



Bit Quântico 5: GABRIELA BARRETO LEMOS AND FISH OUT OF WATER

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[bass intro]

Gláucia - Hello everyone, I'm Gláucia Murta and this is the podcast O Q Quântico. [congas] We're starting another bit quântico and today we're going to tell the story of Gabriela Barreto Lemos, who pursued a path both in theory and experiments, and who along the way came across several Nobel Prize winners. And Gabriela, in addition to being a great scientist, is also a great storyteller, as you will soon discover.

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Gláucia - Gabriela Barreto Lemos is currently a Professor at the Physics Institute at the Federal University of Rio de Janeiro, but she is from Minas Gerais and began her studies at the Federal University of Minas Gerais. In fact, you may have already noticed that most of our interviewees have some connection with UFMG. This is no coincidence, since both Leo and I did our PhDs there and we met during that period. Well, to start telling Gabriela's story, we asked how she became interested in quantum physics.

Gabriela Barreto Lemos: Hmm... How did I become interested? I wanted to do cosmology, actually. And at UFMG, at the time, there was no cosmologist, there was no one to guide me during my undergraduate studies. So I went to talk to the course coordinator, right?

Gláucia - This story begins in the early 2000s. At that point, Gabriela was already studying Physics and was trying to enter a more specific area of research. And since there was no one to guide her in cosmology, the course coordinator suggested another direction.

Gabriela Barreto Lemos: So he suggested that I look for Professor Maria Carolina Nemes, who was working, at the time, with particle physics.

Gláucia - Professor Maria Carolina Nemes is a very important and beloved name in the Brazilian physics community. I had the pleasure of taking a quantum class with her, and look! I can say that it was inspiring to hear about quantum from someone who loved so much what she did. Maria Carolina passed away in 2013 and in her honor the Carolina Nemes Prize was created, for female physicists at the beginning of their careers whose research work has contributed significantly to the advancement of physics or physics teaching in the country. But going back to Gabriela, she went there and talked to Maria Carolina, and decided to start studying particle physics with her. This was at the end of the semester, right before Gabriela went on vacation.

Gabriela Barreto Lemos: And when I came back from vacation she said, “look, there's something that's making me much more excited than particle physics. Something that is making me feel like this, losing my sleep.” And that was Serge Haroche's experiments.

Gláucia - Serge Haroche is a French experimental physicist, who at that time was developing pioneering techniques to manipulate and measure quantum systems. These techniques led to him winning the Nobel Prize in Physics in 2012, and they

were based on trapping light, that is, trapping photons, between mirrors, in what we call a cavity.

Gabriela Barreto Lemos: He could see a Schrödinger's cat situation in the cavity, where you have an atom entangled with the photon in the cavity. So he was creating Schrödinger's cats.

Gláucia - We haven't yet explained what entanglement is here on the podcast, but in Episode 6 we'll talk a little about it. For now, don't worry if you don't know what "an atom entangled with a photon" means, the important thing is that the Professor who would guide Gabriela, Maria Carolina Nemes, was in love with it.

Gabriela Barreto Lemos: And I fell in love too. I read Serge Haroche's articles, then I started with quantum optics and quantum theory from there.

Gláucia - But why did this interest Gabriela so much?

Gabriela Barreto Lemos: I was interested because these are phenomena that were happening there, which don't make sense in our logic of thought in physics, which we call classical physics. So, actually, that, that was the big question, right, like, it's a bit like Alice in Wonderland, in a way, when you read a work like that, in undergrad, for me, I felt like Alice who had, you know, gone down that hole and had found phenomena that were completely crazy, you know, and fascinating, fascinating... but that didn't make sense outside the hole, right. And I wanted to live in a world that was like that, you know, my revolt is that I couldn't see quantum phenomena on a daily basis, so I wanted to understand why? Why?

Gláucia - So that's how Gabriela did her scientific initiation with Maria Carolina and then her master's degree as well. But then the time came to decide what to do for the PhD.

Gabriela Barreto Lemos: Then I really wanted to leave Minas Gerais and I even applied for a lot of scholarships abroad, and I received a lot, a lot, a lot, a lot of no. And many, more than receiving many no's, many ignoring things. The only email that was very beautiful, that we sent to a physicist called Claude Cohen-Tannoudji, who is a Nobel laureate.

Gláucia - Claude Cohen-Tannoudji is another French physicist, born in Algeria, who won the Nobel Prize in 1997 for experimental techniques to manipulate atoms using lasers, in a process called atom cooling.

Gabriela Barreto Lemos: And he sent such a beautiful email reply, because he knew Carolina's work, look how cool, and she was so moved by this email. He said, "look, I retired", right, super elegant email like that and saying that he knew her work, that he respected her work a lot and that he had just retired and that unfortunately he couldn't get more students, but we were supposed to write to a former student of his called Alain Aspect, who today, at some point I think he will win the Nobel Prize, who is a guy who does a beautiful, beautiful, work.

