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Higgs10: When spring 2012 turned to summer

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Fabiola Gianotti, Rolf Heuer and Joe Incandela in a packed CERN auditorium on the day of the announcement of the discovery of the Higgs boson. (Image: AFP / Denis Balibouse)

At the Higgs boson search update seminar on 13 December 2011, things were already looking promising. The data had allowed us to constrain the Higgs boson mass to the range from around 115 to 130 GeV, and both ATLAS and CMS had tantalising hints of a new particle around a mass of 125 GeV. Those hints were not yet sufficiently strong to claim a discovery, the local significance was between 2.6 and 3.6 sigma, but they were enough to ensure that the eyes of the world would be on CERN as the data taking resumed in spring 2012 at a larger centre-of-mass energy: 8 TeV, compared with 7 TeV in 2011. The year's big high-energy physics conference, ICHEP, was to be held in Melbourne, Australia, starting on 6 July 2012. We both had our tickets booked, and an update on the Higgs boson search was a key part of the agenda. Plans were made for a two-way link to relay the Higgs boson sessions live from Melbourne to CERN's Main Auditorium. Meanwhile, both experiments got on with data taking and analysis ...

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Fabiola Gianotti, Joe Incandela

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Higgs10: When spring 2012 turned to summer

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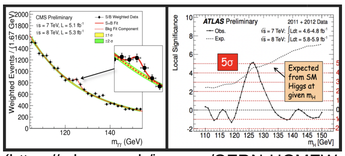
The year's big high-energy physics conference, ICHEP, was to be held in Melbourne, Australia, starting on 6 July 2012. We both had our tickets booked, and an update on the Higgs boson search was a key part of the agenda. Plans were made for a two-way link to relay the Higgs boson sessions live from Melbourne to CERN's Main Auditorium. Meanwhile, both experiments got on with data taking and analysis.

It was around mid-June that things started to get really interesting. By then, ATLAS had been seeing an excess of events in the two-photon channel, at the same mass as the excess reported at the end of 2011 based on an independent data sample, but nothing in the rarer four-lepton channels. It was clear to us both that we needed to see a signal in the gamma-gamma and lepton channels before going to the Director-General, Rolf Heuer. In the middle of June, CMS unblinded its analysis to find a four-sigma signal in the two-photon channel, and three-sigma in the leptons. Meanwhile, ATLAS's Higgs boson sample received its first four-lepton candidates. We went to see Rolf.

The following weeks were incredibly intense. It was imperative that the collaborations maintained complete confidentiality, and it was impressive how well that was respected, not only outside but also within CERN. ATLAS did not know what exactly CMS had, and vice versa. The two of us would keep each other informed almost daily, but we did not disclose the other experiment's results to our respective collaborations. Together with Rolf Heuer, we were the only ones who had the full picture of what was going on. This was essential to maintain confidentiality, but also to avoid ATLAS and CMS influencing each other, and to ensure that emotions did not affect the ongoing work. The pressure was enormous, people were working around the clock making millions of checks and cross-checks, and they had to remain calm and focused. The rest of CERN, and indeed anyone following particle physics, must have felt the energy emanating from the community, because the sense of anticipation was tangible.

The CERN Council met during the week of 18 June and decided that, whatever ATLAS and CMS had to say about the status of the Higgs boson searches, it should be said at CERN. We rapidly changed our travel plans, and CERN announced a Higgs boson update seminar for 4 July – the latest date compatible with both of us being in Melbourne in time for the plenary sessions of ICHEP. The primary direction of the two-way link with Melbourne was reversed: those arriving early for the conference would now follow the seminar at CERN remotely. The Council's decision was taken as a sign that we had an announcement to make but, at that point, we were not telling anyone what we'd be announcing. Nevertheless, eminent theorists such as Carl Hagen and Gerry Guralnik decided to attend, and we invited all the other theorists who had been involved with developing the theory back in the 60s. As a result, François Englert and Peter Higgs also joined us on the day. Two years earlier, the four had shared the APS's Sakurai Prize along with Robert Brout and Tom Kibble, both now sadly departed, for their work on spontaneous symmetry breaking in gauge theories.

It went right down to the wire. The results were still being checked and double-checked until just days before the seminar, and we were putting the final touches to our presentations until minutes before the seminar began. Walking into the auditorium, past the people rolling up their sleeping bags because they'd camped out overnight to ensure their places, we felt tremendous pressure along with great pride for what our community had managed to achieve over the decades. Then, as soon as it began, it seemed that a huge weight was lifted. The room was a sea of faces, ranging from those of people whose working lives had been devoted to building the LHC, ATLAS and CMS, to those whose careers were just beginning. Everyone was with us and, because the results were so compelling, neither of us needed our banks of back-up slides in case we were called upon to justify the details.



(https://cds.cern.ch/images/CERN-HOMEWEB-PHO-2022-133-1)

Plots shown by Joe Incandela for CMS and Fabiola Gianotti for ATLAS show a clear 5 sigma discovery signal. (Image: CERN)

It was an amazing day, seen live around the world by half a million people, and reported by the media to over a billion. The media focused heavily upon us as the spokespersons but of course we were just the messengers. This success was the culmination of a multigenerational effort spanning decades. The capability of the particle physics community to deliver beyond expectation was truly inspiring. From the original theory through phenomenology to the design and construction of the accelerator, the detectors and the computing infrastructure, the tiny signal we were able to tease out from a large background was a credit to everyone who played a part. It was the triumph of a community that was able to achieve what many would have deemed impossible, bringing together expertise from every branch of the field.

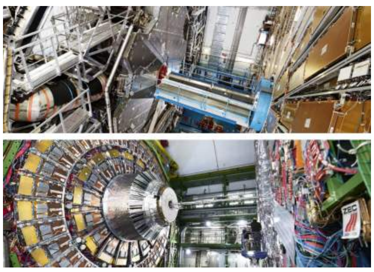
Peter Higgs was treated like a rock star on the day. His reaction gives the measure of our field: when pressed for comment by the media, he replied that this was a day for the experiments, and there would be plenty of time to talk to the theorists later. A little over a year later, François Englert and Peter Higgs shared the Nobel Prize in physics for "the theoretical discovery of a mechanism that contributes to our understanding of the origin of mass of subatomic particles, which recently was confirmed through the discovery of the predicted fundamental particle by the ATLAS and CMS experiments at CERN's Large Hadron Collider."

Fabiola Gianotti and Joe Incandela, Spokespersons of the ATLAS and CMS experiments at the time of the Higgs boson's discovery.

