The Fine-Tuning Argument & the Many Worlds Interpretation of Quantum Mechanics

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Abstract

Scientist have discovered that some of the fundamental aspects of nature are to be fine-tuned for the existence of life - especially for the existence of intelligent life. Based on these discoveries the so-called Fine-Tuning Argument (FTA) has been established, which according to its proponents shows that design is the best explanation for that circumstance. Sceptics often bring up to possible existence of a multiverse for the explanation of the fine-tuning in the universe. There are different types of multiverses which are discussed in literature. One type of multiverse comes from the Many Worlds Interpretation (MWI) in Quantum Mechanics (QM). In this essay I will argue that the MWI is not a good option for sceptics to attack the FTA, because 1) it is a problematic interpretation of QM and 2) even if true, would not threaten the viability of the FTA.

1. Introduction

In the last decades - beginning in the late 50s - scientists have discovered that certain aspects of nature, like its initial conditions and the constants in the laws of nature, must be fine-tuned to a very strong degree to make life in the universe possible. [1] Even a slight deviation from the values our universe has, would have life prevented to exist. This holds especially for the existence of intelligent life. Based on that, a Fine-Tuning Argument (FTA) for the existence of a Designer of the universe can be formulated:[2]

1. The fine-tuning of the universe is due to physical necessity, chance, or design.
2. It is not due to physical necessity or chance.
3. Therefore, it is due to design.

Sceptics usually attack premise 2 of the argument. It is argued that our universe is one of gazillions (or maybe even infinite) universes in the wider multiverse. Therefore, it is not surprising that a universe like ours (with the fine-tuning as observed) could arise by chance among all the other universe in the multiverse, which are mostly hostile to life. There are different types of multiverses which are discussed in literature.[3] One type of multiverse comes from the Many Worlds Interpretation (MWI) in Quantum Mechanics (QM). In this paper I will argue that the MWI is not a good option for sceptics to attack the FTA, because 1) it is a problematic interpretation of QM and 2) even if true, would not threaten the viability of the FTA. This paper is structured as follows: First, I will give a brief overview about fine-tuning. Second, I give a brief introduction to the MWI. Third, I present two strong arguments against its viability, as a preferable interpretation of QM, which would already disqualify it as an option to argue against the FTA. The last part before the conclusion shows why the MWI does not threaten the MTA, even if it would be the correct interpretation of QM.

2. Fine-Tuning

In this Chapter I will give a brief exposition what fine tuning commonly entails. For life to exist in the universe, a lot of things need to be in place: First, stable matter and predictable reliable processes are required. Second, a complex and tailor-made chemistry is needed to provide the building blocks for biological bodies. Third, a fitting environment like planets for survival is required. Forth, an appropriate energy source like a sun is necessary. Furthermore, the requirements for complex life are much more stringent than for simple life. There are several types of fine-tuning which are discussed in literature.[4] First, there is a fine-tuning of the initial conditions of the Big Bang. Second, the right kind

[1] For example: Lewis, Geraint F.; Barnes, Luke A. *A Fortunate Universe: Life in a Finely Tuned Cosmos*. Kindle ed. Cambridge: Cambridge University Press, 2017; Barrow, John, and Tipler, Frank . *The Anthropic Cosmological Principle*. Oxford: Oxford Univ. Press, 1988.
[2] Craig, William Lane, *Reasonable Faith (3rd edition): Christian Truth and Apologetics*. (Wheaton: Good News Publishers/Crossway Books, 2009), 161.
[3] Max Tegmark "Many Worlds in Context" in Many Worlds? Everett, Quantum Theory, &Reality, ed. Simon Saunders, Jonathan Barrett, Adrian Kent, &David Wallace. Kindle-Version. (Oxford: OUP, 2010), 556-571.
[4] Robin Collins," The Teleological Argument", in *The Blackwell Companion to Natural Theology, ed.* William Lane Craig and James Porter Moreland. (Malden, MA: Wiley-Blackwell), 2009, 211

of natural laws are required. Third, there is a fine-tuning of the constants of physics/nature. Fine-tuning also exits in some other higher-level principles. For life to thrive also the right kind of galaxy, the right kind of Solar system, the right kind of planet most be in place. And finally, there exists even fine tuning in biology. Note, if the first three conditions were not fulfilled there would not even be stars and planets. And even if all conditions are in place, there is no guarantee that the complex machinery of life could arise just by chance. In the following I give examples for fine-tuning of the laws of nature, for the natural constants and for the initial conditions of the universe.

2.1. Fine-Tuning in the Laws of Nature

In the following, I present two cases for finetuning for the laws of nature which are even closely related to quantum physics. First, Bohr's rule of quantization of quantization describes the fact, that electrons occupy only fixed orbitals (or energy levels) in atoms.[5] From the perspective of Newtonian mechanics electrons could have any size of orbits around the atomic nucleus like the Planets in our solar system around the sun. However, according to the laws of electromagnetism, which are described by the Maxwell's equations, any charged particle that is acerating will emit radiation. While electrons move orbit around the nucleus their direction is constantly changing, and they are therefore accelerating. This would entail, that they would radiate. This radiation would cause the electron to lose energy. The orbit of the electron would decay so quickly that that atoms could only exist for a very short time. Thus, without the existence of this rule of quantization -- or something relevantly similar -- atoms could not exist, and hence there would be no life.

