



## Episode 01 - THE MORE QUANTUM, THE BETTER

*"Italic"*: Excerpt from pseudoscience speech

[in brackets]: sound effect

**OPENING \*\*\*\*\* \*\***

[intro - bass]

**Lu** - In November 2021, an email arrived at Arco, the science communication magazine where I worked, which said:

**Leo** - [radio filter] Hello, good morning, I'm a professor in the Maths Department at the Federal University of Santa Maria and I have a podcast project about science, more specifically about quantum theory and misinformation.

**Lu** - He says a few more things, until he comes to the following:

**Leo** - [radio filter] ...But something that is becoming increasingly clear to us is that we need someone from outside the area to moderate the technical discussion and help with the journalistic production of the content.

**Lu** - Quantum theory?!... At the time, I had a slight idea of what that was. Very slight. So the first thing I did after reading the email was to google the word "quantum".

**[Google translator's voice]** Physical principles - atoms - quantum floral - quantum computing - book The Secret - Einstein - quantum consciousness - quantum bracelet - quantum mattresses...

**Lu** - I knew that a lot of this was related to scientific research (and it was very hard science). But I also knew that many of these results had nothing to do with science. But which was which? And why do so many different things have quantum in their names? It was with this in mind that I replied to the email and ended up meeting Leo, the author of the email.

**Leo** - Hi, I'm Leonardo Guerini, I'm a mathematician and researcher into the foundations of quantum theory, and even before I wrote this email, I had been discussing this project for a while with a good friend who is also a researcher, Gláucia.

**Gláucia** - Hi everyone, I'm Gláucia Murta, I work at the University of Düsseldorf in Germany. I'm a physicist and I also do research in quantum theory, currently in the area of quantum information and cryptography. Leo and I have known each other for a long time, because we did our PhDs around the same time. Lu, on the other hand, I only met recently, because she replied to Leo's email. And that's what gave rise to the 'O Q Quântico' team.

**Lu** - So finally introducing myself, I'm Luciane Treulieb, I'm a journalist and, like Leo, I also work at UFSM, coordinating science communication activities.

**Leo** - As you can see from the Google search, people often hear more about bracelets and quantum florals than they do about science. In this podcast, we want to talk about quantum theory, but also about pseudoscience and misinformation.

**Lu** - But don't worry about knowing everything straight away: I'm here to represent the public who don't even know about physics, let alone quantum physics.

**Gláucia** - And if you're wondering, why do I need to know about quantum? The point is that quantum is present in our daily lives. When you have an MRI scan or an ultrasound, you're using quantum physics... And it's also present when you have laser surgery, and even in the transistors of your computer, which are very small pieces that it needs to function... Quantum is already responsible for many of today's technologies and is increasingly establishing itself as the technology of the future. A lot of things use quantum, so here we want to separate the wheat from the chaff, the science from the pseudoscience.

**Lu** - And it's important to know a little bit so you don't fall for misleading advertising. Because it seems that adding the term "quantum" after a product or service has become a magic marketing formula that makes it look more interesting or efficient, even if we don't really understand why.

**Leo** - Exactly. Ever since I started studying these things for my master's degree, my friends, and sometimes even my family, have asked me questions about the subject. Quantum theory is a subject that arouses interest. And people often arrive at the word "quantum" via non-scientific ways. I'll tell you a little story that happened to me. Once my mum came up to me and said "I've got you a book". Then I looked it up and the name of the book was "Quantum Intelligence". It's still on my bookshelf to this day.

**Lu** - And what did you do?

**Leo** - I told her: mum, this has nothing to do with science. She said "fine, but then read it and tell me why it has nothing to do with science". Then I read the first few pages, and I'm not lying, I think 5 or 6 pages were enough to see that the author, who claimed to be a trained physicist, was not only misrepresenting concepts, but also exaggerating ideas that do exist, that are correct, but making it look like these ideas fit into other contexts.

But how would I explain that to my mum... it's difficult. There are complex concepts, there are technical terms. I wish I had a short answer to give her, but it's complicated.

**Gláucia** - Indeed, it's not that simple, right? Working on this project, we see how difficult it is to talk about quantum to the general public.

[identity - bass and congas]

**Lu** - But we're not alone in this challenge. We talked to 11 experts who work on this subject, from a lot of different angles. We interviewed researchers in physics, maths, philosophy and communication to better understand these topics that have a Q of quantum on them.

**Leo** - This is the podcast O Q Quântico. In the first block of this episode, we will bring a few criteria that help us understand which type of ideas involving the term quantum can be considered scientific or not. In block 2 we talk a little about what characterizes pseudoscience. And in the last block, we show that even well-intentioned pseudoscience can be quite dangerous. Come with us as we start episode 1: The more quantum, the better.

