PROCEEDINGS OF SCIENCE

Outreach and educational activities of ALICE in the times of the pandemic

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The onset of the COVID pandemic in 2020 stopped all outreach and educational activities with in-person participation. The ALICE collaboration soon adapted to the new situation imposed by lockdowns and other restrictions. The multitude of online tools and platforms available allowed us to continue reaching out to the public. In-person visits and talks were replaced by virtual visits and virtual talks, done with dedicated equipment and allowing remote audiences to see the experiment and interact with scientists. Masterclasses for high-school students were also adapted and were held online; web-based versions for the analysis programs were developed, making it easy for students at home to take part in this exciting hands-on activity and become scientists for a day. This new format made it possible to reach out to new audiences, both students and general public, who normally would not have the opportunity to travel and participate; it also motivated more colleagues to be involved in outreach. We will discuss how these online activities were implemented and the experience gained.

41st International Conference on High Energy physics - ICHEP2022
6-13 July, 2022
Bologna, Italy

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PoS(ICHEP2022)378

1. Introduction

Outreach and communication are undeniably an integral part of the scientific process. Our target groups are diverse, and so are the aims we try to achieve: explain to the general public what we do and how we do it and thus increase their scientific literacy and demystify science; tell the taxpayers how their money is invested for research; inspire the youth and prepare the next generation of scientists; inform the media, who have great power over the public; convince decision makers about the necessity of fundamental research and thus ensure funding; provide evidence-based information, since plenty of wrong facts and conspiracy theories circulate on the web.

Among the various outreach and communication tools available in our digital era, "traditional" activities such as visits still hold an important place. Seeing the tools of scientific research and interacting with scientists, visitors are offered a better insight into the world of science. A big effort has been made over the years to involve ALICE members as guides and accommodate as many visit requests as possible.

Out of various educational activities for different age groups, particle physics masterclasses, addressed to high-school students with the aim of inspiring them, is the most prominent one. Many ALICE institutes organise masterclasses based on ALICE data. With the onset of the COVID pandemic all these activities had to stop. In the following sections we discuss how we adapted them, using online platforms, thus ensuring the continuity of our outreach programme even without in-person participation.

2. ALICE visits

Visits to the ALICE experiment are very popular; the highlights are the tour of the cavern when access underground is possible. At all times visitors can see the exhibition, installed on the surface at Point 2, where a short film introduces them to ALICE and real detector items are on display. The visitors cover a broad spectrum; in their majority they are high-school or university students. During 2019, more than 12 000 visitors (1000 groups) had the opportunity to visit ALICE (the underground installations and/or the exhibition); in addition, during the CERN Open Days, 14-15 September 2019, 2600 persons visited the ALICE cavern.

With the onset of the COVID pandemic all in-person visits were cancelled.

3. ALICE virtual visits

Following the lead of ATLAS and CMS, who first introduced organised virtual visits [1], and after years of doing ad-hoc ALICE virtual visits with our personal laptops or phones, we eventually installed, in March 2018, dedicated equipment in the ALICE Run Control Centre (ARC). This includes videoconferencing equipment, plus two high resolution cameras: one fixed, showing the speaker, and one robot camera, with predefined positions showing different views inside the ARC.

Virtual visits were organised upon request, for remote audiences, and often combined with local events. The very first one was for Spanish teachers, for an event organised by the University of Bilbao, in May 2013. These virtual visits were taking place mainly from the ARC. Occasionally they also included a tour of the cavern, done with the virtual guide's private phone or tablet.

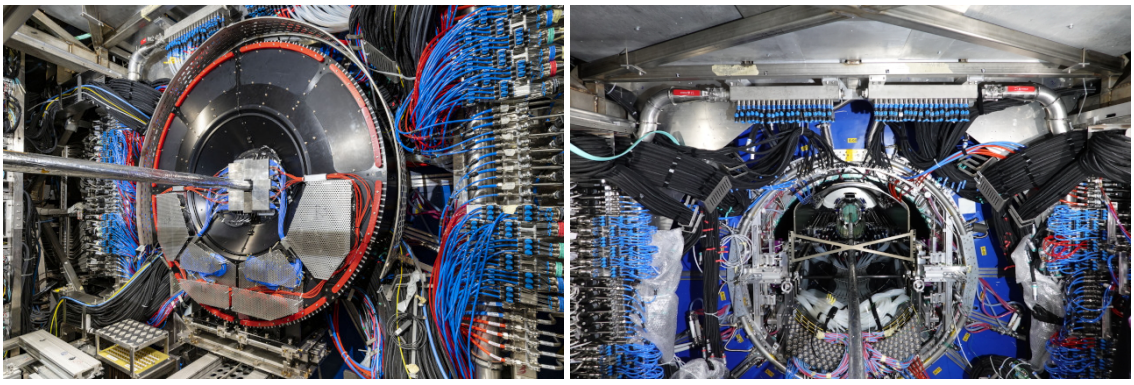

Figure 1: Some rare views offered to the ALICE virtual visitors during LS2. Left: the Fast Interaction Trigger (FIT) detector, A-side, and the beam pipe; right: the outer barrel of the new Inner Tracking System (ITS) and the beam pipe.

