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Physics and Society

Making physics research tangible for the public

Alice Kohli

There are many books on how to teach the workings of, say, simple electrical circuits to high school students. In fact, it is any teacher's job to find the best way to do that. But how does one go about imparting cutting-edge physics to the broad public? In many research institutes in Switzerland, communication teams are wrapping their heads around this question every day of the week.

The task is not an easy one. There is a multitude of topics, very different personalities to deal with, and various audiences to reach. This article aims to dissect the scenarios in which communication with the public can happen – and possibly to inspire research institutions and scientists on how to engage larger audiences.

Let us assume you are a researcher at a physics department of a medium-sized Swiss university. You have made a discovery and were able to publish it in a renowned journal. You might have had to compromise on a couple of paragraphs with your fellow researchers or make adjustments following the peer-review process. Nevertheless, you control the message that is being conveyed, while the peer-reviewed publication process gives your work credibility and enhances your reputation among the experts in your field of research.

Publications in journals as well as talks at academic conferences can advertise your work within the physics community and lead the way to interesting collaborations or possibly new job opportunities. For your research institution, the publication is an important and also fairly objective factor to justify grant requests and get funding.

However, the more specific the journal, the less noticeable your paper will be to people outside your field of research. If your discovery is published in a multidisciplinary science journal, you can reach a wider audience. But even all the combined readers of *Nature* and *Science* still only amount to a very narrow segment of the general public.

Use your own channels

There are several reasons why you might want to have more people know about your discovery. One reason is public funding. In a direct democracy like Switzerland, it is crucial that your research institution can rely on the goodwill of the electorate – and for this they have to know and appreciate the work you do. Your institution might also be trying to attract more students. This is mainly a challenge for smaller physics departments, since many high school students think that studying physics is synonymous to enrolling to ETH or EPFL.

There are many ways in which a research institution can engage with the public via their own means of communication. All institutes run their own websites with all the necessary information, some publish newsletters, have a blog and feed

one or several social media channels. It can be a time-consuming task and the intensity and diversity of communication is a question of human resources.

The vetting of topics worthy to be published on the department's website or social media channel usually happens within the institute. At the University of Berne, scientists work together with the people responsible for public outreach in deciding which scientific finding is newsworthy and to what level, says Peter Wurz, director of the Physics Institute at the University of Berne. *“Depending on the news value it will be just a news item on the University web page, or all channels will be served, or a press release to media representatives will be published”.*

A close collaboration between scientists and the administrative staff running the communications channels of the institute is of utmost importance, says Aicha Lang, managing director of the Physics Department at the University of Basel. There might be many good ideas around on how to convey a message, she says, but it is a major challenge to write about physics research, so that a large public can understand the main concepts.

Go beyond your department

Universities, most public research centres and some private research institutions have communication departments with staff writers. Many of them publish own magazines, newsletters and blogs to engage with their students, prospective students, alumni and the interested public.

At the Paul Scherrer Institute in Villigen, all science writers have both a scientific training and a training in science communication. *“This means they know how to write for a lay audience, while having a scientific background”*, says Mirjam van Daalen, head of the communications department at PSI.

The scientific background of science editors does not always overlap with the scientists' specific field of research, but they are knowledgeable enough that they can make sense of scientific discoveries and, most importantly, put them in a larger context. *“Like with all complex research, coming up with good explanations while not dumbing down the science too much is always a challenge we face. It's all about striking the right balance between intelligibility and accuracy”*, says Leonid Leiva, a member of the communications team at IBM Research in Rueschlikon.

Science editors are experts at making a discovery attractive to people who have little background knowledge and might have never heard of your field of research before. Many science editors working at the communications department of a research institution also have experience in working for large media outlets. This can come in handy when a story needs to be pitched to a newspaper or TV station.

Get in the news

However much work is put into your institute's own communication channels – to get your discovery into a general-interest media outlet, such as a daily newspaper or the news show of a television channel, is the holy grail of all communication efforts.

As mentioned before, the so-called press release is the first step towards getting a spot in general-interest media. A press release is a standardized letter to the editors of a news outlet. It contains highly condensed information of what your research is all about. The main message of your discovery will be emphasized and sharpened to a couple of key sentences.

Newsrooms are flooded with press releases on a daily basis. And editors at news outlets do not share the goals of the editors working for the communications team of your research institution. They have little to no interest to promote your research institution and feel solely obliged to their readers, to keep them informed and entertained.

Much research has been done on why a story gets picked up by news media. A well-established theory is the so-called “news values” theory, which consists of a number of factors that make events “newsworthy” [1]. News values apply to all segments of the news, from politics to economy and also to scientific discoveries.

Let us look at some of the news values that might get journalists interested in your discovery.