[Opening song and cat]

## **BLOCK 1 – SCIENCE AND COUNTERFEITING\*\*\*\*\***

[mattress scene entrance song]

**[Parallel scene]:**

**Seller:** Hello how are you?

**Samara and Vitor:** Olá.

**Seller:** Nice to meet you Vitor, hi...

**Samara:** Hi, nice to meet you, Samara.

**Seller:** Let's move on, you're interested in quantum, right?...

[mattress scene exit song]

**Gláucia** - So, I think the first thing we have to make clear is that there is a quantum science, the science that is studied in universities and research groups in a very serious and well-founded way. And it's generating new technologies.

**Lu** - Which is what you and Leo work with, right?

**Gláucia** - Yes. Quantum science in general refers to very small systems, things like atoms, electrons and photons. And on this scale there are interesting phenomena that are also quite counterintuitive, different from everything we are used to in our day-to-day lives. So on the one hand, quantum science describes some surprising effects, which can sometimes sound like magic when you first hear about them. On the other hand, it is responsible for many of the most modern technologies we have today.

**Leo** - This combination makes quantum theory a great target for misinformation. Apart from science, there are these other areas, which we can call pseudoscience and quantum mysticism, which include things like quantum health, quantum coaches, quantum products. But the problem isn't necessarily in the use of the word "quantum" itself.

**Pablo Saldanha:** I don't think physics has a patent on the word quantum, it's like, oh, today you can only use the word quantum if you're talking about physics.

**Leo** - This is Pablo Saldanha, Professor in the Physics Department at Federal University of Minas Gerais and a researcher in quantum optics.

**Pablo Saldanha:** No. Like 'energy', for example, this is a word that's used in physics in one context and in society it's used in another context. 'Force' too, there's no problem with that. But what has to be clear is: what we call energy, in common sense, is not what we call energy in physics in general, right?

**Leo** - In other words, there's nothing new about using scientific terms, particularly from physics, to describe a product. And this happens even with more innocent terms, like Pablo said: 'force', 'energy'... the term "quantum" is just another word, available for anyone to borrow.

**Pablo Saldanha:** Now, it has to be very clear that there's nothing scientific about it. Because the problem is when you use a word that comes from science to try to give a scientific face to something that has nothing to do with science.

**Lu** - [highlight] Trying to give a scientific face to something that has absolutely nothing scientific about it.

That is the point, right? We hear these things and many of them sound scientific. And we don't even understand a lot of what we hear. For example, listen to this:

[radio static]

*“And apart from that it has therapeutic energies, which are already scientifically proven, which are: the quantum energy of the sun, which are quantum stones... they emit a frequency that is identical to the sun's rays.”*

[radio static]

**Lu** - I have no idea what quantum energy from the sun or quantum stones are. And I don't know exactly what quantum physics is about either. So if I don't know one thing or the other, how can I tell what's really scientific?

**Leo** - Lu's question is really difficult to answer. And I can already tell you that even after listening to this episode, even after listening to our entire season, you won't have a magic formula to differentiate one thing from another. The problem starts with the meaning of the word "scientific". Think about it: can you define what science is? Everyone has a rough idea of what it is, but what is the precise definition of science?

**Gláucia** - Eh, that is not a simple question. Ideally, we'd like to have a list of criteria to characterize what is science. And then we could just follow that list to check if something fulfills all the requirements. If it does, it's science; if it fails any of them, it's not. But the problem is that this ready-made list doesn't exist...

**Leo** - The discussion about what is scientific or not doesn't just happen in the context of quantum science, it's a discussion about science in general, and in fact this is still an open problem. In epistemology, which is the part of philosophy that deals with knowledge, there's even a name for it: it's the demarcation problem. In other words, how do we set the boundaries of what we call scientific knowledge?

**Gláucia** - Marcelo Shappo, a physics professor at the Federal Institute of Santa Catarina and science communicator, told us a little about this problem.

**Marcelo Shappo:** It's very difficult from an epistemological point of view, from the point of view of the philosophy of science, in a nutshell, to say science is this, pseudoscience is that. [...] on the other hand, if we just go off on a tangent without at least trying to outline an answer, we're leaving people with more doubts than actually valid information for them to use.

**Gláucia** - We don't want to go off on a tangent here either, so we're going to bring three essential elements of what we like to call science: to be scientific, an idea needs to be [plim] systematic, [plim] falsifiable and [plim] reproducible.

**Leo** - We start discussing these concepts with an answer from Schappo.

**Marcelo Shappo:** Science is a process, a process of what? A process of obtaining answers, so we always have questions. Asking questions about nature is part of who we are as human beings, it's part of our curiosity to look at the world and try to understand how it works.

**Leo** - Another expert that we talked to is Osvaldo Pessoa Jr. Osvaldo did his undergraduate degree in physics and philosophy at the same time, a master's degree in experimental physics and a PhD in the philosophy of quantum physics. Today he is a Professor of philosophy at USP. Osvaldo brings up one of the essential elements of science.