When CERN returned to "normality" after the first lockdown due to the pandemic, it became clear that, due to the COVID measures, it would be some time before in-person visits could restart. Virtual visits being the only alternative, they became the norm. We therefore started conducting such visits in a more systematic, organised way and with better equipment. For the underground tours dedicated equipment was acquired, consisting of a Samsung Galaxy mobile phone with a good camera, a stabiliser arm (gimbal) and headphones, paired with the phone via bluetooth. An ALICE virtual visit includes a tour of the cavern, as long as underground access is possible, and a tour of the ARC; ideally, it is conducted with two guides, one in the cavern and one in the ARC.

Depending on the status of works in the cavern, and where the guide is allowed to go, virtual visitors often get to see more than during a tour in person. For example, during LS2 (LHC Long Shutdown 2), there were occasions when they could get a glimpse of the newly installed detectors in the "heart" of ALICE (see Figure 1).

Upon request by a school, university or a local event's organisers and once date and time are agreed on, the visit is registered on a dedicated indico category [2] and guides are identified, trying to match the language requirement of the audience. In addition, "open virtual visits" for individuals are organised regularly [3]; these are announced on social media (FB, Twitter) [5] and on the CERN virtual tours and talks site [6]. They include a short introduction, visit to the cavern, tour of the ARC and a Q&A session, at the end. Typical duration is between one and one-and-a-half hours, depending on the number of questions from the participants. The virtual visits are done using zoom or zoom webinar platforms [4]. If recording of the visit has been requested, this is also done via zoom.

Since 2013, a total of 160 virtual visits of ALICE have taken place and 110 of them occurred after September 2020. Some thousands of people in more than 35 countries have been reached (Figure 2). Involving colleagues of different nationalities we have conducted visits in ten languages. A single virtual visit which was followed by thousands of middle-school students in the UK and elsewhere was one during an event [7], organised by the Victoria and Albert Museum, London, on the occasion of the exhibition "Alice: Curiouser and Curiouser" [8] . Another virtual visit, part of a bigger event for Korean audiences, combined with a CMS virtual visit, was done on the occasion of

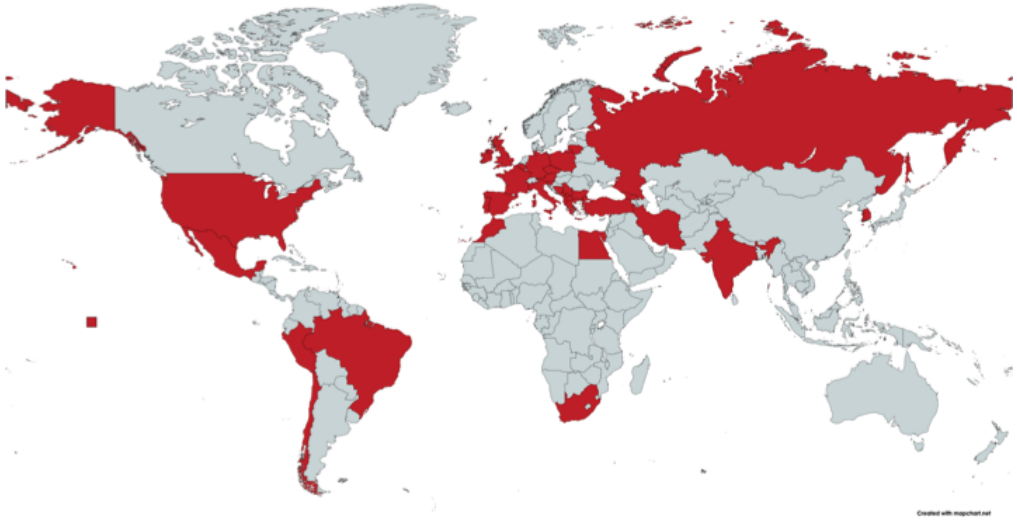

Figure 2: Countries for which ALICE virtual visits have been held

"The Cosmonaut" arts-and-science exhibition at the Hanyang University Museum, Seoul, Korea [9].