Fabiola Gianotti, Joe Incandela

ATLAS and CMS release results of most comprehensive studies yet of Higgs boson's properties

The collaborations have used the largest samples of proton–proton collision data recorded so far by the experiments to study the unique particle in unprecedented detail



From top to bottom, pictures of the ATLAS and CMS detectors (Image: CERN)

Today, exactly ten years after announcing the discovery of the Higgs boson, the international ATLAS (https:/science/experiments/atlas) and CMS (https:/science/experiments/cms) collaborations at the Large Hadron Collider (https:/science/accelerators/large-hadron-collider) (LHC) report the results of their most comprehensive studies yet of the properties of this unique particle. The independent studies, described in two papers published today in *Nature*, show that the particle's properties are remarkably consistent with those of the Higgs boson predicted by the Standard Model (https:/tags/standard-model) of particle physics. The studies also show that the particle is increasingly becoming a powerful means to search for new, unknown phenomena that – if found – could help shed light on some of the biggest mysteries of physics, such as the nature of the mysterious dark matter (https:/science/physics/dark-matter) present in the universe.

The Higgs boson is the particle manifestation of an all-pervading quantum field, known as the Higgs field, that is fundamental to describe the universe as we know it. Without this field, elementary particles such as the quark constituents of the protons and neutrons of atomic nuclei, as well as the electrons that surround the nuclei, would not have mass, and nor would the heavy particles (W bosons) that carry the charged weak force, which initiates the nuclear reaction that powers the Sun.

To explore the full potential of the LHC data for the study of the Higgs boson, including its interactions with other particles, ATLAS and CMS combine numerous complementary processes in which the Higgs boson is produced and "decays" into other particles.

This is what the collaborations have done in their new, independent studies, using their full LHC Run 2 data sets, which each include over 10 000 trillion proton–proton collisions and about 8 million Higgs bosons – 30 times more than at the time of the particle's discovery. The new studies each combine an unprecedented number and variety of Higgs boson production and decay processes to obtain the most precise and detailed set of measurements to date of their rates, as well as of the strengths of the Higgs boson's interactions with other particles.

All of the measurements are remarkably consistent with the Standard Model predictions within a range of uncertainties depending, among other criteria, on the abundance of a given process. For the Higgs boson's interaction strength with the carriers of the weak force, an uncertainty of 6% is achieved. By way of comparison, similar analyses with the full Run 1 data sets resulted in a 15% uncertainty for that interaction strength.

"After just ten years of Higgs boson exploration at the LHC, the ATLAS and CMS experiments have provided a detailed map of its interactions with force carriers and matter particles," says ATLAS spokesperson Andreas Hoecker. "The Higgs sector is directly connected with very profound questions related to the evolution of the early universe and its stability, as well as to the striking mass pattern of matter particles. The Higgs boson discovery has sparked an exciting, deep and broad experimental effort that will extend throughout the full LHC programme."

"Sketching such a portrait of the Higgs boson this early on was unthinkable before the LHC started operating," says CMS spokesperson Luca Malgeri. "The reasons for this achievement are manifold and include the exceptional performances of the LHC and of the ATLAS and CMS detectors, and the ingenious data analysis techniques employed."

The new combination analyses also provide, among other new results, stringent bounds on the Higgs boson's interaction with itself and also on new, unknown phenomena beyond the Standard Model, such as on Higgs boson decays into invisible particles that may make up dark matter.

ATLAS and CMS will continue revealing the nature of the Higgs boson using data from the LHC's Run 3, which starts tomorrow at a new high-energy frontier, and from the collider's major upgrade, the High-Luminosity LHC (https://science/accelerators/high-luminosity-lhc) (HL-LHC), from 2029. With about 18 million Higgs bosons projected to be produced in each experiment in Run 3 and some 180 million in the HL-LHC's runs, the collaborations expect to not only reduce significantly the measurement uncertainties of the Higgs boson's interactions determined so far but also to observe some of the Higgs boson's interactions with the lighter matter particles and to obtain the first significant evidence of the boson's interaction with itself.

Find out more in the ATLAS (https://www.nature.com/articles/s41586-022-04893-w) and CMS (https://www.nature.com/articles/s41586-022-04892-x) Nature papers.

The Higgs boson, ten years after its discovery

The discovery of the Higgs boson at the Large Hadron Collider and the progress made since then, have allowed physicists to make tremendous steps forward in our understanding of the universe

10th anniversary of the discovery of the Higgs boson (Image: CERN)

Geneva, 4 July 2022. Ten years ago, on July 4 2012, the ATLAS and CMS collaborations at the Large Hadron Collider (LHC) announced the discovery of a new particle with features consistent with those of the Higgs boson predicted by the Standard Model of particle physics. The discovery was a landmark in the history of science and captured the world's attention. One year later it won François Englert and Peter Higgs the Nobel Prize in Physics for their prediction made decades earlier, together with the late Robert Brout, of a new fundamental field, known as the Higgs field, that pervades the universe, manifests itself as the Higgs boson and gives mass to the elementary particles.

"The discovery of the Higgs boson was a monumental milestone in particle physics. It marked both the end of a decades-long journey of exploration and the beginning of a new era of studies of this very special particle," says Fabiola Gianotti, CERN's Director-General and the project leader ('spokesperson') of the ATLAS experiment at the time of the discovery. "I remember with emotion the day of the announcement, a day of immense joy for the worldwide particle physics community and for all the people who worked tirelessly over decades to make this discovery possible."

In just ten years physicists have made tremendous steps forward in our understanding of the universe, not only confirming early on that the particle discovered in 2012 is indeed the Higgs boson but also allowing researchers to start building a picture of how the pervasive presence of a Higgs field throughout the universe was established a tenth of a billionth of a second after the Big Bang.

The new journey so far

The new particle discovered by the international ATLAS and CMS collaborations in 2012 appeared very much like the Higgs boson predicted by the Standard Model. But was it actually that long-sought-after particle? As soon as the discovery had been made, ATLAS and CMS set out to investigate in detail whether the properties of the particle they had discovered truly matched those predicted by the Standard Model. By using data from the disintegration, or 'decay', of the new particle into two photons, the carriers of the electromagnetic force, the experiments have demonstrated that the new particle has no intrinsic angular momentum, or quantum spin – exactly like the Higgs boson predicted by the Standard Model. By contrast, all other known elementary particles have spin: the matter particles, such as the 'up' and 'down' quarks that form protons and neutrons, and the force-carrying particles, such as the W and Z bosons.

By observing the Higgs bosons being produced from and decaying into pairs of W or Z bosons, ATLAS and CMS confirmed that these gain their mass through their interactions with the Higgs field, as predicted by the Standard Model. The strength of these interactions explains the short range of the weak force, which is responsible for a form of radioactivity and initiates the nuclear fusion reaction that powers the Sun.

