

Medium

 Search WriteSign
upSign
in

The Fantasy Science Lab



Schrödinger's Cat for Everyone

Bridging the gap
between science and
fiction.

(And its role in sci-fi.)

[Follow publication](#)

Radha Pyari Sandhir

Follow

7 min read · Jul 15, 2020



52



Let's chat about something that is mentioned in just about any science fiction that has anything to do with quantum physics: Schrödinger's cat. Spoiler: it's not a real cat. We'll take a look at it in the context of the sci-fi film *Coherence* (2013).

Disclaimer: no cats were harmed in the writing of this article.

SCHRÖDINGER'S CAT IN COHERENCE (2013)

The 2013 film *Coherence* by James Ward Byrkit depicts what is at first a standard dinner party among friends in a quiet suburban neighborhood. Things begin to go wrong when a comet appears in the sky overhead: they find themselves face to face with their selves from alternate realities. The group tries to make sense of the bizarre situation by reading the notes of a physics professor. This is where Schrödinger's cat comes into the picture

(taken from the [transcript](#)):

There's a cat in a box that has, like, a 50/50 chance of living because there's a vial of poison that's also in the box. So, regular physics would say that it's one or the other. That the cat is either alive or dead. But Brian would argue that quantum physics says that both realities exist simultaneously. It's only when you open the box that they collapse into a single event.

They go on to discuss another possibility, that instead of simultaneous states collapsing to a single event, there are multiple realities:

There is another theory: that two states continue to exist separate and decoherent from each other, each creating a new branch of reality based on the two outcomes. Quantum decoherence ensures that the different outcomes have no interaction with each other...So we're in the box. We're the cat. We're both alive and dead. So, there are two separate realities, presumably until the comet passes.

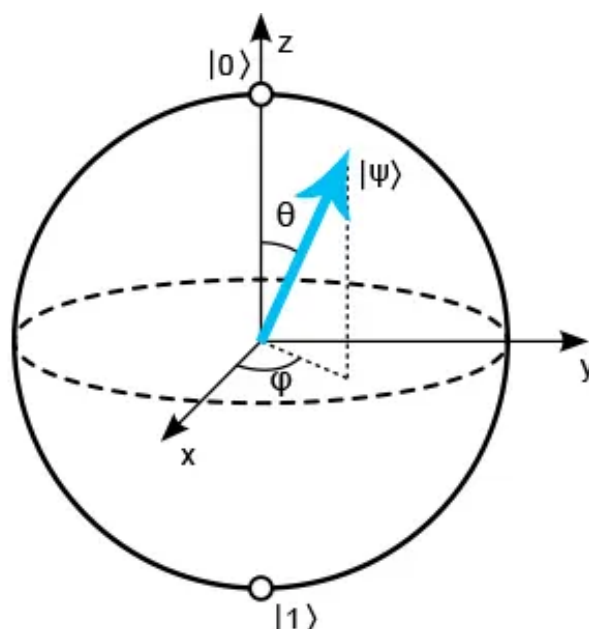
That the different branches of reality are usually independent but are now somehow overlapping due to the comet appears to be the explanation behind the movie. This context has a very real basis in quantum physics, in the form of *quantum superposition*. And the famous thought experiment by physicist Erwin Schrödinger was a response to one of the interpretations of what may be happening when someone observes superposition. So before we chat about Schrödinger's cat, let's talk a bit about superposition and what is known as the *qubit*.

THE QUBIT AND THE BLOCH SPHERE

In classical computers, like the device you're using to read this, all

information can be broken down into *bits* which can take on one of two values: 0 or 1. The fundamental computing unit of a quantum computer works a little differently and is called a quantum bit or *qubit*. It can not only take a value of 0 or 1, it can also be in what is known as a superposition state, which is a probabilistic superposition of a 0 and 1. Qubits are forced to become one or the other when we need to take a look at them, that is, they end up looking like classical bits. This apparent transition from quantum to classical is called *decoherence*. So, if you have a hundred qubits that are in a 50–50 superposition of 0 and 1, then when you *measure* them, i.e., ask them for information, about half will say 1 and half will say 0.

A qubit can be represented by what is known as the *Bloch sphere*. The top, corresponding to the North Pole if the sphere were Earth, is the state 0. And the South Pole is the state 1. The blue arrow marked with the greek letter *psi* is an arbitrary state of the qubit.



Quantum computing basically involves manipulating the probabilities in a qubit's superposition state by moving the blue arrow around the sphere. For

instance, for a 50–50 superposition it would lie halfway between 0 and 1. Once the arrow is successfully moved around, we measure the qubit, that is, extract information from it, and the arrow moves to point to either the North Pole or the South Pole, with likelihoods depending on the state it had been in. For instance, if a qubit had a 5% chance of becoming a 0 and a 95% chance of becoming 1, then after measurement it would most likely become a 1 — but it could also become 0. And, according to something called the *Copenhagen interpretation*, before measurement, the qubit's reality was not definite: after measurement, it 'collapses' to one of the two.