Gláucia - This interview with Gabriela took place in mid-2022. And isn't Gabriela a lucky charm? A few months later, Alain Aspect actually won the 2022 Nobel Prize in Physics. But don't worry, because when she received the suggestion to contact him to possibly do a PhD under his guidance, the year was still 2005. Did it work?

Gabriela Barreto Lemos: And then we wrote to Alain Aspect, who never responded. And then I finally said I'm going to Rio de Janeiro, because there's a very famous guy there, Luiz Davidovich...

Gláucia - Luiz Davidovich is Professor Emeritus of Physics at UFRJ and a big name in quantum optics in Brazil. Today he has also dedicated himself to important political and management positions: for example, he was president of the Brazilian Academy of Sciences between 2016 and 2022. But his career as a physicist was very prominent, and he also collaborated with important names in the international scientific community.

Gabriela Barreto Lemos: ...who even worked with Serge Haroche a lot on these experiments, doing the theoretical part. And then I came to Rio, and there's something interesting: when I took the exam...

Gláucia - The exam that Gabriela refers to here is the selection test to enter the doctorate.

Gabriela Barreto Lemos: And I was a very good student, but I messed up, it's something I do a lot in exams, like, it's scary, then I didn't do so well in the exam, so I passed, I passed with a scholarship, but I didn't pass, like, in the first few positions, and then, I couldn't get Luiz Davidovich to supervise me, but he suggested a young man called Fabrício Toscano.

Gláucia - Fabrício Toscano remains firm and strong as a professor at UFRJ, but he works in an area called quantum chaos, and this was not exactly the area in which Gabriela had planned to work.

Gabriela Barreto Lemos: But in the end, we managed to sort of align our ideas, Fabrício and I, and we then studied quantum systems in contact with environments where there were chaotic dynamics. And then, at the end of the doctorate, Fabrício and I made an experimental proposal. Generally, the theorist makes the experimental proposal and hands it over to the experimentalists to carry out, right, however, when I went to hand it over to the experimentalists to carry out, Professor Paulo Henrique Souto Ribeiro...

Gláucia - Paulo Henrique Souto Ribeiro is now a Professor in the Physics Department at the Federal University of Santa Catarina, but at the time he was head of the laboratory at UFRJ, which is on the island of Fundão. But he said that there was no one to carry out this experiment that Gabriela was proposing, everyone was already busy with other projects. But, if Gabriela was really interested, they had the equipment there and she could try to do the experiment herself.

Gabriela Barreto Lemos: So I said, oh, you know what, I'm going to do this experiment. Guys, I got there at the laboratory, it was a tiny laboratory, it was like this, it's a table against the wall, the optical table, tiny, there was a little space, and there was only a little corridor for you to walk, right, and access the table, and there I put a computer and Paulão, he arrived at the door, he is very big...

Gláucia - Here, Gabriela is talking about professor Paulo Henrique Souto Ribeiro, who is also known as Paulão...

Gabriela Barreto Lemos: So, he arrived at the door, he didn't even go in, there was only room for one person in there, and no Paulão could fit in there at all, and I remember that I was so uncomfortable that that laboratory was so dry that I took a bunch of ... because labs are dark, they're not that big... so I printed out a bunch of images of Monet's gardens and covered my lab with Monet. So it was a laboratory that had nothing to do with the other laboratories in Fundão, which were all dry and large, but without... and I created a super cozy environment there.

And then I discovered that experimentation is really a matter of detail, of doing things very detailed, like this, calmly, rotating and so on. Then I started to play music, then you start to relax, and you start to do things calmly, with patience, little by little. And then Fabrício was like, "Gabriela, it won't work, because we need a distance between the lens and the mirror of 12.4532 millimeters, it won't work, this system is chaotic". Wow, I was desperate, it won't work... The lens, I said it was a thin lens, but the lens is a centimeter wide, guys, help, I'm going to have to change all my calculations.

Gláucia - Unlike theory, practice, the experiment in the laboratory is full of obstacles and difficulties that we cannot even imagine. Then think about what happened to Gabriela, who only had theoretical training!

Gabriela Barreto Lemos: Then the guys put up with all my hysteria, and Paulão put up with it too. I almost burned the equipment, and I went, wow, I learned the details of experimental physics and it worked, like that. In the end, one of Paulão's students helped me more with the experiment, he joined the

work, but basically, that thing went by leaps and bounds for me, like that. And in the end, what I learned is that it works. Surreal. So those details about the size of the lens, the distances that are not perfect and so on, even with all that, we managed to see, wonderfully, the phenomenon that I had imagined, you know, it came here, it was very beautiful, it was like, wow, when the figures came out, what beautiful figures, and that was when I did my first experiment.

Gláucia - This whole saga, going from theory to experiment, passing through the cramped laboratory with Monet's gardens, is more or less the summary of Gabriela's doctorate. The next stage is the post-doctorate, or post-doc, for those familiar with it.

