A NEW Interpretation of Quantum Mechanics with a Conceptual Conjecture for 'Quantum Gravity'

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September 4, 2024

Abstract

This work makes three contributions. First, we propose a NEW Interpretation of Quantum Mechanics. Second, we make a conceptual NEW Conjecture for gravitational interactions of quantum particles, that can serve as a seed for a new line of mathematical investigations into Quantum Gravity. Third, we explore experimental tests of the NEW Conjecture and the NEW Interpretation.

1 Introduction

The comforting deterministic picture of physics governing the familiar slow-moving, macroscopic objects was shattered with the advent of Quantum Mechanics and Relativity. Relativity required us to accept ideas of time-dilation, length-contraction, and relativity of simultaneity. The demands Quantum Mechanics made of us, to accept concepts like superposition, entanglement, and 'collapse of wavefunction', have been arguably even harder. Computationally, Quantum Mechanics and especially Quantum Field Theory have led to astonishing triumphs, despite a rather ludicrous machinery of cancelling out infinities to obtain precise agreements with measurement. Conceptually, the story is different - there are many Interpretations of Quantum Mechanics, each unsatisfactory in its own way.

We propose a NEW Interpretation that we believe is the simplest - without the need for many worlds, or hidden variables, or relative reference frames. Our (NHEHANEW, or NEW for short, see next section) interpretation has similarities with some of these other intepretations, but is distinguished by taking the concept of superpositions to its full logical conclusion.

We follow the NEW Interpretation with the NEW Conjecture for how gravity sees quantum particles. Our conjecture takes the probabilistic interpretation of the wavefunction seriously, and claims that only standard model interactions are quantum. In colloquial terms, the conjecture implies that

gravity is not quantum and gravity will not cause collapse of the wavefunction. What is more, we conjecture that gravity continues to 'see' the full wavefunction, even when electromagnetic interactions lead observers to believe that the wavefunction has 'collapsed'.

Hallmark of science is falsifiability. We outline an experiment to test the NEW Conjecture about gravitational interaction between quantum particles and we predict a unique outcome to a version already proposed for other purposes. Along the lines of another experiment involving Quantum AI, we discuss how the NEW Interpretation can be directly tested, at least in principle.

The paper concludes with a brief summary. This work is simply meant to be a seed. If viable, the NEW formalism will require a lot of care and nurturing to develop fully.

2 The NHEHANEW (NEW) Interpretation of Quantum Mechanics

In this section we specify our interpretation of Quantum Mechanics, explain the name, and compare it with other interpretations.

To establish the minimal notation used in this paper, we consider the double slit experiment, with a particle going through slit A or slit B. We will later abuse this notation, using the letters A and B broadly to denote multiple possible quantum outcomes in general. An equal probability superposition state of the photon with no relative phase difference is described by the wavefunction

$$|\psi\rangle = \frac{|A\rangle + |B\rangle}{\sqrt{2}}. \tag{1}$$

We simply follow this idea to its logical conclusion - every quantum interaction since the beginning of the universe that has multiple possible outcomes results in a joint wavefunction of the interacting particles with appropriately (complex) weighted outcomes. *The interacting particles include those making up our eyes, ears, and brain cells generating what we experience as thoughts.*

We believe that a lot of the complexity around the 'Interpretations of Quantum Mechanics' arises from the age-old human propensity to consider ourselves as somehow special. We posit that a lot of perceived 'paradoxes' are simply modern reincarnations of the same stubborn human denial that initially rejected the idea that the Earth was not the center of the universe because *we* saw the Sun and the stars revolving around us in the sky. What if we humbly accept our place in this universe on the exact same footing as a photon or any other collection of particles?

If we fully accept this notion, we completely do away with the very concept of 'Observation' in a philosophical sense.

Let's say a human H was completely quantum mechanically isolated from a photon passing through the double slit up to the point they perform a 'measurement'. According to conventional quantum mechanics, the unitary evolution of the photon wavefunction stops at this point, and a projective

'collapse' reveals state $|A\rangle$ or $|B\rangle$. In our NEW Interpretation, the new joint wavefunction of the human H along with the photon is

$$|\psi_{H,Photon}\rangle = \frac{|H_A\rangle|A\rangle + |H_B\rangle|B\rangle}{\sqrt{2}}, \tag{2}$$

where H_A is the human who thinks that the measurement yielded result A and H_B thinks the result was B.

