where we are simple observers, rather than participants, in some sort of twisted, convoluted cosmic puppet show!

What needs to go? Realism, Locality or Freedom of Choice?

Most physicists seem to agree that the conspiring super-deterministic universe model is a little bit ridiculous. As computer scientist Scott Aaronson puts it: “Invoking conspiratorial correlations among all the brains, measuring instruments, and subatomic particles in the universe to make it look like quantum mechanics is true is vastly stranger than the thing it’s supposedly trying to explain.” He points out that there is little difference between invoking something like that and invoking a superhuman deity. I think he does make quite a valid point.

Sooo – tell me – what do you think needs to go? Realism, locality, both realism and locality, or free will? What worldview do you choose? (no pun intended!! … 🙂)

Coming Soon…

Thank you so much for watching – I hope you enjoyed this video! There was a lot to take in – I know. However, if you are still hungry for more, remember that I have put loads of reference links on my website. There are many controversial topics in this video; of course don’t take my word for it, do your own research, have a little think, and once your brain is completely fried like mine, please do come back and write all your thoughts under here, in the comments section!

Also, I must say that I had to finish the script here, as the video was getting way too long and dense! So I’ll cover creation of past histories & the Participatory Universe in the next video. I have to confess that John Archibald Wheeler is my favorite physicist of all time, so I am really looking forward to that! Have already written about half the script, so not long to go now. Here’s a summary of what I am planning to cover:

- The Conway-Kochen Free Will Theorem
- Discussion on the definition of free choice. Is Bell's definition realistic for human being's free choices? Is it sensible to put human being's free choices at the same level as a random number generator?
- Past history creation & free will. Double slit experiment. Delayed choice experiment
- John Wheeler & Stephen Hawking's thoughts on past history creation
- Revision of the assumptions uncovered earlier in the popular argument against free will. What happens when we let go of most of them? Turning the model inside out
- John Wheeler's Participatory Universe, the Universe as a Self-Excited Circuit, and Law without Law. Alternatives to deterministic linear causality.

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Finally, can I say thank you so much to all of you who have donated! I am immensely grateful – your support means a lot to me! It's not just the financial side that it's important, but it is your regular support (in any form) that keeps me motivated and productive. Without it, this channel would not be able to survive right now.

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and get one step closer to making my dream a reality.

Thank you ever so much for watching and for your support!
See you all very soon … 😉

Dolors

Hungry for more? References and more information on the topics discussed above:

Indeterminism:

http://en.wikipedia.org/wiki/Indeterminism

http://www.informationphilosopher.com/freedom/indeterminism.html

Bell's theorem:

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http://www.nature.com/news/physics-bell-s-theorem-still-reverberates-1.15435

Experimental tests – violation of Bell's inequalities:

http://en.wikipedia.org/wiki/Bell_test_experiments

http://qudev.ethz.ch/content/courses/QSIT10/presentations/QSIT-BellsInequality.pdf

The freedom of choice assumption and its implications (presentation):

http://meetings.aps.org/Meeting/MAR13/Session/W3.1

John Bell's concept of local causality (great quotes from Bell also on free choice):

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Leggett & Leggett Garg Inequalities:

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The Quantum Physics of Free Will:

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‹ What is Physical? – Crumbling Physicalism

Do Electrons Have Free Will? ›

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