This is where Schrödinger's thought experiment comes in.

SCHRÖDINGER'S CAT

In 1935, Erwin Schrödinger published a paper called "The Present Situation in Quantum Mechanics" (originally published in German). In the paper, he proposed a thought experiment that involved a cat, which is a macroscopic object. This thought experiment wasn't to demonstrate the funkiness of quantum physics, it was a push back to the Copenhagen interpretation, by hypothetically extrapolating quantum effects on a microscopic level to everyday macroscopic objects.

The original thought experiment involved a cat and poison, but I will follow the example of Caltech physicist Sean Carroll, and use sleeping gas instead. Because we don't really need to talk about dead cats, now, do we?



It goes something like this:

Get Radha Pyari Sandhir's stories in your inbox

Join Medium for free to get updates from this writer.

Enter your email

Subscribe

Place a cat in a box along with a special quantum apparatus. The apparatus consists of a quantum system that's in a superposition state, and a vial of sleeping gas that either breaks or doesn't break according to the superposition. For the sake of this illustration, let's pretend that the quantum system is a single qubit in a 50–50 superposition of 0 and 1, and the vial remains intact if the qubit is 0 and breaks if the qubit is 1. The cat is, therefore, in a superposition state of awake and asleep, its state entangled with that of the quantum system, until you open the box and *observe* it, observation being the measurement. The cat's reality is undetermined prior to the opening of the box. And Schrödinger was basically like: you can't really believe that before you open the box the cat is in a superposition of

awake and asleep!

In the original paper, the quantum apparatus was a radioactive substance that had a 50–50 chance of decaying within an hour. Here is the excerpt from the translated version:

One can even set up quite ridiculous cases. A cat is penned up in a steel chamber, along with the following device (which must be secured against direct interference by the cat): in a Geiger counter there is a tiny bit of radioactive substance, so small, that perhaps in the course of the hour one of the atoms decays, but also, with equal probability, perhaps none; if it happens, the counter tube discharges and through a relay releases a hammer which shatters a small flask of hydrocyanic acid. If one has left this entire system to itself for an hour, one would say that the cat still lives if meanwhile no atom has decayed. The psi-function of the entire system would express this by having in it the living and dead cat (pardon the expression) mixed or smeared out in equal parts.

Quick side note: I do so adore how he inserted “pardon the expression” when speaking of a dead cat. Now back to the thought experiment. There are, of course, many issues with it! (Apparently, the late Stephen Hawking said: “When I hear about Schrödinger’s cat, I reach for my gun.”) For instance, the cat is *not* a microscopic quantum particle, and there are many factors like the environment that can force the system to be ‘measured’ prior to you opening the box — a little wind, some microscopic critters on the insides of the box, the Geiger counter itself performing a measurement, you get the point. It’s difficult to think of such a system as truly quantum. But we needn’t get into the issues here because the point of our chat today is to describe the thought experiment.

There are other ways of looking at this hypothetical scenario; the Copenhagen interpretation is not the only interpretation of quantum physics, though it's the most commonly taught. The *Many Worlds Interpretation*, which the film *Coherence* seems to refer to though not by name, involves the various components in a superposition decoupling from one another, evolving independently, and existing in their own classical realities — which may be attributed to decoherence. For Schrödinger's cat, this means that in one reality, if you open the box you will find the cat asleep. And in another reality, another you will find it wide awake.

If you were in the fictional universe of *Coherence*, and a comet happened to be flying overhead, you may see both, since comets can apparently cause different parts of a superposition to interfere with one another — which makes for very interesting dinner parties.

A version of this article was originally published on Dec. 10, 2019, on [Film Inquiry](#).

MORE TO EXPLORE

Articles

ThoughtCo: [Understanding the “Schrödinger’s Cat” Thought Experiment](#) (2019)

National Geographic: [The Physics Behind Schrödinger’s Cat Paradox](#) (2013)

Papers

E. Schrödinger. “Die gegenwärtige Situation in der Quantenmechanik“. Naturwissenschaften. (1935) (Translation by J. D. Trimmer published in 2014.)

Books

B. Greene. “The Hidden Reality: Parallel Universes and the Deep Laws of the Cosmos by Brian Greene.” Vintage. (2011)

G. Bacciagaluppi. “The Role of Decoherence in Quantum Mechanics.“, The Stanford Encyclopedia of Philosophy (2003)

Videos

Talks at Google: Sean Carroll: “Something Deeply Hidden: Quantum Worlds & the Emergence of Spacetime” (Schrödinger’s cat mentioned at 21:31 onwards in the context of MWI)

MinutePhysics: Schrödinger’s Cat (2011)

[Quantum](#)[Schrodingers Cat](#)[Science Fiction](#)[Writing](#)



Published in The Fantasy Science Lab

5 followers · Last published Jul 15, 2020

Follow

Bridging the gap between science and fiction.



