Bit Quântico 4: THE CAT

[in brackets]: sound effect

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[bass intro]

Gláucia - Hello, I'm Gláucia Murta and this is another Bit Quântico, which complements our regular episodes. Today, we are going to tell the story of a cat.

[congas]

Gláucia - In episode 4 we talked about the “the most intelligent picture”, which is the photo taken of participants in a Conference on quantum physics that took place in Solvay, Belgium, in 1927. Among the participants of this conference, there were several important names in quantum theory. Among them was Erwin Schrödinger, an Austrian physicist who described with his equation the way quantum systems evolve in time. But perhaps you know Schrödinger from another story.

Marcelo Terra Cunha: Ok, the most famous one is the cat, right.

Gláucia - Here we listened to Marcelo Terra Cunha, professor in the mathematics department at Unicamp, who is already a regular here on the podcast.

Marcelo Terra Cunha: It is important to talk about Schrödinger's cat also to correct what often appears about Schrödinger's cat.

Gláucia - Schrödinger's cat is one of the most famous anecdotes in popular culture about quantum theory. It all starts with a well-closed box that is well isolated from its surroundings. Inside this box, we have [plim] an atom that has an excited electron, that is, that is in a more energetic state than it should be and at any moment will decay and emit a photon, [plim] a sensor, capable of detecting photons, [pen] a hammer, connected to this sensor, and ready to be activated, [plim] a flask with a deadly poison, and finally [plim] a cat [cat].

Marcelo Terra Cunha: He creates the entire mechanism that when it decays, a photon will be emitted which is enough to release a hammer that breaks a glass containing poison and this kills the cat.

Gláucia - As Terra said, when this excited electron emits the photon, this whole chain of events releases the poison that ends up killing the poor cat. And we know that this atom will eventually decay, that is, that it will eventually emit the photon, but...

Marcelo Terra Cunha: …but this is treated via quantum theory, you cannot specify at which instant of time this decay will actually happen.

Gláucia - In other words, the description given by quantum theory says that this atom enters a superposition of ‘already have emitted the photon' and ‘not yet have emitted the photon’.

Marcelo Terra Cunha: So he creates this way of coupling the superposition of a microscopic system…

Gláucia -…which is the atom…

Marcelo Terra Cunha: …to the macroscopic system…

Gláucia - …which is the cat…

> **Marcelo Terra Cunha:** …and saying look, within the rules of the game, if we take everything literally, this superposition will continue until we open the box.

Gláucia - In other words, as long as we don't open the box, in principle, the superposition of the electron emitting or not the photon can be somewhat transferred to a superposition of the glass being broken or not, which leads to a superposition of the poison being released or not. In the end, we would have a superposition of a living cat and a dead cat. [blunt] But what is the moral of this story? Pablo Saldanha, a physicist from UFMG, is here once again to tell us what Schrödinger meant by it.

> **Pablo Saldanha:** At this time, he had an anti-realist view of quantum physics, saying that this mathematical formalism does not represent reality in itself. [...] But if you say, no, you are describing reality itself, the atom is excited and fundamental at the same time [...] if you carry this out you will conclude that the cat is alive and dead at the same time, okay?

Gláucia - In other words, Schrödinger invented this anecdote as an argument in favor of anti-realism. For him, the cat-in-the-box story clearly shows that we cannot take a realist point of view and say that the superposition of the atom is something real, because this logically leads to the conclusion that the superposition of a dead and alive cat would also be possible… which would be absurd.

> **Pablo Saldanha:** Which showed that if this quantum superposition, this realistic interpretation, must not exist at the level of a cat, it must not exist at the level of an atom either.

Gláucia - So we see that Schrodinger's cat is a theoretical argument in favor of anti-realism, that is, in favor of not interpreting elements that arise in quantum theory, such as superposition, literally. However, despite being a good argument, it is not sufficient to give the final word on the matter. But we'll talk more about that in our next episode.

[bass]

Gláucia - This quantum bit ends here. Until then!

[cat]