A Conversation with
Anna Beliakova

Anna Beliakova is a full professor of mathematics at the University of Zurich. She was born in Minsk (Belarus) and completed her doctorate in 1994 under Professor Robert Schrader at the Free University in Berlin.

Her areas of expertise are topology, in particular knot theory, as well as quantum invariants and their categorization.

In 2011 Prof. Beliakova developed a unified theory of quantum invariants for the 3-dimensional homology spheres in collaboration with Le and Bühler. Later, she introduced horizontal tracks in bi-categories, which she used in 2016 for the construction of the Khovanov-Homology in rings.

In 2007, Anna Beliakova founded the Junior Euler Society at the University of Zurich, which promotes students' interest in mathematics. Since 2018 she is co-chair of the SwissMAP Equal Opportunities Committee.

- Could you say some words about your career? What were the decisive points and/or difficult choices?

The first very important point, perhaps not only in my career but in my whole life, was the fall of the Berlin Wall. At that time, in 1989, I was visiting a friend in eastern Germany, and suddenly the wall that we all thought would be forever, fell down. I went to the other side and asked a professor at the Free University Berlin for a PhD position. Actually, at that point my English was not good enough to fully understand his answer, but I understood that it was rather positive than negative. That is how I obtained my PhD position in Berlin, and had this great opportunity to continue my studies. So this was a major event that determined both my personal and professional lives.

The second turning point happened when I was around 30 years old, with my 3rd postdoc and two small children. I was living in Basel and my husband moved to the region of Zurich because he found a job there. During the weeks, I was alone with two small kids, and with very unclear career chances. At that point I decided to reduce my position in Basel to 20% and join my husband in Zurich. We put our kids in childcare in the canton Schwyz, which was completely unusual in those times. I had to take an additional teaching job at the Technical School in Rapperswil to pay for the childcare. Looking back, this was the right decision. It allowed me to work on my habilitation from home, and after a while I got the SNF professorship and finally my current job at UZH.

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- Could you tell us about your field? What are the exciting things happening there at the moment?

I am a quantum topologist. This is an interdisciplinary domain, where we are using ideas from mathematical physics to produce topological invariants of braids, links or 3-dimensional manifolds. At the beginning of the century these invariants were categorized. This means we could lift polynomial invariants to chain complexes. The most exciting feature is that the surfaces connecting knots in 4D induce maps between these chain complexes, so we gain insides into 4-dimensional phenomena through categorization. My dream is to categorize 3-manifold invariants.

- What were your most exciting or rewarding research experiences?

For me the latest one is always the most exciting. After I've understood the problem, I am usually not as interested as I was at the beginning. So for the moment I am really excited about my current project: find a description of 3-manifold invariants that admits a categorization.

- What is, in your view, the right balance between creativity and hard work in mathematics?

I think this depends a lot on the person. There are people who can just be sitting in a chair, thinking about something and get a great idea. For me that doesn't work. I need to work hard in order to get ideas. And then selecting the right one from all these ideas is again hard work. Sometimes, you write a paper without years of working just because you profit from the thoughts you had before. But I would not say that ideas come for free.

As an anecdote, I heard about a mathematician for whom the environment was very important. Once he got a great idea standing on a specific mountain in the Swiss Alps. And apparently, you can meet him there every day because he's still waiting for the next great idea that will change his life. So people work in different ways.

What I really appreciate a lot in mathematics are collaborations, where we exchange ideas and motivate each other. I do much better in collaboration, speaking with people, than when sitting alone in my office. And this is where I have a lot of fun in my job. For me personally, collaboration is the best way to produce new mathematics.

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- Many people in the general public have little or no idea about what mathematicians do. What, in your view, can we do to sell our subject better?

This is clearly a challenge because the problems we are working on are usually not simple to describe. But on the other hand, it is impressive how little the public knows about mathematics. If I tell someone I'm a mathematician, the first reaction is usually, "Oh, you should be very good in multiplying big numbers!" If I say that I am doing research they ask, "Are there any open problems in mathematics?" So we definitely need to change this view on mathematics.