1. **Timeliness:** It is only news if it just happened. If you made your ground-breaking discovery last year, journalists have less reason to publish the story. They might become suspicious – why has nobody else taken the topic up yet?
2. **Consonance and continuity:** These news values refer to the development of a news story. A news story usually is the next step in a series of stories. If the newspaper reported on the discovery of a new exoplanet, the audience is going to expect another story when the next exoplanet is discovered.
3. **Composition:** Physics has a particularly tough standing in the field of science reporting due to its abstract nature. Medicine and/or biology breakthroughs are much more likely to be reported on. But if you are lucky, the news value of composition plays a role and the editors deem it necessary to add a physics piece in between several medicine and biology pieces.
4. **Threshold:** The threshold indicates the signal intensity required to draw attention. Additionally to being recent and the next step in a series of discoveries, a scientific publication needs to stand out from the everyday noise. Oftentimes this is found in a superlative as in “for the very first time” or “the largest apparatus ever built”.
5. **Unexpectedness:** An example that illustrates this concept and is used extensively in journalism schools is “dog bites human” equals an everyday event that is not newsworthy, whereas an event of the kind “human bites dog” would be unexpected and thus newsworthy.
6. **Clarity:** The message that is being conveyed must be unambiguous. This is rather tricky since scientific find-

ings usually come with a fair amount of ambiguity. Journalists prefer to iron the vagueness out, which oftentimes leaves the message of the news piece to appear clearer than the message of the initial scientific paper. This can be detrimental to the actual physics, while at the same time, it helps the audience grasp the implications of the finding.

7. **References to elite persons or nations:** These are cultural parameters. The actions of the “elite” are perceived to be more consequential than the actions of the non-elite. Elite in this context means “of general identification”. In our context, this might be a well-known physicist from a country we culturally feel close to. The most elite nation in Swiss journalism is obviously Switzerland itself. Thus, stating the importance of the Swiss research site, the residence of the researchers in Switzerland, the love of a foreign researcher for Swiss fondue, etc. can only help.
8. **Reference to persons:** Information about the motivation of the physicists and their personal life will impact the audience's reception. This news factor is also called “human touch” and is the reason the family life or the hobbies of a scientist are mentioned in the media. Obviously, the “human touch” is the main driving force that makes medicine, one of the most successful topics in science journalism. It might be more difficult to put physics discoveries in a human context. Journalists will try and write about how your discovery might contribute to making people's lives healthier, happier, or more meaningful, which often bears some pitfalls.

The news values may change with time and their weighting factors certainly vary from publication to publication. But in general, the more news value items can be ticked, the more likely the story is to find an audience.

Bring people in

Media journalists are the gatekeepers to the information that gets shared with the broad public. But with the advent of social media, classical news outlets have lost a part of their audience. Also many media consumers have lost trust in classical news media. Journalists are under an immense pressure to publish stories – and sometimes this is to the detriment of the quality of the reporting.

There is one way in which physicists can engage with the public, that news media cannot provide: It's making people come to the research institutions, see what is going on and talk to the scientists directly.

Public lectures are one way for research institutions to engage with the public with a natural “human touch”. “*Public talks attract a broad and interested audience and are generally very well received*”, says Katharina Müller, particle physicist and managing director of the Physics Department at University of Zurich.

Not every topic automatically attracts an audience. “*People are very interested in cosmology and the universe, these are certainly topics easy to communicate*”, says Müller, but according to her, you may 'sell' any topic if you can connect it somehow to an experience the audience already has and show the people behind research in a nice story.

The communications team of the Physics Department at University of Fribourg suggests arranging the main message to spotlight some hot topics of the moment such as ecology, quantum computing, astrophysics, clean energy, or sustainability.

According to Mirjam van Daalen from PSI, everything that deals with the secrets of nature or the universe is of great interest to people. The same applies to topics that address the social relevance of research. *“Material sciences are less accessible”, she says, “especially when it comes to methodology”.*

Jonathan Home, Professor of Quantum Electronics at ETH Zurich has experience with public talks on complicated subjects. In 2015, he gave a TED (TED stands for Technology, Entertainment and Design) talk titled “How to build a quantum computer?” [2]. At TED conferences, speakers are invited to give short talks about their field of work, or “ideas worth spreading”. Home’s predecessor talked about astronomy (“very complex black holes”) and got a lot of responses from the audience. *“And then I came with my atoms, the simplest building blocks of matter, and these were ‘too hard’”,* Home remembers laughingly.

It is more difficult to make quantum computing attractive. But it is not impossible. The TED organization provides speakers with a guide on how to prepare their talks [3] and these instructions are what make TED talks so successful. One of the most important rules is about the duration: A TED talk never exceeds 18 minutes.

In a public lecture, your most difficult task is to break down your findings so they are easy to understand. This is what science journalists hone throughout their careers and it is what teachers do on a daily basis. One principle you can always apply is to break down the essence of your research into single elements of knowledge and then reconstruct these elements to form a conclusive story. This technique goes back to the Swiss pedagogue Johann Heinrich Pestalozzi [4]. Kircher and Girwitz wrote a good book [5] that adapts this technique to teaching physics.