Each of us perceives reality through electromagnetic interactions - our eyes interact with light, our neurons fire. These are downstream interactions from what we call an 'observation', but in our interpretation, the joint state containing the human thinking they have observed state $|A\rangle$ and the photon in state $|A\rangle$ is superposed with the joint state containing the human thinking they have observed state $|B\rangle$ and the photon in state $|B\rangle$, to give the full state of the system after what would have been called an 'Observation'.

We make a distinction between two concepts - Observation with a capital O, which somehow concludes something about the state of the object being observed, and observation with a small o, which makes a more limited claim of what the 'observer' has seen.

Nothing has been conclusively Observed with a capital O (photon remains in a superposition, no collapse) - we just have a superposition of a collection of particles $|H_A\rangle$ 'who thinks they have conclusively observed (with the small o) the photon in state $|A\rangle$' with another collection of particles $|H_B\rangle$ 'who thinks they have conclusively observed the photon in state $|B\rangle$'.

Taking this idea to its logical conclusion: I wasn't ever really born - the state in which I was born exists in superposition with the state in which I wasn't. One of the states in superposition just happens to include a collection of particles that include neurons firing generating 'thoughts', making 'me' think 'I exist'. The Sun did not rise this morning; the state in which 'I saw the Sun rise' exists in superposition with the state where the Sun never formed in the first place, and with the state in which life never developed on this Earth etc.

Nothing Has Ever Happened And Nothing Ever Will - this is the NHEHANEW Interpretation of Quantum Mechanics (NEW for short). It is all a big blob of superpositions, since the beginning of the universe.

2.1 Comparison with Other Interpretations of Quantum Mechanics

There are features of the NEW Interpretation that are parallel to other interpretations, yet it differs from every one in substantial ways.

2.1.1 Many Worlds Interpretation

The similarity between the NEW Interpretation and the Many Worlds Interpretation is the acceptance of both A and B states on an equal footing and rejecting the idea that the wavefunction of the photon exclusively 'collapses' to solely reveal either $|A\rangle$ or $|B\rangle$ state.

The difference is that the NEW Interpretation treats H_A and H_B on par with any other material particles, and has no qualms about talking of humans in states of superposition. There are no 'many worlds' in NEW. The two states do not live in two separate, non-interacting worlds; they exist in superposition in this very same world. This is more than a semantic difference - if it is possible to devise such an experiment, the states $|H_A\rangle|A\rangle$ and $|H_B\rangle|B\rangle$ can be made to interfere.

The idea of 'many worlds' necessarily introduces complications, as beautifully analyzed in [1]. Either we take the 'Single Mind' or 'Splitting Worlds' view, when we literally have to keep creating copies of the world with an unknown source of energy and space for such duplications. To avoid this, [1] comes up with the 'Many Minds' idea. We have not seen a definition of the concept of 'mind' in physics, and disagree with the conclusion on page 204 of this reference, in the paragraph below Eq. (8), that we have derived a contradiction. We comment further in section 2.1.6 on what might happen when a human in a state of superposition of beliefs is asked what they believe.

The NEW approach humbly treats human bodies and 'minds' as collections of interacting particles. We reject the idea of Observations with a capital O where the particle being observed itself somehow collapses into one state or the other. Instead, we follow Einstein and Heisenberg's original insight that we can only talk of observables in the truest sense - we even have to specify the observer. H_A and H_B can see different things, just as two observers in different reference frames can see different things. Except, H_A and H_B happen to be more intimately connected - they were the same person up until the observation, and even in the future, they can interfere!

2.1.2 Hidden Variables Interpretations

The NEW Interpretation embraces the non-deterministic nature of quantum mechanics. There are no hidden variables, and no attempt to create a deterministic theory.

Once we reject the concept of Observation, perhaps some of the urgency around the need to find a deterministic explanation dissipates. We don't have to deterministically explain why the photon itself collapsed to state $|A\rangle$ or $|B\rangle$; there is no uncertainty as to which state 'it' will suddenly collapse to when 'we' perform an observation. There is no 'Observation' in Quantum Mechanics in the NEW Interpretation; just a continuous unitary evolution.

2.1.3 Relativist Interpretations

The NEW Interpretation is aligned with the Relativist Interpretation [2] in treating humans on par with any other collection of interacting particles. The relativist interpretation also effectively demotes Observations to lower-case observations, by insisting that these are relative to the observer making the observation.

The NEW Interpretation diverges from the relativist interpretation in that it does not call for a separate, observer-dependent wave function. One can argue that to describe the world from H_A's perspective vs H_B's perspective, we effectively create two separate wavefunctions, akin to the relativist interpretation. However, the signature feature of the NEW Interpretation that the states $|H_A\rangle|A\rangle$ and $|H_B\rangle|B\rangle$ can be, in principle, made to interfere, remains a distinguishing characteristic compared to Relativist Interpretation.

