

# The Higgs announcement as open science

*Achintya Rao*

Most physics seminars are seen by dozens at most, but the 2012 announcement of the discovery of the Higgs boson reached hundreds of thousands of viewers, including non-physicists. What can this event tell us about opening up science to the general public?

On 4 July 2012, Joe Incandela and Fabiola Gianotti (pictured) stood in front of the kind of audience that most performers can only dream of, as hundreds of thousands of people across the globe tuned in to watch them on live stream. But this impressive turnout was neither for a major sporting event nor for a new tech product launch; they were about to deliver a technical scientific talk in the main auditorium at CERN.

“It was amazing and it was overwhelming,” recalls Rolf-Dieter Heuer (also pictured), who was Director-General of CERN at the time. “That was a morning which is difficult to forget.” It was on that very day that Incandela and Gianotti, representing respectively the CMS and ATLAS collaborations at CERN, announced to the world that they had found a new particle, whose properties were consistent with those of the standard model Higgs boson.

What was remarkable about the audience at this historic moment was not only its size, but also that many who watched the announcement had no background in particle physics. But how did CERN stage an event with such a wide reach? And what did they learn about making science open — not only to professional scientists, but also the general public?

## A culture of sharing openly

Openness is enshrined in CERN’s [convention](#), which states that “its experimental and theoretical work shall be published or otherwise made generally available”. It is well-known that all particle physics papers published based on research conducted at CERN’s laboratory in Geneva, Switzerland, are shared under open access, and some of the collaborations at CERN also share their research data openly.

Conversely, what has gone relatively unnoticed is the openness with which the incremental progress of science is shared via live streams from CERN. These transmissions are meant to cater primarily to the tight-knit but distributed community of high-energy physicists. Somewhere between a third and half of all active particle physicists perform some of their research at CERN. However, since most of these scientists

are not based in Geneva, the laboratory also hosts a webcast service to allow researchers located abroad to watch lectures, meetings and seminars taking place on campus.

With the exception of internal meetings for the collaborations, all of these are available publicly, without requiring a CERN account to watch them, and receive a modest audience that does not strain the IT department’s resources. However, on 13 December 2011, only a few months before the discovery of the Higgs boson, CERN realized that the potential audience that would watch the webcast of the announcement could be several times larger than previously imagined.

## A surprising reach

When the Large Hadron collider (LHC) was first switched on, the world was told that the machine would either help discover the Higgs boson or rule out its existence entirely. Upon analysing collision data that the LHC had provided until the end of 2011, neither ATLAS nor CMS were able to rule out the existence of the Higgs boson. There were regions in the mass spectrum they had studied that showed the presence of a slight excess of collision events. It was time to share this with the community.

The 2011 end-of-year seminar at CERN was meant to be a routine affair, providing an update to the community on where the two collaborations were in the search for the Higgs boson. But people outside the collaborations began to speculate that a discovery might be on the horizon. Although the ongoing COVID-19 pandemic has now made webinars mainstream, ten years ago, CERN’s video-streaming solution was in for a rude surprise.

“There was a huge online audience, far more than there are particle physicists in the world,” grins James Gillies, CERN’s former head of communications from his office next to the main auditorium. The laboratory had to reinforce the webcast service to cater to the overwhelming demand.

“The content was technical even for specialists and the details are not trivial at all, so I was surprised



when I was told after the seminar of the crowds who watched it,” recalls Guido Tonelli (CMS Spokesperson 2010–2011), who presented the CMS results that day. “There was clearly a perception in the general public that what was happening at CERN was very important for humankind.”

The results in December 2011 from ATLAS and CMS showed that the excess in the data had a statistical significance of around  $3\sigma$ . Although far from the  $5\sigma$  gold standard of discovery, it was clear that if the excess was caused by a real particle, it was only a matter of time before the experiments identified the culprit.

### A change of plans

The next update from the experiments had been meant to be presented at the biennial International Conference on High Energy Physics (ICHEP), taking place during 4–11 July 2012 in Melbourne, Australia. ATLAS and CMS were to show the results of analyses performed on data from 2011 and from 2012.

However, the closer they got to the conference date, Heuer recalls, the clearer it became that the experiments might report something at least close to discovery if not discovery itself. “We decided that since CERN is funded mainly through European countries,” he explains, “we owed it to some extent to our Council members, to our sponsors, that the results were presented at CERN.” An unusually early 9 a.m. start was negotiated so that the seminar could still be the curtain-raiser at ICHEP, albeit presented from another continent.