Gabriela Barreto Lemos: And then when I went to the postdoc, I wanted to go back to theory, because I found it more interesting... I wanted to get out of that dark laboratory. And I applied to a lot of places, a lot... Then, again, either I didn't receive an answer, or I received a no. Then I was in Bolivia, on a backpacking trip in Bolivia, and then I stopped at an internet café, at one time, on December 31st, I remember exactly, and I went to check my email, you know that thing? Then there was an email from Paulão saying "look, this vacancy has opened for a scholarship there in Vienna. But the deadline is December 31st", and he had sent that, I don't know, on the 28th, I don't know.

Gláucia - In other words, on December 31st, in the middle of a backpacking trip in Bolivia, Gabriela found out about a postdoctoral position in Vienna, Austria, with the deadline to apply for it being December 31st. But as you can already see, Gabriela is not one to be intimidated. Right away she told her friend who was there with her to go get a coffee because she needed to apply for a postdoctoral position.

Gabriela Barreto Lemos: So I went there, applied, applied like this, in the dark, completely, shooting in the dark, I wrote what I could there, a letter of intent, a study plan, everything at the internet cafe, then I came back, finished my trip to Bolivia, and so it worked. It worked because when I was on another trip, in Mexico...

Gláucia - We are listening to Gabriela travel to various places: Rio, Bolivia, Mexico... in the case of Mexico, the reason for the trip was to participate in a conference. The academic world is complicated in many aspects, but on the other hand it also makes it possible to make some spectacular trips from time to time. So after the conference, Gabriela took a few days of vacation, on a beach in the state of Oaxaca.

Gabriela Barreto Lemos: Then I get an email saying, look, we want an interview with you for this thing you applied for in Vienna. But it's like this, this week. "Guys, I'm in Oaxaca", "no, but it has to be this week". So I stood there by the pool, with my laptop and made the call, and there were several Professors on the other side. All the Professors in the Vienna Quantum group, which is a large group, with several Professors. And I, like, with my clothes, tried to put on some blouse that looked less like a beach vacation. I went outside and did the interview... and the call failed... and you wouldn't believe it, the battery ran out in the middle of the interview. And I was, you know that thing that is only at the top, like this, tidy, at the bottom, are you still like a beach style person? And I ran around the inn with this laptop to look for a cable. And it worked, and they asked me to go to Vienna that week.

Gláucia - So that hurriedly prepared documentation there in Bolivia and the interview carried out in the pool at the inn in Mexico turned out to be successful. And in 2012, Gabriela won a very prestigious postdoc scholarship to work in Vienna with a researcher called Anton Zeilinger. We said that Gabriela was a lucky charm, right? By coincidence (or not), Zeilinger would also win the Nobel Prize in 2022, along with Alain Aspect, who appeared here in the story before. But despite her success in getting the position, that didn't stop her from feeling like a fish out of water in Vienna.

Gabriela Barreto Lemos: This scholarship, I only discovered later, was very prestigious. I don't know how I got it, I don't know, because I didn't have the CV for this scholarship. Didn't they make a mistake? Did they not change my resume with another person? So, I was a total fish out of water, like that. I was like, what am I doing here? What am I doing here?... Then I understood later, I got to know Zeilinger better, and because I was so excited, he said, I know that you don't have much experience, no, you're going to learn!

Gláucia - And she really learned. After being very successful in this postdoc in Vienna, Gabriela was a resident scientist at the Art Institute of Chicago school, in the United States, where she even had the challenge of teaching quantum physics to Fine Arts students, after which she did another postdoc at the International Institute of Physics, in Natal, Rio Grande do Norte, and was a visiting professor at the University of Massachusetts, in the United States. Today Gabriela is a Professor at the Federal University of Rio de Janeiro, a member of the Justice, Equity, Diversity and Inclusion Commission of the Brazilian Physics Society, and mother of Fidel, who was born in April 2023.

Gabriela Barreto Lemos: Kind of crazy, right? This story.

Gláucia - Well, it's important to say that Gabriela has always been a great student, as well as a super hard worker, as we saw... but even so, in this final part when she talks about the Vienna scholarship, when she asked herself “what am I doing here?” and felt like a “fish out of water”, we see that even excellent professionals can end up doubting themselves. The so-called imposter syndrome is a phenomenon in which people feel like frauds, doubting their abilities, and questioning their talents and achievements. Imposter syndrome can affect professionals at different stages of their career and is quite common among students who have just entered a new academic environment. In my case, the impostor syndrome started to hit when I stopped being evaluated by exams and started being evaluated by CV, where now the counting of points is more subjective. Today I can deal with this feeling better because the years of experience have shown me the value of the different particularities of my trajectory. [congas] Science is a human endeavor, and therefore should not be restricted to being carried out by a group of people with a specific profile. The different trajectories, which reflect different cultures and ways of thinking and learning about the world, only contribute to the advancement of science, and perhaps that was exactly what the committee for the Vienna postdoc scholarship was looking for when they selected Gabriela.

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Well, Gabriela's story shows us that, in addition to hard work, it's important to aim high for our goals and keep trying, even after several no's, even with insecurities,

and go for it, even if sometimes we are dressed from the waist down in a “beachy outfit” and other times we feel like a “fish out of water”.

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