2.1.4 Spontaneous Collapse theories

The NEW formalism does not make a distinction between the macroscopic and microscopic systems; everything all together is one blob of superpositions. In NEW formalism, no additional nonlinear and stochastic terms are added to the Schrödinger equation. In fact, with its proposed forever unitary evolution of the 'wavefunction of the universe', the NEW formalism removes the whole idea of 'Collapse', spontaneous or otherwise.

2.1.5 Penrose Interpretation

This is a type of Spontaneous Collapse Theory, rejected by the NEW Interpretation for the same reason as all Spontaneous Collapse Theories. In the next section 3, we make a NEW Conjecture about how gravity perceives a quantum particle. In a sense, our view is almost diametrically opposite - gravity not only does not cause 'Collapse', but it could be the only interaction that perceives the whole wavefunction.

2.1.6 Thinking causes collapse

One the face of it, since NEW Interpretation does not place humans in any special place, it might appear that thinking cannot be responsible for 'Collapse' in the NEW perspective. However, we must ask what is the nature of thinking. To the extent that these are electromagnetic interactions, which the NEW formalism takes to be quantized, it is possible that simply by thinking 'did I observe state $|A\rangle$ or $|B\rangle$', if initially the human H was in a superposition state $(|H_A\rangle + |H_B\rangle)/\sqrt{2}$, she may cause 'collapse' in the sense that *she* may now be in state $|H_A\rangle$ or $|H_B\rangle$. We revisit a similar scenario in section 4, where we discuss testing the New Interpretation with 'friendly' Charlie.

2.2 A NEW look at some Familiar Concepts

2.2.1 The Anthropic Principle

To some degree, the Anthropic Principle follows directly from the NEW Interpretation. The universe is a blob of superpositions. Along some paths, no humans might exist, for all we know, even galaxies may not form. You or I sitting in a laboratory making measurements only exist along those paths where we can.

However, the scope of NEW is more limited than that of the Anthropic Principle. We are simply proposing an Interpretation of Quantum Mechanics, and saying that to the degree that there is a freedom to take different paths like spin up or spin down, the universe is a superposition of all of these with appropriate complex amplitudes as computed by Quantum Mechanics/Quantum Field Theory. This will align with the claims of the Anthropic principle within the scope of all the allowed paths in the QM/QFT we start with.

The Anthropic Principle can go beyond and talk about any tuning of the parameters of the starting QM/QFT itself. This will be beyond the scope of the NEW Interpretation.

In the scenario of a parameter-less 'Theory of Everything' - a Quantum Theory where the standard model quantities like elementary matter particle masses and coupling constants are not parameters of the theory, but perhaps there is a finite probability amplitude for all possible parameter values - the Anthropic Principle and the NEW Interpretation will become equivalent.

2.2.2 Wigner's Friend

The NEW Interpretation sees no 'paradox', readily accepting superpositions of humans with different beliefs. To Wigner's comment that "... appears absurd because it implies that my friend was in a state of suspended animation before he answered my question", the NEW Interpretation humbly answers "yes, she was", and rejects the argument that "It follows that the being with a consciousness must have a different role in quantum mechanics than the inanimate measuring device". Conscious or not, alive or not, having a mind/intellect or not, the NEW Interpretation treats all collections of interacting particles on the same footing.

2.2.3 Axioms of Quantum Mechanics

A thorny axiom of Quantum Mechanics is the one involving projective 'collapse'. This axiom is most unsatisfying, because in order to specify the state of a system after measurement, we need to know the outcome of the said measurement!

While for all practical calculations everything remains the same, the NEW Interpretation provides this comforting insight - there really is nothing in the physical description that violates unitarity, and we are not truly making an Observation about the particle itself that causes it to Collapse. When

we 'observe' (with the small o) a particle in state $|A\rangle$, we put ourselves in state $|H_A\rangle$, and observe everything as if the particle was in state $|A\rangle$. There are no two steps, unitary evolution and projective collapse. There is just the forever unitary evolution of the wavefunction of the universe. As we are eagerly awaiting the result of an experiment that we think will force a particle to be either in state $|A\rangle$ or $|B\rangle$ exclusively, the question to ask ourselves is not 'what state will the particle be found in', but 'will I be $|H_A\rangle$ or $|H_B\rangle$' when the result comes in.

