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Survey of Quantum Suicide or Quantum Immortality

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Abstract*:* In quantum mechanics, quantum suicide is a thought experiment, originally published independently by Hans Moravec in 1987 and Bruno Marchal in 1988, and independently developed further by Max Tegmark in 1998. It attempts to distinguish between the Copenhagen interpretation of quantum mechanics and the Everett many-worlds interpretation by means of a variation of the Schrödinger's cat thought experiment, from the cat's point of view. Quantum immortality refers to the subjective experience of surviving quantum suicide regardless of the odds. The paper is a survey of the experiment of quantum suicide.

Keyword: Quantum Mechanics, Immortality, Survey

I. INTRODUCTION

The Many Worlds interpretation (MWI), proposed by Everett in 1957 but virtually unnoticed for about a decade, has survived 25 years of fierce criticism and occasional ridicule to become the number one challenger to the leading orthodoxy, ahead of the Bohm [6], Consistent Histories and GRW interpretations. Why has this happened? The purpose of the present paper is to briefly summarize the appeal of the MWI in the light of recent experimental and theoretical progress, and why much of the traditional criticism of it is being brushed aside.

The "quantum suicide" thing really just says that your experience always continues, that there's always a next-moment. You are "a conscious perspective having a particular experience", currently a being-a-person-in-a-world experience, moment by moment. That consciousness cannot end. The theory doesn't specify the content of any next-moment though.

II. THE EXPERIMENT

A. HOW THE EXPERIMENT WAS PROPOSED?

One cat goes into a box; this cat is Schrödinger's cat.

He proposed a scenario with a cat in a sealed box, wherein the cat's life or death depended on the state of a subatomic particle. According to Schrödinger, the Copenhagen interpretation implies that the cat remains both alive and dead (to the universe outside the box) until the box is opened.

The reason "the cat's life or death depended on the state of a subatomic particle," is because of the Copenhagen interpretation of Quantum Mechanics. The correct theory is:

It holds that quantum mechanics does not yield a description of an objective reality but deals only with probabilities... According to the interpretation, the act of measurement causes the set of probabilities to immediately and randomly assume only one of the possible values.

So, how are these related? The cat in the box only dies when the state of the subatomic particle is known to you. Until then, it's both alive and dead.

Why is this important? Because another theory says every possible outcome happens in one universe or another. This means every time you open the box, the universe "splits." In one universe, the cat dies. In another, the cat lives.

So if you repeat the experiment a billion times, in one universe, you've got an immortal cat. Perhaps that cat's consciousness is, in itself, immortal in its own universe. I mean, living a billion times seems pretty unlikely, right? That's more of a philosophical position than scientific one, though.

The apparatus is a “quantum gun” which each time its trigger is pulled measures the z-spin of a particle in the state $(|\uparrow i + |\downarrow i)/\sqrt{2}$. It is connected to a machine gun that fires a single bullet if the result is “down” and merely

makes an audible click if the result is “up”. The details of the trigger mechanism are irrelevant (an experiment with photons and a half-silvered mirror would probably be cheaper to implement) as long as the timescale between the quantum bit generation and the

actual firing is much shorter than that characteristic of human perception, say 10−2 seconds. The experimenter first places a sand bag in front of the gun and tells her assistant to pull the trigger ten times.

Since there is exactly one observer having perceptions both before and after the trigger event, and since it occurred too fast to notice, the MWI prediction is that I will hear "click" with 100% certainty. When her assistant has completed his unenviable assignment, she will have heard ten clicks, and concluded that collapse interpretations of quantum mechanics are ruled out at a confidence level of $1-0.5^n \approx 99.9\%$. If she wants to rule them out at "ten sigma", she need merely increase n by continuing the experiment a while longer. Occasionally, to verify that the apparatus is working, she can move her head away from the gun and suddenly hear it going off intermittently. Note, however, that almost all terms in the final superposition will have her assistant perceiving that he has killed his boss.

What we've done here is tie the survival of the experimenter to a quantum state, meaning she now exists in a superposition of being both alive and dead. There's a 50% chance she survived the initial round, and she has the same chance for every subsequent repetition of the experiment. No matter how many times she repeats the experiment, half the time, she survives.

Of course, her overall survival chances are way less than 50%. The version of her that died in the initial experiment doesn't have a 50% chance of coming back to life in the next experiment. But each living version of the experimenter retains that chance at survival, even if the overall chance of survival keeps falling to 25%, then 12.5%, then 6.25%, and so on. Let's say that in one universe, an experimenter eventually emerges having survived 50 such tests in a row — something she has less than a one in quadrillion chance of surviving, which is way more than is needed to meet the 5-sigma level of certainty needed for an official discovery.

What makes this interesting, is that if the many-worlds interpretation of quantum mechanics is true, then at the point at which a decay might happen, the universe splits in two — into one universe in which it decays and I die, and another in which it does not decay and I live. Assuming there is no afterlife, I will cease to exist in one universe but not in another. So, the argument goes, although there will be others who will exist in the universes in which I die, I will only ever exist in the universes in which I survive, so I will only ever observe the universes in which I survive. From my perspective, I will never die, I will always be saved from death by quantum indeterminacy.

Connected to this is the theory of quantum immortality, which posits that no one ever dies, they only appear to. Whenever I might die, there will be another universe in which I still live, some quantum event (however remotely unlikely) which saves me from death. Hence, it is argued, I will never actually experience my own death, but from my own perspective will live forever, even as countless others will witness me die countless times. Life however will get very lonely, since everyone I know will eventually die (from my perspective), and it will seem I am the only one who is living forever — in fact, everyone else is living forever also, but in different universes from me.

B. THE DIFFERENCE

Normal suicide: the act of suicide is governed by Newtonian physics. The result is predetermined, and there is no "chance". You may not know what that result is, but that is simply because we don't have the time or resources to compute it.

Quantum suicide: the act of suicide is governed by Quantum physics, and the result is determined by chance. Under certain interpretations, both results can occur at the same time by existing in different parallel universes resulting in a universe where no matter how many times you try to kill yourself, you survive**.**

C. THE QUESTION REMAINS

Many physicists would undoubtedly rejoice if an omniscient genie appeared at their death bed, and as a reward for life-long curiosity granted them the answer to a physics question of their choice. But would they be as happy if the genie forbade them from

telling anybody else? Perhaps the greatest irony of quantum mechanics is that if the MWI is correct, then the situation is quite analogous if once you feel ready to die, you repeatedly attempt quantum suicide: you will experimentally convince yourself that the MWI is correct, but you can never convince anyone else!

III. CONCLUSION

The Quantum mechanics says objective reality doesn't exist, that instead all we see are probabilities collapsing into one particular configuration... and all other possible realities might just exist together in a quantum multiverse.

Quantum suicide is a thought experiment that was suggested as a way to determine experimentally, at least in principle, whether the many-worlds interpretation of quantum mechanics is correct.

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