The experiments have also demonstrated that the top quark, bottom quark and tau lepton – which are the heaviest fermions – obtain their mass from their interactions with the Higgs field, again as predicted by the Standard Model. They did so by observing, in the case of the top quark, the Higgs boson being produced together with pairs of top quarks, and in the cases of the bottom quark and tau lepton, the boson's decay into pairs of bottom quarks and tau leptons respectively. These observations confirmed the existence of an interaction, or force, called the Yukawa interaction, which is part of the Standard Model but is unlike all other forces in the Standard Model: it is mediated by the Higgs boson, and its strength is not quantized, that is, it doesn't come in multiples of a certain unit.

ATLAS and CMS measured the Higgs boson's mass to be 125 billion electronvolts (GeV), with an impressive precision of almost one per mil. The mass of the Higgs boson is a fundamental constant of nature that is not predicted by the Standard Model. Moreover, together with the mass of the heaviest known elementary particle, the top quark, and other parameters, the Higgs boson's mass may determine the stability of the universe's vacuum.

These are just a few of the concrete results of ten years of exploration of the Higgs boson at the world's largest and most powerful collider – the only place in the world where this unique particle can be produced and studied in detail.

"The large data samples provided by the LHC, the exceptional performance of the ATLAS and CMS detectors, and new analysis techniques have allowed both collaborations to extend the sensitivity of their Higgs-boson measurements beyond what was thought possible when the experiments were designed," says ATLAS spokesperson Andreas Hoecker.

In addition, since the LHC started colliding protons at record energies in 2010, and thanks to the unprecedented sensitivity and precision of the four main experiments, the LHC collaborations have discovered more than 60 composite particles predicted by the Standard Model, some of which are exotic 'tetraquarks' and 'pentaquarks'. The experiments have also revealed a series of intriguing hints of deviations from the Standard Model that compel further investigation, and have studied the quark–gluon plasma that filled the universe in its early moments in unprecedented detail. They have also observed many rare particle processes, made ever more precise measurements of Standard Model phenomena, and broken new ground in searches for new particles beyond those predicted by the Standard Model, including particles that may make up the dark matter that accounts for most of the mass of the universe.

The results of these searches add important pieces to our understanding of fundamental physics. "Discoveries in particle physics don't have to mean new particles," says CERN's Director for Research and Computing, Joachim Mnich. "The LHC results obtained over a decade of operation of the machine have allowed us to spread a much wider net in our searches, setting strong bounds on possible extensions of the Standard Model, and to come up with new search and data-analysis techniques."

Remarkably, all of the LHC results obtained so far are based on just 5% of the total amount of data that the collider will deliver in its lifetime. "With this 'small' sample, the LHC has allowed big steps forward in our understanding of elementary particles and their interactions," says CERN theorist Michelangelo Mangano. "And while all the results obtained so far are consistent with the Standard Model, there is still plenty of room for new phenomena beyond what is predicted by this theory."

"The Higgs boson itself may point to new phenomena, including some that could be responsible for the dark matter in the universe," says CMS spokesperson Luca Malgeri. "ATLAS and CMS are performing many searches to probe all forms of unexpected processes involving the Higgs boson."

The journey that still lies ahead

What's left to be learned about the Higgs field and the Higgs boson ten years on? A lot. Does the Higgs field also give mass to the lighter fermions or could another mechanism be at play? Is the Higgs boson an elementary or composite particle? Can it interact with dark matter and reveal the nature of this mysterious form of matter? What generates the Higgs boson's mass and self-interaction? Does it have twins or relatives?

Finding the answers to these and other intriguing questions will not only further our understanding of the universe at the smallest scales but may also help unlock some of the biggest mysteries of the universe as a whole, such as how it came to be the way it is and what its ultimate fate might be. The Higgs boson's self-interaction, in particular, might hold the keys to a better understanding of the imbalance between matter and antimatter and the stability of the vacuum in the universe.

While answers to some of these questions might be provided by data from the imminent third run of the LHC or from the collider's major upgrade, the high-luminosity LHC, from 2029 onwards, answers to other enigmas are thought to be beyond the reach of the LHC, requiring a future 'Higgs factory'. For this reason, CERN and its international partners are investigating the technical and financial feasibility of a much larger and more powerful machine, the Future Circular Collider, in response to a recommendation made in the latest update of the European Strategy for Particle Physics.

"High-energy colliders remain the most powerful microscope at our disposal to explore nature at the smallest scales and to discover the fundamental laws that govern the universe," says Gian Giudice, head of CERN's Theory department. "Moreover, these machines also bring tremendous societal benefits."

Historically, the accelerator, detector and computing technologies associated with high-energy colliders have had a major positive impact on society, with inventions such as the World Wide Web, the detector developments that led to the PET (Positron Emission Tomography) scanner, and the design of accelerators for hadron therapy in the treatment of cancers. Furthermore, the design, construction and operation of particle physics colliders and experiments have resulted in the training of new generations of scientists and professionals in other fields, and in a unique model of international collaboration.

Further information

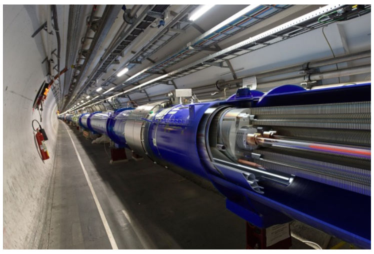
Video news release : https://videos.cern.ch/record/2296228 (https://videos.cern.ch/record/2296228)

Pictures of the 4 July 2022 event will be added here (https://cernbox.cern.ch/index.php/s/jnNBmpI7fCnA31P).

Higgs boson background information can be found here (https://home.cern/press/2022).

LHC Run 3: physics at record energy starts tomorrow

The Large Hadron Collider is ready to once again start delivering proton collisions to experiments, this time at an unprecedented energy of 13.6 TeV, marking the start of the accelerator's third run of data taking for physics



3D cut of the LHC dipole (Image: CERN)

A new period of data taking begins on Tuesday, 5 July for the experiments at the world's most powerful particle accelerator, the Large Hadron Collider (LHC), after more than three years of upgrade and maintenance work. Beams have already been circulating in CERN's accelerator complex (https:/news/news/accelerators/large-hadron-collider-restarts)since April (https:/news/news/accelerators/large-hadron-collider-restarts), with the LHC machine and its injectors being recommissioned to operate with new higher-intensity beams and increased energy. Now, the LHC operators are ready to announce "stable beams", the condition allowing the experiments to switch on all their subsystems and begin taking the data that will be used for physics analysis. The LHC will run around the clock for close to four years at a record energy of 13.6 trillion electronvolts (TeV), providing greater precision and discovery potential than ever before.