2.2.4 The Second Law of Thermodynamics - The Arrow of Time

The fundamental laws of physics are symmetric with respect to the forward or backward direction of time; the daily world around us is clearly not. To encode this empirically observed fact into our theory of the physical world, physicists have made up the Second Law of Thermodynamics, observing that the total entropy of an isolated system left to spontaneous evolution cannot decrease. This law renders natural processes irreversible, establishing an arrow of time.

Consider our state in superposition from Eq. 1. The state $|\psi\rangle$ is symmetric. According to the NEW interpretation, we humans experience the arrow of time because we, as H_A, can only see the path where the particle is in state A. The universe as whole remains unitary and beautifully symmetric; it is just that with every interaction around us, *our* 'path' - what we can interact with through standard model forces - gets further and further constrained.

The NEW Interpretation says that because we are the kind of creatures that can only interact with a quantum particle by 'observing' it to be $|A\rangle$ or $|B\rangle$, through our interaction with this particle, one bit of information will appear to have popped along our 'path' out of thin air. There is no Observation with a capital O, the universe as a whole is still symmetric with the whole $|\psi\rangle$ as the wavefunction of the particle. It is just us humans along our path H_A who now think that the entropy has increased, as the description of our 'path' in the universe just got more complex - we have to specify we are H_A, not H_B. In a sense, the NEW Interpretation is not an interpretation of Quantum Mechanics at all; what we really need to interpret is *us*! Just as we are these creatures confined to one planet out of many that orbit the Sun, the NEW Interpretation says we are also creatures confined to one 'path' like H_A along the universe, out of many.

3 The NEW Conjecture for Gravitational Interactions of Quantum Particles

Albert Einstein said "Make everything as simple as possible but no simpler". If we take the wavefunction with all its glorious superpositions and spread-out nature seriously, how much can we simplify? The NHEHANEW Interpretation is one facet of this; we embrace a true wavefunction of the universe that continues to evolve unitarily.

However, experimentally, we observe that even when the wavefunction has a probability amplitude of $1/\sqrt{2}$ of taking path $|A\rangle$, we either observe a whole particle there or none - we never observe half a particle. The quanta are undeniable.

Going back to Einstein and Heisenberg's insight of focusing solely on what we observe, what truly is undeniable is that we *observe* particles as whole quanta. Only when something *interacts* with our eye, for example, that it's a whole photon or none, never half of a one. What if rephrasing Einstein, we endeavor to "make everything only as complex as necessary, but no more", and posit that it is only the standard model *interactions* that are quantum. While a 'particle' is not interacting, its wavefunction can be all spread-out, but for standard model interactions, it has to 'gather itself' and interact as a whole particle.

To the best of our knowledge, all the tests of quantum mechanics come from electromagnetic interactions. In particular, we do not yet have convincing evidence that gravity is quantum. Taking Schrodinger's wavefunction seriously in its entirety, let us ask a question: what if gravity truly sees this whole spread-out wavefunction? For example, a gravitational test particle in the presence of a source with a wavefunction $\psi(x,t)$ and total energy E_0 could behave something like it would in the presence of an energy density $E(x,t) = E_0|\psi(x,t)|^2$.

The New Conjecture then states that only standard model interactions are quantum; gravity sees the whole wavefunction of the system. The curvature of space-time created by a quantum particle would be dictated by a stress-energy tensor derived from the whole wavefunction. A stationary particle with a wavefunction $\psi(x,t)$ and total energy E_0 could correspond to $T^{00} = E_0|\psi(x,t)|^2$.

Conversely, thinking of our quantum particle as the test particle now, we could ask: in the presence of a given stress-energy tensor T, how does this particle's wavefunction react? One answer could be based on conservation of probability - if T curves spacetime sending a small spacetime volume element dV in the neighborhood of point (x,t) to dV', we define ψ' at this point as just a version of the original ψ rescaled by a real number so that $|\psi|^2 dV = |\psi'|^2 dV'$.

3.1 Consequences of the NEW Conjecture with the NEW Interpretation of Quantum Mechanics

Looking at the NEW framework together, something fascinating emerges. The NEW Interpretation alerts us to the simultaneous existence of H_A and H_B in the same world. From the perspective of H_A, everything they observe through standard model interactions is along their 'path' involving $|H_A\rangle|A\rangle$. Could H_A know about the existence of H_B?