**Osvaldo Pessoa Jr.:** Well, I would say that science is an extension of our common and usual knowledge. We have knowledge of our daily lives, but when we start to investigate things that aren't so intuitive or obvious, we start doing science, we start to apply a method to systematically measure things.

**Leo** - [sound effect] 'We start to apply a method to systematically measure things'. Without a doubt, science needs to be systematic. You need some kind of method if you want to study something. But many other non-scientific doctrines are also systematic. In fact, all those areas we've already mentioned here, such as quantum

health and quantum coaching, are also methodical and organized. They have a certain internal logic. But it's not enough to be methodical and to make sense in order to be scientific. Other important ingredients are still missing.

**Oswaldo Pessoa Jr.:** And finally, in the history of science there is, of course, the experimental data, the observations. They're very important, right? But there's also the theoretical explanation part, the theories. So science has an observational experimental component and a theoretical one.

**Leo** - And this is perhaps the most fundamental characteristic of science: the elaboration of a theory and its confrontation with evidence.

**Gláucia** - In other words, in order to do science, being creative and thinking outside the box is essential. We've had many advances that were only possible because someone seriously considered possibilities that at first glance seemed completely absurd. In fact, some ideas in quantum physics came about in exactly this way, as we will see in the next episode. But at the end of the day, you always have to be careful to see if the idea you are defending is supported by what you find when you do experiments. In Schappo's words:

**Marcelo Shappo:** Science moves away from myth in the sense that it's a process [...] it's a process based on what? On trying to understand the world in a controlled way, through experimentation and by putting its explanations to some kind of test, some kind of verification.

**Leo** - Here, when we talk about a test or experiment, it's not necessarily something crazy, like mixing substances in a coloured flask while wearing a white coat. An experiment can basically be any kind of verification, from putting eggshells on a plant to see if it grows better or testing whether your football team wins every time you wear the same shirt.

**Gláucia** - But we have to bear in mind that many people before us have also proposed theories and generated experimental data, which leaves some things very well established. This data also counts as evidence to be considered. So when we



evaluate a new idea, it's important to make sure that it doesn't contradict something that has already been established.

**Leo** - In other words, the more controversial is the idea you are defending, the greater and more robust the evidence in its favor should be. This is sometimes called the "Sagan standard", in honor of the famous American astronomer and science communicator Carl Sagan, who basically said that [radio filter] "extraordinary claims require extraordinary evidence".

**Lu** - Ok, but... you said before that a lot of things can count as evidence, so maybe these mystical ideas also have evidence to support them, right? For example, when someone says:

[radio static]

*"I'm going to tell you some details of my story, showing you step by step of what I did to reach my quantum leap."*

[radio static]

**Lu** - If she has reached this quantum leap, she is claiming that this step-by-step she mentions has had a positive result... So shouldn't this success story count as evidence in favor of the product or service? Why is this way of arguing not considered scientific?

**Gláucia** - Hmm ok, you have a point, indeed it does count as evidence in favor of the product. But to conclude that because of this one piece of evidence the product works is not a scientific argument. This is basically because of the confirmation bias. When you promote an idea by saying "look, it's worked before", you're focusing on the positive history of that product/service. But what if the product has only worked once every ten times? Or once every thousand times? Or every million times? Would you still recommend something like that? Even a broken clock is right twice a day.

**Leo** - In the scientific method, we do exactly the opposite. We ask ourselves: is it possible that this idea is wrong? Is there any way I can show that this is wrong? How can I get evidence that it is wrong?

**Gláucia** - It sounds like a pessimistic way of interacting with the world, but there's a better word for it: skepticism. A scientist only believes in an idea after searching through experiments for all the possible weak points. That's what sets scientific ideas apart: to begin with, you have to be able to test them to see if they are false. In other words, for a theory to be scientific, it must be testable; for a theory to be scientific, it must be [plim]"falsifiable".

**Leo** - Here it's worth emphasizing that "falsifiable" doesn't mean "wrong" or "incorrect", it just means that there is a way of proving it in case it is incorrect. For example, the statement that 'your football team wins every time you wear the same shirt' is falsifiable. There's an experiment to test it: you just have to wear the same shirt to several games and if your team loses, it's proven false.

**Gláucia** - But if your team wins all those games, then you have evidence that you're on the right track, because, in scientific terms, we say that the experiment has corroborated your theory. It may sound strange, but not all ideas are falsifiable. For example, have you ever thought about hiring a quantum coach?

