

# SUMMER AT CERN!

BY JOE MUISE, CHRISTOPHER SARKONAK, AND SARAH TORRIE



Group photo of the International High School Teacher Programme 2019

The summer of 2019 will be one to remember! Canadians Christopher Sarkonak, of Manitoba, and Sarah Torrie, of Ontario, had the incredible opportunity to participate at the International High School Teacher (HST) Programme 2019 at CERN in Geneva, Switzerland. The twenty-first edition of this annual two-week program in July saw 45 high school teachers from 33 countries around the world participate in a series of lectures, on-site visits, exhibitions, and hands-on workshops that were designed to invigorate and introduce these teachers and, through them, their future students to cutting-edge particle physics. Fellow Canadian Joe Muise, of British Columbia, was selected this year to participate in the International Teacher Weeks (ITW) 2019 in August. The three Canadian participants in this year's programmes at CERN are just the fifteenth,

sixteenth, and seventeenth Canadian educators to have ever been selected to attend with Christopher and Joe being the first two ever selected through direct application to CERN.

Sarah had the tremendous honour of being awarded the Canadian Association of Physicists (CAP) Award for Excellence in Teaching High School/CEGEP Physics for Ontario. Nominated teachers submitted a nominator form, five letters of support, a curriculum vitae and other supporting documents. Successful candidates were then given the opportunity to apply for the 2019 Perimeter Institute Physics Education Scholarship via a statement of intent in which candidates explained why they would like to be considered and how the activities would enhance their teaching. Through this process Sarah was selected to participate in HST 2019 and the Perimeter Institute's Einstein Plus workshop.

Christopher and Joe both applied directly to CERN for their positions in these programmes and that meant answering a series of four short essay questions and producing a one-minute video, where you have to explain why you are the ideal candidate to participate in CERN's international teacher programmes. These essay questions include why you want to attend the programme, how you will disseminate the knowledge acquired, an opportunity of where your students could investigate particle physics concepts, and what you



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## SUMMARY

The twenty-first edition of this annual two-week program in July saw 45 high school teachers from 33 countries around the world participate in a series of lectures, on-site visits, exhibitions, and hands-on workshops that were designed to invigorate and introduce these teachers and, through them, their future students to cutting-edge particle physics.



Jeff Wiener discusses the "most feared question at CERN"

might name a new particle detector in the LHC. Applicants are encouraged to show originality in their videos, and leave an impression with the selection committee regarding their appreciation for modern physics and their teaching style.

One of the most amazing things that strikes almost anyone that goes to CERN for a program like this is the level of collaboration that goes on here. There are physicists, both of the applied and theoretical varieties, engineers, students, and so many others that all work together to try to achieve a deeper understanding of the universe around us and answer the big questions: what is the universe made of? How did it begin? What are the laws that govern the universe? These questions unify the people here regardless of where they come from, even countries that are typically at war with each other, as they seek answers that are bigger than any of us.

At the beginning of July, both Christopher and Sarah set out from Brandon, Manitoba and Toronto, Ontario to make Geneva, Switzerland their home for the next two weeks. The program kicked off on the Sunday with a welcome reception, a CERN treasure hunt, and the first introductory sessions. On Monday there were the first sessions on particle physics and a tour of the Synchrocyclotron, the first particle accelerator to be built at CERN, starting operation in 1957. Most of Tuesday and Wednesday afternoon were then used to continue building an understanding of the operation of particle accelerators and how to deliver that knowledge back to high school students.

Wednesday morning started off with a presentation by the host, Jeff Wiener, on elementary particle physics in early physics education. Here he talked about his research where he is looking at the best practices for teaching particle physics, and quite often science in general, to avoid student misconceptions. Then came the opportunity to see the S'Cool Lab where the team gave a presentation on budget-friendly, interactive labs and demos for the classroom. S'Cool Lab develops resources for classroom teachers to build, and most often 3D print, lab equipment to be



3D printed quarks



Sarah Torrie building a proton in CERN's S'Cool Lab

used in the classroom. Participants were also given the opportunity to tour the CERN exhibit halls during this time.