Second, according to Pauli exclusion principle, no two fermions can occupy the same quantum state. Fermions are spin ½ particles. The Pauli Principle arises from fact, that in quantum mechanics that the joint wavefunction of a system of identical fermions (for example electrons) must be antisymmetric.[6] Therefore, not more than two electrons -which are fermions - can occupy the same orbital in an atom, since a single orbital consists of two possible quantum eigenstates corresponding to the spin pointing in one direction and the spin pointing in the opposite direction. Without the Pauli principle all electrons would be at the lowest energy level. And in this case no complex chemistry would be possible - and also no life.[7]

2.2. Fine-Tuning in the Constants of Nature

The constants of nature are quantities whose values cannot be influenced, and which do not change spatially nor temporally. These constants appear in the equations of the natural laws but are not determined by them. Examples are the speed of light c, Planck's constant, the gravitational constant

[5] Robin Collins, "The Teleological Argument", 213
[6] Paul A. Tipler and Gene Mosca, *Physik für Studierende der Naturwissenschaften und Technik*. ed. Kersten, Peter, Wagner, Jenny (Springer, 2019), 1218.
[7] Robin Collins, "The Teleological Argument", p.213.

G, rest mass of an electron, rest mass of a proton. When discussing fine-tuning, usually the life-friendly range of values of a physical quantity is compared with the range of values in which the physical quantity could generally lie. The relative width of the life-friendly area is therefore decisive not the absolute width! For example, for gravity the range of values which allows complex life and the range of possible values compared results in a fine-tuning of one part in ~10^{36}![8] The FTA does not consider each constant which is relevant for fine-tuning in isolation. For instance, Figure 1 depicts the case for the gravitational constant G and the fine structure constant α in combination (where α_0, and G_0 are the values in our universe). [9] The blue area indicates the life friendly range of values, the red area the range of values for which life cannot exit. Note, that the plot does not end at the axis and has a logarithmic scaling to make it possible to be displayed here. If one would change the axis to linear and if one would extend the strength of gravity up to the strength of the strong force, as an estimate of what's possible, then in this figure, the 'stable stars' region, where life is possible takes up less than one part in 10^{35} of the whole plot![10]

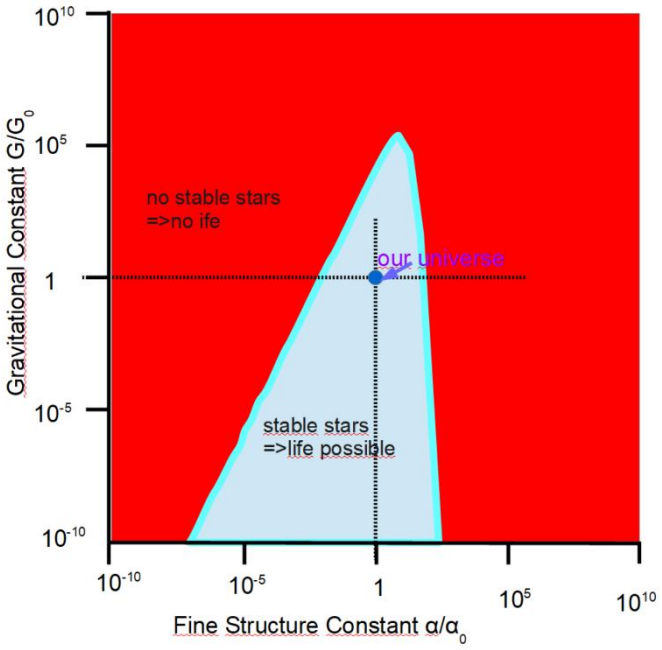

Figure 1: The stability of stars is a function of the strength of the electromagnetic force and the gravitational force

2.3. Fine-Tuning of the Initial Conditions of the Universe

The initial conditions of the universe are described by the distribution or configuration of matter and energy at the beginning of the universe. According to philosopher of science Stephen Meyer "Physicists refer to the initial distribution of mass-energy as 'entropy' (or 'initial entropy') fine tuning."[11] For a universe like ours, which has still today a very low entropy, to arise from the Big Bang, an exceptionally low entropy – or highly specific – configuration of mass and energy at the beginning was required. The theoretical physicist Roger Penrose has calculated the fine-tuning required for the initial entropy given the wide range of possible values for the entropy of the early universe. He came up with an unfathomable high degree of fine-tuning: one part in $10^{10^{123}}$.[12] That is a number with 10^{123} zeros. For comparison, the number of particles in the whole visible universe[13] is ca.

[8] Stephen C. Meyer. *Return of the God Hypothesis*. Kindle ed. (HarperOne: 2021),731.
[9] Lewis, Geraint F.; Barnes, Luke A. *A Fortunate Universe: Life in a Finely Tuned Cosmos*, 111.
[10] Ibid.
[11] Stephen C. Meyer. Return of the God Hypothesis, 234.
[12] Roger Penrose, *The Road to Reality: A Complete Guide to the Laws of the Universe* (New York: Alfred A. Knopf, 2005), 757–765.
[13] Stephen C. Meyer. Return of the God Hypothesis, 236

10^{80} and the probability for our solar system (including its inhabitants) to arise from a random collision of particles and radiation is much more likely: one part in $10^{10^{60}}$.[14]