Like humans experimenting with photons bringing $|A\rangle$ and $|B\rangle$ together to interfere, an imaginary experimenter outside of our world could in principle bring the two paths $|H_A\rangle|A\rangle$ and $|H_B\rangle|B\rangle$ together to interfere, but in this scenario, since the evolution is always unitary and reversible, the resulting entity may be neither H_A nor H_B. In particular, such hypothetical experiments can wipe

out or modify human memories and thwart the whole idea of H_A trying to infer the existence of H_B by messing with the very existence of H_A in the process!

There is one avenue for H_A to know that their world is something more than what they see along the path $|H_A\rangle|A\rangle$ - they can use gravity for their experiments! The NEW conjecture states that a test particle could, for example, experience the gravitational influence equivalent to $E(x,t) = E_0|\psi(x,t)|^2$, with the complete wavefunction $|\psi\rangle = \frac{|A\rangle+|B\rangle}{\sqrt{2}}$.

3.1.1 Dark Matter and Dark Energy

What will happen when H_A, who is convinced that the photon is in fact exclusively in state $|A\rangle$ as observed through electromagnetic interactions, now performs a gravitational measurement? Since gravity is registering the full picture, parts of which are unseen through standard model interactions by H_A, H_A will see confounding results and may have to invent concepts like dark matter and dark energy to try to make sense of what they are seeing!

Through electromagnetic interactions, we may observe the Sun rise in the sky, we may observe galaxies and stars and planets in certain positions. We may try to describe gravitational motions of celestial objects based on what we observe through our electromagnetic instruments. This is akin to H_A trying to describe their world convinced that the photon is exclusively in state $|A\rangle$. In the meanwhile, the gravitational forces governing the motion of the celestial objects are reacting to 'the whole picture', something like $E(x,t) = E_0|\psi(x,t)|^2$, ψ being the full wavefunction of the entire universe this time. This includes the 'paths' where the celestial objects are in different positions, when some of them do not even exist etc.

When an apple detaches from the tree on this Earth, the apple is feeling the gravitational pull as dictated by 'the whole picture', including the cases where the Earth did not exist or was in a different position. It may be that during the fall of the apple to the Earth, the average contribution of all the other 'path's does not change substantially, and the effective motion of the apple under gravity can be described in a way that makes sense in the world as seen by H_A through their electromagnetic measurements. However, such effective 'local' descriptions may be inadequate beyond 'local' observations like apples falling. It is possible that what we call dark matter and dark energy is in fact a gravitational observation of 'the full picture' by us humble humans confined along our 'path' H_A.

3.1.2 Why is Gravity so much Weaker than Other Forces?

The NEW formalism has a natural explanation for the weakness of gravity. Consider again the case of the apple falling to the Earth. While we as humans, existing along a specific path similar to H_A above, are convinced that the Earth is under our feet, in the whole 'blob of superpositions' since the beginning of the universe, the gravitational field of the would-be Earth is far more spread out.

The Earth is effectively only a little bit under our feet; for the most part it is spread out all over the universe. The apple is then feeling a gravitational force that is almost perfectly balanced out in the 'whole picture'; it is only the tiniest leftover fluctuation along paths similar enough to our H_A that make it fall to our Earth, and we humans along path H_A see it as an extremely weak gravitational force.

4 Experimental tests of the NEW Interpretation and the NEW Conjecture

This section explores experimental tests for the NEW framework. Setups similar to tabletop experiments currently proposed to test Quantum Gravity [3, 4] can test the NEW conjecture. This could also be considered an indirect test of the NEW Interpretation of Quantum Mechanics. Testing the NEW Interpretation directly may be possible in more distant future with intelligent Quantum AI standing in for humans, along the lines of the experiment proposed to test Wigner's Paradox (please see [5], and the excellent list of references therein, far more complete than ours).

4.1 A Tabletop Experiment to Test the NEW Conjecture

We provide an outline of a potential experiment to test the NEW conjecture in broad strokes here. An excellent review of current experimental techniques is provided in [6]. Our proposed experiment could use a diamond nano-crystal hosting a Nitrogen Vacancy (NV) center as described in the section IV, part C of this reference. We just need one particle in a quantum superposition state, not two entangled particles. The diamond nano-crystal is subjected to a magnetic field, which makes up-spins move right while down-spins go left.

$$|\psi\rangle = \frac{1}{\sqrt{2}}(|L\downarrow\rangle + |R\uparrow\rangle). \tag{3}$$

Our core idea is to test whether the microdiamond went left or right using *gravity*.