Thursday and Friday of the first week then focused on particle detectors, including the opportunity to build a particle detector, a cloud chamber, in the S'Cool Lab, and the medical applications



of the work done at CERN. Some people already know that CERN is the birthplace of the internet, where the touchscreen was first developed, and, of course, where the Higgs Boson was discovered just a few years ago, but most people don't realize the contributions that CERN has made to medicine. In 1977 two physicists from CERN, David Townsend and Alan Jeavons, built and used a PET (positron emission tomography) system in Geneva Hospital. Today, the MediPix, a particle track detector originally developed for use in high energy physics, is now being used to create the first 3D colour x-ray images of a human. There is ongoing research into hadron therapy in cancer treatments and how this will allow the maximum radiation dose to be targeted on the tumour with little damage to surrounding tissue. This technology has been known since 1946, but it is only recently that cancer patients have started to receive treatments in this way. However, there have since been even better methods of cancer treatment discovered with carbon-ion therapy and anti-positron therapy.

Friday afternoon was one of the highlights of the program with the tour of the CMS Experiment! This is one of the two major experiments at CERN, the other being the ATLAS Experiment, as 4300 particle physicists, engineers, technicians, students, and support staff from 42 countries work to make new discoveries about the universe. The CMS detector is 21 metres long,

has a diameter of 15 metres, weighs 14 000 tonnes, and produces a magnetic field 100 000 times stronger than the Earth! The sense of awe and wonder that one is immediately struck with upon entering the CMS cavern is something that cannot be put into words.

The second week started with learning about the data processing and analysis that goes on at CERN as they try to organize information from the 40 million particle collisions per second that occur when the LHC is fully up and running. Tuesday featured an incredible day of workshops from the Perimeter Institute. Dave Fish and Laura Pankratz walked the teachers through resources on climate change, introductory quantum physics, relativity, the principles of dark matter, and the basic processes of science that are offered through the Perimeter Institute's outreach program and are ready to be implemented in any high school physics classroom.

Wednesday's focus was on antimatter research being done at CERN with a fantastic lecture from Michael Doser and a tour of the Antimatter Factory. This was definitely one of the most fascinating lectures and tours of the program! The lecture portion of the program on Thursday with talks on the engineering challenges at CERN and the possibility of future accelerators. Can you imagine that they might next build an accelerator 100 km in circumference?!

Joe's experiences at CERN's International Teacher Weeks Programme was very similar to Chris' and Sarah's with the High School Teachers Programme, with 47 teachers from 38 countries taking part. Instead of a session with representatives of the Perimeter Institute, the International Teacher Weeks Programme had the opportunity to learn from Neil Atkin, founder of Rubbish Science of the UK. Neil brought incredible enthusiasm and challenged the teachers to find interesting ways to engage all students. The group were fortunate to be able to visit a second detector, in addition to a tour of CMS. The group spent an afternoon at the ALICE detector learning about how it used to study quark-gluon plasma. The two programmes are for the most part parallel offerings, with small differences based on tour and presenter availability.

Throughout the programs there was also a tremendous opportunity to talk and collaborate with colleagues from around the world and this resulted in the final reports and presentations on Friday. With each topic presented throughout the program a different focus group was assigned to put together a report and presentation on how to bring that information back to the classroom. One of the most amazing parts of these programs was being able to speak and collaborate with colleagues from around the world, whose passion for physics is so clearly visible. Sharing stories about classrooms, ideas, and resources has had a tremendous impact on what any physics classroom will look like from this point forward for those that participate in this program.



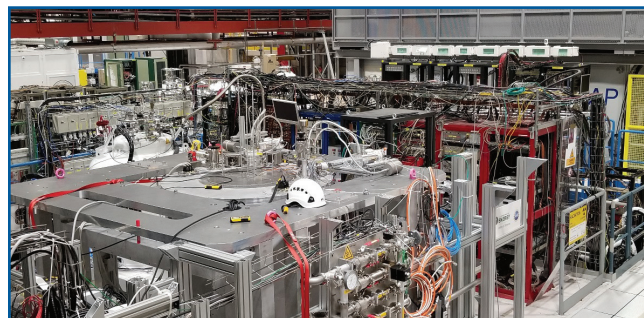
One of the teacher groups in the CMS Cavern.