Jonathan Home’s TED talk has been viewed many thousands of times online. For complicated topics, video recordings might be even more impactful than live speeches, because the audience can pause or rewind a video if they fail to understand a detail. Many universities put recordings of public talks online.

The people attending your public lecture or watching the recording online already have an interest in physics. To trigger that interest is the job of parents as well as of primary, secondary and high school teachers. There are some measures that research institutions can take to help with spreading the fascination among young people. And it is in their best interest: The fascination for physics is what caused taxpayers to approve billions of francs for the funding of science institutions in the past.

With opening their doors, research institutions can let people experience the science with their own eyes – and hands. Many research institutes have established recurring events

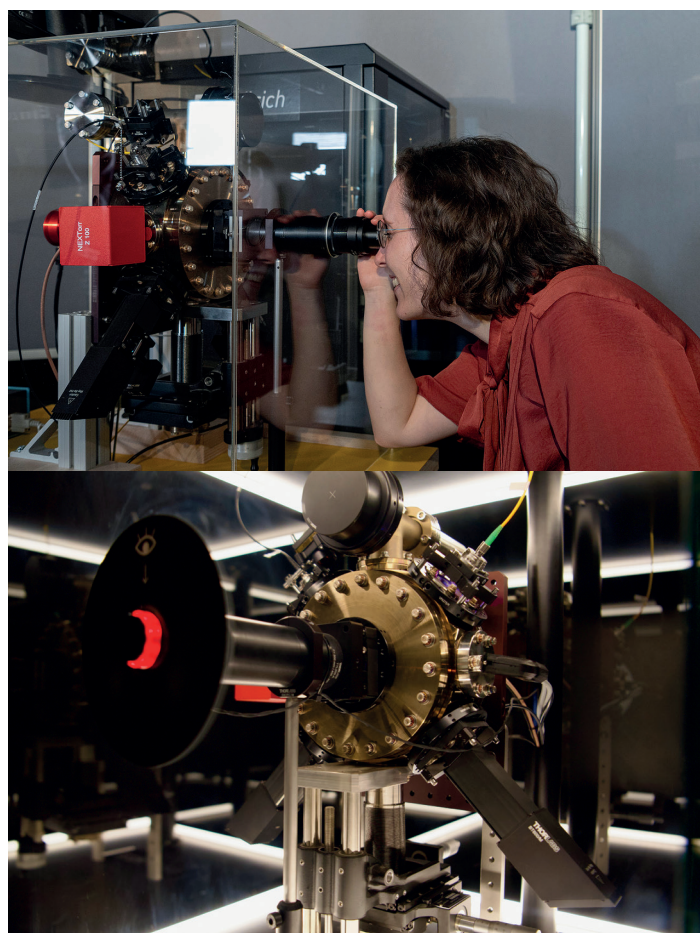
for the general public, like “Science Sundays” at ETH Zurich, “Saturday Morning Physics” at University of Basel, “Science and Nature Festival” at the University of Zurich, “Nuit de la Science” at the University of Geneva, to name just a few.

Many research institutions offer kids lectures, kids experiments, lab tours, science fairs, and exhibitions. The largest research institutes, PSI and CERN, host their own science museums. Astronomical observatories offer tours for the general public and for children. The most enthusiastic of high school students are even allowed to handle the biggest machines: For example at the Beamline for Schools competition held at CERN and DESY (Hamburg), as described on page 57.

Making science accessible

One of the best-known places that helps parents and teachers trigger an interest in physics in young children is the Swiss science centre Technorama in Winterthur. The museum offers hands-on experiments in the fields of mechanics, electricity, magnetism, optics, and fluid dynamics on three floors and in several labs. All experiments are interactive and children adore pushing the buttons and pulling the strings.

Recently, Technorama also took a leap into the world of so-called “modern” physics. Jonathan Home and his team set up an ion trap on the museum’s premises, in which single ions can be made visible [6]. The instrument requires high-precision laser technology. For a museum, where the visitors are supposed to be able to touch everything, mounting this device was a challenge.



The “Viewing atoms” installation. Source: Technorama Winterthur

The fact that the exhibit was a success and that people can now see single ions and even manipulate them is a huge achievement. “*It is unique, nobody else in the world can offer something like that*”, Jonathan Home says. Other science museums and education programs have reached out because they also want to build such devices.

The museum collected responses to the exhibit from the public. Many of the visitors were fascinated by the possibility of being able to see individual atoms at the touch of a button. Some were more impressed by the complicated-looking machinery and the spooky atmosphere in the dark room. It is unlikely that many of the visitors fully grasped the science behind the exhibit, but responses collected through questions written on sticky-notes showed that many deep thoughts were provoked in visitors of all ages.

In addition, the exhibit – and with them the ion traps made by Jonathan Home and his team – made it to Swiss televi-

sion and was covered in a science show [7]. Possibly, some of the TV viewers or museum visitors will show up at your research institution in a lecture about quantum computing.

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