We know what happens when we investigate whether the particle went left or right using usual standard model (i.e. electromagnetic) methods. Textbooks like the Feynman Lectures [7] beautifully explain this picture in the context of a simple double slit experiment, where we try to observe the path the photon took by shining a little light to 'see' what happens. As the light we shine becomes strong enough to be certain the particle went one way or the other, any interference pattern downstream disappears, indicating a loss of superposition or 'collapse' of the wavefunction.

Instead of using traditional electromagnetic methods to observe whether the particle left or right, we propose using gravitational methods, for example, a torsion balance. The measurement apparatus can be tested by creating pure spin-up states, which will cause the torsion balance to twist right, and pure spin-down states, which will cause the torsion balance to twist left.

What happens when we create a state in superposition? Revisiting the traditional double slit experiment, when we measure which slit the particle went through, we always observe a whole particle going through the left slit or a whole particle going through the right slit. If gravitational measurement worked the same way, we would expect the torsion balance twist left half the time and to twist right half the time.

However, the NEW formalism predicts something completely different - when the superposition state contains equal spin up and spin down amplitudes, the torsion balance won't budge!!

An experiment to test for Quantum Gravity through Non-Disturbance Condition (NDC) has been proposed in [3]. Fig. 1 in this paper depicts a schematic large detector positioned to measure the path taken by a particle in flight, right or left. This work assumes that this measurement gives one bit of information about the gravitational field with outcomes denoted by + and -. The NEW formalism predicts that the measurement using a gravitational detector will appear to yield NO information, single outcome 0, because it is simultaneously reacting to the full wavefunction which is symmetric (assuming that the 'left' and 'right' branches are equidistant from the detector).

The gravitational detector is itself a source of gravity, and one would imagine that it will 'pull' the probability distribution of the particle wavefunction towards itself through gravitational attraction. To the extent that this gravitational influence of the detector on the particles in flight can be ignored, the NEW formalism predicts that we will continue to obtain $P_+ \approx 1$. In fact we can represent the predicted result for part (b) of figure 1 in [3] as, $P_{0+} \approx 1$, which is completely different from saying either $P_{++} + P_{-+} = 1$ or $P_{++} + P_{-+} \neq 1$.

What is more interesting, if we put both a traditional electromagnetic detector and a gravitational detector in the path in this same setup of paper [3], the NEW formalism predicts that we will find the particle to be either spin up or spin down as registered by the electromagnetic detector, but the gravitational detector will continue to not budge, registering what we call the non-informative position 0 above, because it continues to 'see' the complete superposition state. However, since we performed an electromagnetic measurement, we will now find each of P_+ and P_- to be 1/2.

If this is not sufficiently bizarre, NEW makes a further claim. Consider the traditional electromagnetic observation. When the particle is allowed to remain in superposition, we always find $P_+ = 1$ and $P_- = 0$. When we (electromagnetically) observe the particle in flight, now suddenly, P_- is not 0. With probability half, the particle arrives on that branch when it never did before. How do we explain this?

NEW predicts that for every what we called H_A before, or for every 'us' who sees the particle in spin-up state, there is a version that was H_B before, or a version of 'us' who sees the particle in the spin-down state. According to the forever unitary evolution of the universe, if the two versions of us

and the particle in spin-up and spin-down state were to interfere, what would emerge is a version of 'us' who always sees that $P_+ = 1$.

Here is a prediction that may be the most difficult to accept - since the NEW conjecture says that gravity sees 'the whole picture', and in the whole picture, gravity will always see $P_+ = 1$ and $P_- = 0$, even when we (electromagnetically) observe the particle along the way causing P_- to be greater than 0 in our 'path' of the universe. If we made a gravitational measurement at the position of the final detector, we will always find $P_+^G = 1$ and $P_-^G = 0$, regardless of where our electromagnetic final detector finds the particle, to the extent that effective quantum/electromagnetic/gravitational isolations can be experimentally realized as have been conveniently assumed in these arguments.

4.2 An Experiment to Test the NEW Interpretation

The NEW Interpretation can be valid even in the case that the New Conjecture is not. Can we test the NEW Interpretation directly without reference to gravity? Let us restrict to electromagnetic interactions and observations for this discussion.

This is much harder, as it will call for 'an intelligent entity' to simultaneously register the existence of two separate paths, e.g. as experienced by H_A and H_B. In something like the Many Worlds Interpretation, this would be truly impossible, as this interpretation does not provide for interactions between the different worlds. However, in the NEW Interpretation, as we noted before, H_A and H_B can in principle interfere.