Another typical question that even students of mathematics ask is, why use something in dimension N when our real world is three-dimensional? Here I usually explain that when you wake up in the morning in a good or a bad mood, it might depend on your last conversation with your relatives, the well-being of your friend, what you ate yesterday, and so on and so on. You could easily come up with a list of 10 parameters just to explain how you feel today. And of course, a mathematical model that could predict how you feel tomorrow will not only depend on just 3 parameters. Cambridge analysts for example, represented a person as a point in a seven-dimensional space. And apparently, this is a quite good approximation of how we function by elections.

What we should make clear to people is that a lot of things around us are based on mathematical models. And they work, because the mathematics was well understood and even simplified down to clear and fast algorithms. We are profiting from this every day. Like Siri which is nothing more than an artificial intelligence which is again a good algorithm that works. We see this everywhere be it money transfer or the medical industry. All these things exist and work because the mathematics behind them is completely understood.

This is probably our job to stress this point and to show how important it is to further develop mathematics in order to have a leading position in technology and to be competitive with other countries. It's really a key point.

It is important for us to make an effort and to speak with people from neighbouring fields. In SwissMAP we have this possibility.

- What did SwissMAP change in your research life?

SwissMAP is great. I was never supported as much as during the years since SwissMAP was created. We have unique possibilities to organise conferences, invite colleagues, hire postdocs and even organise some special activities for female mathematicians that help them to develop their careers. This is an amazing opportunity, and it has enriched my research quite significantly.

- What in your opinion could promote or encourage cross-project collaborations within SwissMAP?

This is not just a SwissMAP problem, but one we see everywhere in science. For example, people in algebra and geometry would usually not collaborate. The way mathematics was developed in the past was by dividing fields and isolating problems to be able to solve them. We are used to dig deeper and deeper holes, to become more and more specialized to produce new results. This is a successful strategy. But even deeper results may come from a broader perspective; therefore it is important for us to make an effort and to speak with people from neighbouring fields. In SwissMAP we have this possibility by organizing conferences that border on different domains and by meeting colleagues from physics.

I have learnt a lot since the beginning of SwissMAP. For example, on a conference organised by Grigory Mikhalkin in Tessin last summer, I heard lectures on enumerative geometry and tropical knots and then used their methods in my research. I also learned about theoretical physicists view on the categorization of 3-manifold invariants in one of the SwissMAP conferences.

I think just making people talk to each other is already a lot. In order for this cooperation to go further, we probably need a few more years where we continue to talk to each other and organise more of such interdisciplinary activities. It is probably too optimistic to expect an immediate result here.

Speaking to the public is quite similar as speaking to colleagues from neighbouring fields. This effort should be valued and appreciated more. For example, I have just read the book "Love & Math" by Edward Frenkel. I really see this book as a serious effort to popularise a certain mathematical program. The author reached a broad mathematical audience and in so doing, contributed to the success of this program. This definitively deserves some recognition.

- As co-chair of the Equal Opportunities Committee in SwissMAP, what plans do you have to encourage female researchers and young families in science?

We've already had a few very good things implemented, like the program that encourages professors to hire women PhD's and postdocs, by paying 50% of their salary through SwissMAP. We are reimbursing childcare costs during conferences for SwissMAP participants, etc.

In 2019 we launched a new mentoring program. The idea is to fix the "leaky pipeline", i.e. to encourage talented young people especially women to continue their research career. On the SwissMAP website, we collect short CV's of the mentors, showing each other's experiences and areas of expertise as well as explain where they can help especially well. In this way our young researchers may choose mentors that best suit their needs and profit from their experience. I'm really looking forward to this program.

Corinna Ulcigrai is also organising a women lunch in Zurich, where female mathematicians can chat, exchange experiences and also help each other.

Finally, we are currently implementing a new hiring policy in SwissMAP aiming to reduce bias in the hiring process.

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