3. The Many Worlds Interpretation

In 1957 Huge Everett came up with a novel interpretation of QM. Like other theories on QM Everett's theory is motivated to solve the measurement problem. Using the terminology of von Neumann, Everett considers two processes which describe two fundamentally different ways in which a quantum system can evolve.[15] Process 1 is the is the discontinuous and random change which happens when an observer and a measurement device from outside interacts with a quantum system in an appropriate way. Everett describes Process 2 as "the continuous, deterministic change of state of the (isolated) system with time according to the Schrödinger equation."[16] Everett argues that since the measurement devices and the observers carrying out the experiment are also physical systems it is not clear why there should be two processes at all.[17] Everett proposed the whole universe can be described by a universal wave function. There is just one all-encompassing quantum state describing everything in the universe.[18] You, your friends, me, your house, my gym, my family, my two cats Daisy and Jack (which I am not planning to abuse for quantum experiments - promise) the Andromeda Galaxy, my neighbours thrash can etc. If one wants to apply QM to the whole, universe Process 1 would require an outside observer of the whole universe, which is problematic for Everett (and also many other physicists). Therefore, Everett simply dispenses with Process 1 and therefore with the wave function collapse and the measurement problem altogether.[19] He regarded the pure wave function given by process 2 as a complete theory. The implications are that if we for example perform a measurement in a quantum experiment were there are several distinct possibilities for the result, the world splits into several branches - one branch for each possibility - as soon as a measurement takes place. Therefore, at a later point this interpretation got the name "Many Worlds Interpretation" (MWI). In the MWI the thought experiment with the poor cat of Erwin Schrödinger would split or branch into a living cat and into a dead cat.

As a side note: The problem of an observer "outside" the universe is only incoherent on atheism. For theism there is no problem since God could be the one doing the observing.

Since the time Everett came up with this new approach, there has been a lot of development on the MWI, for example to answer the question when splitting into new branches occurs.[20] Current MWI proponents argue that the decoherence of superpositions causes splitting. According to Wallace

[14] Roger Penrose, *The Road to Reality: A Complete Guide to the Laws of the Universe*, 764.
[15] Bryce Seligman Dewitt, *The Many Worlds Interpretation of Quantum Mechanics* (Princeton Series in Physics). Kindle ed. Princeton University Press, 1973, 3.
[16] Ibid.
[17] Travis Norsen, *Foundations of Quantum Mechanics: An Exploration of the Physical Meaning of Quantum Theory* (Springer: 2017), 274.
[18] Bryce Seligman Dewitt, *The Many Worlds Interpretation of Quantum Mechanics,8-9.*
[19] Bryce Seligman Dewitt, *The Many Worlds Interpretation of Quantum Mechanics,8*.
[20] Tim Maudlin, *Philosophy of Physics: Quantum Theory (Princeton Foundations of Contemporary Philosophy, 33)* (Princeton: PUP, 2019), 175-178.

"branching is caused by any process which magnifies microscopic superpositions up to the level where decoherence kicks". [21] Branching is therefore not restricted to quantum experiments. For example, biomolecular interactions like protein molecules encountering each other in cells usually do not produce long-lived superpositions. Science writer Philipp Ball points out: "There would then be at least as many splitting events affecting each of us every second as there are encounters between our molecules in the same space of time. Those numbers are astronomical."[22] And this example is just one of many.

MWI Proponents argue that the MWI has the advantage that it does not require the wavefunction collapse postulate according to which a measurement collapses the wavefunction into an eigenstate of the measured eigenvalue, because in the MWI there is no such a thing as the collapse of a wave function. As Raymer writes: "An attractive aspect of this many-worlds interpretation is that, in a sense, it is simple. There is only one quantum state representing everything. There is no need to 'solve' the measurement problem. There is no need for human thought to intervene by updating the quantum state, and quantum theory can even be seen as a deterministic theory. "[23] For the modern day MWI proponent Daniel Wallace "the 'Everett interpretation' is just quantum mechanics itself, read literally, straightforwardly—naively, if you will—as a direct description of the physical world, just like any other microphysical theory. " [24]

Leaving aside the requirement to have gazillions of worlds instead and the fact that all the other branches are not detectable, there are also other strong arguments against the MWI, which cast doubt if the alleged advantaged justifies the acceptance of the MWI as the favored interpretation of QM. In the following I will present two such arguments.

3.1. The Problem of Probability

In other Interpretations of QM, like the Copenhagen Interpretation or collapse theories, the probabilities are the probabilities for the quantum state to collapse in one way or another, when a measurement is performed. The MWI has difficulties to make sense of probability since every possible outcome in an experiment will occur with absolute certainty.

Let's consider an experiment with spin ½ particle where the initial preparation of each particle is spin-up along a direction d such that

$$\Psi_{+d} = \tilde{p}\Psi_{+z} + \tilde{q}\Psi_{-z}$$

[21] David Wallace, *The Emergent Multiverse* (Oxford: OUP, 2012), 99.
[22] Philip Ball, Beyond Weird. Kindle ed. (Random House, 2018), 222.
[23]Michael G. *Raymer, Quantum Physics (What Everyone Needs To Know®)* (Oxford: Oxford University Press, 20187), 299.
[24] Wallace, David. The Emergent Multiverse (S.2). OUP Oxford. Kindle-Version.