"We will be focusing the proton beams at the interaction points to less than 10 micron beam size, to increase the collision rate. Compared to Run 1, in which the Higgs was discovered with 12 inverse femtobarns, now in Run 3 we will be delivering 280 inverse femtobarns[1]. This is a significant increase, paving the way for new discoveries," says Director for Accelerators and Technology Mike Lamont.

The four big LHC experiments have performed major upgrades to their data readout and selection systems, with new detector systems and computing infrastructure. The changes will allow them to collect significantly larger data samples, with data of higher quality than in previous runs. The ATLAS (https:/science/experiments/atlas) and CMS (https:/science/experiments/cms) detectors expect to record more collisions during Run 3 than in the two previous runs combined. The (https:/science/experiments/lhcb)LHCb (https:/science/experiments/lhcb) experiment underwent a complete revamp and looks to increase its data taking rate by a factor of ten, while (https:/science/experiments/alice)ALICE (https:/science/experiments/alice) is aiming at a staggering fifty-fold increase in the number of recorded collisions.

With the increased data samples and higher collision energy, Run 3 will further expand the already very diverse LHC physics programme. Scientists at the experiments will probe the nature of the Higgs boson with unprecedented precision and in new channels. They may observe previously inaccessible processes, and will be able to improve the measurement precision of numerous known processes addressing fundamental questions, such as the origin of the matter–antimatter asymmetry in the universe. Scientists will study the properties of matter under extreme temperature and density, and will also be searching for candidates for dark matter and for other new phenomena, either through direct searches or – indirectly – through precise measurements of properties of known particles.

"We're looking forward to measurements of the Higgs boson decay to second-generation particles such as muons. This would be an entirely new result in the Higgs boson saga, confirming for the first time that second-generation particles also get mass through the Higgs mechanism," says CERN theorist Michelangelo Mangano.

"We will measure the strengths of the Higgs boson interactions with matter and force particles to unprecedented precision, and we will further our searches for Higgs boson decays to dark matter particles as well as searches for additional Higgs bosons," says Andreas Hoecker, spokesperson of the ATLAS collaboration. "It is not at all clear whether the Higgs mechanism realised in nature is the minimal one featuring only a single Higgs particle."

A closely watched topic will be the studies of a class of rare processes in which an unexpected difference (lepton flavour asymmetry) between electrons and their cousin particles, muons, was studied by the LHCb experiment in the data from previous LHC runs. "Data acquired during Run 3 with our brand new detector will allow us to improve the precision by a factor of two and to confirm or exclude possible deviations from lepton flavour universality," says Chris Parkes, spokesperson of the LHCb collaboration. Theories explaining the anomalies observed by LHCb typically also predict new effects in different processes. These will be the target of specific studies performed by ATLAS and CMS. "This complementary approach is essential; if we're able to confirm new effects in this way it will be a major discovery in particle physics," says Luca Malgeri, spokesperson of the CMS collaboration.

The heavy-ion collision programme will allow the investigation of quark–gluon plasma (QGP) – a state of matter that existed in the first 10 microseconds after the Big Bang – with unprecedented accuracy. "We expect to be moving from a phase where we observed many interesting properties of the quark–gluon plasma to a phase in which we precisely quantify those properties and connect them to the dynamics of its constituents," says Luciano Musa, spokesperson of the ALICE collaboration. In addition to the main lead–lead runs, a short period with oxygen collisions will be included for the first time, with the goal of exploring the emergence of QGP-like effects in small colliding systems.

The smallest experiments at the LHC – (https:/science/experiments/totem)TOTEM (https:/science/experiments/totem), (https:/science/experiments/lhcf)LHCf (https:/science/experiments/lhcf), (https:/science/experiments/moedal)MoEDAL (https:/science/experiments/moedal), with its entirely new subdetector MAPP, and the recently installed (https:/science/experiments/faser)FASER (https:/science/experiments/faser) and (https://snd-lhc.web.cern.ch/)SND@LHC (https://snd-lhc.web.cern.ch/) – are also poised to explore phenomena within and beyond the Standard Model, from magnetic monopoles to neutrinos and cosmic rays.

A new physics season is starting, with a broad and promising scientific programme in store. The launch of LHC Run 3 will be streamed live on CERN's social media channels and high-quality Eurovision satellite link (https://newsdirect.ebu.ch/nodes/uuid:b212196f-4d36-4527-83be-73f0c2b97a9f/details) starting at 4.00 p.m. (CEST) on 5 July. Live commentary from the CERN Control Centre, available in five languages (English (https://www.youtube.com/watch?v=06kFq1QF5-s), French (https://www.youtube.com/watch?v=MHlWrDCiSuI), German (https://www.youtube.com/watch?v=6m72FngbN4I), Italian (https://www.youtube.com/watch?v=sNu1jMp3Zcg) and Spanish (https://www.youtube.com/watch?v=nm-awslJMxc)), will walk the viewers through the operation stages that take proton beams from injection into the LHC to collisions for physics at the four interaction points where the experiments are located. A live Q&A session with experts from the accelerators and experiments will conclude the live stream.

Further information

To follow the live stream on EBU satellite, you will need to create an account. The event will be accessible here (https://newsdirect.ebu.ch/nodes/uuid:b212196f-4d36-4527-83be-73f0c2b97a9f/details).

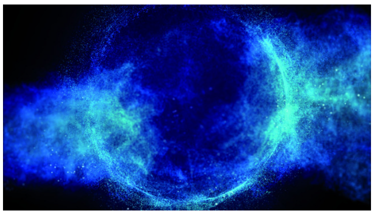
Pictures of the day will be added here (https://cernbox.cern.ch/index.php/s/EacPckkCMFcJ8ya).

Run 3 background information can be found here (https:/press/2022/run-3).

[1] An inverse femtobarn is a measure of the number of collisions or the amount of data collected. One inverse femtobarn corresponds to approximately 100 trillion (100 x 10^{12}) proton–proton collisions.

Home.cern, CERN Courier: New online resources on the Higgs boson

What's so special about the Higgs boson? Why should I care? What's next? If these questions torment you, head straight to home.cern.



A graphic artistic view of the Brout-Englert-Higgs Field (Image: CERN)

Needless to say, working at CERN has not turned all of us into particle physics experts. So if the celebrations of the anniversary of the Higgs boson discovery have your brow sweating in terror at the thought of being asked to describe spontaneous symmetry breaking in the Standard Model of Particle Physics, fear no more: the communication group within IR-ECO (Education, Communication and Outreach) has devised a nifty new webpage dedicated to the Higgs boson and indexing the most common questions surrounding its nature and the research conducted to break its secrets. Whether you need short fact-sheet-type nuggets of information on various aspects of the Higgs boson or in-depth explainers, the Higgs boson page (https://home.cern/science/physics/higgs-boson) has you covered.