[radio static]

*"[...] an incredible workshop for you about quantum coaching, how we can use the principles of quantum physics in practical life to understand that our reality is the result of what we think, what we feel."*

[radio static]

**Leo** - If you're thinking about hiring someone like this, let me save you the money: the arguments of all the quantum coaches we've been able to follow on the internet go along the same lines: it's about thinking positively..., mentalizing..., co-creating a successful reality for yourself.

[radio static]

*"Because quantum physics explains that every thought changes your feelings and automatically changes your molecules, your molecules in your body, your atoms change completely."*

[radio static]

**Gláucia** - In other words, the basis of all this reasoning is the mantra: if you mentalise success, it will come true. In principle, this seems falsifiable, right? For example, we can put this to the test by doing the following experiment: we buy a lottery ticket and mentalise that we're going to win the prize. But what if it doesn't work out?

[radio static]

*“Then you may ask me why I never hit the jackpot? The reason is that you don't really believe that you can become a millionaire overnight. We're more conditioned to believe that we'll be mugged than that we'll win a jackpot.”*

[radio static]

**Leo** - Well, if it didn't work out, according to this reasoning, the explanation is simple, it's because you don't really believe, you didn't mentalize correctly. Because if you had, you would have won.

**Gláucia** - What we realize is that this mantra of positive thinking can't be shown to be false, because if the result wasn't as expected, it was a problem of execution. In other words, it's already assumed that this mentalisation always works. So, by definition, there is no experiment to prove that this idea is false. If you don't succeed, it's not a problem with the method. It is your fault [blunt].

**Leo** - This kind of idea which cannot be falsified is what we call 'infallible truth' [effect]. It's like a self-fulfilling prophecy, and we find it in quantum pseudoscience all the time. One of the founders of quantum theory, the physicist Wolfgang Pauli, has a famous phrase to refer to this kind of reasoning: [filter radio] "it's not even wrong". It's not even wrong, because it's the kind of thing that we cannot even prove if it is true or false. In other words, it's not the kind of idea you can discuss scientifically.

**Lu** - We also came across a situation that exemplifies an infallible truth, but in a somewhat unexpected way. To tell this story, we first need to talk about the 'Instituto questão de ciência', which is a non-profit organization whose main objective is to promote the use of scientific evidence in public policies. So, at the request of the 'Instituto questão de ciência', Marcelo Schappo, who has already appeared here in the episode, went on a mission to take part in a congress more or less like an undercover agent. Only it wasn't just any congress, it was a...

**Marcelo Schappo:** quantum health congress in order to see what this congress had to do with quantum physics and health.

**Lu** - But it soon became clear that...

**Marcelo Schappo:** it was basically a pseudo-science congress from start to end, so they're going to sell quantum florals to balance the vibrations of the kidneys, liver and I don't know what emotional state.

**Lu** - Beyond sounding dubious, at least to me, Marcelo tells us that in the middle of a lecture on the subject, someone raised their hand and asked:

**Marcelo Schappo:** but what if you have adverse reactions, taking that quantum floral and all?

**Lu** - In other words, the person wanted to know if this quantum floral could cause any harm. What do you think the speaker answered?

**Marcelo Schappo:** He replied that if any of your patients complain that they've had this, this or that bad thing after taking this quantum preparation that's given to them, you can tell them that you're not afraid of a lawsuit because there's no active ingredient in this stuff.

**Gláucia** - [sound effect] there is no active ingredient.

In other words, it's impossible for it to do any harm, because there's simply nothing there that can do anything. It cannot do any good either.

**Marcelo Schappo:** the guy openly told everyone in the auditorium: rest assured that it can't have any effect or any reaction because there's nothing in it.

**Gláucia** - Analyzing this argument carefully, we see that this speaker used and abused the infallible truth that the floral works only on the basis of positive thinking: first he convinces the buyer that the floral works because...

**Marcelo Schappo:** it would simply be a vibrational, energetic thing, there's nothing physically active there...

**Gláucia** - And precisely because of this argument, "there's nothing physically active", he's protected from any complaints from the client! No-one will have any evidence that a possible sudden illness was caused by the product. In fact, nobody will have any evidence of anything. And that's precisely why this is a pseudo-scientific practice.

**Leo** - So far we've brought up falsifiability as one of the main characteristics of science, but the truth is that this criterion, alone, also encounters some problems, both in a philosophical sense and in a practical sense. Starting with the more philosophical aspect, one of them is that a concept of science based on falsifiability will never determine that a theory is true. In that case, the best we can say about a theory is that it hasn't yet been proven false.

**Gláucia** - And this revealed a change in attitude towards science. The romantic view of science as the search for truth has been replaced by the search for what "passes all the tests for the time being, but may eventually fail". In other words, science is incapable of providing absolute certainty. This is a very uncomfortable thought. Human beings like to feel safe, we like certainties. Meanwhile, the seductive voice of pseudoscience always speaks confidently and promises wonders.