If we perform a measurement of the z-component of the particle's spin, the values $p = |\tilde{p}|^2$ and $q = |\tilde{q}|^2$ (with p + q = 1), are in the Copenhagen interpretation or in collapse theories according to Born's rule the probability *p* of a particle coming out *spin-up along z* and the probability *q* of a particle coming out *spin-down along z* at a measurement. But in the MWI the world would split into two branches each time when a particle is measured and therefore both events always will occur with certainty. So, assigning a probability value to an outcome makes no sense. Quantum physicist Travis Norsen writes about the consequence of omitting the measurement postulates (such as the Born rule):" …in the conventional interpretation, these measurement postulates provide practically the entire testable content of the theory – they tell us, in particular, about the probabilities for various possible measurement outcomes. And it is precisely the fact that these probabilities match up with the empirically observed outcome frequencies, that we believe in the quantum formalism in the first place. So, if Everett's 'many worlds' theory is to be worth taking seriously at all, it will need to be able to account for these conventional probabilistic claims." [25]. While, in other QM interpretations *p* would just the probability of a particle coming out spin-up along z, in the context of the MWI this becomes the branch weight of the *spin-up along z* branch that the measurement creates. To reproduce the measurement statistics from Born's rule, the MWI proponents must weigh the worlds/branches differently – each according it's branch weight. Travis Norsen sees a problem with that approach: "That is, the formula for the branch weights – the equation telling us how much to "care" about each individual branch in the tree – is really just the Born rule. So, the overall argument has a strong air of circularity about it: if you weight the branches using the Born rule, then (the Born-rule-weighted-sense-of) "most" of the branches will display Born rule statistics. It seems that we get the Born rule out (as a description of the statistics that will be observed in typical branches) only because we put the Born rule in (as a measure of how much each branch should count in our assessment of what is typical) ".[26]Additionally, according to Everett and also many modern day MWI followers, all branches in the MWI are equally real, so what do the branch weights mean in that context? If all branches are equally real, the branch weights seem to have no physical meaning! The values p=0.1 and q=0.9 would give the same result then the values p=0.5. and q=0.5, since in the MWI context at each particle measurement both possible events happen.

Modern day MWI proponents try to solve this issue treating the branch weights "as measures of how much individual observers within an MWI world" should care about their various descendants. [27] MWI advocates basically argue that even if according to that theory the outcome of an experiment is known with certainty, a rational agent would act just like someone who is uncertain about that outcome and assign probabilities to different possible outcomes.[28] To do that, several MWI advocates

[25] Travis Norsen, *Foundations of Quantum Mechanics*,283.
[26] Travis Norsen, *Foundations of Quantum Mechanics,284*.
[27] Ibid.,286.
[28] Tim Maudlin, *Philosophy of Physics: Quantum Theory*, 183.

came up with arguments based on decision theory. For example, David Wallace spends three long chapters on this topic in his book *The Emergent Multiverse*[29]. He writes: "I use considerations of rationality to make sense of probability in terms of agents' preferences between bets, an approach to probability which makes just as much sense in the Everett interpretation as in non-branching contexts …, by considering the preferences of a rational agent who knows the current quantum state of his branch, I will prove that such an agent acts exactly as if he assigned probabilities to the outcomes of future events in accordance with the Born Rule."[30]

In Standard decision theory the expected utility of each possible action is calculated by weighting the value, or utility, of each possible outcome by its probability and summing these terms. Then one chooses the act with the greatest expected utility.[31] MWI proponents must now give good "rationality principles" that imply that a rational MWI agent must treat the weights of future branches exactly as the non-MWI agents use Born's Rule, in order to assign a probability to the unknown future outcome, would. As Mauldin puts it "the squared amplitude must enter into the decision-making procedure just as a probability would, yielding the same set of decisions. The rational Everettian will, to that extent, act as if the squared amplitude were a probability."[32]

First, an initial observation: This whole approach about pretending as if there were some uncertainties of the future quantified by various probabilities even when no such uncertainty exists sounds not really "rational" to me. On a first glance this sounds like just assuming the MWI to be true and then to construe ways to make it look plausible.

Since the argumentation around this topic are usually very technical and long, I can only give a summary of concerns which are usually raised against the decision theoretical approach.

Some scholars have attacked the plausibility of set of axioms of rationality, which is assumed, and they argue that there are other coherent rational strategies that violate some of the axioms employed by Wallace when he tried to prove Born's rule. For example, philosopher of physics David Albert demonstrated that the choice preference order, which is required in Wallace's prove, can be capricious.[33] He argues that also other choice rules than Born's rule would work. He introduces the so called 'fatness rule'. For this rule the branching weights would correspond to a branching dynamic based on the actual fatness of the persons in each branch. The idea is that since fatness and mass go together, the fatter a person is the larger the corresponding branch amplitude must be. This may sound strange, but philosopher of physics Iñaki San Pedro explains "the point is that no matter how awkward the rule is, it needs not be 'irrational'. Thus, there is no good justification for the specific preference

[29] David Wallace, *The Emergent Multiverse*, 113-244.
[30] Ibid., 158.
[31] Tim Maudlin, *Philosophy of Physics: Quantum Theory*, 182
[32] Tim Maudlin, *Philosophy of Physics: Quantum Theory*, 184
[33] David Albert "Probability in the Everett Picture" in *Many Worlds? Everett, Quantum Theory, &Reality*, ed. Simon Saunders, Jonathan Barrett, Adrian Kent,&David Wallace. Kindle-Version. Oxford: OUP, 2010.

order Wallace choses in his derivation of the Born rule." [34] Wallace responds to approaches like Albert's by arguing that this violates one of the specific constraints of rationality his axioms.[35] However, San Pedro offers the following reply to Wallace: "Both Albert and Price would be seen as acting 'irrationally' in that sense. But this is exactly the point they want to make: their choices need not be irrational, they just do not maximize a certain expected utility "[36] Furthermore, Wallace writes when discussing violations of the rationality axiom *diachronic consistency*: "Similarly, in a branching universe, to accept a conflict of interest between my pre-branch and post-branch selves is to cease to see them as the same person."[37] Well, as I will argue in the next Section pre-branch and post-branch selves are not the same persons! So, the fundamental assumption, that the "rational agent" is always the same person is wrong and this point alone casts doubt on this whole decision theoretic approach to bring in the Born rule.