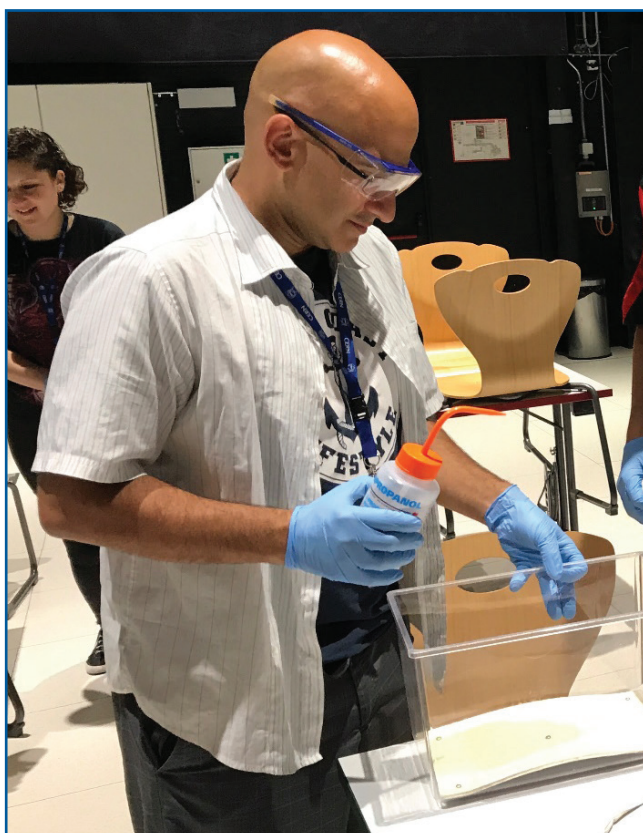
Teachers exploring The Perimeter Institute's resources



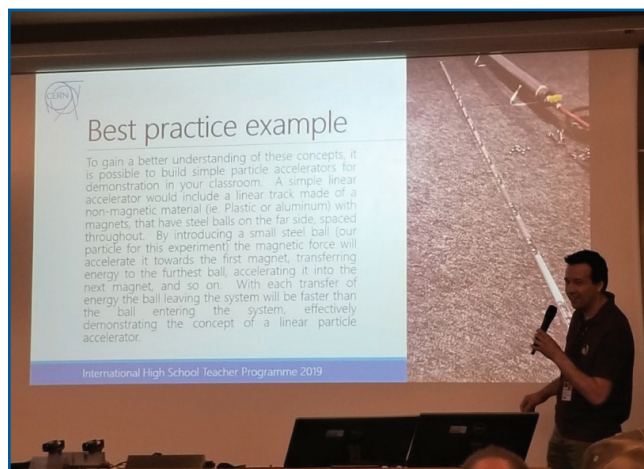
Sarah Torrie, Dave Fish of the Perimeter Institute, Christopher Sarkonak, and Laura Pankratz of the Perimeter Institute.



Antimatter Factory



Joe Muise works to build a cloud chamber during a session in CERN's S'Cool Lab.



Christopher Sarkonak presenting a particle accelerator best practice example.

medals-teaching/hscta/nomination-procedures-hc/. Applications are due February 28<sup>th</sup> 2020.

Teachers interested in attending CERN's international teacher programmes also have the option of applying directly through CERN's online platform. Details can be found at: <https://teacher-programmes.web.cern.ch/itp/international-teacher-programmes>. Applications close on January 13, 2019.

Educators can also visit <https://scool.web.cern.ch/classroom-activities> to learn more about the activities developed by CERN's S'Cool Lab.

The Perimeter Institute's resources can be found at <https://www.perimeterinstitute.ca/outreach>

If you are interested in nominating a teacher for the CAP Award for Excellence in Teaching High School/CEGEP Physics you can visit <https://www.cap.ca/programs/medals-and-awards/>