In parallel, the "Higgs10" *CERN Bulletin* pieces covering the past decades of Higgs boson research, indexed here (https://home.cern/news/series/higgs10), will allow you to revise your particle physics and CERN history. Two additional pieces, delving into Higgs research after the 2012 discovery, will close the series in the coming issues of the *CERN Bulletin*.

Finally, the July/August issue of the *CERN Courier*, dedicated to the anniversary of the discovery, offers an expert insight into Higgs boson research. You will find all new articles on the *Courier*'s website (https://cerncourier.com).

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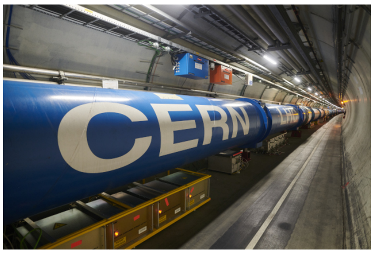
- Higgs boson page on home.cern (https://home.cern/science/physics/higgs-boson)
- Higgs10 Bulletin articles (https://home.cern/news/series/higgs10)
- CERN Courier (https://cerncourier.com)

Thomas Hortala

Watch the live stream of the launch of Run 3 on CERN's internal screens or on social media!

On 5 July, after more than three years of long shutdown, the physics season will start at the LHC with a new energy world record



The Large Hadron Collider is set to break a new energy world-record on 5 July (Image: CERN)

A mere day after the 10th anniversary of the discovery of the Higgs boson celebrations at CERN, the LHC will make the promise of a bright future for particle physics a reality, breaking a new energy world record of 13.6 trillion electron volts (13.6 TeV) in its first stable-beam collisions. These collisions will mark the start of data taking for the new physics season, called Run 3.

The launch of the LHC Run 3 will be streamed live on CERN's social media channels and by high-quality Eurovision satellite link on 5 July starting at 4 p.m. Live commentary in five languages (English, French, German, Italian and Spanish) from the CERN Control Centre will walk you through the operation stages that take proton beams from their injection into the LHC to collision points. A live Q&A session with experts from the accelerators and experiments will conclude the live stream.

For those on site at CERN, **the live will be broadcast on the screens in the three CERN restaurants** with English subtitles. If you need to take an afternoon coffee break, think 4 p.m.!

Fitted out to cope with the more intense beam, the LHC will allow physicists to collect more data during Run 3 (which will last until the end of 2025) than they did in the first two runs combined. The upcoming physics season will be focused on the study of the properties of the Higgs and the search for physics beyond the Standard Model of particle physics.

Join us for this historic event: connect on Facebook (https://www.facebook.com/cern/), YouTube (https://www.youtube.com/channel/UCrHXK2A9JtiexqwHuWGeSMg), Instagram (https://www.instagram.com/cern/?hl=en) or LinkedIn (https://www.linkedin.com/company/cern/mycompany/verification/).

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Visit this page (https://home.cern/news/news/cern/join-cern-historic-week-particle-physics) for a list of events surrounding the start of Run 3 and the anniversary of the discovery of the Higgs boson.

(Video: CERN)

Computer security

Computer Security: Dear summer students, welcome!

In order to make your digital life as comfortable as possible, there are a few things you need to know

A warm welcome to the summer-student class of 2022! We're glad that you made it in these troubled times! We offer a packed agenda for the next two months: challenging lectures; interesting projects to tackle with your team; and lots of time to take a great big gulp of CERN's academic freedom, spirit and creativity! In order to make your digital life as comfortable as possible, however, there are a few things you need to know.

When you join CERN, you're given a CERN computing account. Take care of your account password (https://home.cern/news/news/computing/computer-security-easy-way-lose-passwords) as any evil-doer might misuse it to spam the world on your behalf, abuse CERN's computing clusters in your name, download journals in bulk from CERN's digital library, or simply compromise your CERN PC and extract your photos, documents or personal data, or spy on you using your computer's microphone or webcam. Worst-case scenario, the whole Organization is at risk (https://home.cern/news/news/computing/blackmailing-enterprises-you-are-patient-zero)! Similarly, take good care of your CERN and personal computers, tablets and smartphones. Give them some freedom to update themselves so you benefit from the latest protective measures (https://home.cern/news/news/computing/computer-security-what-do-apartments-and-computers-have-common). "Auto-update" is a good friend, just make sure that it's enabled – as it should be by default.

A particularly nasty way to lose your password, at CERN or at home, is to reply to so-called "phishing emails", i.e. emails asking for your password. No serious person – the CERN Computer Security team, the CERN Service Desk or your CERN supervisor – would send such an email, only dishonest people or fraudsters would. So stay on the lookout and don't enter your password in weird webpages. Don't click on links in emails obviously not intended for you, for example, emails not addressed to you, not coming from the real CERN (https://home.cern/news/news/computing/computer-security-when-cernch-not-cern), not written in one of your native languages, or of no relevance to you. Ask us at Computer.Security@cern.ch if you have any doubts. Similarly, don't randomly click on web links, but stop and think first. Otherwise, you might infect your computer (https://home.cern/cern-people/updates/2018/03/computer-security-malware-ransomware-doxware-and) in no time – and the sole remedy will be a full reinstallation of your device (easier if you have backups!).

CERN has awesome network connectivity to the world. But it's for professional purposes. While private usage is tolerated, please do not abuse this. Keep your bandwidth low. In particular, refrain from bulk downloading movies or software. Remember "copyright"? It also applies at CERN. Any violation of copyright reported to CERN will be followed up and any infringement costs will be passed on to the perpetrator. The same holds true for pirated software. If you have stored pirated licence keys on your device, it's time to delete them. Companies are monitoring for abuse of their software and infringement costs can quickly reach five to six figures (https://home.cern/news/news/computing/computer-security-when-free-not-free). This one is of particular importance: if you need particular software, have a look at CERN's central software repositories (https://information-technology.web.cern.ch/services).

While you're at CERN, you might be working on a project requiring digital resources – setting up a webpage, writing some code, developing hardware. Please don't reinvent the wheel if you need a database. Or a webserver. Or some software. The CERN IT department can provide a wide variety of centrally managed and secure services (https://home.cern/news/news/computing/computer-security-go-clever-go-central) for your digital convenience. Just put yourself on their shoulders and build on top. Free up your time and brain for creativity and let CERN IT provide the tools. Moreover, make sure that all your development work, software, design drawings, documentation and so on are made available to your supervisor when you leave. This will ensure your legacy lives on at CERN. If you keep them to yourself, they'll get purged and deleted, and your time at CERN will be forgotten.