Some scholars argue that the standard decision theory approach cannot even be applied in the context of the MWI. Huw Price argues that, the standard decision theory approach, where a specific utility function (which is in the case of Wallace the Born rule) is maximized, is valid only in a one-world picture. In the MWI context this would not work, because agents in that context will have different preferences than those in one-world. Price points out that one can consider the fact that there is not just oneself to worry about, but many future selves to worry about as well. Price argues that alternatives to the Born rule, which are not 'irrational', are available. Like Albert, he also provides an alternative, which is the so-called 'distributive justice' rule. [38]

Philosopher of physics Tim Maudlin shows that even granting Wallace theorem does not mean that the MWI can recover the usual understanding of Born's rule. Maudlin uses a dangerous quantum experiment involving somebody called Erwin.[39] I will modify Maudlin's example slightly. In the experiment at the start of this section we introduce a Box A and a Box B. If the *spin-up* event occurs, a trigger opens a door and lets in a big dangerous dog into Box A. If the *spin-down* event occurs, a trigger opens a door and lets the dog into Box B. Let's assume that the probability p of a particle coming out *spin-up along z* is 0.7 and the probability *q* of a particle coming out *spin-down along z* is 0.3. Let us further assume, I am forced by a terrorist to choose were to put in my cat Jack (I just broke my promise, but I also do not want to use other people or other people's cats, especially not Erwin Schrödinger's, who has already suffered a lot). According to standard decision theory, a rational agent – which would be me – ought to put Jack in a case of uncertainty about the outcome but accepting the Born's Rule probabilities for the possible outcomes in Box B (since I love Jack and it is my

[34] http://philsci-archive.pitt.edu/9096/1/isManyWorlds_CriticalReview.pdf (accessed 05.05.2021)
[35] David Wallace, The Emergent Multiverse TBD
[36] http://philsci-archive.pitt.edu/9096/1/isManyWorlds_CriticalReview.pdf (accessed 05.05.2021)
[37] David Wallace, *The Emergent Multiverse*,169.
[38] Huw Price "Decisions, Decisions, Decisions: Can Savage Salvage Everettian Probability?" in *Many Worlds? Everett, Quantum Theory, &Reality*, ed. Simon Saunders, Jonathan Barrett, Adrian Kent,&David Wallace. Kindle-Version. Oxford: OUP, 2010.
[39] Tim Maudlin, *Philosophy of Physics: Quantum Theory*, 189.

preference that he survives). However, I would be also unsure if that choice would yield a living Jack. According to the theorem derived by Wallace, if I were a rational MWI agent, I would have to make the same choice. Whereas in the collapse theory world or in a Copenhagen Interpretation world the "choice of act is accompanied by foreboding: If the less likely event should occur, and Box B gets triggered, you will have failed to save"[40] Jack, in the MWI world I would know that I would have one successor of Jack who will be saved and one which would die. The actual branching outcome with the different branch weights is known for certain in advance. As Maudlin puts it the "rational Everettian acts like an agent faced with uncertainty in that she makes the same choice, but unaccompanied by foreboding."[41] Thus, making choices in the MWI is different from making choices in worlds governed by other interpretations of QM. Therefore, Born's rule as in the original understanding has not been recovered.

Since MWI is deterministic, there is an impact on the concept of agents. According to the article on decision theory in Stanford encyclopedia of philosophy an " 'agent' here stands for an entity, usually an individual person, that is capable of deliberation and action."[42] But if everything is fully determined and there is no genuine free will, this concept of rational agent becomes difficult. If the laws of physics are deterministic, and the laws of physics give a complete description of human behaviour our actions are not free. David Wallace addresses this issue when he writes "For the record, I don't myself think there is any incompatibility between freedom and mechanism; see Dennett (1984; 2003) for arguments to this effect, and Kane (2002) for a variety of other views." [43] So he seems to hold compatibilist view on freed om of the will, which is in my view deeply problematic. Since in the MWI everything that can happen will happen then when "I" make decisions "I" must make every decision (the quotes around "I" are to indicate that even the concept of personal identity loses its meaning, see further below), the word "free" is deprived of any meaning. One might respond that rational agents can be also computers or also as Wallace writes "(non-free) control system designed to make maximally rational decisions when presented with alternatives."[44] However, computers and control systems are developed by humans and are set up in a way to perform decisions based on input data in a certain way.

A further concern is the fact, that the examples often provided when discussing the decision theoretic approach, are examples where there is something really at stake (winning money, survival), and where it makes sense to talk about rewards. But if I do a quantum experiment normally there is nothing like that involved. One can question what even means to talk about rewards in quantum experiments when

[40] Ibid.
[41] Tim Maudlin, *Philosophy of Physics: Quantum Theory*, 189.
[42] https://plato.stanford.edu/entries/decision-theory/ (accessed 02.05.20021)
[43] David Wallace, *The Emergent Multiverse*,135-136.
[44] David Wallace, *The Emergent Multiverse*,135-136.

all outcomes will happen, why should I care about assigning some probabilities, which have a different meaning in MWI context as well.