**Leo** - From a broader point of view, falsifiability is not enough to settle the question of what is scientific or not, partly because of the complexity of the scientific endeavor.

Especially in the last century and a half, there has been a scientific boom, in which science has expanded both its area of activity and influence.

**Gláucia** - So in the end, perhaps it's too much to expect that so much diversity can be captured by a single criterion, such as falsifiability. So let's bring another essential characteristic of science: it must be [plim] reproducible.

**Leo** - In other words, if an idea is true, it must be true whenever it is put into practice under the same conditions. That's why when we write a scientific article, we must always be explicit about the methods used, to make it clear how any other scientist could reproduce our results. This clarity is essential.

**Gláucia** - Going back to the idea that all you have to do is mentalize success and it becomes real, we can see that this is exactly what quantum coaches don't do. After all, it's essential for them to describe this mentalisation process as inaccurately as possible.

**Leo** - In addition, there are a few famous experiments that claim to prove, for example, the effects of the mind on quantum phenomena. In fact, this is an argument that pseudoscience always likes to bring: "there was that obscure experiment..." or "according to that one scientist...". The problem is that these are experiments that were done either in a not rigorous way, or that could not be reproduced by other groups. So we also see the importance not only of using the scientific method, but also of a robust and active scientific community.

**Gláucia** - Scientific knowledge is reliable because it has been corroborated by various independent groups, who have searched for flaws and have found none. This is what justifies the great authority we recognise in science. And that's why so many products and services want to brand themselves with scientific adjectives, such as the term "quantum".

[transition - cat]

## **BLOCK 2 – PSEUDOSCIENCE \*\*\*\*\***

[mattress scene entrance song]

**[Parallel scene]:**

**Seller:** Come with me and I'll show you the mattress options we have. [steps]  
We have two lines, the plus line and the premium line, the difference is that the premium line comes with chromotherapy and massage, but the quantum of the two is the same... Come here, let's test it out, this one is the premium, I've even put a pillow there for you

[mattress scene exit song]

**Lu** - Now that we understand some of the characteristics of science, it's worth asking the question in the other direction: how do we characterize pseudoscience? One of the people we spoke to about this is Thaiane Oliveira, who is a Professor of communication at the Fluminense Federal University. Thaiane has been researching misinformation and digital media over the last years.

**Thaiane Oliveira:** Pseudoscience can be understood as the use of elements that resemble the scientific method. It uses elements similar to scientific information and presents itself as supposedly scientific.

**Gláucia** - In other words, pretending to be science is a characteristic feature of pseudoscience, and this makes our task of separating one from the other very difficult. The result is that we find a lot of correct scientific information mixed up with more esoteric ideas.

**Leo** - Many of these things are even put in an eloquent and well-organised way. For example:

*“Sometimes they say but what's this quantum thing, that's it, oh I believe it, I don't believe it, does it work? Wait, don't you use ultrasound? Resonance itself, magnetic resonance, resonance is one of the quantum principles.”*

**Leo** - Well, calling resonance a quantum principle is already a stretch, but ok, so far it would just be this innocent mistake. But then the person says...

[radio static]

*“There are some techniques that are more, as we joke, that is quantum technology. I think it’s interesting to talk about the one that I’ve been practicing the most nowadays, which is quantum floral frequency therapy, right.”*

[radio static]

**Leo** - Frequential flower therapy has now completely entered pseudoscience.

**Lu** - Thaiane also draws our attention to the success of the pseudo-scientific segment on the Internet. According to her, they specialize in...

**Thaiane Oliveira:**[...] using strategies that are very specific to the platforms, right, so using the platform, using the visibility resources of the platforms, knowing about the algorithmic mediations themselves to be able to give more visibility and propagate....

**Lu** - This has to do with when you go on Instagram or Facebook and see people selling products and quantum therapies. Then you get curious and search for the subject on Google. And then, more and more, this is appearing in adverts, on your social networks and in advertisements on the internet as a whole.

**Lu** - We're not going to delve into the discussion about algorithms here in the episode, but there's a whole debate about the regulation of social media and their transparency.

**Gláucia** - And combined with this mastery of how networks work, there is also a commercial flair:

**Thaiane Oliveira:** There's a characteristic that has been very present in these movements, in these webpages, which is a real commercial interest, in other words, it's a commercialisation of hope, or of fear, a commercialisation of emotions in the digital environments that are formed from an understanding of how to build networks.



**Gláucia** - Commercialisation of hope... Can you imagine being seriously ill and being offered a so-called miracle drug? So, in my opinion, this is a very serious point, because when emotion is at play, when you're vulnerable, you often lose the ability to evaluate something objectively and rationally.

**Leo** - And going back to the previous point, it's even worse when this miracle drug is mixed with some scientific term.