Finally, like anywhere else, there are some rules to respect. Use of CERN's computing facilities is governed by the CERN Computing Rules (https://cern.ch/computingrules). Basically, be reasonable. Don't do anything that could be considered immoral, illegal or abusive. Similarly, personal use of CERN's computing facilities is tolerated, but within the aforementioned limits. For example, browsing pornography is forbidden unless you have a good professional reason to do so (and it might be awkward receiving a corresponding cease-and-desist email from us). In another example, crypto-mining on CERN's computing clusters (https://home.cern/cern-people/updates/2018/01/computer-security-computing-power-professionals-only) is definitely a no-no. Just don't.

So, make sure that you respect these few ground rules – keep your system up to date – protect your password – STOP-THINK-DON'T CLICK – respect copyright – preserve your work – follow the CERN Computing Rules. We wish you a great and exciting stay at CERN. Have fun and enjoy!

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Do you want to learn more about computer security incidents and issues at CERN? Follow our Monthly Report (https://cern.ch/security/reports/en/monthly_reports.shtml). For further information, questions or help, check our website (https://cern.ch/Computer.Security) or contact us at Computer.Security@cern.ch.

This article is a republication of a text originally published in June 2021.

Computer Security team

Official news

MyFiles: A new platform for storing financial documents

The FAP department has developed a platform called MyFiles (https://myfiles.cern.ch/) to replace the AIS media application in which payslips, internal tax certificates and individual annual statements are currently archived.

As of July 2022, the pay statement notification sent to members of the personnel will point them to this new platform, where they will be able to consult their monthly statement, as well as their financial documents history since January 2001, when electronic payslips were introduced.

The individual breakdown of pension rights, sent annually by the Benefits service of the Pension Fund, will also be available in MyFiles as of this summer. The 2022 breakdown will be sent out in August.

Announcements

Cutting-edge computing technologies to be highlighted in CERN openlab summer-student lectures – follow the talks online

Would you like to learn about the innovative computing technologies that underpin CERN's groundbreaking physics research? Join us for the CERN openlab (https://openlab.cern/) summer-student lecture programme. It is free and open to all, wherever you are in the world. Lectures will be given by CERN experts on topics ranging from quantum computing to machine learning, and from distributed computing to open data. The lectures will be livestreamed via the CERN Webcast website (https://webcast.web.cern.ch/) and the CERN Lectures YouTube channel (https://www.youtube.com/c/CERNLectures/featured). A full list of lectures can be found here (https://indico.cern.ch/category/15588).

The lectures are organised as part of CERN openlab's annual summer-student programme. For the first time since 2019, summer students are back on the CERN site. The CERN openlab summer students will each spend nine weeks working with some of the latest hardware and software technologies, as well as learning how advanced computing solutions are used in high-energy physics. This year, 1770 students applied to the programme. From these, 32 students, of 18 different nationalities, were selected.

CERN openlab

Save the date for the CERN and the Environment workshop: 12 and 13 October 2022

CERN strives to be a role model for transparent and environmentally responsible research. Its strategy with respect to the environment is based on three lines of action: reducing the Laboratory's impact on the environment; reducing energy consumption and increasing energy re-use; and developing technologies that can help society preserve the planet.

The CERN Environmental Protection Steering Board (CEPS) and many departments are working on diverse projects in this vein. In recent months, you may have seen various initiatives presented or described in articles published in the Bulletin, from the CERN Innovation Programme on Environmental Applications (https://kt.cern/environment/CIPEA) (CIPEA) to the Masterplan (https://cds.cern.ch/record/2792532?ln=en), the CERN public-facing environment reports (https://hse.cern/environment-report) to the Year of Environmental Awareness series (https://home.cern/news?title=environmental+awareness&topic=All&type=All&audience=24&tid_3=&date_from=&date_to=) , and there is much more going on besides that you may or may not have heard about.

This is why, with environmental concerns taking centre stage, we are pleased to give you advance notice of the forthcoming *CERN and the Environment* workshop, which will be held on 12 and 13 October in the Council Chamber.

In this workshop, we will update you on the many environmental initiatives completed or under way at CERN, with a view to providing a global picture and understanding of such initiatives inside the Organization. Together, we will explore various themes and ideas, and we look forward to gathering feedback from the CERN community on matters that affect us all, and to further exchange on future objectives.

Full details will be communicated at the end of the summer.

We hope many of you will be able to join us on this occasion. In the meantime, have a pleasant summer!

Benoît Delille, Mar Capeans Garrido, Manfred Krammer, Chris Hartley, Sonja Kleiner, Roberto Losito and Serge Claudet.

Planning for upcoming email migration

In the coming months, CERN mailboxes will be moved from the current on-premises Microsoft Exchange platform to the Microsoft Exchange Online service (https://mailservices.docs.cern.ch/ExchangeOnline/). This will provide users with the latest functions and improved security.

Users will have their mailboxes migrated in waves from September until the middle of 2023. The process will be seamless, managed by the email service team in the IT department. Users' mailboxes – and calendars, contacts and tasks – will remain available during the migration. Users will be informed in advance of their migration.

Those using Microsoft Outlook on a machine centrally managed by the Computer Management Framework (CMF) will not need to do anything. Those using other email clients may have to do some reconfiguration following the migration; however, clear and simple instructions (https://mailservices.docs.cern.ch/ExchangeOnline/Migration/Overview/) will be provided for the most popular clients.

Further communications on this subject will be sent via email over the coming months. The technical teams responsible for this upgrade understand the central role that email plays for all of us in our work and will make every effort to ensure disruption is kept to an absolute minimum.

IT department

CERN colloquium on 7 July - "Legacies of racism and sexism in science" with Angela Saini

Join the audience on 7 July at 4.30 p.m. for a CERN colloquium on "Legacies of racism and sexism in science" presented by science journalist Angela Saini.

Angela Saini will explore the devastating history of prejudices around gender and race that pervaded the birth of modern Western science, and the legacies those prejudices have left in modern-day biology and medicine.

The colloquium will take place in person in the CERN Council chamber (503/1-001) and online attendance is possible via webcast.

For more information, visit the Indico event (https://indico.cern.ch/event/1176078/).

Car-sharing service operational again

(Image: CERN)

After a long closure owing to the pandemic, the car-sharing service (https://sce-dep.web.cern.ch/mobility/car-sharing) has been up and running again since 14 June 2022.

This service, which is run by the Mobility Centre (https://sce-dep.web.cern.ch/campus-life/mobility) and is available to the entire CERN community, provides a fleet of 35 vehicles of different types, which can be booked online.

Following a pilot run in 2021, a new vehicle-booking system using the Glide app (https://app.glide.io/) and the glide.io (https://app.glide.io/) website has been introduced. The booking procedure is explained in detail in the comprehensive user's guide (https://sce-dep.web.cern.ch/sites/default/files/User%20path%20guide%20GLIDE.pdf).