Maudlin makes an important point when discussing an example about the very practical problem of how to interpret Lab results of a quantum experiment in context of MWI: "The next morning, having recovered the data, the Many Worlds theorist has to decide what to infer. The collapse theorist or the pilot wave theorist in the same situation can reason, given the physical hypothesis that the high-probability outcome occurred, that the data from the lab reflects which hypothesis was correct. But the Many Worlds theorist knows that no matter what results come in from the lab, those results were certain to occur on either hypothesis. The decision theoretic approaches try to show that various rationality principle require an agent ought to adjust her beliefs in certain ways. But no matter how these normative matters come out, there is a non-normative fact to explain."[45]

Furthermore, branching does not only occur in the presence of a rational agent. It also occurs all around the universe, all the time since the beginning of the universe. Mauldin similarly argues: "The normative principles endorse strategies that work for the relatively high-amplitude successors and fail for the relatively low-amplitude ones. We can justify using the rules to make practical decisions if we decide to care more about our high-amplitude successors than our low-amplitude ones, but how could our decision about what to care about in the future have any bearing on the course of evolution in the past, or the historical success of inferences such as those about the electrons? It is hard to see how to integrate the normative character of these proofs with the physical facts we seek to explain." [46]

A maybe unwanted consequence of the elaborate derivation of Born's rule for the simplicity of the MWI is summarized by in critical review of Wallace book *"The Emergent Universe"*: "Moreover, his derivation of the Born rule requires no fewer than ten new axioms governing the game in which a rational agent is to engage, so this cannot be part of a world view that consists in just unitary quantum mechanics with no extra postulates."[47] Finally, in my view if the whole project of deriving Born's rule is dependent on bringing in this discussion about rational agents making "decisions" under certainty, then this is not better than saying that the choice of the conscious observer is responsible for the outcome of an experiment, as some scholars who support the Copenhagen Interpretation do.[48]

3.2. Personal Identity and Consciousness

The second argument against MWI deals with personal identity and consciousness. If the world splits into several other worlds every time the decoherence of a superposition occurs, then preservation of

[45]Maudlin, Philosophy of Physics: Quantum Theory, 194
[46] Maudlin, Tim. Philosophy of Physics: Quantum Theory (Princeton Foundations of Contemporary Philosophy, 33), 2019, 195.
[47]Ian D Lawrie, *The emergent multiverse – quantum theory according to the Everett interpretation*, Contemporary Physics. Vol. 57. Issue 2.(Taylor-Francis, 2016), 234-237.
[48] See for example: Henry P. Stapp. *Quantum Theory and Free Will*. Kindle ed. Springer, 2017.

human personal identity over time (diachronic identity) does not exist. Personal identity concerns itself with how I can be the same person over time.

MWI advocate Wallace responds to this issue about caring of the future of the successors in an experiment, which is directly related to the question about personal identity: "Why should she care? Well, an agent's future self is her future self just by virtue of the causal, structural, dynamical relations between it and the agent's past self. There is (I assume) no indivisible, immaterial soul which passes through my life and magically makes me a single being: what makes the stages of me at different times all me is that they are appropriately related. And it seems, at least, that an Everettian agent's future selves stand in all the same relations to her as a non-Everettian agent's future selves stand to her. It's hard to see why, in the Everett case, I should regard my future self as any the less me—why I should not treat his goals and desires, his hopes and dreams, as my own—just because I actually have multiple such selves."[49]

There are numerous problems with this statement. First, he assumes that human beings are just material and that there is no soul (to that more later). Second, there is no meaningful way to connect the "you" or "I" before the quantum "split" to the "you" or "I" after it."[50] When a split occurs "you" (or "I") cease to exist and two (or more) copies of "you" (or "me") emerge. So, one cannot talk about future selves but should talk about successors (as Wallace does in other places in his book), descendants or of copies.

Note, that on materialism even without the MWI, there is an issue with personal identity: Our body changes over time. We grow older and every cell in our body will have been replaced by others after a period. So, if we are just our bodies, there is no personal identity persisting over time! New Testament scholar and neuro-scientist Joel B. Green, who is a Christian physicalist who also denies the existence of the soul, provides the counter argument that one can ground personal identity through change via the sameness of our individual narratives.[51] Green proposes that "our identity is formed and found in self-conscious relationality with its neural correlates and embodied narrativity or formative histories." [52] However, it is difficult to see on Physicalism that a narrative is more than bundle of sentences. And it is not convincing to say that our personal identity is based on that. That is because as our life unfolds, the narrative grows and therefore changes, which negates the "sameness of our individual narratives." But even if there would be personal identity on materialism in a non MWI view, this would not work anymore for the MWI. In the MWI there will be just (several) copies of the persons after the branching and there is no special path for a version of you to persist. Therefore, there is no

[49] David Wallace, *The Emergent Multiverse*,135.
[50] https://iai.tv/articles/the-many-worlds-fantasy-auid-1793?_auid=2020 (accessed 01.05.2021)
[51] R. Keith Loftin and Joshua R. Farris, ed. Christian Physicalism?: Philosophical Theological criticisms. Kindle ed. (Lanham: Lexington Books,2018), loc. 5928.
[52] Joel B. Green, *Body, Soul, and Human Life: The Nature of Humanity in the Bible* (Grand Rapids: Baker Academic, 2008), 179.

"I" that persists over time. While some materialists try to identify our personal identity with the space time worm made up of "object stages"[53], in the MWI the space time worm becomes a Hydra with a gazillion of heads.

Furthermore, how is consciousness preserved during when splitting occurs? Philip Ball discusses this issue, when considering the implications of numerous copies of oneself being produced by splitting events and when one claims that the 'I' at each moment of time, "is defined by a complete classical description of the state of his body and brain". Ball argues that "such an 'I' could never be conscious of its existence. Consciousness relies on experience, and experience is not an instantaneous property: it takes time, not least because the brain's neurons themselves take a few milliseconds to fire. You can't 'locate' consciousness in a universe that is frantically splitting countless times every nanosecond, any more than you can fit a summer into a day."[54]

An MWI advocate might finally reply, that this all well and good but we are doing physics here, so please do not disturb us with theses metaphysical objections. This would tacitly assume that physics is all there is, and metaphysics does not contribute anything meaningful to the discussion. However, MWI proponents themselves make a lot of metaphysical statements, for example when they discuss the ontology of the MWI. This issue is important, since there are few things which are more existential than the question if the notion of selfhood is true or not. If selfhood is an illusion, the most basic ontological datum everybody is aware of, then what else can we place our trust in and why should I even care about any decision theoretic rules for "rational agents", when rationality disappears with selfhood.

