100 years of relativity and enthusiasm for bringing science to public

November 25 2015, by Lionel Pousaz

Time and space are celebrating their 100th wedding anniversary. To mark the centenary of relativity theory, Anais Rassat and her cross-Channel accomplices have put Einstein front and center in an entertaining animated film. The EPFL physicist explains her approach.

On November 25, 1915, Albert Einstein presented his theory of general relativity at the Prussian Academy of Science. Time and space became just two sides of a single coin, and we never saw things in quite the same way again. The Universe got a birthday with the Big Bang, GPS satellites that use the same equations could be developed, much to drivers' delight, and the portrait of the physicist sticking his tongue out has become the iconic image of the genius. Today, Anais Rassat and her colleagues are launching an animated film to explain the theory to the public.

This isn't the EPFL physicist's first shot at communicating difficult scientific concepts to the layperson. That happened in Hyde Park, where she took to a podium amongst all sorts of religious orators and political satirists. She has been a Huffington Post contributor, lead of Euclid's education and public outreach activities Project, a member of the TedX Paris committee, a LIFT conference participant… In short, she combines her passion for research with her vocation as a scientific communicator, and explains the reasons behind her commitment.

Physicists are saying that the 100-year mark of general relativity is not just another birthday. Do you feel this way?

Anais Rassat: This was an extraordinary moment in science, one that changed the world. For a century, or nearly a century, relativity has been practically unassailable. It gave a verifiable explanation for the phenomenon of gravity; it allowed us to give the Universe a birth date, to imagine the Big Bang, whereas before, we didn't even know if it had a beginning. At a more down to earth level, without Einstein's equations, GPS satellites wouldn't work. At the same time, we're coming the point where the theory appears to be reaching its limits. In the late 90s we realized that the Universe was accelerating. That doesn't jive with the equations, which basically tell us what the Universe should look like as a function of the matter that's in it. In reality, for the theory of relativity to explain the Universe accurately, there would need to be a whole lot more matter than what is observed.

Does that mean the theory is wrong, or has mistakes in it?

That's exactly what I'm trying to explain to the public. In science, we don't talk about absolute truth. The theory of relativity is correct insomuch as it agrees with observations. And for it to agree, we've introduced, among other things, the concept of dark matter. Yet recent observations are giving us very good reason to think that this invisible matter actually exists. It must be in the form of exotic particles, we don't yet know exactly.

The theory had somehow predicted the existence of this matter even before we observed it?

That's probably the case. In fact, it's possible that general relativity only describes about 5% of the Universe, in other words, visible matter. Dark matter makes up another 25%. The remaining 70% would be dark energy, a sort of exotic force that decrees that the laws of gravity change at the very large scale. But that introduces more complex problems. It's possible that it doesn't really exist, and corresponds instead to a problem in the theory. That's why I try not to talk about it too much! Whatever the case may be, we have a theory that precisely explains everything that we can directly observe, but doesn't account for up to 95% of everything that exists!

Do you think we'll figure it out in the near future?

A lot could happen in the next 20 to 30 years. For example via the Euclid project, which I'm involved with along with 1300 other physicists from all over the world. Some people think that the equations should be changed to correspond to the observations, and others think that we should add other elements that still haven't been observed, like dark energy. We will map out the Universe in detail and obtain new elements of a solution. The final goal is to understand if the theory needs to be changed, or if there are new elements that exist that have been invisible up to this point.

Let's go back to your animation. It doesn't go into these details.

It's a film for the public, and a way of giving this historically important scientific anniversary some visibility. I've been preparing this for years with director Jamie Lochhead. Together, we came up with the scenario, and the lion's share of the work was done by animation expert Eoin Duffy. Finally, we had the good fortune to obtain the participation of David Tennant, a British actor famous for having incarnated the main character in Doctor Who, for the voice-over. Our project was funded by the British Science and Technology Facilities Council.

You seem to have a very good network of scientific communicators on the other side of the Channel!

It was in England that I began to be interested in the issue of scientific communication. I was writing the introduction to my thesis, fifty or so pages in which I had to recount the entire history of cosmology, among other things. It seemed to me that I could do a better job of this by explaining it to the public. I went to Hyde Park in London, to the well-known "Speaker's Corner," where anyone can stand up on a soapbox and hold forth on anything their heart desires. I had brought a telescope along for observing the Sun and a huge poster on which I had written "ask me about the Big Bang." I found myself among lots of other speakers, mostly carrying on about religion or politics, and I did some speed communication, a bit like speed dating. I gave myself three minutes to give my speech, no more.

Was it a good experience?

I found that it helped me better understand my own subject matter. I learned to speak without using jargon. That's essential, because the more you use a specialized language, the more you lose sight of what you really want to say. You sometimes even forget what the fundamental question you're trying to answer is. I discovered that by communicating to the public, I was able to gain perspective on my own work.

Be that as it may, scientific communication doesn't count for much on an academic CV.

Even so, it's an investment that could realistically have an enormous return. Eventually, if you have the public's support, you will obtain funding to do your research. But it's a collective investment, which benefits the entire scientific community. Hence the importance of motivating individuals and rewarding this kind of ability. Fortunately, things are changing and communication with the public is becoming increasingly valued. For example, if you are applying for a position at NASA, this aspect counts for 25% of the evaluation.

Is it part of scientists' mission to gain public support?

As scientists we have a responsibility. We're funded by the public, and we owe them something in return. In a time of crisis, such as the one we're currently in, I'm often asked why we should continue to fund basic research. My favorite example is the discovery of quantum mechanics. We had funded this research in the 1930s, at a time of economic and social crisis far greater than anything we're experiencing today. Yet without this research, we wouldn't now have computers or the Internet. Science transforms society, sometimes in unpredictable ways, but it has always and will always do so.

Science also brings about social change, and new ways of seeing the world.

Of course. That's what I call cultural capital, as opposed to technological capital. Where did we come from? What is our place in the Universe? These are very good questions that are important in themselves, but they also have a real impact on how we see the world. For example, when you realize that we're not at the center of the Universe, that our solar system is just one of innumerable solar systems in our galaxy, and that there are billions of galaxies… that understanding unites us and brings us closer together as human beings. I don't want to wax philosophical, but I think that this vision puts plenty of things into perspective and opens up new ways of thinking about who we are.

Provided by Ecole Polytechnique Federale de Lausanne