When CERN announced that the seminar would take place in Geneva instead of Melbourne, those within the wider community began to suspect that discovery was imminent. The event caught the attention of the theoretical physicists who, in 1964, had identified the symmetry-breaking mechanism associated with the Higgs boson. On 26 June, one of them, Carl Hagen, got in touch with Gillies and informed him that he and his collaborators — Gerald Guralnik and Tom Kibble — would like to attend the seminar. Gillies then extended an invitation on behalf of CERN to the other theorists involved,

François Englert and Peter Higgs. (Sadly, Robert Brout, Englert’s collaborator, had passed away in 2011).

Journalists also invited themselves to attend the event, and CERN didn’t turn them away. Indeed, Heuer notes that when journalists contacted CERN to ask if they could come, they were told, “You might regret it if you don’t.”

### A dual audience

Despite welcoming journalists and informing the world that a public webcast would be made available, CERN made it clear that the seminar would nevertheless be aimed at the particle-physics community.

“I prepared my talk for our community,” Incandela notes, “with an awareness of the historical importance of it. To be honest, I did not know so many people would be watching that weren’t experts, and how far it would go.” He is emphatic that as a major result for the field, the only appropriate thing to do was to present the science and the details that the field recognized.

“I have no regrets about that and I’m not sure I could’ve done much differently if I had been told I also have to reach non-experts,” he continues. “It’s like you know somebody who’s never watched a certain sport, they have to just watch it; you can’t tell the team to play it in a way that’ll make it easier for them to understand.”

At the same time, CERN decided to provide running commentary to aid the non-expert spectators. “After the previous Higgs update seminar the year before,” Gillies explains, “people were writing to us saying they didn’t understand what was going on. So this time we thought we had to do something about that.”

To provide support to the journalists in attendance, a team of experts sat with them in a different conference room at CERN, explaining the proceedings taking place in the main auditorium. Experts were also available via public chat to respond to questions being posed to CERN by those watching the seminar remotely and a live blog provided information about the slides to those without the necessary expertise to interpret them.

### An overwhelming response

The big day arrived. “I came in much earlier than normal into the facility,” says Heuer, “and I can tell you people were queuing in front of the auditorium out into the garden of the canteen. I have never seen this before. Despite the fact that some of them stayed overnight there the mood was just great.”

Incandela finished preparing his presentation at 08:52 a.m. in his office, uploaded the talk to the online platform, and walked across the street to the auditorium. “Instead of being really stressed out about giving the talk, I was almost a little bit too elated,” he says from his office in Santa Barbara, USA.

“One thing I learnt was that when I’m giving a talk like that,” he continues, “I think about all the people that I’m representing. You have this responsibility: so many people had done this incredible work and I wanted them to be represented well.”

Incandela recalls a collective gasp when he showed the first of many plots confirming the existence of the new particle before the audience broke into applause.

“I was around a third of the way through the talk when I realized that this is not a defence, this is a celebration,” he adds. “And then I really started having fun with it.” When Gianotti showed the ATLAS results, the world had confirmation that the particle existed.

A press conference was held immediately after the talks, following which Heuer and Incandela took a series of flights to Melbourne. To their great surprise, when they arrived at the lounge in Singapore, they came across newspapers with themselves on the front pages. Exhausted, Incandela slept through the connecting flight from Singapore, but hadn't realized that Heuer had shown the newspapers to the crew and pointed Incandela as the one on them.

“I was asleep so I didn't know what was going on, but after I woke up suddenly the entire crew of this giant Airbus A380 wanted a picture of me and Rolf on the stairs of the airplane,” Incandela recalls. “That's when I suddenly realized that this is much bigger than I thought.

We'd been doing this stuff for decades, no-one seemed to be that interested and suddenly we're world news.”

### **A new frontier beckons**

In July 2022, ten years since the Higgs announcement, the LHC will embark on a new journey. When the proton beams will collide at an energy of 13.6 TeV, the accelerator will have broken its own record for the highest-energy human-made particle collisions. And in keeping with its culture of openness, CERN will once again invite the world to watch the proceedings and join the celebrations as particle physics begins to explore a new energy frontier.

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### **Competing interests**

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