The new booking system allows you to borrow a vehicle from different locations around the CERN site, to select how long you need to use it for and to amend or cancel your booking at any time.

The Mobility Centre team is pleased to share these developments with you!

SCE department

Restaurants offer student discount over the summer

(Image: CERN)

During the summer period (15 June–15 September), all students born in or after 1997 and who have a contract lasting at least one month are entitled to a 10% discount on meals purchased in CERN Restaurants No. 1 and 2.

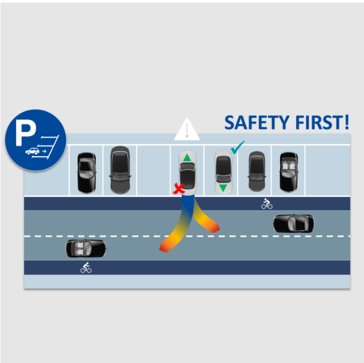
Initiated and financed by Novae, this measure is intended to ensure that students can afford to choose from the full Novae range on the Meyrin site. The discount applies to hot meals, salads and sandwiches at lunch or dinner.

Students wishing to take advantage of the discount should contact their secretariat to obtain a badge that they will need to present at the restaurant along with their CERN access card. The discount will be applied at the till, provided that the following conditions are met:

- Purchases must be made during the lunch or evening service (11.30 a.m.–2.15 p.m. and 6.00–8.30 p.m.).
- Both badges must be presented (CERN access card + CERN student badge issued by the secretariat) and must bear the same name.
- A hot meal, salad or sandwich must be purchased.
- Only one meal per person: the discount does not apply to trays containing more than one meal or only drinks or cakes.

SCE department

New signs to improve road safety



(Image: CERN)

Since the beginning of June, you may have spotted new road signs at strategic points around the CERN site. These signs indicate where reverse parking is compulsory.

This measure is intended to reduce the risk of accidents and keep traffic flowing safely. Reversing out of a parking space can be dangerous, especially when it's onto a busy road or into a cycle path.

In the event of a site evacuation, vehicles must exit the site rapidly. Reverse parking is therefore strongly recommended wherever possible for safety reasons.

SCE department

Come and meet CERN scientists at Science Night

The 13th Science Night, taking place this summer, will feature a CERN activity stand

(Image: CERN)

On 9 and 10 July 2022, in the magnificent setting of the Perle du Lac park in Geneva, the Science History Museum will be holding its 13th Science Night, on the theme "*Et pourtant…*" (*And yet*...). The event will allow participants to discover science in a relaxed and festive setting.

CERN will be taking part with a stand called "*Rencontre avec l'invisible*" (*Encounter the invisible*).

How does a detector work? What is the mechanism that explains the origin of mass? Come and meet CERN scientists and explore the fundamental principles of physics. Fun activities will be organised for all ages, including drawing, workshops, virtual reality experiences and a brand new demonstration to celebrate the 10th anniversary of the discovery of the Higgs boson.

More information is available at www.lanuitdelascience.ch

Take part in climate action through CERN's online Webfest challenge 2022

The Webfest – CERN's annual hackathon based on open web technologies – will celebrate its tenth anniversary this year.

(Image: CERN)

The Webfest – CERN's annual hackathon based on open web technologies – will celebrate its tenth anniversary this year. CERN is marking this milestone with a bumper edition: rather than taking place over a single weekend, this year's Webfest will run online across July and August. This will enable participants to develop their ideas and projects over a longer period of time.

Due to the COVID-19 pandemic, the last two years have seen the Webfest held online, with over 300 people from 63 different countries taking part in last year's event. This year, the Webfest will continue in an online format, once again providing another opportunity for students from around the world to get involved. The last two years have shown how students from across the globe can work together successfully to innovate for positive societal impact.

The Webfest has been running annually since 2012, with the aim of encouraging collaboration between bright young minds. During the event, participants collaborate on innovative projects and design applications that could be beneficial to society. In previous years, participants have worked on a broad range of creative projects. Last year's theme of the UN Sustainable Development Goals (SDGs) saw several ideas pertaining to environmental impact, under the umbrella of SDG 13: climate action. Projects focused on nuclear energy, wildfire alerts, increasing understanding of climate change, and more.

As part of CERN's Year of Environmental Awareness, the theme of the upcoming Webfest will be climate action and sustainability. Students taking part will be assigned to a challenge related to climate action, with the challenges set by a project linked to CERN. Students will work together in small teams to propose solutions for the challenge they have been set.

The introductory session will be held on Friday, 8 July, with the winners announced in the closing session on Wednesday, 31 August. Between those dates, there will be two further feedback sessions, as well as workshops and networking sessions.

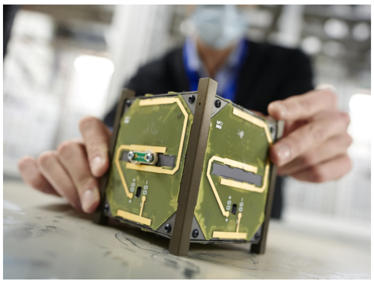
The World Wide Web was born at CERN; help us continue that legacy by joining us online to get involved in climate action and make a difference. Together, we can put technologies like the web, machine learning, data visualisation and more to use in the fight against climate change.

Find more information on the Webfest, including how to register, here (https://indico.cern.ch/event/1174981/). Registration closes on Tuesday, 5 July.

Alexia Yiannouli

Tune in for the launch of the first CERN-driven satellite

On 13 July, the first CERN-driven space mission will be launched from Europe's Spaceport



The CELESTA satellite underwent testing at the CHARM facility (Image: CERN)

On 13 July, CELESTA will be launched into space: this microsatellite is the first space mission driven by CERN, in collaboration with the University of Montpellier and the European Space Agency (ESA).

The CERN community is warmly invited to tune in for the launch of CELESTA (https://kt.cern/aerospace/celesta) on 13 July at 12.15 CET. Note that the launch requires exceptionally good weather conditions, which might mean that it is delayed by a few days, but the time will not change. The live footage will be made available in CERN restaurants, shared on CERN social media channels and available on ESA's WebTV (https://www.esa.int/ESA_Multimedia/ESA_Web_TV) and Arianespace's YouTube channel (https://www.youtube.com/channel/UCRn9F2D9j-t4A-HgudM7aLQ).

The satellite's payload is the Space RadMon (https://kt.cern/aerospace/spaceradmon), an instrument used to monitor radiation effects on electronics, entirely based on off-the-shelf components and calibrated at CERN's irradiation facilities. The satellite itself has been tested at system level at CHARM (https://kt.cern/aerospace/facilities), CERN's mixed-field irradiation facility, showing the potential of this innovative approach for future space missions.