**Marcelo Yamashita:** It's a need to bring credibility to what you're saying.

**Leo** - Here we heard Marcelo Yamashita, Professor of physics at UNESP and scientific director of the Instituto Questão de Ciência, the same institution that appeared here earlier, sending Schappo to the quantum health congress.

**Marcelo Yamashita:** So if at first you say that a clay filter with the words love and gratitude will cure you of illnesses, the person might laugh at you, then you won't be able to sell your product. But once you've constructed a whole narrative to involve the person who is listening to you within a context [...] that sometimes a particle behaves like a wave, that there is the wave-particle duality, and that sometimes Einstein had doubts and he died thinking that quantum mechanics was perhaps incomplete, then you involve the whole person in a story perhaps of mystery, of curiosity.

**Gláucia** - All those things Yamashita mention are legitimate, there really is such a thing as wave-particle duality, Einstein even had doubts about quantum theory being complete. By the way, don't worry if all these scientific terms don't make sense to you now, we'll talk about them later on the podcast. The point here is that adding these peculiar elements makes the clay filter narrative more convincing. Even if one thing has nothing to do with the other.

**Thaiane Oliveira:** So that's a big distinction and it's a characteristic [...] of what pseudoscience is, this attempt to be similar, to look like science, whether through the use of jargon, the use of elements that denote a scientific relation or even using the communication characteristics of scientific methods themselves to validate themselves as scientific.

**Gláucia** - Beyond language and legitimate concepts, pseudoscience often replicates science's own structures. Pseudoscientific magazines, journals, study centers and postgraduate courses are created. In fact, some of these courses take place within public universities, which are the country's largest scientific centers.

**Lu** - We've seen here that there are even conferences, right? Like the one Marcelo Schappo attended. In other words, if you thought that quantum health is a serious scientific topic because there are specialization courses and congresses with "experts", we have bad news, because the hole is further down...

[transition - cat]

### **BLOCK 3 – CHARLATANS AND DANGERS OF WELL-INTENDED PSEUDO**

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[mattress scene entrance song]

**[Parallel scene]:**

**Samara:** Can I put my feet on?

**Seller:** You can, no problem.

**Samara:** But it won't get dirty.

**Seller:** No, but this one is supposed to get dirty... Now I'm going to switch on the quantum, ok?

[mattress scene exit song]

**Pablo Saldanha:** You can even say that positive thinking will improve your life in various ways, going into psychology and so on, for things that have nothing to do with quantum physics, that's fine. But if you use quantum physics to try to support it, in a non-scientific way, then it's very bad. And if you do it to make money, then it's much worse, then it's charlatanism of the worst kind.

**Leo** - I think this statement of Pablo Saldanha, physicist from UFMG who appeared here earlier, represents one of our greatest motivations for talking about quantum theory to the general public. We spend years studying these ideas, during our undergraduate, master's, doctoral and post-doctoral studies, you know, they are

ideas that we have learnt not only to appreciate but also to respect, which are valuable for explaining the world in which we live. So I confess that I take it a little personally when someone comes along and distorts these concepts in order to make money out of it.

[radio static]

*"[...] in this course you will have the opportunity to receive more than 25 Atlantis quantum commands [...]"*

[radio static]

*"Today I want to show you how you can make a quantum leap in your mind."*

[radio static]

*"So if you've heard that there are courses on how to utilize quantum principles in practical life, you can believe that this is possible."*

[radio static]

**Leo** - We know that many people who consume and disseminate pseudoscientific ideas have good intentions. But there are also people who exploit these ideas with malicious intent and for their own benefit, who are really charlatans. It turns out that it can be very difficult to unmask a person like this, even when we know that it is charlatanism.

**Gláucia** - There is a true story involving several scientists, a magician and a mystic that illustrates well this difficulty of dealing with charlatans. But we tell you about that another time. For now, we want to draw attention to the fact that, if on the personal side you have complete freedom to sympathize with these ideas and consume these products, on the other hand, on the collective side, on the side of how to structure our society, even well-intentioned mysticism poses serious risks. Thaiane Oliveira, a communication professor at UFF who appeared here earlier, talked to us about these risks.

**Thaiane Oliveira:** There are lots of them, right. I'll name a few. Firstly, I think it's disbelief, the loss of credibility of the science institutions themselves, teaching, research and scientific production...

**Gláucia** - Scientific reasoning is a great tool for opening our minds and exploring new ideas. But beyond this intrinsic value, there are very real developments that depend on science.

**Leo** - We've just been through a pandemic, and it's very clear that if scientific institutions were stronger, if there was greater demand for a government based on science rather than on proven ineffective treatments, the number of deaths would be radically lower. By the way, since we've mentioned health and ineffective treatments... here is Marcelo Yamashita again.

**Marcelo Yamashita:** But when you go to the health side of things, it's a little more dangerous, because people can eventually give up some serious treatment because they believe in these ineffective, pseudo-scientific treatments, and then their health condition gets worse.