4. ALICE masterclasses

The "International Masterclasses - hands-on particle physics" (IMC) [10], the flagship activity of IPPOG (the International Particle Physics Outreach Group) [11], is a very successful outreach programme addressed to high-school students. Invited to a university or research centre, they spend a day of immersion in particle physics, following lectures and analysing real data from an experiment using dedicated software packages. At the end of the day they participate in a videoconference, connecting up to five different institutes, and discuss their results, similarly to what is common practice for international collaborations. ALICE has been participating in IMC since 2011, when measurements using data from the LHC experiments replaced the previous measurements based on LEP data. In addition to participation in the international masterclasses programme, held in the period February – April every year, ALICE members organise local masterclasses (without videoconference), sometimes going to the schools, as well as masterclasses for physics teachers.

By analysing data collected with the ALICE detector, high-school students search for strange particles from their V0 decays, identify them based on the invariant mass of the decay products, and eventually observe strangeness enhancement, one of the first signals for the Quark Gluon Plasma [12]; or they count tracks of charged particles in proton–proton and lead–lead collisions and calculate the nuclear modification factor R_{AA} [13].

These measurements were done, until recently, with packages based on ROOT, which had been developed simplifying the ALICE event display program. Installation of ROOT was therefore a prerequisite. Versions for Linux, Ubuntu, macOS were available, and in the last years also for windows; another alternative was to use a virtual machine. All these required installation of the software and testing prior to the masterclasses.

5. ALICE masterclasses in the COVID times

With the onset of the COVID pandemic in March 2020 schools and universities closed as countries went to lockdown. As a consequence, the international masterclasses 2020 were interrupted half-way. In the autumn of 2020, as the second wave of the pandemic led to new lockdowns, it became clear that the only possibility for international masterclasses 2021 was to hold them online, with the students at home. The ROOT-based versions of the ALICE exercises were not suitable for such a scenario; the installation of software by the students on all sorts of PCs, laptops or tablets might have been problematic. The packages were therefore rewritten from scratch, based on Javascript in one case and using Jupyter notebooks in the other; these new versions can be run using simply a web browser.

Thanks to these tools we were able to organise masterclasses with students participating remotely. On February 11th 2021, "International Day of Women and Girls in Science" [14], established by a United Nations resolution in 2015, ALICE masterclasses for girls were held in India, organised for the first time by the University of Jammu, in the Czech Republic, and in Greece. During the "official" period of IMC 2021, 25 sessions with ALICE measurements and 6 videoconferences were held. In almost all cases students were at home. Zoom was used for the introductory talks. For the data analysis the students were sent to zoom breakout rooms in small groups of 5–6 persons with one tutor per room. The merging of the results and the final discussion were done once everybody was back in the main zoom room.

Virtual visits to ALICE were included in the day's schedule for almost all ALICE masterclasses. In this way many participants got a glimpse of the experiment, whereas in previous years, it was the "priviledge" of those invited to CERN from the local area.

The end-of-the-day videoconference was done via zoom webinar. This made it easier for moderators to participate since their physical presence at CERN was not required. The students had many questions, which indicates that they are less inhibited when they do not need to speak and are more at ease submitting questions in writing. However, many made the remark that they missed seeing the other students - the international nature of the event conveyed with the videoconference was somewhat lost.

Running the masterclasses in this way the students inevitably missed the in-person interactions. However there were certain advantages: students in remote places could be reached, who could not participate when travelling to the organising institutes was required. Lecturers and tutors located in different places could participate, which gave flexibility to the organisation. In some cases (Sarajevo, Thessaloniki, Chania) physics teachers participated as tutors during the analysis, after following a training session beforehand. Their participation gives them the advantage that, being familiar with the tools, they can use them in class for extracurricular activities. Some female students who had participated in masterclasses for girls helped as tutors during a later session.

Even though some institutes chose not to participate since they could not invite students, the overall impression of those who took part was positive. The flexibility that the online platforms offer allowed us to reach people who could not participate in the "classical" format of the event.

In 2022, as we were almost back to normal, most masterclasses were held inviting the students to the institutes. However the week 7–11 March 2022 was dedicated to online masterclasses, allowing students located at many different places to participate in such an online session. Again

this year, on the 11th February, online ALICE masterclasses for girls were organised in India and in Greece and greatly appreciated by the participants.

6. Summary and conclusions

The use of online platforms provided a nice substitute for events with physical presence of the participants and ensured the continuity of the outreach and educational activities of the ALICE collaboration in the times of the COVID pandemic.

The virtual visits give to remote audiences the opportunity to get a glimpse of a CERN experiment and interact with scientists; they even allow virtual visitors to see more than during a real visit. Online masterclasses, made possible due to browser-based versions of the analysis exercises, allow students in remote places to participate. They also offer more freedom in the organisation, with lecturers, tutors, and moderators connecting from anywhere. In this way more people have the opportunity to be involved.

With the return to normality we resumed our activities with in-person interaction. However, having gained experience with online events, we intend to continue doing, in parallel to real visits, also virtual visits for those who can not travel to CERN. As for the masterclasses, in addition to inviting students to institutes, we intend to continue organising also online sessions.

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