With CELESTA, CERN is seeking to showcase the impact of these technologies and facilities on society, in particular in the aerospace field. Learn more about aerospace applications of CERN technologies here (https://kt.cern/aerospace).

Antoine Le Gall

Ombud's corner

The 4W repair kit for work relationships

How can we support members of our Laboratory in addressing conflict early on, before it reaches the Ombud's Office?

At the International Ombuds Association's international conference, which I attended back in April, one of the speakers[1], Dr Patricia Robinson, shared a simple model that front-line managers can use to have productive conversations to help their people move towards better working relationships and belonging. The model helps them find out what is important to disputants, calm emotional heat in their teams, and get to the source of conflict.

The first step to catch conflict early is to make disputants **feel truly listened to**, by listening for **WHAT**, **WHO**, **HOW** and **WHY**.

Following the speaker's invitation to spread the model, and because it makes total sense given what I observe in the Ombud's Office, I'm pleased to share it with you and to illustrate how it works with a practical example.

Listen for	Your goal as listener	Ways to achieve that goal
WHAT is important about what happened?	• Convey that you understand what's important about what happened	• **ASK**: "What's on your mind? What's going on for you?" • **REPHRASE** from fact to opinion and **CHECK**: "Let me see if I understand you correctly …" • **REFLECT**: "You thought/felt/believed …" • **CHECK** again: "Is that right?"
WHO are the disputants in this issue and what is their relationship with each other?	• Convey that you see them as three-dimensional people • Humanise disputants to each other as multi-dimensional people • Get context on their behaviour	• **ASK** *people* questions: "Tell me about yourself/your relationship/etc." • **SUMMARISE & CHECK** your reflection, then **ASK** an open-ended question • **SUMMARISE**, **CHECK**, **ASK** about what they said or **REPEAT** back the last few words with a question inflection
HOW has this issue impacted each disputant?	• Convey that you understand the emotional impact of the conflict on each disputant and how they feel	• **ASK**: "How did it impact you/make you feel?" • **LABEL** impact/feelings & **CHECK** • **REFLECT**: "So it sounds like you feel sad/angry etc.. because of …" • **CHECK**: "Is that right?" It is OK to be wrong; if you are they'll correct you
WHY are the disputants impacted? What are the underlying needs, wants or values?	• Convey that you understand why they were impacted the way they were, or why they acted the way they did (needs/wants/values)	• **ASK**: "What was important or upsetting about that to you? What made you feel or do that? Don't use *why*. • **REFRAME** from complaint to underlying need/want/value and **CHECK** • **REFLECT**: "So it sounds like you really want/need/value (e.g. appreciation, respect, acknowledgement, being heard etc.)" • **CHECK**: "Is that right?" It is OK to be wrong; if you are, they'll correct you

(https://cds.cern.ch/images/CERN-HOMEWEB-PHO-2022-138-1)

Table Ombud (Image: CERN)

Here is this useful model transposed to a real-life situation*:

Maria shares an office with Anne. Their desks face each other. Despite Maria's efforts to cultivate a pleasant work relationship with Anne, Anne does not want to discuss anything with Maria that is not strictly work related. No small talk about kids or holidays. No smile, no coffee, no sharing of jokes. Maria, who is a joyful and very sociable person, is struggling with the situation and opens up about it to her manager, Andrew.

This is how Andrew could make Maria feel that he has really listened to her concerns and that he understands the situation, from her perspective.

Maria: "*It can't go on like this, with Anne opposite me, it feels like I'm facing a wall. No smile, no chatting, although she behaves perfectly normally with other colleagues*."

Andrew: "*I see that something is really affecting you. Let me hear more about what the matter is in relation to Anne. What does a typical day in the office look like?*"

Maria, prompted – with empathy – to give specific examples, explains.

Andrew: "*Let me see if I understood you correctly. Anne stays absorbed in her tasks and doesn't answer when you say good morning, ask how she is or invite her to go for coffee. You also have the impression that she behaves differently with other people. Is that correct, did I understand you well?*"

Maria confirms, feeling she has her manager's full attention.

Andrew: "*Anne has been working here for 10 years and she's highly appreciated by the team, although, indeed, she's not a very talkative person. But she is very professional in her work. You joined the team only recently and we all appreciate your friendly, sociable nature. Both you and Anne are working mothers with packed schedules, and you both have a heavy workload, but you are both doing a great job. Do you feel that the relationship is always difficult, or is this happening more at specific times, like the beginning of the week or day?*"

Maria – now reminded of the points she has in common with Anne – explains further.

Andrew: "*How does this make you feel? Do you take this problem home with you? Does it impact your relationship with the other team members as well? How do you think it may impact Anne?*"

Maria – encouraged to share her feelings – thinks for a minute and explains that she feels disappointed, sad and angry at the same time. She feels relieved to express these feelings.

Andrew: "*OK, I see. If I understand you well, you're sad and angry because Anne doesn't seem to be interested in having a friendly relationship with you as a colleague and you feel rejected, is that right?*"

Maria confirm and feels that her feelings have been understood.

Andrew: "*What is it that makes you feel rejected and sad? Could it be that a lack of a smile or a sad face is somehow contagious and goes against your nature? What was it like in your previous job? Is it also possible that you're concerned that Anne may have negative things to say when the extension of your contract is discussed*?"

Maria confirms that, indeed, she had a very good working relationship with a colleague in her former job and misses that atmosphere. She's disappointed that she hasn't been able to recreate the ambiance she was used to in her new job. She's also worried that the difficult relationship with Anne may have an impact on her contract length and she feels that this would be unfair.

Andrew: "*I understand that you need acceptance and belonging from your team and that companionship with your direct colleagues and warmth in the office are essential to you. Am I right? Thank you for sharing this with me. Let me think about how best to proceed*."

As you can see, the 4W kit has not solved the conflict between Maria and Anne, but Andrew has made Maria **feel listened to and understood**, and he has also received important information about **the root cause of the conflict**.

The combination of these two things opens the path to informal dispute resolution. The next step for Andrew is to have the same conversation with Anne.

When supervisees turn to you to share conflictual situations, the first step to a successful resolution is making sure that they feel really listened to. Keep this 4W repair kit in mind, as it will help you take this first step.

* Real names have not been used.

Laure Esteveny

I want to hear from you – feel free to email ombud@cern.ch with any feedback or suggestions for topics you'd like me to address.

NB: If you would like to be notified about posts, news and other communications from the CERN Ombud, please register to receive the CERN Ombud news (https://e-groups.cern.ch/e-groups/EgroupsSubscription.do?egroupName=cern-ombud-news).

[1] Patricia Robinson, Ph.D., Hitotsubashi University, Tokyo, Japan

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