Wiseman, Cavalcanti, and Rieffel consider an intelligent AI [5] in the context of Wigner's Friend scenario. Along the lines of their experiment, we consider the following setup. Assuming 'friendliness' as defined in this work, we use an Artificially Intelligent agent Charlie, and human Alice. Our experiment is relatively simple. We begin with a particle in a superposition state,

$$|\psi\rangle = \frac{|A\rangle + |B\rangle}{\sqrt{2}}. \tag{4}$$

We ask Charlie to perform a measurement, and then to record this measurement as $|R_A\rangle$ or $|R_B\rangle$, one bit of information recorded in another single particle. We have now created two 'path's. Along one path,

1. Charlie observes the state of the original particle to be $|A\rangle$. As an intelligent observer, this version of Charlie has observed the particle in this state, so we have $|C_A\rangle$ version of Charlie along this path.
2. Charlie records this observation, causing the recording particle to be in state $|R_A\rangle$.

There is a second path with A replaced with B everywhere above. Let us assume that there is Alice, a human, outside, who is isolated quantum mechanically from the original particle and Charlie.

After Charlie's observation and recording, Alice can observe the state of the recording particle. We would expect that if she finds it in state $|R_A\rangle$ and afterwards asks Charlie what he recorded, she would be talking to $|C_A\rangle$ who would answer consistently. The same would hold true with A replaced with B above.

Alternatively, in principle, Alice can choose to set up her experiment to cause $|R_A\rangle$ and $|R_B\rangle$ to interfere! For example, with a setup like the Mach-Zehnder interferometer, she could observe $P_+ = 1$, confirming a state in superposition. Note that the only entity that can put the recording particle in state $|R_A\rangle$ is $|C_A\rangle$, and the only entity that can put the recording particle in state $|R_B\rangle$ is $|C_B\rangle$. If Alice observes interference between the states $|R_A\rangle$ and $|R_B\rangle$, this implies that Charlie must be in a superposition state of $|C_A\rangle$ and $|C_B\rangle$ - an intelligent entity in a superposition state!

What would happen if having observed interference between $|R_A\rangle$ and $|R_B\rangle$, she asks Charlie what he recorded. The NEW formalism says this Charlie is in fact a superposition of $|C_A\rangle$ and $|C_B\rangle$. How in the world would this Charlie answer?!

Depending on the implementation of the Quantum AI Charlie, it could be that in order to respond to Alice, he must make an 'observation' of his internal state. Since this is an electromagnetic observation, at this point, we again have a bifurcation with one version of Charlie believing he recorded R_A and answering accordingly - this will be the branch with C_A and A_A (the version of Alice who believes Charlie answered he recorded R_A) in superposition with the branch with C_B and A_B.

At this point, we realize that all arguments above should go through with AI Charlie replaced with human Bob! We have just conceptually described an experiment that could verify the existence of humans in states of superposition. Then, our arguments in the above paragraph are describing a version of 'thinking causes collapse'. It may not be possible to realize these experiments with the levels of quantum separations needed between systems to maintain these superpositions, but with sufficient technological advances, experiments along these lines may one day make it possible to 'observe' human and AI superposition states.

5 Summary and Future Work

This paper proposes a NEW Interpretation of Quantum Mechanics, painting the universe as a blob of superpositions where 'Nothing Has Ever Happened And Nothing Ever Will' - NHEHANEW or NEW for short. Fantastic as it may sound, it is no more so than any other interpretation. It is also arguably the simplest and most 'natural' in the sense that it truly considers humans as part of the physical universe on par with any other collection of interacting particles. We compare and contrast our proposal with existing interpretations of quantum mechanics, highlighting similarities

and differences. A signature characteristic of the NEW Interpretation is that different 'path's along which different things appear to happen are truly in superposition and can interfere.

Quoting Einstein one last time - 'logic will take you from A to B, but imagination will take you everywhere'. With the universe as a blob of superpositions, we make the NEW imaginative Conjecture that while standard model interactions are quantum, gravity truly sees this whole picture described by the full wavefunction of the universe. Test particles could experience similar gravitational interaction due to a quantum particle with a wavefunction $\psi(x,t)$ as it would in energy density $E_0|\psi(x,t)|^2$, where E_0 is the total energy of the particle. The NEW formalism consisting of the NEW Interpretation along with the NEW Conjecture has a novel way of interpreting existing enigmas like dark matter and dark energy.

For experimental tests, we tweak existing proposals using tabletop experiments to test quantum nature of gravity and farther into the future, experiments involving intelligent Quantum AI. The NEW formalism makes unique, verifiable, and falsifiable predictions. We have outlined these experiments in very broad strokes; variations along these lines can be explored for optimal feasibility and clarity.