Written by Radha Pyari Sandhir

539 followers · 77 following

Follow

Scientific Advisor. Writer. Physicist. Cat lady and caffeinated.

No responses yet



Write a response

What are your thoughts?

More from Radha Pyari Sandhir and The Fantasy Science Lab



 In Qiskit by Radha Pyari Sandhir

How to Write a Quantum Story

Teleportation. Entanglement. The multiverse. Whether you're looking to develop a...

Jan 4, 2023  132  4

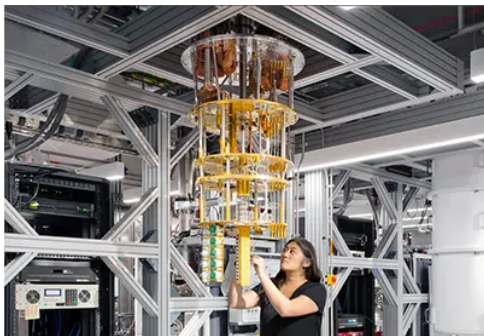


 In The Fantasy Science L... by Radha Pyari Sand...

The Sci-fi Writer's Guide to Quantum Physics

For sci-fi writers looking for story ideas or wanting to add some quantum oomph to...

 Jan 13, 2020  74



 In Qiskit by Radha Pyari Sandhir

7 Reasons You Should Learn Quantum Computing Now

You've landed on the Qiskit blog, so you've definitely heard of quantum computing. Or, ...

Jun 28, 2022  260  4



 In Cozy Learning by Radha Pyari Sandhir

The mental space you'll gain from organized information

How organizing vital information creates space for the tasks that matter—and why it'...

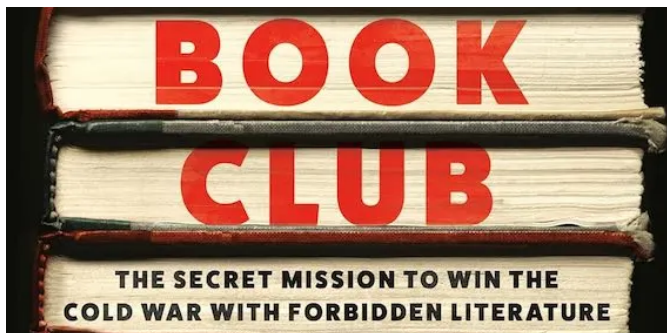
Sep 28  51



See all from Radha Pyari Sandhir

See all from The Fantasy Science Lab

Recommended from Medium



 Mal Warwick

How the CIA penetrated the Iron Curtain . . . with books

When we think about the CIA, we tend to conjure up images of brush passes, dead...

Jul 30



 In Long. Sweet. Valuable. by Ossai Chinedum

I'll Instantly Know You Used Chat Gpt If I See This

Trust me you're not as slick as you think



May 16



25K



1462





 Avi Loeb

A Recap of the Anomalies of 3I/ATLAS on the Day of Its Closes...

Like in any blind date, encounters with interstellar objects can result in dealbreaker...

2d ago  1.4K  85

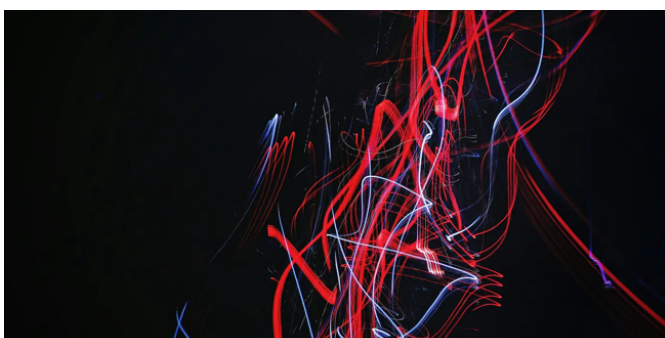


 Jordan Gibbs

ChatGPT Is Poisoning Your Brain...

Here's How to Stop It Before It's Too Late.

 Apr 29  26K  1289



 Will Lockett 

AI Will Destroy Everything

But not in the way you think it will.

 3d ago  1.8K  37



 In Long After the Thrill by Shaant

I Didn't Know These Common Habits Were Signs of Mental...

These everyday habits felt harmless, until I learned they were quiet signs my mind was...

 Apr 24  27K  793



See more recommendations

[Help](#) [Status](#) [About](#) [Careers](#) [Press](#) [Blog](#) [Privacy](#) [Rules](#) [Terms](#) [Text to speech](#)