I want now to come back to the claim of Wallace that there is no soul which is part of the human make up and which could account for things like personal identity and consciousness. The "problem of consciousness" is assumed to be solved by the proponents of the MWI just on materialistic terms. However, the nature and origin of consciousness is one of the most important unsolved question in science and philosophy,[55] and as we have seen above the MWI make things even worse. There are different views, but it is difficult to see how to get consciousness out of pure matter. While the reductionist view is still held by many, there are several non-reductionist views how to solve this puzzle: property dualism, emergence, substance dualism etc.[56] Also, since the invention of QM there has also been a lot of discussion on the relation of consciousness and QM and some scholars belief that consciousness can cause the collapse of the wave function .[57] While substance dualism is a minority

[53] Moreland, J. P., and William Lane Craig. *Philosophical Foundations for a Christian Worldview*, 2nd ed. Downers Grove, IL: InterVarsity,2017), 320.
[54] Philip Ball, *Beyond Weird*, 224.
[55] Mihretu P. Guta, "The Non-Causal Account of the Spontaneous Emergence of Phenomenal Consciousness" in *Consciousness and the Ontology of Properties*, ed. Mihretu P. Guta. Kindle ed. (New York: Routledge, 2018),125-126.
[56] *Consciousness and the Ontology of Properties*, ed. Mihretu P. Guta (New York: Routledge, 2018).
[57] See for example: D. Chalmers and K. McQueen, "Consciousness and the collapse of the wave function" in *Consciousness and Quantum Mechanics, ed.* S. Gao. (Oxford: OUP: Forthcoming, expected 2021); Henry P. Stapp. Quantum Theory and Free Will. Kindle ed. Springer, 2017.

position, in my view it is the only view which can account for all the data which is available. Arguments against dualism are not strong. For example, to claim that certain brain events are causing our thoughts, or the brain causes our consciousness is to equate causation with correlation. Philosopher of science Mihretu Guta writes on the interrelation of neural correlates and certain behaviors, "that the correlation between phenomenal consciousness and brain state, while functionally linked, is not causally grounded. For example, a normal functioning of the brain is necessary for the normal functioning of mental states. But from this nothing follows to the effect that such correlations are metaphysically necessary nor is it the case that they are causally grounded." [58] Also the so-called closure of the physical universe is an unproven assumption and cannot be used as an argument against substance dualism.

Furthermore, Substance Dualism is also not just an obsolete unsubstantiated folk believe, since it can be supported by good philosophical arguments[59] and by independent on empirical evidence. For lack of space, I will restrict myself to the second category. There is empirical/evidential support for something like a soul based on Near Death Experiences (NDEs), which show that conscious experience can happen even in the absence of any brain function. There have been scientific studies on NDEs by several scholars who systematize the data. For example, Jeffery Long studied thousands of NDEs.[60] I mention some of the characteristics of NDEs Long describes: NDErs (people who had NDEs) have highly organized and lucid experience while unconscious or clinically dead. NDErs may see and hear in the out-of-body (OBE) state, and what they perceive is nearly always real. NDEs of blind people often include visual experiences. The striking similarity of content in NDEs among very young children and that of adults strongly suggests that the content of NDEs is not due to preexisting beliefs. The remarkable consistency of NDEs around the world is evidence that NDEs are real events. Furthermore, there are many testimonies of NDEs with evidential character, where there is additional corporation that the experience is true. In their book *Beyond Death: Exploring the Evidence for Immortality* on NDEs the scholars Gary Habermas J. P. Moreland describe several such evidential NDEs.[61] In one example "a woman who had both a flat EEG reading, and no vital signs had been declared dead. But she spontaneously revived about three and one-half hours later. In fact, she regained consciousness and lifted the sheet off of her face as she was being taken to the morgue by an orderly. Then she reported that she had floated over her body during the resuscitation attempts. She precisely described not only the procedures used in her attempted rescue but also the number of persons who came into the hospital room, what they said (she even repeated a joke told to relieve the tension), and perhaps most interestingly, she described the designs on the doctors' ties. All of these claims were carefully checked with the medical records and the doctors present. It was determined that her entire description was

[58] Mihretu P. Guta, "The Non-Causal Account of the Spontaneous Emergence of Phenomenal Consciousness", 148.

[59] See e.g., Moreland, J. P. *The Soul: How We Know It's Real and Why It Matters.* Kindle ed. Chicago: Moody Publishers, 2014.

[60] Jeffrey Long and Paul Perry. *Evidence of the Afterlife: The Science of Near-Death*. Kindle ed. (HarperOne, 2010), 46.