**Gláucia** - In fact, there are studies showing that people who resort to alternative treatments, such as quantum florals with no active ingredient, are more likely to abandon conventional treatment, which is carefully tested and based on evidence. Marcelo Schappo adds...

**Marcelo Schappo:** So there are patients who cope well with both, they do Monday, Tuesday and Wednesday a conventional treatment and Thursday and Friday an alternative treatment, yes. There are these types of patients, but those who do this tend to abandon conventional treatment more easily. And that's one of the dangers.

**Leo** - And from a more concrete point of view, we also need to think about the health of our pockets.

**Marcelo Schappo:** So our daily sweat, the work that it takes us so long to get there, in a while we'll go and buy a little rubber bracelet with a quantum hologram that costs R\$250 and doesn't give you anything that it's offering. The claims are unfounded. So it's not just a danger to health and well-being, but it's a financial danger, we're putting our health at risk and we're putting our finances at risk.

**Leo** - Speaking of financial danger, perhaps even more serious is when it involves public money. We must emphasize here that a large part of scientific activity in Brazil and around the world is financed by public funds, which must be managed responsibly. Here, Yamashita again.

**Marcelo Yamashita:** It's actually important that the population knows where their money is being invested in, so public institutions are paid for with the taxes of citizens. So it's important that we give back to them, to society, to the population, what we're doing, as an accountability, you know.

**Gláucia** - And that's different from everyone's choice of how to manage their own money. And Schappo emphasizes that we need to ensure that people have access to the right information so that they can make better decisions.

**Marcelo Schappo:** A lot of people are looking for these treatments and they're not aware that these treatments are not evidence-based. So here's the thing, we need to clarify it so that if the person decides in favor of any of them, then they decide at least in the most enlightened way possible. And then, if they want to take the treatment without an evidence base, ok, that's their problem. But not in the public service. The public service has to offer the best for a very simple reason: the money is limited.

**Leo** - Investment in science and technology is essential for the development of any country. After so many investment cuts like those that have occurred in recent years, it is more than ever essential that these amounts are well invested. And investing well, in this case, is investing in research that is well-founded by science. [blunt]

**Lu** - To close this discussion about quantum products and financial dangers, we want to invite Samara Wobeto, who is a producer here on the podcast, to the table. Throughout the episode, you heard excerpts from a visit she made, together with Vitor Zuccolo, who is also our producer, to a quantum mattress store. Listen to her there.

**Samara** - Hey everyone. So, Vítor and I visited some mattress stores that Vítor found in a Google search, to try to understand how quantum works in products. In the first store we visited, the salesman talked about quantum, but he also talked a lot about magnets and electromagnetic fields, things like...

[radio static]

**Seller:** The magnet is in nature, it is in the earth. But we lost a lot of contact with the magnet, [...] due to the shoes, due to the asphalt.

[radio static]

**Samara** - According to him, it was important to have a mattress with magnetic technology because magnets realign iron ions both in our body and in other things, such as water.

[radio static]

**Seller-** You compare, you take two glasses of water, one you put on top of the magnetic field, the other you don't. Then you drink both waters, it's the same water, one is light, and the other seems to go down square.

[radio static]

**Samara** - But until now the salesman hadn't reached the quantum yet, right? Which was what we were most interested in. Then he asked us to lie down on one of the mattresses, which was the most VIP, and he was going to show their quantum technology in practice...

[radio static]

**Seller-** Yes, it will have radiofrequency, which is quantum, there will be chromotherapy in this one and there will be massage, okay? I'm going to turn on the quantum one first, because it's the big one.

[radio static]

**Samara** - The salesman pressed a button on the control, turned on a light and... nothing. Just that little light on there... But then he said that quantum is silent and explained some things like:

[radio static]

**Seller:** Quantum is the same, okay, there is no weaker or stronger quantum.[radio static] The frequency it is emitting is between 50 and 60 Hz, this is the frequency that the mattress emits.[radio static] Here I'm talking about power treatment, right, here I'm going straight to the cell.[radio static] This tablet here is a natural anti-inflammatory.[radio static] It is long-wave infrared.

[radio static]

**Samara** - And although this was the most memorable visit, it's not very different from what we heard in the other stores we visited. And then to finish, we asked about the prices, right? The budget for the cheapest mattress she gave us was more than seven thousand reais. So we see in practice this financial danger that you were talking about before.

**Leo** - Thanks Samara! It's cool that we bring this true case from the mattress store here, because it illustrates well the difficulties we have when analyzing a product that claims to be quantum. For example, although much of what the salesman says is nonsense, we come across a lot of scientific terms, so many that it becomes a mess: he talks about radio frequency, iron ions, electromagnetic force, 50 hertz... quantum is just another word in this whole mix. And this situation is similar to the situation in the book that my mother gave me, which I told about at the beginning of the episode: a bunch of difficult words, which in isolation have a scientific meaning but which appear all mixed together in a somewhat meaningless way, like if the goal was really to confuse and impress people. This messy discourse ends up being difficult to combat precisely because it is diffuse.