Intriguing theoretical questions remain as well. What does the term $m\overline{\psi}\psi$ in the standard model mean? The Higgs Mechanism through which the standard model Lagrangian gets masses for matter particles involves spontaneous symmetry breaking. The theory remains symmetric; we just pick a ground state with respect to which the symmetry appears to be broken. Through the NEW lens, we observe the similarity of this situation with us humans constrained along the path H_A that happens to be picked for us. Is there a deeper similarity between these concepts? Is it only when we 'observe' standard model interactions as creatures constrained to our 'path' like H_A that we happen to 'observe' a specific vacuum expectation value (vev) for the Higgs? Are there H_Bs out there for whom the Higgs vev is different? If the NEW Conjecture is valid and gravity truly can see the whole picture, how would gravitational interactions capture these worlds of H_Bs where the Higgs vev is different?

The standard model contains a small violation of the CP and T symmetry, both of which have been experimentally observed. These violations are captured in the standard model through the CKM matrix elements, and the CPT symmetry is believed to be conserved, preserving causality. The CP and T violation is because 'the weak eigenstates of quarks are not mass eigenstates'. This feels like a clue from nature to help us understand the interplay between standard model interactions and gravity. Parity and Time Reversal are spacetime concepts, and charge an internal quantum number. If we interpret the daily Time's Arrow as discussed in section 2.2.4, why is there still this leftover small asymmetry?

Among the many places where imagination can take us are also dead ends and flights of fancy not rooted in this physical universe that we inhabit. Everything proposed in this work can easily be wrong. Much work remains to try to find logical holes in our arguments and if there are no obvious

insurmountable contradictions, to try to put it on a firmer logical and mathematical ground. Tweaks to the NEW theme can be explored, NEW perspectives on the whole existing body of Physics can be investigated. We invite comments and discussion.

ACKNOWLEDGEMENTS: While this small contribution only explicitly cites a handful of references below, we gratefully acknowledge the large body of work that has made this line of thought possible today. We sincerely apologize for any (probably with an m in front!) errors and omissions due to our ignorance. The author warmly thanks organizers of the 'Physics With Friends' Meetup group Yevgeny Binder and Dimitri Papaioannou for creating a vibrant, welcoming community. Thanks to Yevgeny, Dimitri, and Siamak Tafazoli for numerous discussions. Huge thanks to Anil Ananthaswamy, for insightful and inspiring conversations, for his thought-provoking book 'Through Two Doors At Once' [8], and the recent Scientific American article 'The Quantum Observer' [9] on the proposed Wigner's Friend experiment. My thanks to Anupam Mazumdar for logistical assistance with this arXiv submission and for pointing out additional references to their work.

References

[1] David Albert and Barry Loewer. Interpreting the many-worlds interpretation. *Synthese*, 77(November):195–213, 1988.

[2] Andrea Di Biagio and Carlo Rovelli. Stable facts, relative facts. *Foundations of Physics*, 51(1), February 2021.

[3] Farhan Hanif, Debarshi Das, Jonathan Halliwell, Dipankar Home, Anupam Mazumdar, Hendrik Ulbricht, and Sougato Bose. Testing whether gravity acts as a quantum entity when measured, 2024.

[4] Sougato Bose, Anupam Mazumdar, Gavin W. Morley, Hendrik Ulbricht, Marko Toroš, Mauro Paternostro, Andrew Geraci, Peter Barker, M. S. Kim, and Gerard Milburn. Spin Entanglement Witness for Quantum Gravity. *Phys. Rev. Lett.*, 119(24):240401, 2017.

[5] Howard M. Wiseman, Eric G. Cavalcanti, and Eleanor G. Rieffel. A "thoughtful" local friendliness no-go theorem: a prospective experiment with new assumptions to suit. *Quantum*, 7:1112, September 2023.

[6] Sougato Bose, Ivette Fuentes, Andrew A. Geraci, Saba Mehsar Khan, Sofia Qvarfort, Markus Rademacher, Muddassar Rashid, Marko Toroš, Hendrik Ulbricht, and Clara C. Wanjura. Massive quantum systems as interfaces of quantum mechanics and gravity, 2023.

[7] Feynman, Leighton, and Sands. *The Feynman Lectures on Physics*, volume III, chapter 1.6.

[8] Anil Ananthaswamy. *Through Two Doors At Once*.

[9] Anil Ananthaswamy. The quantum observer. *Scientific American*, July/August, 2024.