[61] see also J. Steve Miller, *Near-Death Experiences as Evidence for the Existence of God and Heaven: A Brief Introduction in Plain Language. Kindle ed. (*LLC: Wisdom Creek Press, 2012),138.

correct, even though her EEG reading had been flat during that entire time." [62] There are many other similar cases. Materialistic explanations to account for NDEs vary (drugs, oxygen deprival, neural spikes etc.). While all these explanations even often fail[63], they completely break down for evidential NDEs. NDEs prove at a bare minimum prove that consciousness experience without functioning brain is possible and purely materialistic accounts fail. This really hints strongly to some form of substance dualism since what is the bearer of this experience when the brain is dead.[64]

Also, if human beings are a body-soul unity, diachronic identity can be established by the soul. While things like our body or our character can and do change, these changes are according to Aristotle accidental (that is nonessential) changes.[65] However, the soul as our essence and set of our ultimate parts and capacities[66], does not change.[67] There are also unanswered questions in case of substance dualism, but if one does not assume materialism from the outset, then I submit some form of substance dualism is the most reasonable view. Unlike other interpretations of QM, the MWI has a problem to deal with souls. There is no scientific concept of how souls are copied along with the body during the branching events.

4. The Impact of the MWI on the FTA

If the Many World interpretation turned out to be true, the question would arise how this would impact the FTA. This depends on when the first split after the Big Bang occurs in relation to the time when the laws of nature and natural constants got fixed. If the laws and constants of physics in place from the very beginning of the universe and interwoven in the Big Bang or if they get fixed at a later point but before the branching starts to happen, than the MWI does not weaken the FTA regarding laws of physics and constants of nature, since they are the same in all worlds which emerge over time. MWI proponent David Wallace writes: "For instance, it is not infrequently suggested that the value of the charge on the electron—which appears (Barrow and Tipler 1986: 288–366) to be fairly tightly constrained by the existence of life—can be understood by postulating a multiverse in which it takes all conceivable values, and noting that most of them are barren of life. To make such a story work using an Everettian multiverse, we would require some underlying quantum theory in which the charge of the electron was dynamically determined in such a way as to take different values in different branches; such a theory would, presumably, make other concrete and testable predictions. (Note that our current best theory of electromagnetism, the Standard Model, does not have this feature: the electron charge is dynamically determined (via spontaneous symmetry breaking) but its

[62] G. R. Habermas and J.P. Moreland, *Beyond Death: Exploring the Evidence for Immortality* (Eugene, OR: Wipf & Stock Publishers, 2004),161.
[63] J. Steve Miller, *Near-Death Experiences as Evidence for the Existence of God and Heaven: A Brief Introduction in Plain Language*, 87-134
[64] Jeffrey Long and Paul Perry. *Evidence of the Afterlife, 50*.
[65] R. Scott Smith. Kindle *Authentically Emergent: In Search of a Truly Progressive Christianity* (Eugene, Oregon: Cascade Books, 2018), 108.
[66] Moreland, J. P., and William Lane Craig. Philosophical Foundations for a Christian Worldview, 2nd ed. Downers Grove, IL: InterVarsity,2017),274-275.
[67] Loftin, R. Keith and Farris, Joshua R., ed. *Christian Physicalism?: Philosophical Theological criticisms*. Kindle ed. (Lanham: Lexington Books,2018), loc. 1662.
R. Scott Smith. Kindle *Authentically Emergent: In Search of a Truly Progressive Christianity* (Eugene, Oregon: Cascade Books, 2018), 108.

value is branch-independent."[68] So at least according to the Standard Model, some of the constants of nature will have to be the same in all branches of the Many Worlds universe. Therefore, having more universes does not solve this fine-tuning problem. Also, the issue of the fine-tuning of the initial conditions and the laws of nature is still present.

In order to have a real impact on the FTA is as mentioned already above "some underlying quantum theory in which the charge of the electron was dynamically determined in such a way as to take different values in different branches" [69] is necessary, which goes beyond the Standard Model of Physics. For lack of space and since we talk now about a problematic interpretation of QM (MWI) embedded into a speculative cosmological model, I will only briefly mention the MWI in context of cosmology. In quantum cosmology (QC), QM is combined with cosmology and applied to the origin of the universe. This is not without problems. For example, when dealing with quantum gravity, QM has to be applied to space time itself since at the time of the Big Bang no matter was present.[70] If QC were true in conjunction with the MWI, then there might be a way to get between all the different worlds different values for the constants of nature and the other types of fine-tuning. However, here another kind of fine-tuning problem arises, which is concerned with the initial and boundary conditions of the mathematical equations describing QC models. For a detailed treatment on that issue see "*The Return of the God Hypothesis*" by Stephen Meier.[71] Maybe the fine-tuning also reappears at another point: A mechanism would be required which makes sure that the different universes which emerge get different values regarding natural constants and can also have also initial conditions. Also, a mechanism which could create different laws of nature is required.

5. Conclusion

In this paper I have argued, that the MWI is scientific problematic because if the probabilities cannot be handled in a proper way, they cannot make sense of the experimental results of QM. I have further argued, that the MWI is philosophical problematic since it destroys the notion of personal identity and selfhood. For these two reasons alone the MWI should not be the preferred interpretation of QM. Furthermore, even if the MWI would be true, fine-tuning would not disappear. Therefore, the MWI is not a good option for sceptics to attack the FTA. The sceptic of the FTA might look for other types of multiverses to find a home for his skepticism. However, also there he should not hope for too much.[72]

[68] Wallace, David. The Emergent Multiverse (S.368). OUP Oxford. Kindle-Version.
[69] David Wallace, *The Emergent Multiverse*, 368.
[70] Davies, Paul. *Cosmic Jackpot : Why Our Universe Is Just Right For Life*. (Boston : Houghton Mifflin, 2007), 75.
[71] Stephen C., Meyer, *Return of the God Hypothesis*, 576-590.
[72] See Stephen C., Meyer, *Return of the God Hypothesis* for a full discussion on different types of multiverses.

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