**Gláucia**- xactly, it's even difficult to understand what claims are being made, in order to be able to explain what's wrong. So in a nutshell, what we can conclude from this case is that, from a scientific point of view, none of this makes much sense! There's no quantum effect working as an active principle in that mattress. But we want to go beyond this short answer. So in the next few episodes we're going to explore some of these scientific concepts that appear mixed with pseudo-scientific ideas and products, so that we can understand which of these ideas make sense or not and why.

[transition - cat]

**CLOSING \*\*\*\*\***

**Gláucia** - We're coming to the end of the episode, and you may have realized that so far, in this podcast about quantum theory, we've basically explained nothing about... quantum theory.

**Lu** - That's not by chance, we planned this episode just to present the main ideas of pseudoscience and quantum mysticism, and to understand why the arguments behind these ideas are very different from scientific thinking.

[identity track - bass and congas]

**Leo** - We've already said that these ideas are not supported by quantum theory. But the fun is to understand: why on earth would anyone talk about quantum consciousness? The quantum vibration of success? Why would coaches be quantum? Where does this association come from? And the most interesting thing about all this is that... in fact, there are legitimate elements of quantum theory mixed in at the core of these ideas.

**Gláucia** - These concepts and these relationships are what we want to tell you about. We'll start in our next episode, where we'll talk about quantum theory, the emergence of the theory and how it is present in much of the technology you use on a daily basis.

**Lu** - I invite you to listen to Episode 2: I have a theory.

**CREDITS \*\*\*\*\***

[identity track - drums, then bass and piano]

**Leo** - We will leave some recommendations on our website if you want to know more about some things that appeared here in this episode. You can find this extra



material, including the episode transcript and the English translation, on our website [www.ufsm.br/oqquantico](http://www.ufsm.br/oqquantico).

And if you liked the episode, you can help us by recommending it to friends who are interested in the topic. Also follow the podcast on Instagram @oqquantico.

**Lu** - The mattress store scene was reproduced from a real situation that Vitor and Samara experienced. To preserve the salesman's identity, the scene was recreated and in the episode the seller was played by actor Felipe Dagort.

**Gláucia** - In this episode you heard excerpts from interviews with Pablo Saldanha, Osvaldo Pessoa Jr., Marcelo Schappo, Thaiane Oliveira and Marcelo Yamashita. We thank all our interviewees.

In the episode we used excerpts from YouTube channels: elainne ourives, tiago benevides, unknown facts, TV unesp, William sanches and the podcast quantum physics in real life.

**Lu** - O Q Quântico is presented by me, Luciane Treulieb, Gláucia Murta and Leonardo Guerini

In addition to the three of us, Samara Wobeto and Vitor Zuccolo complete the Podcast's team of producers

The script for this episode was written by me, Leonardo Guerini, and Samara Wobeto, with contributions from Gláucia Murta

The Project was conceived by Leonardo Guerini and Gláucia Murta

The script consultancy is carried out by the team from the Ciência Suja podcast

Sound editing is by Leonardo Guerini, Vitor Zuccolo and Mateus Scherer

The recording support is by Pablo Ruan

The original music is by Pedro Leal David

The visual identity and cover illustrations are by Augusto Zambonato

Milene Eichelberger takes care of social media

And our website was developed by Daniel Carli

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**Lu** - Thanks for listening and see you in the next episode!

[transition - cat]

**POST CREDITS CAUSE** \*\*\*\*\* \*

**Marcelo Schappo:** and I'll tell you what, look how interesting it is, I took a photo of this congress, it's like a behind-the-scenes curiosity for you, I took a photo of this congress to show "look, I'm here", and I took a photo of the public in the auditorium and in that photo the conference bag appeared, which is also classic, right, anyone who's ever been to a scientific congress knows that the little material you get there, the conference bag, which had the name of a company that sells these florals, which I won't mention here logically, but there was the name of a company and a photo of the famous [...] which is another classic name in quantum physics. So it was this photo that appeared in the article I wrote for the magazine 'Questão de Ciência'. A few days after the article was published, I received a message from someone from this company saying "look, I'm going to sue you" I hadn't even understood why we were going to be sued because I hadn't mentioned any company, I hadn't mentioned any speaker, "ok but come here, what happened? I didn't mention any company," I replied, "No, in the photo that appears there's the name of my company". So look how interesting it is, you have a company that sponsors a pseudoscience congress and then you don't want your own company to be associated with this kind of discussion, what a curious thing.

[cat]